

DYNAMICS OF POLICY INTERVENTIONS:
THE CASE OF THE GOVERNMENT AND THE AUTOMOBILE INDUSTRY IN JAPAN
c.1900 - c.1960

by

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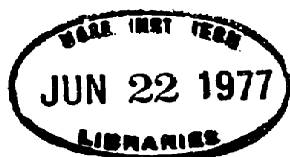
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ABSTRACT

This study elucidates the development of the Japanese automobile industry for the period from c. 1900 to c. 1960 from the viewpoint of a policy intervention analysis using Donald T. Campbell's "quasi-experimental design" as a research framework. The focus of study is to investigate how policy interventions of the Japanese Government helped the automobile industry develop up to the period before Japan became one of the world's most powerful auto manufacturing nations today. This thesis consists of two analyses: 1) a historical analysis of why and how the government intervened in this industry and how industry reacted to the interventions (CHAPTERS II and III), and 2) a numerical analysis of how these interventions affected industry at large using macro time-series data of production, foreign auto supply (imports and assembly), and exports (CHAPTERS IV, V and VI).

CHAPTER I defines the present research, addresses the research motivation, proposes the working model for the policy intervention analysis, examines Campbell's quasi-experimental design in the light of the research topic, and summarizes the procedure and structure of the research.

The Japanese Government exercised eight major policy interventions for 60 years since the automobile industry was born. CHAPTER II and III describe four prewar interventions and four postwar ones, respectively.

CHAPTER IV points out an important aspect of what other numerical intervention analysts have missed in Campbell's "maturation" question and visually identifies the intervention impacts on the structural changes of data trends. In most cases of the above data, the impacts are clearly observed on the logarithmic scale.

CHAPTER V analyzes how the interventions affected the internal structural changes in the production data trends. The analysis employs the Kalman Filter method to estimate the time-variant parameters of the system that fits the production history data. The results give new and valuable information for assessing the interventions.

CHAPTER VI identifies the internal logic of the interventions for ousting the foreign influence from the Japanese auto market and examines this logic against Raymond Vernon's product cycle model of international trade and investment. The results demonstrate that the domestic auto supply successfully took over the foreign supply twice, once in prewar and once in postwar, with identical policy logic, and that the government consequently chose the less developed countries' pattern of the Vernon model by controlling the supply market.

CHAPTER VII integrates the results of both historical and numerical analyses into the matrix form to examine two basic hypotheses for the working model; that: 1) the interventions formed the cause and effect iterative cycles, and 2) the Japanese Government learned the past interventions for exercising the next intervention. The matrix shows that both hypotheses are generally valid insofar as the case of the Japanese Government's policy interventions towards the automobile industry is concerned.

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"I have no data yet. It is a capital mistake to theorise before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts....."

A. Conan Doyle, The Adventures of Sherlock Holmes, Chapter 1 (The Adventures of A Scandal in Bohemia), London: George Newnes, Ltd., 1894, p.5.

CHAPTER I
INTRODUCTION

SECTION I-1
DEFINITION OF RESEARCH

(A) Purpose

By proposing a hypothesis that policy intervention be in essence a goal-seeking causal learning process inasmuch multiple cases of intervention are iteratively exercised over time, and by choosing a particular case of intervention, this research attempts to reduce a complexity of policy interventions into three main foci: 1) whether or not successive interventions form a series of cause/effect iterative cycles, 2) whether or not there are consistent patterns in all or some stages of the intervention process over different cycles, and 3) whether or not the government has a learning capability to attain a goal by policy intervention.

(B) Selection of Case

The case of policy interventions by the Japanese Government in the

automobile industry during the period, c.1900-c.1960 is selected. This selection is based on the following reasons: 1) Japan's automobile industry developed by replacing overwhelming foreign imports which were technologically and economically superior from the domestic market, under strong government protection and regulation. It is hence an appropriate case to look at the dynamic interactions between polity and economy, in which the political priority (the state's goal to replace foreign dominance) surmounted economic rationality; 2) The Japanese Government saw that the establishment of the automobile industry would act as a vital force primarily to the country's military, and secondarily to its industrial development, so that numerous policy interventions were exerted during the last seventy years. The abundance of intervention cases are of great assistance to our research; 3) Data are relatively well recorded, and are not kept secret in the esoteric government's files. 4) The Japanese automobile industry was firmly established relatively recently (in the 1960s), and despite being far behind other industrially advanced countries, caught up with them swiftly to become one of the world's most powerful exporting nations. Hence, the elucidation of its growth process in the context of policy interventions might be of particular interest to other countries especially perhaps, developing countries.

(C) Scope and Limit

The level of observation of both policy interventions and policy impacts is macroscopic and aggregate to focus on only the major interventions of the Japanese Government and their impacts on the level of firm. This research necessitates the coverage of a long period in order to investigate the above three points of the research purpose. Hence, the microscopic details of the rudimentary interventions around the major interventions and the internal impacts within a firm are not covered by this research.

Rather than critically examine the existing body of theory on the state/industry relationship against the particular case selected by this research, or to empirically analyze this case in the light of an existing theory or model, much research effort is made first, to acquire the historical knowledge of the Japanese Government's policy interventions so as to investigate the existence of the single-series causal chain of intervention occurrences, and second, to heuristically develop a methodology for a structural intervention analysis based upon the substance of historical knowlege.

(D) Method

Regarding policy intervention as a control treatment and policy impact as a control effect, this research adopts Donald T. Campbell's quasi-experimental design as a basic research framework. Among other

threats to both internal and external validity in the quasi-experimental design, the elimination of the two threats, the "history threat" and the "maturation threat," paves the main course of research work.

In order to numerically identify the impact of policy intervention given historical evidence of intervention, a particular dynamic estimation method called the "Kalman Filter" is employed. The Kalman Filter contains a built-in learning mechanism to be able to estimate the time-variant parameters of a dynamic model. This research proposes a simple difference equation model as the "benchmark" structure to identify the impact of intervention.

SECTION I-2

POLICY INTERVENTION ANALYSIS: RESEARCH MOTIVATION, WORKING MODEL AND RESEARCH FOCUS

(A) Research Motivation

The treatment of the interactions among social structures on various levels in the formal language of dynamics [1] has increasingly become an important research area in the current stream of political science. A classical example was brought forth by L.F. Richardson in his arms race article [2], which evidently grounded the path for his followers [3]. Methodologically still in the Richardsonian differential-equation approach, but substantially in the old Marxian tradition, A. Przeworski and G.D. Soares [4], and A. Przeworski and F. Cortes [5] cast a new light of viewing class consciousness, or purist vs. revisionist intra-party conflict along the lines of the East European political economist, Oscar Lange [6]. One may also recall the work by G.O. Brewer and R.D. Brunner who applied the Samuelsonian simple dynamics of the acceleration principle and multiplier, to examine Daniel Lerner's theory of development, based upon a simulation model of economic development, urbanization and political participation [7]. In purely engineering orientation, J.A. Forrester and his associates constructed the provocative world dynamic model [8], which later ignited criticism on the lack of theory as well as empirical

evidence [9]. Many other old and new developments throng about; O. A. Davis, M. A. H. Dempster and A. Wildavsky's federal budgeting dynamics [10]; J. P. Crecines's municipal-budgeting dynamics [11]; N. Choucri and R. North's economic-potential-and-war-probability dynamics [12]; W. Nordhaus' Phillips-curve-and-voting-turnout dynamics [13]; D.A. Hibbs' politics-of-economic-policy dynamics [14]; and the like.

With respect to the interaction between polity and economy, there are two distinctly different standpoints on causal ordering in the research exemplified above. The first kind, which covers most empirical research done so far, is an attempt to identify economic variables which are deemed to influence, together with other social attributes, the behavior of polity in various forms, such as the decision on military expenditures, the probability to enter a war, voting turnouts influenced by the economic performance of the incumbent in office or the campaign promises by candidates, workers' violence triggered by the deterioration of unemployment or other economic conditions, political participation accelerated by economic development in rural areas, and the like. It is evident that these research efforts regard economic variables as an exogenous cause to the behavior of polity.

In contrast, a bulk of research efforts focuses on the reverse causation: i.e., the goal-seeking polity intervenes into the economy. However, due to the inherent difficulty in transforming political

attributes into operational variables, only a limited number of studies courageously attempt to elucidate this causation in the formal language of social dynamics. Some examples are found in the research area of government problem-solving [15], which places the main focus on the budget-formation processes and has not yet arrived at the elucidation of their impacts on the economy [16].

On the conceptual level, a systematic account of the interactions between polity and economy is given by Talcott Parsons [17]. He claims that any society, an aggregate level of "social animals," has the four indispensable functions performed by the four different social infrastructures: goal-attainment by polity, adaptation by economy, integration by culture and pattern-maintenance by household. For these four substructures of society, there are at least six interface exchanges, through which social media [18], or currencies [19], run to link one structure to the other. In regard to the interactions between polity and economy, Parsons proposes a double interchange model, in which polity intervenes into the economy in two ways: control over capital funds and encouragement of productive enterprise. In return, economy renders the right to intervene to polity. The media to facilitate these transactions are political power and physical resources. In proposing this model, Parsons refers to a state's control over the central bank and credit rates [20].

The difficulty of the application of the Parsonian model into

practical research on the polity-economy interchanges is multifold. Some key problems are spelled out here. First of all, his double exchange model between polity and economy is too simple to be applied. Needless to say, evidence suggests that although the encouragement of productive enterprise and the control of capital funds are the ubiquitous interventions by government in industry, they are hardly exhaustive. In his numerous writings, Parsons's strong belief lies in cross-society similarity rather than the differences unique to each society with respect to social functions. Therefore, he seems to pick up only a limited number of functional resemblances, which results in the simplicity of the model due to the discarding of much functional uniqueness.

Second, contrary to the above question of system simplicity, a follower of the Parsonian theory of social transactions faces the problem of system size. In arguing four functional imperatives for the survival of the society, Parsons always focuses on the society as a whole. Accordingly, his six pairs of subsystem-interactions become simple in order to keep the level of complexity of a total system within the capacity of a theoretical argument. This approach involves an enormous research effort, which soon discourages the researcher. A possible solution to this problem is a careful check of system decomposibility based on the so-called ceteris paribus theorems [21]. However, this check also no doubt requires a great amount of research work.

Third, Parsons' assumption of system maintenance as the ultimate goal of the society is too vague to be applied in research. This "homeostasis" assumption [22], analogous to the mental balance of an individual in its developmental process, is static and deeply rooted in perfectionism, i.e., seeking the perfect social functions performed by the perfect social structure [23]. In such an impersonalized society, the importance and contribution of a human actor in various decision-making processes tends to be neglected. For example, the control over capital funds allocation by the polity in exchange with the economy is not an action by the impersonalized entity called polity or government, but a decision won by some key policy-formulators within such an organization, perhaps through intra-organizational conflict and confrontation over the best possible policies.

Fourth, Parsons' understanding of the goal-seeking function of polity to attain total system maintenance limits the meaning of the goal itself. In fact, economic stability, for example, as an objective of intervention by the polity, may lead to the system maintenance of the society as a whole. However, the polity is likely to have other objectives, more ambitious ones, which may be attained in the long-run at the expense of a short-run social instability. What is of vital importance here is a look at the problem-solving interventions by polity which simultaneously aim at keeping "homeostasis," e.g.,

economic stability, and at generating a new value or state, e.g., economic growth. The structural functionalistic view of society as the system-maintenance implementing body is, in fact, incomplete, lacking more dynamic aspects of problem-solving operations.

Finally, Parsons' concept of "power" is not articulated enough to differentiate the institutionalized legal enforcement from the informal steering guidance of the polity. In Parsons' argument, "power" is defined as a medium of exchange similar to "currency" in economic transactions. This notion sharply differs from those of Robert A. Dahl [24] and Harold D. Lasswell or Abraham Kaplan [25]. Dahl's "power" consists of two human capabilities: 1) the capability to produce a change in outcome patterns in a repetitive process, and 2) the capability to guide an actor to a different behavioral course from a would-be one. On the other hand, Lasswell/Kaplan's "power" notion is defined in terms of behavioral acts of individuals. Their "power" is human participation in a process to form decisions or policies which involve severe sanctions as well as rewards upon non-compliance or compliance. The Parsonian "power" concept is found in the implementation process of functions of the polity, while Dahl or Lasswell/Kaplan's "power" is rooted in human behavior. It is quite likely that an informal coercive guidance or political lobbying by some individuals, whose roles are entitled to formulate policies within the political subsystems, is antecedent to any formal intervention. In such a case, the Parsonian account of power as a

medium of a functional exchange would miss the important power exchanges which may not appear on an already institutionalized level.

Despite several ambiguities and operational difficulties, Parsons' structural-functional theory of social transactions, in general, contains many implications of great importance. First, it emphasizes the causal ordering from polity to economy. As pointed earlier, the previous fashion of the treatment of economic variables in political science research viewed the economy as one of many causal forces upon political decisions. Parsons proposes a different direction. Second, in arguing the particular case of polity-economy interactions, Parsons strongly believes in the superior position of the power-based political legitimization over economic optimality [26]. His emphasis on the political-value-driven goal-seeking operation vis-a-vis the economy leaves ample possibility for macro political research which can treat economic variables differently. Third, Parsons' new insight into political power on an institutionalized level makes it possible to incorporate an otherwise descriptive analysis of policy intervention into the same systematic account as a power analysis on individual political actors. Dahl's "capability" notion of power on an individual actor level may be applied to an intervention analysis on an aggregate level of a political entity such as government.

(B) Working Model

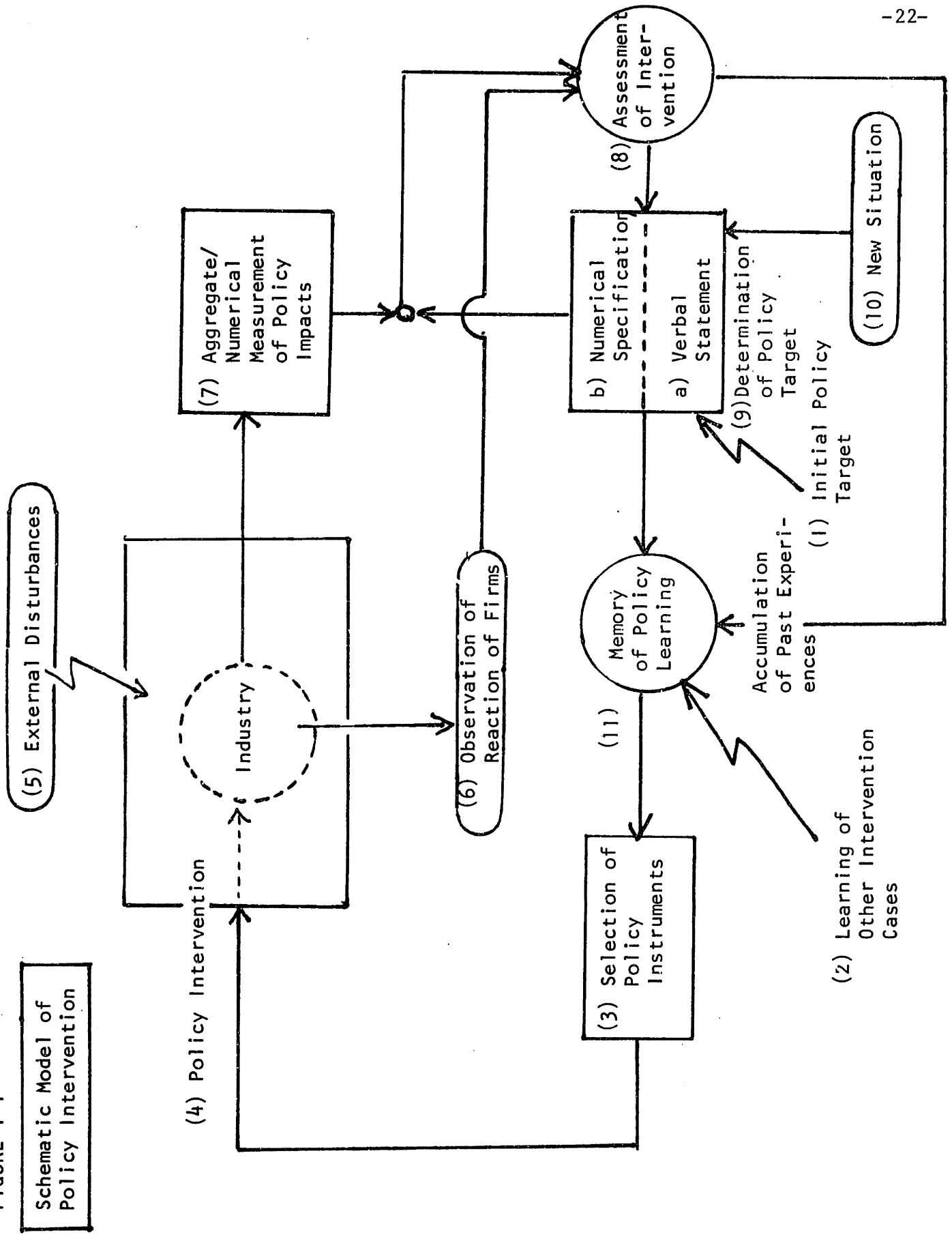
Interest in the treatment of social transactions in the formal language of dynamics, interest in the causal ordering from polity to economy, and the examination of Talcott Parsons' interaction model in the light of research practicability, all of these research motivations select a workable research motif : a dynamic analysis of policy intervention of government to one particular industry.

The first research effort is the proposition of a working model which schematically depicts the dynamic process of policy intervention by incorporating much of the preceding discussion on dynamics, causal order and Talcott Parsons. The model is shown in FIGURE I-1. As is clear, the model is in essence a feedback cycle of government learning to attain a policy goal [27]. The intervention process comprises:

- (1) In the very beginning of intervention, the initial policy target (or goal) is determined by government as a whole, or by a competent agency in particular. This initial policy is not ameliorative of old policy interventions. It is an unprecedented policy target with which a dynamic cycle of intervention starts.
 - a) The policy target would be first conceived of as political advocacy which has not yet been articulated in terms of actual implemental procedures. Examples are: the

FIGURE I-1

Schematic Model of Policy Intervention



enhancement of technical capability of a particular industrial sector, the quality improvement of a manpower supply system, the expulsion of foreign dominance in a domestic market, the maintenance of the current position in an arms race, and the like. These policy targets are normally announced on the top level of government, such as in a cabinet meeting or in high administrative bureaux.

- b) In some cases, the policy target is numerically articulated. Perhaps, in setting these numerical targets, the government has a formal or informal communication with industry in order to see the practicability of prospective policy implementation. The examples can be found in economic policies, such as a certain target rate of inflation or unemployment. The case of an arms race is of this kind: a number of increases in the holding of nuclear warheads to balance against an opponent. However, it is too unrealistic to assume that every verbally advocated policy target is accompanied by well-specified numerical goals.

- (2) Assuming that the government has a learning capability, the precedents of similar intervention cases would be learned before appropriate policy instruments are selected. For example, in order to establish a new

industry without experience at home, the government might learn from other countries and their experiences. If the government has successful experience in other areas, it would be likely that such success is directly learned or copied.

- (3) The third step is to select the best possible combination of policy instruments to achieve the defined policy target. The most common policy instruments may be: subsidy, grant-in-aid, tariff and tax control, government procurement, and the like. Instead of copying one of the precedented cases, government may also heuristically create a new policy instrument. Adding such a new policy innovation to the old precedents, the government accumulates the total number of policy alternatives.
- (4) Combining a verbally-stated policy target, its numerical interpretation if any, and policy instruments in unison, the government formally intervenes in industry in either direct or indirect form. The indirect intervention is exemplified by a tax incentive for purchasers, not for manufacturers, which is often observed in production policy.
- (5) While intervention is being exercised, sometimes

unexpected external happenings enter into the intervention arena. Examples are: sudden economic slump, unexpected oil crisis, war, change of government, change in administration, etc. [28].

- (6) Impacts of intervention are observed by the government on various levels. Due to the confidentiality of the internal activities of firms, the lowest level of impact observation is perhaps the reactions of individual firms. The observation is not necessarily comprehensive but could take an informal and random form of, say, complaint, appraisal, suggestion, or lobbying heard from various firms concerned.
- (7) Government must ultimately observe the impacts of intervention in numerical form. These statistics do not necessarily correspond to what the government has predetermined as an impact assessment measure. It is possible that the government finds a new indicator for the assessment of impacts.
- (8) Combining the information of (6) and (7), the government would assess the current policy intervention. The assessment sometimes makes formal or informal hearings by inviting industry people; or it is done within the

government excluding feedbacks from the outside.

(9) The assessment would lead to the setting of a new policy target if the current intervention is assessed as unsuccessful and hence needs further elaboration and amelioration. If it is regarded as a success, the government might exercise the same intervention continuously with the consolidated confidence of its policy implementation.

(10) When a new situation occurs before the ultimate policy goal has been attained, the government probably sets up a new policy target which is superimposed on the assessment of the current intervention exercise.

(11) All of information of intervention assessment is stored in the memory of government's policy learning to be used for a later cycle of goal attainment.

The major similarities and differences between this model and the Parsonian interaction model are as follows:

First, the policy instruments defined in this model are more or

less identical to Parsons' "in's" from polity to economy [29], but are more specific than Parsons' two "in's," i.e., the control of capital funds and the government's encouragement of productive enterprise.

Second, this model depicts only two-subsystem interactions with an emphasis on the polity side. Rather than proposing a total model of society which includes numerous interactions among other subsystems, this model tries to maintain a workable size. In so doing, it is a priori assumed that the five other interactions, i.e., between polity and household, between polity and culture, between economy and household, between economy and culture, between household and culture, do not significantly affect the interactions between polity and economy in the course of policy intervention. Instead of doing a tiresome check of the so-called "system decomposability" (or the ceteris paribus question), it is loosely postulated that culture characterizes the value with which a policy target is determined, the household continuously extends legitimacy supports to the government and furnishes a work force and culturally-based consumer patterns to the economy.

Third, the "homeostasis" assumption is not incorporated in this model. Instead, the model emphasizes the problem-solving and goal-attainment behavior of polity, which might induce even a short-time social instability.

Fourth, with respect to "power," the model adopts the combination of Parsons' and Laswell/Kaplan's power concepts. That is, the power defined in this model has two meanings: 1) the act of polity in executing insitutionalized (or structured) policy instruments which involve a severe sanction or reward upon non-compliance or compliance, and 2) the policy formulator's persuasion and negotiation with the economy prior to a formal intervention.

Fifth, the model is not such a theoretical construct of the "true" social structures and functions applicable to any society as Parsons claims. Rather, it shows one example of conceivable steps the polity would take in intervening into the economy.

Sixth, the model contains the concept of a "feedback" more clearly than the Parsonian model does. A feedback dynamic process must form a closed circuit in which an action flow goes in a consistent direction. Parsons' "double " and "mutual" interchange model is ambiguous in this regard, for Parsons, the "right to intervene," or the "control of productivity" as the "in's" from economy to polity [30] really mean the intervention inputs from economy to polity, and hence are independent of the outputs of the polity's intervention as feedback information. Our model clearly specifies the impacts of intervention as "information" the polity feeds back. In this respect, our model adopts Karl W. Deutsch's interpretation of the Parsonian theory of social transactions [31]. However, though Deutsch's emphasis on the

information feedback is conceptually taken in this model, the model intentionally avoids Deutsch's optimistic view about the possible quantifiability of such feedback information based on the analogy between power and the Parsonian "currency."

(C) Research Focus

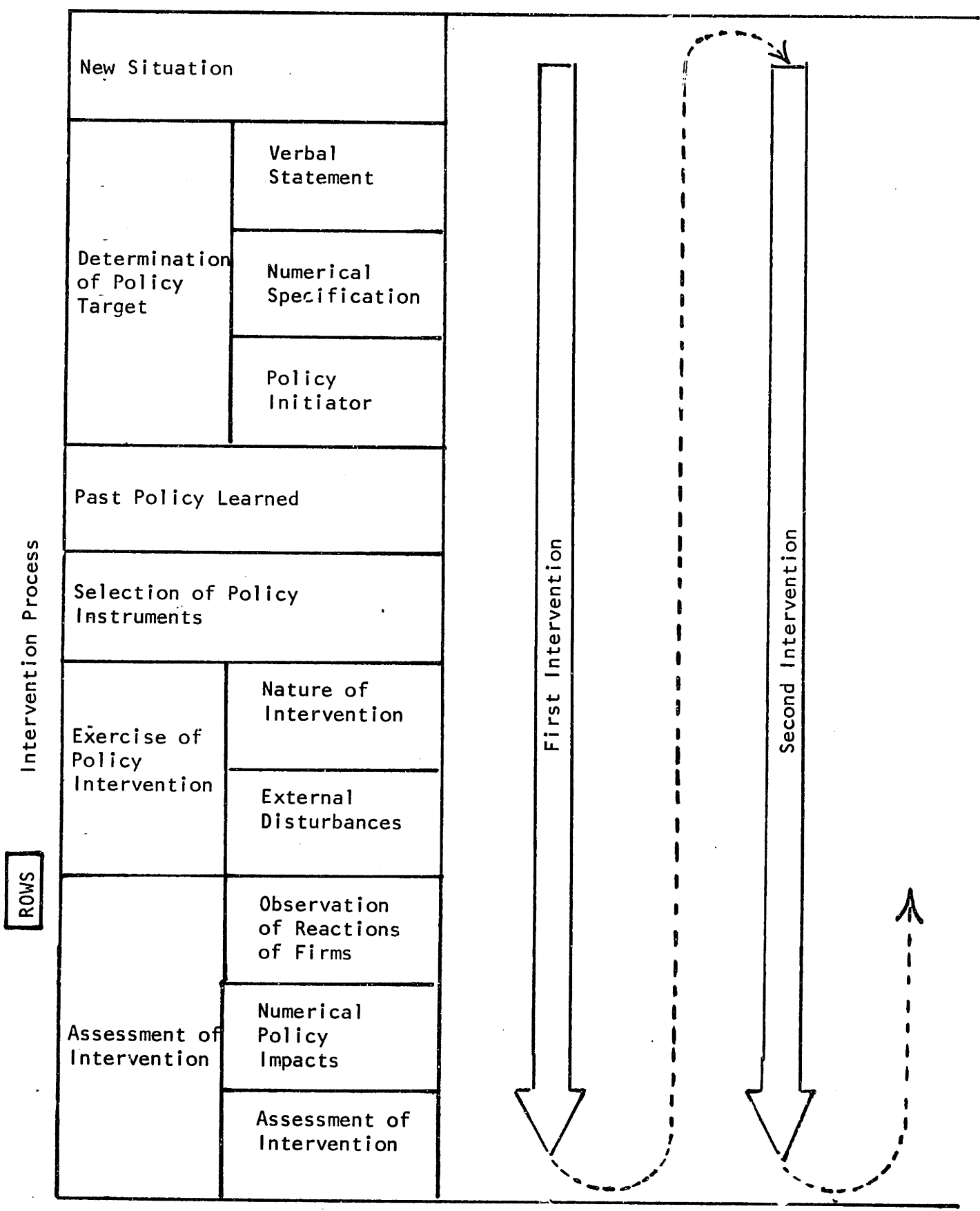
Among other assumptions incorporated in the proposition of the working model, most crucial are: 1) there exists a causal link from the preceding intervention cycle to the current one, and 2) the government has a learning capability in exercising an intervention by making maximum use of past experiences.

These hypotheses are equivalently restated in terms of the structural property of the working model: 1) there is a link from (8) to (9) in FIGURE I-1, and 2) there is a link from (8) to (11) in FIGURE I-1, respectively. It is structurally evident from FIGURE I-1 that these hypotheses are completely independent of each other. The former "causal" hypothesis assumes the situation in which a previous intervention has not attained the policy target so that further interventions enter successively until an ultimate goal is met. Then, the unsuccessful or insufficient past intervention becomes a cause for the current new intervention. This cyclical iteration is possible even

if the connection line between (8) and (11) does not exist, since the closed loop is guaranteed by the connection between (8) and (9). In other words, it is possible that multiple interventions enter over time, perhaps randomly and by a trial-and-error approach, even if the government has no learning capability. On the other hand, if there is no link from (8) to (9) but only a link from (8) to (11), intervention does not explicitly form an iterative cycle to narrow the difference between the policy target and the actual outcomes. Instead, the government always sets up a new policy target but makes maximum use of the past intervention cases, perhaps merely by copying the previously-used policy instruments. Therefore, the combination of these two independent hypotheses yields a new joint hypothesis that: policy intervention is in essence, a goal-seeking causal learning process so long as multiple cases of intervention are iteratively exercised over time.

The validation test of this joint hypothesis requires the substantiation of each component of the working model with a particular case study. For this purpose, a matrix presentation is adopted by expanding the working model into multiple intervention cycles. The framework of such a matrix is shown in FIGURE I-2. The rows represent the components of the working model plus one additional investigatory piece of information such as Policy Initiator (who actually set up a policy target, only the government or a joint policy-making of government and some other organization?) [32]. The

Cycles of Intervention



ROWS

c.1900 ————— TIME —————> c.1960

columns represent the cycles of intervention on a time scale.

In filling out each cell of this matrix, the focus centers on the two main observations: 1) whether or not the preceding intervention cycle is causally linked to the succeeding cycle as shown by a dotted line in FIGURE I-2, and 2) whether or not the same pattern of a total or partial set of rows of a column repeatedly appears over different intervention cycles. The first observation no doubt aims at the examination of the first "causal" hypothesis. Though the second observation ultimately tries to examine the second "learning" hypothesis, it yields other findings of policy significance as follows:

- i) If approximately the same pattern of a pair of the rows from the New Situation through Selection of Policy Instruments repeatedly appeared, the existence of a consistent pattern of government's problem-solving by policy intervention would be indicated.
- ii) If approximately the same pattern of a pair of rows of Verbal Statement and Nature of Intervention repeatedly appeared, the existence of a consistent manner of government's goal-attainment approach would be indicated.
- iii) If approximately the same pattern of a pair of the rows of Selection of Policy Instrument and

Observation of Reactions of Firms repeatedly appeared, the existence of a consistent pattern of firms' behavior upon a particular intervention would be indicated.

- iv) If approximately the same pattern of a pair of the rows from Selection of Policy Instruments through Numerical Policy Impacts repeatedly appeared, the existence of a consistent pattern of the relationship between intervention and its impacts would be indicated.

The main body of this research is to substantiate the above matrix using the case of the Japanese Government's policy intervention in the automobile industry for the period c.1900 - c.1960. Evidently, the substantiation of the matrix should comprise two main tasks: a historical investigation and a numerical analysis on possible impacts of intervention. For a general framework to conduct these two tasks, this research adopts Donald T. Campbell's "quasi-experimental design."

SECTION I-3

RESEARCH FRAMEWORK: INTERVENTION ANALYSIS AS A "DYNAMIC" QUASI-EXPERIMENTAL DESIGN

The quasi-experimental design advocated by Campbell and others [33] is a "spin-off" from the basic rules of measurements in a laboratory experiment, which are popularly known among engineers and natural scientists as the experimental design. The experimental design is particularly concerned with avoiding two fallacies: 1) the erroneous supposition of a causal relationship between an experimental treatment and effects on a subject, and 2) the erroneous generalization from a locally-observed experiment to a general theory. In their search for comparable rigour in experimental and educational psychology, Campbell and other psychologists have adopted the central features of the experimental design. These reorganized rules are now widely known among social scientists as the quasi-experimental design. The term "quasi" denotes the frequent impossibility of repetition of social science experiments, which makes a true control experiment impossible. Although the situation of policy intervention analysis is not exactly identical, there is a similar need for a rigid research framework based upon the quasi-experimental design. [34].

This research is a policy intervention analysis focusing on the

dynamic interactions between government and industry. The suitability of D.T. Campbell's quasi-experimental design as a research framework for intervention analysis has been examined, both in the context of a general attempt to find a fruitful and relevant method for investigating the interactions between the Japanese Government and also in the course of modifying the specific features of the quasi-experimental design to suit the specific issues dealt with in this research.

(A) The Quasi-experimental Design in the Light of
Policy Analysis

In Campbell's terms, these two fallacies are discussed under the headings of: 1) threats to internal validity, and 2) threats to external validity. The former are fallacies consisting of drawing erroneous conclusions on the efficacy of a policy interaction in a way analogous to improper reasoning from experimental evidence in a laboratory. The latter comprise conclusions improperly extrapolated from a specific intervention case to a different context, or used in forming a general theory.

In the context of policy intervention, Campbell raises nine major threats to internal validity, of which eight are relevant to this research as a post-hoc non-experimental intervention analysis [35]. These are: 1) the history threat, 2) the maturation threat, 3) the

instability threat, 4) the instrumentation threat, 5) the regression artifact threat, 6) the selection threat, 7) the experimental mortality threat, and 8) the selection-maturation interaction threat.

i) The Threats to Internal Validity

The history threat means the careless overlooking of causal factors other than just policy intervention. Suppose for example that the Japanese Government intervened in the automobile industry at a specific time and that automobile production increased after the intervention. Then, the history threat is a quick conclusion that the intervention caused production to increase. There might have been other causal factors which were entirely independent of the government intervention, such as the firms' individual efforts to enlarge production capacity or some economic factors causing an increase in demand which in turn elicited an increase in production. In this regard, the quasi-experimental design emphasizes the importance of a historical investigation of rival causal hypotheses.

The maturation threat consists of a failure to recognize the time-trend inherent in the data and thus concluding incorrectly that an increase or a decrease has been caused by intervention. Suppose that automobile production reached an unprecedentedly high level and there was evidence of intervention before the production data went up.

Then, the maturation threat is the hasty conclusion that the intervention caused a jump in the production data. However, it might be that the data had an exponential trend and that the period considered might be too long to allow this exponential trend to be seen. Thus, the quasi-experimental design warns against a lack of consideration of the time-based dynamics of data, such as natural growth, fatigue and secular trends.

The instability threat consists of drawing false conclusions regarding the efficacy of intervention in a situation where measurement errors (or sensor noise) and random fluctuations of a focused entity (or system noise) are relatively large. For example, an increase or a decrease in automobile production after a government intervention occurs might reflect only the overall instability of production data due to either measurement inaccuracy or the immature and hence unstable production performance of the industry itself, rather than an effect of intervention.

The instrumentation threat is not the most appropriate description in the context of this research. The measurement unit threat would seem to be a closer approximation to the true meaning of Campbell's instrumentation threat. This consists of drawing false conclusions about the efficacy of intervention as a result of using improper measuring units. An example would be the attempt to assess the efficacy of policy intervention by comparing two data-point pairs at

different levels of automobile production, and choosing absolute values, rather than growth rates. If one were taken from an early period of development, and the other from a mature period, with the intention of evaluating an intervention which occurred between the two, any estimate of growth rate between the two pairs would be misleading because the growth rate of the industry would in any case be expected to start at a very high level and decline thereafter. The quasi-experimental design recognizes this possibility and emphasizes the importance of the careful selection of an appropriate measuring unit.

The regression artifact threat is a general fallacy in any regression analysis consisting of picking up unrepresentative extreme data points in a data set and leading to an erroneous assessment of intervention. Clearly, this fallacy is not uniquely associated with a policy intervention analysis but may appear in any research involving a regression technique.

The selection threat means the improper unrepresentative selection of data to assess policy intervention. Suppose that an intervention had a specific focus on the production of small passenger cars. If the data for total vehicle production were used for policy assessment, without knowing the intervention exclusively aimed at small passenger cars, then the evaluation of intervention based upon such broad data as total vehicle production would lead to an erroneous conclusion. A

good example can be drawn from a case in this research. The technology introduction policy of the Ministry of International Trade and Industry (MITI) during the 1950s and 1960s was directed at the production of small vehicles. Thus, selection of the data for total vehicle production without knowledge of the relative share of small vehicles in total production yields no significant conclusion.

The experimental mortality threat is evaluating the effect of an experimental treatment ignoring the fact that a subject itself changes over time or is replaced by a new one while the treatment is in progress. This threat appears more often in a biological, psychological or educational experiment where a living subject is involved, rather than in a physical experiment where the subject remains relatively unchanged. The meaning of this threat in the context of an intervention analysis can be understood with an example drawn from this research. Suppose that the Japanese government intervened in the automobile industry over a long period, and that the industrial structure had been continuously changing by the replacement of old enterprises by new ones. In this case, a long-range policy assessment would require time-series data of production. Accordingly, the quasi-experimental design reminds us to ask whether the validity of this data is not imperilled by the experimental mortality threat.

The selection-maturation interaction threat is a combination of the maturation threat and the selection threat discussed above. If a treatment is applied to two different subjects which have a different maturation pattern, effects may be different since the true effects, if any exist, are superimposed on such a maturation trend. Therefore, if the selection of a subject is biased, it is very difficult to identify the causal relationship between a treatment and its possible effects. In the case of a policy intervention analysis, this threat deserves a special attention. Suppose that the Japanese government enacted law to grant a production subsidy to automobile manufacture. Due to the different growth patterns of different products, such as, large trucks and small passenger cars, this subsidy might have different effects depending on the product mix composition.

ii) The Threats to External Validity

Campbell raises six major threats to external validity in a policy intervention analysis, of which five are relevant to a post hoc intervention analysis such as this research [36]. These are: 1) the interaction effects and testing threat, 2) the interaction of selection and experimental treatment threat, 3) the multiple-treatment interference threat, 4) the irrelevant responsiveness of measures threat, and 5) the irrelevant replicability of treatments threat.

The interaction effects and testing threat is a weak external counterpart of the experimental mortality threat to internal validity discussed above, with more emphasis on the change, rather than loss or replacement, of a subject. If a subject is known to be very sensitive to a control treatment and as a result undergoes dynamic change over a period, the experimental situation becomes more and more unique and loses its general applicability. If the Japanese Government continuously intervened in the automobile industry to such an extent that the industry became more and more dependent on and/or sensitive to government intervention, it would become more difficult to draw a policy implication for other industries, or indeed other countries. This is better explained by a simple analogy of a dynamic system. That is, the future output trajectories of two identical dynamic systems might be completely different if they received different initial conditions. Furthermore, if they later on responded differently to an external stimulus, the two systems would diverge not only because of the difference in initial conditions but also because of the difference in their responses to external forces. Accordingly, the quasi-experimental design cautions us that a careful investigation of the uniqueness of policy intervention as well as of the responsive patterns of the subject area is needed before policy conclusions may be drawn for other cases.

The interaction of selection and experimental treatment threat is the external counterpart of the selection threat to internal validity.

This threat is the fallacy of drawing general conclusions from a case where selection is severely biased and uniquely related to a treatment. In the context of a policy intervention analysis, this threat means the extraction of a general policy implication from a particular policy impact case. The previously-mentioned MITI technology introduction policy is one example. In essence, this policy was a technology transfer policy which worked well for several manufacturers such as Nissan Motors in the area of small passenger car production. However, it did not make any direct impact on other companies which specialized in such products as large trucks and buses. Furthermore, Toyota Motors did not apply MITI programme to its small passenger car production. Therefore it seems unjustified to draw the general conclusion that the technology transfer policy worked very well.

The multiple-treatment interference threat is the fallacy of applying only one of multiple interdependent treatments to a different setting. In the case of a policy intervention analysis, this threat would be an irresponsible policy recommendation unaware of the fact that the experimentally identified effects were jointly caused by multiple interventions. Again, an example may be seen in the case of the above technology introduction policy of MITI. Suppose that this policy had been appraised and had attracted other countries, perhaps the LDC's which might have a keen interest in learning the Japanese lesson. The quasi-experimental design warns that the mere application

of this MITI policy is not guaranteed to succeed in LDCs since, as this thesis will show, the technology introduction policy was implemented in parallel with the import suppression policy.

The irrelevant responsiveness of measures threat is a warning based upon the recognition that treatments are complex so that effects normally involve desired outcomes as well as redundant ones. The differentiation of irrelevant treatments which may yield redundant outcomes from the relevant treatments which produce real impacts is generally difficult. Therefore extrapolation from a single experiment to another case needs a careful examination of what caused real effects. This warning is thus based upon the degree to which all of the threats to internal validity are ruled out.

The irrelevant replicability of treatments threat is a general warning against simplistic general conclusions from a case where a complex set of treatments work in interaction and where some of them are difficult to repeat. For a policy intervention analysis, this threat cautions that an application of the same interventions to a different area may not yield the same effects because some policy interventions are difficult to replicate due to the differences in political, economic and social environment.

iii) Merits and Demerits of the Application of the

Quasi-experimental Design to Policy Intervention Analysis

Formulating a policy intervention analysis as a quasi-experimental design has both advantages and drawbacks. In the first place, a researcher can systematically search for and try to eliminate all the threats to validity. Thus, he can maintain a more neutral position and avoid the so-called "trapped administrators' self-assessment." Secondly, the quasi-experimental design views a series of policy interventions as a learning process, and so a failure in one particular instance is not a crucial problem, since, in theory at any rate, it may be learned from and lead to new policies to correct it. An administrator, on the other hand, may be politically very vulnerable to the short-term consequences of a single failure. Thirdly, since these threats are a well established method in natural science, it is possible to reorganize and systematically conduct a policy intervention analysis involving an interlocking complexity of policies. Fourthly, the quasi-experimental design suggests a new approach for policy science studies, combining several disciplines, such as economics, law, political science, sociology, etc. In particular, understanding a policy intervention as a control treatment suggests the possibility of employing an operational study in which the qualitative nature of intervention would be incorporated into an operational variable. This is a particularly important advantage in that policy intervention studies today are either overwhelmingly descriptive or quantitative, and there are few intermediate cases of either descriptively analyzed policies or laws or numerically

evaluated policy impacts.

It is also necessary to mention some of drawbacks. First of all, application of the quasi-experimental design to a policy intervention analysis tends to force a researcher into becoming a perfectionist, which often discourages or delays a piece of research, particularly if there are time constraints. The rigid check of a complicated policy analysis against the possible presence of the above threats requires an enormous amount of time. Secondly, despite the fact that policy intervention is a human act based upon individual value judgement, the somewhat inhumane and systematic, or structural functionalistic, approach of the quasi-experimental design seems to involve the risk of neglecting the most important aspect of policy intervention, that is, the political ideology or value justifying intervention. Thirdly, the quasi-experimental design would seem to have a tendency to allow the researcher, who is a post defact evaluator, to gradually become less and less aware of the sharp distinction between his own situation, and that of the policy-maker, who is an experimenter in real time. The intervention analysis can easily become irresponsible in terms of practicability or implementability, and excessively critical of past policy implementation.

(B) The "Dynamic" Quasi-Experimental Design: Emphasis on the
Two Major Threats to Internal Validity and on the Dynamic
Learning Process of Interventions

This research attempts to analyze the successive policy interventions of the Japanese government on the automobile industry over a relatively long period from c.1900 to c.1960 by regarding them as a single causal chain. The subject matter and the objective of this research requires a slight deformation of Campbell's quasi-experimental design approach, though preserving much of its basic stance. This deformation consists of particularly emphasizing the following three points: 1) the history threat, 2) the maturation threat, and 3) the dynamic learning process of government interventions.

The primary purpose of the history threat is to rule out rival hypotheses causing effects, provided that an intervention and a proclaimed policy impact have been already proposed. However, this thesis research has to begin, in the first place, with an inquiry into the substance and nature of the Japanese government's interventions. Next, an investigation must be made of the areas at which the interventions were aimed. This requires a considerable amount of historical research before the application of the quasi-experimental design. In comparison with the standard case in which both interventions and proclaimed effects are given for an immediate

application of the quasi-experimental design, the otherwise laborious historical analysis of this research has a notable advantage. That is, among the threats to internal validity, the history threat, the selection threat, and the experimental mortality threat are simultaneously handled in the course of a historical investigation. Furthermore, almost all of the threats to external validity are checked in parallel. The questions as to which variables should be selected as a suitable indicator of policy impacts (the selection threat) and whether or not the components producing data in those variables remained constant or changed (the experimental-mortality threat) are in essence subject to a historical investigation of the substance and nature of interventions. The detailed examination of this case of intervention and of the degree to which this case can be extended to other cases (the external validity) will also be based upon a careful overall historical investigation.

A similar effort is made to avoid the maturation threat. The purpose of this in Campbell's quasi-experimental design is to "filter" the time-dependent macro trend from data so as to identify real impacts of policy interventions. This procedure is somewhat analogous to variance/covariance analysis based upon a linear additive model to identify a particular effect, among others, of a particular manipulable dependent variable, or to a standard econometric treatment for eliminating seasonal cyclical fluctuations. However, special attention must be paid to the applicability of such an approach to

this research.

Recall that of this research examines the long-range development of the government intervention from the very beginning of the Japanese automobile industry. If the industry grew "smoothly" as does human vocabulary capacity of vocabulary learning [37], the original maturation threat could be directly applied. However, if government intervention had been designed to create the automobile industry from scratch and make to rapidly develop to a mature stage, the developmental process might be more plausibly no longer seen as smooth, but with a radically changed "maturation pattern." In this case, the original maturation threat may be applied to each period in which the data trend contained a smooth maturation pattern. Then, the question arises of whether or not it is a good approach to: first, focus on each period, second, apply the original maturation threat, and third, cumulate them into a single time-series.

Technically speaking, this approach contains no procedural violation; but substantially speaking, it misses a fundamental issue in policy intervention to be explored in this research. Suppose that the production data of automobiles grew very sharply at the initial stage of a particular period, and later stagnated at a certain level, thereby forming a "smooth" rapid-stagnation pattern. Suppose further that in a successive period, the same production data took off exponentially from the previous stagnation. If there is a good reason

to believe that an intervention caused this structural change of trend from one period to the other, the original meaning of the maturation threat would need a different implication and hence the elimination of the maturation pattern would become a fatal violation. Rather, emphasis must be laid on the causal link between an intervention and a maturation change. If a policy is not regulatory, but designated for instance to promote automobile production, a careful observation of changes in maturation over an entire intervention history gives an important clue for policy assessment. In short, this research attempts to elucidate how the Japanese Government intervene to help the automobile industry develop over the past 60 years; an intervention is recognized, in this research, as a control treatment causing not only effects in an impact variable in a particular period but also secular changes in its structure.

Third, the relatively long time-span of intervention occurrences chosen by this research gives more insight into what Campbell initially stresses as the dynamic learning process of policy intervention. Failures and successes might occur equally in a long learning process of intervention. Therefore, so long as an analysis focuses on a single time period and a single intervention, an investigation into the learning process of policy administrators is hardly possible. A long-range intervention analysis may help to guarantee external validity. For example, whether or not policy administrators learned past experience, whether or not the same

intervention appeared at different times, whether or not the same intervention caused the same effect, whether or not the same effects are caused by different interventions, etc., can be answered only if the time-span of the intervention history is reasonably long.

The basic view of intervention as a learning process is fundamentally related to this new view of the maturation threat. If data maturation changed, for example, from a rapid-stagnation pattern to an exponential one after an intervention occurred, the government was supposed to learn that intervention changed the maturation pattern. The government should have learn more than just that its policies affected industry. By perceiving how its intervention changed the structure of an impact variable, it should, at least theoretically, be able to control future behavior of the industry by a process of accumulating and updating its knowlege. Rather than trial-and-error intervention by "experimental" administrators as discussed by Campbell, intervention with a clear learning focus on maturation patterns is more responsible since a policy "experiment" sometimes creates an unexpected adverse consequence no other government can ameliorate in the immediate future. The firm stance of this research as a post hoc dynamic policy intervention analysis includes an investigation as to whether or not the Japanese Government had a learning capability in intervening in the automobile industry over its 60-year developmental history.

SECTION I-4
PROCEDURE AND STRUCTURE OF THE
PRESENT RESEARCH

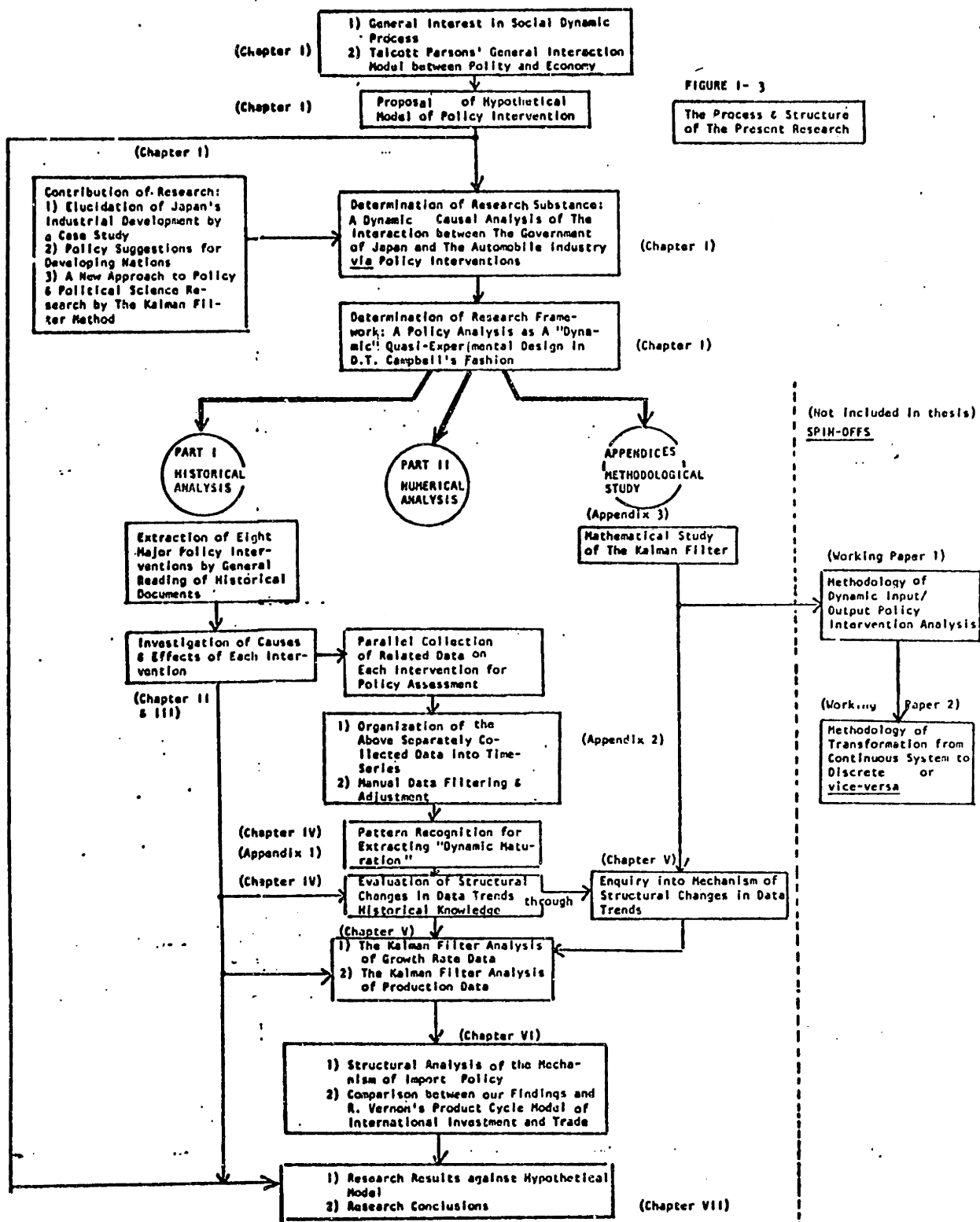
This research has been conducted by following the procedure described in FIGURE I-3.

PART I: HISTORICAL INTERVENTION ANALYSIS

Of the two major threats to the internal validity in D.T. Campbell's quasi-experimental design, the elimination of the "history" threat was the first research task.

First, a number of documents that describe the history of the government's automobile policies and the development of the industry were examined in order to get a rough idea of the causal ordering of the interactions between the government and the industry.

Second, from this somewhat random historical search were revealed eight major policy interventions that occurred during the period from the 1880s to the 1960s, which presumably had considerable impact on the behavior of the automobile industry. Each of the eight major policy interventions constitutes a section in PART I. The first



chapter covers the four interventions in the pre-World War II period. The second chapter deals with the other four postwar cases.

The decision to select these cases of government intervention for analysis was not made on the basis of any conventional theoretical framework, but was rather based on a general human capability for recognizing the boundaries of events, a capacity whose ultimate justification lies in the ability to make consistent sense of the evolution of the subject matter. The reason for using this intuitive approach rests on the desire in collecting data to avoid any distortion and confusion caused by tenuous social theory. Admittedly, some cases might have deserved a richer investigation with a better-founded socio-economic theory. However, some of these attempts had to be omitted because of time-constraint and, more importantly, the definition of our research purpose, i.e., substantial understanding of the long-range metamorphosis of the industry in the policy context. Only the repetition of recognized similar patterns of events over time yields an insight into a possible theoretical construct, while a theoretical analysis of a time-sliced event tends to emphasize the optimal or ideal course of action. In short, this research is more interested in "what actually happened," rather than in "what must have happened."

Third, for each intervention, an attempt was made to identify the following: 1) the major causes triggering the government's

intervention, 2) the substance of the intervention, and 3) its impact on the behavior of the industry. The results of these findings are discussed in CHAPTERs II and III under the respective titles: (A) Pre-intervention Environment, (B) Policy Intervention, and (C) Policy Impacts. The flow diagram which summarizes the causal environment around each intervention is attached to the end of each section as a quick reference for the next numerical intervention analysis.

PART II: NUMERICAL INTERVENTION ANALYSIS

The elimination of the second major threat to internal validity---the "maturation threat"---is the first task in the numerical intervention analysis of PART II.

While conducting the historical analysis, all numerical data associated with each intervention were recorded. These data were subsequently organized according to the different time-series and plotted on a logarithmic scale. The use of the logarithmic scale in data-plotting needs no further explanation. Any data which involve the dynamic growth property must always be plotted on a logarithmic scale. Some data were obviously either missing or inconsistent, reflecting variation in the nature of available sources. Then, at the third step, inconsistency in data was filtered and sorted by a desk calculator. If the data were related only to a particular intervention and hence

could not be incorporated into a time-series, they were inserted in the appropriate parts of the historical analyses. In other words, only the data which could construct a time-trend to encompass more than two interventions were subject to the numerical analysis of PART II.

The maturation threat discussed by D.T. Campbell cautions researchers to analyze the time-trend of data transition. This implies that the visual pattern recognition of the data trends is imperative to eliminate the maturation threat. In conducting the pattern recognition, it is emerged that D.T. Campbell's maturation concept needs to be extended to the dynamic situation where maturation has two operational meanings: 1) mere coordinate shift along either the vertical or horizontal axis (This is the original meaning of Campbell's maturation), and 2) dynamic structural changes from the previous apparent structure to a new structure (i.e., structural metamorphosis of data trends). This new finding of the second type of maturation (termed "dynamic maturation" in this research) heuristically comes from pattern recognition of the actual data.

This pattern recognition determined that the time-series data evolves by being successively transformed from one distinct pattern another. These patterns are simple and ubiquitous, being: 1) the linear trend, 2) the rapid-stagnation trend, 3) the exponential trend, and 4) the parabolic trend. If structural changes occur, then output is automatically affected. However, the converse of this statement is

not always true. That is, if output changes, this does not necessarily mean that there is a change in the structure which produces the output. Note that the converse case involves the coordinate shift of the same data trend, i.e., the same structure with a new initial condition. To sum up, D.T. Campbell's maturation deals with this coordinate-shift, whereas this research is more concerned with dynamic maturation in which time-series data changes the structural pattern. Hence, the focus of this research was strictly whether or not the government's interventions induced such a structural change.

Two steps were taken in approaching this question. The first was to investigate the structural property of each of the four apparent patterns. In other words, what kind of "dynamic" structures would yield these patterns? The second step was the visual investigation of whether or not the historical knowledge of PART I would correspond to the structural changes of the major time-series data. The results of these two steps are the main contents of CHAPTER IV. If the interventions in fact occurred shortly before the data trends entered the new pattern and the trend patterns simultaneously contained the dynamic structures, then the intervention analysis would continue further by asking: "which part of the structure was affected by the government's intervention?" The first half of CHAPTER V is devoted to this question.

Since the data were plotted on a logarithmic scale, the inquiry

into the dynamic structure required consideration of the relationship between the ordinary scale and the logarithmic. For example, a linear trend on the ordinary scale would resemble the rapid-stagnation pattern if it were plotted on the logarithmic scale. With basic knowledge of the difference equations, this research thus concluded that all four of the apparent patterns could be approximately structured by the simple first-order heterogenous difference equation. The argument on this point is covered in APPENDIX 1 since it involves technical discussions.

The visual identification of the correspondence between the government's interventions and the structural changes of the data trends led to the selection of four key variables: production, import, export, and motor vehicle supply. The selection of these variables was based upon the previous historical analysis. They seemed to be the most important variables to which the government referred in determining whether or not interventions were necessary. Since an emphasis was placed on visual pattern recognition, the numerical data tables appear in APPENDIX 2. Following the successful approximation of the dynamic structures of the four trend patterns by the simple difference equation, research identified the high degree of correspondence between the time of the interventions and structural changes in the data trends. Then, the analysis investigating how the interventions affected these dynamic structures continued. Much time was spent in the preparatory work searching for the relevant methodology for this analytical purpose.

Methodological Study

The first effort in this part made was to examine the applicability of the two competing methodological paradigms. These are: 1) Box/Tiao or Box/Jenkins' noise model approach, and 2) the structural equation model approach. [38]

The former approach tries to identify the intervention impact on the dependent variable for the two versions of the same noise model: the one which does not have the intervention term and the one which contains the intervention term. The model to be used is the well-known auto-regressive/moving-average (ARMA) model which requires the parameters to be time-invariant and needs to be fed all historical time-series data at once. Although it has these "static" and "post hoc" constraints, this approach has one notable advantage: that is, in applying Box/Tiao or Box/Jenkins' model, we do not have to know the exact structure of the impact-generating mechanism. This feature becomes a great relief to a researcher whose research area has no well-established theory.

The latter approach is the counter-proposal to the former approach. If the input/output structure to feed the policy inputs and produce the policy impacts, together with other conceivable inputs and outputs, were a priori known in the form of the structured simultaneous equations holding no "identifiability" question, the

existence of the policy impacts could be statistically tested by comparing the "policy-off" structure (in which the policy input variables are ruled out) and the "policy-on" structure (in which the policy input variables are included). Since any hierachically-structured simultaneous equations can be reorganized into a reduced form, this approach can handle the dynamic nature of the impact-generating system in which the parameters are not time-invariant, but time-variant.

After carefully examining these two approaches in the light of our analytical purpose, we have concluded that neither would be suitable. There are three main reasons.

First, the above two approaches are more or less applicable to the situation in which factors other than policy interventions can strongly affect the outcome. An example is D.T. Campbell's original work on Connecticut's crackdown on speeding to reduce highway fatalities [39]. As the potential causes for the reduction of death tolls in 1956, many other causes than just Governor A. Ribicoff's extremely severe crackdown policy in December 1955 were conceivable. For example, the relatively dry and less snowy weather and the decrease of the vehicle registrations in 1956 were thought to be among other potential causes. In order to single out the impact of the governor's crackdown measure, a statistical test is perhaps necessary [40].

No one can deny that the development of the Japanese automobile industry has been caused by many factors other than just the government's interventions. However, when we read the history of the development of the Japanese automobile industry, we were overwhelmingly impressed by the fact that the response of the industry to government intervention was extremely sensitive. For example, as we will delineate in CHAPTER II, the production curve of all 4-wheel vehicles abruptly jumped up and rode on the rapid increasing trend since 1925 after the government enacted the Law of Support for Military Vehicles in 1918. Later we found that this law induced large enterprises to enter automobile manufacturing with the attractive incentive of the military procurement in 1924. The production of small passenger cars started declining parabolically in 1938 after the minister of commerce and industry issued the limited embargo on the production of small passenger cars in 1937. Later we found that Nissan Motors whose small car production accounted for nearly 90% of the nation's total output at that time was forced to comply with this military government's order. The curve of foreign car supply started sharply declining and immediately reached the bottom after the government promulgated the Law Regarding Automobile Manufacturing Enterprise in 1936. Later we found that this law made illegal the business of the two powerful American assembly plants in Japan whose production accounted for more than a 90% of foreign car supply. These facts simply demonstrate that when the history threats were thoroughly

examined so that other causal possibilities were gradually ruled out, the motivation for employing the above two approaches disappear.

Second, the static post-hoc nature of the ARMA model can not reflect metamorphosis of the data. Suppose that we could successfully identify the behavior of the production data trend that encompasses the sixty-year history of the Japanese automobile industry by the ARMA model. Then, we would be obliged to believe that the same structure existed for sixty years or so, although it produced a different output. Such a belief is a crucial threat to the internal validity with respect to history. As we will discuss in PARTs I and II, the Japanese industry has grown by radically changing its structure in order to accomodate a changing environment. Recall that our analytical purpose was to identify the impacts of the interventions on the data-generating structures, which means that we a priori assumed that the structures would have dynamically changed. Thus the static structure of the ARMA model conflicts with our basic assumption. The first kind of maturation we have previously pointed out relies exactly on this static philosophy regarding the structure of dynamism. If the same structure holds, the intervention would work to shift the output value, thereby implying the first kind of maturation. This is why the application of the ARMA model to the intervention analysis places the intervention constant as the linear additive in the model.

Third, the structural equation approach can not be applicable to

the present research since we do not know the the policy impact-generating mechanism. It is precisely the investigation of such a mechanism that is a primary objective of the present research. The fact that this research used economic variables as the major indicators for assessing the policy impacts suggests, at least ideally, that economic theory could be used to construct the structural equations. However, the scope of our research was quite broad, and focused on the single macroscopic causal chain of dynamic interactions between polity and economy over a long period which implies that the microscopic economic argument would be submerged and would not appear on the observational level. Perhaps our position on this would be better explained by the analogy to the two economic dynamics. [41]

The theory of the multiplier effects of investment says that if the propensity to consume is between 0 and 1, the national income becomes stagnated at a certain level, forming the rapid-stagnation growth curve. On the other hand, the theory of the demand/supply curves says that if the modulus of slope of the demand curve is smaller than that of the supply curve, both demand and supply become stable as time goes on (i.e., the Cobweb theory). Now, suppose that the government does not know either of the above theories but is aware, by looking at past trends, of the fact that national income is beginning to stagnate or that demand or supply is becoming unstable. If the government worries about such a situation, it probably does something to ameliorate it.

What the government does might be a policy intervention to change the propensity to consume or the relation between the demand and supply slopes, or neither of these. In any case, if the intervention were successful and the situation were in fact improved, the government would increase its knowledge of the impact-generating mechanism on either national income or demand/supply relations. The knowledge the government acquired does not necessarily correspond to the theory of the multiplier effect of investment or the Cobweb dynamics. Rather, it is knowledge accumulated through a trial-and-error learning process of an empirical law. The point we would like to make here is not that the economic theory is wrong but that the government could learn about the impact-generating mechanism of the economic entity by a repeated trial-and-error learning process, even though it is ignorant of economic theory. Furthermore, as long as this repetition process is extended to a long time-period and hence becomes macroscopic, the government is apt to look at only observational trends (such as the rapid-stagnation curve of the national income or the instability curves of demand/supply in the above cases) because the need for policy interventions emerged from the deterioration of these trends in the first place. This research tried to investigate the intervention effects by standing at such a government's side and by emphasizing such a learning process.

A careful examination of the existing two approaches to the intervention analysis clarified what kind of methodology this research needed. It must meet at least two requirements: 1) identify the internal structural changes in the dynamic system which incorporated the intervention inputs, 2) reflect the learning process of the government's recognition of the data trends. The best possible approach is the Kalman Filter.[42]

The Kalman Filter is a set of algorithms to: 1) first, at time t , predict the "system state" for the next period $t+1$, and 2) then, at time $t+1$, correct (or, update) the previous, perhaps a little bit inaccurate, prediction when information concerning the difference between the past prediction and the present actual value of the system output is available. Putting it differently, it is the "on-line" learning estimation process for increasing knowledge of the system's behavior (state) by using the maximum amount of the past and the most recent input/output information. Here, the "system state" implies the internal, sometimes invisible, structure of the system that completely governs the system output.

These features struck us for their close resemblance to the government's learning process mentioned above. Now, let us compare between the two. Suppose that the government worried about the ever stagnating production curve. Then, the government carried out a

certain policy intervention to ameliorate this stagnation. Suppose further that the intervention was successful and hence the once-stagnated production curve took off and set forth a new growth trend. By this experience, the government would gain knowledge of how its intervention affected production. If the same problem occurred in the future, it would be likely that the government would intervene again in the same way or in a different way having the same impact. The above process exactly corresponds to the Kalman Filter's state estimation process. The Kalman Filter estimates the structure of the system by learning the past trend of the production curve. If the situation changed and the production curve suddenly departed from the past trend, the Kalman Filter would start changing (correcting) the previously estimated system structure to accommodate the new situation.

In this research, the Kalman Filter was applied to only the production data recognizing that a majority of the government's policies have been focused on production. This is based upon the historical analysis of PART I. In addition to direct application to production data, the Kalman Filter was also applied to the growth rate data under the assumption that the growth rate, rather than production itself, might have been the government's major concern in assessing production performance. The growth rate is more sensitive than the level, and hence is the key indicator allowing comparison over time and space. Before applying the Kalman Filter, this research spared a

considerable amount of time for for investigating the mechanism of the structural transfer from one to the other of the previously-mentioned four trend patterns (i.e., the linear, the rapid-stagnation, the exponential and the parabolic trends). Such an understanding is imperative to the assessment of the Kalman Filter results.

All of the above research work appear in CHAPTER V. The discussion of the basic mathematical concept of the Kalman Filter will be attached in APPENDIX 3. In the course of the study of the Kalman Filter, this research yielded two working papers which have been discarded and will not appear in this thesis. The first paper is on the methodology of the application of the Kalman Filter when the complete time-series data of the government's interventions were available in the form of numerical figures, such as subsidy, grant-in-aid, public loan, tax, etc. Since we did not investigate these data on account of both financial and time constraints, the application of this methodology was precluded. The second paper is on the methodology of the transformation from continuous system to discrete one, or vice versa, by the so-called "Z-transform." Evidently, most economic (dynamic) models are written in terms of continuous functions. However, the data we observe are discrete. Therefore, the empirical verification or application of these models demands the discrete transformation. Since we did not adopt the structural equation approach to the intervention analysis, this working paper lost its utility and hence was abandoned.

CHAPTER VI will be devoted to the different intervention analyses of significant importance. As we will delineate in PART I, the development of the Japanese automobile industry can not be fully understood without knowledge of how crucially foreign imports both before and after the war affected the government's policy interventions. In short, what the government did was to protect the domestic automobile industry first by suppressing foreign imports, and, second, by stimulating domestic production, without sacrificing the nation's total supply. The underlying policy was what the so-called "exponential take-over"; which means that domestic production took over from predominantly foreign supply within a very short period forming an exponential share curve to total supply. This research has identified the fact that the same policy logic obtained at both times when the government promulgated the most radical Law Regarding Automobile Manufacturing Enterprise in 1936 and when the government instituted the guidelines for foreign technological contracts in 1952. CHAPTER VI will discuss how these happened.

The fact that the major government interventions were mainly concerned with the encouragement of production and the suppression of imports suggests a comparison of Raymond Vernons's model of international investment and trade [43] with our findings. He proposes three different patterns for the relationship between domestic production, domestic consumption, imports and exports. These patterns

correspond uniquely to the respective sequences of industrial development of the U.S., other advanced countries and less developed countries. Then the last part of CHAPTER VI first discussed the structural properties of R. Vernon's model, and, then investigated which pattern was most appropriate for the case of the Japanese automobile industry. The investigation also yielded valuable information for assessing the government import suppression policy.

All of the above findings are distilled into the matrix proposed in FIGURE I-2. The entire research is summarized in this matrix. The first part of the final chapter, CHAPTER VII, presents the filled matrix. Research conclusions are drawn from this completed matrix. The first question as to whether or not successive interventions form a series of iterative cause/effect cycles is answered by examining the dynamic linkages in each column of the matrix. The second question as to whether or not there are consistent pattern in all or some stages of the intervention process over different cycles is answered by examining each row of the matrix. The third question as to whether or not government has a learning capability for attaining a goal by policy intervention is answered by examining development along the row of policy assessment. Finally, the limits of the present research are pointed out and a proposal is made for the future development of this line of research.

PART I
HISTORICAL INTERVENTION ANALYSIS [1]

CHAPTER II
PREWAR POLICY INTERVENTIONS

SECTION II-1
THE FIRST MAJOR POLICY INTERVENTION: THE LAW OF
SUPPORT FOR MILITARY VEHICLES

(A) Pre-intervention Environment

The subject of the 70-year-long developmental process of the Japanese automobile industry in a historical context is an exciting one for historians of industrial technology. However, our task in this research is not to be a mere romanticized delineation of historical anecdotes, but rather a careful reconstruction of events into a causal chain with a strict focus on government policy interventions.

We believe that the dawn of the Japanese automobile era could be characterized by the three conditions: a) the first appearance of foreign cars imported or brought back to this country as either a

Western rarity or a travel souvenir by a handful of curiosity-seeking upper-class people under the influence of "Westernization," b) the small inventive efforts to make (perhaps, in a more appropriate word, "assemble" or "copy") a car by some engineers who did not have sufficient financial assistance, and c) the early recognition of the potential use of trucks for military purpose by military engineers, which later led to the birth of Japan's automobile industry. These three historical "wrappings" aim at demonstrating the origins of three important aspects of cars in the policy context, which one may find even today. These are: i) the perennial problem of "import cars" which have been kept expensive and hence beyond the reach of the general public, ii) Japan's typical pattern of technical achievement by both indigenous efforts and assimilation of foreign technology, and iii) the sweetheart-relationship between government and industry.

1. Early Imports and The Creation of A Social Perception of An Automobile by The Japan Automobile Club

History records that a foreigner who resided in Yokohama imported a car called "Orient," a steam-powered vehicle, in 1897. This perhaps was the first public appearance of a 4-wheel car in Japan.[2] Many other imported cars followed the "Orient." As of 1908, the number of registrations at the Tokyo Police Authority was 61 [3] of were prohibitively priced. This average salary was nearly equal to the

monthly maintenance cost of a car [4]. Thus, car owners at that time were exclusively wealthy and hence members of the aristocracy. These people gradually formed a dinner salon at Japan's most expensive hotel, the Imperial. The salon became in 1910 the nation's first automobile association, The Japan Automobile Club consisting of nearly 120 members led by Count Shigenobu Okuma. These people were drawn from the most distinguished social constellations at this particular period of Japanese modernization. It is said that those who helped the establishment of this aristocratic salon were a couple of foreign traders in Tokyo and Yokohama who imported and sold automobiles.

The fact that more than half of the car owners in Japan belonged to this club inevitably led to its being not only a social club of wealthy automobile amateurs, but also the advisory board for the government in formulating automobile-related policy. This can be clearly seen in the club charter. In its first article, it said: [The Club] "aids the government in promulgating laws and regulations to protect the interests of automobiles in general.....and to promote the improvement of road conditions." [5]

2. Small Inventive Efforts of Car Manufacturing [6]

Before the automobile industry formally emerged in Japan with the full support of the military, there existed several small-scale

inventive firms in car manufacturing. They had several notable features in common. They engaged in custom-ordered production only, designed by one or two engineers with college-level or lower technical education, manufactured in a small blacksmith-like shop, and with insufficient capital to support a car enterprise. Despite unsuccessful development later on, Japan's early start in car manufacturing was only 5 to 10 years behind Europeans and Americans. This strongly suggests the high degree to which Japan tried to assimilate Western technology, not only at the government level but also privately. The Japanese way of assimilating Western technology can be seen in various industrial sectors. Here, we will examine one case in the automobile industry.

The First Firm: Tokyo Automobile Manufacturing [7]

This firm was founded by Shintaro Yoshida who previously ran a bicycle business. Yoshida first opened a foreign car shop, "Motor & Co.," in downtown Tokyo in 1901 in an attempt to sell the aforementioned steam-powered "Orient." In 1902, his company changed its name to "Automobile & Co." and entered the car assembly business by importing a two-cylinder, horizontal-opposed engine from the U.S. His idea in starting this business was quite simple. At that time, half the cost of an imported foreign car was accounted for by the cost of an engine. To minimize the cost he tried to sell a car by mounting an imported engine with Japanese chassis & coach work. Yoshida's

associate, Komanosuke Uchida, who went abroad at an early age and acquired car repairing skills was responsible for the production of these. Yoshida's entrepreneurial ambition was not satisfied with the current simple assembly business and he tried to go on to the establishment of an independent car manufacturing company by inviting financial supporters. However, he confined to small scale manufacturing because the establishment of new enterprise was banned by the government to facilitate the sale of government's economic development bonds after the Russo-Japanese War (1904-1905). Then, in 1907, Yoshida established Tokyo Automobile Manufacturing and introduced the Uchiyama-made "Takuri." This was the nation's first car to be made without major foreign parts. Initial production of the Takuri model attained 17 units, of which only 14 Takuris were sold. The possible reasons for the failure of the Takuri model are pointed out [8]: i) too small to get in with a tall hat, ii) the out-of-date chain-drive as compared to the shaft-drive of foreign cars, and iii) the interior decoration was too "shoddy." This failure was too much, and Yoshida's early attempt ended with the return to an old foreign car dealer business in 1909. Although the experience of Tokyo Automobile Manufacturing resulted in a failure, there is no doubt that this company marked the opening of Japan's automobile manufacturing industry. It also demonstrates that this kind of industrial product is sensitive to public's demand perception, which in turn gives public policy ample room to intervene.

Other than Yoshida's Tokyo Automobile Manufacturing Company, several small factories tried in vain to produce a car. One observer points out the common reasons for their failures: such as i) lack of entrepreneurship, ii) not paying attention to or learning about their competitors' technical achievements, iii) not assimilating technical devices in advanced foreign cars, and iv) the prototypes they conceived were all small as opposed to the fashion at that time for chauffeur-driven passenger cars. [9]

3. The Genesis of Government Intervention

a) Low Import Tax and High Automobile Tax

As we have seen, the first automobile import came in 1897. The import tariff at that time was 50 % ad valoren for a complete car. However, according to the preferential tariff agreement between Japan and France, 35% and 30% rates were actually levied on a complete car and auto parts respectively. In 1911, the tariff was further lowered as a compensation for the increase in the automobile tax. The amended rates were: [10]

	<u>Official Rate</u>	<u>Actual Rate based on the Agreement Between Japan & France</u>
Complete car	50 %	35 %
Auto Parts	20 %	25 %
Engines	20 %	20 %

We have already noted that the members of the Japan Automobile Club accounted for a majority of imported car owners. Therefore, the low tariff rates were believed to reflect pressure from the influential members of the club, who were the principal beneficiaries of a low import tax on the Ministry of Finance. The club applied further pressure to lower these rates and obtained a 25% ad valorem tariff for all imports except engines. This tariff rate was said to be one of the lowest internationally, which later provided foreign makers with ample reason to export their products to Japan or assemble them in Japan with less expensive imported parts, hence creating the most serious problem for industry and government later on.

Before 1907, the automobile tax was at an annual flat fee of 3 yen which equalled the tax on a bicycle. [11] In 1907, Tokyo City decided to levy a flat fee increased ten-fold (30 yen) on an automobile. This is the first official recognition of the necessity to impose a different tax on a new means of transportation. Different prefectures levied different automobile taxes referring as their yardstick to

their tax on a carriage. For example, in 1911, Tokyo Fu ("Fu" stands for a specially designated administrative district equivalent to a prefecture), Osaka Fu, and Kanagawa Prefecture levied 66 yen, 40 yen and 50 yen, respectively. The higher tax rate of Kanagawa Prefecture reflects the fact that it included Yokohama City where most foreign traders resided. The increasing extravagant behavior of wealthy people in the Japan Automobile Club led Tokyo Fu to reconsider the current automobile tax and thus to impose, in 1912, an extremely high tax, which consisted of a 60-yen city tax, a 21-yen additional tax, a 30-yen city special tax, totalling 111 yen. The relatively high automobile tax of Japan at present dates back to this period. Furthermore, Japan's high automobile tax at this early stage simply designated a car as a luxurious commodity owned by a distinguished cohort of upper-class people. This seems to be a very important recognition when one looks at the history of the Japanese automobile industry in a social setting. In Japan, a car, in particular a passenger car, had long been a consumer product inaccessible to the general public. The social perception of it has remained as something different, i.e., a status symbol, and this attitude has constantly been an obstacle to the attempts of the industry at mass marketing.

b) Military Recognition [12]

The automobile was successively adopted in Europe and North America

during the late industrial revolution. The early recognition of the military utility of motor vehicles is not surprising if one admits that a car is a machine-powered replacement for a horse-powered carriage. The military of the advanced countries had already employed motor vehicles for transporting soldiers as well as weapons to the front. The Japanese Imperial Army learned of this new innovation in military technology relatively early, through a military attache in Paris. In 1907, the Imperial Army officially decided to undertake R&D on the potential use of this new "weapon" and so imported a French-made truck. A year later, in 1908, another truck was imported from France for further examination of its mechanical structure and military potential. In 1910, the Army ordered Tokyo and Osaka Arsenalns to produce two prototypes based on a German truck. These were successfully completed in 1912, at a cost of 9,000 yen in R&D expenses. After comparative road tests with the foreign makes, the Army became more confident about manufacturing military trucks using Japanese technology. The marked difference between the Imperial Army's trucks and their foreign counterparts was as follows:

Imperial Army's:	4 cylinders, gasoline-powered
Foreign:	6 cylinders, diesel-powered

Then, in 1912, the Army established the Committee to Survey Military Vehicles. The principal function of this committee was to investigate whether or not this new means of transportation could be used in rough

fields in Manchuria, present-day China. The successful outcomes of the Manchurian test led the committee to conclude:

- 1) A truck is useful as a means of supplemental transportation in the field
- 2) The maintenance cost is great. Therefore, it is not recommended that the Army own trucks. It is more advantageous for the public to own them during peace time, the Army to requisition them during wartime

In 1915, the Army's four prototypes were brought to the Tsingtao capture operation, where their tremendous utility was demonstrated and impressed Army generals. This incident no doubt paved the road toward the 1918 Law of Support for Military Vehicles.

(B) Policy Intervention

1. The Law of Support for Military Vehicles

(1918; Amendment 1921) [13]

The satisfactory outcomes of the first (1912) and the second (1916) Manchurian tests on the performance of domestic-made trucks and their striking usefulness in the Tsingtao operation finally resulted in the

promulgation of the Law of Support for Military Vehicles [LSMV] on March 1918, effective from May 1918. The summarized text of this law is as follows:

1. Purpose

To facilitate the production of military trucks and the private ownership of them for eventual war-time requisition.

2. Measures

Production Subsidy

The government gives a subsidy of less than 2,000 yen per truck to a manufacturer that produces trucks subject to a military requisition.

Purchase Subsidy

The government gives a subsidy of less than 1,000 yen per truck to the purchaser.

Maintenance Subsidy

The government gives the purchaser a subsidy of less than 300 yen per truck for maintenance expenses.

3. Conditions

Eligibility

- i) Residents of Japan
- ii) Japanese citizens or a juridical person established in accordance with Japanese law.
- iii) A corporation is eligible if the majority of its capital is Japanese-owned and Japanese also have a voting-majority.

Regulations and Compensations

- i) No one may change the structure or performance of the LSMV-designated truck without permission of the government.
- ii) The LSMV-designated truck may not be mortgaged.
- iii) The owner of the LSMV-designated truck must be responsible for its maintenance and repair.
- iv) The owner of the LSMV-designated truck may not reject military requisition.
- v) Two kinds of compensation will be given to the owner upon requisition:
 - a) compensation for use,
 - b) compensation for requisition. [14]

(C) Policy Impacts

1. Difference between Expectation and Reality: Post facto
Policy Assessment

a) "Flow" Analysis

The impact of the LSMV on truck production can be vividly demonstrated in the following statistics: [15]

<u>Year</u>	Expected # of		<u>B/A(%)</u>
	<u>LSMV</u> <u>Designation(A)</u>	<u>Actual</u> <u>Designation(B)</u>	
1918	15	4	26.7
1919	10	3	30.0
1920	100	22	22.0
1921	73	28	38.4
1922	No data	3	NA
1923	No data	16	NA
1924	No data	84	NA

The low percentage of the actually designated trucks as compared to the Army's expectations shows that the Law of Support for Military Vehicles did not function properly as an incentive. One possible

reason for this is said to have been the rigid technical specification by the Army [16], which might have discouraged both manufacturers and purchasers. In addition to this widely-advocated explanation, we believe that the nearly constant designation ratio around 30% or less from 1918 to 1922 raises one important policy question: Why does this remain constant?

Now let us imagine two possible situations. On the one hand, it might be that the industry was not capable of meeting the Army's expectations. In this case, a 30% ratio would reflect the state of performance of the industry at that time, and the government simply expected too much from industry. On the other hand, it might be that the government already had fixed criteria for the percentage of yearly designation upon application. Accordingly, this 30% ratio would imply the so-called bureaucratic "incrementalism" (i.e., following past precedents) [17].

Now consider the dynamics of the interaction between policy and industrial response. If the government always designated the LSMV trucks in accordance with a fixed ratio, the industry would be likely to gradually submit a number of applications calculated on the basis of the previous year's designation ratio. In this situation, the government would discourage production. As we will discuss below, evidence suggests that the firms' response to the Law of Support for Military Vehicle was very high, which seems to suggest that the above

speculation would not be too unrealistic.

Suppose that the government approved the LSMV trucks rather loosely by increasing the designation ratio every year. If industry was aware of this increasing trend of the government's approval, it would be likely that the application, and so production, would also increase. That is to say, the increase in approval functions as an incentive to industry. Of course, if the government had a rigid technical specification or bureaucratic incremental approval policy in designating the LSMV trucks, this incentive would no longer have functioned.

The above argument is based upon the view that data are regarded as "flow." However, it is likely that if the Army recognized the shortage of the LSMV trucks in a stock pile, the trucks produced in previous years were designated later, which suggests the need to look at the "stock" data.

b) "Stock" Analysis

Due to the nature of the Army's intention to maintain a stock pile of suitable trucks for military emergencies, it is necessary to look at the same data in "stock" form and draw a policy implication. The previous table is converted as follows:

<u>Year(t)</u>	Sum of A(t)	Sum of B(t)	<u>D(t)/C(t) [%]</u>
	<u>C(t)</u>	<u>D(t)</u>	
1918	15	4	26.7
1919	25	7	28.0
1920	125	29	23.2
1921	198	57	28.8
1922	NA	60	NA
1923	NA	76	NA
1924	NA	160	NA

Roughly speaking, this table shows that in each year the Army held one third of what it needed [18]. The above table also shows that the Army's expectation as of 1921 was realized three years later, in 1924.

Next, we will compare D(t) with the actual production of the industry and examine how the LSMV worked. As we will delineate in the following discussion, there were only three companies which were granted the LSMV status. Their production data are: [19]

Year	Yearly Sum				
<u>.(t)</u>	<u>TGE</u>	<u>Ishikawajima</u>	<u>DAT</u>	<u>Total</u>	<u>E(t)</u>
1918 (start)				0	0
1919	12			12	12

1920	49			49	60
1921	28			28	89
1922	0	(start)		0	89
1923	2	3	(start)	5	94
1924	9	5	2	16	110

Then, the following comparative table of $D(t)$ and $E(t)$ suggests the government behavior with regard to the LSMV designation:

<u>Year(t)</u>	<u>D(t)</u>	<u>E(t)</u>	<u>D(t)/E(t)[%]</u>
1918	4	0	NA
1919	7	12	58.3
1920	29	60	48.3
1921	57	89	64.0
1922	60	89	67.4
1923	76	94	80.9
1924	160	110	145.5

The percent figures in the above table simply suggest the dynamic process in which the government (i.e., the Army) eventually absorbed domestic trucks produced by the three major manufacturers by 1924 [20].

2. Aligning Manufacturers in Front of the Law

We have already seen that early independent efforts in car manufacturing soon encountered financial difficulties and growing competition from imports which were particularly encouraged by the conspicuous consumption patterns of wealthy people. The military recognition of the potential utility of trucks for battlefield transportation gave the final blow to their financial agony and thus completely refabricated the tapestry of the first inventive stage of Japanese automobile development. That is to say, the impacts of the Law of Support for Military Vehicles can be seen not in the increase of production, but in the reduction and absorption of the weak enterprises. This first experience seems to create the industry's immunity to government interventions which was to last for the next 60 or so years. Now let us describe what happened with those companies in chronological order.

a) Kaishinsha Automobile Works [21]

This company was established by Masujiro Hashimoto in July 1911, as an import dealer as well as an assembly plant using imported auto parts. M. Hashimoto was a Tokyo Institute of Technology graduate with a keen engineering interest in designing an internal combustion engine. A year later, in 1912, he completed a prototype car called

"Dat," of which technical specifications were: 2 cylinder, 12 horse power, and a 2.03-m wheel base. This prototype was said to have many technical problems and so was discarded later on. In 1914, Hashimoto made a second attempt to build a better model whose engine was reduced to 10 horse power, and was vertically arrayed. Except for tires, spark plugs, and magneto, all of the parts of this car were built by Hashimoto himself.

At the same time as the promulgation of the Law of Support for Military Vehicles [LSMV], Hashimoto consolidated the structure of his company into a corporation with assets of 0.6 million yen. The new business was the production of military trucks, in addition to the current operation of manufacturing passenger cars. His first ambition was to build, in order to apply under LSMV, a 1-ton truck whose major technical specifications were: a 2,200-cc, water-cooled, vertically-arrayed, 4-cylinder, 15 horse power engine; a 99 inch wheel base; and 5 seats. This car failed the qualification test for the LSMV designation because it adopted the inch measuring system rather than the metric one that was required by law. Later, in 1924, Hashimoto's advocacy of the technical superiority of inch bolts was recognized by military engineers and so his vehicle was designated eligible for the government subsidy.

However, the Kanto Great Earthquake in 1923 that hit almost all of the Tokyo area destroyed his manufacturing plant, which forced him to

move to Osaka. In addition, the massive inflow of foreign cars triggered by the vast purchase order by the City of Tokyo after the earthquake worsened his business. Since then the company's financial situation was further aggravated, resulting in the merger with the equally ailing Jitsuyo Automobiles, Ltd. on the advice of a high-ranking Army general. The merger was finally completed in 1926 with equally shared capital totalling 150,000 yen under the new name, DAT Automobile Manufacturing, Ltd. The naming of the new company indicates the status superiority of Hashimoto's Kaishinsha Automobile Works which held the LSMV designated model. However, the president of this company was not Hashimoto, but G. Kubota of Jitsuyo Motors reflecting Kubota's financial superiority backed by his principal company, Kubota Iron Works. In fact, this merger can be regarded as the purchase of the company by Kubota who was attracted by Kaishinsha Automobile Works' LSMV status. In 1929, the new product of this company, DAT Model 61, was designated as the second and third categories of the LSMV military trucks.

b) Jitsuyo Motors, Ltd.[22]

As described above, this company eventually merged into DAT Automobile Manufacturing, Ltd. together with Kaishinsha Automobile Works in order to manufacture a large size military truck under the new law. However, the rise and fall of this company mark the significant milestones in the history of the Japanese small passenger

cars.

In 1918, an American aircraft engine designer, William Gorham, arrived in Japan to seek a Japanese market for his engine. Besides his principal business, he made a prototype of a small tricycle two-seater passenger car named "Kushi-car" as a gift to his Japanese business patron. This car mounted a Harley-Davidson motorcycle engine. For its mechanical simplicity and easy maneuverability, the "Kushi-car" was considered as a possible replacement for Japan's famous man-powered "Rickshaw" (in Japanese, "Ri-ki-sha"), drawing the attention of some ambitious entrepreneurs like Gonshiro Kubota of Kubota Ironworks, Ltd. The latter subsequently founded Jitsuyo Motors, Ltd. in 1919 to commercialize Gorham's "Kushi-car" with capital of one million yen. This company thus bought all patents associated with the "Kushi-car" from W. Gorham and started the small-scale production of the "Gorham Model," a small 4-wheel passenger car spun off from the aforementioned "Kushi-car." W. Gorham was hired by this company as chief engineer. As we will see later, this Gorham Model became Nissan Motors' "Datsun," one of the world-famous Japanese small cars.

Although Kubota's aim was to create a new market for an inexpensive small passenger car, this idea clashed with the artificially created social perception of automobiles which favoured more expensive foreign imports. Jisuyo Motors eventually faced a severe financial crisis, and W. Gorham moved to G. Ayukawa's Tobata Cast Iron Works in 1922. Amidst

exacerbated financial difficulty and the absence of a leading engineer, Jitsuyo Motors managed to keep going and introduced a new model, called "Rira," at 1,600 yen in 1922. This model mounted a water-cooled 4 cylinder engine as compared to Gorham's air-cooled smaller one. Although the production of this model attained the level of 20-30 units per year, the orientation of the industry toward the military subsidy under the Law of Support for Military Vehicles gradually decreased the production and sales of a "Rira" model. As a result, in 1926, this company was merged with Kaishinsha Automobile Manufacturing and entered into the government-manipulated competition of military truck production.

c) Tokyo Gas & Electric Industries, Ltd. (TGE) [23]

The first direct impact of the law can be seen in the emergence of a new brandname of military trucks, "TGE." This company was originally engaged in the production of gas and electric equipment. Before the law was enacted, the company established a new automobile manufacturing division in 1916. In the next year, Osaka Arsenal ordered Tokyo Gas & Electric Industries to build a truck for military procurement by copying a French truck model. Upon the promulgation of the Law of Support of Military Vehicles, this model, called "TGE A-Type," applied for the LSMV designation in 1919 and, of course, was immediately granted it. It is particularly important to observe that the start of this company as an automobile manufacturer was initiated

by the government while its predecessors were not. This explains why although other competitors suffered from severe financial problems in the post World War I depression, TGE's truck business developed steadily.

d) Ishikawajima Motors [24]

The law also made an impact on another company, Ishikawajima Shipbuilding, Ltd. In 1918, this company purchased the production and sales rights of the Wolseley truck from British manufacturer. However, Ishikawajima Shipbuilding's establishment of the automobile manufacturing division was delayed until 1920. This delay may be attributed to the complexity of the LSMV subsidy calculation. The unsuccessful result made Ishikawajima hesitate to enter into competition. Upon the amendment of the law in 1921, the automobile manufacturing division finally started production. However, a Tokyo Gas & Electric Industries' lead in the LSMV race, and its great advantage of close contact with the government changed the original plan of this company. The new strategy was to start with non-LSMV truck production and later undertake LSMV truck production if market demand increased. Accordingly, Ishikawajima's Wolseley model applied for the LSMV designation in 1924. Two years later, in 1926, Ishikawajima's first assimilation period of foreign technology was over as it dissolved the technical contract with British Wolseley Motors. Later in 1927, the automobile division was separated in order

to concentrate on the production of LSMV trucks and became Isikawajima Motors, Ltd.

The case of Ishikawajima Motors deserves special attention for it vividly demonstrates the typical pattern of Japan's foreign technology assimilation that can be observed in the nation's various industries. All of the important factors had already appeared in this case, i.e., i) the entrepreneurship-led technical contracts, ii) with an advanced foreign company for domestic commodity production, iii) focusing on government incentives.

e) Hakuyosha Motors [25]

The rise and quick dissolution of this company marked the end of the first stage of the development of the Japanese automobile industry which was, as we have seen, incorporated under the government umbrella. As the only company that tried, but in vain, to conduct its business independently of government in this period, the case of J. Toyokawa's Hakuyosha Motors has many implications and paves the path for the late-comers in the field of small car production.

Hakuyosha Motors was established in 1922 by Junya Toyokawa for the purpose of selling his small passenger car, called "Otomo", which mounted an air-cooled, 2-cylinder, 850 cc engine. The initial capital

for this company was 1 million yen, which was large in comparison with, for example, Ishikawajima Shipbuilding's 0.2 million yen capitalization when it started the automobile division. What Toyokawa visualized in starting this company exactly coincided with the corporate strategy for small car production against the foreseeable inflow of American cars a quarter century later. Toyokawa drew the following blueprint:

- 1) In order to compensate for the inferior quality and low public reputation of the Japanese cars as compared to foreign imports, the price of "Otomo" must be lower than that of a Ford model by 30%.
- 2) In consideration of income level, road conditions, and the physical shape of the Japanese people, a small 4-wheel car should be aimed at.
- 3) A simple air-cooled engine is appropriate .
- 4) Production should be started with a level of 50 units per month.
- 5) Highly qualified manpower must be recruited.
- 6) For carrying out the above plan, a capital of 1 million yen is needed.

The price of "Otomo" in 1924 was 1,200 yen, 20% below the Ford 4-seater (1,500 yen). Up to 1923, 250 "Otomos" were said to have been

produced. A sufficient number of skilled engineers were hired. The initial 1 million yen came from the giant Mitsubishi Bank. Thus Toyokawa's initial business success seemed assured, which in fact encouraged him to ask Mitsubishi Bank for an additional 2 million yen loan to compete against a Ford model that dramatically entered the Japanese market in 1923. However, the reaction of Mitsubishi Bank was rather disappointing. Mitsubishi, following its own plan, proposed that: 1) the structure of Hakuyosha be consolidated into a corporate system involving people from a much broader business circle, 2) the price must be less than 1,000 yen (900 yen was suggested), if Otomo was to survive among well-marketed American cars, 3) the annual production should be somewhere around 300 units. Toyokawa agreed with this, whereas other executives disagreed. This confrontation among top executives of Hakuyosha led to the tragic dissolution of this company in 1927, after the opposing executives and engineers were transferred to the LSMV-designated manufacturer, Tokyo Gas & Electric Industries.

3. The Actual Inception of Japan's Automobile Industry in View of Production

So far we have learned that the Law of Support for Military Vehicles did not realize the original objective of guaranteeing the

supply and stock of military trucks. However, we have also learned that the law eventually served to reorganize and realign automobile manufacturers and attract several new entries. The reorganized automobile industry of Japan consisted of three major companies: Tokyo Gas & Electric Industries (TGE), Ishikawajima Motors, and consolidated DAT Motors. Now, let us look at the production data of these three makers after the promulgation of the law in the following table:

[26]

<u>Year</u>	<u>TGE</u>	<u>Ishikawajima</u>	<u>DAT</u>	<u>Total</u>
1919	12			12
1920	49			49
1921	28			28
1922	0			0
1923	2	3		5
1924	9	5	2	16
1925	6	103	18	127
1926	0	202	43	245
1927	25	243	34	302
1928	70	246	117	433
1929	58	205	111	432
1930	57	177	137	371
1931	180	300	122	602

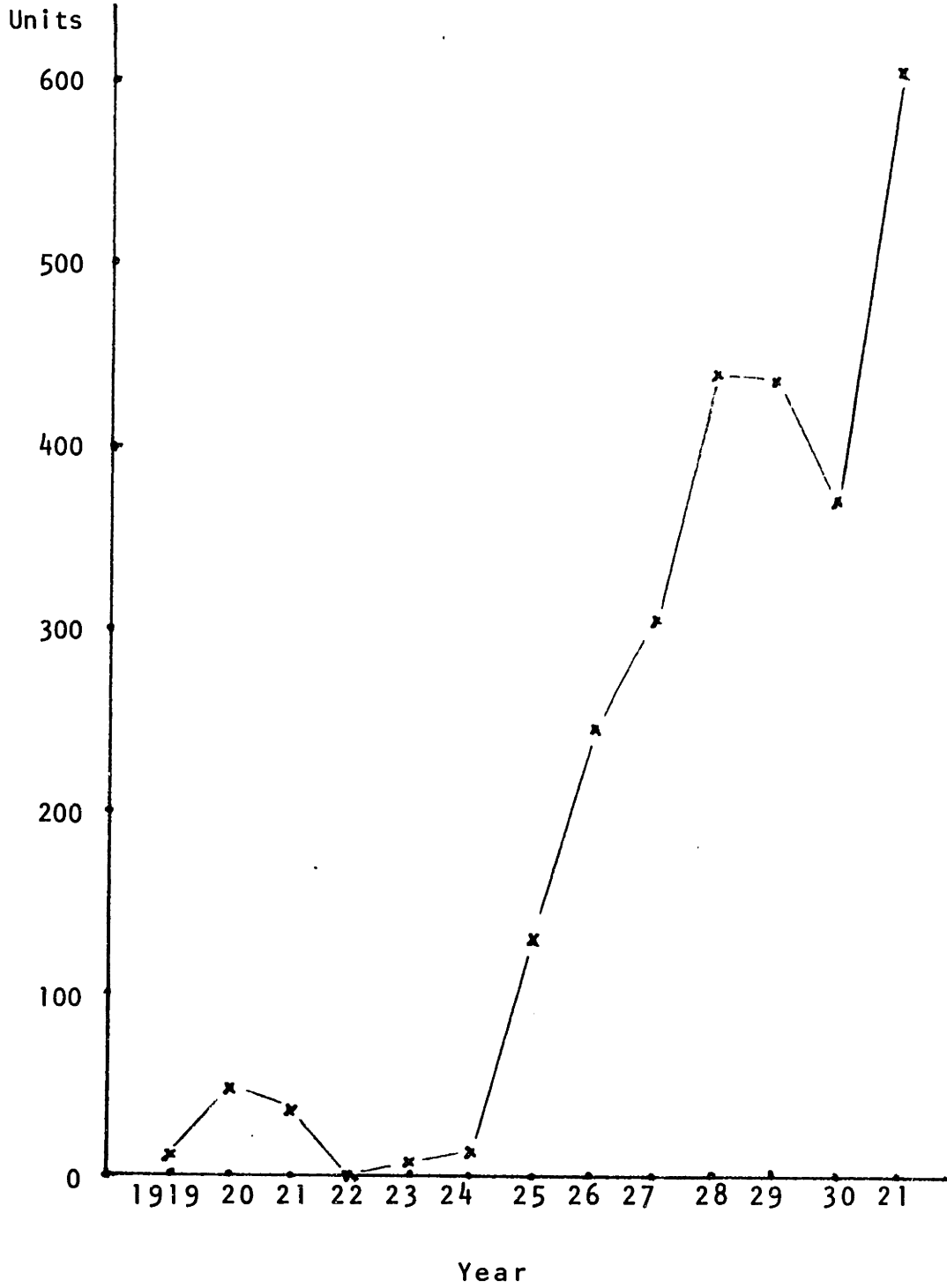
(After 1932, the Army prohibited the publication of data)

Several important observations are worth making here. First, TGE had experienced a difficult period until it finally made a big leap in 1931, although the entry of this firm into automobile manufacturing was instigated by the government. Second, from 1925, Ishikawajima took the lead and accounted for most of the production trend of the whole industry. As described previously, Ishikawajima's production was the Japanese version of a British truck (Wolseley), and other companies were manufacturing domestic models. The relative advantage of Ishikawajima vis-a-vis the two other competitors suggests that the transfer of foreign technology worked well already at this early stage of the Japanese automobile industry. Third, the performance of DAT Motors was between the above two firms, though its production went up rather steadily.

Now, special attention must be paid to the trend of total production. Numerical observation indicates the smooth trend curve. FIGURE II-1 corroborates this fact. Prior to 1924, production, i.e., of TGE only, fluctuated randomly. However, after all three LSMV companies were aligned, the production curve grew smoothly. This is grounds enough for saying that the Japanese automobile industry actually took off in that year. Therefore, we conclude that the Law of Support for Military Vehicles in fact had the effect of making the industry take off.

FIGURE 11-1

Total Production of TGE,
Ishikawajima Motors and
DAT Motors: 1919-1931



4. The Birth of Automobile Standardization as a Policy Tool to Manipulate the Automobile Industry

As we will observe in the subsequent discussion, vehicle standardization had constantly appeared to be a major policy tool for the government's intervention into the automobile industry. One important result of the Law of Support for Military Vehicles is the beginning of automobile standardization in various legal categories. Although the law strictly focused on a large-size military truck, our historical investigation had found that it was indirectly related to the later normalization of a small car.

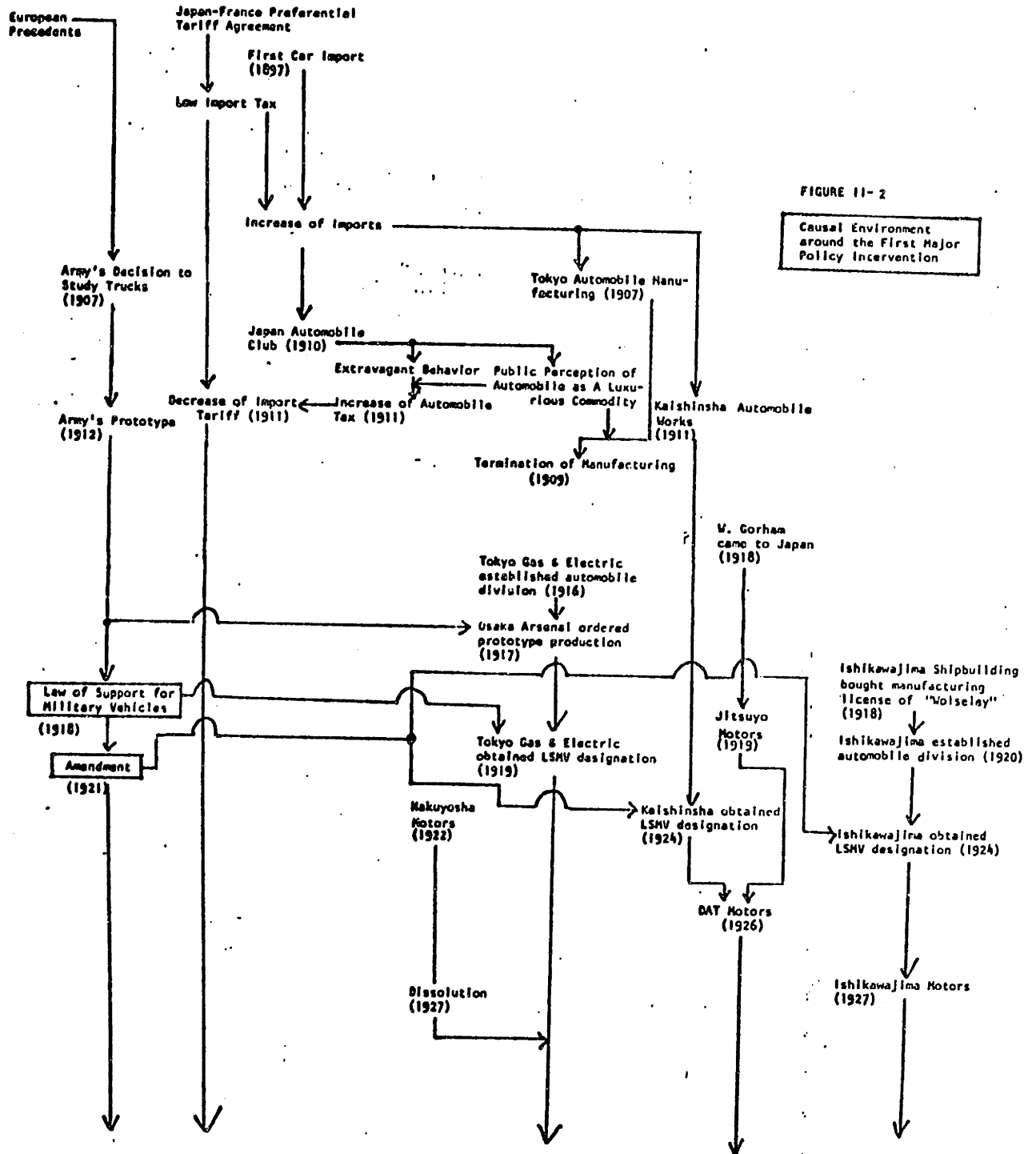
The jurisdiction to regulate the use of an automobile belonged to the Ministry of the Interior, which controlled all police forces in Japan. Recognizing this right of the Interior Ministry, the Imperial Army asked the ministry to offer the no-driving license privilege to military personnel who were about to finish training courses at the newly-established Army automobile school. Until around 1920, there was no driving license required in Japan. In the process of the examination of this issue raised by the Army, which had been continuously consolidating its own automobile policy since the Law of Support of Military Vehicles was promulgated, the Interior Ministry came up with the following no-license designation for a small car in 1926.

Width: less than 90 cm
Length: less than 240 cm
Engine: less than 3 hp,
 less than 350 cc
Gear: 2 forward.

The visible impact of this no-license privilege for a small car can be found in several motorcycle models and Jitsuyo Motors' Graham Model which mounted engines within the above specification. However, such an engine specification was soon recognized to be too small. With lobbying from several manufacturers of small cars, the Interior Ministry expanded the range of a no-license small car to 500 cc in 1930. In 1933, the engine size was again changed to 750 cc. This historical fact demonstrates how the no-license status functioned as a psuedo-incentive for manufacturers. Manufacturers were in fact very sensitive to the normalization of a small car. For example, the specification of a 750 cc engine aimed at checking the well-infiltrated British Austins, which had 1,000 cc engines, in the Japanese market. [27]

(D) Summary Chart of the First Major Policy Intervention

FIGURE II-2 summarizes the causal environment of the first major policy intervention described in this section.



SECTION II-2

THE SECOND MAJOR POLICY INTERVENTION: THE MCI STANDARD MODEL

(A) Pre-intervention Environment

1. The Sudden Entry of The Two American Assembly Plants

As one potential cause for a series of policy interventions in the 1930s, one must look at the issue of foreign assembled cars by two foreign corporations, Japan Ford, Inc. and Japan General Motors, Inc. The exclusion of foreign cars from the Japanese market had been a major issue in policy considerations up to very recently. Here we will delineate the origin of the problem.

Ford Motors, Inc. and General Motors, Inc. founded the knockdown plants for assembling their Ford and Chevrolet models in Japan, in 1925 and 1926, respectively. Before their establishment, Ford and Chevrolet models had been sold through individual trading companies on a case-by-case basis. For example, Ford models were handled by Sales Frazer & Co. in Yokohama. Some historians of Japan's automobile history observe [28] that the head office of Ford Motors had no strong sales interests in the Japanese market until it received a surprise order from Tokyo City. It was rather the enormous market potential of China that attracted this US producer.

On September 1, 1923, central Japan suffered from the nation's biggest earthquake called the "Kanto Great Earthquake," which almost completely destroyed the streetcar tracks of Tokyo City. Then, immediately after the earthquake, the city purchased nearly 2,000 Ford buses (including some trucks) in order to swiftly repair the city's public transportation system. This unprecedentedly large single purchase stimulated American Ford to reassess the potential of the Japanese market. In accordance with the report filed by the company's marketing specialists, Ford Motors established a knockdown plant in Yokohama in 1925, on a trial basis. Naturally, GM, as Ford's competitor, followed suit and so established a similar plant in Osaka in the following year.

Why did they choose the strategy of building an assembly plant rather than a complete manufacturing one? The answer seems to be rather clear. Assembled cars would be a lot cheaper than imported ones by a factor ranging from 120 to 133 % [29] due to the following reasons:

- 1) The Japanese tariff was higher on a complete import car, than on imported auto parts [30]. Also, it would be rather easy to go through the tariff barrier by lowering invoice prices of thousands of imported parts.

- 2) In spite of low productivity, the low labor cost of Japanese workers could lower the price [31].
- 3) It would be possible to replace some parts by cheap Japanese products if they met quality standards [32].

The conditions that permitted the entry of Ford and GM to Japan simply summarize what we have outlined in the previous section. The Japanese automobile industry started under the aegis of the Law of Support for Military Vehicles. However, statistics simply suggest the unsuccessful outcomes. So far the government was interested only in large-size trucks, and had no major policy to protect domestic models equivalent to Ford or Chevrolet. This can be seen in the fact that the Japanese tariff on imports of complete cars as well as auto parts was still very low. The financial background of the three major LSMV-designated companies, Tokyo Gas & Electric Industries, Ishikawajima Motors, and DAT Motors, was so weak that the total capital of all three companies was smaller than that of Japan Ford, Inc. alone [33]. The tendency of the Japanese people to prefer foreign products to their own was favourable to the business of foreign companies

2. Economic Recession and The Birth of MCI's Policy

Japan's international trade balance went into the red in 1919, after she had enjoyed an unprecedented post-World War I prosperity. The trade deficits had been increased ever since [34], which resulted in the nation-wide "Buy-Japanese-Products" and export boosting campaigns. In June, 1926, the government established, in the Ministry of Commerce and Industry (MCI), the "Committee for Promotion of Domestic Products," a government-level organization for import substitution. In 1926, the Minister of Commerce and Industry sent Inquiry No.7, to the committee, in which he asked for the committee's recommendations with regard to the following points: [35]

- . The demand for automobiles have grown year by year.
- . The total car imports amounted to 33 million yen in 1928. If a 20 % annual increase rate continued, Japan would have to spend 200 million yen for car imports alone in ten years.
- . The production of subsidized military trucks was still on a small scale. Hence, prices of those trucks were still high, which obviously weakened Japan's competitiveness against imports.

In these circumstances, what would be appropriate government policies?

Upon investigation, the committee drafted the following recommendations in May, 1930: [36]

The current situation was in fact dangerous in view of both Japan's international balance of payments and national defense. The committee suggested the following policy goals:

- . The automobile industry should concentrate on the production of trucks and buses, rather than passenger cars.
- . Within five years, the production scale must attain a level of 5,000-unit-per-year.
- . The automobile industry must adopt the following centralized production system:
 - i) The government specifies a standardized model,
 - ii) Each car maker participates in the production and assembly of this standardized model on a division-of-labor basis,
 - iii) Production will be under the control of a central organization.
- . The Government should take appropriate measures to facilitate the production and distribution of standardized models, such as:

- i) compulsory use of domestic instead of imported cars by all public organizations,
- ii) amendment of the current low tariff rate,
- iii) production grants-in-aid.

3. The Ministry of Railroad's (MOR) Lead in The Government's Automobile Policy: Inter-ministerial Conflict [37]

The fact that the Committee for Promotion of Domestic Products was established within MCI, reflecting the nature of problem, i.e., the promotion of domestic industrial products, and that the committee dealt with the situation of the domestic automobile industry in response to the Ministry of Commerce and Industry's inquiry, indicates the leadership of MCI in setting the nation's automobile policy after the first Ministry of the Army's (MOA) initiative since 1907. However, this governmental committee was an inter-ministerial gathering consisting of several other agencies. Naturally, an inter-organizational conflict over political as well as jurisdictional "hegemony" emerged. In particular, a confrontation between MCI and the Ministry of Railroad (MOR) became most important. MOR had a strong interest in the nation's automobile policy, maneuvered for the adoption of its own line and tried to thwart the competent efforts of the MCI in the Committee for Promotion of Domestic Products.

It should be pointed out that MCI's involvement in the government's automobile policy had no significant progress until the Minister of Commerce and Industry sent his inquiry to the committee. As already seen, the vast inflow of relatively cheap and more reliable American cars had begun in 1926, ironically simultaneously with Japan's serious economic depression. There was no major evidence that MCI gave a special warning against such an inflow, before it came through the committee whose establishment was primarily caused by a general externality, i.e., the economic depression. Therefore, it might be a fair observation that MCI's automobile policy was directly triggered by the nation's economic condition in general, coupled with the indirect cause of a rapid influx of foreign cars.

On the other hand, MOR's policy involvement was caused directly by those American cars. The surprising quick infiltration of domestically-assembled American Ford and Chevrolet models into the Japanese market led the MOR to recognize potential threats to its cargo and passenger business. On September 5, 1929, the MOR established the "Committee to Survey the Motor Vehicle Transportation Network," which later recommended the opening of MOR's own bus network. The committee members consisted of high-ranking officials, on a bureau chief level, from the various ministries such as MOR, MCI and MOA. The hottest debate in this committee centered on which bus, i.e., a foreign import or a domestic make, should be used for the future MOR

bus lines. Despite the tireless lobbying of the foreign car dealers on a Diet level, the strong nationalistic view won in August, 1930, and the final decision was for the exclusive use of domestic buses. Before this decision was made, MOR set its own standards for the MOR bus and held, in December, 1929, an official performance test for the prototypes submitted by the three companies, Ishikawajima Motors, Tokyo Gas and Electric Industry and DAT Motors. These prototypes adopted a low floor body while the Ford and Chevrolet bus models had a higher floor body. This fact is particularly important in the sense that the forthcoming Law Regarding Motor Vehicle Transportation Enterprise in 1932 followed the same line and made it illegal to use the high-floor American buses for not only the MOR bus routes but also all public and private bus lines. This point will be discussed later on. The satisfactory results of these road tests no doubt strengthened the confidence of the committee in deciding on the exclusive use of domestic buses. Then, immediately after the decision was made, MOR contracted to purchase 17 domestic buses from the above three companies.

How greatly this purchase contract helped these companies, which were near bankruptcy because of shortage of capital in the midst of the nation's worst economic depression, was shown by the fact that upon receiving a purchase order for one bus, the company could borrow some 4,200 yen from a bank. The following episode is recorded: the presidents of the three companies, accompanied by their executive managers, paid a courtesy visit to the MOR, and expressed their

gratitude. This fact surely indicates that the three companies' financial situations were so bad that even a sum of about 2,000 to 26,000 yen for each was a great relief. In one way or another, it is not difficult to speculate that MOR might have firmly established its superior position in the nations' automobile policy by this procurement contract.

(B) Policy Intervention

1. The Determination of The MCI Standard Model

In response to the report of the Committee for Promotion of Domestic Products, MCI established the "Survey Committee for the Establishment of the Automobile Industry," again within this agency, in May, 1931. The membership of this committee was seventeen standing members: two full professors of The Tokyo Imperial University, four officials from MOR, one official from MCI (Head of Industrial Engineering Bureau), three officials from MOA, two officials from MOI, two bureau heads from the Ministry of Finance (MOF) (one from the Budget Bureau and one from the Taxation Bureau) and three company presidents of Ishikawajima Motors, Tokyo Gas and Electric Industry and DAT Motors, plus one associate professor of The Tokyo Imperial

University as an ad hoc member [38]. The membership structure clearly evidenced the continuing predominance of MOR's influence over the government's automobile policy-making. The primary objective of this committee was to determine a standard specification for centralized production as recommended by the Committee for Promotion of Domestic Products.

Again in this committee, a continuing confrontation between MCI and MOR appeared, this time over the issue of the size of a standardized model. MCI insisted on a popular medium-small size equivalent to Ford or Chevrolet. In contrast, MOR supported a bigger size. Both ministries refused to give way, reflecting their differences in administrative jurisdiction and in their recognition of problems. The comparative list of their opinions is shown below: [39]

The View of MCI's Bureau of Manufacturing

- 1) We must admit that today's most popularly-used cars in Japan are either Fords or Chevrolets. Moreover, they are medium-small (i.e., "popular")-size. Therefore, our standard model should be the same size as those.
- 2) Having the same size standard model as a Ford or a Chevrolet can make the interchange of auto parts between domestic cars and foreign ones possible, thereby facilitating the rapid diffusion of our standard models.

- 3) The lower price of a medium-small model appeals to a much broader class of purchasers than current public and military procurements.

The Contrasting View of MOR's Bureau of Transportation

- 1) The successful sales of Fords and Chevrolets in the Japanese market are not due to their size, but to the low prices and their wide sales network.
- 2) These American popular cars are in fact not economical. The durability of their parts is fairly poor, for high profits are expected from the quick replacement of auto parts.
- 3) We can draw maximum advantage from the past experience of manufacturing military-subsidized trucks in producing a medium-size car rather than a medium-small one, for which we have no relevant experience.

Four months later, in September, 1931, the committee announced a government-specified car officially called the "MCI Standard Model" the major specifications of which were: [40]

- i) two different truck models (1 ton and 1.5 tons)
- ii) three different bus models (23 seats, 32 seats, 40 seats)
- iii) engines: 6 cylinders, 45 hp, 4,390 cc

iv) maximum speed: 45 km/h.

Then, the committee assigned the following design allotments under MOR's technical guidance:

Ishikawajima Motors:	engine
Ministry of Railroad:	bonnet, frame, chassis, spring coils
DAT Motors:	transmission, clutch, propeller shaft
Tokyo Gas & Electric:	front axle, rear axle, brakes

The government ordered the above three companies to start work on the prototype of the MCI Standard Model in September 1931, and it was completed six months later, in March 1932. In June 1932, these three companies formed the Domestic Automobile Consortium whose primary functions were to handle the administrative job of the government in giving the manufacturing subsidy to the manufacturers and passing on the government's manufacturing orders. The establishment of the consortium would be regarded as the first step toward an eventual merger of the three companies. However, the frequent changes of mechanical design by the government's engineers hampered the original functions of the consortium and hence reduced the motivation to merge.

2. Remarks

The above specifications of the MCI Standard Model highlight an interesting observation. First, they clearly indicate MOR's victory over MCI in the "size" debate. The new model was apparently a medium-size car similar to the MOR prototype buses already operating on the new MOR bus line. Second, the minimum seat number of 23 for a bus type nullified the previous MOI regulation which permitted only less than 23 seats [41]. This shows MOR's leading role as a major procuring agency. However, despite the heavy involvement and responsibility of MOR in the process of conceiving the MCI Standard Model, a new situation was developing with regard to the MOR bus line system. We will discuss this point later.

Although the determination of the MCI Standard Model aimed at starting the domestic production of a new model in competition with American cars, the primary incentive lay in the procurement of the Ministry of Railroad. This is the reason why MOR maintained a relatively influential role in the government policy-making body. In addition to the above investigation, our research has also found an important law which should not be overlooked in relation to this second major policy intervention [40].

In 1931, the Law Regarding Automobile Transportation Enterprise was enacted for the purpose of regulating excessive competition among many small-scale transportation companies. This law became effective in the next year, 1932. However, a close examination of the text of this law revealed a rather important implication. That is, it specified a legally operating bus as one which had a floor height of less than 610 mm. The bus bodies of American Ford and Chevrolet at that time exceeded this limit, so the law automatically forbade transportation companies to use these foreign vehicles. We have already mentioned that when the official performance test of MOR in December 1929 was made, the prototypes submitted by the three companies already adopted this low-floor bus body. Therefore, we may conclude that this law had already been planned in late 1929. As we have learned, so far the typical approach of the government in intervening in the automobile industry was the setting of technical specifications. The Law of Support for Military Vehicles in 1918 was such a case. The second major intervention, in the case of the MCI Standard Model was the technical standardization itself. However, it is quite important, in this second case, to see the emergence of the peripheral law to support the primary law. As we will delineate, the strategy of the government in implementing a policy objective by enacting a primary law and in the mean time by hedging it round with minor peripheral laws would be repeated later in the course of interaction between the Japanese Government and the automobile industry.

(C) Policy Impacts

1. The Failure of The MCI Standard Model: Two Main Reasons

It was impossible to find proper statistics on the production of the MCI Standard Model for the purpose of this research. However, the failure of this government attempt to oust foreign cars assembled by two foreign companies from the Japanese market seems quite apparent [43]. The following seem to be the two major reasons for the lack of success of MCI's standardized model:

- a) military imperatives necessitating a policy shift of the LSMV subsidy toward a larger and more powerful six-wheel truck, and
- b) economic imperatives for larger MOR buses.

Here, we will examine each case as follows:

a) Military Imperatives [44]

It is particularly interesting to observe that the primary reason for the failure of the MCI Standard Model policy was the Manchurian Incident which, as we recall, the Army had prepared for a long time. Note that the Law of Support for Military Vehicles in 1918 and 1921 originated from the satisfactory road tests on the rough Manchurian

battlefields conducted in 1907 and 1916. These tests were simply based upon conditions that the Army supposed would exist during hostilities in the severe winters and rough terrain of Northern China. Such conditions were realized on September 18, 1931.

Manchurian conditions required six wheel trucks which were more powerful than the current MCI four-wheel model. The Army's requirements are seen in the fact that from May 1930, the LSMV included a category of a 6-wheel truck. The subsidy given for this new category was triple that for a 4-wheel one. Ishikawajima Motors was the first firm to submit a 6-wheel truck to the government for the LSMV designation. After the Manchurian Incident, the LSMV excluded the 4-wheel category and could be applied only to a large 6-wheel truck whose capacity had to be more than 1.5 tons. This new measure obviously neglected and discouraged the firms which had so far concentrated on LSMV 4-wheel trucks. This is a typical example in which the state's objectives took priority over the fate of private enterprises in prewar Japan. In fact MOR by-passed the existing firms and sounded out the three giant "Zaibatsu's" on the possibility of manufacturing a large 6-wheel military truck. First, Mitsui and Sumitomo rejected MOA's inquiry and expressed their corporate decision not to enter the vehicle manufacturing business. Then Mitsubishi showed an interest, but with the condition of a limited amount of production because of the uncertainty involved in sales of MOA's large trucks. Then MOA had to come to a compromise and turned to the

existing three firms.

b) MOR's Retreat from The MCI Standard Model [45]

We have seen that in the process of specifying the MCI standard model by the Survey Committee for the Establishment of the Automobile Industry, MOR took the initiative since this model anticipated MOR's procurement for its bus lines. The first MOR bus line was opened with 17 buses supplied by TGE (75 horse power model) and Ishikawajima Motors ("Sumida," 57 horse power model) in December 1930. However, shortly after the inauguration of its lines, MOR encountered a new problem. Japan is a mountainous country, so that the MOR bus lines had to pass along many rough mountain roads, which naturally required a more powerful larger-size bus than one on the MCI standard. This change of policy by MOR with respect to bus size conflicted with the Ministry of Interior (MOI) which had exclusive administrative jurisdiction over all roads and their construction. A trial run of a large bus by MOR was said to have hit the edges of house roofs alongside the bus routes. MOR's solution to this problem was quite audacious: it widened roads by itself with at most unwilling consent from MOI. This episode vividly demonstrates how earnestly MOR was thinking of laying-out its own bus network. After getting permission from the Diet to incur expenses for the construction of both roads and roadside-shelter areas, MOR informally persuaded Mitsubishi Shipbuilding to manufacture a large bus.

The historical record is not clear on why MOR should have sounded out such a dark horse in the automobile business as Mitsubishi Shipbuilding on the possibility of manufacturing a large-size bus. However, it is a plausible conjecture that because of jurisdictional confrontation between various ministries MOR could not ask the existing makers which, as we have seen above, had already come under the strong administrative influence of either MOA or MCI. Also, it is said that TGE and Ishikawajima's buses had shown many defects, which made MOR bypass these companies in its procurement. Mitsubishi once tried automobile manufacture in 1917 and built various prototypes since then, but none were ever sold. However, this time, greatly encouraged by the promised MOR procurement, Mitsubishi re-entered vehicle manufacturing with a large bus, which it derived from by copying and modifying (i.e., "sketching") three different foreign bus chasses. It introduced a model called "Fuso" in 1932, which was followed by a fuel-saving diesel engine version in 1935.

The above account of the policy shift of the Ministry of Railroads shows that policy resulted in the entry of a new manufacturer, rather than modifying the production of trucks and buses of the industry as a whole. The relatively small procurement of MOR is shown in the following table: [46]

MOR Procurement

<u>Year</u>	<u>Bus</u>	<u>Trailer</u>	<u>Accompanying Car</u>	<u>Trucks</u>	<u>Total</u>
1930	15	0	0	10	25
1931	7	1	4	0	12
1932	25	15	36	4	80
1933	53	0	0	11	101
1934	98	0	0	19	197
1935	69	0	0	10	180

2. The Failure of the Attempted Merger

We have noted that the Domestic Automobile Consortium established in 1932 which appeared as a consequence of the first major policy intervention, the Law of Support for Military Vehicles, was expected to eventually lead to the merger of the three companies, Tokyo Gas & Electric Industries, Ishikawajima Motors and DAT Motors, and had survived the nation's economic recession. However, the financial situation of these firms worsened so that MOA asked for the speed-up of a merger of the current three LSMV manufacturers. The process of merger did not go smoothly primarily because they were financed by different banks. TGE received an executive from its primary bank, The Jyugo Bank. Ishikawajima was associated with Daiichi Bank, whereas a majority of DAT Motors' stocks were held by Tobata Cast Iron Works. First, Ishikawajima Motors absorbed smaller and almost bankrupt DAT

Motors on March 1933, and established Automobile Industrial, Ltd. with a capital of 3.2 million yen. This new company also built an engine for the 1.5 ton MCI Standard Model in the beginning, but starting in 1934, terminated the production of the MCI Standard Model and concentrated on the LSMV large truck engines. Finally, in December 1934, TGE and Automobile Industrial were partners in a newly created consortium-like sales company, Kyodo Domestic Automobile, Ltd. in September 1937.

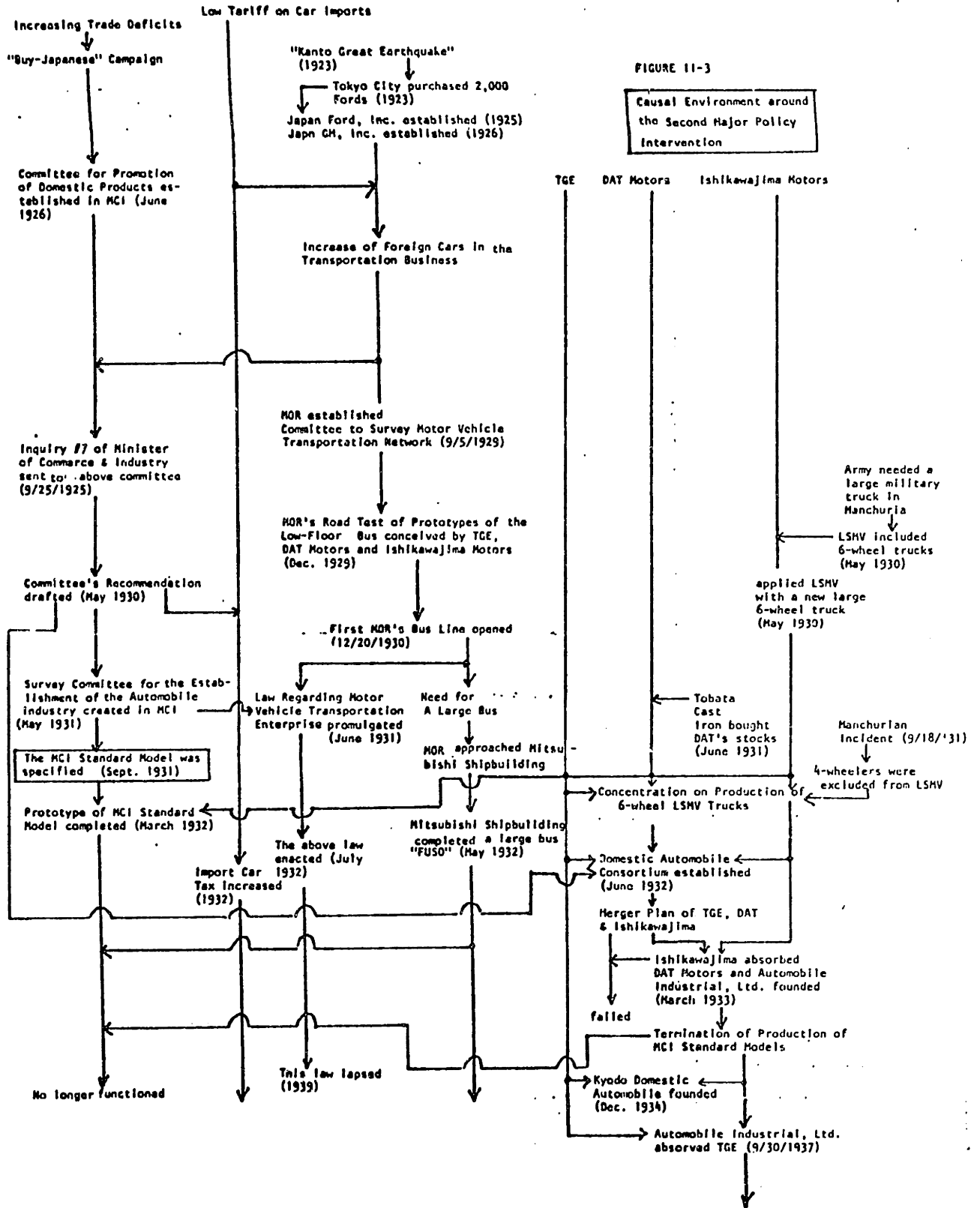
3. Remarks

The lesson to be drawn from the above historical evidence is quite important. Recall that the first major policy intervention worked to help these three companies emerge as a LSMV-designated manufacturer. As time passed, the second major policy intervention now forced them to merge into one, which was still heavily dependent upon government procurement, in particular from the military. If manufacturers heavily depended upon government procurement and totally complied with government technical specifications, their products would become more specialized and lose flexibility in product differentiation. Product orientation could not be changed so easily as government policy could in meeting a new situation. Thus, when government changed technical specifications, it would have to choose a new firm since the existing firms had already been specialized in a particular kind of product.

Product specialization of the existing LSMV firms in military vehicles and the new entry of Mitsubishi Shipbuilding exemplified this case. Later we will see more cases of this kind.

(D) Summary of the Second Major Policy Intervention

FIGURE II-3 summarizes the causal environment around the second major policy intervention described in this section.



SECTION II-3

THE THIRD MAJOR POLICY INTERVENTION: THE LAW REGARDING AUTOMOBILE MANUFACTURING ENTERPRISE

(A) Pre-intervention Environment

1. Military-Civilian Complex in Policy Planning

We have already seen that the Manchurian Incident of September 1931 resulted in the abandonment of the MCI Standard Model, and shift to a larger 6-wheel truck. However, it is particularly interesting to observe that the Manchurian Incident led to a quite different policy orientation, too: a much smaller, so-called "popular-size," truck equivalent to a Ford or Chevrolet. This apparent contradiction came from two different assessments on the use of military trucks in the Manchurian Incident: one that concluded that it was impossible to use small trucks under the severe condition of Manchuria and thus large 6-wheel models were needed and another that was based on an actual fields experience with American Fords on the Manchurian front.

During the Manchurian Incident, the Army experimentally employed Fords and Chevrolets for army corps transportation and discovered out their superb maneuverability [48]. Futhermore, the Army needed a vast supply of automobiles for a hypothetical war operation against USSR in

the vast Northeast Chinese theater along the Russian boader [49]. Large requirements meant mass production. Since the production scale of the current large 6-wheel vehicles was still very small, the Army eventually decided that it would be necessary to mass-produce these smaller vehicles. MOA started R&D on a popular-size truck in March 1933 [50]. Rumours of this new decision spread to various manufacturers. As we will see, its most significant impact was on Gisuke Ayukawa's Tobata Cast Iron Works before it established an independent automobile manufacturing company, Automobile Manufacturing, Ltd. in August 1933.

The Army's initiative soon encountered a legal problem since the MCI Standard Model was already legally defined. It concluded that it would be necessary to prepare new legislation in order to avoid a legal conflict with the MCI Standard Model. This is the principal origin of the government's third major policy intervention, the Law Regarding Automobile Manufacturing Enterprise of 1936 [51].

The government agency responsible for industrial affairs was the Ministry of Commerce and Industry. In January, 1934, MOA began negotiations with MCI on drafting a new law. Our historical research found that there was a serious split within MCI concerning MOA's proposal, with high-ranking officials maintaining a laissez-faire position, while middle-ranking officials, backed by the Army, held a more nationalistic view [52].

Undoubtedly rumours about the on-going debates within MCI and the negotiations reached the industry. Then, in September 1934, the four leading automobile makers, Nissan Motors (a successor of the Automobile Manufacturing), Tokyo Gas & Electric Industry (TGE), Kawasaki Car Body and Mitsubishi Heavy Industry, collectively lobbied the Ministry of Commerce and Industry to take a strong line on behalf of the domestic automobile industry. They requested the following:

[53]

- i) exclusive licensing of automobile manufacturing
- ii) establishment of the government's manufacturing subsidy
- iii) levy of higher import tariff
- iv) reduction of various automobile taxes, and
- v) guaranteed demand (public procurement).

Based on MOA's preparatory R&D and the manufacturers' petition, the Committee to Determine the Technical Specifications of A Domestic Vehicle was established under the procurement bureau of MOA in October 1934 [54]. Its primary task was to determine appropriate technical specifications for a popular-size car equivalent to Ford or Chevrolet. Upon the decision of this committee, MOA ordered Automobile Industrial, Ltd. and Kawasaki Car Body, Ltd. to develop a prototype with a cargo capacity of 1.5 tons and with a 4-or 6-cylinder engine.

A couple of months later, the prototype was completed, and its road tests encouraged government officials to claim that Japan could make a popular-size car with equivalent technical performance to that of American cars in the same category. The series of steps taken by MOA has three important implications: first, the committee took exactly the same approach as the Survey Committee for the Establishment of an Automobile Industry did for the previous MCI Standard Model. Second, the typical process starting with military R&D and ending with the prototype development by private manufacturers commissioned by the government did not change since the first major policy intervention we have already delineated. Third, the government always started its interventions on the basis of its own technical specifications. As we will see in the next chapter, this typical approach of the government continued even in the postwar period.

Because of the sharp split within MCI and the opposition from top-ranking officials of MCI, MOA temporarily gave up further negotiations with MCI. Taking advantage of the change of personnel in MCI when the nationalistic officials were promoted, MOA resumed negotiations in April 1935. Shortly after the resumption of negotiations, considerable progress was achieved. That is, a month later, in May 1935, the head of the manufacturing division of MCI was dispatched to Germany to learn about Hitler's policy on the forthcoming "Deutsche Volkswagen Gesellschaft, GmbH." (established later on September 16, 1938). This mission was kept secret even from

MOA. In winter 1935, more comprehensive negotiations started between MOA and MCI with respect to the draft plan prepared by a small nationalist group in MCI [55].

2. Economic Externality: The Rise in Price of Foreign Cars Caused by the Nation's Second Embargo on Gold Exports

In SECTION II-1, we pointed out that the import tariff applied to automobiles was rather low as a result of the Japan-France preferential tariff agreement. We also noted that this low tariff barrier invited the entry of the two American assembly plants. Surprisingly enough, it was in 1932 when the government first touched this problem and increased the car import tax to a modest 35% for all items, for the purpose of protecting the domestic industry, upon the recommendation of the Committee for Promotion of Domestic Products. This measure was a counterpart to the production policy, i.e., the MCI Standard Model. However, as we have already seen, the attempt to promote domestic cars by technical standardization failed, so that this peripheral tariff measure lost its ultimate target, i.e., promotion of domestic production, and merely resulted in an increase in price of foreign cars. However, in fact, a very sharp price rise of foreign cars occurred in 1933, which encouraged domestic producers to infiltrate the market which was then dominated by foreign models.

Ironically, the primary cause of this price increase came not from the government's measure mentioned above, but from the nation's second embargo on gold exports announced in July 1932. Here we will see how this happened in a brief review of Japan's foreign exchange and international trade before 1932. [56]

In the four year period from 1914 to 1917, Japan enjoyed a tremendous balance of trade. At that time, exports reached 4 billion yen while imports were 3 billion yen [57]. Despite this economic boom, the government banned the export of gold in 1917. Three reasons for this rather contradictory decision were: i) the US also banned gold exports in this year, ii) there was speculation that gold traders in Shanghai would take Japan's gold since they could no longer rely on US gold, iii) cotton transactions previously done by US gold would probably require the Japanese gold [58]. However, Japan's excess of exports turned into a deficit two years later because the post World War I economic boom increased imports, starting in 1919. This economic boom ended in only a year and its repercussions came in the shape of world-wide depression in March 1920. After that the economy stagnated and Japan's trade deficit remained large, as shown in the following table: [59]

<u>Year</u>	<u>Balance of Trade</u>
1918	+ 269
1919	- 178

1920	- 486
1921	- 432
1922	- 338
1923	- 622
1924	- 725
<u>1925</u>	<u>- 356</u>

(unit: millions of yen)

Despite the economic depression during this period, Japan's gold holdings were still high. For example, the amount as of 1914 was 341 million yen while by 1922 it had increased nearly five times to 1.83 billion yen [60], which obviously kept commodity prices high compared with other countries. This is shown below: [61]

Wholesale Price Index (Yearly Average)

<u>Year</u>	<u>US</u>	<u>UK</u>	<u>Japan</u>
1913	100	100	100
1919	211	241	235
1920	239	310	240
1921	149	198	181
1922	158	165	182

Then, in 1922, the Ministry of Finance announced a forthcoming

release of gold when the rate of exchange for the US dollar had climbed from its current low level of \$ 48.00/100 yen to the official parity of \$49.85/100 yen. However, ironically, the rate continued to decline to \$ 38.50/100 yen in 1923 and early 1924 reflecting Japan's trade deficits in this period. It took six years for the rate to regain near parity (\$ 48.62/100 yen in late 1929). This was primarily achieved by the success of the tight budgetary policy of the Hamaguchi Cabinet [62]. Since the initial target was met, the release of gold was finally executed in January 1930. However, the Great Depression triggered by the vast slump of the New York Stock Market could not allow Japan to maintain this for long. Then, Japan again banned gold exports in December 1932. As a result, the exchange rate considerably decreased as shown below: [63]

Before: \$ 43.37/100 yen

After: \$ 19.88/100 yen

Accordingly, the price of almost all foreign imports including automobiles and parts went up after the second ban on gold exports, thereby functioning as a protective tariff which was far greater than the previous government's decision on automobile tax. This new situation unexpectedly gave domestic producers an advantage in competing with the two overwhelming American subsidiaries and with foreign producers. It may be worth looking at the comparative

time-series trend of prices of foreign and domestic cars. Some idea about the changes of price of foreign cars sold in the Japanese market can be found in the following price changes of Ford Models: [64]

<u>Year</u>	<u>Price(yen)</u>	<u>Type</u>
1902	8,000	
1903	6,000	
1906	4,000	
1907	5,600	Convertible
1916	2,800	Convertible
	3,500	Sedan
1920	1,995	Model T Convertible
	1,495	Model T Truck
1927	2,195	Model A Sedan
	1,645	Model A Truck
1931	1,735	Convertible
	2,200	Sedan
	1,825	Truck (Model 165)
1934	3,200	Convertible
	3,475	Sedan
	2,885	Truck (short)
	3,075	Truck (long)

During the period from 1902 to 1916, the price was extremely high,

which reflects the public image of a car as a luxury commodity, created by the wealthy people in the Japanese Automobile Club, History tells us that a cheap price did not promote sales during this period [65]. The 1920 price is a fixed price by Ford Motors, Inc. This is the first case of price fixing of foreign cars in Japan [66]. After Ford introduced the new model A, the price increased 10%. A tremendous increase of the 1934 price as compared with that of 1931 was simply due to the aforementioned increase of foreign exchange rate that happened because of the second ban on gold exports by the government in late 1932.

3. The Birth of A New, Entrepreneurial, Auto Maker:

Nissan Motors, Ltd. [67]

In the midst of the on-going formation of government automobile policy, Nissan Motors, Ltd. emerged as a new entrant in the automobile business. Because of its entrepreneurial nature, it was little affected by government intervention.

The predecessor of this company, Tobata Cast Iron Works, Ltd., was founded in 1910 by Gisuke Ayukawa, one of the most ambitious entrepreneurs in prewar Japan. Tobata Cast Iron Works started its business as a leading manufacturer of combustion engines for marine

and agricultural use. It also supplied many parts of cast irons to manufacturing industries. In 1928, it began to produce almost all cast-iron parts for Ishikawajima Motors' military-subsidized trucks. It is worth noticing that all parts of DATSON (or DATSUN) models of DAT Motors were also supplied by this company. Furthermore, since 1929, Tobata Cast Iron Works won the contract for parts for Ford and Chevrolet models assembled by Japan Ford and Japan General Motors.

By manufacturing parts for different models, Tobata Cast Iron Works might have gained important technology in automobile manufacturing and thus increased its corporate interest in manufacturing its own automobiles. In June 1931, it finally changed its articles to add automobile manufacturing, increased its capital to 11 million yen and officially entered into competition with the other auto makers who had been heavily dependent on the government support; hence were oriented toward the production of large 4-wheel vehicles. Instead of following this course, Ayukawa's strategy was rather ambitious as follows:

- i) First, produce an inexpensive car that would sell well.
- ii) Profits on sales of this model would be invested to gradually enlarge the scale of production and learn the technology of mass production.
- iii) In the meantime, continue parts production for Ford &

Chevrolet in order to acquire their technology and apply it in the near future to the production of an equivalent car.

iv) As the first step, the production and sale of DATSUN models would be appropriate, for this model can compete against these existing foreign and domestic small cars.

<u>Model</u>	<u>Price(Yen).</u>
Austin 7	1,600
Morris Minor	1,900
New Era (Domestic 3-wheel Car)	600

Exactly following this corporate strategy, Ayukawa immediately started negotiations with the financially ailing DAT Motors and eventually absorbed it into Tobata Cast Iron Works in June 1931. Two months later, in August, a new DATSUN model by Tobata Cast Iron Works was completed and put on sale for 1,200 yen. The pricing came from the initial production target of 100 units per year. Ayukawa's idea was the following: even if this model had to be sold at a 50 % off in order to compete against the cheapest car, an estimated annual loss of 60,000 yen would not hurt Ayukawa's conglomerate. Note that the technical specifications of this model:

Passengers: 1 or 2
Maximum speed: 65 km/h
Engine: 495 cc, 10 hp, 4 cylinders,
water-cooling

exactly followed the previous model of DAT Motors.

While Ayukawa's idea was being gradually realized, there happened an incident within the automobile industry. We have already discussed in the previous section how the government determined the specifications of the MCI Standard Model in 1932. In order to implement this policy, the government requested the existing three makers, Ishikawajima Heavy Industries, Tokyo Gas and Electric Industries and DAT Motors to merge in order to consolidate the production of MCI Standard Models. The first approach to this came with the merger between Ishikawajima Motors and DAT Motors in 1932. In 1931, Tobata Cast Iron Works had already purchased all the stock of DAT Motors. Therefore, this government intervention interfered with the implementation of Ayukawa's much broader ambition. As a second step, G. Ayukawa established an independent automobile manufacturer, Automobile Manufacturing Industrial, Ltd, in December 1933, with a capital of 10 million yen. This capital was shared by Tobata Cast Iron Works and Nippon Sangyo (Ayukawa's conglomerate composed of more than 200 subsidiaries). The corporate objective of the new company was to achieve: 1) the production of DATSUN models (primarily small passenger

cars) at about a 5,000 per year level, and 2) the mass-production of parts for Fords and Chevrolets.

In preparation for the establishment of a new company, Ayukawa asked William R. Gorham to lay out production plants and invited seven American engineers to help Mr. Gorham in June 1933. Note that W. Gorham had already come to Tobata Cast Iron Works in 1922 due to the financial troubles of Jitsuyo Motors.

The gap between the government's medium-size vehicle policy and Ayukawa's small-size policy can be clearly seen in the speech Ayukawa gave, in March 1934, on the occasion of the establishment of the new company. He said:

- i) The production of 1,000 units per year proposed by the Committee to Establish Japan's Automobile Industry is too small. In order to survive economically, the automobile industry must produce 10,000 to 15,000 units per year.
- ii) Perhaps it would survive if the government increased the import tariff so that the current price of foreign cars would be doubled. However, such a policy would not be economically healthy.
- iii) The current government policy of requesting the annual production of 25,000 units is mistaken. Suppose that a loss of 1,000 yen is inevitable on each unit.

The industry as a whole would loose the huge amount of 25 million yen per year. However, the current government subsidy is negligible.

- iv) If the Japanese industry reached a technical level equivalent to Ford or GM, within, say, 5 years, it would be possible to coexist with foreign competitors. For this reason, we must improve our own technology by producing parts for foreign models, so that within 5 years or so we will be able to the domestic cars technically compatible with foreign cars with all Japanese parts [68].

(B) Policy Intervention

1. The Law Regarding Automobile Manufacturing Enterprise [LSMV] (1936)

As a result of intensive preparatory work described above, the Law Regarding Automobile Manufacturing Enterprise was finally promulgated on May 29, 1936 and enacted on the same day. The text of this law is summarized below: [69]

1) Purpose of this law [70]

To firmly establish automobile enterprise in Japan,
consolidating national defence and promoting
industrial development (Article 1)

2) Definition of the automobile manufacturing enterprise

The automobile manufacturing enterprise is defined as one
which undertakes production or assembly of automobiles
or parts (Article 2)

3) Licensing of automobile manufacturing

i) A company which wishes to undertake automobile
manufacturing enterprise in the following fields
must obtain a production license from the government
(Articles 1 and 2, of LAME's Procedures)

a) the production or assembly of automobiles with
an internal combustion engine of more than 750 cc,
amounting to 3,000 units per year.

b) the production of auto parts worth 3,000 car units
per year.

ii) The government gives a license in consideration of the
demand-supply condition at a given time. (Article 16)

- iii) A company which may apply for the production license is a corporation of which the majority of stock is held by Japanese and the majority of the votes are controlled by Japanese. (Article 4)

4) Special allowances given to a licensed company

- i) A licensed company is exempted from income tax and operating profit tax for a period of five years starting the year in which a license is awarded.
- ii) A licensed company is exempted from local tax to be designated (Article 7)
- iii) A licensed company is exempted from import tax for necessary machinery and material imports (Article 8)
- iv) A licensed company is allowed to add to capital for the purpose of equipment investment before full payment of dividend is completed.(Article 9)
For this purpose, a licensed company is allowed to float bonds beyond the limit specified by the Laws of Commerce (Article 10)

5) Protective measures

- i) The government regulates the importation of items that

are considered to impede the manufacturing enterprise of a licensed company. (Article 11)

- ii) The government levies an import surcharge equivalent to less than 50 % of the value of an import.

(Article 12)

6) Control measures

The government issues an order allowing governmental supervision, and changes of sales prices and conditions.

(C) Policy Impacts

1. The Birth of A New Enterprise: Toyoda Motors, Ltd. [71]

All the historical documents we have investigated unanimously show that the most significant impact of the Law Regarding Automobile Manufacturing Enterprise was the new entry of an unknown Nagoya-based company, Toyoda Automatic Weaving Machinery, Ltd. (the predecessor of today's Toyota Motors) As is well known, Toyota Motors is now one of the two most powerful auto producers in Japan. The origin of this

company dates back to this period. It will be seen below that his company has very different characteristics from its predecessor, Nissan Motors. The difference was already apparent at the very beginning of its operations, and since then it has exemplified a certain pattern of corporate behavior in an environment of intervention.

The predecessor of this company was a Nagoya-based company founded by the noted inventor/entrepreneur, Sakichi Toyoda, that had come to dominate the weaving machinery market. In 1929, Toyoda received a patent royalty from a British company, of roughly £ 0.1 million (UK) (amounting to same 1 million yen), for its spinning machinery patents. With this money, Kiichiro Toyoda, son of the founder, started his long-cherished dream of manufacturing an automobile. Kiichiro Toyoda graduated in mechanical engineering from the Tokyo Imperial University, as did Nissan's G. Ayukawa. Kumabe, then Associate Professor at the Tokyo Imperial University and an ad hoc member of the government's Committee for Establishment of Automobile Industry, and Toyoda worked together on their joint graduation thesis. During the period in which the government set up several committees to formulate its automobile policy, Kiichiro Toyoda was in touch with these developments through his friend Kumabe. His earnest interest in government policy is shown by the fact that he visited various policy planners such as Hideo Kobayashi (who was a chief designer of MOR's bus), Kaoru Ban of MCI (who was said to have drafted the Law Regarding

Automobile Manufacturing Enterprise) and Col. Hisao Ito of MOA (who participated in the government planning board representing the influential Imperial Army). Toyoda's closeness to the government's policy-makers is in sharp contrast to Ayukawa's entrepreneurial approach and perhaps stems primarily from the scale of their enterprise. Ayukawa was an entrepreneur "boss" with a powerful financial base, whereas Toyoda was an engineer/executive of his father's company, who certainly did not have the financial resources to set up a large scale automobile manufacturing enterprise. However, his most valuable asset was his personal relationship with various key figures involved in the formation of the government's automobile policy.

In 1931, Kiichiro completed his first motorcycle engine of only 2 hp. It is rather surprising that with this humble beginning, Toyoda Automatic Weaving Machinery, Ltd. decided to enter automobile manufacturing two years later, in September 1933. This decision reportedly faced strong opposition from company executives who were very conservative in their business approach. However, Kiichiro Toyoda's ambition carried the final decision. His plan was: 1) to aim at a popular model equivalent to American Ford or Chevrolet models then widely sold in the Japanese market, and 2) to focus on the Chevrolet model for engine design, on account of its gas economy, on the Ford model for chassis design, on account of its durability, and on the DeSoto model for body design, on account of its innovative

styling. Then, in October 1934, the first prototype engine was completed, which was followed by the first prototype car in May 1935 , a year before the Law Regarding Automobile Manufacturing Enterprise was promulgated.

The timing of this prototype saved face of the government which tried in vain to push the two companies, Automobile Manufacturing and Tokyo Gas & Electric Industry, to produce 6,000 to 8,000 units per year. Both companies rejected this government plan. Then, the Imperial Army sounded out two "Zaibatsu's," Mitsui and Mitsubishi. Again, both conglomerates rejected the plan on account of the risks involved. The Army then sounded out Nissan Motors, which also rejected the plan since it already planned to realize the complete domestic production of the Chevrolet model within 20 years. In this deadlock, the government heard of the entry of an unknown Nagoya-based company into the automobile business. History tells us that Kazuo Kumabe, a friend of Kiichiro Toyoda, reported Toyoda's automobile manufacturing plan to the Army. This plan was as follows:

- 1) mass production of a popular medium-sized 4-wheel vehicle
- 2) initial monthly production target of 2,000 units (1,500 truck models and 500 passenger cars)
- 3) Regardless of the government support, the company will pursue the above plan

- 4) the company can carry out the plan if annual losses are less than 1 million yen.

It is not clear whether or not Toyoda actually intended to start automobile manufacturing without government support. Our confusion stems from Kiichiro Toyoda's memoir. He said:

- 1) The automobile manufacturing business dependent on the Law Regarding Automobile Manufacturing Enterprise is not my desire.
- 2) It is true that this business is so difficult that it may need legislation. However, it is a wrong view that the law created automobile enterprise.
- 3) Nationalism is not the sole factor governing consumer behavior. More important is to provide them with cheap and high quality products. However, it is quite impossible to sell a cheap vehicle from the beginning. In this regard, the Law of Automobile Manufacturing Enterprise is useful in order to prevent dumping of foreign cars in the Japanese market now.

The official 5-year production plan of Toyoda Motors submitted to the government in its request for government licencing is as follows:

a) Production

<u>Year</u>	<u>Passenger Car</u>	<u>Truck</u>	<u>Bus</u>	<u>Total</u>
1936	150	700	150	1,000
(2nd half)				
1937	2,500	2,500	1,000	6,000
1938	5,000	5,000	2,000	12,000
1939	8,000	7,000	3,000	18,000
1940	8,000	7,000	3,000	18,000

b) Prices

Passenger cars: 3,300 yen

Bus chassis: 3,150 yen

c) Sales Approach

- . Establish at least one Toyoda dealer in every prefecture
- . For assisting these dealers, establish a loan financing company with a capital of 1 million yen

2. The Change of Corporate Strategy of Nissan Motors

The covert preparations for the forthcoming Law Regarding Automobile Manufacturing and ever-intensified communications between

the government and Toyoda Auto Weaving Machinery seems to have made a considerable impact on the corporate strategy of Nissan Motors, which once placed the major emphasis on the market mechanism and wanted to avoid excessive intervention by the government. Our investigation will center on when and why Nissan Motors changed its previous entrepreneurial approach and later became the full recipient of government intervention.

We have seen that, in March 1933, DAT Motors, which came into Ayukawa's conglomerate in June 1931, was incorporated into the newly created Automobile Industrial as a result of Army pressure and further the government plan. However, the evidence that Tobata Cast Iron Works sought and obtained the manufacturing licence for the DATSUN model in September 1931 seems to indicate that Ayukawa still opposed the government policy favouring large 6-wheel vehicles and the medium-size MCI Standard Models. This stance lasted at least until Toyota finally filed the application for the manufacturing license under the newly-enacted Law Regarding Automobile Manufacturing Enterprise in 1936. The most ominous situation Ayukawa perceived was not the existence in itself of a new potential competitor, but a shift in policy of the Zaibatsu groups under government pressure. Mitsui agreed to finance this unknown company under the guidance of the Army [72]. The effort of Nissan Motors to forestall the possible emergence of a most powerful competitor, supported by both the government and the giant Zaibatsu, can be seen in the fact that, in December 1935,

Ayukawa sent two executives and one American engineer to the US to negotiate with a Detroit-based second-rank American manufacturer, Graham-Page Motors, over the swift purchase of all of Graham-Page's production facilities for medium-small vehicle production. Recall that Ayukawa intended to eventually produce Japanese-made Fords or Chevrolets after his company had gained sufficient technical expertise for automobile production through the production and sale of small cars. The fact that Toyoda Auto Weaving Machinery introduced a prototype of the medium-size passenger car, "Model A-1," in May 1935 and the medium-size truck, "Model G-1," in November 1935, and would likely become the first licensee under the Law Regarding Automobile Manufacturing Enterprise, meant Nissan Motors had to urgently undertake the purchase of a financially failing company in a package, which was not an unprecedented approach for Gisuke Ayukawa [73].

The technical feature of Graham-Page Motors that appealed to Ayukawa's Nissan Motors was its engine, which could be used for both a passenger car and a truck. The final contract with Graham-Page Motors was signed in April 1936, and stated: [74]

- 1) Nissan Motors purchases Graham-Page Motors' Detroit plant, including all manufacturing facilities, for more than \$0.18 million US.
- 2) Graham-Page Motors designs a new "Model 73" engine for Nissan Motors at Nissan's expense.

- 3) Nissan Motors will buy 500 units of this engine from Graham-Page Motors.
- 4) Graham-Page Motors is responsible for making a prototype of a new truck model with a 1-2 ton capacity for Nissan Motors.

According to this contract, the blue print of a new truck model arrived at Nissan Motors from Graham-Page Motors in May. Nissan Motors also signed the technical contracts with US Spencer Manufacturing Industries, Inc. and US Ferro Machinery Cast Iron, Inc. in May and October 1936, respectively.

Upon the return of the these three negotiators in July 1936, Nissan Motors sent the Minister of Commerce and Industry the license application later that month, was granted it two months later, in September 1936. The production plan Nissan Motors submitted for the application was as follows: [75]

<u>Year</u>	<u>Passenger Car</u>	<u>Truck</u>	<u>Bus</u>	<u>Total</u>
1936				
(2nd half)	0	0	0	0
1937	2,500	2,000	1,500	6,000
1938	6,000	4,000	2,000	12,000
1939	10,000	6,500	3,500	20,000
1940	15,000	10,000	5,000	30,000

In parallel with these efforts, Nissan Motors started plant construction and commenced the production of its own popular-size vehicle named "NISSAN" in March 1937. The first NISSAN model came off the line two months later, in May 1937, and its technical specifications were as follows: [76]

NISSAN TRUCK.

Max. Capacity:	4 tons
Engine (Model AT):	3,670 cc

NISSAN SEDAN.

Passenger Capacity:	5
Max. Speed:	120 km/h
Engine (Model A):	3,670 cc

As is evident, both models used the same engine.

3. The Disappearance of The Two American Subsidiaries

Following the promulgation of the law in May 1936, on September 22, 1936, the Ministry of Commerce and Industry sent Japan Ford, Ltd. and Japan General Motors, Ltd. the notice setting annual production ceiling as follows:

Japan Ford: not exceeding 12,360 units
Japan General Motors: not exceeding 9,470 units

The above calculation was made by examining the amount they assembled in the previous three-year period from August 9, 1932 through August 9, 1935 [77]. As we have seen, the primary purpose of the law was to eventually eliminate the business of these American subsidiaries in Japan, and it was actually achieved when both foreign imports and foreign cars assembled by the foreign companies disappeared from the Japanese market in 1939. However, this did not happen easily and the American subsidiaries in fact tried their best to circumvent the law.

a) Japan Ford [78]

Ford's strategy of overseas operation was well known in Japan to include a gradual transition from an initial assembly operation to a manufacturing plant followed an initial assembly plant. The visible impact of the new law on Ford's overseas business strategy can be seen in its hurried effort to move from assembly to manufacturing. Ford publicized the following new plan in October, 1935, a year before the promulgation of the law:

- i) Capital will be doubled from 8 to 16 million yen. A greater portion may be owned by

Japanese, but only by Ford dealers.

- ii) Within three years, a purely-domestic Ford model will be manufactured by the new Japanese company.
- iii) However, corporate decisions of the Japanese subsidiary are subject to approval by the head office of US Ford Motors, Inc.

Along with this plan, Ford quickly started a secret negotiations with the City of Yokohama over the purchase of city-owned land for plant construction. It is reported that the city welcomed Ford's plant construction. However, these negotiations came to nothing due to strong joint pressure on the city by MOA and MCI. Then, Ford undertook a second round of negotiations with C. Asano, a Yokohama-based entrepreneur in the cement business, and finally bought 327 acres of his land in April, 1935.

On the occasion of the promulgation of the law, the general manager of Japan Ford reportedly said, in order to reassure Ford dealers: "If legislation could establish an automobile industry, Japan's automobile industry should have been already founded a long time ago. The business of Japan Ford, Ltd. is here to stay."

b) Japan General Motors [79]

When this company was established in Osaka in 1926, US General

Motors, Inc. promised that operation of this knockdown assembly plant would be terminated within four years. Whether or not this was merely a posture intended to discourage Japanese competitors is not clear from our investigation. The fact is that they continued assembly operation beyond the four-year period. As was Japan Ford, Japan GM was aware of government preparations for the forthcoming legislation, and directed intensive lobbying at the Ministry of Commerce and Industry to obtain approval of a joint venture with a Japanese company so as to comply with government policy. However, MCI showed strong disapproval because of Japan GM's wish to hold 51% of the stock. The first approach was made to Nissan Motors. However, after Nissan Motors independently applied for a license, Japan GM's negotiations fell through. Next, Japan GM individually applied for licensed company status and this was granted in September 1936. However, the limit set on production was too low for profitable operation, and so the company was inevitably forced to close operations.

(D) Summary of the Third Major Policy Intervention

FIGURE II-4 summarizes the causal environment around the third major policy intervention described in this section.

SECTION II-4

THE FOURTH MAJOR POLICY INTERVENTION: THE COLLECTIVE INTERVENTIONS OF WAR CONTROL

(A) Pre-intervention Environment

1. Legal Preparation for War Control

Starting with the Manchurian Incident on September 18, 1931, Japan gradually intensified preparations for conflict and finally entered the most devastating war. The main concern of this section is not to investigate why she went into the war, but how the war affected the automobile industry.

The Law Regarding Support for Military Vehicles in 1918 has been seen, in SECTION II-1, as the first major government intervention directed at the automobile industry, and as the first piece of industrial legislation with an exclusively military objective. From then on, not only automobile policy but also general industrial policy was developed with the combination of military and industrial objectives. However, from the Sino-Japanese Incident in 1937 up to the end of the Pacific War, industrial policy was completely subordinated to military goals.

Many of the economic controls used during the Pacific War were designed by the Hirota Cabinet elected after the attempted military coup (called the "2.26 Incident") of February 26, 1936. Despite the tight monetary policies of the preceding cabinets, intended to curb the rising rate of inflation since the Manchurian Incident, the Hirota Cabinet increased the budget by nearly 30%, of which the defence budget accounted for 43%. It was this government which first used the term "quasi-war-economy," and passed a considerable amount of war control legislation in the 69th Diet [80]. Most significant in the context of automobile policy were the Principles of the 5-year Plan for Important Industries announced by the Ministry of the Army on May 29, 1937. This plan designated 13 industries, including the automobile industry, as the key industries for the nation's war objectives. In this plan, current production potential of 37,000 units as of 1936 would by 1941 be increased to 100,000 units, and stocks would be kept at 300,000 units (of which half would be trucks, excluding small vehicles) by 1941 [81]. The plan was generally opposed by industrialists on the grounds that it ignored the limited production capacity of Japan's economy at that time [82]. However, the abrupt occurrence of the Sino-Japanese Incident in July dispersed all this opposition. The next Konoe Cabinet formally proposed a massive programme of war economic controls at the 72nd and 73rd Diets.

The two important laws enacted by the Konoe Cabinet were the Law Regarding Temporary Measures for Exports and Imports and the Law of

National Mobilization promulgated on September 10, 1937 and April 1, 1938, respectively. The first law did not only regulate international trade but it could also "control internal supply and demand if necessary" (Article 2). It was a comprehensive law, embracing most possible industrial controls, and more importantly, it had the character of enabling legislation (called "jyuken-hoki" in Japanese), allowing each ministry to issue its own administrative directives. Under it, the Ministry of Commerce and Industry was rapidly able to promulgate all necessary wartime controls over manufacturing, commodity distribution, consumption, and prices [83].

The Law of National Mobilization comprised fifty articles which included the government control of every aspect of socio-economic activities under the Imperial Order. In addition to the wartime regulations, this law allowed the government to intervene in manpower training and supply (Article 22), industrial R&D (Article 25), and corporate planning (Article 24) [84]. It also had the nature of enabling legislation.

2. General Policy Implementation for War Control: The Plan for Materials Mobilization

Having constructed this legal basis, the government then proceeded to implement its wartime industrial objectives. First, the Planning

Agency was newly created in October 1937, under the direct control of the prime minister, by absorbing the previous Bureau of Materials and Planning within the Prime Minister's Office. The fact that uniformed military officers joined the agency indicates the militaristic nature of the planning process. Next, under the general leadership of this agency, the government announced the first Plan for Materials Mobilization in January 1938, which was later amended on June 23, 1938, because the government recognized that the original targets could not be achieved because of the underestimation of exports. The most important features of the revised plan (called the "S-13 Revised Plan") are the priority given to guaranteeing military supplies, the sacrifice of all unnecessary production and the embargo on unnecessary imports. In particular, the plan selected 32 raw materials which the nation had to conserve. These included all of those needed for automobile production, such as steel, pig iron, aluminium, zinc, heavy oil, gasoline, rubber, etc. [85].

At this point, the plan was exclusively concerned with the supply of the 32 raw materials and their appropriate distributions to the Army, the Navy and civilian consumption. Then, in January 1939, the Planning Agency announced the Plan for Production Consolidation which set annual production targets for the 15 designated industrial products, including automobiles. The automobile production plan will be discussed in the next part [86].

3. Further Legal Measures for War Control

On September 1, 1939, World War II broke out. Price increases in Europe and export embargos by the countries which entered the war led to sharp increases of domestic prices in Japan. As we have seen, the price controls had already been instituted under the Law Regarding Temporary Measures for Exports and Imports. However the tremendous price increases (nearly 10% for almost all commodities in the first month after the outbreak of war) led the government to enforce a more comprehensive and complete price controls based on the Law of National Mobilization. Then, on October 18, 1939, the new price controls were enacted in the form of Imperial Edict # 703. This so-called "10-18 Price Control" was the transitional vehicle for immediately stopping any price increase until the government later set official prices (Article 7) [87]. In the beginning, the newly consolidated controls focused on industrial raw materials, but later they were to affect ordinary consumer commodities. This came about dramatically with the enactment of the Regulation of the Manufacturing and Sale of Luxurious Commodities and the Control Order for the Necessities of Life on July 6, 1940 and April 1, 1941, respectively. The former regulation (called the "7-7 Ban") included not only expensive items such as automobiles, radios, shoes, watches, etc. but also such items as food, clothing and toys. With the enactment of this order, the state started to control the individual's life and to legislate what was called "spiritual mobilization for war imperatives." The second order set up coupon

rationing of the necessities of life. Upon the promulgation of this order (Imperial Edict # 362) control of all of Japanese daily life passed into the hands of the government [88].

On October 19, 1940, the government promulgated, again under the Law of National Mobilization, another regulatory measure which had wide reaching effects on industry: the Regulation Regarding Corporate Accounts (Imperial Edict # 680). This regulation had two principal aims. By ordering firms to give first priority to the national interest, it rejected the principle of profit-maximization in free economic competition. Secondly, it modified the equity capital. A firm had to obtain ministerial permission to pay dividends at a rate of more than 8% [89].

Having fundamentally affected the bases of corporate behavior by these measures, the government then intervened in the structure of industrial organization. On August 30, 1941, the Law Regarding the Organization of Important Industries was promulgated. It was Imperial Edict # 831, having its legal basis in the Law of National Mobilization [90]. It required each industrial sector to form an industrial association (for large firms) and a consortium (for small and medium firms). The industrial association, or called "To-sei-kai" (association for control), was essentially a coercive cartel whose president had the power to appoint and fire the board members not only of the industrial union or consortium, but also of the member firms.

However, the government had the right to appoint the president of the association. Thus the government was in a position to exercise full control over industry.

(B) Policy Intervention

1. Ban on Production of Passenger Cars [91]

In accordance with the Planning Agency's Revised Plan for Materials Mobilization of 1938; on August 4 the director of the manufacturing bureau of MCI sent Nissan and Toyota a notice asking them to restrict passenger car production. They were requested to concentrate on truck production and stop supplying passenger cars for civilian use. Four months later, in January 1939, this government request became a mandatory ban on passenger car production, except for a limited supply of command vehicles.

2. The Planning Agency's Automobile Production Plan

Among the 15 industries designated in the Plan for Production Consolidation of 1939, the government's targets for automobile production were: [92]

<u>Year</u>	<u>Production</u>	<u>Growth Rate</u>
1938	15,700 units	
1939	45,000 units	186.6%
1940	65,000 units	44.4%
1941	80,000 units	23.1%

In comparison with the targets of the earlier MOA, this was modest; although it should be noted that the two plans adopted different calendar years (MOA's 5-year plan was on the calendar year basis, while the Planning Agency adopted the fiscal year used in government budgetary planning). The trend of growth rates might give an important clue as to how the government attempted to implement the target. As shown in FIGURE II-5, the growth rate would decline exponentially, which means that the production curve would form a rapid-stagnation pattern. This is quite significant: the plan would have to be a "crash project," with a high initial growth rate, if it were to reach the target rate of 80,000 units p.a. by 1941. At the Far East War Criminal Court starting May 3, 1946, the coincidence between the year of Pearl Harbor and the target year of this plan, as well as the MOA's Principles for a 5-year Plan for Important Industries of 1937 became an important issue regarding whether or not the government had intended to start the war in 1941. The only fact to have been made clear in this respect is that the military was greatly influenced by the successful USSR's 5-year economic plan and hence set the target five years ahead when the plan was conceived in 1937 [93].

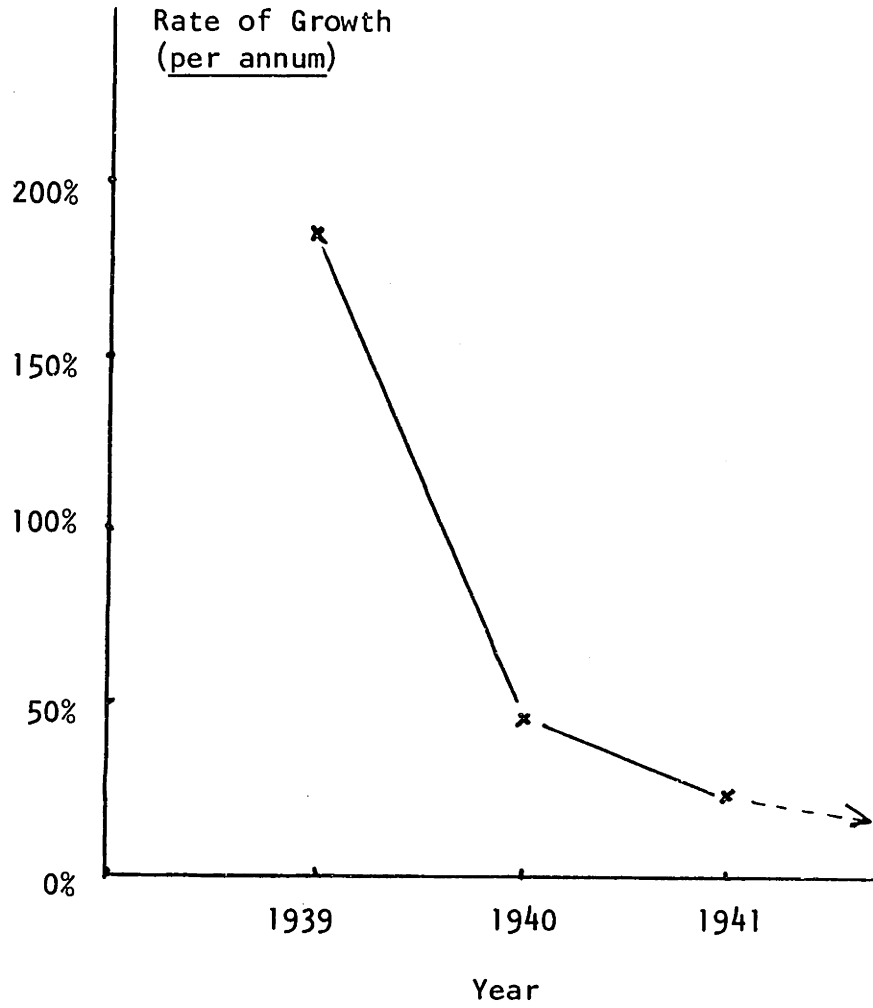


FIGURE 11-5

Growth Rate of Automobile Production
in Planning Agency's Plan for
duction Consolidation of 1939

Examination of this plan on the level of the industrial firm suggests a rather interesting conclusion with regard to the government view of the automobile industry. The following table shows the production plans assigned to the two leading companies, Nissan and Toyota, by the Planning Agency [94].

<u>Year</u>	<u>Nissan</u>	<u>Toyota</u>	<u>Combined</u> <u>% of Plan</u>
1939	20,000	20,000	89
1940	25,000	25,000	77
1941	40,000	40,000	100

First, the two companies were equally treated with the identical assignments. Second, both companies were supposed to increase their growth rates (25% in 1940 and 60% in 1941) while, as seen in the previous table, the growth rate for total production was to decrease exponentially. This perhaps means that the government plan relied totally on the ability of these two companies to sharply increase their production in 1941. The government would seem to have been relying solely on Nissan and Toyota for the final production figure of 80,000 units in 1941.

3. Specific Cases of Intervention in the Automobile Industry under War Controls

The creation of a system of legal controls over various industrial activities under the ultimate authority of the Law of National Mobilization was briefly delineated in the previous part. Specific government intervention in the automobile industry was wide-ranging and will be discussed below.

Following the ban on passenger car production, the government intervened in vehicle supply. On May 6, 1938, the government enforced supply control under the 1937 Law Regarding Temporary Measures for Exports and Imports. That is, sales of vehicles could be approved only by reporting to the government 1) the technical specifications of a vehicle to be sold, 2) sales amounts and prices, 3) the purchasers, 4) the time of delivery, and 5) the reason for sales. This shows clearly that the above law was widely interpreted to apply to not only imports & exports but also to have the most general implications for the whole range corporate activities. Then, from August 1939, government rationing of the supply of trucks and buses was enforced in accordance with the Planning Agency's Plan for Production Consolidation of 1939 [95].

The "10-18 Price Control" of 1939 was also applied to motor vehicles. Recall that this law froze every price at its October 18,

1939 level. However, the rapid increases in tire and material prices since then made it difficult to enforce the "10-18 Price Control" on automobiles and so led to the establishment of a MITI committee on vehicle pricing on July 29, 1940. Basing their decision on a broad interpretation of the Regulation Regarding Corporate Accounts of 1940, the committee decided on a uniform list price for every vehicle part, effective from August 21, 1943.

In August 1939, the MCI established the Committee on Automobile Technology, with the aim of finding ways to improve the performance of large trucks, which had revealed many defects on the Chinese front, and to develop fuel-saving technology. Later, the committee was incorporated into the National Research Institute for Automobiles, established in July 1940. A notable achievement of R&D was the first national decision, on May 30, 1940, to standardize parts production. Previously, parts had been produced by many small firms organized in the All Nippon Federation of Automobile Parts Manufacturers, but now the government ordered the automobile manufacturers to produce parts by themselves [97].

The final major intervention under the Law of National Mobilization was the establishment of the Association for the Control of the Automobile Industry on December 24, 1941 under the Law Regarding the Organization of Important Industries (This law was legally based on Article 18 of the Law of National Mobilization). Later, the

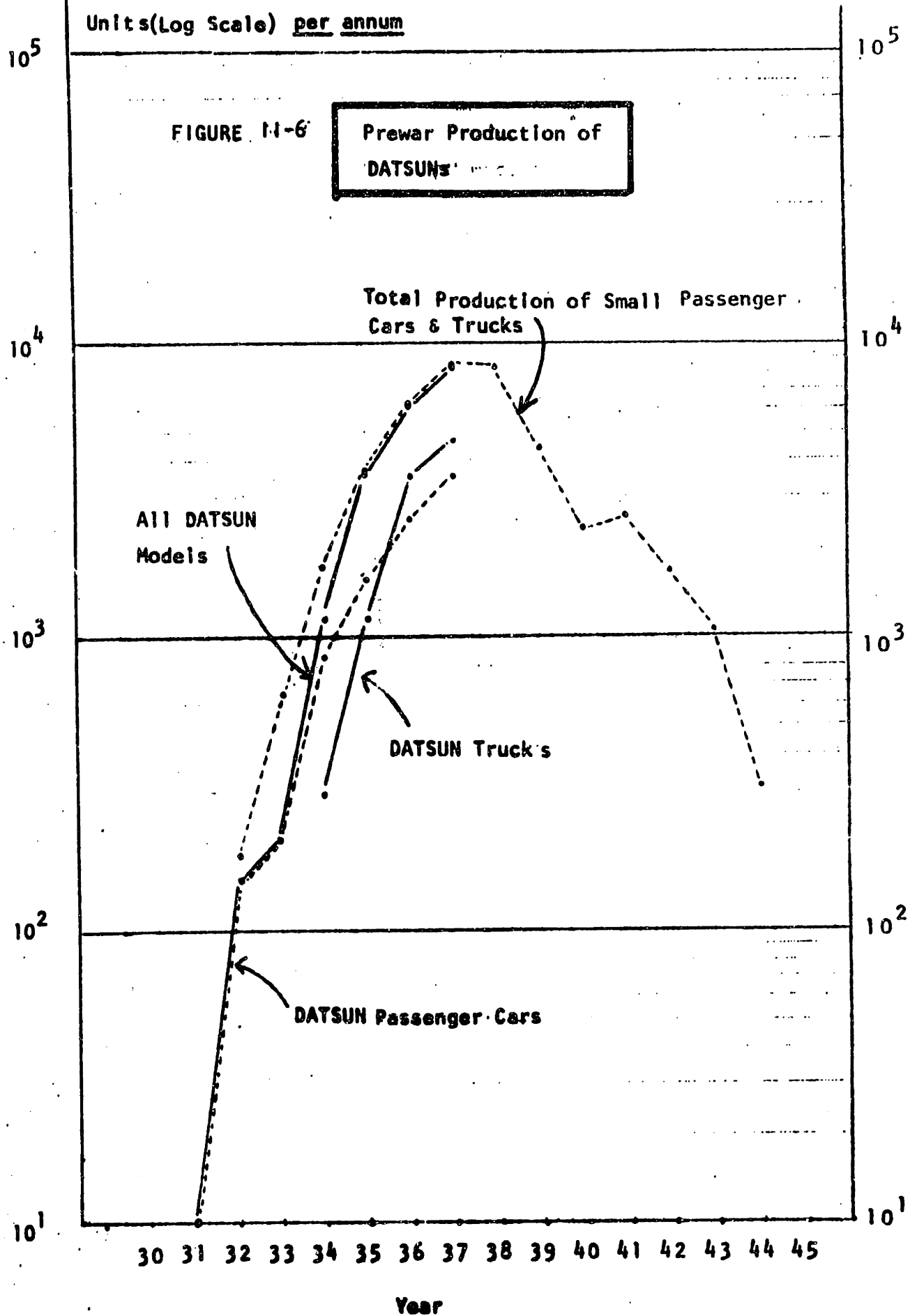
association absorbed Nippon Automobile Supply, Ltd. (a semi-public corporation) which was established on August 25, 1942 to facilitate government control of supply. Two years after its formation, the association was dissolved and incorporated into the newly created Ministry of Munitions in December 1943 [98].

(C) Policy Impacts

As the Japanese government at this time was militarily controlled, the automobile industry did not have much freedom of choice in complying with this coercive legislation.

1. Production of the "Datsun" models

The embargo on the production of passenger cars, together with the supply control of 1938 and the "7-7 Ban" of 1940, made a direct impact on Nissan, which had started with a small passenger car model, i.e., the Datsun. How the production of Datsun was affected by this embargo may be seen in FIGURE II-6 [99]. First, the data up to 1937 suggests that Datsun production accounted for most of the nation's total small vehicle production. Second, from 1936, production of Datsun trucks passed that of passenger cars. Third, in 1937, production saturated parabolically and then started declining in a parabolic shape. However the above interpretation remains speculative, since the Datsun data



after 1937 have not been available for this research. However, the company history of Nissan Motors records that the Datsun passenger car was officially halted in December 1938, four months after the minister of commerce and industry sent the embargo notice in August 1938 [100]. Thus, the saturation of the nation's total production in 1938 was simply caused by the government ban on passenger car production, and the parabolic declining curve from 1939 on represented only production of the Datsun truck. Because of its small size, the Datsun truck was aimed at a civilian market. As seen previously, the government enforced stringent supply control under the Law Regarding Temporary Measures for Exports and Imports in May 6, 1938. The primary purpose of this control was to restrict civilian vehicle supply to maintain military supplies. Thus, it would be a plausible conjecture that the first half, or parabolic growth in the production curve for total small vehicles represented Datsun production, and the second half, or parabolic decline, jointly showed the effects of the ban on passenger car production and government supply control. In December 1943, Nissan closed the production lines of the Nissan passenger car and the Datsun truck [101].

2. Appointment of the President of "Toseikai"

The second major government action was the appointment of the president of the Association for the Control of the Automobile Industry ("Toseikai"). As mentioned before, the Planning Agency's Plan

for Production Consolidation totally relied upon Nissan and Toyota. In fact, from the time of the promulgation of the Law Regarding Automobile Manufacturing in 1936, these two companies represented most of the output of the Japanese automobile industry. At that time, it was generally supposed that the president of the association would be chosen from one of the two companies. However, the government appointed Shigeyasu Suzuki, the president of Diesel Motors. Diesel Motors was the new name of the previous Tokyo Automobile Industries, Ltd., which had been formed by the amalgamation of Ishikawajima Motors and Tokyo Gas & Electric both of which had specialized in military vehicles. S. Suzuki was an army officer with the rank of lieutenant army general. Recall that under the Law Regarding the Organization of Important Industries, the president of the association had enormous power including the appointment and dismissal of executives of the member companies. Thus, the appointment of S. Suzuki as President of the Association for Control of the Automobile Industry meant total military control of the industry from both the organizational and the manpower sides. Masasuke Murakami, who was the most eligible candidate for the presidency, with strong support from the industry, resigned from the presidency of Nissan Motors so as to avoid further conflict with the military government [102].

3. Policy Shift to Aircraft Manufacturing

The third major impact of the series of the government war controls

during this period was the order given to the major manufacturers to allocate production facilities to aircraft production. In both MOA's Principles of the 5-year Plan for Important Industries of 1937 and the Planning Agency's Plan for Production Consolidation of 1939, the main emphasis was placed on ensuring the production of aircraft. No target figure for aircraft production appeared in these plans on account of military secrecy. However, the government's desperate need for as many aircraft as possible may be seen in the reorganization of the production system of the major automobile manufacturers. On December 29, 1942, the Imperial Army sent Nissan Motors a directive to manufacture aircraft engines for trainers. Then, in August 1943, Nissan reorganized the company to enter full scale production of aircraft engines. Meanwhile, Toyota established Tokai Aircraft, Ltd. by absorbing Kawasaki Aircraft in February 1943. Thus, the entry of the two leading manufacturers into aircraft production was not a consequence of the companies' entrepreneurial decisions, but was dictated by the government. Clearly it impaired their previous efforts to concentrate on vehicle production [103].

(D) Summary Chart of the Fourth Major Policy Intervention

FIGURE II-7 briefly summarizes the causal environment around the fourth major policy intervention described in this section.

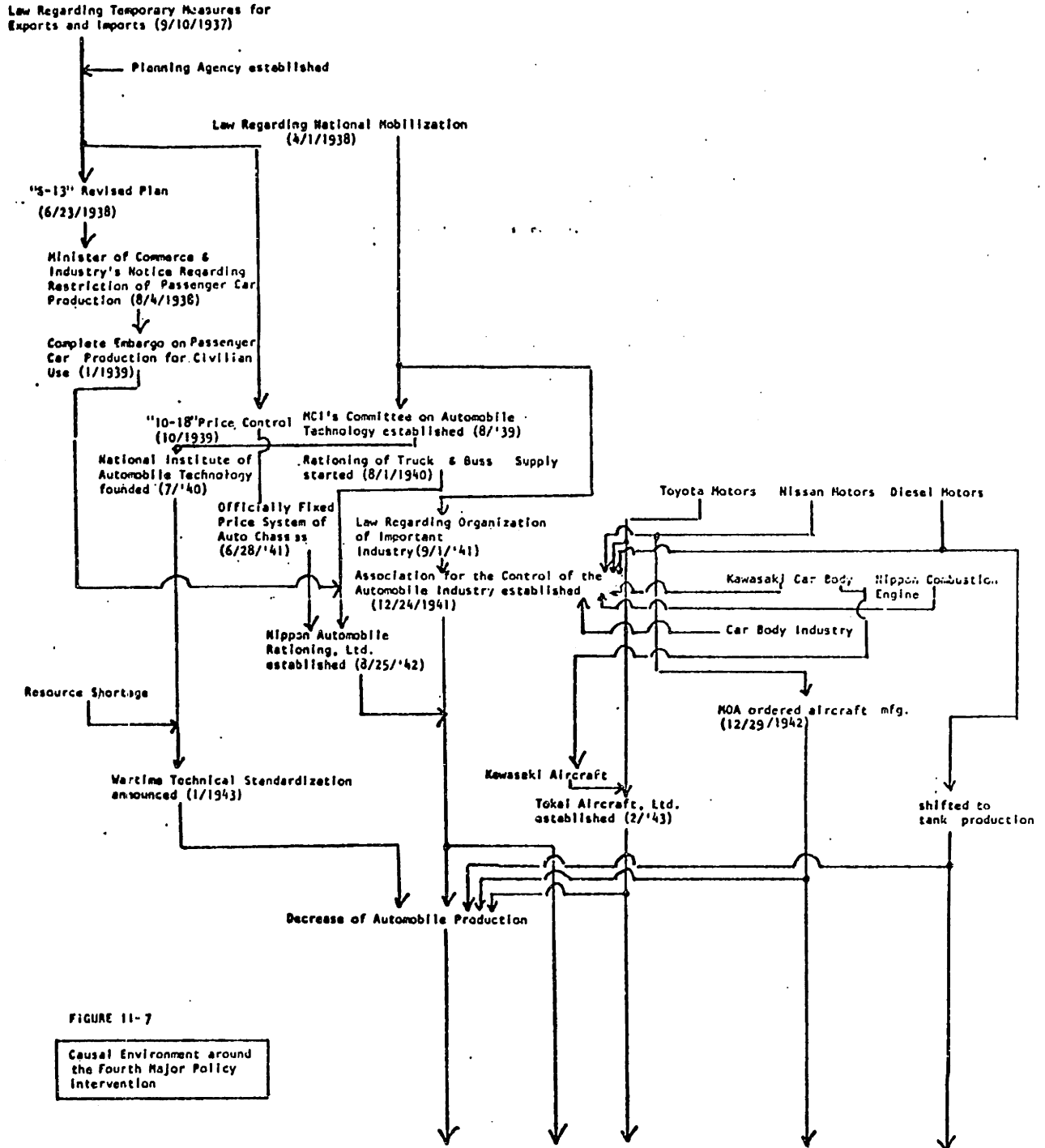


FIGURE 11-7
Causal Environment around the Fourth Major Policy Intervention

CHAPTER III
POSTWAR POLICY INTERVENTIONS

SECTION III-1

THE FIFTH MAJOR POLICY INTERVENTION: THE GHQ SUPREMACY

(A) Pre-intervention Environment

1. Eradication of Wartime Legal & Institutional Hindrances

During the period covered in SECTION II-4, various interventions successively made the motor vehicle production more difficult. The fatigue of war had become worse. Material resources were nearly exhausted. The tilting industrial policy favouring the aircraft manufacturing impaired automobile production. Then, the war ended. The Allied Occupying Forces led by the Americans landed in Japan. Eventually all prewar political structures were suspended. There was a complete change of governing authority with the Japanese government being placed under the supreme commander of the Occupation. As a natural result of defeat, the eradication of wartime legal and insitutional vehicles was the first task of the Occupation. Following are some key incidents: [1]

- 8/ 5 . The imperial edict announced the end of war.
- 8/26 . The Ministry of Great East Asia, and the
Ministry of Munitions were abolished.
 - . The MCI was revived.
- 9/ 2 . The surrender of Japan was signed
 - . The GHQ ordered the dissolution of the
Navy and the Army (the GHQ's first ordinance).
 - . The GHQ ordered the demolition of the munitions
industry.
- 9/20 . The Imperial Construction was suspended by
imperial edict.
- 9/21 . The US Government commanded the GHQ to
dissolve the "Zaibatsu."
- 9/29 . The GHQ ordered the repeal of the major wartime
laws.
- 10/24 . The Law Regarding Automobile Manufacturing
was repealed.
- 11/14 . The Association for the Control of the
Automobile Industry was dissolved.
- 11/20 . The dissolution of the "Zaibatsu" was
ordered by the GHQ.
- 12/20 . The Law of National Mobilization was repealed.

As is clear, most of the wartime legal obstacles to automobile

production were rapidly eradicated. Structural-functionally speaking, upon their demolition, the situation reverted to what it had been during the period covered in SECTION II-3, say the 1930s. In fact, the grand objective of the Occupation was to destroy all Japan's military-oriented industries and scale down her economy to the level of the 1930s and make it agrarian again. However, it is unclear whether or not the structural demolition of legal & institutional vehicles would by itself be enough to automatically return every situation to that of the 1930s. As long as policy intervention is viewed as a dynamic process, the factors considered to have determined the postwar course of events must include those initial conditions which had evolved even during the war.

2. The Two Fears and Shortage of Transportation

Japan's four-year war officially ended when General Douglas MacArthur signed the surrender of Japan aboard on the USS Missouri on September 2, 1945. For the Japanese automobile industry as well as the Government which had been working together toward the replacement of foreign cars in the Japanese market by the products of her own automobile industry, it was a time of fear and desperation.

The industry and the government both feared that the General Headquarters of the Allied Occupation Forces (GHQ) would never allow

the production of automobiles simply because the Imperial Army was so involved in building up the automobile industry to ensure a domestic supply of means of transportation during and before the war. The question seriously raised at that time was whether or not a car was classified as a weapon by the GHQ. The second major fear was more serious than the first: "Will American cars again wipe out Japanese cars?" On this point, the government and the industry concluded that for the time being it was unlikely that American cars would enter the Japanese market. There were three grounds for this conclusion. First, current domestic production of cars in America did not meet demand. Second, there was a great shortage of transportation at that time which might hinder the economic recovery of Japan. Third, Japan's holdings of foreign currency reserves did not then allow imports other than foods and basic materials [2].

As to the first point, it was said [3] that as of 1946 US demand for cars amounted to 8.5 million units whereas supply only came to 3.0 million. In the light of an excess demand of 5.0 million, it is surely right to claim that American cars would not enter the Japanese market for a while. With regard to the second point, the following statistics show the drastic decline of motor vehicle stocks shortly after the war [4]:

<u>Year</u>	<u>Trucks</u>	<u>Buses</u>	<u>Total</u>
1936	51,338	28,745	80,083

1937	52,995	24,344	77,339
1938	55,063	24,024	79,087
1939	54,461	23,181	77,642
1940	60,517	22,394	82,911
1941	54,263	21,965	76,228
1942	56,319	21,744	78,063
1943	56,864	21,502	78,366
1944	55,506	16,769	72,275
1945	43,235	11,119	54,354

These statistics also show the shortage of motor vehicles during this time. See, for example, [5]:

<u>As of April 4, 1946</u>	<u>%</u>
Total Stocks of Motor Vehicles	100
Motor Vehicles Needing Repair	67
Currently Operating Motor Vehicles	32

(B) Policy Intervention

1. GHQ's Permit to Restart Truck Production

Recognizing the serious shortage of transportation due to war damage, the GHQ immediately issued, on September 25, 1945, Memorandum #38 which permitted Japan to restart the production of trucks within certain limits of allocated materials. The condition attached to this GHQ permit was a maximum level of 1,500 units per month. The reopening of production of passenger cars was not allowed because of the shortage of raw materials [6].

This permission was not freely granted by GHQ on its own initiative starting immediately after the war, but obtained after tireless lobbying and petitioning, by the three people who headed the prewar automobile industry, Genhichi Asahara of Nissan Motors, Kiichiro Toyoda of Toyota Motors and Ichibei Terasawa of MCI [7]. In parallel with the request for permission to produce, they asked for another important permit. The manufacturers recognized that the most serious obstacle to the reopening of motor vehicle production would be the current shortage of tyre rubber due to both war damages and the heavy demand for aircraft during the war. Then they also asked the GHQ for a permit to import rubber. Accordingly, GHQ gave import permission for a maximum of 6,000 tons [8].

2. Material Rationing Measures

In addition to the shortage of motor vehicles, the shortage of industrial materials was also serious. Under GHQ guidance, the government established the Center for Economic Stabilization, the predecessor of today's Economic Planning Agency, on August 12, 1946. The first task of this agency was to develop a material rationing system. On October 1, 1946, the Temporary Law Regarding Material Demand & Supply Adjustment was promulgated and enacted on the same day. The purpose of this law was to give the government legal authority to implement material resources rationing according to the economic rehabilitation plans filed by the Center for Economic Stabilization. Under this law, the government issued, on November 20, 1946, the Procedural Rule Regarding Allocation of Designated Production Materials [9].

However, industrial production was far below the government's expectation due to the slow production of steel. Recognizing that the slow rate of steel production was primarily caused by the crucial shortage of fundamental energy resources, i.e., electricity and coal, the government announced the so-called "Tilting Production System" in December 1946. This system is simply a positive feedback production system designed to increase both steel and coal production. The system functioned by: [1^]

- 1) First, allocating a majority of imported heavy oil to power plants
- 2) Second, allocating electricity to the steel industry
- 3) Third, allocating steel production to coal mines
- 4) Then, allocating coal production to the steel industry

[Repeat this process]

In order to backup the "Tilting Production System," the government created the Reconstruction Financial Bank, the predecessor of today's Japan Development Bank, on January 25, 1947, under the Law Regarding Reconstruction Financial Bank promulgated on October 8, 1946. The allocation of funds through this bank followed the government's industrial priorities. [11]

3. GHQ's Permit to Restart of Passenger Car Production [12]

We have seen that the production of passenger cars was prohibited when the industry was granted the production permit of trucks in 1945 because of the shortage of industrial materials. However, the industry had continued lobbying the GHQ for the production permit. On March 9, 1946, Nissan and Toyota jointly filed a written request for permission. In this request, Nissan showed the company's desire to

produce 25 Datsun models and 15 Nissan models, totalling 40 units per month. However, the GHQ rejected this request a month later, in April 1946. Further lobbying and petitions continued. Then, finally, on June 3, 1947, the GHQ issued Memorandum #1715 which permitted the industry to manufacture passenger cars under the following conditions:

- 1) Only small passenger cars with an engine of under 1,500 cc with annual production of 300 units
- 2) Only 50 large passenger cars that will be produced by part stocks held by Toyota Motors.
- 3) These passenger cars should not be sold to private customers.
- 4) Manufacturers should submit to the government a sales report which clearly indicates the purchasers.

As is apparent, GHQ's conditions were so restrictive that the manufacturers continued the second round of lobbying for the full-scale production permission. It was nearly two years later, on October 25, 1949, that the GHQ lifted the above conditions by Memorandum #2053.

(C) Policy Impacts

1. Slow Tempo of Truck and Bus Production and Conveyance
of US Military Vehicles

We have seen that the GHQ's permission to reopen non-passenger vehicle production was conditional. It had two constraints: monthly production be 1,500 units and 2) within limits of material allocation. However, it was said [13] that the 6,000 ton limit on rubber imports for vehicle tires allowed at most 500 units per month, 30 % of the GHQ's allowance. On the other hand, the government's resource allocation to the automobile industry also restricted the scale of production. For example, in 1946, the total supply of steel was 447,000 tons, of which only 10,050 tons (2.2 %) was allocated to this industry [14]. For fiscal 1947, the government's "Tilting Production System" plan forecast 720,000 tons for total steel allocation, including previous stocks, whereas only 525,200 tons (72.9 %) was actually yielded, reflecting rather a unsuccessful outcome of this quite innovative production system. Of the actual amount of steel production in 1947, the same percentage (2.2 %, equivalent to 11,200 tons) was allocated to the automobile industry, of which 6,700 tons was given to the medium and large truck manufacturers [15]. The difference between demand and actual supply was quite apparent as shown in the following report filed by the Consortium of Automobile Manufacturers [16]:

	<u>Given(A)</u>	<u>Consumed(B)</u>	<u>B - A</u>	<u>A/B %</u>
Steel(t)	7,587	30,742	23,155	24.5
Pig Iron(t)	1,951	8,069	6,118	25.3
Coal(t)	15,280	25,373	10,093	59.5
Cokes(t)	3,211	7,785	4,574	41.4
Heavy Oil(kl)	1,825	2,929	1,104	62.5

Vehicle production of Fiscal 1946 amounted to 14,154 units [17]. Therefore, with this figure we can determine the approximate amount of the above materials needed for producing one unit vehicle. At the same time, we can also compute how many vehicles would be produced if the industry relied only on government allocated resources. Our simple calculations give the results below: [18]

	<u>Material Consumed</u> <u>per Vehicle (C)</u>	<u># of Vehicles which could</u> <u>be produced on Gov.'s</u> <u>Allocation (D)</u>
Steel	2.172 t	3,493 units
Pig Iron	0.570 t	3,423 units
Coal	1.793 t	8,522 units
Coke	0.550 t	5,838 units
Heavy Oil	0.207 t	8,816 units

These results indicate that steel or pig iron was needed most. Since it was the limiting factor, presumably only 3,493 or 3,423 units could be produced from allocated materials. However, actual output ran at nearly three times this level. This mystery is accounted for quite simply by the black market transactions which were quite common during this particular period of Japan's postwar industrial development.

Now, it is quite evident that automobile production permitted by GHQ in the very beginning of the postwar era could not even reach the limit of 18,000 units per year, because of the shortage of both rubber for tires and material resources allocated by the government. The resulting problems of the existing manufacturers were aggravated in the serious strikes triggered by the GHQ's policy of democratization of labor unions announced on April 7, 1947 [19].

Under this situation, the GHQ started providing the government with military vehicles on December 14, 1946. The statistics for this transfer are as follows: [20]

<u>Year</u>	<u>Trucks</u>	<u>Tractors</u>	<u>Trailers</u>	<u>Buses</u>	<u>Total</u>
1946	7,683		6,474		14,157
1947	1,186	179	3,024		4,389
1948	1,687	213	540		7,440
1949	872	3	242	44	1,161
1950	46		54		100

The figures for 1946 clearly indicate that the serious setback in production this year was recognized by GHQ. The sharp decrease of 1950 was due to the Korean War that broke out on June 25, 1950.

2. First Postwar Production of Passenger Cars

Although GHQ's restrictions on restarting passenger car production were disappointingly severe, the industry's response was very rapid. Only two months later, in August 1947, Nissan introduced the first postwar Datsun model (Model DA) whose specifications were: 4-seater, 65 km/h max speed, 722 cc engine. This model was almost identical to the 1936 model, Datsun Sedan Model 15 [21]. This clearly indicates that Japan was nearly a decade behind in small passenger car production.

On the other hand, as we have seen in the previous chapter, Toyota had concentrated on the government's specified medium vehicles and hence had no previous experience in small passenger car production. However, greatly encouraged by GHQ's restriction to 1,500 cc, Toyota introduced the Toyopet Models SA(passenger car) and SB(truck) in October 1947. These two models used the same engine (27 hp & 995 cc) [22]. It is interesting that Model SB was first completed, in April

1947, before GHQ's Memorandum # 1,715. Recall that before June 1947, manufacturers could produce only non-passenger vehicles. The use of the same engine in both models shows that Model SA consisted of a passenger car body mounted on a truck chassis. This so-called "camouflage" method was also adopted by Nissan Motors.

3. Industry Calls for an Emergency Reconstructuon Policy

The serious shortage of transportation banished the fear of the automobile industry that GHQ would never allow Japan to resume motor vehicle production, and resulted in the surprisingly early giving of permission to restart non-passenger vehicle production. However, the resource shortage and war fatigue of the industry itself held back production and eventually led to GHQ transferring American cars. The prewar lesson of the swift sweeping of market by foreign cars had not been forgotten by automobile manufacturers. Thus the industry was the first to call for a strong national automobile production policy.

On November 25, 1945, three automobile producers, Nissan Motors, Toyota Motors and Diesel Motors (the successor of Mitsubishi Heavy Industry's Automobile Division) formed the Consortium of Automobile Manufacturing with the intention of controlling the newly-created Congress of Automobile Industry. On June 18, 1947, the Committee of

Automobile Industry, an organ of this Consortium, published the following report: [23]

- 1) A defect of the government's "Tilting Production System" is the failure of the importance of transportation.
- 2) The committee recognized that for a while cheap American cars would not enter the Japanese market. So, during this favorable time, the industry had to develop its technical capability and catch up with advanced foreign competitors. Recognizing Japan's high technical capability, already demonstrated in aircraft manufacturing, it would not be impossible to equal the American standard within a few years.
- 3) Automobile industry is a general manufacturing industry relying on a great network of suppliers in various other manufacturing industries. Therefore, its importance in the nation's future industrial development is obvious. The strengthening of this industry must be recognized as an important goal by both public and private policy makers.
- 4) The shortage of key materials must be dealt with.
According to the Center for Economic Stabilization's

production forecast for fiscal 1947, the industry was to be allocated only 15,960 tons of steel implying an annual production of only 7,355 units. For normal operation, the industry needed a production level of at least 31,200. This of course was impossible in the light of the material shortage. But at least the level of 18,000 units per year set by the GHQ had to be met.

Clearly, this report did not exactly suggest a course of government policy other than increasing material supply and paying due attention to the importance of the automobile industry for economic recovery.

4. Government Views on the Postwar Automobile Policy

a) The Report of the Center for Economic Stabilization

A year after these policy proposal from the industrial side, on August 3, 1948, the Center for Economic Stabilization's Survey Department set forth the following view of the government: [24]

On National Policy

- i) Past history suggests that without proper protective measures, the market will sooner or later

- be filled by foreign vehicles .
- ii) The existence of a domestic industry will prevent monopolistic pricing practices of foreign manufactures in the Japanese market.
 - iii) Nearly 0.5 million workers are engaged in automobile manufacturing. Therefore, government automobile policy should be responsible to these workers.
 - iv) Recognizing the GHQ's ban on aircraft manufacturing, the automobile industry is the only industry that can maintain and improve the nation's technical capability.

On Transportation Policy vs. Production Policy

- i) MOT's transportation policy has to take precedence over MCI production during the period of a controlled economy, so as to eliminate redundancy in motor vehicle production. However, as the economy recovers and free competition is resumed, MOT supply-oriented policy should be replaced by MCI policy designed to increase competition between manufactures.
- ii) Further, current MOT policy is only concerned with guaranteeing means of transportation, and does not consider whether they are domestic or foreign. It does not consider whether such policies will eventually invite the entry of foreign competitors.

- iii) MCI production policy must emphasize mass production.
- iv) The current decision not to allow black market steel transactions forced manufacturers to use funds from the Reconstruction Financial Bank for operating costs, rather than for their original purpose of investment in equipment.

On Foreign Investment

- i) Because profits are currently higher in sales than in manufacture, it may safely be said that this is the sector where foreign investment will concentrate.
- ii) Therefore the government should help manufacturers import advanced foreign production equipment by extending credit.
- iii) Such a measure is indispensable if the industry is to renew its current obsolete plant and be oriented toward the production of large 4-ton vehicles, rather than "toy"-like small cars.

On Specialization

- i) The combined production capacity of Nissan and Toyota is at most 20,000 units per year, which is less than the monthly production of a single US company. The weak position of the Japanese automobile industry requires a specific

orientation of production. Quite simply, it is impossible for Japan to compete with foreign makers in the category of a "popular-size" car.

- iii) The category in which Japan can compete with foreign producers is that of large 4-ton vehicle.
- ii) However, the two companies currently have an ambivalent policy of parallel production of both small cars and large 4-ton vehicles. This suggests that they are not courageous enough to compete against foreign manufacturers in the 4-ton category. They will withdraw from international competition in this category and concentrate on small car production as an escape if large foreign vehicles enter the market.
- ii) Therefore, the government should establish a third company that can specialize in the production of 4-ton vehicles. The government should give this company every kind of credit and assistance.
- iii) Mitsubishi Heavy Industry has experience in producing large military trucks and buses and is an appropriate candidate for the role of such a third company. Its high technical capability is proved by its aircraft manufacturing.

b) The Basic Counterplan for the Automobile Industry

Two months later, on October 28, 1948, MCI's official policy on the automobile industry was announced under the title of the "Basic Counterplan for the Automobile Industry." We have seen that the CES report called for a strong government (i.e., MCI) production policy and looked somewhat unfavourably at the two leading automakers. MCI policy differed slightly from the CES report; but nonetheless it showed a marked similarity in its crucial points.

Before the announcement from MCI, the Association of Automobile Manufacturers (AAM) and the MIC officials in charge of automobile manufacturing had had a series of informal meetings to discuss the future of the industry. The issues discussed in the meetings covered a wide scope, such as production planning, material supply, financial aid, price setting, equipment investment and labor force. The points raised were carried to the automobile sub-committee of the government's Committee for Economic Reconstruction Plan in September 1948, where the government's 5-Year Plan for the Reconstruction of Automobile Production was conceived

MCI Counterplan included the following policy orientations public:
[25]

1) New automobile purchases under the government's 5-Year

Plan of Economic Reconstruction should be exclusively domestic.

- 2) Owing to the current shortage of foreign exchange, imports of foreign cars will not start.
- 3) Currently effective price controls on automobiles will gradually be removed.
- 4) Current automobile rationing should be gradually removed.
- 5) Technical design of present domestic models is not behind the international level. Therefore the current system of production will not need a major change. However, obsolete equipment must be swiftly replaced by advanced foreign competitors. For this purpose, special import licences should be given to domestic manufacturers.

Point 1 is the new measure directing public procurement under the 5-Year Economic Reconstruction Plan. As we have seen in the previous chapter, public procurement was the major policy incentive that worked well on the automobile industry. This is the first time in the postwar era that this old policy tool appeared in the government's automobile policy. As is quite clear, the essential goal of the above policy proposals is the preparation for a gradual shift of the nation's economic system from controls to a free market. However, owing to the immature state of the industry, the government was reluctant to abandon controls at this stage.

Points 2, 3, and 4 on the other hand revealed the same basic attitude as the policy advocated by the Center for Economic Stabilization. Both CES and MCI had a rather optimistic view of the entry of foreign cars to the Japanese market. As will be discussed in the following section, foreign cars actually started entering through a channel the government could not have foreseen at this time. MCI also believed that the major obstacle to reconstruction of the automobile industry and to fair competition was the practice of fixed price setting or "Maru-ko."

A marked difference between the two policy proposals can be found in Point 5, where MCI maintained that the current production system did not need to be renewed. The CES's view was just the opposite, that the innovative step had to be taken of concentrating on large 4-ton vehicle production. Due to the close tie between MCI (as the agency in charge of manufacturing) and the AAM (as the consortium of automobile manufacturers), the above policy proposal did not mention the selection of a particular manufacturer for government support. This fact seems to reflect the difference in administrative interest between the two agencies. The CES had no substantial part of the industry under its administrative umbrella.

5. The Korean War Special Military Procurement

The existing policy of production curtailment imposed by the occupation was abruptly changed to a policy of productive enhancement when the Korean War broke out on June 25, 1950. A month later, on July 10, the munitions headquarters of the US Armed Forces in Japan informally notified Nissan Motors, Toyota Motors and Isuzu Motors of the purchase order of Japanese trucks. From July 31, 1950 to April 30, 1951. 11,920 vehicles (9.8 billion yen) were purchased. A breakdown by company is as follows [26]:

<u>Date of Order</u>	<u>Nissan</u>	<u>Toyota</u>	<u>Isuzu</u>
7/31/1950	---	1,000	300
8/12/1950	2,915	2,329	---
8/26/1950	---	---	515
Nov /1950	(210)	(230)	---
1/ 5/1951	---	---	441
3/ 1/1951	1,106	1,350	---
	(500)	(720)	
4/30/1951	304	---	---
<u>Total</u>	4,325	4,679	1,256
	[5,035]	[5,629]	

Note: 1) () means the procurement for the National Police Reserve ordered by the US Armed Force; 2) [] means the total including those for the National Police Reserve.

The Korean War procurement had made a great impact on the Japanese economy and resulted in the first postwar economic boom called the "Special Procurement Boom." [27] With respect to the impact on the automobile industry, the procurement helped these three companies rather than the industry as whole. For example, the production of the "Nissan Type A" of Nissan Motors nearly doubled from 207,015 units in January 1950 to 398, 671 units in December 1950 [28], while the annual growth rate of total 4-wheel vehicles declined from 40.9% in 1949 to 10.1% in 1950 [29]. Evidence shows that the major companies also increased their capital stock shortly after the Korean War. This is shown below: [30]

<u>Company</u>	<u>Increase in Capital</u>	<u>New Capital</u>	<u>Increase Rate (%)</u>
Nissan	100	130	333
Toyota	217	418	108
Isuzu	50	unknown	---
Hino	100	200	100

(unit: in million yen)

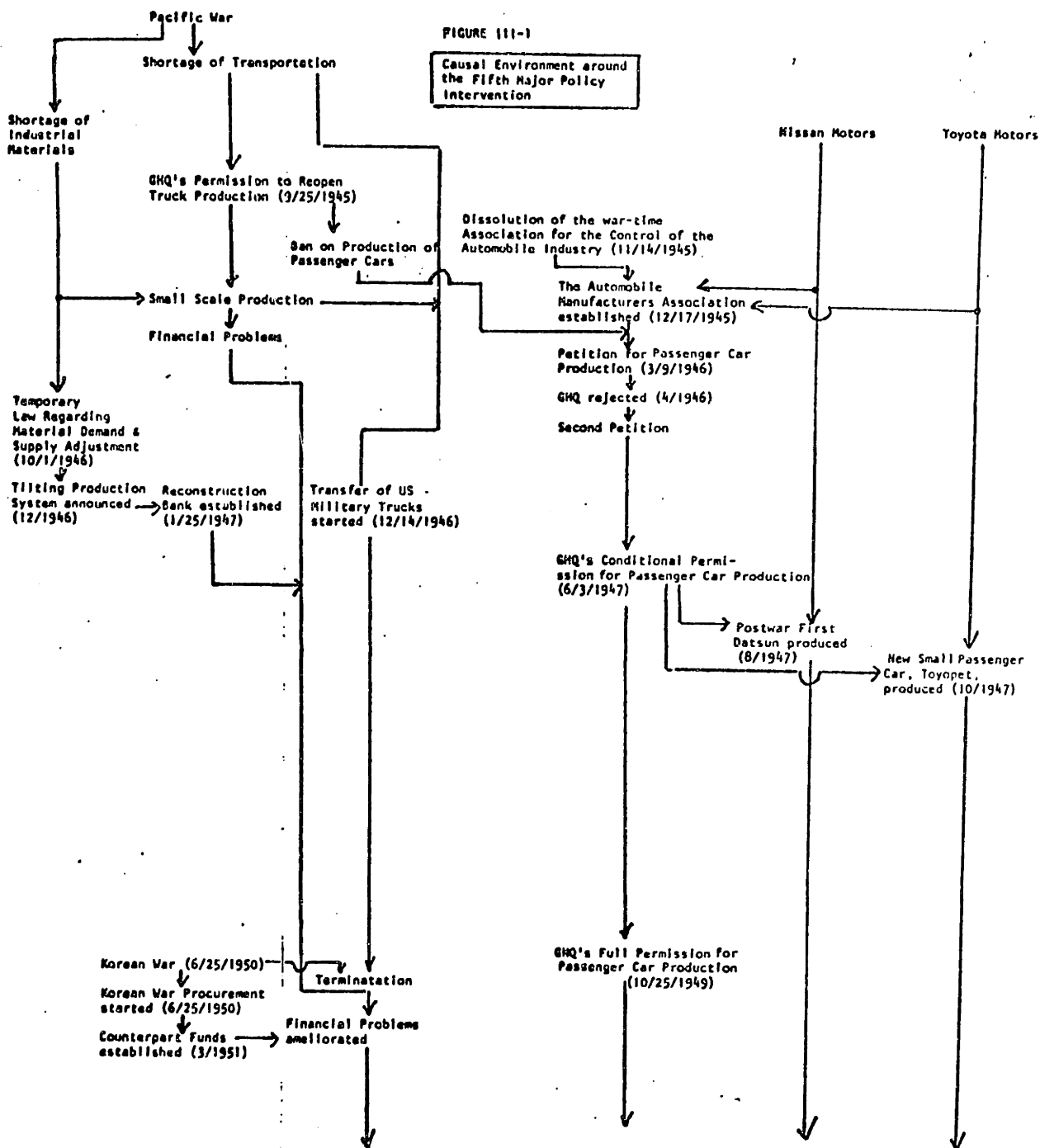
In addition to these capital increases, the companies received Counterparts Funds totaling 70 million yen, which were partitioned as follows: [31]

Nissan	20 million yen
Toyota	20 million yen
Isuzu	20 million yen.

The Counterpart Funds were established to help the aforementioned Tilting Production System. Their sources were the government sale of free US aids.

(D) Summary Chart of the Fifth Major Policy Intervention

FIGURE III-1 summarizes the causal environment around the fifth major policy intervention described in this section.



SECTION III-2

THE SIXTH MAJOR POLICY INTERVENTION: THE REGULATION REGARDING THE CONVEYANCE OF FOREIGN VEHICLES [32]

(A) Pre-intervention Environment

1. Formal Channel of Foreign Car Imports [33]

As we have seen in the preceding chapter, imports of foreign cars stopped in 1939 due to the military government's embargo policy. The Law Regarding Automobile Manufacturing Enterprise that prohibited imports lapsed on January 16, 1946, which automatically meant that there were no longer any legal obstacles to foreign car imports. Consequently, the prewar import dealers formed the Federation of Foreign Car Dealers (FFCD) in October 1946. During the period immediately after the war, all exports and imports, foreign currency transactions, and domestic capital transactions, without any exceptions, were under the strict control of the GHQ. The import dealers had to obtain a contract licence from the Agency of International Trade, a part of the GHQ. Therefore, the FFCD lobbied the GHQ intensively in order to obtain an import license, starting in February 1947. The first imports of motor vehicles were permitted four dealers in December, 1948, amounting to a total of 126 cars. Later, in February 1949, the FFCD established the Overseas Automotive Service

(OAS) which represented the dealers vis-a-vis the Government and GHQ. The OAS continued to be the channel for contracts with the policy-making body, the GHQ, and it dealt with the Technology and Science Division (TSD) of the Economic and Science Section (ESS) of GHQ.

Upon the transfer of authority from the Occupation to the Government of Japan and the change in the "Measures of Foreign Exchange" in March, 1950, the rules on the import of foreign cars // were modified. The new procedure under the "Law of Foreign Exchange" required the OAS dealers to file a contract with the Agency of International Trade, which was now under the jurisdiction of the Japanese Government, and to request a quota of foreign currency for each fiscal quarter. There is no great policy interest in the formal procedures for foreign car imports. However, the situation at that time was in fact much more serious, as we will see below.

2. Informal Channel for Foreign Car Imports

As long as foreign cars flowed in through the formal channel described above, no serious problem would have occurred since the government could monitor and control them by the allocation of foreign exchange quotas. However, there was a large legal loophole.

According to the "International War Agreement," no tax was imposed on foreign cars imported by the military personnel and families of the occupation force. "The Japan-US Agreements on Executive Authority,"

effective from February 28, 1952, reconfirmed this position after the end of the occupation. As far as cars imported by foreign civilians were concerned, the agreement between the GHQ and the Japanese Government ruled out any import taxes until the high prewar tariff was dropped. However, as we have seen, these imports were restricted to OSA dealers with GHQ approval. Then, the question arose as to the ultimate destination of the foreign cars used by civilian foreigners. Not suprisingly, they reached the Japanese market through blackmarket transactions [34].

3. The Problem of Foreign Cars Provided by the Occupation Authorities

We have seen, in the preceding chapter, that foreign trucks and trailers were given to Japan in recognition of the serious shortage of means of transportation caused by US air raids during the last year of the war. The GHQ authorized, in the first instance, the supply of 8,620 trucks and 8,759 trailers in December, 1946. By 1949, nearly 22,000 trucks, buses and trailers had been provided [35]. It must be noted that the provision of US military trucks and trailers was initially intended only to rehabilitate the war-devasted freight transport system. However, in March, 1950, the GHQ sounded out the Japanese Government on the possibility of selling off 150 Ford cars to

the Japanese taxi companies in Yokosuka, where the US Navy base was located [36]. One should bear in mind that in this month the Law of Foreign Exchange was enacted and all foreign trade previously handled by GHQ's Agency of International Trade came under the authority of the new governmental Committee of Foreign Exchange. At this time, Japan was just about to become autonomous and to start relying on her own industrial economy, and the foreign cars imported by US military personnel reached the stage where they had to be disposed of. The committee finally authorized this GHQ request and granted foreign currency reserves to the taxi companies in April 1950. The committee's decision seems to have been related to the controversial "Ichimanda Statement." On April 12, 1950, President Ichimanda of the Bank of Japan said, in a newspaper interview, that: 1) Japan had again become an independent nation-state. 2) Thus, it was her obligation to fully participate in the international economic order. 3) In this regard, Japan would do better to buy the less expensive and more reliable foreign cars rather than clinging to a protectionist policy for the domestic automobile industry [37].

This was a most fearful situation for both the Japanese automobile industry and the Ministry of International Trade and Industry (MITI), the successor of the prewar Ministry of Commerce and Industry (MCI) [38]. Immediately after the decision of the committee, in May 1950, the Automobile Manufacturers' Association (AMA) lobbied the ESS of the GHQ and expressed its strong opposition to such a disposal measure.

Despite this political lobbying, the committee later allocated nearly 610,000 US dollars for fiscal 1951 for purchasing 3,100 used foreign passenger cars disposed of by personnel of the occupation army [39].

The unofficial process by which foreign cars trickled into the Japanese market is particularly important to investigate if one recalls that the import of foreign cars was the major cause of the third major policy intervention and that, as we have seen in the previous section, industry as well as government, in particular MCI and the Center for Economic Stabilization, did not foresee the problem of the foreign cars disposed of by the army of occupation. Now, let us see how this happened.

In April, 1950, one office of the GHQ asked MITI about the possibility of spending 500,000 US dollar per fiscal quarter to purchase 500 surplus foreign cars (approximately, \$ 1,000 per car). MITI opposed such a move for the following reasons: [40]

- 1) Domestic production of small passenger cars had not yet begun full operation.
- 2) It would take at least three years to put production on a normal schedule.
- 3) The used cars to be disposed of by American military personnel should be handed to OSA dealers and normal import procedures should apply, or they

should be exported to a third country.

- 4) Japan's limited foreign currency reserves must be used to import basic materials which the country could not do without.

As is evident, MITI strongly opposed the GHQ request so as to protect domestic producers of small passenger cars on the reasonable grounds that Japan had a shortage of foreign currency. Because of this strong opposition, the issue was frozen for a while until September of that year. In that month, the issue was brought up again in a different context.

The primary purpose of the occupation was to disarm Japan and establish democracy in what they called a militaristic totalitarian nation. Therefore the occupation tried to impose severe reparations on Japan. However, the Cold War drastically changed this ideal philosophy of the occupation and resulted in the setting up of the National Police Reserves (the law regarding this national police force was enacted on August 10, 1950), the predecessor of today's Japanese Self-defence Force. The issue in September was just concerned with the performance of radio cars for the National Police Reserve Force. The argument was simply that domestic radio cars were technically poor, and that it was therefore necessary to purchase the American vehicles that were to be disposed of by the US occupation force. Faced with

this political pressure, MITI consulted the manufacturers and finally eased its previous opposition. The three conditions MITI attached to the authorization of disposal were: [41]

- 1) Foreign cars had to be demonstrably technically superior to all available domestic products.
- 2) The purchase had to be urgent.
- 3) The cars disposed of had to be considered not to depress the market for domestic passenger cars.

This MITI concession resulted not from the change of view of MITI itself, but rather from political pressure from another governmental organization, i.e., the Ministry of Transportation (MOT). MOT is the competent agency for granting a licence to a taxi company. Because of strong lobbying by the industrial association of taxi companies, MOT pushed MITI to permit the disposal of American used passenger cars [42]. As we have already seen, before the September debate, the government had already allowed the taxi companies in Yokosuka 145 American cars.-In fact, our historical investigation has found that the formation of MITI's strong production policy during this period was also stimulated by the increase of demands for passenger cars from the taxi companies. This will become clear below.

4. Increase in the Number of Taxis and MOT's licensing Policy

It can be said that postwar passenger car policy was determined by both the GHQ's disposal of American cars traded in by military personnel and the growing demand for passenger cars from the taxi companies, whose number was increasing rapidly due to the rather unrestrictive licensing policy of the Ministry of Transportation. The former point has been discussed above. Here, we will deal with the latter.

In prewar Japan, the largest customers for American assembly subsidiaries as well as import dealers were the taxi companies. This is vividly illustrated in the following table: [43]

Makes Used for Taxis in Tokyo City (1935)

<u>Model</u>	<u>#</u>	<u>%</u>
Ford	2,547	43.5
Chevrolet	1,561	26.6
Dodge	355	6.1
Plymouth	214	3.7
Chrysler	182	3.1
Essex	162	2.9
DeSoto	136	2.3

Graham Page	105	1.8
Nash	101	1.7
Buick	84	1.4
(Others)	411	6.9

During the war, the taxi companies were under the strict control of the government fuel-saving policy. Since the third regulation regarding gasoline consumption came into effect from September 1941, taxi operations were almost banned in Japan. Following this lean period, the taxi companies resumed operations immediately after the war. In December 1945, the prewar small companies were merged into several large enterprises. Increasing military personnel in the occupation army and their families were new customers for those taxi companies. However, the number of taxi companies did not increase until the Law of Highway Transportation was promulgated on January 1, 1948 (effective in October, 1948). Under this law, the new license would be automatically granted if an applicant met the requirements. The results of this law may be seen in the following statistics:

[44]

of Taxi Companies and Cars in Tokyo City

<u>Year</u>	<u>Companies</u>	<u>Taxi Cabs(Rate of Increase)</u>	
1948	9	1,628	
(Before the Law)			
1949	40	2,454	50.7%

1951	215	6,934	182.6%
1953	289	12,200	75.9%

The above table also indicates an interesting observation. That is to say, although the number of taxi cabs increased impressively, the increase in the number of companies is even more impressive. Those numbers naturally include both large and small companies, so that we can not readily deduce great shortage of operating cabs. However, the calculation of the number of cabs per company seems to be a more suitable indicator. Our calculation is shown below:

<u>Year</u>	<u># of Cabs per Company</u>
1948	180.9
1949	61.4
1951	32.3
1953	42.2

So far, our discussion has proceeded under the assumption that the figures for Tokyo City would represent the national picture, since this research could not find the proper national statistics, except for the following one: [45]

Annual Registration of Taxi Companies

<u>Year</u>	<u>#</u>
1936	22,297

1937	21,309
1938	20,108
1939	16,016
1940	8,849
1941	3,362
1942	2,047
1943	1,748
1944	1,154
1945	820
1946	801
1947	800
1948	846
1949	985
1950	1,438
1951	1,846
1952	2,251
1953	2,842
1954	3,288
1955	3,559

In this table, a tremendous increase in taxi licenses may be observed in 1950. We assume that this was caused partly by the enactment of the aforementioned Law of Highway Transportation and partly by the economic boom set off by the Korean War. Recall that the GHQ's embargo on the production of passenger cars was completely

removed only in 1949, and that domestic passenger cars adopted the so-called "camouflage" method (passenger body on truck chassis). Furthermore, government policy had not emphasized the production of passenger cars. Rather, the policy was oriented towards the large cargo truck as shown in the 1948 policy proposal of the Center for Economic Stabilization.

Now, we have learned that prewar taxi cabs were almost exclusively foreign passenger cars, that the Law of Highway Transportation increased the number of taxi licenses, that the domestic production of passenger cars was fully permitted by GHQ only in 1949, and that such a domestic passenger car was a small truck in camouflage. Then, the question would arise: who supplied the taxi cars? The answer is what we have described previously: the disposal of American cars from the occupation.

(B) Policy Intervention

1. The Regulation Regarding Conveyance of Foreign Vehicles

We have seen that GHQ's proposal for the disposal of military-owned American cars was first opposed by MITI, but later agreed to as

necessary for replacing the low-performance domestic police patrol and radio cars. Also MITI's concession reflected strong pressure by the news media in favour of the high performance vehicles. The following steps were involved in the legal authorization of this proposal.

First, MITI negotiated with GHQ over the amount of foreign currency reserves to be allocated for the purchase of foreign used cars, and agreement was reached on the figure of \$ 4.0 million for fiscal 1951. Next, MITI's International Trade Bureau, Machinery Bureau, Trade Promotion Bureau and MOT held quadripartite meetings to develop a legal basis for this quota [46]. Then on June 9 1951, the Regulation Regarding the Conveyance of Foreign Vehicles [RCFV] was promulgated and immediately enforced as an interministerial ordinance of both MITI and MOT. The basic content of this law is as follows: [47]

License Requirement

The purchaser of foreign used cars disposed of by foreigners residing in Japan must obtain a license from both the Ministry of International Trade and Industry and the Ministry of Transportation.

Application and Licensing

The application for the purchase of foreign used cars

disposed of by foreigners in Japan must be submitted to the Machinery Bureau of MITI. The final license is granted by both MITI and MOT.

Transaction by Foreign Currency

The purchase of foreign used cars disposed of by foreigners residing in Japan must be carried out with foreign currency allocated by the government.

Applicant Qualification

Applicants eligible for permission to purchase foreign used cars under this law are: 1) the news media, 2) the police, 3) the hospitals, 4) the Diet and courts, 5) the taxi companies for foreigners only, and 6) others who are designated by the Ministers of MITI and MOT as able to contribute to economic and cultural promotion (i.e., tourist companies).

In 1951, MITI received 5,000 applications for 11,535 cars, of which 586 vehicles were authorized for public offices and 1,414 vehicles for private enterprises. Under the agreement between MITI and MOT, the maximum price of each foreign car was set by MITI to be one which was

more than the used car price in the US by a factor of \$300 so as to encourage foreigners to sell their used cars in Japan. MOT policy clearly favoured purchasers, by setting a price much lower than what it would have been in a free market. However, excess demand raised blackmarket prices much higher than the MITI official settings [48]. In addition, we have already noted in the first section of the previous chapter that the Japanese conspicuous consumer behavior led to a preference for foreign cars rather than domestic makes.

2. The Lapse of the RCFV and The Non-Foreign Exchange Imports

The Regulation Regarding Conveyance of Foreign Vehicles lasted for only one year, and became null and void on July 1, 1952. Before the abolition of this law, the liberalization of European new car imports under the allocation of foreign currency was implemented in April 1952 [49]. This change in import regulations was based on the government's new policy of centralizing import administration under the umbrella of the Laws on Foreign Exchange and Investment. MGT issued the following memorandum on the new procedure: [50]

- 1) In accordance with the Special Provision in Article 11 of the Law on Foreign Exchange, persons other than US citizens may purchase foreign vehicles from US military personnel on a

yen basis. In this case, the law requires the purchasers to obtain permission from the Minister of International Trade and Industry.

- 2) To encourage American military personnel to sell their used cars to Japanese dealers (i.e., OSA) on a US dollar basis on their departure for the US, the government applies foreign currency reserves to such a transaction.
- 3) Used cars are transferred without compensation from US military personnel to persons who are not US citizens. A certificate must be obtained from the Ministry of International Trade and Industry.
- 4) The import of new American cars will be limited to 20% of the total foreign currency reserves allocated for all vehicle imports.
- 5) If European used cars are conveyed from "third-country persons" (those who are neither Japanese nor US military personnel, such as Chinese and Koreans), yen-based free transactions are guaranteed by law.

The centralization of import administration by the above procedure resulted in greater administrative complication as shown in the following list: [51]

<u>New/ Used</u>	<u>Seller</u>	<u>Buyer</u>	<u>Compensation</u>	<u>Limit/Permit</u>
New Cars	OSA	J,M,F	Yen	No
Used	F	J,F	Yen	No
Used	M	M	Yen/MC	No
Used	M	J,F	Yen	Yes
Used	M	J,F	Credit	Yes
Used	M	OSA	Trade-in	No
Used	M	OSA	Leave	Yes
Used	M	J,F	No	Yes .

(Note: J=Japanese, M=US military personnel, F=Foreigners,
MC=US military scrip)

Although the permission for purchases from the US military personnel was granted by MITI, MOT played the key role in setting up the new procedure, reflecting its position as the licensor of taxi companies. In November 1947, the MOT's Automobile Bureau propounded the Basic Principle Regarding the Import of Foreign Passenger Cars, of which the major points were: [52]

Basic policy stance

. To facilitate the import of foreign passenger cars in

recognition of the current state of the domestic automobile industry .

Future Efforts

- . To attempt to make it possible for Japanese to buy new American cars with yen.
- . To make an effort to abolish MITI's current certification requirement.
- . To encourage domestic producers to lower current passenger car prices by allowing foreign car imports.

As is evident, MOT's policy contrasted sharply with the production policy of MITI. MOT held the view, standing on the side of the taxi companies who were the primary purchasers of new and used foreign passenger cars, that foreign imports should be facilitated. On the other hand, MITI's view was that such imports would hamper the development of domestic manufacturers, and hence should be suppressed. In fact, MOT's efforts were implemented in 1948 [53]. That is, in January 1948, the converted-yen (the yen with the certificate of conversion from foreign currencies) requirement for the purchase of new foreign cars was removed, which meant that buyers no longer had to obtain a foreign currency allocation. Two months later, in March, the certification requirement for used car purchasers from military personnel was finally removed. These MITI decisions are said to have

been based on the following facts [54]: 1) foreign used car imports had not banned domestic production of passenger cars during the last year, 2) the administration of the current procedure was laborious, and 3) the certification requirements eventually created black-market brokers. However, as we will see in the following discussion, the situation would have developed in a way not foreseen by MITI.

(C) Policy Impacts

1. MITI's Inquiry to Manufacturers

Upon the enactment of the Regulation Regarding the Conveyance of Foreign Vehicles on June 9, 1951, it became clear that there had been a vast inflow of American cars, in sharp contrast to the rather optimistic forecasts by the Cons3, 1948), and by the Ministry of Commerce and Industry (October 28, 1948). The reason for this unexpected inflow was the conveyance of used cars disposed of by American military personnel upon the termination of the occupation. The crucial rationale for the optimistic view, Japan's shortage of foreign currency reserves, was irrelevant. The increasing number of taxi companies, resulting from the Law of Highway Transportation

(January 1, 1948), were able to absorb the used cars of US military personnel. MITI was at least sensitive to this drastic change as will be shown below.

In September 1951, MITI asked the leading manufacturers about the possible impacts of the conveyance of American used cars on their production. Responding to this inquiry, the three makers, Nissan Motors, Toyota Motors, and Kosoku Kikan Motors, jointly filed the following report on October 8, 1951: [55]

On the Present State of the Industry

Complying exactly with GHQ orders granting the conditional permission for production (July 1947) and full permission (October 1949), the industry had learned that small passenger cars were suited to the Japanese people for various physical and economic reasons. The time had come for the best technical specification of such a small car to be determined. In order to compete with foreign makers, it was imperative to mass produce small passenger cars. Thus, the industry needed investments of roughly 300 million yen for consolidating the production system, and it would take a year to do this.

On Government Policy for Promotion of Small Passenger Cars

- a) To favour an equipment investment loan from the Japan Development Bank.
- b) To promote the import of equipment.
- c) To promote the import of automobile parts.
- d) To levy a lower automobile tax on small cars than an large cars.
- e) To levy a higher commodity tax on foreign cars.

On Conveyance of Foreign Vehicles

- a) To minimize the quota allocation for the purchase of foreign used cars.
- b) To levy an import tax on foreign cars brought in by foreigners as personal effect.
- c) To ban the transfer of such a car in the Japanese market.
- d) To institute a strong "Buy-Japanese" policy aimed against foreign makes.

However, as we have already seen, the trend of policy was in the opposite direction, i.e., the legalization of non-foreign exchange transactions in foreign used cars in July 1952. As we will discuss later on, the major points in the above petition were eventually realized not because of industry pressure but because of the excessive inflow of used cars on the non-foreign exchange basis that became conspicuous in the latter half of 1953 [56]. Recall that until that

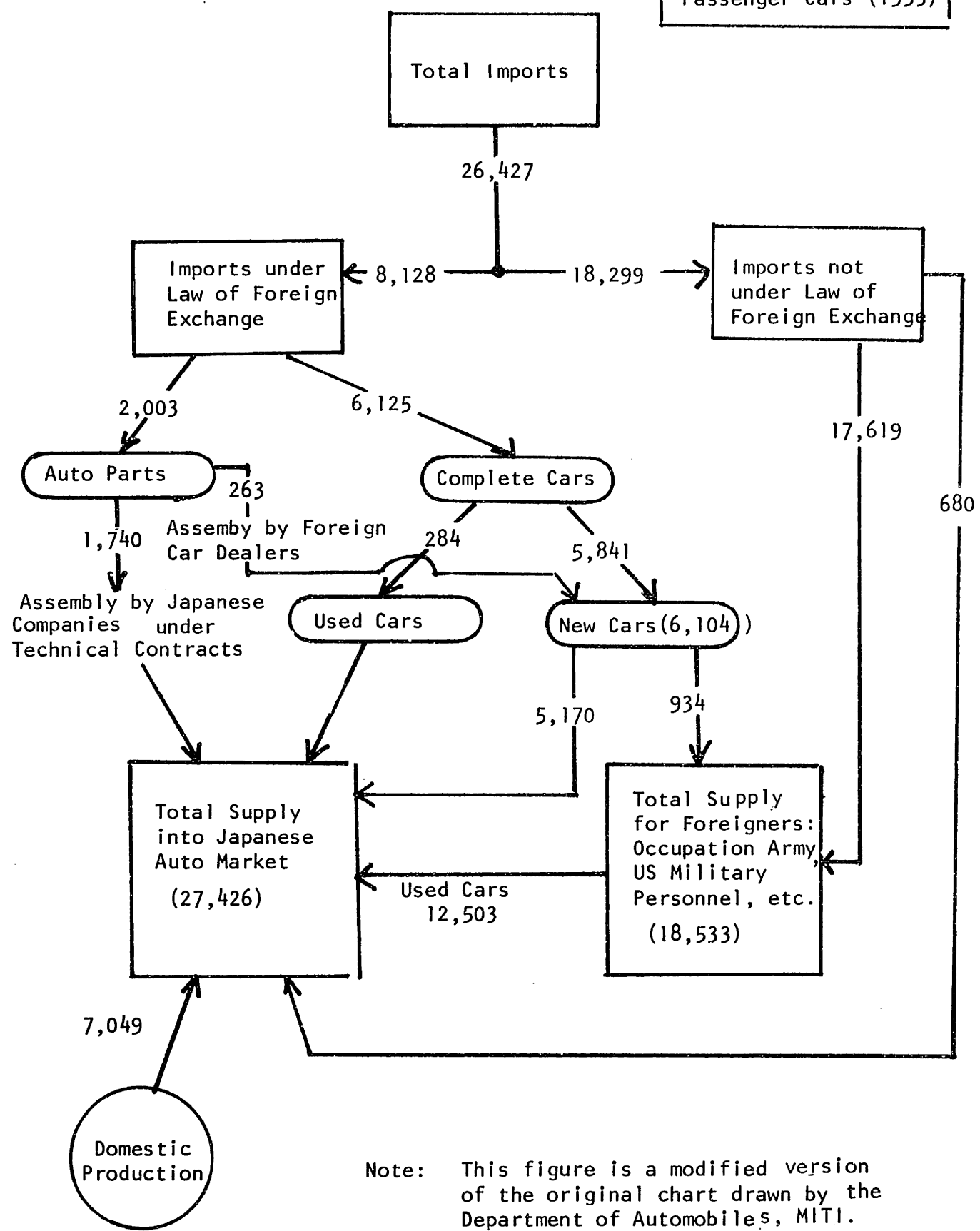
time, MITI's policy had further facilitated the inflow of the non-foreign exchange used cars.

2. Restriction of Non-Foreign Exchange Imports

Contrary to MITI's decision to ease the regulation on non-foreign exchange transactions of foreign used cars in the first half of 1953, the situation was rapidly changed in the latter half of that year. In July 1953, The Lower House Committee on International Trade and Industry at the 26th Diet picked up the issue of the rapid infiltration of used cars on the non-foreign exchange market and recommended regulations to control this irregular import route. Since these transactions could be handled in yen, the government could not obtain accurate statistics as to how many foreign cars had actually passed into the Japanese market. According to the survey of the Ministry of Finance, roughly 24,000 cars would be sold in Japan annually [57]. So long as the annual supply including those imported and used by military families is concerned, FIGURE III-2 gives a rough idea.

In response to the committee's decision, MITI, MOT, the Ministry of Finance (MOF) and the Ministry of Foreign Affairs (MFA) took quick action to prepare for legal regulation of non-foreign exchange transactions. The points the four ministries agreed on were: [58]

Total Supply of Passenger Cars (1953)



Note: This figure is a modified version of the original chart drawn by the Department of Automobiles, MITI.
 Source: Motor Vehicle Almanac, 1955, p. 143.

- 1) With regard to the import of military vehicles by the US army, the current no-tariff policy would hold.
- 2) Passenger car imports by US military personnel require MITI permission and thus are liable to import tax. The import of only one car per person in 16 months is authorized. This car may not be traded in within 16 months.
- 3) Only one car in every two years may be imported by either a Japanese or a foreigner on a non-foreign exchange basis. These cars may not be traded in within two years.
- 4) Cars imported into Japan by either Japanese or foreigners as gifts or personal effects would be thoroughly scrutinized and come under the same regulations governing trade-ins.

On these points, the government immediately started negotiations with the US army in late 1953. Except for Point 2, all points were agreed to by the US army and so were enforced. With respect to Point 2, the US army issued the notice to import dealers, replacing "16 months" by "one year." Accordingly, on February 1, 1954, the new regulations of the transfer of foreign vehicles were enacted as an amendment of the Import and Trade Control Ordinance of 1949 [59]. It is particularly important to observe that the government could resume

strong import restriction by the curtailment of the transfer of American used cars to Japanese buyers on a no-foreign exchange basis. This was achieved a year and a half after the Regulation Regarding the Conveyance of Foreign Vehicles repealed.

We have already observed that when MITI asked the domestic manufacturers about the possible impacts of foreign passenger cars being disposed of in 1951, the industry asked the government for strongly repressive policy. This request was at length realized after three years of unsettled policy debate. In the mean time, the "Buy-Japanese" campaign also urged by the industry in 1951, was finally established.

On March 12, 1954, the "Buy-Japanese" policy for automobiles and synthetic fibres was confirmed by a cabinet meeting under Prime Minister S. Yoshida. Under this decision, [60]

- 1) The central government's offices must exclusively use domestic passenger cars.
- 2) the central government will reduce subsidies to local governments which do not comply with this decision.
- 3) The central government's offices may not purchase foreign passenger cars for two years.

In Section II-2 of the previous chapter, we learned that the

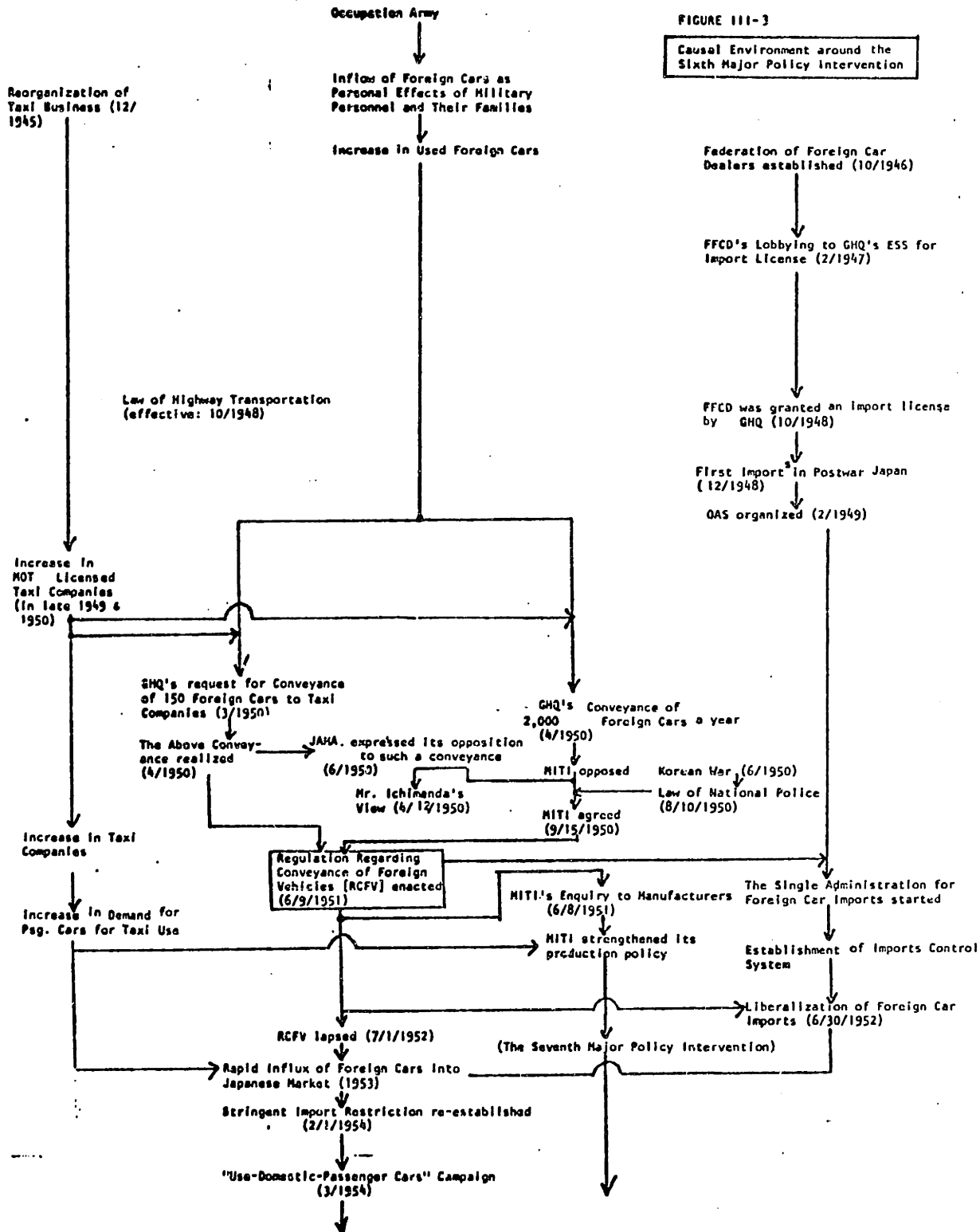
economic recession and the tremendous balance of payments deficits led to the "Buy-Japanese" campaign, and consequently gave birth to the Ministry of Commerce and Industry's automobile policy, i.e., the MCI Standard Model in 1931. Likewise, Japan suffered from large trade deficits in 1953, which also led to a "Buy-Japanese" campaign in 1954 that placed the major emphasis on the automobile industry. It is thus obvious that the two cases strikingly resemble each other. If we believe in the repetition of history, we would anticipate consolidation of MITI's automobile policy. This will be the subject of the next section.

(D) Summary Chart of the Sixth Major Policy Intervention

FIGURE III-3 summarizes the causal environment around the sixth major policy intervention described in this section.

FIGURE III-3

Causal Environment around the Sixth Major Policy Intervention



SECTION III-3

THE SEVENTH MAJOR POLICY INTERVENTION: MITI'S GUIDELINES REGARDING FOREIGN TECHNICAL & ASSEMBLY CONTRACTS FOR PASSENGER CAR PRODUCTION

(A) Pre-Intervention Environment

1. Growing Demand for Passenger Cars

We have already seen that GHQ approved the reopening of passenger car production in 1947, but under stringent conditions with regard to the amount produced. Two years later, in 1949, the complete reopening of production was finally permitted. Then both Toyota and Nissan started producing passenger cars. However, due to the long period of no R&D on passenger cars both during and after the war, what they built were so-called "camouflages" of prewar truck models, i.e., a passenger car body mounted on a truck chassis, whose performance and comfort were obviously inferior to the American cars brought into Japan by US military personnel and their families. In 1950, Japan's economy entered the "Special Korean-War Procurement Boom," which created a growing demand for passenger cars, particularly for taxi use. The demand for taxi vehicles was also triggered by what some people called the Ministry of Transportation's (MOT) "unlimited

grants" for new applications under the Law of Highway Transportation of 1948. In order to satisfy this demand, the government approved the import of foreign cars without specifically allocated foreign exchange. This was the fearful situation the Japanese automobile industry was most afraid of, as we have observed in SECTIONs III-1 and III-2.

2. Early Approaches to Technology Contracts

To be sensitive to the course of a market is perhaps an indispensable requirement for corporate survival. Responding to the new demand for passenger cars, several companies followed an old strategy, i.e., technology contracts with a foreign producer. CHAPTER II has already identified the precedents for such technological contracts with advanced foreign companies. Ishikawajima Motors, for example, built "Wolseley" military trucks under a technology contract at the very beginning. Nissan once tried to reach an agreement with GM in 1934, but failed because of the arrogant intervention of the Imperial Army. Later, Nissan bought all technical facilities of Graham-Page Motors. In compliance with the militaristic Law Regarding Automobile Manufacturing of 1936, Toyota produced "popular-size" cars by taking a lead from three foreign models, Ford, Chevrolet, and DeSoto. Though not formal technology contracts, many prewar companies bought design blue-prints and production machinery from foreign

companies. Therefore, it seems self-evident that ample precedents for foreign technical contracts already existed in the prewar period. The prewar entrepreneurs were more more flexible and international with regard to contacts with foreigners. It was the militarism and nationalism of prewar policy-makers, who had planned the eventual wartime transfer of the automobile industry to aircraft production, which had led to the great emphasis on domestic models. Now, let us see what happened in the postwar period during which all the militaristic and nationalistic policy orientations were removed by the occupation.

A worthwhile move towards a technology contract did not come until 1950. Among others, two cases are worth citing here. In 1950, a San Francisco-based banker brought up, through an overseas office of the Japanese Automobile Manufacturing Association [JAMA], the possibility of creating a joint enterprise with a Japanese partner to assemble 100 units/day of an American passenger mode. After a careful examination of the conditions of this offer, the Automobile Manufacturing Association concluded that it would be difficult to find a Japanese partner under these conditions and then notified him of the rejection [61]. Following this unsuccessful attempt, new negotiations started between Kaiser-Fraser Motors of the US and East Japanese Heavy Industry. The companies reached an agreement in September 1950. It was agreed that: [62]

- 1) East Japanese Heavy Industry held an exclusive license to assemble all Kaiser-Fraser's all vehicle models.
- 2) The production of the Kaiser-Fraser's "Henry-J" model would start in 1951, on a scale of 500 to 1,000 units per year.
- 3) Kaiser-Fraser would supply all materials necessary for EJHI's production.
- 4) The companies would exchange engineers to promote technological diffusion.
- 5) Sales would be undertaken by a new sales company.
- 6) Products would be sold to occupation military personnel for US dollars.
- 7) Exports would be undertaken by Kaiser-Fraser's export division.
- 8) Parts would be imported for the knockdown assembly on a non-foreign exchange basis, and would be paid for by sales profits.

Under the above agreement, East Japanese Heavy Industry introduced the first knockdown "Henry-J" in June, 1951. Up to the end of 1952, 335 units of this model were produced [63]. Two interesting observations are readily drawn. First, this technical contract aimed at US military personnel as the potential customers. We have seen that in April of that year, the GHQ approached the Japanese government about the disposal of 2,000 used cars. That is to say, it was the time

when the American cars brought with the occupation army were about to be traded in. It also seems to be a plausible conjecture that the shortage of taxi cabs was a stimulus for this bilateral technical contract. Second, the part imports were considered to be made on a non-foreign exchange basis. This strategy seemed to attempt to bypass the strict regulation and control of foreign currency reserves which the Japanese government practiced during this period. In short, the implication of the Kaiser-Fraser/East Japanese Heavy Industry case is quite obvious; there was another possibility, other than the conveyance of American used cars, for foreign passenger cars to legally enter the Japanese market, against the production policy of the MITI protecting the domestic manufacturers. Now, let us examine one more case of foreign technical contracts before MITI set up its guidelines.

Three months after Kaiser-Fraser and East Japanese Heavy Industry reached their agreement, negotiations started between Willys-Overland and two Japanese companies, Fuji Heavy Industry and Central Japanese Heavy Industry. A manager of Willys-Overland in charge of the Far East market arrived in Japan and begun negotiations with these two companies in an attempt to find the best Japanese partner to assemble its products including a 4-wheel-drive "Jeep." Then, the final agreement was reached between Willys-Overland and Central Japanese Heavy Industry in July, 1951. A glance at this agreement shows that:

- 1) Central Japanese Heavy Industry held an exclusive licence to assemble all Willys-Overland's products.
- 2) Assembled cars would be sold for Korean War Special Procurement, Far East markets and to "third-country" nationals in Japan.
- 3) Initially, Central Japanese Heavy Industry would start with completely knockdown cars, but then imported parts gradually be replaced by domestic ones. Willys-Overland would provide technical assistance for this.
- 4) Kurashiki Rayon, Ltd. and Fraser International, Ltd. would jointly establish Fraser Motors Company, a sales subsidiary. This company would be in charge of the import of parts, sales and maintenance services.
- 5) Four sales dealers would be selected from OAS members.

This contract with Willys-Overland was motivated by the Korean War procurement of the American army in Japan. As we have noted, the disposal of military trucks which started in 1946 was halted after the Korean War broke out on June 25, 1950. In the meantime, the Law Regarding Conveyance of Foreign Vehicles of 1951 was primarily motivated by the nation's need for high performance police cars in

conjunction with the establishment of the National Police Reserve in 1950. Thus, the Willys-Overland contract seems to reflect new kinds of localized demands for automobiles.

(B) Policy Intervention

1. MITI's View on Technology Contracts

As the Kaiser-Fraser and the Willys cases may have suggested, during the period 1950-1951 those manufacturers which felt themselves threatened by the industry leaders, Nissan and Toyota, often entered into technology contracts with foreign manufactures. As latecomers, their approach was to quickly enter into competition in passenger car production, which was greatly stimulated by the growing demand of the taxi business. Recalling prewar precedent, this entrepreneurial strategy closely resembled the initial move of Nissan Motors when it purchased DAT Motors in 1931 and, with substantial assistance from American companies, started producing small Datsun passenger cars. The entry of Nissan Motors was, as we have seen, also motivated by the growing demand for passenger cars demonstrated by the successful introduction of the two American assembly subsidiaries, Japan Ford and

Japan General Motors. The postwar revival of this rather ubiquitous approach to catching up with the international level of industrial manufacturing had only one difference; the unknown companies walked a step ahead of the existing two powerful companies in passenger car production. In this regard, the MITI issued the following warning, entitled the "Basic Policy Regarding Technical Contracts" on June 9, 1952: [65]

- 1) The government is concerned about the current excessive competition for technology contracts with foreign makers on the ground of possible deterioration of foreign currency reserves.
- 2) The government's solution for this unfavourable situation is to strengthen its control over technology contracts by controlling the foreign currency allocation.
- 3) The government's basic policy is to approve those technology contracts which will permit parts production with no royalty fees after the contract is terminated.
- 4) What the companies should emphasize in negotiating technology contracts is the fact that automobile manufacturing demands mass production. In this respect, if many companies apply, the present state of the nation's reserves of foreign currency can permit only small amount for each technology contract. Therefore,

from the national economic point of view, it is impossible for many manufacturers to simultaneously realize the mass production under many technology contracts.

This official MITI view on technology contracts suggested three main points regarding the government's future regulation: 1) strict selection of the companies to be authorized technology contracts by the government, 2) mandatory requirement of naturalization of the foreign models after the termination of the contract, and 3) government-backed negotiations with foreign manufacturers.

2. Guidelines Regarding Foreign Technical & Assembly Contracts for Passenger Car Production

Among these basic principles, MITI announced the Guidelines Regarding Foreign Technical & Assembly Contracts for Passenger Car Production on October 3, 1952. A summary of these guidelines follows:
[66]

A. On Foreign Investment

- a) The government generally rules out any foreign investment in the automobile sales sector. Hence, under the Law of

Foreign Investment the transfer for this purpose of
of interest and capital in foreign currency can not
be authorized.

- b) Foreign investment in the production sector is authorized
under the Law of Foreign Investment only if
the government regards it as contributing to the
development of the Japanese automobile industry. Hence,
the transfer of interest and capital in this case
may be permitted,

B. On Technology Contracts

- a) With regard to a technology contract aimed
at improving existing production lines for
domestic models, the government will authorize it under
the Law of Foreign Investment on the basis of whether
or not it will contribute to the development of the
domestic automobile industry. Hence, the government
guarantees the royalty payments to the foreign firm
in foreign currency.
- b) With regard to technology contracts for
manufacturing foreign models in Japan, they may be
authorized provided that:
- i) manufacturing licenses will ultimately be
given to the Japanese companies, and

ii) the no-royalty-fees production of at least 90% of the following 11 items will be permitted within 5 years from the time the contract agreement is made:

1. engine parts
2. transmission parts
3. front axle parts
4. rear axle parts
5. steering parts
6. clutch parts
7. chassis
8. cooling system
9. propeller shaft & universal joints
10. wheels
11. brake system,

c) Imports of raw materials for a) and of automobile parts for b) will be given priority.

C. On Assembly of Foreign Models

a) Foreign investment and the technology contracts aimed only at the assembly of foreign models in Japan can not be authorized.

- b) Parts imports for assembly contracts which do not satisfy the above so-called "11-item naturalization provisions" may be permitted on the same basis as normal vehicle imports, which are now subject to the quota allocation of foreign currency.

These MITI guidelines had many policy implications. First, foreign investment in the automobile industry was permitted only if it would help the manufacturing companies. It was considered that a chief reason for the success of the American assembly companies in prewar Japan was their heavy investment in sales. This point has already mentioned in our previous account of the Ministry of Railroads' argument during the early 1930s with MCI over the issue of the government's standard car. Thus investment in the sales sector was ruled out in MITI's new guidelines. Second, the requirement of the complete naturalization of foreign parts and vehicles production was very strong and comprehensive. This seems also to have stemmed from prewar experience. Before the enactment of the comprehensive Law Regarding Automobile Manufacturing Enterprise in 1936, several companies tried to reach the technical arrangements with foreign manufactures which would eventually lead to the complete naturalization of both parts and complete cars. Nissan's attempt with Japan General Motors in 1934 was a good example of this, although it failed because of military intervention. Therefore, we think that MITI's guidelines were the postwar equivalent of the stubborn prewar

policy on foreign technical contracts. However, MITI's guidelines also had some similarities to the 1936 law. That is, the Point [C-a] above clearly suggests MITI kept in mind the lesson of prewar experience. As we have seen, the primary purpose of the Law Regarding Automobile Manufacturing was to make the assembly of foreign passenger cars in Japan illegal. The restriction of foreign investment in assembly only, and subject to the terms of the guidelines, shows a marked resemblance to the the controversial law in 1936.

(C) Policy Impacts

1. The Revue of The "Cameleons": A Great Achievement in Technological Assimilation

Under the proclaimed policy of limiting of the number of manufacturers allowed to make technology contracts, four companies finally obtained MITI's approval. They were: Nissan Motors, Isuzu Motors (the successor to prewar Diesel Motors, itself the result of the merger of Ishikawajima Motors and Tokyo Gas & Electric), Hino Motors (a spin-off of prewar Diesel Motors), and Shin-Mitsubishi Heavy Industry (the result of the merger of East Japan and Central Japan

Heavy Industries). Note that all of these companies had had close contact with prewar government automobile policies. In other words, no new entry was authorized by the government. Both Isuzu (the name came from the MCI's Standard Model) and Hino had specialized in the government-procured large gasoline and diesel trucks for government procurement in the prewar period. Now, having obtained technology contracts, they could enter into competitive passenger car production. A brief examination of each contract follows:

Nissan Motors [67]

The negotiations between Nissan and Austin (UK) started in late 1952, two months after the MITI announced the guidelines. The contract was signed on December 4, 1952, and approved by the government on December 23. This contract did not include the ultimate purchase of the production license for Austin's models, but did provide for the naturalization of Austin's parts. Among the contract conditions, the following points seem of the most significance:

- 1) Nissan was to import and assemble knocked down Austin Model A-40s at the rate of 2,000 units/year.
- 2) The knockdown parts of the A-40 to be gradually naturalized by Nissan over a target period of three years.
- 3) British Austin approves the transfer of Austin

parts to Nissan's own models (e.g., Datsun).

4) The contract period to be seven years.

The "magic number" 2,000/year had appeared elsewhere. For example, it was 2,000 units/year when the GHQ discussed the conveyance of the American used cars in 1950. Also, it was 2,000 units/year when the government announced the annual ceiling on car imports from Europe and the US, respectively, upon the repeal of the Regulation Regarding the Conveyance of Foreign Vehicles in July 1952 [68]. In other words, the approval of the Nissan-Austin technical contract meant that the previous maximum level of the nation's passenger car imports was taken over by a single company which had the right of technical assimilation. This seems to be the most notable aspect of government-approved technological assimilation in relation to the import policy we have described in the previous section.

The second interesting observation in Nissan's contract is the fact that Austin's parts could be used in its own models, in particular, the Datsun. The contract agreement simply indicated that Nissan had no intention of assembling and manufacturing Austin models for ever. Rather, its corporate strategy aimed at technical assimilation for its own model, which exactly complied with the Point [B-a] of MITI's Guidelines. The memoir of M. Kawamata, the ninth president of Nissan Motors, disclosed that a deliberate effort was made not to conflict the existing Datsun production, but to strengthen it. The clear

specification in the agreement of the right to apply Austin parts to Nissan's own models was thus imperative. Kawamata also maintained that the sales of Austin A-40s, aimed at the taxi companies, were not quite as successful as their competitors' models, e.g., Toyota's Toyopet, or even as their own Datsuns. However, despite such a modest result on the financial side, the significance of Nissan's technological contract with British Austin was enormous as shown by the product development of Nissan models later on. The following chronological list of Nissan's various passenger cars and trucks corroborates this:

<u>Year</u>	<u>Model</u>	<u>Technical Spec.</u>
1954	Austin A-40 (knockdown)	Engine: Type 1G, 1,197 cc 4-seater sedan
1956	Austin A-50	Engine: Type 1H, 1,489 cc 5-seater sedan
1957	Austin A-50 ('57)	Engine: same as the '56 model 6-seater
1957	Nissan Junior (B40)	Engine: Type 1H, 1,489 cc 1.5 ton truck
1960	Nissan Junior (B140-A)	Engine: Type G, 1,488 cc 1.5/2.0 ton truck
1961	Nissan Cedric	Engine: Type G, 1,488 cc 6-seater sedan

1961	Nissan Cedric Custom	Engine: Type H, 1,883 cc 6-seater sedan
1966	Nissan Cedric ('66)	Engine: Type SD20, 1,991 cc 6-seater sedan

The above list shows that Austin's technology was directly assimilated into Nissan's medium-size models, first trucks and later passenger cars. The complete naturalization of the Austin A-50 with Nissan's own parts was realized in September 1956, nearly four years after the contract was signed. After this so-called "chameleon" period, Nissan developed medium-size cars by its own efforts. In parallel with the knockdown Austin A-40, Nissan started the development of the new postwar Datsun, Model 110, in September 1952. This model incorporated many valuable lessons learned for the naturalization of Austin's parts. The prototype Datsun Model 110 was completed in June 1954, only two years after the project was started.

Isuzu Motors [69]

As we have observed in the previous chapter, Ishikawajima Motors and Tokyo Gas & Electric merged into a new company called Tokyo Automobile Industrial in 1937, in order to concentrate on large military trucks. In 1941, the company changed its name to Diesel

Motors in keeping with the national policy of fuel saving by changing to heavy oil. The company again changed its name to Isuzu Motors in 1949. The new name, as we have mentioned above, was the same as that given to Ministry of Commerce's Standard Model in 1931. Recall that Ishikawajima Shipbuilding entered automobile manufacturing under the first major policy intervention, the Law of Support for Military Vehicles in 1918, by purchasing a license for the British Wolseley. Thus Isuzu Motors had nearly 4 decades of experience in technology contracts. The salient feature of the postwar revival in 1952 was its ambitious entry into passenger car production by a licensing agreement for the British Rootes Motors' Hillman model. The main points of the Isuzu-Rootes Group agreement comprised:

- 1) Isuzu Motors to hold the exclusive right to import all models of Rootes Motors.
- 2) Isuzu Motors to start the complete knockdown assembly of Rootes Motors' Hillman Minx leading to the ultimate naturalization of all parts.
- 3) Isuzu Motors to pay 49 million yen to Rootes Motors as a partial payment of royalty fees. Rootes Motors then to invest this payment in the new sales company to be jointly established with Isuzu Motors with a capital of 51 million yen.
- 4) The contract period to be five years.

The above agreement was approved by the government on March 6, 1953. Points 1 and 2 resembled similar provisions in the Nissan-Austin contract. However, Point 3 deserves special attention. In MITI's Guidelines, foreign investment in the sales sector was prohibited. Point 3 in fact did not violate this guideline since Rootes' sales investment would be made in yen, thereby bypassing the scrutiny of the Law of Foreign Investment. According to this arrangement, Japan did not have to spend foreign currency reserves to induce foreign investment in the sales sector. The majority of the capital of the new sales company was held by Isuzu Motors, so it was assured control, not by the foreign firm, as had been in the case with both prewar Japan Ford and Japan General Motors. The first assembled Hillman Minx came off the line on October 29, 1953. Ten years later, on June 17, 1963, Isuzu's spin-off from Hillman was introduced with the name Bellett.

In February 1954, the production level attained 100 units per month (1,200 units per year). With this, and Nissan's 2,000 units per year, Japanese manufacturers added significantly to the national supply of foreign passenger cars.

Hino Motors [70]

The predecessor of this company was Hino Heavy Industry, a spin-off of the prewar Diesel Motors. Thus Hino Motors and Isuzu Motors were

property-corporate siblings. However, their postwar courses were rather different. Hino's technical contract with the French government-owned Renault went a step further than that of Isuzu. Only three days before the government approved Isuzu's contract, Hino gained approval for its agreement on March 3, 1953. The important points were as follows:

- 1) Hino Motors to hold the exclusive license to manufacture Renault's Model 4CV.
- 2) For the production of the first 100 units, Hino Motors to receive all parts from French Renault (i.e., complete knockdown).
- 3) The naturalization of the Model 4CV to be completed within five years.
- 4) The initial knockdown assembly to start with 1,300 units per year, and gradually increase.
- 5) Chyugai Renault, the exclusive Japanese Renault dealer to be incorporated into Hino Motors. Later, Hino to establish its own sales subsidiary, Hino Renault Sales, Ltd. to be in charge of the sales of Hino's knockdown and naturalized 4CVs.

The Hino-Renault agreement did not differ much from the cases of Nissan and Isuzu. It included the complete naturalization of the French model, starting from complete knockdown assembly. Only the

sales arrangement was slightly different from the other two cases. That is, in compliance with MITI's mandatory ban on foreign investment in the sales sector, Hino first absorbed Renault dealer and later technically reestablished it as its own subsidiary. Under this contract, the first Hino knockdown 4CV was completed at an amazing speed, in mid-March 1953. Eight years later, April 1, 1961, Hino introduced its own spin-off model, the Contessa.

Shin Mitsubishi Heavy Industry [71]

Recall that the Ministry of Railroad approved Mitsubishi Heavy Industry about the possibility of producing large buses, which went against the ongoing government attempt to stimulate the Japanese automobile industry by introducing the medium-sized MCI Standard Car. During the war, Mitsubishi manufacture the well-known "Zero Fighter" and many army tanks. Due to the dissolution of the prewar Zaibatsu by the GHQ as part of the policy of democratizing the Japanese industry, in 1950 Mitsubishi Heavy Industry was split into three, West Japan Heavy Industry, Central Japan Heavy Industry, and East Japan Heavy Industry. The early technical contract between East Japan Heavy Industry and Kaiser-Fraser in 1950 and between Central Japan Heavy Industry and Willys-Overland in 1951, before the MITI guidelines, have already been discussed in the beginning of this section. After the government instituted the guidelines on September 1, 1953, only the contract between the newly-named Shin Mitsubishi Heavy Industry and

Willys-Overland, was permitted to continue. The essential points of this newly authorized contract did not differ from the previous agreement. For example,

- 1) Shin Mitsubishi Heavy Industry to hold the exclusive license to manufacture Willys-Overland's "Jeep."
- 2) Kurashiki Fraser to take charge of the sales of Mitsubishi's Jeep.
- 3) The contract to last for five years.

Mitsubishi's case was somewhat different from the other three, in that they did not intend to produce passenger cars, but rather, as had been the case before the war, special performance vehicles for public procurement. However, from the policy point of view, approval of the Mitsubishi agreement did not constitute domestic production of a "military weapon." Remember that the conveyance of the foreign used cars could not be stopped by MITI because of the performance problem of the domestic police cars. Accordingly, it concentrated its efforts on trying to permit the possible impact of Jeeps from the US, for the purpose of saving the nation's foreign currency reserves, and perhaps MITI's face, too.

2. Technology Transfer Vs. Non-Technology Transfer

We have learned that MITI's Guidelines Regarding Foreign Technical & Assembly Contracts for Passenger Cars in 1952 had a profound impact on the nation's small passenger car production, introducing new competitors into the two-company oligopoly situation. The foreign passenger cars started to enter the market at the same time as that the government was cracking down on irregular transactions involving foreign used cars on a non-foreign exchange basis. In fact, the previous sixth major policy intervention and this intervention must be dealt with in unison, not because they came at the same time, but because they had the same were origins, i.e., the conveyance of US military passenger cars and the growing oligopsony in the taxi cab market. In this regard, we will see the following table: [72]

Taxi Cabs by Brand

<u>Brand</u>	<u>1955</u>	<u>1962</u>
Toyopet	23.7	40.2
Datsun	16.9	35.9
Austin	3.6	(Nissan Cedric) 9.6
Renaut	7.6	(Hino Renault) 3.3
		(Contessa) 3.7
Hillman	2.8	1.9
Ohta	2.4	vanished
<u>Prince</u>	<u>2.2</u>	<u>3.5</u>
Chevrolet	11.1	0.8
Ford	8.4	1.0

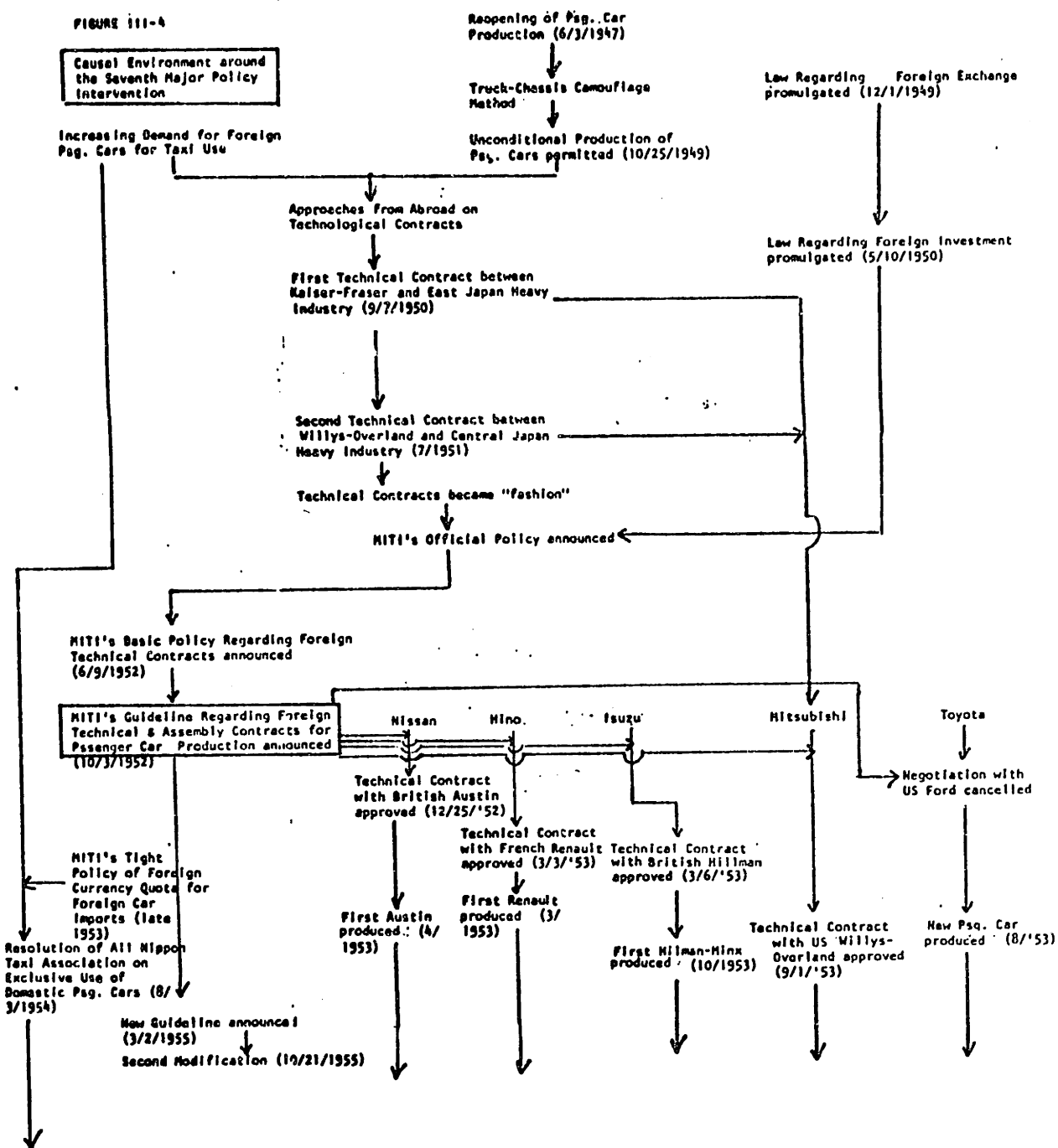
Plymouth	4.8	0.7
<u>Dodge</u>	<u>3.1</u>	<u>0.6</u>
Others	13.5	5.6

Several important observations come readily from this simple table. First, Toyota's domestic model, Toyopet had sold well, which seemed to vindicate Toyota's confidence in a "doing-by-itself" policy without a foreign technology contract. Toyota first approached Ford on a possible technical agreement, but the negotiations failed. Second, its technology contract seems to have benefited Nissan. The increased sales of Datsun in 1962, and the added sales of the Cedric (Nissan's version of the previous Austin) strengthened Nissan's market share. Third, the American models became marginal by 1962, suggesting the success of the government policy in ousting foreign cars from the taxi market. We have shown in the previous section that American cars accounted more than 90% of prewar taxis. Thus, the entry of the new Japanese-assembled European passenger cars and their domestic spin-offs finally marked the end of this most annoying and long-lasting problem.

(D) Summary Chart of the Seventh Major Policy Intervention

FIGURE III-4 summarizes the causal environment around the seventh major policy intervention described in this section.

FIGURE III-4



SECTION III-4

THE EIGHTH MAJOR POLICY INTERVENTION:

THE MITI PEOPLE'S CAR PLAN

(A) Pre-intervention Environment

1. MITI's Plan for the Rationalization of the Automobile Industry

The investigation of prewar policy interventions in CHAPTER II has revealed a distinct pattern of government intervention in the automobile industry. It always started with the specification of a technical standard for public procurement. If manufacturers found this incentive attractive, they had to comply with government technical standardization. The first and second intervention cases simply demonstrated this. That is, when the manufacturing firms were technically and financially weak, they inevitably accepted the government's so-called "technology-push," rather than relying on "market-pull." In this case, the biggest market was simply government military procurement.

However, an automobile is not just a military weapon, but also an important public means of transportation suited to a much wider consumer market. The successful entry of the two American assembly

plants and the entrepreneurial ambition of G. Ayukawa with his small Datsun bear this out. Nevertheless, the prewar military government and public perception had regarded the automobile not as an individual consumer durable but to be a public goods. Following this perception, the government ultimately enacted the most drastic laws. The essence of these law was, as we have seen, the government's totalitarian control of industrial activity. When we think of what invited such an ultimate consequence of government policy, we would probably find the causal environment starting with the nation's economic recession during the 1920s. Following the "Buy-Japanese" campaign, the policy first emerged as the technical standardization for procurement, the MCI Standard Model in 1932, and later became the exclusive licensing of manufacturing enterprise, the Law Regarding Automobile Manufacturing Enterprise in 1936.

Now the prewar era was over; and Japan's social and political structures had been radically changed by the occupation. The salient environmental change was a considerable rise in demand for automobiles, resulting from the growing number of taxi companies. Then, the conveyance of American used cars and the non-foreign exchange of foreign cars came to supply this excess demand.

As time went on, the situation continued to resemble that of the 1920s. Japan suffered from economic percussioin of the previous Korean Procurement Boom. The foreign currency reserve position deteriorated,

as it had in the late 1920s. Then, a tight monetary policy was announced by the Bank of Japan in 1953. Reflecting this change of economic environment, MITI issued the guidelines on technology contracts in 1952 as a prelude for the forthcoming import policy. Then, an actual import suppression policy started in late 1953 and 1954, in the form of a restriction on the most annoying non-foreign exchange car imports. A "Buy-Japanese" campaign was instituted in 1954. What would be the next move be?

Recall that the Center for Economic Stabilization once proposed, as Japan's only course of survival, the selection of a single company, perhaps Mitsubishi Heavy Industry, to specialize in large 4-ton trucks. Evidently, the essence of this idea did not differ from the prewar precedent i.e., the government's selection and licensing of automobile manufacturing so as to centralize production. No one thought this possible because of the determination of the GHQ to eradicate all militaristic aspects from Japanese industry. However, as the situation evolved, an idea for a similar totalitarian policy came from MITI five years later.

In July, 1953 [73], the automobile division of MITI announced that the government had been preparing law for rationalizing the automobile industry. This law was tentatively called the "Plan for the Rationalization of the Automobile Industry." The main features of this plan were: [74]

(a) Purpose

- i) To consolidate the Japanese automobile industry,
- ii) To enhance the quality of Japanese cars,
- iii) To lower the price of Japanese cars,
- iv) To strengthen the international competitiveness of Japanese cars.

(b) Method

- i) By the establishment of "rational" production and sales systems,
- ii) By the standardization of raw materials and auto parts,
- iii) By the centralization of automobile R&D.

(c) Measures

On the centralization of production

- i) Automobile production to be placed under a single production administration. For this purpose, the government would enact the Law of Rationalization of the Automobile Industry (a tentative title).
- ii) The industry independently to form a cartel in those

sectors necessary for centralized production. If necessary, an appropriate government body would help decide on the terms of this contract.

- iii) If an agreement on the cartel could not be reached, the government would order an agreement and organize the centralization of production.
- iv) Those firms excluded from such a cartel to receive compensation from the government.
- v) When the cartel is established, the government would supervise and control it.

On the centralization of automobile R&D

- i) The Fourth Division of the MITI National Laboratory of Machinery to be become the Research Institute of Automobiles and to be staffed by industry and the academic sector.
- ii) The legal personality of this institution to be special corporation consisting of all the firms of the industry.

On the standardization of materials and parts

- i) Applying the existing Japan Industrial Standard, materials and parts to be standardized. The government to force the industry to use these standardized materials

and parts for subsequent production.

- ii) The use of standardized materials and parts to require a license from the Minister of MITI.
- iii) The orders for these standardized materials and parts to pass through a proper buyers' cartel.
- iv) If an agreement on such a cartel can not be reached, the government would order the centralization of material and parts orders.

On the centralization of sales

- i) In order to centralize the sales system, the Automobile Finance Bank (tentatively named) to be established with a capital investment from the government, the industry and financial institutions.
- ii) This bank to be subject to the government's supervision.

First of all, the above MITI plan contained an enormous degree of totalitarianism. Second, the plan inherited much from prewar experiences. For example, centralized production under the government was the core of the Law Regarding Automobile Manufacturing Enterprise. The cartels for both production and sales seem to be comparable to the wartime Association for the Control of the Automobile Industry

of 1941 and Nippon Automobile Rationing, Ltd. of 1942, respectively. The mandatory use of standardized materials and parts under government licensing originated in the Law of Support for Military Vehicles in 1918. The establishment of a half-government-half-private R&D institute resembled the wartime National Institute for Automobile Technology of 1940 whose origins were both the Committee to Determine the Technical Specifications of a Domestic Vehicle in 1934, and the Survey Committee for the Establishment of the Automobile Industry of 1931. As we have delineated, the latter committee consisted of government officials, three Tokyo Imperial University engineering professors, and company people, exactly the same configuration as proposed by the above plan. Although this plan seemed to respect the initiative of the industry in forming the production and sales cartels, the coercive enforcement of the government, if these cartels were freely established, simply showed the government's authoritative control of automobile manufacturing. In the previous two sections, we have learned that the government, MITI in particular, helped and protected the industry against foreign competitors in various very successful ways, which were peripheral and avoided direct involvement. The MITI Plan Regarding the Rationalization of the Automobile Industry clearly showed the gradual intensification of government intervention from indirect commitment to direct involvement. However, this arrogant attempt failed for legislation and hence vanished.

2. Early Attempt to Manufacture Mini Cars

As described later, the eighth major intervention intended to create a new auto market for the mini car. Before MITI's People's Car Plan made a considerable impact on the larger firms, there were several small attempts to produce mini cars by completely unknown companies.

The definition of a mini car already appeared in the revised Motor Vehicle Regulations (Article 3, Item 2) of 1949. According to this law, the mini car (light motor vehicle) was one having the following specifications:

Engine: less than 150 cc (4 cycles)

less than 100 cc (2 cycles)

Length: less than 2.8 m

Width: less than 1 m

Height: less than 2 m.

The law did not specify the number of wheels for a mini car. In fact, it is said [75] that this definition intended to give a special tax provision to motor cycles. It was four years later when the differentiation between a motorcycle and a 4-wheel mini car was made by the Law Regarding Road Transportation Vehicles in 1953. The

definition of various motor vehicles by this law is still in effect today. Ordinary, small and light vehicles are defined as follows:

[76]

1) Ordinary Vehicles

Height: more than 2 m
Width: more than 1.7 m
Length: more than 4.7 m
Engine: more than 2,000 cc

2) Small Vehicles

Height: less than 2 m
Width: between 1.3 - 1.7 m
Length: between 3 - 4.7 m
Engine: between 361 - 2,000 cc

3) Light Vehicles (Mini Car)

Height: less than 2 m
Width: less than 1.3 m
Length: less than 3 m
Engine: less than 360 cc.

Encouraged by the special provisions (e.g., an easy driver's license, low excise tax, no vehicle inspection required, etc.) given

by the above 1949 and 1953 laws, several small firms attempted to introduce a mini car into the auto market. These were [77]

- 1) Japan Auto-Sandal KK. (Note: "KK" means a corporation, i.e., "Inc.")

This company produced Japan's first mini car. Two models, a station wagon and a jeep, sold for 380,000 yen each. By 1954, 200 units were manufactured. No production has been recorded since 1954.

- 2) Sumiyoshi Weaving Manufacturing KK.

The original business of this company was to supply automobile interior materials. In 1955, this company produced 48 mini cars called the "Flying Feather." The price of this car was 380,000 yen. However, production of the "Flying Feather" was terminated by the end of 1955.

- 3) Japan Light Automobile KK.

This company produced two "Contac" models, a station wagon and a truck. By 1957, 121 "Contac" models were produced.

(B) Policy Intervention

1. MITI's People's Car Plan

On May 18, 1955, two newspapers reported that the government was preparing legislation which would later have a considerable impact on the automobile industry [78]. This legislation was tentatively called "MITI's Basic Plan to Develop the People's Car." According to the leaked information, MITI was developing the following plan [79].

a) Technical Requirements

- i) maximum speed: more than 100 km/h.
- ii) capacity: 4 passengers or 2 passengers plus 100 kg.
- iii) fuel consumption: 30 km/l (at 60 km/h).
- iv) durability: more than 100,000 km.
- v) engine size: less than 350 cc.
- vi) weight: less than 400 kg.

b) Manufacturer's Price

less than 150,000 yen if 2,000 units per month.
(later modified to 250,000 yen.)

c) Prototype Competition

- i) The minister of MITI to make public the technical requirements for the people's car by the end of June 1955, and encourage manufacturers to participate in the prototype competition.
- ii) A prototype must be completed by the end of June 1956.
- iii) A manufacturer desiring to participate in this competition must apply to the minister of MITI no later than the end of September 1955.

d) Process for Selecting the People's Car

- i) MITI to hold the first official technical test within three months of July 1, 1936 and select several promising prototypes.
- ii) The government to grant a subsidy to the manufacturers which produced those prototypes for further improvements.
- iii) The minister of MITI to have the right to direct the prototype manufacturers to render their patents and manufacturing licenses to third parties.
- iv) The final prototypes to be completed by

the end of June 1957.

- v) Then the minister of MITI to hold a second official technical test for those improved prototypes within three months of July 1, 1957, and choose the best prototype for the people's car.
- vi) This prototype to be further improved, and the final technical specifications of the people's car to be determined by the end of March 1958.

e) Selection of the Single Manufacturer

- i) Among the manufacturers having won in the first official technical test and maintaining a satisfactory technical basis for the mass production of the people's car, one company to be selected by the government by the end of September 1957.
- ii) The mass production of the people's car to immediately start from October 1958.

The government to appropriate a budget to partially help equipment and sales investment and mediate in facilitating the financing of mass production by city banks.

f) Favorable Tax Treatments

The minister of MITI would, if necessary for sales promotion, request other ministries to revise current automobile taxes so as to be more favorable to the people's car.

2. Four Remarks on MITI's People's Car Plan

a) First, the peoples' car was essentially what is today called a mini car. The engine size of 350 cc coincides with the first specification for a small car in 1925. As described in the previous chapter, the Ministry of the Interior granted a no-driving-licence privilege for a small car whose specifications were: 1) length: less than 2.4 m, 2) width: less than 1.0 m, 3) height: less than 1.2 m, 4) engine power: less than 3 hp, and 5) engine size: less than 350 cc. Later, the engine size was increased to 500 cc in 1930 and 750 cc in 1933. As the engine size increased, the no-license privilege was removed, but many favorable tax measures were still applied. Special attention must be paid to the 1933 amendment. The 750 cc specification aimed at protecting the Datsun model against possible invasion by the British Austin, whose engine size was at that time 1,000 cc. Recall that the GHQ specified a maximum engine size of 1,500 cc when it granted permission for passenger car production in 1947. The GHQ's purpose was to avoid Japanese cars becoming potential competitors to American importers. These two precedents suggest that the engine specification

is important in the context of international trade and domestic tax incentives. As seen later, the MITI's people's car plan aimed at giving birth to a vast automobile demand at home and eventually entering the international market, where no potential competitor existed in this category. In this respect, the specification of 350 cc had many implications of policy significance, rather than just being a definition of a mini car.

b) Second, this plan revived prewar teaching of government control of the automobile industry in the use of technical specifications, and tax and financial incentives. As seen, the process of determining the MCI Standard Car in 1932 also started with official technical tests. However, in that case, the committee in charge of the selection of the best prototype invited the manufacturers, and the official test was first proposed by the manufacturers themselves. The fact that the minister of MITI would keep the right of selecting the winning prototype seems to follow the Law Regarding Support for Military Vehicles of 1918, when the technical specifications were determined by the MOA's arsenals. Nevertheless, the approach by technical specifications for a government-determined standard car suggests that the original form of this plan dated back to the MCI's Standard Car.

c) Third, a clear separation between several manufacturers designing a prototype and one engaging in mass production seems to be a new policy innovation. In the prewar cases, there was no such sharp demarcation.

Rather, the government treated several manufacturers equally. The Law of Support for Military Vehicles designated three major producers. Several companies participated in the production of the MCI Standard Model on an independent basis. The Law Regarding Automobile Manufacturing granted manufacturing licenses to several companies other than Toyota and Nissan.

d) Fourth, the selection of only one manufacturer and the specialization on a single model by a single company are only comparable to the case of military vehicles or the case of the MOR's selection of Mitsubishi for large bus production. The prewar Tokyo Automobile Industry specialized in large 6-wheel military vehicles. Mitsubishi also specialized in buses larger than the MCI Standard Model. The idea of the selection of only one company rested on the necessity of mass production. However, as far as policy ideology is concerned, the plan perhaps found its origin in the arrogant military initiatives of the prewar era intended to achieve mass production. Recall that the Center for Economic Stabilization's report of 1948 proposed to select only Mitsubishi to concentrate on the production of a large vehicle. However, the CES's advocacy was based on the high technical capability of Mitsubishi as demonstrated by its aircraft manufacturing, and hence did not distinguish the manufacturer and the designer. In its previous effort to legislate the Plan for the Rationalization of the Automobile Industry, MITI put a strong emphasis on the centralization of production by a coercive cartel. Although this

approach greatly resembled the rationale for the establishment of the Association for the Control of the Automobile Industry of 1941, under the Law of National Mobilization, there was no evidence that the government would establish a production monopoly. Therefore, this MITI people's car plan was unprecedented in the sense of its extreme degree of manufacturing monopoly.

(C) Policy Impact

1. The Industry's Reactions to MITI's Plan [80]

Several weeks after MITI's plan was leaked to the press, a member of the Diet (Rep. Tomikazu Nakamura of the Socialist Party) sent an inquiry about this plan to the Hatoyama Cabinet. Then, Prime Minister Hatoyama expressed that the government was in fact preparing a policy to support mini car production. The controversy of MITI's plan thus became a public argument. On July 12, 1955, the Japan Automobile Manufacturers Association (JAMA) conveyed a special meeting by summoning the top engineers of nine major member companies. On August 3, they reached the conclusion that: 1) it would be impossible to simultaneously satisfy the technical specifications and the price of MITI's plan, and 2) if all of MITI's technical specifications were

met, the price should be increased by a factor of 50%. These conclusions were immediately reported to MITI. Then, both government and industry stopped debating this plan for a while. Three months later, in early December, Yoshinari Kawai, president of Komatsu Manufacturing, abruptly notified MITI that his company was ready to develop MITI's People's Car under the following plan:

- 1) On technical design, Dr. Porsche of West Germany, who designed the Volkswagen and the Renault 2VC, would be consulted.
- 2) The existing firms would join in production of the People's Car on the basis of division of labor.
- 3) The Japan People's Car, KK. would be established to integrate the partial assembly assigned to several companies.

It is particularly interesting to observe that Kawai's plan resembled the decisions by the Survey Committee for the Establishment of the Automobile Industry 24 years ago and the establishment of the Association for the Control of the Automobile Industry 14 years ago. It is also worth noting that the cause-effect relationship between government intervention by new technical specifications and the emergence of a new firm repeated in the case of MITI's plan and Komatsu Manufacturing. Recall that 20 years ago Mitsubishi

Shipbuilding emerged when the Ministry of Railroads (MOR) set forth the new technical specifications which were different from the previous MCI Standard Model.

Kawai's move had a serious impact on auto manufacturers. First, the major auto makers criticized the plan of Komatsu Manufacturing on the ground that a car designed by a foreigner did not mean the "Japanese" people's car. This somewhat notionalistic view also coincided with the strong nationalism that shaped the decisions by the Survey Committee for the establishment of the Automobile Industry in 1931. In late December, the presidents of five major auto-makers met together and agreed that:

- 1) The automobile industry will make an effort to lower the prices of the current domestic small passenger cars to appeal to more consumers.
- 2) The selection of a single manufacturer of the People's Car violates the rule of equal opportunity and free competition.

These conclusions were conveyed to Minister Tanzan Ishibashi of MITI by the representatives of JAMA. Then, Minister Ishibashi finally announced that the plan was not to be enforced anymore. The six-month debate over the controversial People's Car Plan of MITI thus ended.

2. Substantial Impact on Individual Makers

Although MITI's People's Car plan was not carried out due to strong collective opposition by the industry at large, individual manufacturers were influenced considerably by this plan. Our description of how it made an impact on them will be limited, however, since the development of a new product was classified as each company's top secret.

Toyota Motors [81]

This company had been developing a new mini car since Spring 1954. This new model mounted a 700 cc engine and was expected to be sold for around 400,000 yen. On September 22, 1956, it was first introduced as the "Publica," whose technical specifications were:

Engine: air-cooling, 2 cylinders, 4 cycles, 700 cc.

Max. Speed: 100 km/h.

Weight: 580 km.

Nissan Motors [82]

As described previously, Nissan was carrying on implanting Austin

technology to its Datsun models before MITI's plan was made public. Then, Nissan claimed that the used Datsun models could be the People's Cars since the prices of these used cars were around 200,000 yen, i.e., comparable to the price of MITI's People's Car Plan. In contrast to Toyota's covert R&D effort on a mini-size car, Nissan made no further step to introduce a mini car. Instead, it made public the "Datsun Bluebird" on July 29, 1959.

Suzuki Motors [83]

Similar to Toyota Motors, this company was originally a weaving machinery manufacturer. In 1952, this company introduced a light motorcycle model. With the new definition of light vehicles by the Law Regarding Road Transportation Vehicles of 1953, the company's board meeting members decided to enter the auto manufacturing business in April 1953. First, Suzuki purchased one Volkswagen (West Germany), one Lloyd (West Germany) and one Citroen 2CV (France) to disassemble them for technical learning purpose. A year later, in March 1954, the first prototype model was completed. It was introduced to the market in October 1955. The name of this model was "Suzulite" and its price was 420,000 yen. The "Suzulite" mounted a 2-cycle, air-cooling, 360 cc engine. It was the nation's first front-wheel-drive mini car.

Fuji Heavy Industry [84]

This company's predecessor was prewar Nakajima Aircraft Manufacturing. Since aircraft manufacturing was prohibited by the occupation, Fuji Heavy Industry first produced scooters by using rear tires of aircraft stocks and later developed a small passenger car, the "Subaru P-1." The engine size of this "Subaru P-1" complied exactly with GHQ's 1,500 cc limit. The technical features of this model were as follows:

Engine: water-cooling, 4 cycles, 1,500 cc, 45 hp
(4,000 rpm).

Max. Speed: 110 km/h.

Weight: 1,230 kg.

Only 20 models were produced before the company terminated the production of the "Subaru P-1." Next, shortly before MITI's plan was made public, the company started conceiving the "K-10" plan to produce a mini car, of which technical specifications were:

Engine: air-cooling, 360 cc, 15 hp (4,000 rpm).

Max. Speed: 85 km/h.

Weight: 340 kg.

Capacity: 4 passengers plus 60 kg cargoes.

Price: less than 350,000 yen.

This "K-10" project officially started on December 9, 1955. It was said that Kawai's plan fastened the implementation of the "K-10" plan. The project yielded the "Suburu 360" in May 1958, and the sale of this model at the price of 425,000 yen immediately followed.

Toyo Kogyo (Mazda) [85]

This company was long the leading manufacturer of tricycle vehicles in prewar Japan. The company history records that Mazda once tried in vain to manufacture a 4-wheel passenger car in 1937. MITI's People's Car Plan gave Mazda one more chance to challenge the production of a 4-wheel car. Four years after MITI's plan was announced, Mazda's board meeting was held in March 1959, and decided the entry into the production of 4-wheel passenger cars. The policy of this company was the gradual transfer of production from a mini car to a large passenger cars as the income level of general consumers would increase. The R&D on a mini car thus started in April 1959. A year later, the first 4-wheel light vehicle, the "Mazda Coupe R360," was introduced to the market at the price of 320,000 yen. This price was considerably cheaper (20%) than other mini cars. The technical features of the "Mazda Coupe R360" were:

Engine: 4 cycles, 2 cylinders, OHV, 16 hp, 360 cc.

Gas Consumption: 26 - 30 km/l.

Weight: 380 kg.

Capacity: 4 passengers.

The sales of this model attained 2,000 units/month in August 1960. As is clear, except for the price, this Mazda Coupe R360 was the closest to what MITI required for the People's Car in its plan. The successful sales of this model partly demonstrated the promise of MITI's plan, although the already-established sales network by 3-wheelers seemed to be the primary cause for Mazda's successful entry into the 4-wheel vehicle business.

Shin Mitsubishi Heavy Industry [86]

It is said that this prewar leading aircraft manufacturer conceived several plans to manufacture a mini car before MITI's People's Car Plan was announced. As did Fuji Heavy Industry, Shin Mitsubishi Heavy Industry also started with the production of scooters by using aircraft tire stocks. In September 1959, this company first introduced a mini car, the "Mitsubishi 500." It is noteworthy that this company had enough experience in the 4-wheel vehicle production in the prewar period. It supplied larger-size buses to the Ministry of Railroads and larger-size diesel trucks to the Ministry of Army. In the meantime, Shin Mitsubishi Heavy Industry won the government-backed contract to assemble and manufacture Willys-Overland's "Jeeps."

Daihatsu Motors [87]

Similar to Mazda, this company produced 3-wheel trucks in the prewar period. Rather than going directly to 4-wheel vehicle production, Daihatsu started with the production of a mini 3-wheel truck called the "Daihatsu Miget," starting in 1957. A year later, in 1958, the 4-wheel model was introduced.

Honda Motors [88]

In contrast to other major manufacturers of mini cars, Honda was founded after the war. It was established, in October 1946, as a small motorcycle manufacturer. It was relatively late, in 1963, when Honda entered the automobile manufacturing business with its mini truck model.

3. MITI's View after the Plan Was Failed

Why the MITI tried to realize such an extreme legislation as the people's car being produced by a single manufacturer can not be fully explained without an intensive interview with those who actually prepared this plan. The financial constraint of this thesis research precluded such an interview. However, although a post de facto explanation, there appeared MITI's official review on its people's car

plan in 1958 [89]. Following is a brief summary of the review:

Recognition

- i) Domestic manufactureys still had not gained international competitibity. So that a further import restriction would be necessary to protect them. The MITI recognized that the domestic market would be able to be supplied by domestic production without foreign imports.
- ii) Japan's production of passenger cars was still fragile. Furthermore, passenger cars had been sold mainly to taxi companies, which meant that passenger cars had been still regarded not as a consumer durable but as production goods.
- iii) Stimulation of real demand of passenger cars as a consumer durable could be done by the three main measures: 1) increase in the income level, 2) price-down, and 3) improvement of external environemnt such as roads, garages and parking facilities. Of these measures, the industry could contribute to the second measure. Mass production of mini-size so-called people's cars thus would be the most plausible approach to price-down.

On MITI's Plan Leaked to the Press

- i) The plan had not yet been discussed at the MITI's ministerial meeting (the highest decision-making body of each ministry), so that it was still at an planning stage having no official committment.
- ii) However, judging from some favorable impact of this plan on the industry, the original purpose to call upon the industry's recognition of the importance of the concentration on the low-cost passenger car production had been realized.
- iii) The mini-size of the people's car would be suitable for it could become a Japan's specility in exports and fit mass production. The selection of a single manufacturer was thought to be imperative for mass production.

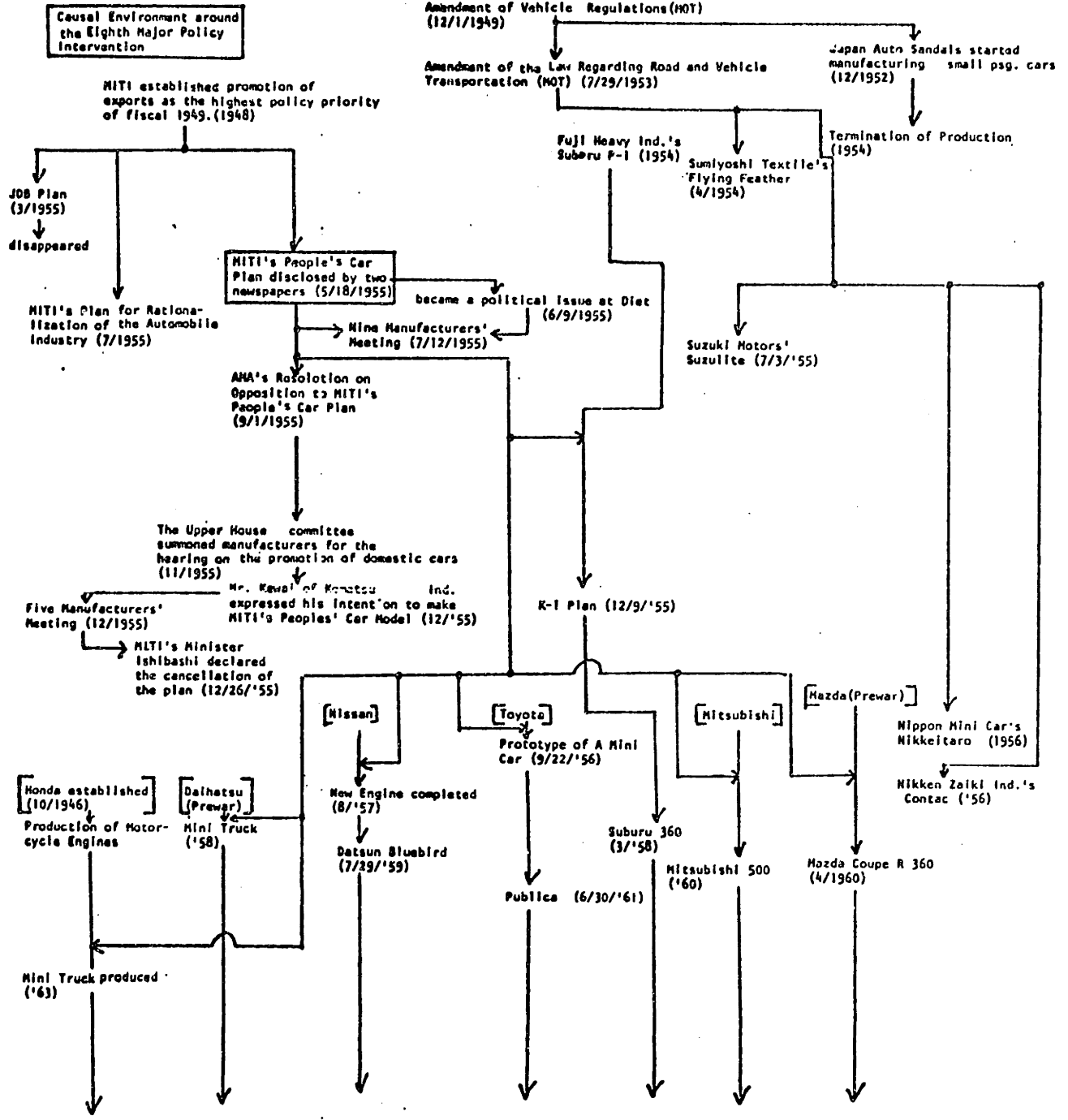
It is particularly important to observe that it was the first time that MITI linked productive policy to export policy in its automobile policy consideration. In the past, MITI had be constantly oriented to the protection of domestic industry from foreign competitors. In the meantime, it was also the first time when MITI tried to change the public perception of automobiles. Recall that our historical investigation started with the public conception of automobiles as an

extravagant commodity only for wealthy people. Perhaps, the incident concerning MITI's People's Car Plan marked the end of one period of the development of the Japanese automobile industry, and, in the meantime the commencement for a new stage.

(D) Summary Chart of the Eighth Major Policy Intervention

FIGURE III-5 summarizes the causal environment around the eighth major policy intervention described in this section.

FIGURE III-5



PART II

NUMERICAL INTERVENTION ANALYSIS

CHAPTER IV

MACROSCOPIC OBSERVATION AND ENQUIRY OF STRUCTURAL PROPERTY OF MOTOR VEHICLE DATA

SECTION IV-1

RECONSIDERATION OF D.T. CAMPBELL'S

"MATURATION THREATS" IN THE CONTEXT OF STRUCTURAL DYNAMICS

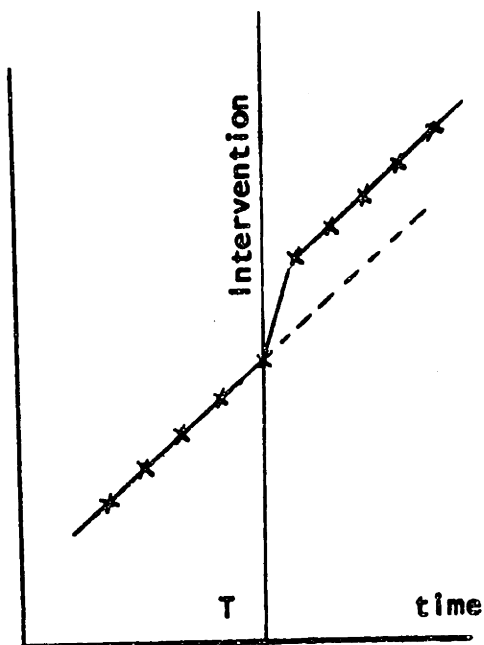
Among the eight common threats to internal validity in D.T. Campbell's quasi-experimental design discussed in SECTION I-3, this chapter will focus on and develop the "maturation" question in the context of the motor vehicle data. According to Campbell, this term originated from a specific problem associated with the experiments of developmental psychology [1]. It denotes a regular change in a variable correlated with the lapse of time. Children might increase the number of words they learn linearly or exponentially. If so, this linear or exponential trend of their learning development is called "maturation." The "maturation" is thus a long-term trend in

time-series data. It is important to recognize that the "maturation threat" is quite different from the "history threat" we have already eliminated in PART I.

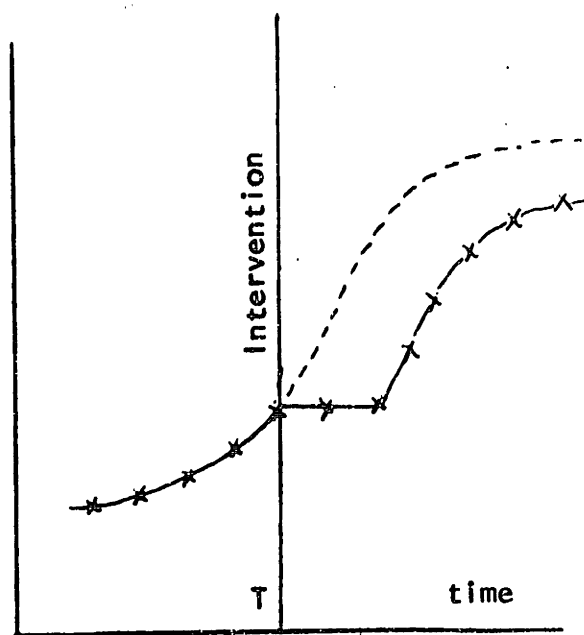
"History" refers more to a set of short-term events which might not be obvious from a superficial observation of a time-series data. On the contrary, it implies an event that substantiates a behavior of a data series. On the other hand, "maturation" is the pattern recognition of a conspicuous regular data trend. Therefore, it seems to be more or less "substance-free" on the ground that it provides a neutral framework of an event observation. Both "history" and "maturation" threats pave an essential ground for a scientific explanation of policy intervention.

Two possibilities can be considered regarding the intervention effects on maturation trends. One is the discontinuity as a coordinate shift. The other is the structural change in a dynamic maturation trend. In FIGURE IV-1, the first two examples show the former case; the third one exemplifies the latter case. A policy intervention shifts the linear trend upward along the Y-coordinate in Example A, while the non-linear third-order functional trend is shifted to the right along the time coordinate in Example B. It is worth noticing that in either case the essential structure of maturation remains unchanged. The only discernible change is a mere parallel shift along either the Y or X-coordinate axis.

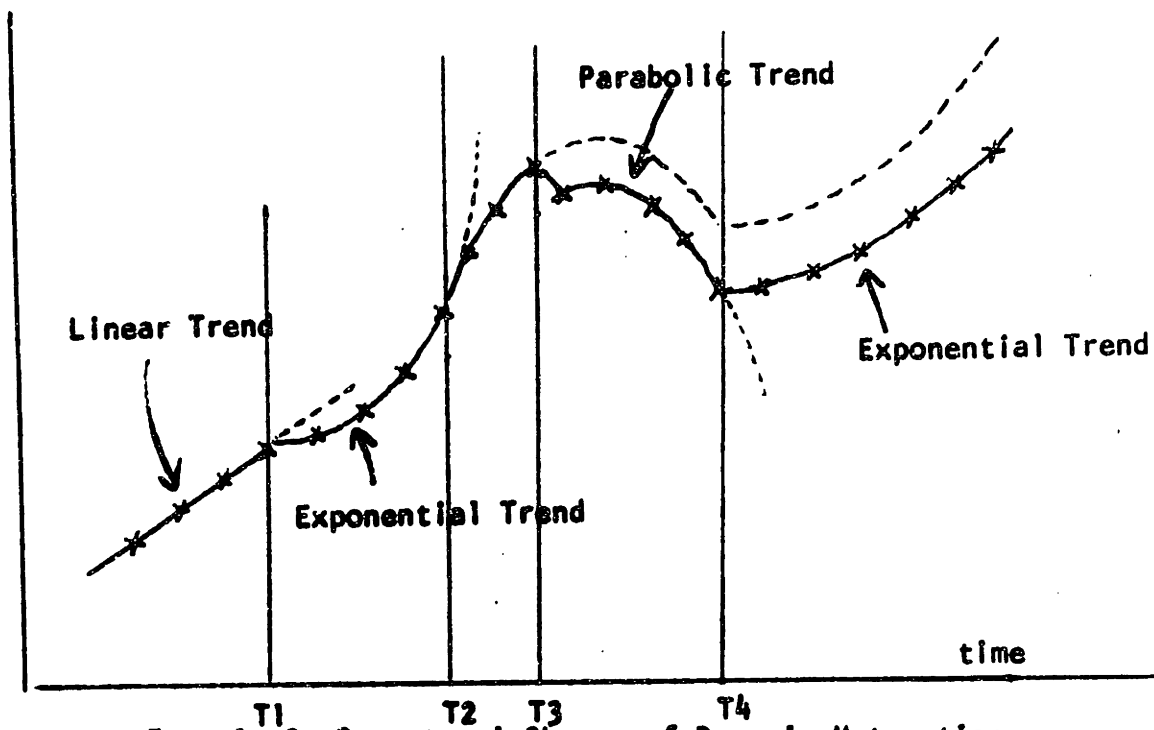
Coordinate-Shift Discontinuity of Maturation Trend vs. Dynamic Change of Maturation Structure



Example A: Y-Coordinate Shift



Example B: X-Coordinate Shift



Example C: Structural Change of Dynamic Maturation

On the contrary, the third case fundamentally differs from the previous two cases. During the whole period, the successive policy interventions change the structure of the maturation trend. After T1, the trend enters into a new structural phase of an exponential growth departing from the previous linear growth curve. After T2, it again enters into the third structural stage, i.e., a parabolic growth. The figure also illustrates a Y-coordinate-shift decremental discontinuity due to the third intervention at T3. Note that no structural change occurs during this period. After T4, the trend resumes exponential growth and continues in this growth pattern. What these illustrative examples demonstrate is quite apparent: there is possibility that intervention would cause not only a coordinate-shift discontinuity but also a structural change of dynamic maturation.

D.T. Campbell and his followers seem to focus on the first two coordinate-shift intervention cases as evidenced in their model formulations (let us call them the "Campbell/Glass/Box-Tia/Hibbs" model [2]). In case of the coordinate-shift intervention, a model can be written in the general form as follows:

Y-coordinate Shift

$$(IV.1) \quad y(t) = f(y(t-1), \dots, y(t-i), \dots, y(t-n)) + b(t)u(t),$$

where $y(t)$: output,
 $b(t)$: intervention impact on output,
 $u(t)$: impulse dummy input to indicate
the occurrence of intervention,
 i : 1, 2, ..., n.

X-coordinate Shift

$$(IV.2) \quad y(t) = f(y(T-1), \dots, y(T-i), \dots, y(T-n)),$$

where $T = t-a$ (a is determined by intervention).

In the case of Eq(IV.1), the intervention sets a new initial condition for $y(t)$ but does not affect the structure of the output trend. In the case of Eq(IV.2), the intervention works to halt the dynamic evolution of output for a certain period. For either model, the essential structure of the output trend remains unchanged since the parameters within the argument are assumed to be time-constant.

On the other hand, in case of Example C, two different models can be proposed as:

First Model: Time-variant Growth Rate Model

$$(IV.3) \quad g(t) = f(a_1(t), \dots, a_i(t), \dots, a_n(t); \\ g(t-1), \dots, g(t-i), \dots, g(t-n)) + b(t)u(t),$$

$$(IV.4) \quad y(t) = (1.0 + g(t))y(t-1),$$

where $g(t)$: growth rate,
 $a_i(t)$: time-variant parameter for $g(t-i)$,
 $b(t)$: intervention impact on a growth rate,
 $u(t)$: impulse dummy input to indicate the
occurrence of intervention,
 $y(t)$: output calculated by the definition
of a growth rate.

Second Model: Time-variant Output Model

$$(IV.5) \quad y(t) = f(a_1(t), \dots, a_i(t), \dots, a_n(t); \\ y(t-1), \dots, y(t-i), \dots, y(t-n)) + b(t)u(t),$$

where $y(t)$: output,
 $a_i(t)$: time-variant parameter for $y(t-i)$,
 $b(t)$: intervention impact on output,

$u(t)$: impulse dummy input to indicate the occurrence of intervention.

The first growth model directly involves a possible impact of intervention on the structural change of an output trend since a growth rate (comparable to the slope of an output curve in case of a continuous function) is time-variant and is affected by intervention. On the other hand, the second model still implies that intervention affects on the output. However, the time-variant specification of parameters incorporates a possible impact of intervention on these values when an intervention-caused output change occurs.

The historical investigation in PART I clearly demonstrates the dynamic transition of the Japanese automobile industry amidst massive government policy intervention. Most importantly, some major interventions reorganized the industry. For example, the Law Regarding Supports for Military Vehicles of 1918 almost completely destroyed the early venture-business-oriented small firms and created the government-controlled larger firms under military procurement. Moreover, the Law Regarding Automobile Manufacturing Enterprise of 1936 again caused the reorganization of the industry by creating a powerful manufacturer, Toyota Motors. Therefore, it seems to be more plausible to conjecture that the data related to the Japanese automobile industry would contain a lot of structural changes. Then,

our choice of a model is apparent: not the Campbell/Glass/Box-Tiao/Hibbs model but the one which involves an intervention impact on the structural transition of an output trend.

SECTION IV-2

HEURISTIC PROCESS TO IDENTIFY DYNAMIC TRENDS

IN MOTOR VEHICLE DATA [3]

1. Logarithmic Data Plotting

Data we will observe in the development of the Japanese automobile industry grows very fast over more than 60 years. For example, annual production of all motor vehicles reached 5,289,157 units in 1970, whereas only 12 vehicles were produced in 1907 [4]. Therefore, there is no way in which we plot all data unless we use the logarithmic scale. Before plotting data, we should know the basic property of the logarithmic scale such that: the vertical axis corresponds to a logarithmic transform of a value on the ordinary scale.

2. Graphical Identification of The Four Conspicuous Maturation Trends of Structural Importance

It is a heuristic prerequisite in scientific observation to find a known pattern in empirical data. Rather than a table presentation, a graphical observation is more suitable for this purpose if one admits the limited capability of numerical pattern recognition. To assist our visual interpretation of maturation trends of Japan's automobile data, we may need some pre-observational preparations.

Unless our time series data fluctuates quite randomly over time, there is some hope to extract the popular maturation trend patterns like:

- a) exponential trend,
- b) linear trend,
- c) rapid-stagnation growth trend,
- d) parabolic trend.

Now, let us discuss these four trend patterns with a focus on the dynamic structure of data generation.

a) Exponential Trend

On the logarithmic scale, an exponential growth trend becomes a linear trend. The slope of this linear trend is a sum of a constant growth rate and 1, provided that a growth rate is defined as:

$$(IV.6) \quad g(t) = (y(t) - y(t-1))/y(t-1).$$

The dynamics to generate an exponential trend is known to be the first-order homogeneous difference equation whose homogeneous parameter corresponds to the slope of the logarithmic linearity. Note

that Eq(IV.6) itself is also the first-order homogeneous difference equation with the homogeneous parameter $[g(t)+ 1]$. Therefore, as long as a growth rate is positively constant, data grows exponentially. However, if it is between 0 and -1, data declines exponentially. These properties are particularly important in light of the dynamics of the data structure. That is, if a linear trend is observed on the logarithmic scale, there is a good reason for us to regard that each point is recursively generated.

b) Linear Trend

It may sometimes happen that time-series data has a linear trend. It is the simplest trend pattern that would validate the linear regression. However, two remarks must be made clear. First, it hardly suggests a dynamic process in the data structure. Second, a linear trend in time-series data would not be observed so easily on the logarithmic scale.

A linear growth trend means that data grows by a constant multiplied by time plus a y-intercept. In other words, once these values are determined in an earlier period, data evolves only on time elapse. In other words, no dynamic recursive mechanism exists for a linear trend.

A linear growth trend forms a convex curve on the logarithmic scale, whose pattern is quite similar to either a so-called rapidly-stagnating trend or a parabolic growth trend, as we will discuss in the subsequent part. Therefore, the visual identification of the linear trend can be done only by plotting data on the ordinary scale. However, as we have mentioned, the long-term time-series data of the Japanese automobile production needs the logarithmic data plotting. Therefore, it would be laborious work to identify linearity from the once-logarithmically-plotted data by re-plotting on the ordinary scale. However, there is a good reason for us to approximate a linear trend as a special case of a rapid-stagnation trend and hence completely disregard it.

c) Rapid-Stagnation Growth Trend

This trend suggests an insightful implication with respect to the dynamic structure that produces data. In short, if a system has a limited capacity of output production, it often happens that output would form a rapid-stagnation. In an earlier period, time-series data grows with an impressively high growth rate, but will be later stagnated with only a marginal growth rate indicating that a system has entered into the fatigue stage. The lesson drawn from this is obvious: we can not praise the high performance of system outputs at an earlier stage; it is possible that a system would stagnate at a

subsequent stage.

If a system is expressed in terms of a first-order heterogeneous difference equation with a less-than-one constant homogeneous parameter and a constant heterogeneous parameter, system output evolves in a rapid-stagnation pattern. An example can be found in the Cobweb dynamics which is familiar to economists [5].

On the logarithmic scale, a rapid-stagnation trend forms the somewhat same pattern as one on the ordinary scale, i.e., a convex curve. Recall that a linear trend discussed above shows also a convex pattern on the logarithmic scale. In addition, the (discrete) growth rate curves of both a rapid-stagnation trend and a linear one share a similar pattern. The similarity between a linear trend and a rapid-stagnation trend with regard to a logarithmic transform and a discrete growth rate simply suggests that we can approximate the former trend by the latter so that we may incorporate the dynamic structure into the linear trend, too.

d) Parabolic Trend

This trend means that data grows and declines parabolically. It is known that a parabolic trend forms also a parabolic curve on the logarithmic scale, but in a "crushed" shape. Its growth rate curve

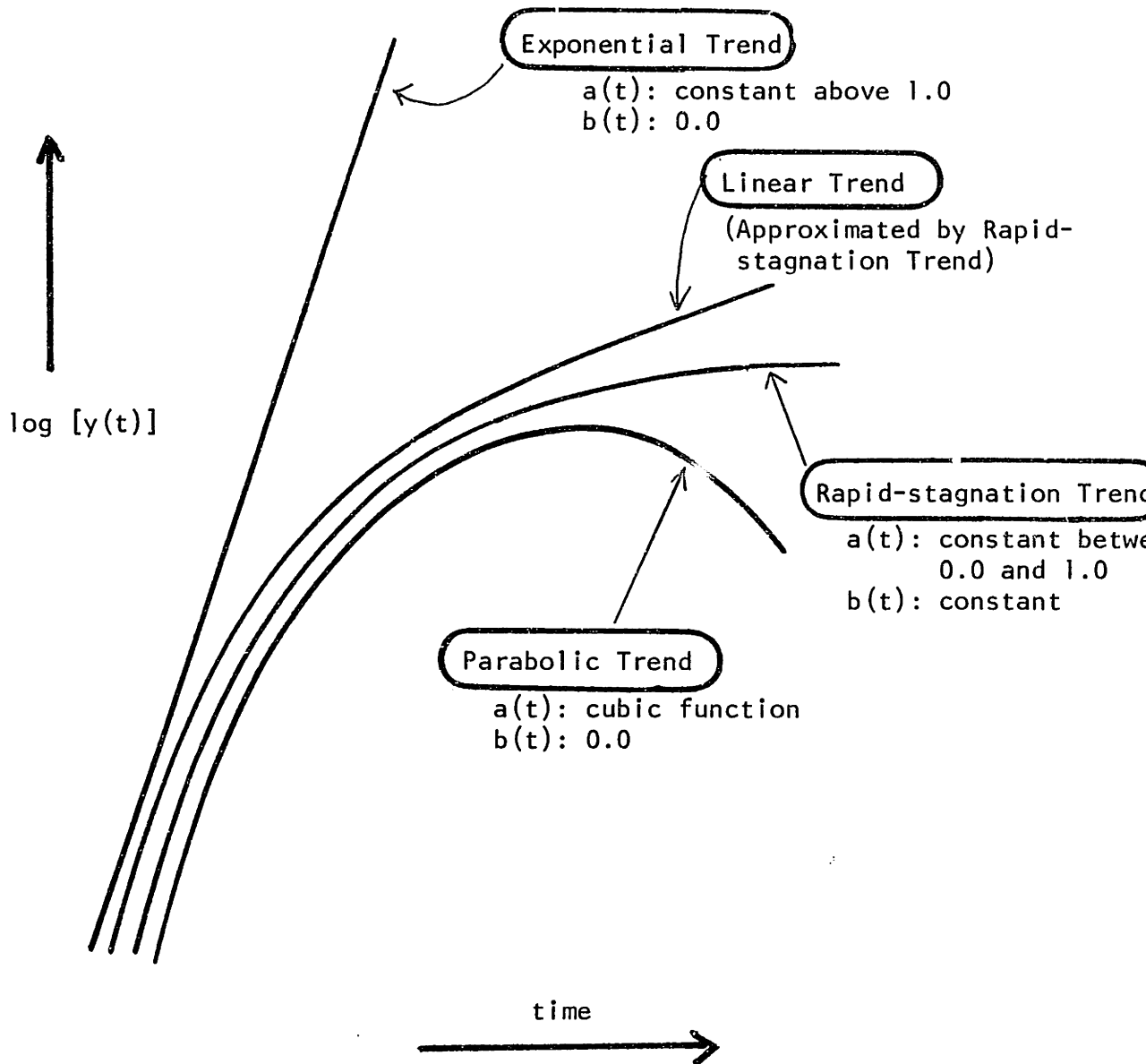
draws a non-linear cubic function. As far as the parabolic growth is concerned, both the growth curve and the growth rate curve are similar to those of a rapid-stagnation trend. In other words, unless data starts declining, it is difficult to visually distinguish a parabolic growth trend from a rapid-stagnation one on both the logarithmic and ordinary scales. However, the conspicuous difference between the two remains in the fact that: 1) a parabolic trend has a declining half, and 2) the dynamic structure of data generation is different.

As illustrated in FIGURE IV-2, our investigations have shown that all of the four data trends contain the dynamic recursive structure which can be formulated by a simple first-order heterogeneous difference equation with a time-varying specification on parameters. This fact suggests that an identification of intervention impact on the structural changes of the Japanese automobile data by the first (Eq(IV.3 and Eq(IV.4)) or the second (Eq(IV.5)) model would be possible if an appropriate technique to estimate these time-varying parameters is available.

Conceptual Illustration of Relationships among Exponential, Linear, Rapid-stagnation and Parabolic Trend under Approximated Time-varying First-order Heterogeneous Difference Equation

Time-varying First-order Heterogeneous Difference Equation

$$y(t) = a(t) \cdot y(t-1) + b(t)$$



SECTION VI-3

EXTRACTION OF MATURATION PATTERNS FROM THE KEY MOTOR VEHICLE DATA

(A) Production

1. Total Production of 4-Wheel Vehicles

a) Prewar Patterns

As is clear in FIGURE IV-3, the randomly fluctuating production in a very small scale up to 1924, indicates that until then, the automobile industry had been hardly organized. However, the next FIGURE IV-4 vividly demonstrates that from 1925 to 1931, the production curve regularly goes up in the rapid-stagnation pattern, which suggests that the industry had gradually shaped its structure, but perhaps due to the still embryonic stage, the production stagnated rather soon.

For the next seven years, from 1931 through 1936, the production curve entered a new stage of exponential growth pattern. This new phase is of great significance in the sense that the zero growth rates in the late years of the previous period was drastically ameliorated and the production curve was placed on a rapidly-increasing

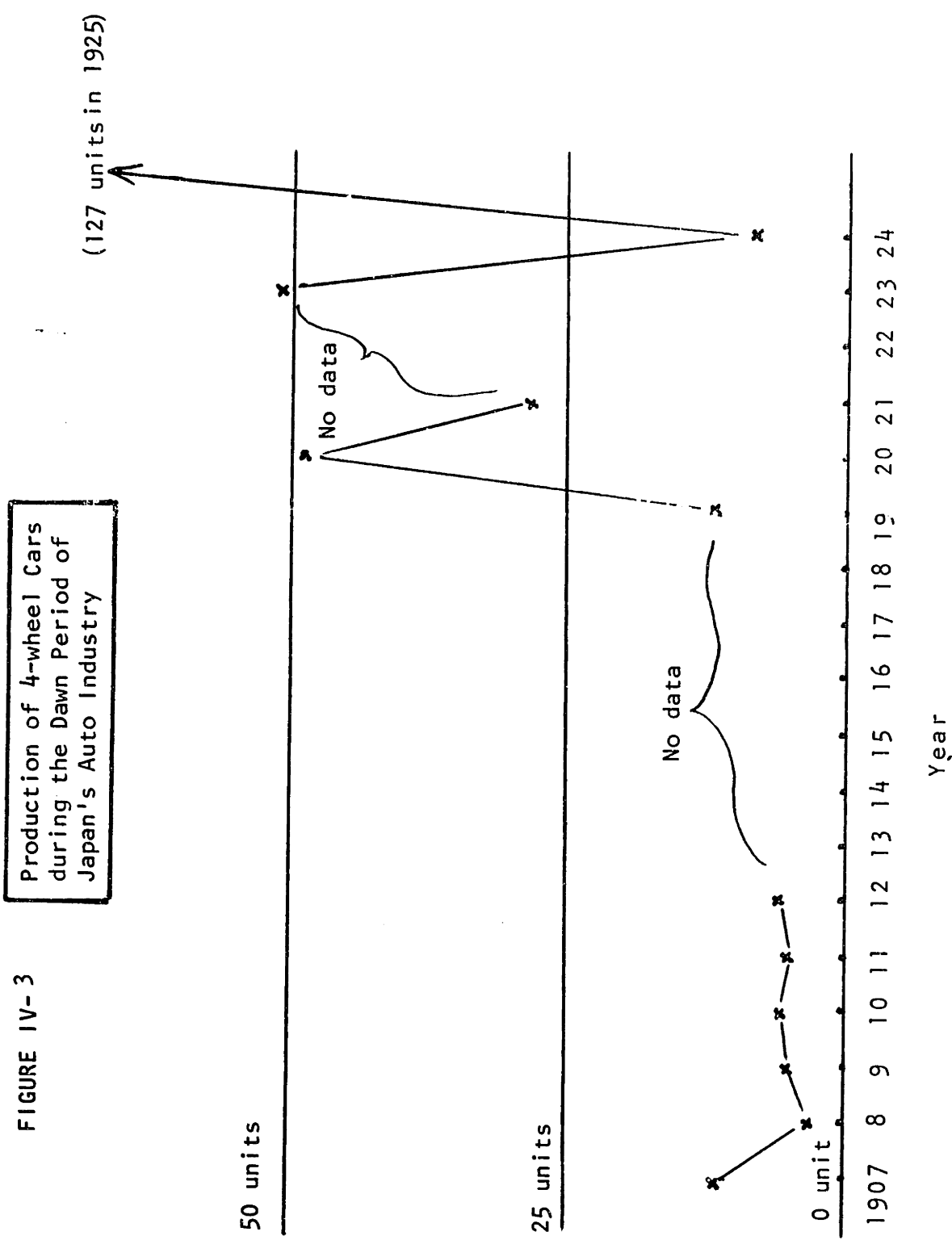
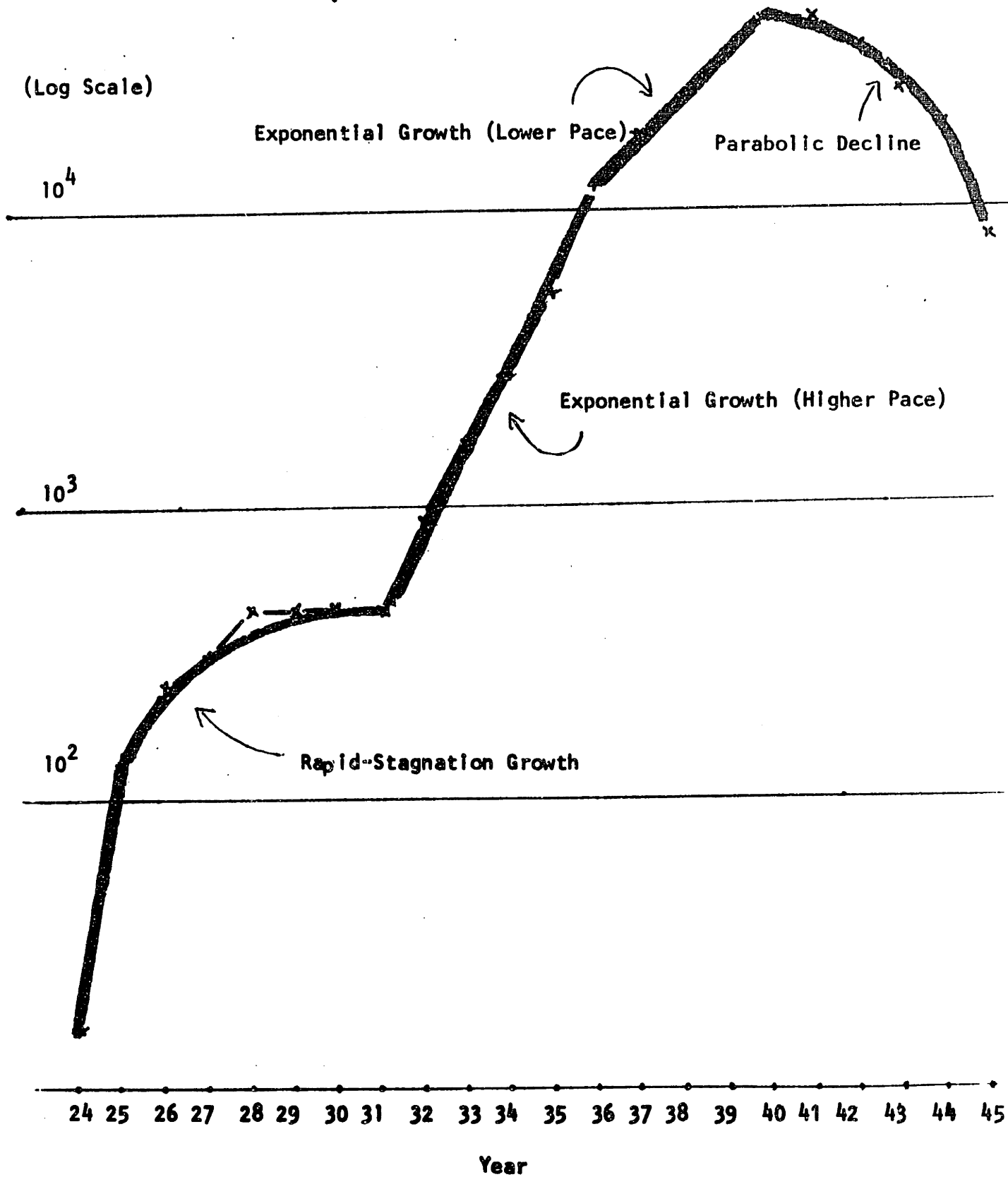


FIGURE IV-3

Year

FIGURE IV-4

Four Growth Patterns of
Prewar Total Production of
4-wheel Vehicles



exponential track.

However, this exponential trend reduced its pace from 1936; and the production growth sustained this pace until 1940.

From 1941 to the end of Pacific War in 1945, the production curve declined parabolically.

The above observations strongly suggest that the production of all 4-wheel vehicles in the prewar period have five conspicuous phases as follows:

<u>Phase</u>	<u>Period</u>	<u>Pattern</u>
1	1907 - 1924	Random (in a small scale)
2	1925 - 1931	Rapid-Stagnation
3	1932 - 1936	Exponential (higher pace)
4	1937 - 1940	Exponential (lower pace)
5	1941 - 1945	Parabolic.

Omitting the first randomly-fluctuating phase, we now observe that the Japanese automobile industry had four distinct structural changes in its production pattern in prewar since it was conceived as an organized industrial entity. These four changes are best illustrated

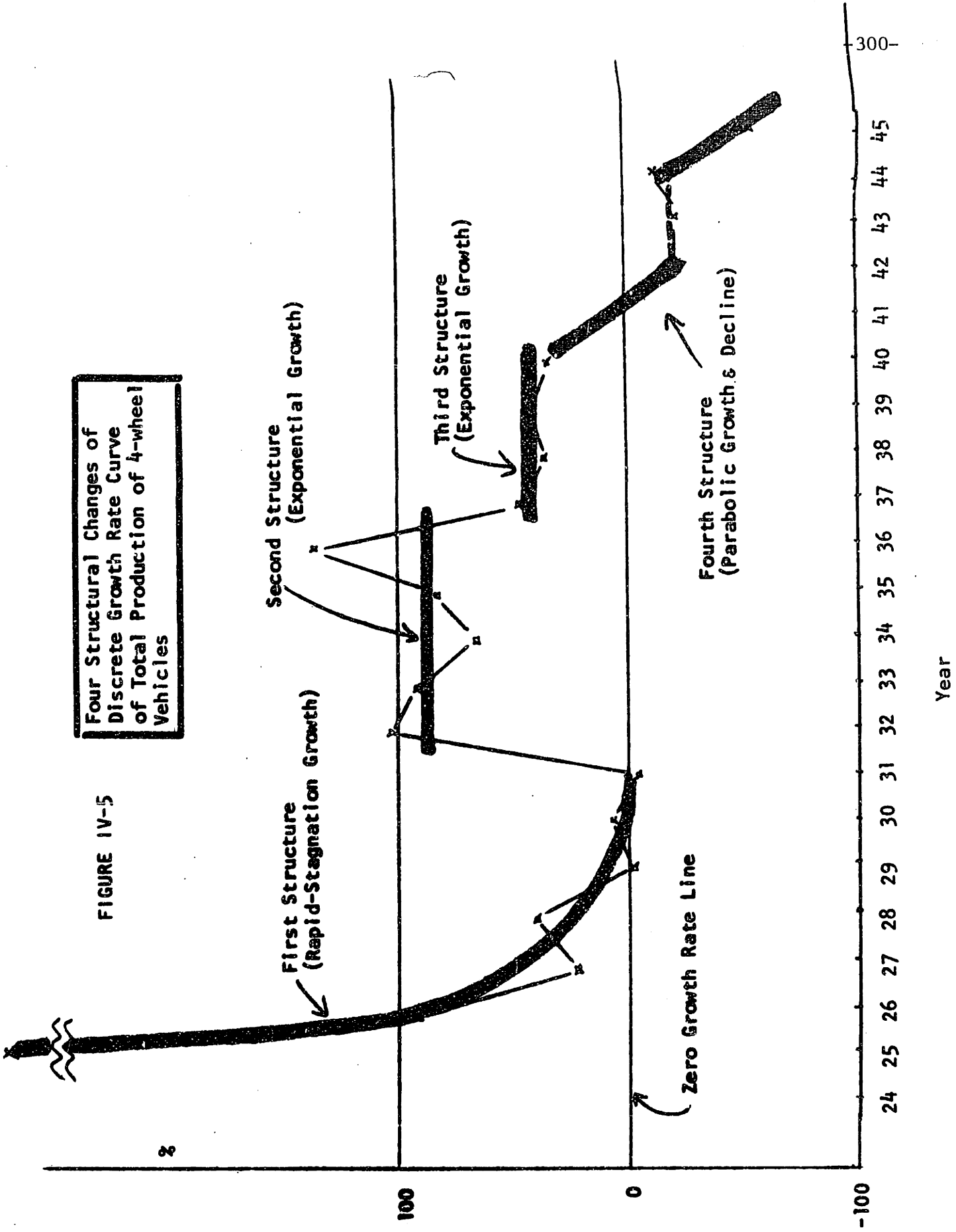
in FIGURE IV-5. This figure characterizes these four structural changes in terms of the four conspicuously different discrete growth rate curves. The hyperbolic pattern at the first structural stage suggests the growth curve is of the form of rapid-stagnation. From 1929 to 1931, the fluctuation around the zero growth line indicates that the growth was stagnated. The jump of the growth rate up to the 100% point in 1932, shows that the industry entered into a new structure. Although some variations are observed, the continuing high growth rates around the level of 85-90% up to 1936, imply the second structural period of exponential growth of automobile production. However, in 1937, the rate declined to a 40% level and continued at that level until 1940, signifying that production entered into the third period with a lower increase ratio of exponential growth. From 1941, the growth rate starts declining semi-linearly. For two years, 1943 and 1944, the horizontal trend indicates that efforts were made to halt the parabolic decrease in production; but the production finally reached the bottom line in 1945, when Japan surrendered in the Pacific War.

b) Postwar Patterns

As seen in FIGURE IV-6, the postwar pattern is not so easily identifiable as the prewar pattern since the data fluctuations are intensified as indicated in FIGURE IV-7. After the war, production

Four Structural Changes of Discrete Growth Rate Curve of Total Production of 4-wheel Vehicles

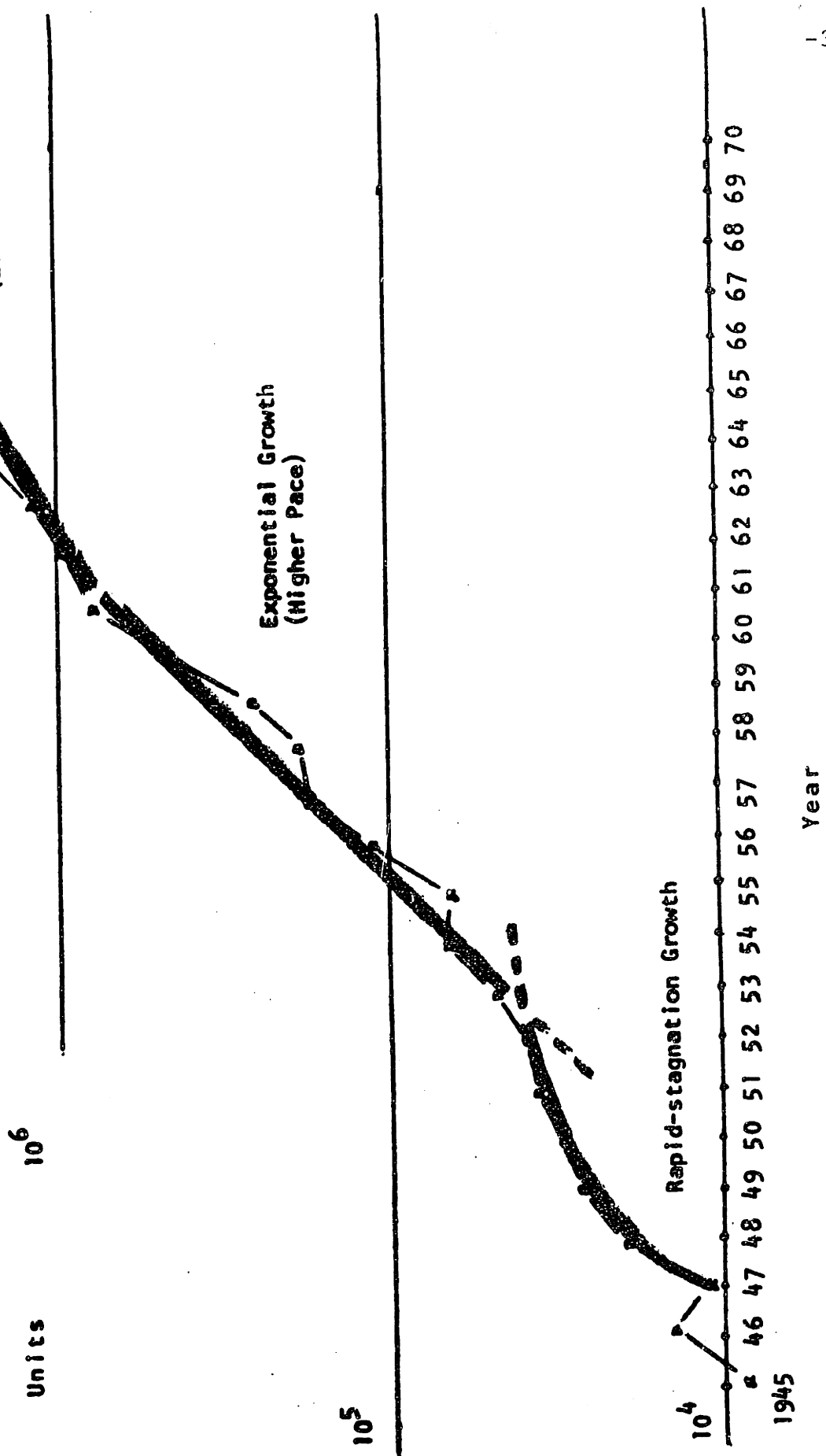
FIGURE IV-5



Year

FIGURE IV-6

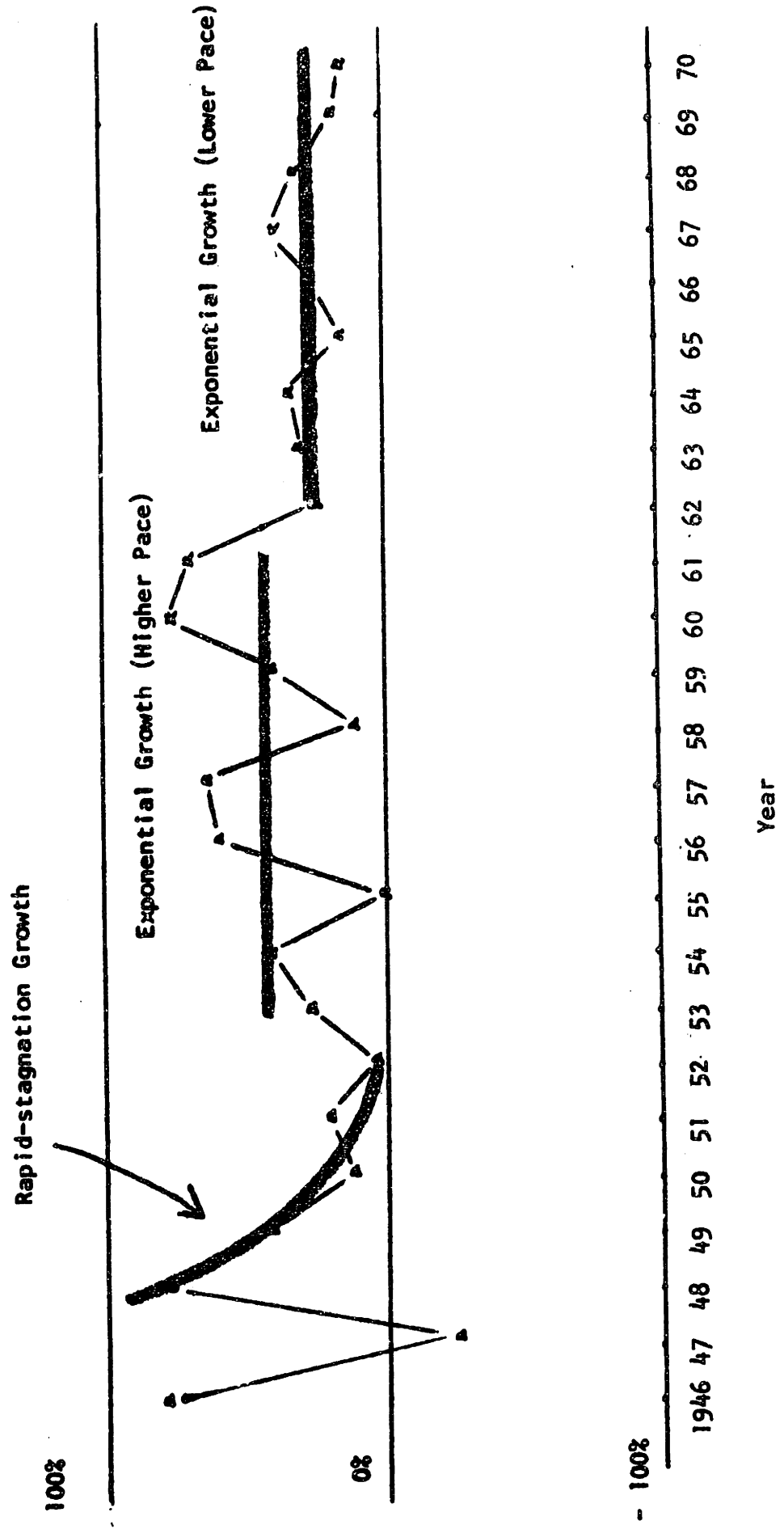
Postwar Production of
All 4-wheel Vehicles



Year

FIGURE IV-7

Growth Rates of Postwar Production
All 4-wheel Vehicles



- 100%

1946 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70

Year

immediately starts growing. However, soon thereafter it declines. A decline slope from 1946 to 1947 looks to be on the extended curve of the prewar decline. This seems to indicate that production had still maintained the prewar state. The actual postwar growth then starts since 1948. Up to 1952, it forms a convex pattern. As indicated in FIGURE IV-7, a growth rate during this period declines more or less hyperbolically. That is, production grows more or less in a rapid-stagnation form. From 1953 to 1961, the production curve roughly forms an exponential trend. From 1961 and thereafter, FIGURE IV-7 indicates a stabilizing trend of a growth rate around the 30% level. This means the production curve had been becoming more and more exponential. In sum, we have observed the following maturation patterns for the postwar data:

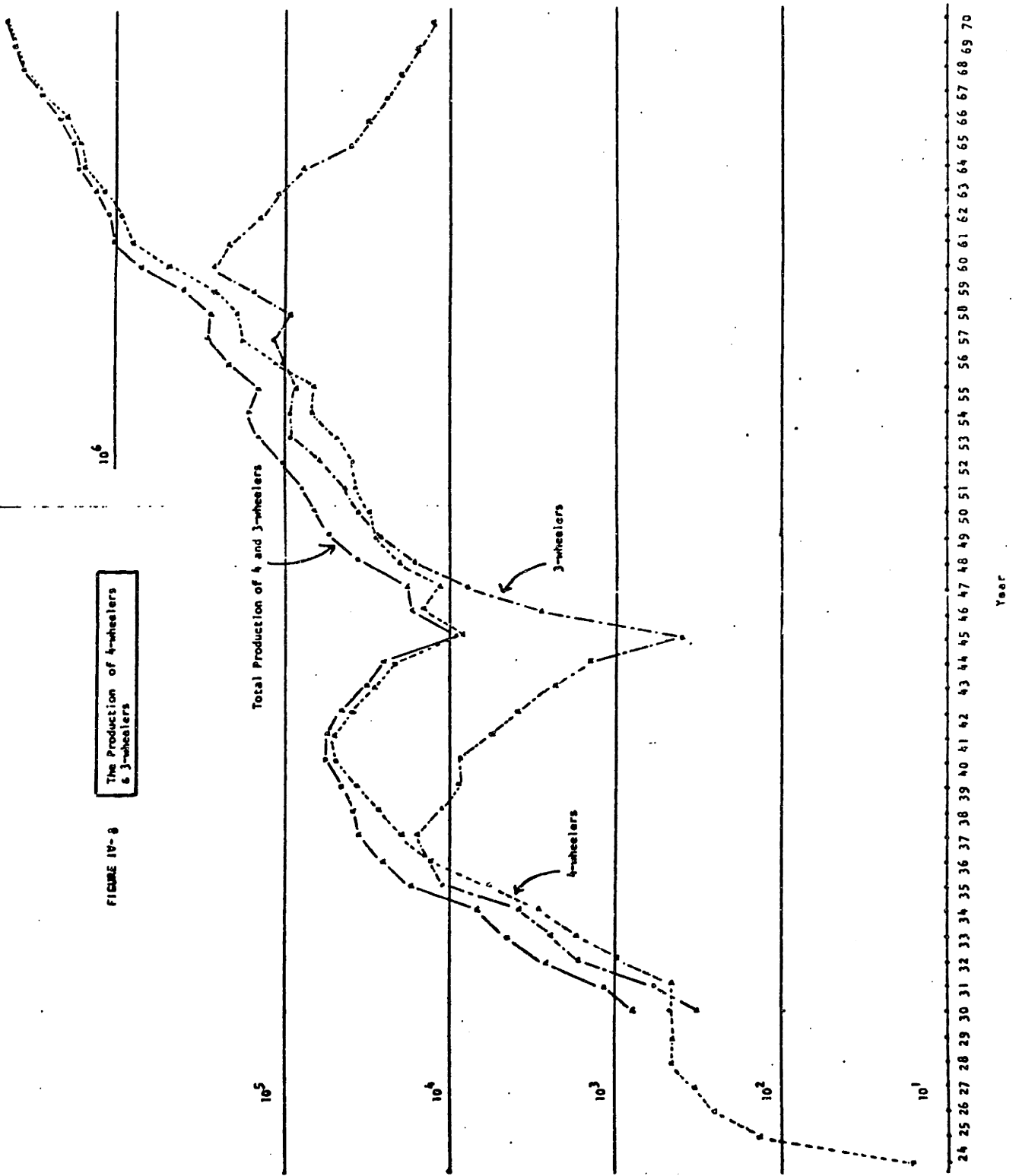
<u>Phase</u>	<u>Period</u>	<u>Pattern</u>
6	1946 - 1952	Rapid-stagnation
7	1953 - 1961	Exponential (higher pace)
8	1962 - 1970	Exponential (lower pace)

2. Production of 3-wheel Cars

The historical policy investigation in PART I has revealed that the Japanese government had exercised no major policy intervention toward the category of 3-wheel cars. However, as shown in FIGURE IV-8, the

The Production of 4-wheelers & 3-wheelers

FIGURE IV-9



production of 3-wheel vehicles once played a dominant role in the domestic supply of motor vehicles, although its relative importance diminished as the production of 4-wheel vehicles increased. This seems an important complement to the knowledge of the developmental process of the Japanese automobile industry.

3. Production by Different Types

a) Prewar Patterns

The observation of the production curves of different vehicle models give us some clues regarding the structural changes we have seen in the trend of the total production. According to FIGURE IV-9, the production of medium and large-size trucks and buses increases drastically in 1932 and 1933, but becomes stagnated in the following two years, i.e., 1934 and 1935. On the other hand, the production of small passenger cars and trucks grows at a tremendously high growth rate until 1935, although its annual growth rate declines linearly as shown in FIGURE IV-10.

Both FIGURES IV-9 and IV-10 would answer the question of why the total production enters into an exponential pattern since 1932 up to 1936. The jump of the total production in 1932 was caused simultaneously by the high increase in the production of medium and

FIGURE IV-9 Production Curves of Different Models

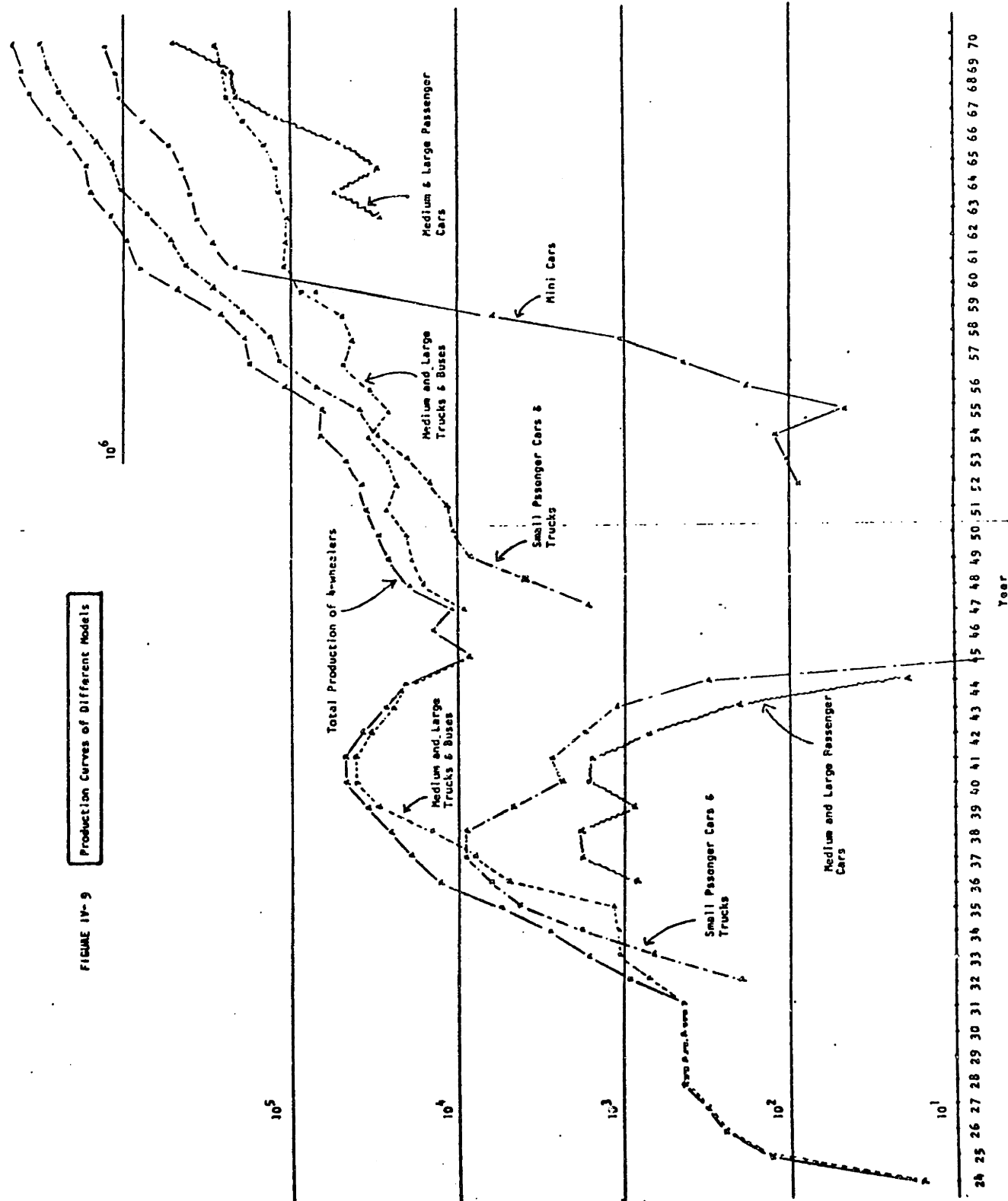
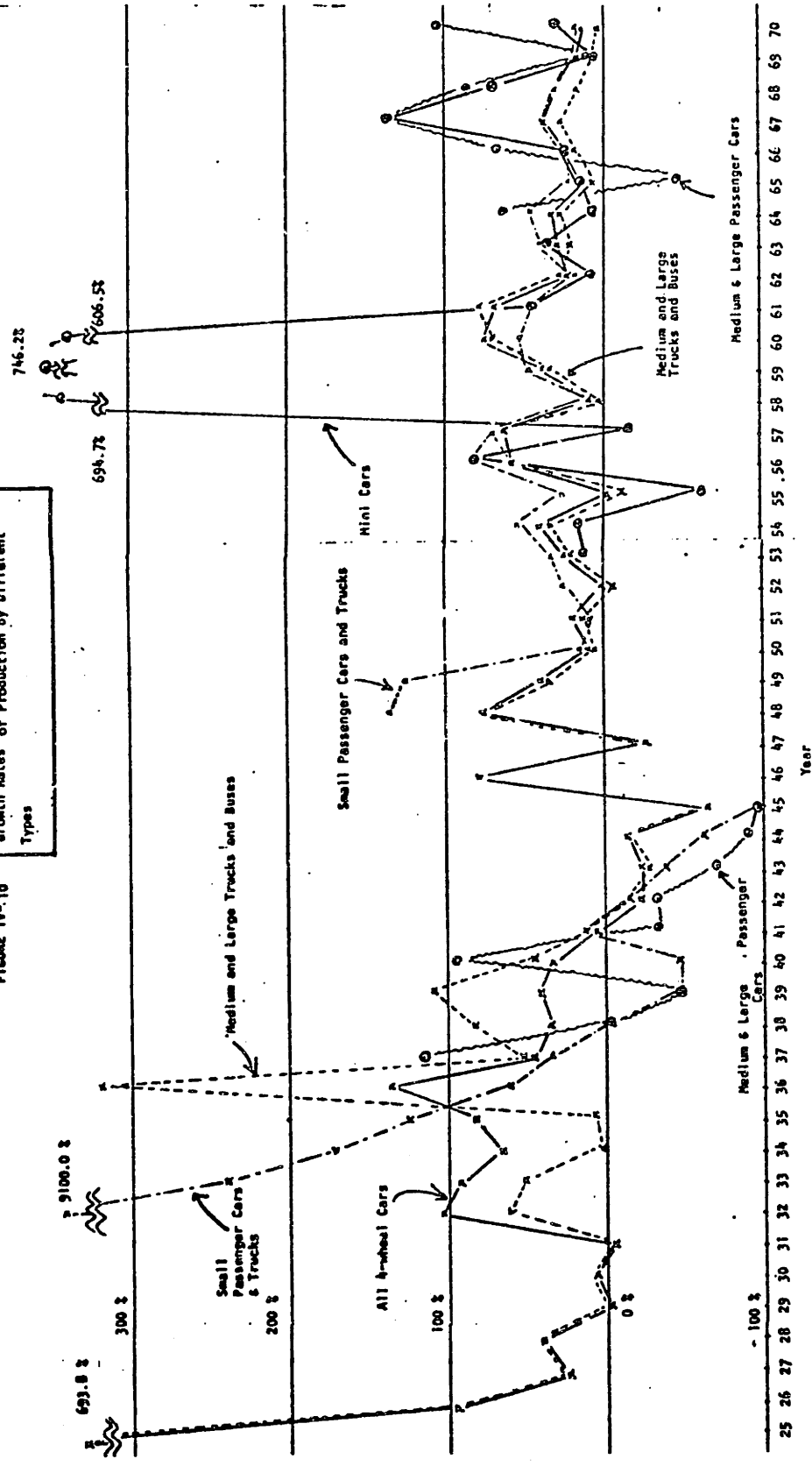


FIGURE IV-10
Growth Rates of Production by Different Types



large-size trucks and buses in this year and the start of large scale production of small cars. While the production of medium cars stagnated during 1934 and 1935, the production of small cars still grew at the same pace compensating for the stagnation of medium-car production, thereby resulting in the exponential growth of total 4-wheeler production. In 1936, the growth rate of small car production slowed, whereas the production of medium and large-size trucks and buses grew again with an impressively high growth rate.

As shown in FIGURE IV-10, there are two levels of growth rate change in total production: 1) high from 1932 to 1936, 2) low from 1937 to 1940. The low growth rate in 1934 on the first high level can be seen as caused by the stagnation of medium and large-size trucks and buses. In the meantime, the high rate in 1936 is caused by the tremendous high rate of the medium and large-size truck and bus production. As investigated above, the level change is primarily caused by the state of production of small passenger cars and trucks, which in turn indicates the importance of this production in shaping the prewar exponential pattern of the total production.

We now have understood that the new entry of small car production makes a great impact on shaping the second and third structures of the exponential growth pattern of total prewar motor vehicle production. It is important to observe to see the relative shares of each of three different vehicle models in total production. As shown in FIGURE

IV-11, the percentage share of small cars goes up linearly from its inception to 1935, i.e., the year before the end of the second structure. However, since 1936, it declines more or less linearly until 1940. From 1940 to 1945, it holds marginal values. Conversely, the relative share of medium and large-size trucks and buses in total production declines linearly until 1935. Since 1936, it starts an upward movement. Remember that medium passenger cars, which started in 1936, shares many design specifications in common with medium trucks and buses. Based upon this fact, we observe that the annual share of medium cars, i.e., trucks, buses and passenger cars in medium size, goes up more or less linearly while that of small cars goes down.

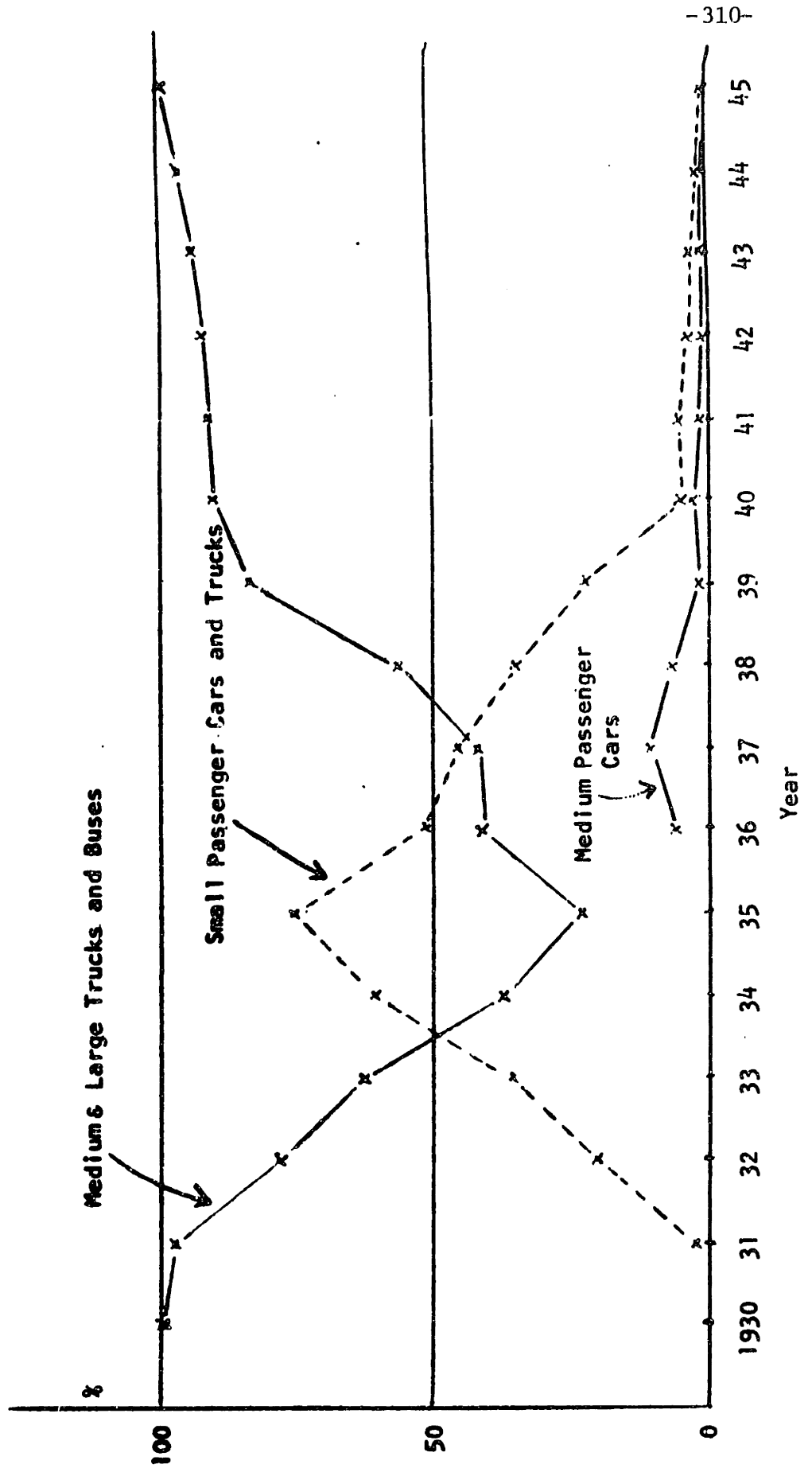
b) Postwar Patterns

The general production trend of medium and large-size trucks and buses resembles that of the total production of 4-wheel vehicles as indicated in FIGURE IV-10. The increasing separation shown in FIGURE IV-9 is due to the difference of the initial starting level since a growth rate in each year recursively generates a production value. On the other hand, the trend pattern of the production of small cars shows a rapid-stagnation. This is more clearly indicated by the growth rate curve in FIGURE IV-10.

The production of small passenger cars and trucks surpasses that of

Percent Shares of the Productions of Three Different Models in Total Motor Vehicle Production

FIGURE IV-11



medium and large-size trucks and buses in 1955. The aforementioned rapid-stagnation pattern of the production curve of 4-wheel vehicles from 1945 to 1955 is characterized primarily by the production of medium and large-size trucks and buses, while the production of small passenger cars and trucks mainly shapes the trend which comes afterward.

In comparison with prewar production, the production of medium and large-size trucks and buses reaches the prewar highest level in 1957, whereas the production of small passenger cars and trucks attains the prewar highest level within two years, i.e., in 1948.

The production of mini cars started in 1952. It abruptly jumped up since 1956, and continuously increased up to 1960, with unprecedented increasing ratios as shown by the growth rate curve in FIGURE IV-10. The curve of this production becomes nearly parallel with that of the production of small passenger cars and trucks since 1961.

The production of medium and large-size passenger cars started quite late, in 1963. The growth trend of this production is observed to be very high as indicated in FIGURE IV-10.

(B) Foreign Supply

The foreign supply of motor vehicles consists of imports and foreign cars assembled in Japan. As shown in FIGURE IV-12, the assembly of foreign cars replaces the predominance of imports in the foreign supply since 1925. In general, the macroscopic trend of foreign supply forms a gradual rapid-stagnation.

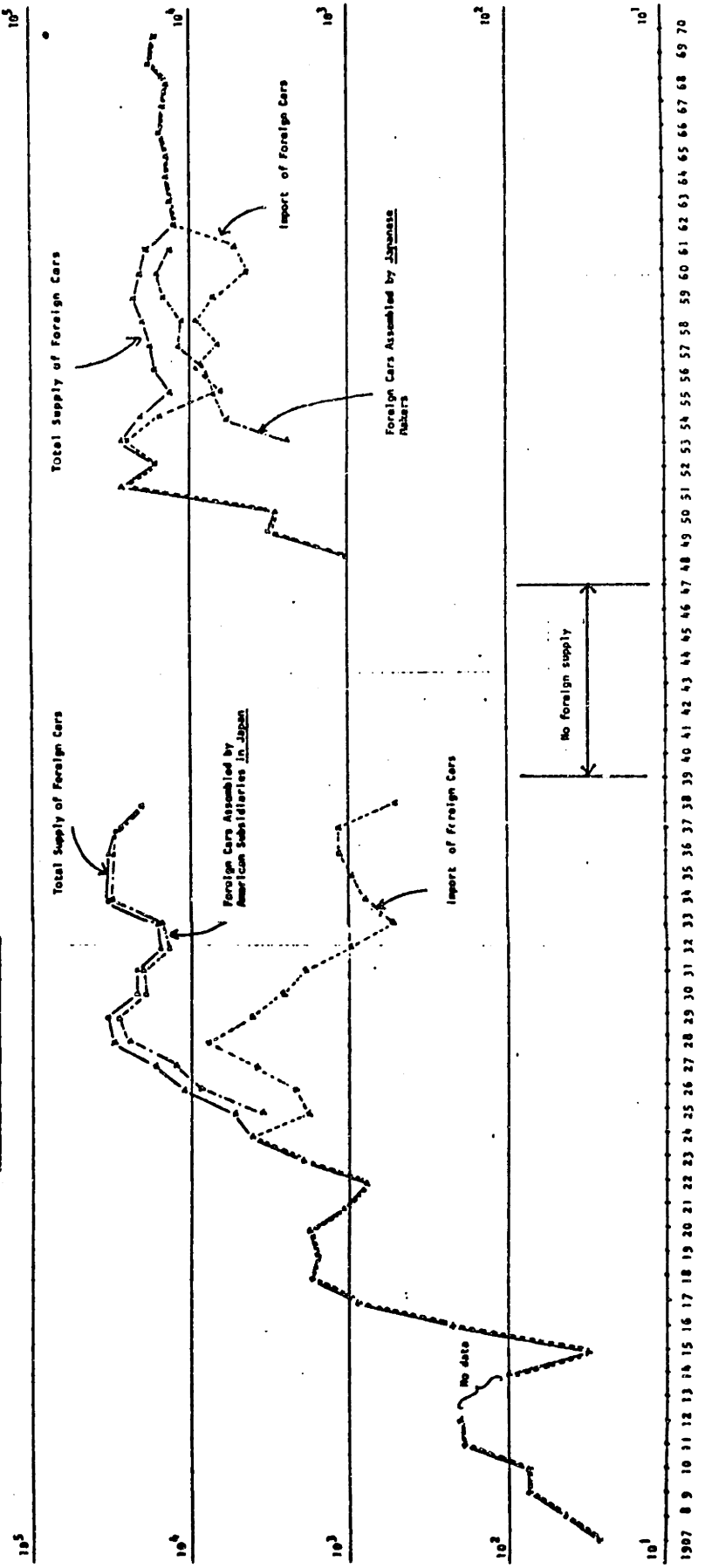
On the other hand, the postwar curve shows a peculiar pattern. For only four years, from 1948 to 1952, foreign supply grows very sharply. However, it becomes stagnated soon thereafter. The constant level from 1955 to 1961 is composed of two components: imports and foreign cars assembled by the Japanese makers. After the assembly terminated in 1960, imports jump up and maintain this level. It is an interesting observation that the postwar foreign supply level is the same as that of the prewar. In other words, no remarkable increase has been observed since the supply stagnated in 1926.

(C) Total Supply of 4-wheel Vehicles

In FIGURE IV-13, the total supply of 4-wheel vehicles is defined to be a sum of domestic production and foreign supply of all 4-wheel vehicles. In other words, it is an overall inflow of 4-wheel motor vehicles into the Japanese market.

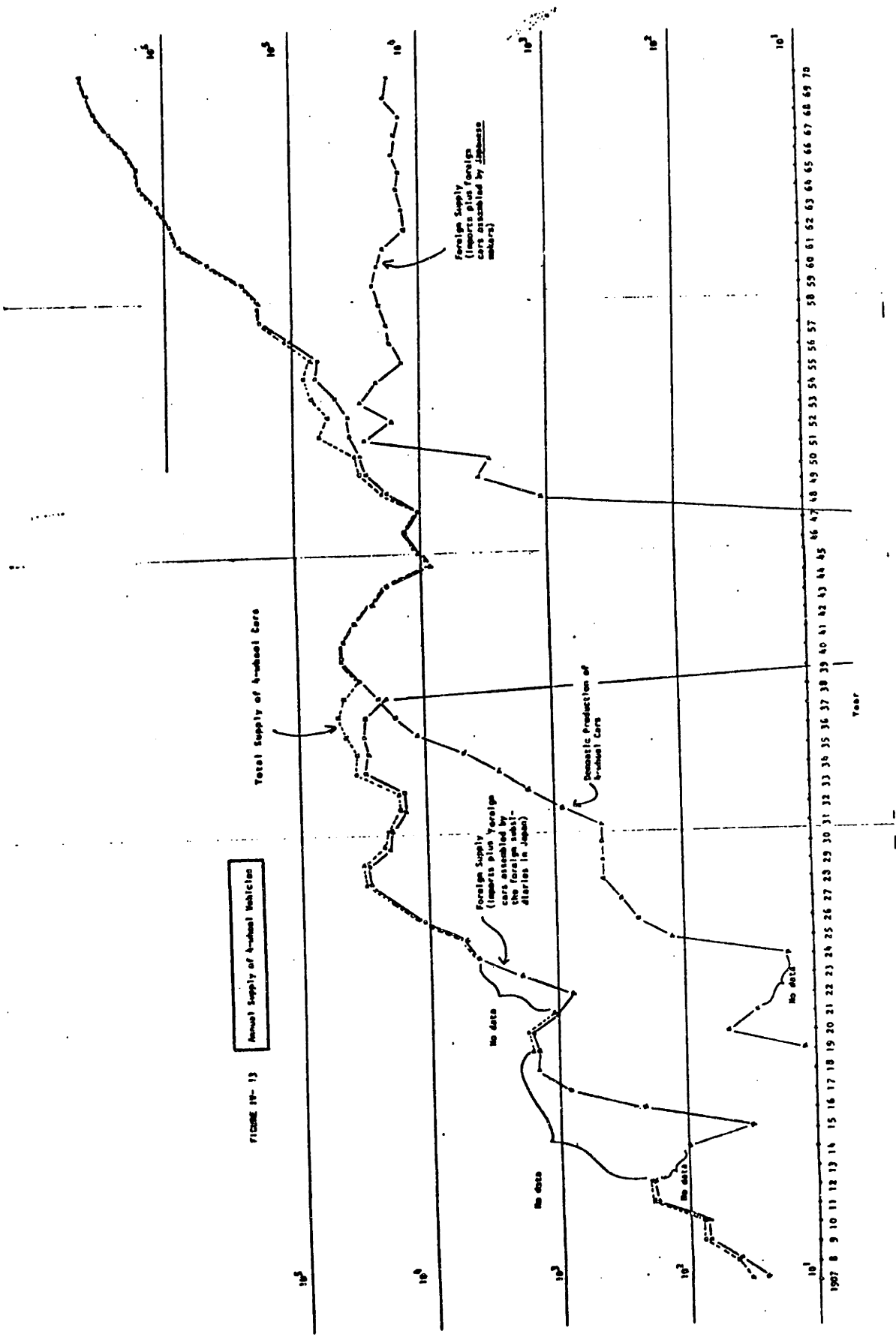
Several important observations are readily made from FIGURE IV-13.

FIGURE IV-12 Foreign Supply of Motor Vehicles



Year

FIGURE 19-13 Annual Supply of 4-wheel Vehicles

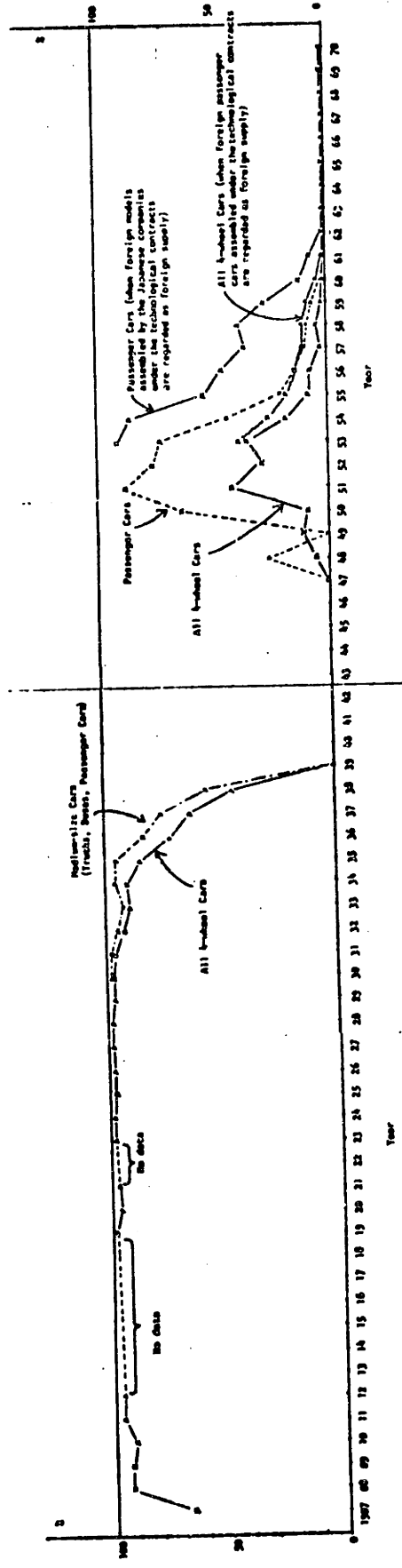


Before the foreign supply suddenly disappeared in 1939, domestic production surpassed the level of foreign supply. Therefore, no crucial decrease of total supply occurred after foreign supply becomes zero. The postwar total supply is almost on the curve of domestic production except for the period from 1951 to 1954, in which the total supply sharply increases because of a rapid increase in foreign imports.

The above observations are more vividly shown in FIGURE IV-14. Until about 1931, foreign supply accounts for nearly all of total supply. However, the share of foreign supply starts declining in 1932. Since then, it continues to decline along a convex curve. Seven years later in 1939, the foreign supply share completely becomes zero. After World War II, the share of the total foreign supply does not reach the prewar level. However, when we look at the share of the foreign supply of passenger cars, the situation looks more or less like the prewar pattern. That is, the increase in the share of foreign passenger cars in 1950 and 1951, indicates that the foreign supply of passenger cars was about to take over the total supply. However, it again starts declining in 1952, as in the prewar period. From 1951 to 1955, it declines in the same shape as the prewar pattern. Since 1956, the share curve reduces the declining pace and eventually becomes zero in 1961. As indicated in the figure, the foreign passenger cars assembled by the Japanese manufacturers make the share curve more gradual for all 4-wheel curves in general, and the passenger car curve in

Relative Share of Foreign Cars
(% Annual Supply of Assemblies)

FIGURE 1B-16



Passenger Cars (When foreign models assembled by the Japanese companies under the technological contracts are regarded as foreign supply)

All-wheel Cars (When foreign passenger cars assembled under the technological contracts are regarded as foreign supply)

Medium-size Cars (Freight, Bus, Passenger Car)

All-wheel Cars

Passenger Cars

All-wheel Cars

Passenger Cars

Passenger Cars

Year

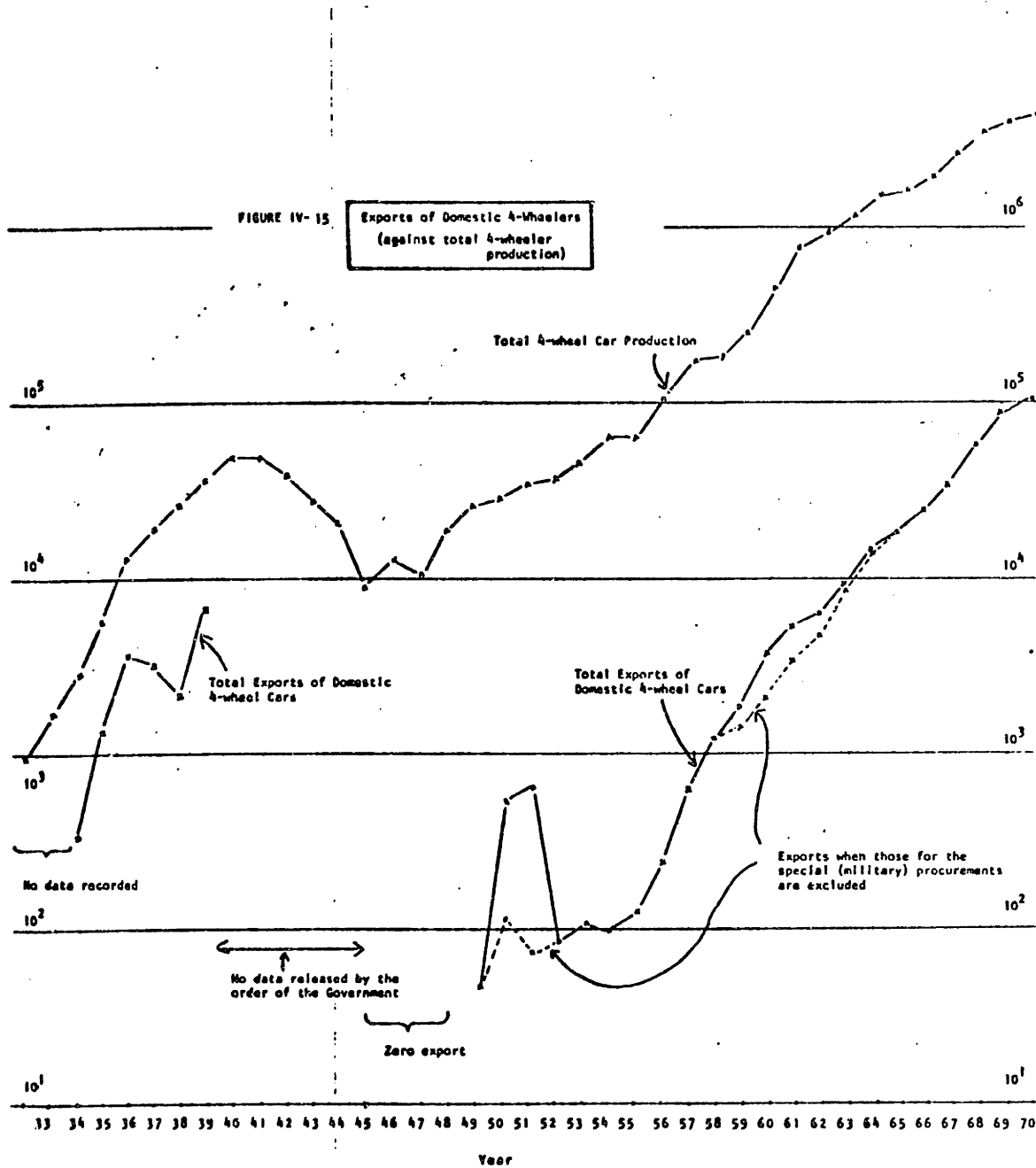
Year

particular.

(D) Exports

FIGURE VI-15 shows the time-series trend of motor vehicle exports in comparison to domestic production. From 1934 to 1939, the exports phenomenally increase. Since 1939, no data could be found because the government banned the publication of export data for military security reasons. After World War II, exports sharply increase in 1950 and 1951. This is due to the special military procurement of the Korean War. If those procured by the American Army are excluded, the export curve increases more smoothly.

The relative share of exports in the total domestic production is shown in FIGURE IV-16. This figure simply illustrates the marginal share of exports during the entire period, except for the periods of prewar and postwar military procurements.



Ratio of Exports to Domestic Production
(All 4-wheel Cars)

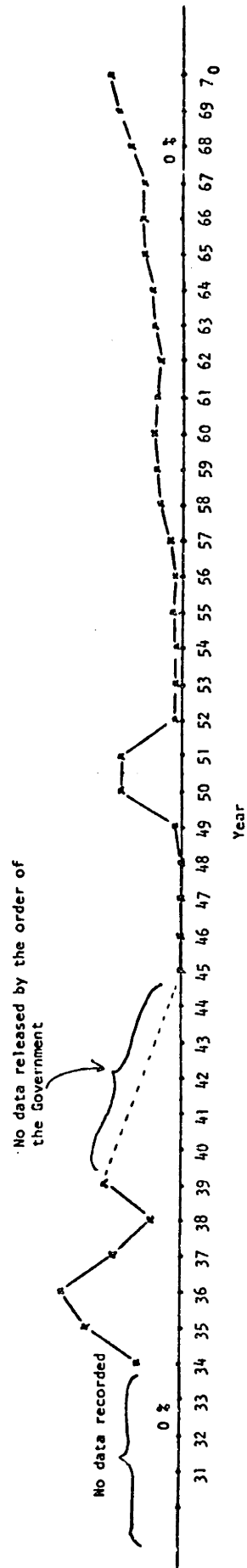
FIGURE IV-16

100 %

100 %

50 %

50 %



SECTION IV-4

MATURATION CHANGES AND POLICY INTERVENTIONS

(A) Rationale for Observation of Only Four Key Data

In the previous section, we observed only four different key data which basically consist of only three independent data variables, i.e., production, foreign supply and exports. The basic rationale for looking at only these data rests on the historical investigation of PART I. That is, the major government interventions were principally directed toward production enhancement, import suppression and export encouragement.

The first major intervention (The Law Regarding Supports for Military Vehicles of 1918), the second major intervention (The Ministry of Commerce and Industry's Standard Model of 1932), the third major intervention (The Law Regarding Automobile Manufacturing Enterprise of 1936), the fourth major intervention (The Wartime Controls), the fifth major intervention (The GHQ Supremacy), the seventh major intervention (The MITI's Principles Regarding Technology Contracts of 1952) and the eighth major intervention (The MITI's Peoples' Car Plan of 1955), all aimed directly at production enhancement. On the other hand, a part of the third major intervention and the sixth major intervention (The Regulation Regarding Conveyance

of Foreign Vehicles) were directed to imports suppression. The eighth major intervention, although it could not be implemented, was related to export encouragement.

The reason for excluding other important data variables, such as stocks, sales, tax, government subsidy, public investment into road construction, government money for purchase loans, and several other economic indicators, is multifold. First, the collection of the three primary data over 60 years was itself time consuming so that the collection of other data was not feasible, Second, the purpose of the thesis research is not economic analysis, rather it is a policy intervention analysis to identify the impact of the major policy interventions to be extracted from history. Third, the research scope of 60 years needs a macroscopic observation of long-range data. If data have a lot of missing periods or categorical inconsistencies, they do not satisfy the purpose of this research.

The historical evidence that the government twice instituted the stringent import suppression policy (the third and the sixth major interventions) suggests that domestic demand always surpassed domestic production. The fact that foreign imports successfully entered into the Japanese market, despite a high tariff and tax burdens, indicates the existence of the strong so-called "market pull." Since the government literally choked the foreign supply, the market inevitably absorbed domestic production, thereby implying that domestic vehicle

stocks had been marginal for a long time. In fact, the government initiated other facilitating policies to strengthen the absorption of domestic production, such as roads construction, tax credits and others. However, the basic policy imperative was, first of all, to fill the market vacancy held by the government import suppression policy. In other words, the government concern was to let production go upward before everything else. The above argument still remains speculative and hence subject to empirical validation. However, given the practical impossibility of collecting other kinds of data, it seems to bear worth.

(B) Maturation Changes and Policy Interventions

Two data, production and foreign supply, will be selected for examining the possible impact of the eight major policy interventions identified in PART I, in recognition of the fact that these interventions formed the production enhancement or the import suppression policies.

1. Production

The following coincidences are between the maturation changes of the production curve of all 4-wheel vehicles and the major policy

interventions:

<u>Change of Maturation</u>	<u>Intervention</u>
Random - Rapid-stagnation (in 1925)	First Intervention (Law of Military Vehicles)
Rapid-stagnation - Exponential (in 1932)	Second Intervention (MCI Standard Model)
Slope change of exponential (in 1937)	Third Intervention (Law of Auto Mfg Enterprise)
Exponential - Parabolic (in 1941)	Fourth Intervention (Wartime Control)
Parabolic - Rapid-stagnation (in 1946)	Fifth Intervention (GHQ Supremacy)
Rapid-stagnation - Exponential (in 1953)	Unidentified
Slope change of exponential (in 1962)	Unidentified

Recall that the first intervention created three new large firms, TGE, DAT and Ishikawajima under the government's encouragement of the production of LSMV trucks (SECTION II-1). Then, it is clear that the systematic growth of the production curve since 1925, is due to the first organization of the automobile industry by the entry of these firms under the first intervention (see FIGURE II-1).

As discussed before, the new exponential trend since 1932, is jointly caused by the rapid growth of the production of medium and large-size trucks and buses and of small passenger cars and trucks (FIGURE IV-9). The new increase of the production of medium and large-size trucks and buses is caused by the MCI Standard Model under MOR procurement (SECTION II-2). However, this production stagnates soon. Ironically, the failure of the MCI Model indirectly caused the high growth of small car production. DAT, which had been producing Datsun models, switched to MCI car production (SECTION II-2). However, because of the failure of the MCI Model, DAT was absorbed into Ishikawajima and started the production of Army trucks. Then, Nissan bought the manufacturing license of Datsun models and entered into mass production of small vehicles (SECTION II-3). Then, the continuing exponential trend of the production of all 4-wheel vehicles is supported by Nissan's production of small cars despite the fact that the growth of production of medium and large-size vehicles becomes stagnated.

The production of medium and large-size trucks and buses again starts increasing in 1936, triggered by the enactment of the Law Regarding Automobile Manufacturing Enterprise in this year. Recall that this law created the entry of a new powerful firm, Toyota Motors. On the other hand, the production of small vehicles is gradually stagnated because Nissan was incorporated into government control under this law and thus started concentrating on the production of

medium and large-size trucks.

In 1938, the Minister of Commerce and Industry notified Nissan Motors of the government ban on the production of "extravagant" passenger cars. As indicated in FIGURE IV-9, the production of small cars becomes stagnated exactly in this year and later starts declining. This decline makes the exponential trend of the total production of 4-wheel cars go down, even though production of medium and large-size trucks and buses increases with a higher log-linear slope (FIGURE IV-9). Therefore, we may conclude that the slope change of the exponential trend during the latter half of the 1930s was jointly caused by the third and fourth interventions.

The parabolic decline of total production is no doubt caused by the collective interventions of the wartime government. As discussed in SECTION II-4, the firms were required to spare production facilities for manufacturing weapons. In the meantime, materials allocation was strictly controlled by the government.

The trend change from parabolic decline to the increasing trend is obviously caused by the permission of the GHQ for the reopening of the automobile manufacturing under the rationed material allocation. The prohibition of weapon production by the occupation authority eased the wartime burdens of the automobile industry and hence made the production of all kinds of vehicles go upward.

It is rather difficult to relate any postwar intervention to the maturation change which occurred in 1953. According to FIGURE IV-9, both the production of medium and large-size vehicles and the production of small vehicles goes up. The intervention which coincides with this period is MITI's guideline of technology contracts (SECTION III-3). However, as long as FIGURE IV-9 is concerned, we have failed to conclude that this seventh intervention caused the 1953 maturation change. With respect to this point, we will employ an extensive analysis in CHAPTER VI (SECTION VI-3).

With respect to the 1962 maturation change, no policy information is available since our historical investigation has been terminated before the 1960s.

The sharp increase of the production of mini cars since 1956 exactly coincides with the eighth intervention (MITI's Peoples' Car Plan). As discussed in SECTION III-4, the plan failed because of the strong opposition of the existing manufacturers. However, the data suggest that the plan made a considerable impact on creating a new area in automobile manufacturing. In fact, the historical investigation has identified that the MITI plan encouraged several new small and medium-size firms to formally enter into mini car production (SECTION III-4).

2. Foreign Supply

The purpose of the third intervention also included the termination of the assembly business of Japan Ford and Japan GM (SECTION II-3). Three years after the law was promulgated in 1936, all of foreign supply became zero (FIGURE IV-12 or FIGURE IV-14).

The constant level of foreign imports since 1952 (FIGURE IV-12) can be regarded to be caused by the implementation of the sixth policy intervention (SECTION III-2).

The emergence of the assembly of foreign models (FIGURE IV-12) is, of course, due to the enactment of the seventh policy intervention (SECTION III-3).

(C) Further Analyses of the Relationship between Structural Changes of Maturation and Interventions

As long as the maturation changes in the growth trend of the production data are concerned, the impact of the major policy interventions is apparent. That is, the interventions affected the maturation changes, rather than the level changes.

The maturation change is a change from one data trend to another.

As discussed in SECTION IV-2 and shown in FIGURE IV-2, each of the four conspicuous trend patterns has a unique structure. The fact that the interventions affected the maturation changes means that one structure was changed to the other structure because of intervention. Then the question arises: is there a unique relationship between the structural transition and intervention?

Recall that each of the four conspicuous patterns of maturation can be formulated into a simple heterogeneous difference equation with the time-varying parameters. The changes in these parameters create a new structure as shown in FIGURE IV-2. This means that the same amount of the impact on the parameters could induce a structural change (hence the maturation change of a data trend) depending upon the previous structure (i.e., the previous values of the parameters). Therefore, the question as to whether or not there is the unique and consistent relationship between the structural transition and intervention can not be answered unless we investigate the intervention impact on the infrastructures (i.e., the parameters) of the data trends. The next chapter will employ this investigation.

Next, with respect to the interventions for import suppression, the impact is also apparent. That is, vehicle imports or foreign vehicle supply, which included the assembly of foreign models in Japan, were actually affected. FIGURE IV-12 shows that because of the interventions (the third and the sixth major interventions), foreign

supply was suppressed on a constant level or later totally eliminated. However, as shown in FIGURE IV-13, the total supply of motor vehicles did not suffer from a major decline, although the relative share of foreign supply drastically went down (FIGURE IV-14). Then the question arises: how were the maturations of foreign supply structurally controlled by the interventions? CHAPTER VI will be devoted to this question.

CHAPTER V
STRUCTURAL ANALYSIS OF PRODUCTION POLICY

SECTION V-1
MACRO-DYNAMIC METAMORPHOSIS OF INDUSTRY'S
PRODUCTION PERFORMANCE

(A) Metamorphic Structural Change: Interpretation by Growth
Rate Curves

In the previous chapter, we have identified the four structural changes among conspicuous trend patterns. These trend patterns have the dynamic mechanisms to transfer a previous value to a current value in an incremental process. In this section, we will further investigate such a dynamic mechanism in the context of policy intervention.

The essential focus of our investigation will be placed on the growth rate curve derived from growth data. The growth rate (either continuous or discrete) is a fundamental reference when one assesses the performance of a dynamically moving object. Suppose that a car is running at a very high speed toward us. Then, our natural response would be to avoid the course of the running car. If we recognize that the speed of the car is very slow, our response would also be slow. Our

response is essentially decision-making based on the recognition of speed, i.e., a growth rate of a distance between a running car and us. This simple metaphor can be applied to our current research concern: i.e., policy decision vis-à-vis automobile production. If production is stagnated, policy would arise to revitalize such stagnation. Stagnation is recognized by both visual observation of production data (as we did in CHAPTER IV) and numerical observation of a proper indicator, which is, we believe, the growth rate curve. We adopt a view that the growth rate is more sensitive to policy making simply because of its numerical sensitivity. With this standpoint, we will discuss the structural change of conspicuous trend patterns in terms of the growth rate curve.

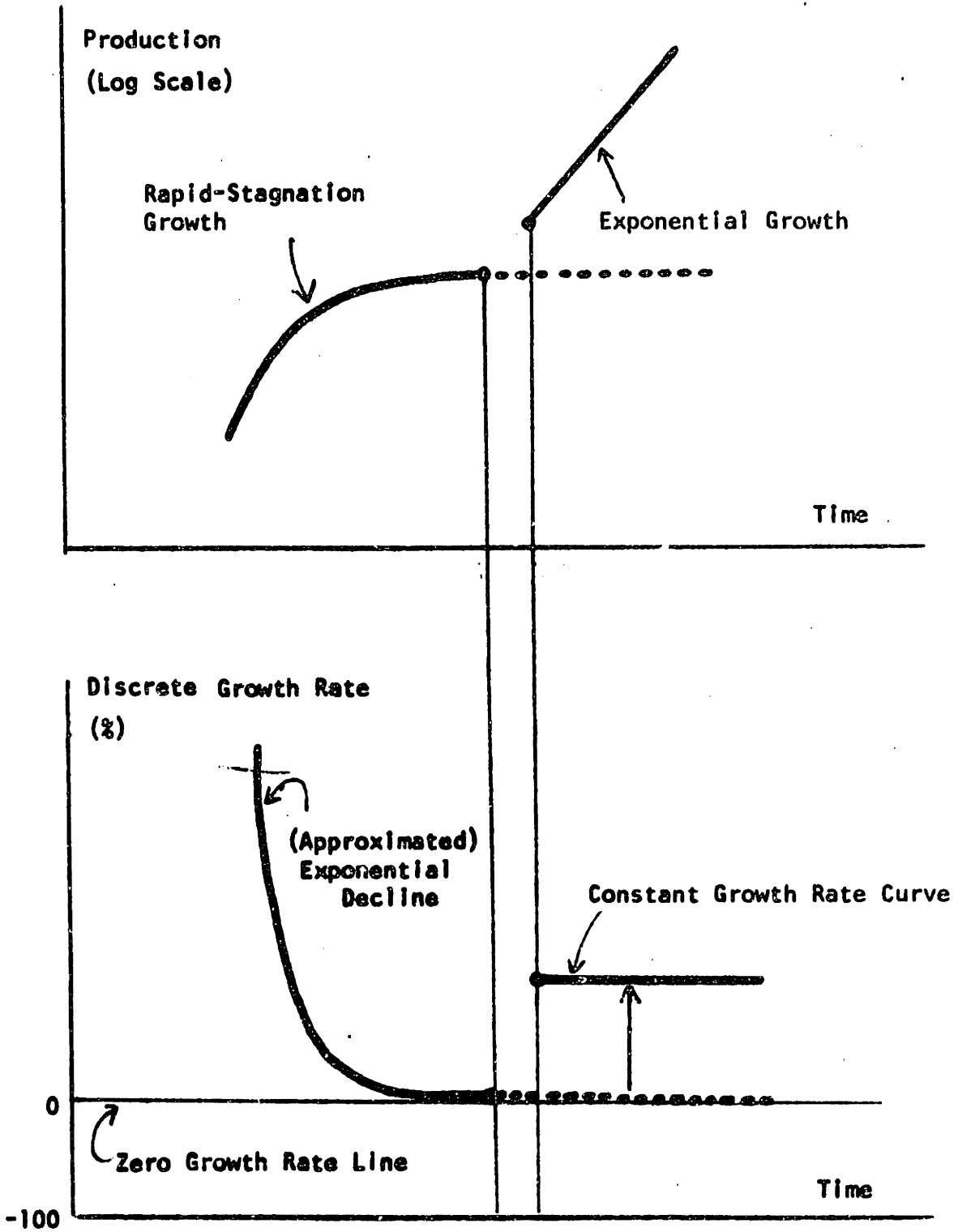
1. From Rapid-Stagnation Growth to Exponential Growth

This change occurred typically in the data of all 4-wheeler production after the MCI's standardized model was determined in 1932. In order to grasp the basic property of this structural change, we refer to FIGURE V-1.

A sharp decline of a growth rate of the rapid-stagnation growth curve may be approximated by a hyperbolic decline curve or exponential decline curve with a less than unity exponent. Recall that exponential growth yields a constant growth rate curve, as shown in FIGURE V-1. Therefore, we can deductively interpret the meaning of this change as

FIGURE V-1

Conceptual Illustration of
Structural Change from
Rapid-Stagnation Growth to
Exponential Growth



that of the "exponential decline-to-constant level" in the growth rate curve. Then, we ask the question: What causes the push from the "zero" level growth rate up to a higher level where it is sustained?

2. From Exponential Growth to Parabolic Growth (and Decline)

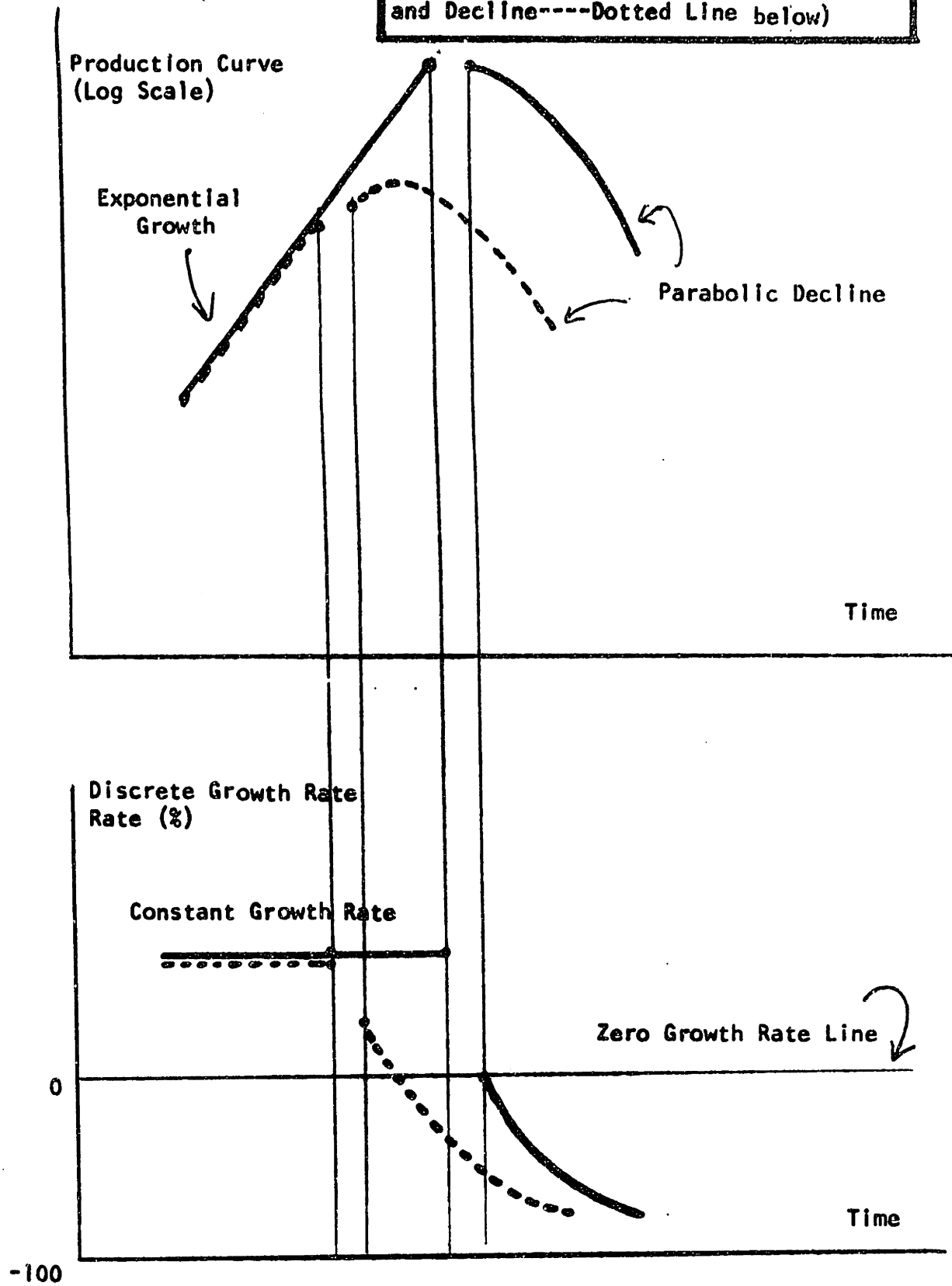
According to our data observations in CHAPTER IV, this change happened:

- i) in the data for all 4-wheelers and medium and large trucks and buses, after 1940 when the government announced the "Fundamental Principles of The Nation's Policy" in preparation for the forthcoming war.
- ii) in the data of domestic small passenger cars and trucks, after 1938 when the Minister of Commerce and Industry sent the mandatory order to ban the production of civilian-use passenger cars.

Structurally speaking, as shown in FIGURE V-2, this change means the previously maintained constant growth rate level started declining toward the ultimate bottom of "-1.0." Then, we might ask the question: did the parabolic decline occur because of an extraneous cause or did the production system itself decay?

FIGURE V-2

Conceptual Illustration of Structural Change from Exponential Growth to Parabolic Decline (or Growth and Decline---Dotted Line below)



3. From Parabolic Decline to Rapid-Stagnation Growth

This change happened in almost all kinds of production data after the Pacific War. Some data, like the production of small passenger cars, have the "zero" production period for a couple of years due to the delay of the GHQ permission of the reopening of production. Then, if such a no-production period is omitted, we have the conceptual illustration of this structural change in FIGURE V-3.

In terms of the growth rate curve, the near -1.0 growth rate jumps up to the positive area and declines again, implying a forthcoming stagnation. In this regard, the following policy questions arise:

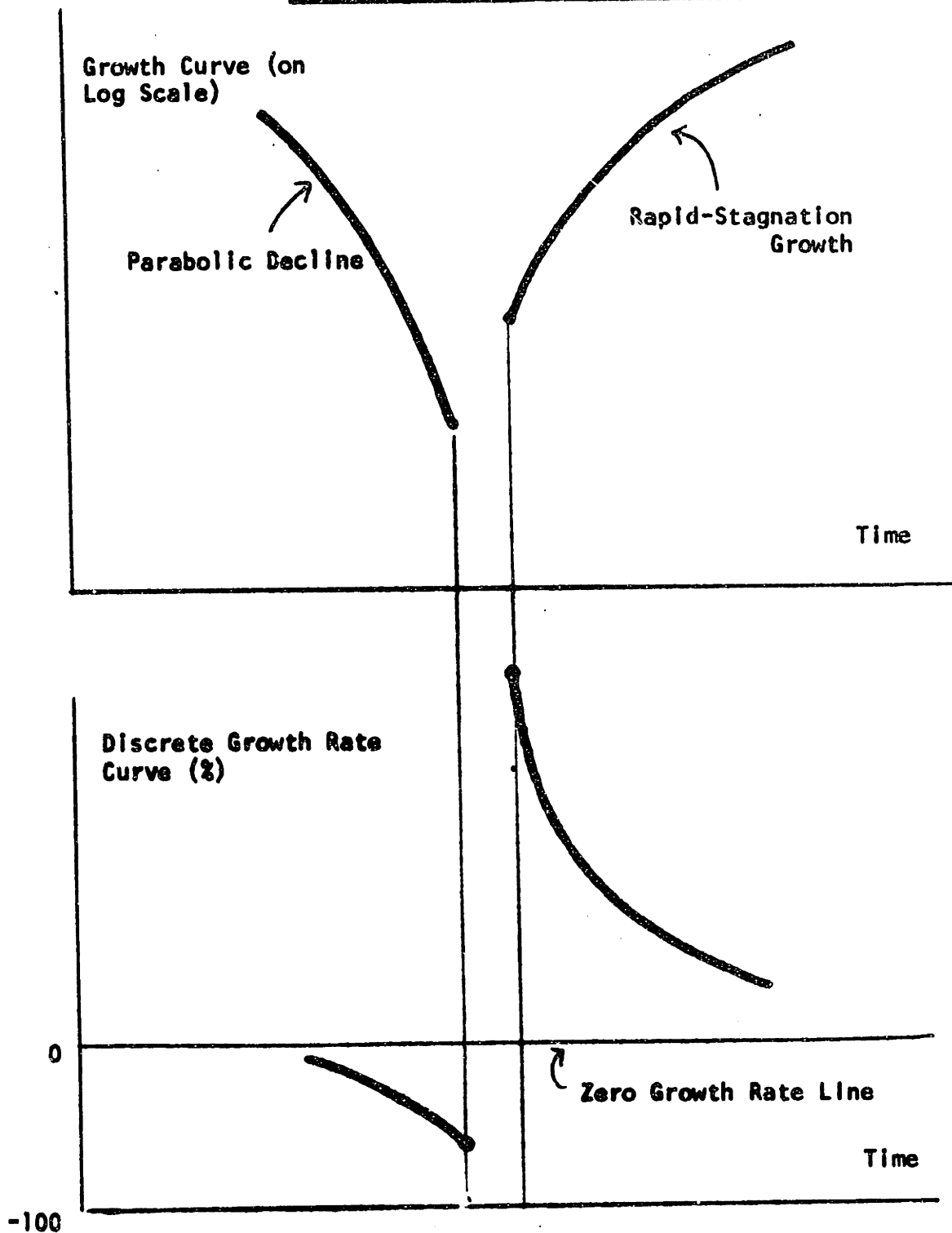
- i) Was the postwar system (i.e., industry) reborn?
- ii) Did the prewar system survive ? If so, did the postwar revitalization policy improve the prewar structure ?
- iii) Up to when did it maintain the prewar pattern ?

4. From Linear (or Mid-Rapid-Stagnation) Growth to Exponential Growth

This change is typically observed when the production of foreign small passenger cars started in 1952 under strict government

FIGURE V-3

**Conceptual Illustration of
Structural Change from Parabolic
Decline to Rapid-Stagnation
Growth**



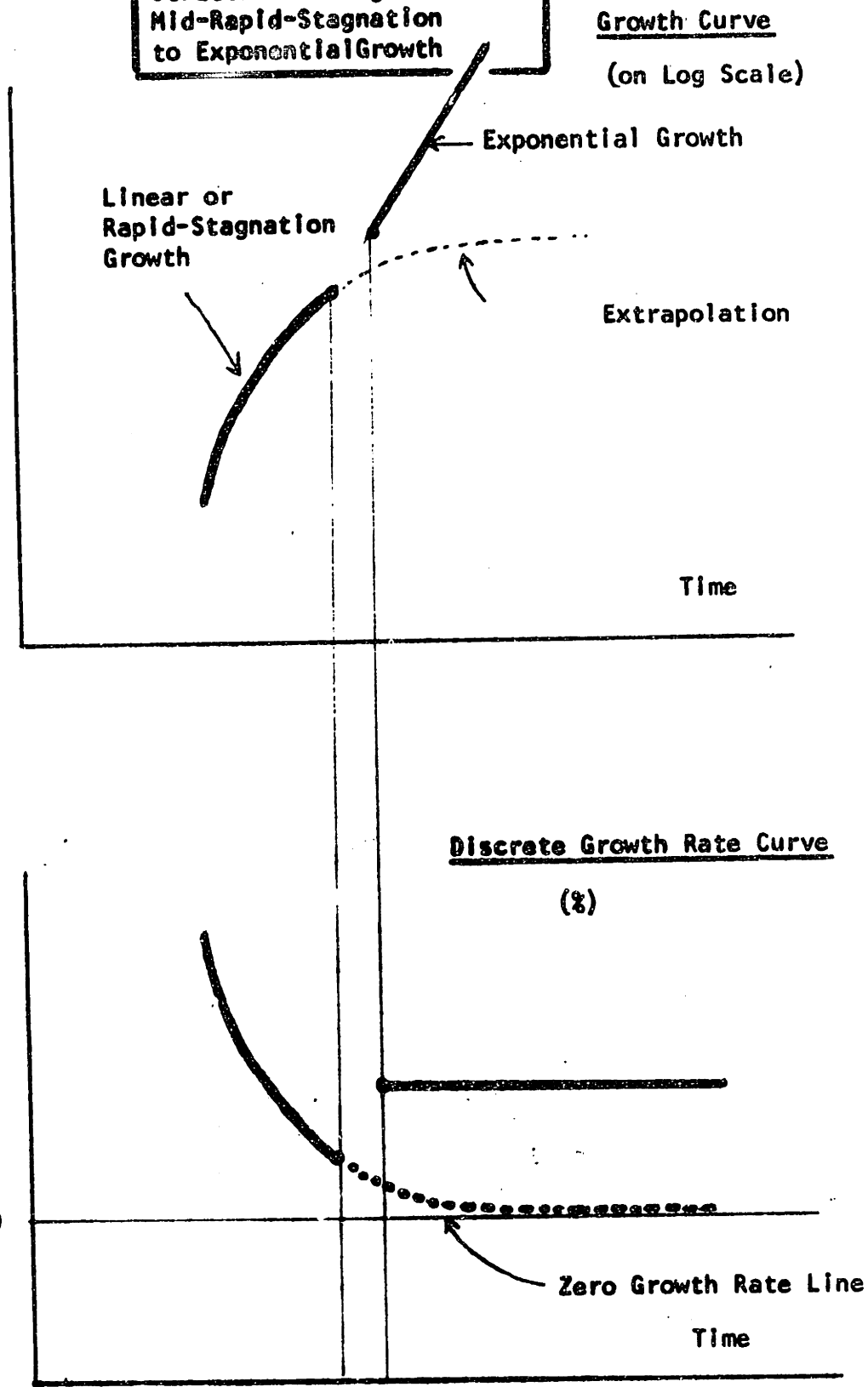
control.

As discussed in CHAPTER IV, the early part of a rapid-stagnation growth pattern sometimes looks like linear growth. This fact is especially clear if we look at data on a logarithmic scale. The same situation would happen for the observation of the discrete growth curves for both cases. Therefore, the term "linear" growth here merely holds in data evidence. In addition, we have already substituted the linear growth trend by the rapid-stagnation one on the grounds that the former trend has no dynamic property in the data generation process.

This change means that a sharply declining growth rate terminates at some point before it reaches the "zero" level as illustrated in FIGURE V-4. Then, it must be worth noticing that this structural change is essentially similar to the first case we have discussed, except that the constant growth rate in a positive value starts well before the previous rates approaches "0."

FIGURE V-4

Conceptual Illustration of
Structural Change from
Mid-Rapid-Stagnation
to Exponential Growth



(B) Model-based Interpretations of Conspicuous Structural
Changes of Growth Rate Curve

1. Purpose of Proposing a Model

There is rich evidence that the Japanese government intervened in the automobile industry for the last 70 years. There is also rich observation to support the fact that after each major intervention the production data for key categories entered into a new structural phase. Our research curiosity leads us to the questions: 1) what happened to the previous structure after government intervention?; 2) did government intervention enhance production performance?; or, 3) did industry improve production performance by itself? The most powerful approach to these questions is, of course, a historical survey involving a careful interview with the people who were actually committed to the policy-making process from both sides: the government and industry. A pitfall associated with this historiographic investigation is the fact that there is no 100% truth to be extracted from human memory. To make matters worse, it is highly likely that trapped information will be collected because past experience is apt to be glorified.

The questions we asked above and the inquiry into the mechanism of the conspicuous structural changes of growth rate patterns are

interrelated. If we successfully identified the mechanism, we would be able to give at least valuable hints on the above questions. In order to identify the mechanism, we need to propose a model which will be able to cover all of the four structural changes of the growth rate curve. This is the primary purpose of the use of a model for our policy intervention analysis.

2. Model

For identifying the structural changes of the growth rate curve, we now propose the following simple model:

$$(V.1) \quad g(t) = a(t)g(t-1) + b(t)u(t-1)$$

Eq(V.1) is a simple first-order heterogeneous linear difference equation. The marked difference from the conventional time-series models like Box-Jenkins' "autoregressive/moving-average" (ARMA) model is quite obvious. That is to say, the two parameters, $a(t)$ and $b(t)$, are no longer fixed but time-variant. As we will discuss in the following part, this feature enables us to inquire into the structural changes of the growth rate curve with greater flexibility.

The model suggests that a growth rate be dynamically determined by the two structures: the first-order homogeneous structure which generates an exponential trend and the first-order heterogeneous

structure which adds the impact of extraneous input to the growth rate determination process. If we assume that the input $u(t)$ is a unit step or impulse function implying an "on/off" situation of policy intervention, the model can switch from homogeneous to heterogeneous. The time-variation of both parameters is first-order. That is, a value in either parameter is determined by the one-period-prior value.

It is particularly important to note our rationale for proposing such a simple first-order model. First, it would be a sufficient structure to delineate the dynamically changing growth rate curve since our parameters are time-varying. They will hopefully explain much of the pattern changes. Second, as already discussed in CHAPTER IV, the four conspicuous pattern changes of dynamic maturation can be approximated by the different types of a first-order difference equation. Third, if we employ a first-order model, it would be rather easy to draw structural implications. For example, the homogeneous parameter roughly implies the acceleration factor vis-à-vis the growth trend of production. Fourth, the first-order model is sufficient to our primary purpose not to accurately forecast a future trend of the growth rate curve, but to examine the structural property of the past trend, i.e., "filtering of historical data."

3. Hypothetical Interpretations of the Four Structural Changes

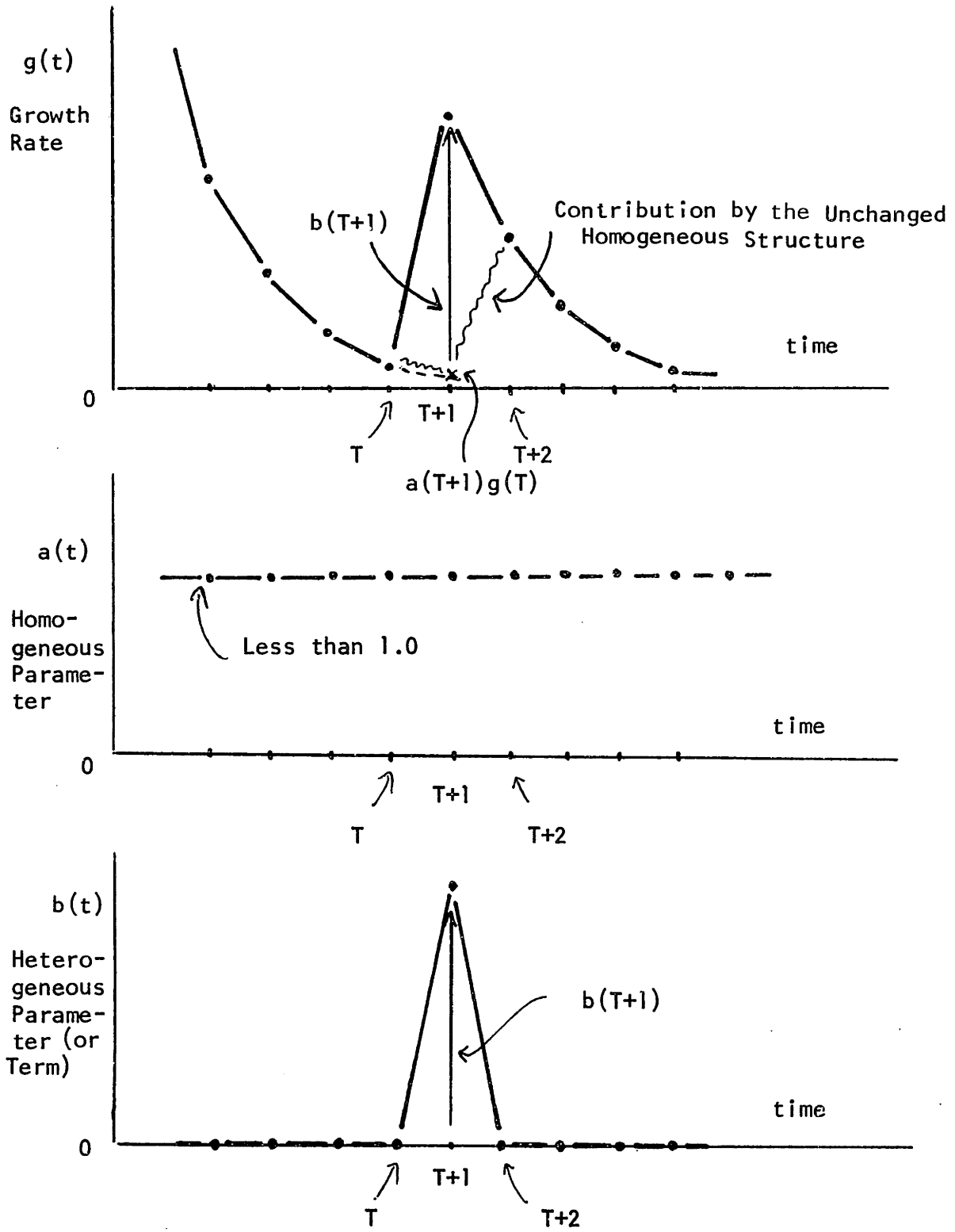
a) From Rapid-Stagnation to Exponential

As long as data are concerned, the production of domestic 4-wheelers was stagnated before 1932, when the government announced the MCI Standard Model. This rapid-stagnation growth is somehow equivalent to the exponential decline of the growth rate, as we have discussed in the previous part of this section. Then, it is quite plausible to conjecture that because of this stagnation, the government intervened into industry in order to push the stagnated growth curve by introducing the government-specified model with an attractive procurement incentive. However, it is quite difficult to postulate that production performance of industry was improved so soon by this single intervention. It is thus more plausible to speculate that production performance remained the same, but the production growth rate of the year next to the intervention year was superficially increased because of government procurements. This situation is shown in FIGURE V-5. One may draw an interesting implication from this picture.

If an exogenous input (we subjectively assume that this is government intervention) did not exist at $t=T$, the growth rate at $T+1$ would reach the "x" point in the figure. However, if the actual growth

FIGURE V-5

Growth Rate Curve When The System with the Unchanged Previous Structure Receives A Single Extraneous Input

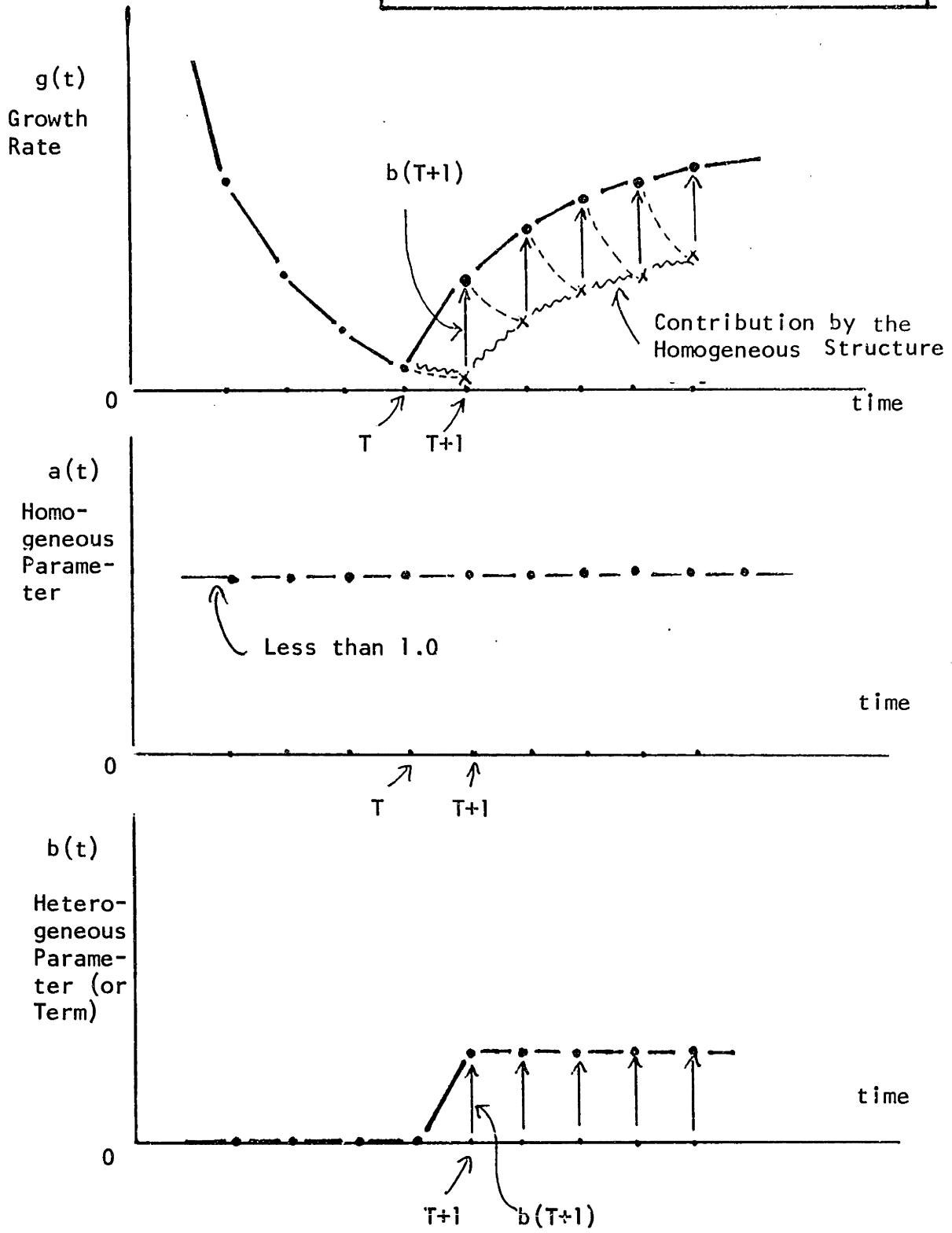


rate jumped up to a high point, the difference between this point and the "x" point would be totally due to such an exogenous input. Now, the growth rate is in fact improved at $T+1$. But, if the input occurred only at a single time $t=T$, the growth rate from $t=T+2$ would again start declining since the previous homogeneous structure remains the same. Therefore, if the government wanted the growth rate to jump up and continue to keep its high position and industry's production performance (i.e., the homogeneous parameter) did not improve itself for meeting such a government expectation, the government would have to intervene continuously until the homogeneous structure is improved. If industry was weak and became more and more dependent upon the government's help, the first high superficial improvement of production (and growth rate) might delay industry's intramural effort to ameliorate production performance. As we see in this figure, this fact provides the government with a good rationale for a long-term intervention. By this process, it is then likely that industry and government create an indispensable relationship of mutual cooperation.

Next, what would happen if the government continuously intervened into industry with a moderate intervention. This situation is hypothetically depicted in FIGURE V-6. As shown in the growth rate curve, the growth rate is gradually improved. Then we ask, what would happen if growth entered into an exponential pattern, given the fact that the previous homogeneous structure is unchanged? This situation

FIGURE V-6

Growth Rate Curve When The System with the Unchanged Previous Structure Receives The Constant Extraneous Input



is exactly the first structural transformation of the growth curve we have identified previously. As shown in FIGURE V-7, an intervention effect at $T+1$ must be relatively big and could be eased in successive years. As discussed above, if intervention disappeared, the growth rate curve would again begin to decline.

b) From Exponential to Parabola

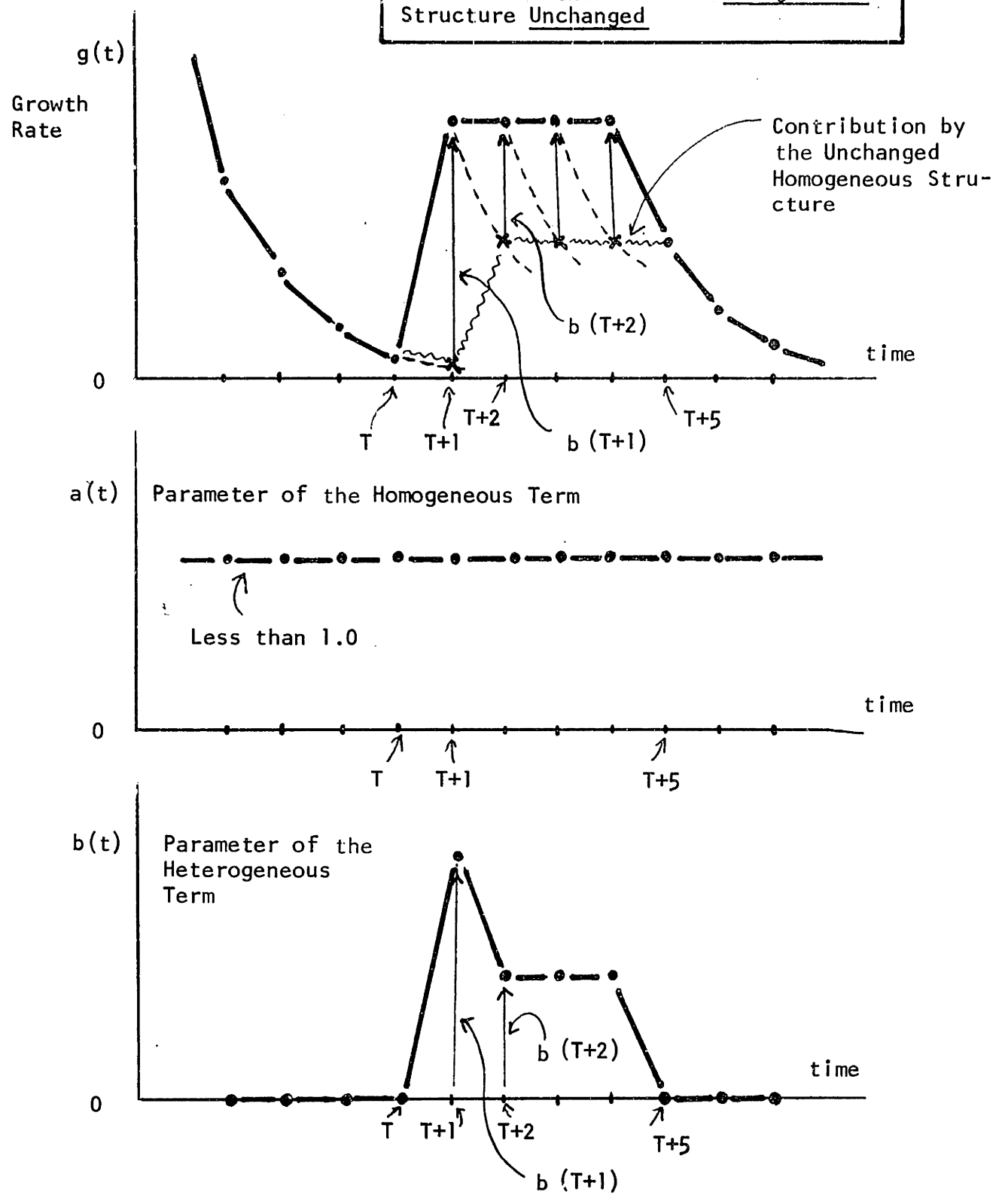
As shown in FIGURE V-5 or FIGURE V-7, if intervention ceased, the growth rate curve would eventually decline and stay near a "zero" level, provided that the homogeneous parameter still remained at a value smaller than 1.0. The structural characteristics of a parabolic pattern has not been described yet, because until the growth trend stagnates, it can hardly be distinguished from a parabolic growth unless it starts declining. However, we categorically classify the growth trend as a parabolic growth if it grows at a declining growth rate smoothly extending to a negative value. Now, the real property of a parabolic growth trend comes when the growth rate curve goes below the zero level. We have two hypothetical cases in this regard.

i) A Strong Intervention to Cease the Exponential Trend

If the current intervention disappears for some reason, a growth rate reaches the near zero level, not immediately, but after a while. However, the data of purely domestic 4-wheeler production indicates

FIGURE V-7

Transformation from Rapid-Stagnation Growth to Exponential Growth with the Previous Homogeneous Structure Unchanged

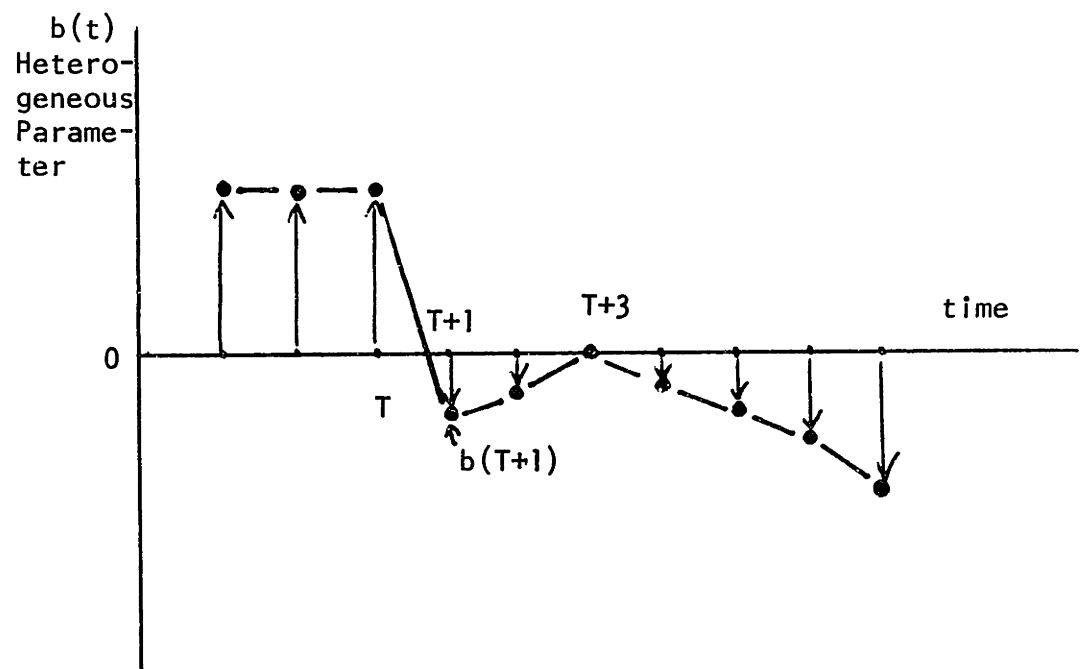
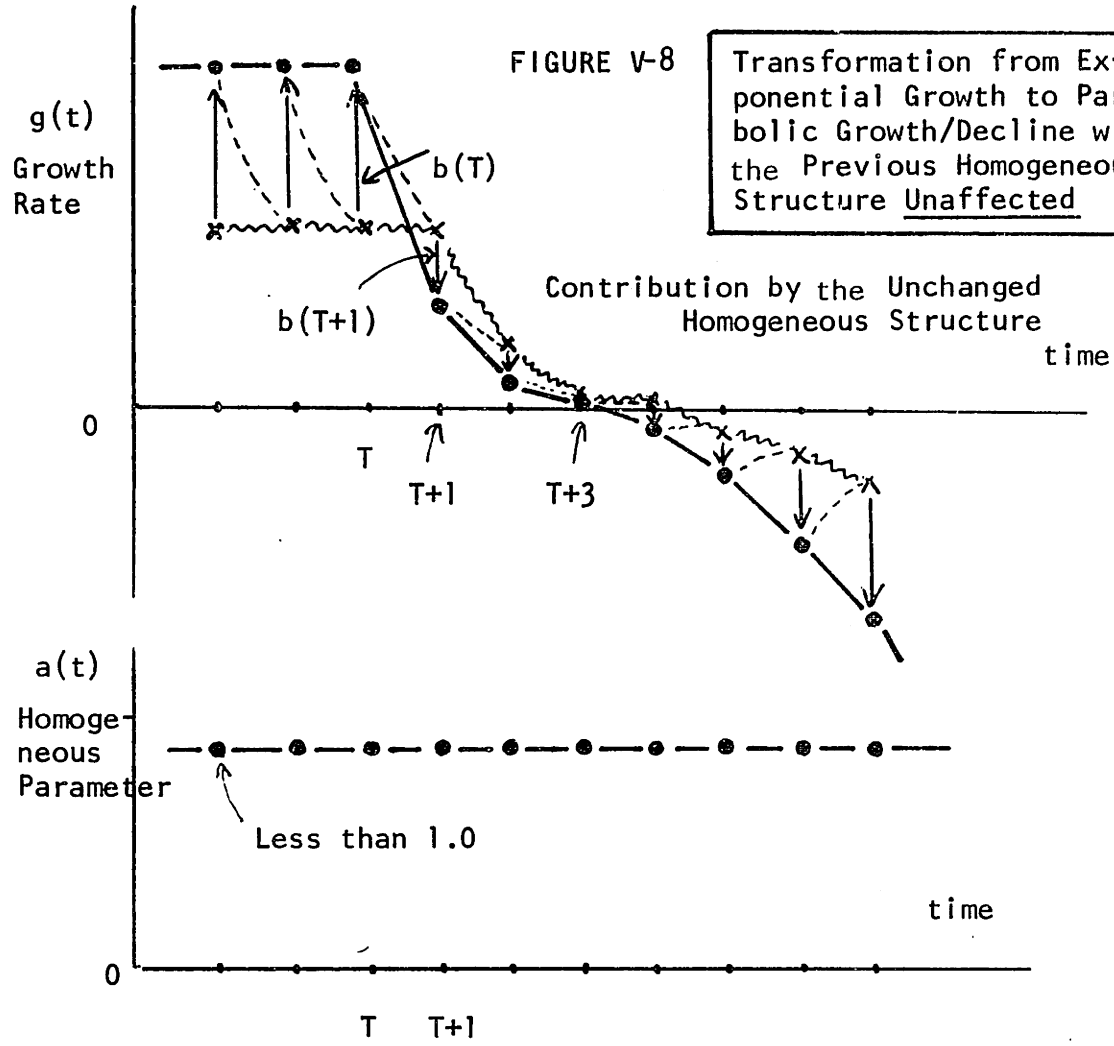


that the exponential growth abruptly ended in 1940 and immediately entered into a parabolic decline pattern. This situation is conceptually illustrated in FIGURE V-8. It is now apparent that a negative force works on this abrupt end of the growth. Of course, if industry itself collapsed and production growth ceased, we would not have to speculate about the existence of an extraneous cause to suppress a growth rate. However, in terms of the conventional logic of a dynamic process of industrial activity, such a situation is hardly supported. Then it might be more plausible to conjecture that the internal homogeneous structure remained the same, but an external force suppressed the growth.

In this situation, any negative effect of intervention at $T+1$ must be quite great. If this strong coercive intervention to suppress production continued, the growth rate curve would sharply enter into the negative region forming more or less a linear pattern. On the other hand, if government feared such a drastic deterioration of production that it eased the magnitude of intervention, the growth rate curve would stay near zero from the negative region. However, if a growth rate ever reached the -1.0 point, the negative intervention would have been increased in magnitude as illustrated in this figure. Although the situation described above remains quite speculative, there is ample evidence that the Japanese military government negatively intervened into industry and consequently led production into a parabolic decline. The strict rationing of material resources

FIGURE V-8

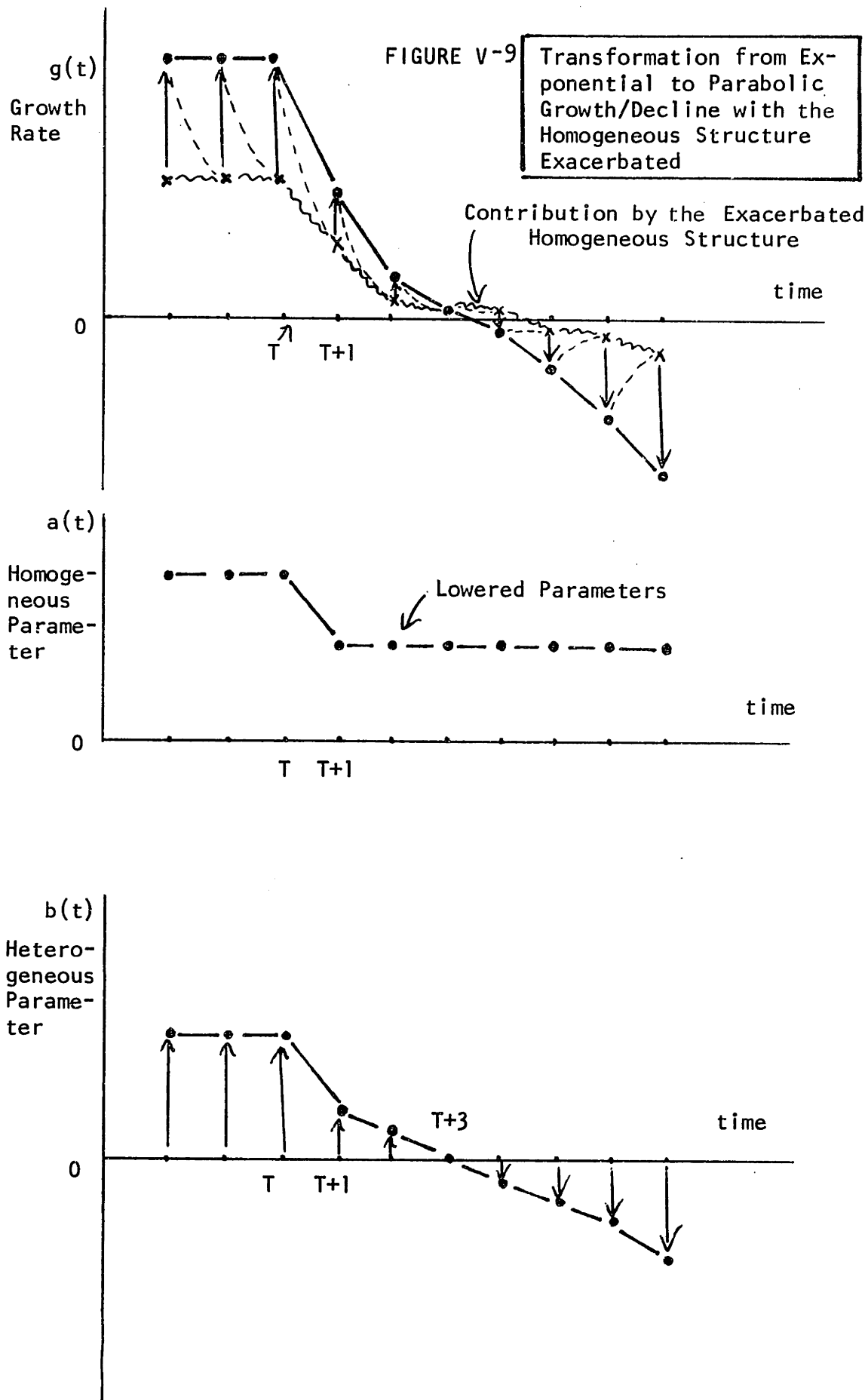
Transformation from Exponential Growth to Parabolic Growth/Decline with the Previous Homogeneous Structure Unaffected



and the mandatory order of aircraft manufacturing are examples of this negative intervention.

ii) Deterioration of the Homogeneous Parameter by a
Decrease in Outside Support

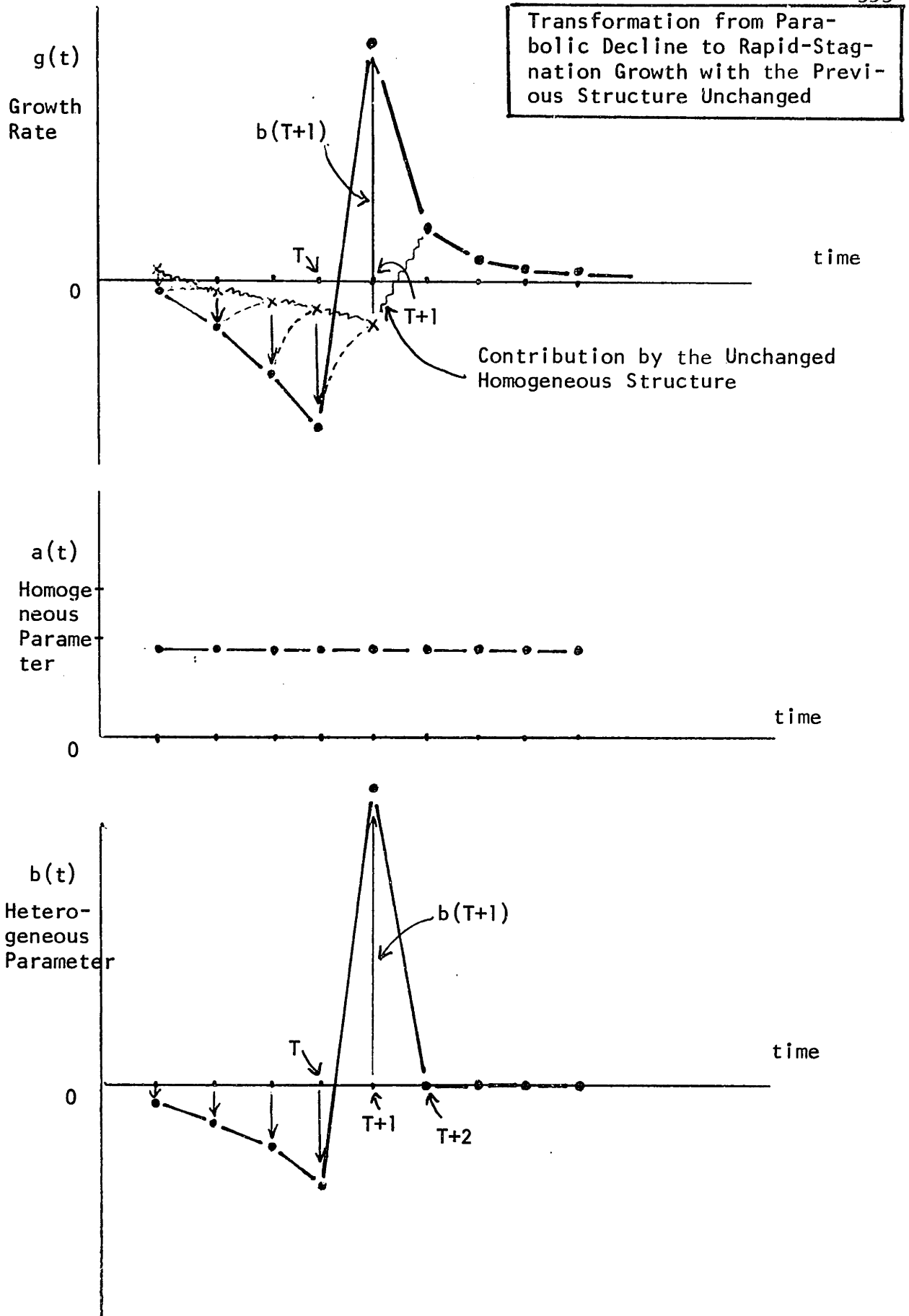
Now we will consider the second case that would eventually cause the growth curve to form a parabolic trend. Assume that for certain reasons the current outside support for productive enhancement could no longer continue, so that the heterogeneous term declined continuously into the negative region. One may conjecture that this situation would reflect the change in government's supportive policy due to fatigue in the economy or the disorientation of industrial policy toward different areas, such as the manufacturing of military weapons. If the homogeneous term was not affected and hence continued to keep a current value even in such a situation, the resultant growth rate curve would decline in convex shape, which would more or less form a parabolic growth curve. However, as already discussed in CHAPTER IV, the standard pattern of the growth rate curve to yield a parabolic pattern on the growth curve is a declining curve of the order of three. Keeping this fact in mind, we now speculate that the homogeneous parameter would be deteriorated for some reason. If this is so, the growth curve would result in a typical parabolic pattern as illustrated in FIGURE V-9. The question as to which was the real situation for the Japanese automobile case is answered by both data observation and historical investigation.



c) From Parabolic Decline to Rapid-Stagnation

After the Pacific War ended, almost all automobile data ceased to decline and thus entered into a new growth trend. Some data immediately started growing, and some did not until the GHQ released the prohibition of production of a specific type. Structurally, this change is the one from parabolic decline to a rapid-stagnation. We have assumed that the previous parabolic decline had been primarily caused by an extraneous force, not by the deterioration of industry's own productive potentiality. Note that most of the production plants could have escaped the air-raids of the American bombers during the war and the GHQ's occupation of plant facilities for a reparation measure terminated soon because of the severe shortage of the nation's transportation. Therefore, it would be realistic to assume that the prewar system of automobile production was continued in the postwar period without a major change of productive potentiality.

If the prewar negative interventions ceased and if production performance of industry maintained the previous level, the growth rate would go up to the zero line from the negative region as shown by the wavy line in FIGURE V-10. This means that the current sharp convex decline of production would change to a concave decline. It is worth noting that unless positive intervention occurred at the next period, the growth rate would never enter into the positive region. If a strong positive intervention occurred at time T and was made explicit



at the next time $T+1$, the growth would immediately enter into the positive region and hence production would go up in a rapid-stagnation pattern without successive interventions thereafter, since industry's prewar production potentiality (i.e., homogeneous parameter) can alone maintain this pattern.

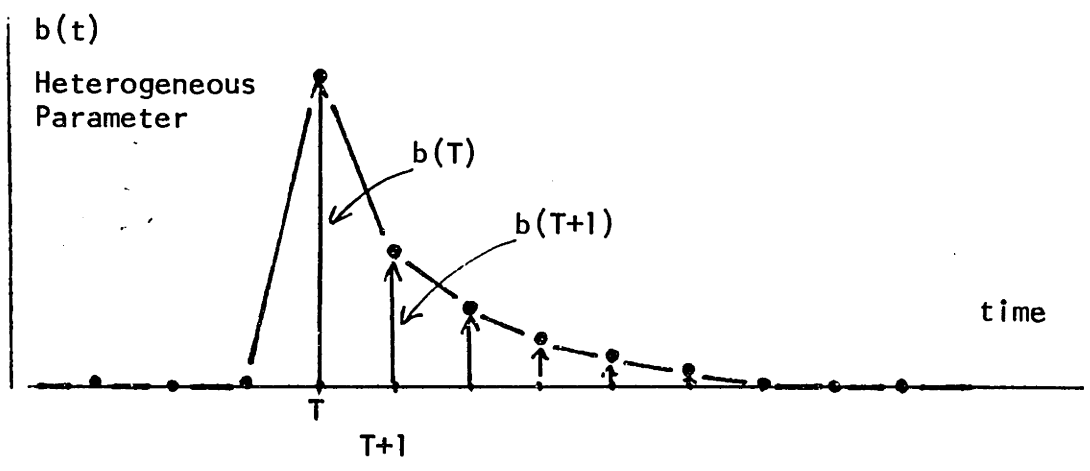
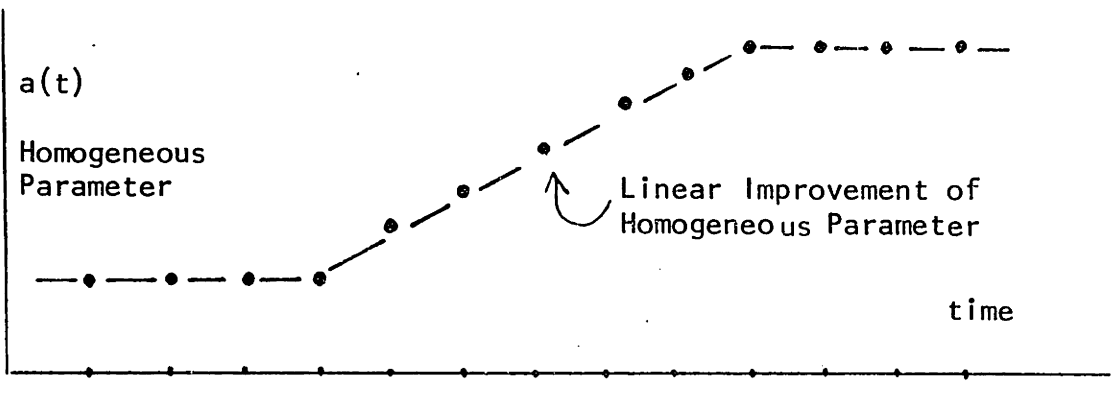
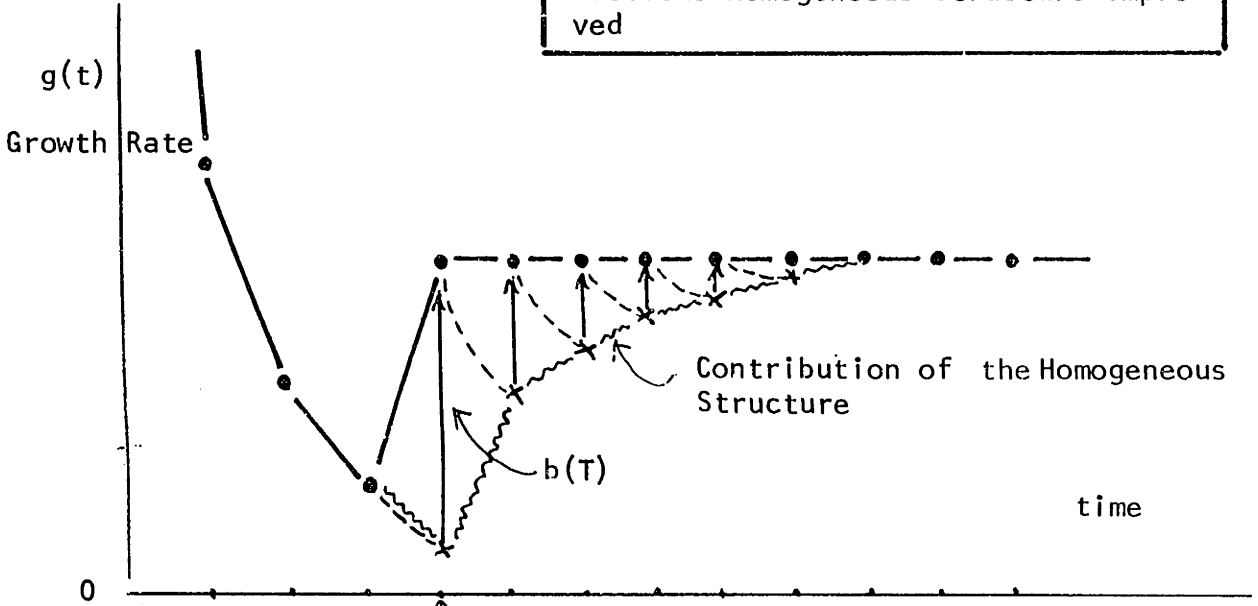
d) From Exponential to Mid-Rapid-Stagnation

This change is applied to the production of domestic small passenger cars before and after the policy on foreign technology contracts started in 1952. The structural nature of this change is essentially the same as that of the first structural change discussed above.

The previous discussion made it clear that the termination of stagnation necessitated a strong intervention. Furthermore, the maintenance of exponential growth needs a successive intervention. However, as discussed in SECTION III-3, the technology contracts approved by the government must include the condition that the Japanese companies could transfer foreign technology to their own models through learning by assembling of foreign models. This suggests that productive performance of industry would have been improved. In other words, instead of relying on government supportive intervention, the improvement of industry's productive performance primarily maintains exponential growth. Structurally speaking, the increase of a

value of the homogeneous parameter and the decrease of a value of the heterogeneous parameter jointly maintain a constant level of the growth rate curve as shown in FIGURE V-11.

FIGURE V-11 Transformation from Rapid-Stagnation Growth to Exponential One with the Previous Homogeneous Structure Improved



SECTION V-2

STRUCTURAL IDENTIFICATION OF GROWTH RATE CURVE

BY THE KALMAN FILTER [1]

(A) Basic Idea of the Kalman Filter

The preceding discussion on the structural changes of the growth rate curve is quite speculative, totally based upon our visual inquiry into the growth rate curves with the knowledge of a simple difference equation. In this section, an effort will be made to examine whether or not the actual data fit our speculative discussion. Our aim is to check the time-variation of both the homogeneous and the heterogeneous parameters. Since the model has the time-variant parameters, we will employ a special technique, called the "Kalman Filter." The Kalman Filter is the "recursive" estimator of a system's "states." Putting it differently, the Kalman Filter is a set of algorithms to reconstruct the system states, whether they are visible (measurable) or invisible (unmeasurable). As a simple analogy, one may regard the gravitation constant in the Newtonian equation as the time-invariant state. It governs the location of a moving object. Also, the speed of a running car is the time-variant state which governs the distance that car reaches. If we regard speed as a measurement variable, acceleration is the time-variant state that determines the current speed of a running car. There are numerous examples of a dynamic system which implicitly or explicitly contain the concept of the system states. In this

regard, the Kalman Filter gives an optimal state estimate if a system can be of the following general form [2]:

$$(V.2) \quad x(t) = Ax(t-1) + Cu(t-1) + Lv(t)$$

$$(V.3) \quad y(t) = Bx(t)$$

$$(V.4) \quad z(t) = y(t) + w(t)$$

where $x(t)$: states vector

$u(t)$: inputs vector

$v(t)$: system noise vector

$y(t)$: outputs vector

$z(t)$: outputs measurement vector

$w(t)$: measurement errors vector.

The features of the above discrete system model are:

- 1) the current states are jointly determined by: i) one-period-prior state values, ii) one-period-prior inputs, and iii) current system noise.
- 2) system's outputs are simultaneously determined by current states.
- 3) the measurement of system's outputs is not accurate, but contains measurement errors.

Upon this system model, optimal state estimates are given by the

Kalman Filter through a recursive process as follows: [3]

Mean Prediction Process

$$(V.5) \quad \hat{x}(t/t-1) = A\hat{x}(t-1/t-1) + Cu(t-1/t-1)$$

Residual (called "innovation")

$$(V.6) \quad r(t) = z(t) - B\hat{x}(t/t-1)$$

Mean Updating Process

$$(V.7) \quad \hat{x}(t/t) = \hat{x}(t/t-1) + K(t)r(t)$$

Eq(V.5) shows the process in which the prediction values of system states are given by the best estimates of the one-period-prior system states and of the one-period-prior system inputs given the state equation model Eq(V.2). Eq(V.6) shows the difference between the actual observation and prediction of system outputs when observation is taken. Then, using this prediction-error information, the Kalman Filter corrects (updates) the state prediction values according to Eq(V.7). The correction criterion $K(t)$ is called the "Kalman Filter gain." It is known [4] that $K(t)$ becomes larger when parameter estimation errors continued to become larger in the past estimation processes and when the variance of system noise is small. As shown in FIGURE V-12, a feedback loop exists to utilize the prediction error in order to find the best estimate and to predict again system states at

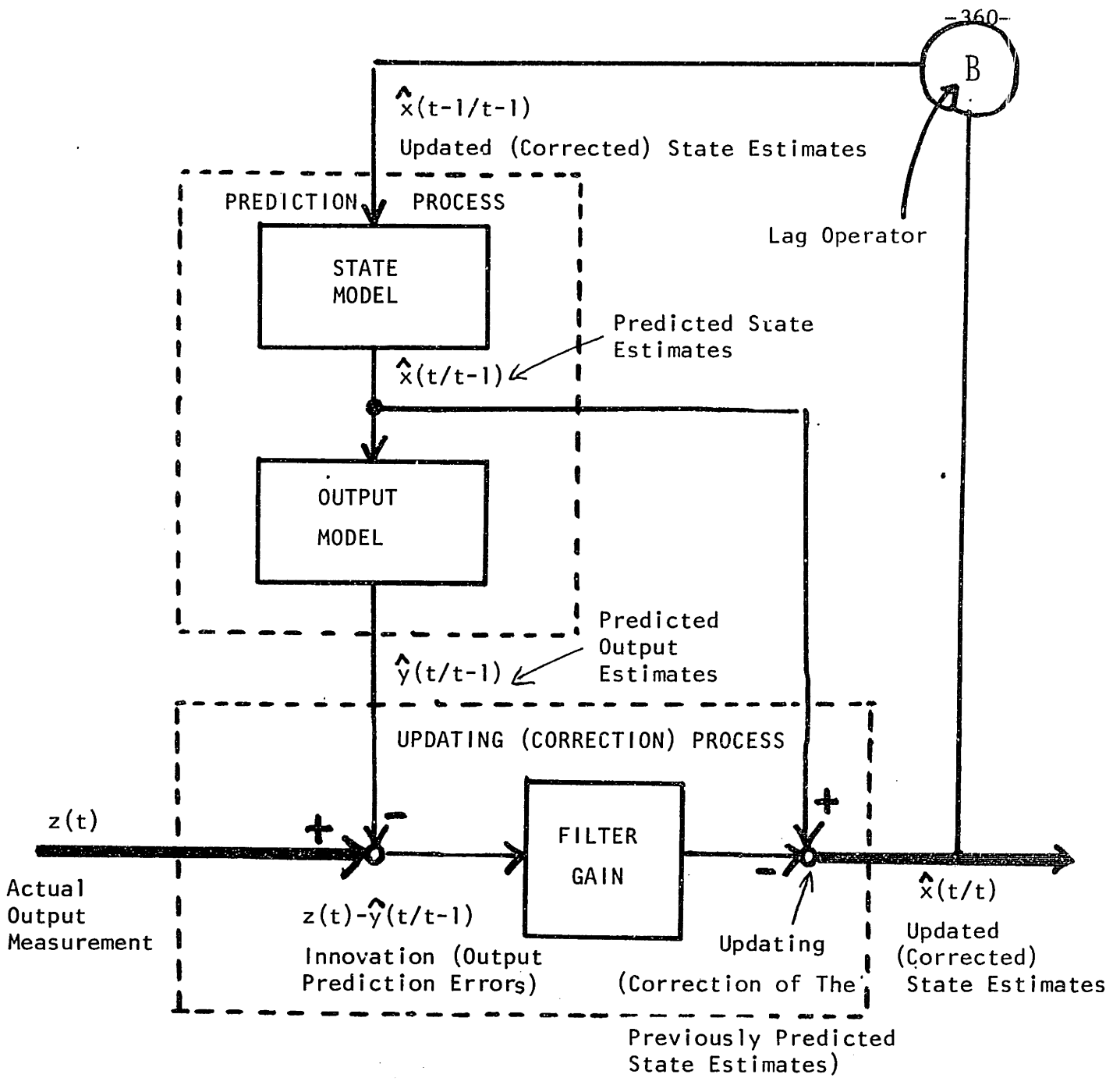


FIGURE V-12

Conceptual Diagram of
the Kalman Filter's
States Estimation Process

the next period. It demonstrates the learning process of the Kalman Filter based on the past prediction error.

(B) The "Kalman Filter Government": The Kalman Filter Applied to
Our Model

The model in Eq(V.1) is a deterministic model which does not involve the stochastic nature of data. The model needs modification in order to apply data which is assumed to contain random errors. The modified model is shown in FIGURE V-13. The following figures, FIGURES V-14 and V-15, show the alternative descriptions of the model. The marked feature of this stochastic difference equation model remains in the specifications of: 1) an input variable, and 2) the time-variation of parameters.

First, our model specification in FIGURE V-13 structurally means $u(t)$ as an input variable. However, as we discussed earlier (SECTION V-3, 3), the real input to the system is the heterogeneous parameter, i.e., an intervention magnitude. Therefore, $u(t)$ in the model indicates the occurrence of intervention, having only 1 or 0 value. This model specification is particularly useful when we have no numerical data regarding the magnitude of intervention, such as an amount of subsidy or procurement, and when we do not exactly know the

A. Growth Rate Measurement Model (Output Measurement Equation)

(V. 8)

$$z(t) = a(t) \cdot g(t-1) + b(t) \cdot u(t-1) + w(t)$$

where

- $z(t)$: measurement of growth rate
- $g(t)$: "true" (without measurement error) growth rate
- $a(t)$: time-variant homogeneous parameter
- $u(t)$: dummy input to indicate the occurrence of policy interventions (unit impulse of unit step function)
- $b(t)$: time-variant heterogeneous parameter (when the input is either unit step or impulse, it becomes the heterogeneous term itself)
- $w(t)$: measurement error

When the input $u(t)$ is either the unit step or impulse function,

(V. 9)

$$z(t) = a(t) \cdot g(t-1) + b(t) + w(t)$$

B. Time-Varying Parameters Model (State Equation)

(V.10)

$$a(t) = a(t-1) + e(t)$$

$$b(t) = b(t-1) + s(t)$$

where

- $e(t)$: perturbation ("system noise") to drive the change in $a(t)$
- $s(t)$: perturbation ("system noise") to drive the change in $b(t)$

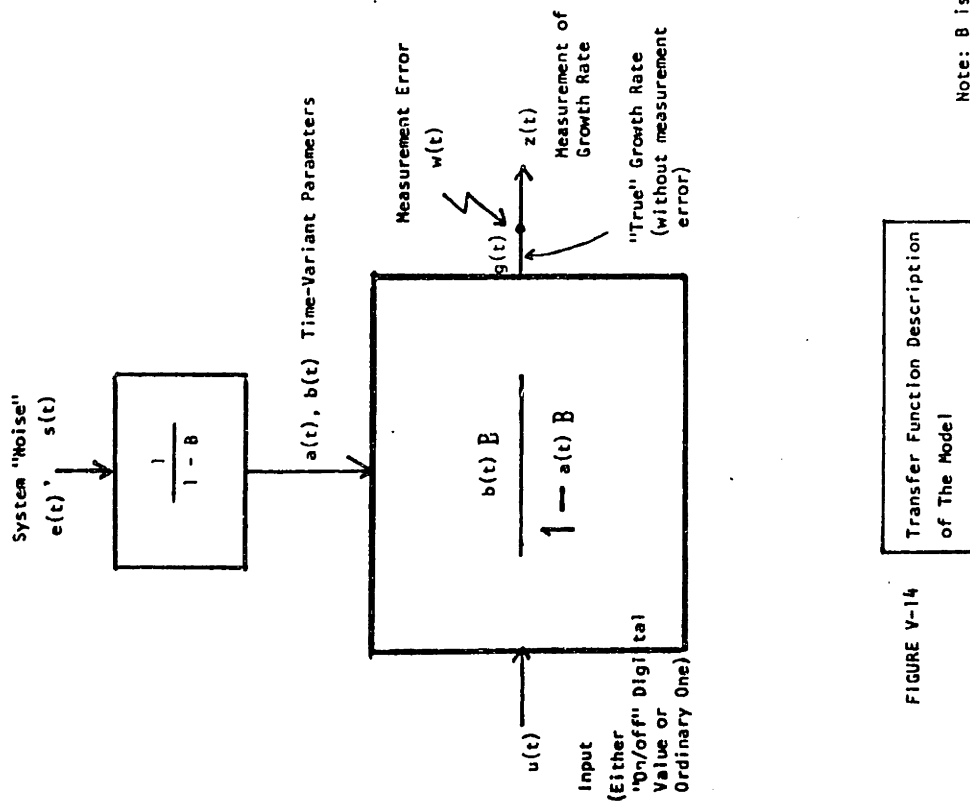


FIGURE V-14

Transfer Function Description of The Model

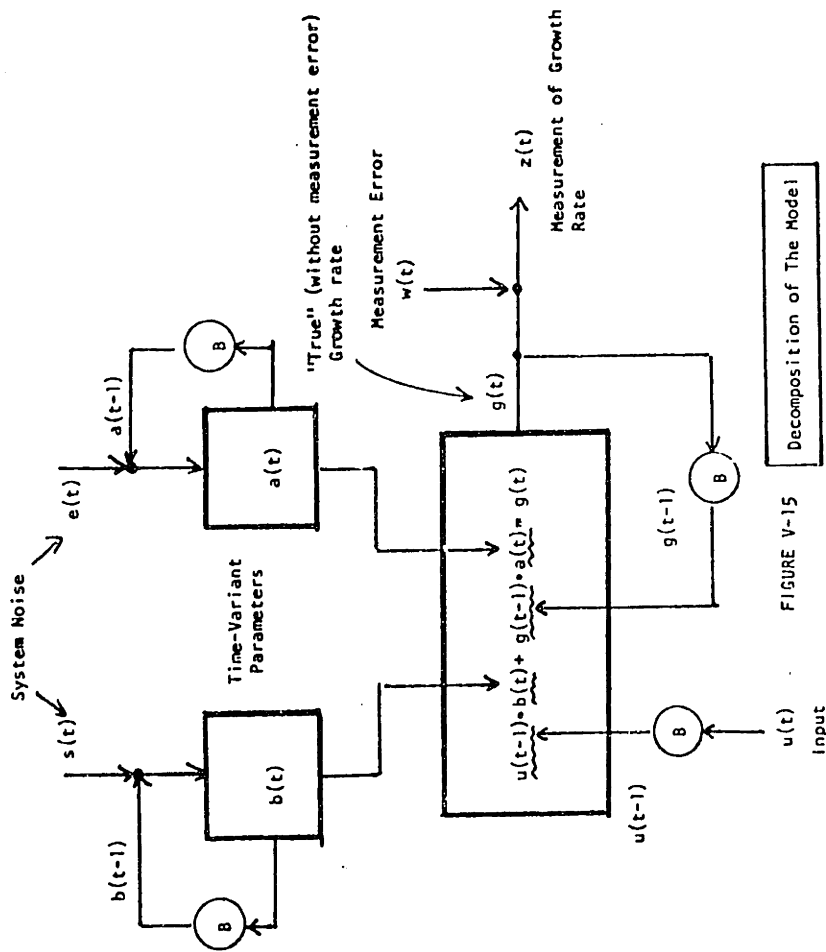


FIGURE V-15

Decomposition of The Model

Note: B is the lag operator.

mechanism to transform these intervention inputs into production performance.

Second, the state model indicates that both homogeneous and heterogeneous parameters at time "t" are determined by their one-period-prior value at time "t-1" and by the "perturbation"(or simply, "system noise") at time "t." Since the coefficients of the terms on the right hand side are specified "unity," the state model assumes that the parameter changes are driven by the perturbation [5]. That is to say, the model admits the ignorance as to the accurate structure of the time-variation of parameters.

Now, let us rewrite the model in terms of the Kalman Filter's state-space description. Define the following vectors

$$(V.11) \quad x(t)' = [a(t), b(t)]$$

$$(V.12) \quad v(t) = [e(t), s(t)]$$

$$(V.13) \quad B(t)' = [g(t-1), u(t-1)].$$

The model is thus rewritten as:

$$(V.14) \quad x(t) = x(t-1) + v(t) \quad [\text{State Equation}]$$

$$(V.15) \quad g(t) = C(t)x(t) \quad [\text{Output Equation}]$$

$$(V.16) \quad z(t) = g(t) + w(t) \quad [\text{Output Measurement Equation}]$$

Directly applying the Kalman Filter algorithms of Eqs. (V.5), (V.6) and (V.7) to the above three equations yields:

Prediction Process

$$(V.17) \quad \hat{a}(t/t-1) = \hat{a}(t-1/t-1)$$

$$(V.18) \quad \hat{b}(t/t-1) = \hat{b}(t-1/t-1)$$

Updating Process

$$(V.19) \quad \hat{a}(t/t) = \hat{a}(t/t-1) - K1(t)r(t)$$

$$(V.20) \quad \hat{b}(t/t) = \hat{b}(t/t-1) - K2(t)r(t)$$

where $K1(t)$: filter gain of $a(t)$
 $K2(t)$: filter gain of $b(t)$
 $r(t) = z(t) - g(t/t-1)$.

Suppose that the Kalman Filter is a collective decision-making body of government. Let us call it the "Kalman Filter Government." Suppose further that at the end of the period $t-1$, the Kalman Filter Government knew, based on the past history of production performance of the automobile industry, that the growth rate curve had been approaching zero level, moving on a track of an exponentially declining curve. Then, at the beginning of the period t , the Kalman

Filter Government forecasts that the growth rate at t will be on a further point along this exponentially declining trend [7]. Such a forecast is based upon two factors: 1) the Kalman Filter Government's knowledge of the current state of production performance of industry, and 2) the Kalman Filter Government's belief that such performance will be continued in the next period [8]. Then, in order to let the growth rate "take off" this stagnated trend, the Kalman Filter Government intervened into industry with some incentive measures, like government procurement. The above decision-making process of the Kalman Filter Government is illustrated in both FIGURES V-16 and V-17.

(C) Preparations for A Kalman Filter Analysis

1. Data Selection and Adjustment

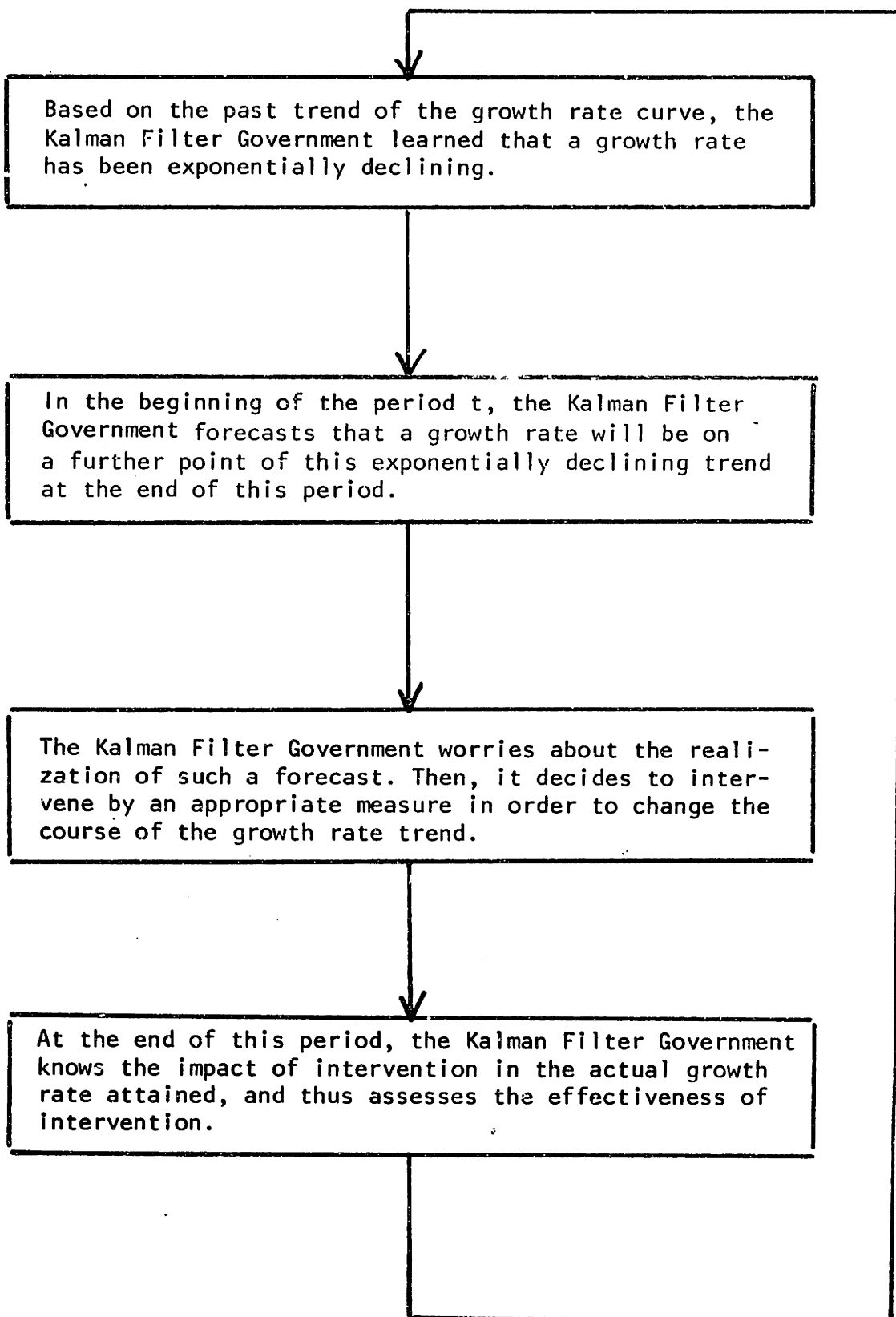
We have chosen the following datasets for the application of the Kalman Filter: [9]

Dataset 1: Production of all domestic 4-wheel cars

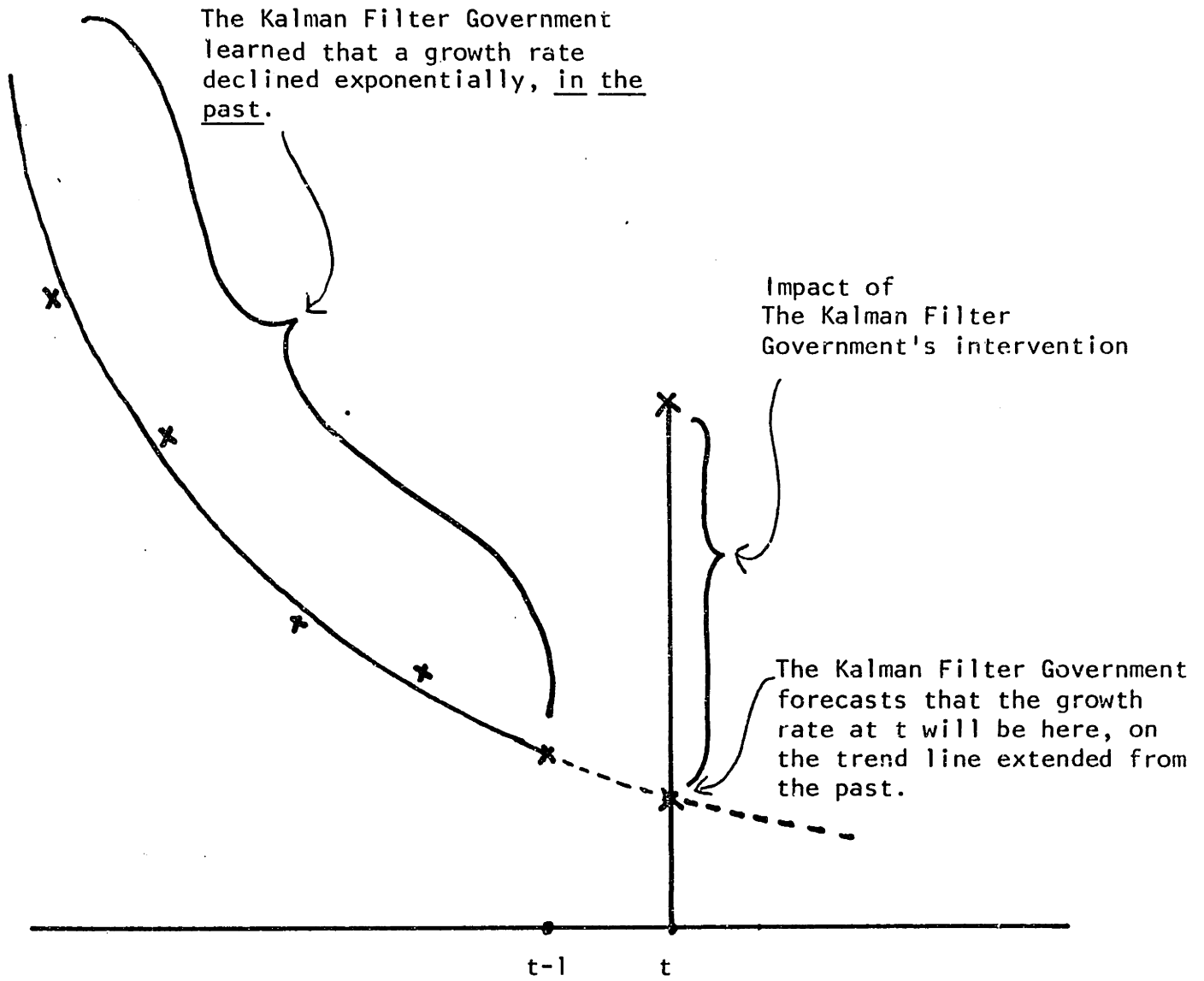
Dataset 2: Production of domestic medium trucks and buses

Dataset 3: Production of small passenger cars.

The selection of the above data sets reflects the previous



The Graphical Example of
The Kalman Filter's
Intervention Process



historical study in PART I on the major areas of government policies. The first intervention (The Law of Military Trucks), the second intervention (The Ministry of Commerce and Industry's Standardized Model), the third intervention (The Law Regarding Automobile Manufacturing Enterprise), the fourth intervention (the collective military policies during the war), and the fifth intervention (the GHQ's permission of the reopening of automobile production), were directly aimed at the production of medium trucks and buses (Data Set 2). The third intervention, the fifth intervention, the sixth intervention (import restriction), the seventh intervention (the technology contract policy), and the eighth intervention (the Peoples' Car Plan), were directly or indirectly associated with the production of small passenger cars (Data Set 3). The Data Set 1 has been added for the purpose of examining the overall impacts of these interventions on an aggregate level.

Before the Kalman Filter is applied, these data have been adjusted. First, the datasets have been "trimmed" to immediately start a conspicuous smooth trend pattern. In other words, the data during the early period of random fluctuation were eliminated on the ground that the Kalman Filter Government could only learn the state of industry's production performance if it had a conspicuous trend pattern. Our pre-analysis examination of the data sets has found the following starting years:

Dateset 1: 1924

Dateset 2: 1924

Dateset 3: 1932.

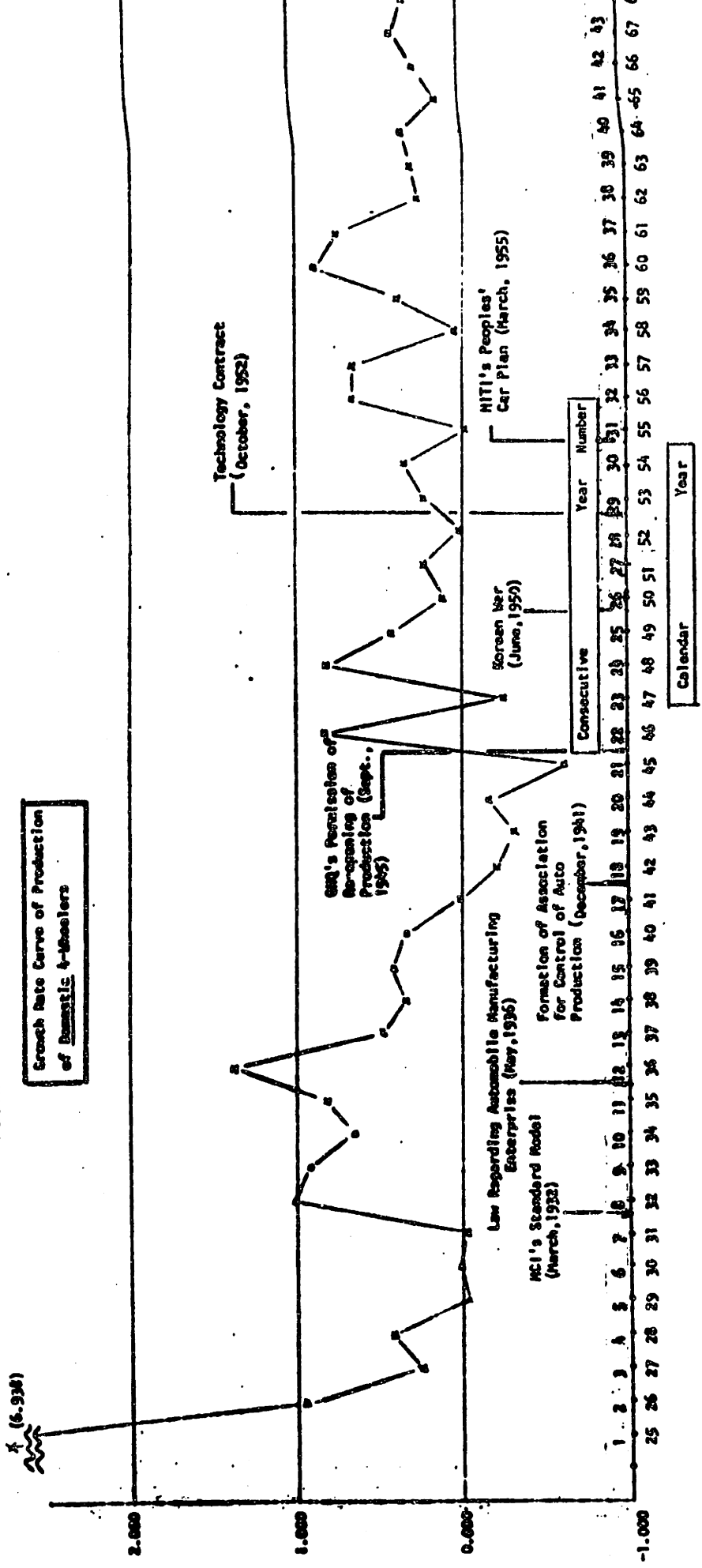
Second, data have been manually "filtered" in advance to show only domestic production, eliminating those of production of foreign models under technical contracts. The reason for this adjustment derives from the assumption that the government would have determined an intervention magnitude by looking at the domestic production of various types of cars as a basic policy reference. Third, data have been "squeezed" not to conflict with the definition of a growth rate. According to the definition of a growth rate, the zero division problem would occur if production of the prior year was zero. Next, we have eliminated these years for our data sets. The time-series graphs of the adjusted data sets are shown in FIGURES V-18, V-19, V-20, respectively.

2. The Specifications of Dummy Input $u(t)$ and Initial Conditions

Input.

The two different types of time functions, namely a unit impulse and a unit step, may be applied to the dummy input $u(t)$ in order to make the model heterogeneous. Technically, the successive occurrence

FIGURE V-18 Dataset 1



1 (6-1938)

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1.000
0.000
-1.000

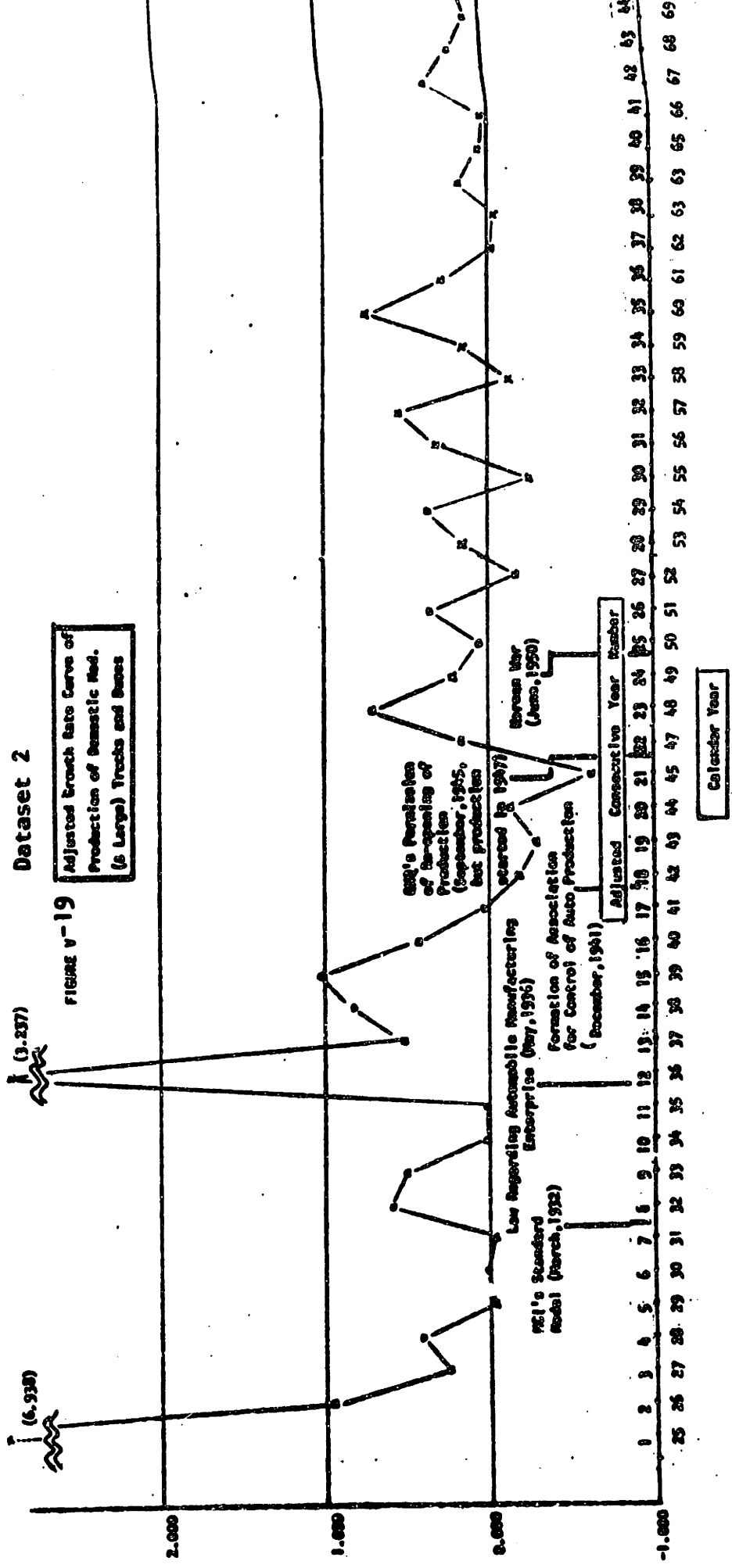
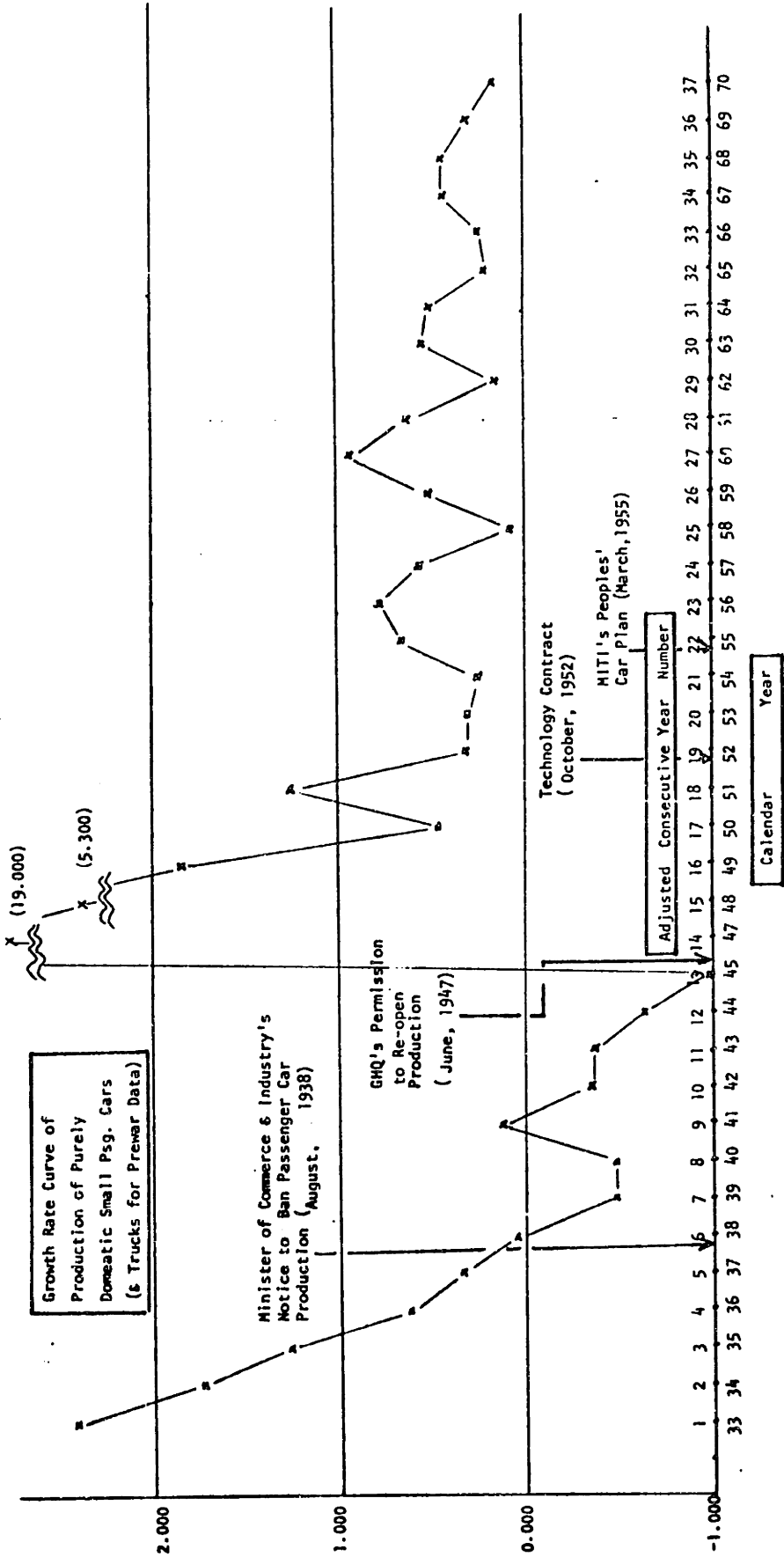


FIGURE V-20



of a unit impulse is equivalent to a unit step input inasmuch as a discrete system is concerned. However, the choice of an input type has more significant meaning than such a technical question.

If we know exactly when intervention began and when it ended, either an impulse input or a step input can be applied. If intervention occurred at a single time, the use of an impulse input is appropriate. If intervention lasted for a certain duration, the use of a step input with a bracketed time period is appropriate. However, if such knowledge is not available, the following strategy would be taken.

First, examine when industry received a major intervention from government. If such an intervention occurred at T , enter a unit step function at $T-1$ in consideration of the first-order delay of real impact [10]. This means that up to $T-1$, the growth rate determination mechanism is assumed to be the first-order homogeneous, i.e., negative exponential, and we let the Kalman Filter learn the value in the homogeneous parameter, which is assumed to indicate the state of industry's production performance during this initial self-development period. Next, keep entering a step input for the rest of a time-series. If intervention ceased for a certain period, the heterogeneous parameter would be expected to become zero, thereby implying an effect of either an impulse intervention or a time-bracketed step intervention.

With respect to the above three data sets, the preceding historical survey suggests that we enter a step input in the following years:

Dateset 1: 1931: Point 7 in FIGURE V-18, since the MCI Standardized Model in 1932 was the first major government intervention after this total 4-wheel production data started a conspicuous trend.

Dateset 2: 1931: for the same reason as above.

Dateset 3: 1937: Point 5 in FIGURE V-20, since the Minister of Commerce and Industry's order in 1938 to prohibit the production of passenger cars was the first major government intervention after this data category started a conspicuous smooth trend.

Initial Condition

The application of the Kalman Filter requires the subjective assignment of the following values:

- 1) the initial parameter estimates, i.e., $x(0/0)$,

- 2) the initial variance of the estimation error, i.e.,
 $\text{var}(x(0)-x(0/0))$,
- 3) the variance level of the system noise, i.e., $\text{var}(v(t))$,
- 4) the variance level of measurement error, i.e.,
 $\text{var}(v(t))$.

The assignment of the first two values is the mere initialization with which the Kalman Filter begins the recursive estimation, while the assignments of 3) and 4) characterize the process behavior of the Kalman Filter estimation.

The previous argument of the structural changes of production data has assumed that the homogeneous parameter would not change much, but the heterogeneous one would vary greatly. This assumption leads to assignments of a smaller value for $\text{var}(e(t))$ and a larger value for $\text{var}(s(t))$. The question of how small or how large such a value is, is subject to a trial-and-error run of the Kalman Filter [11].

The subjectivity of these value assignments reflects the flexibility and, perhaps, the constraint of this method. We have already pointed out that the Kalman Filter is more flexible than an ordinary time-invariant dynamic regression method since it allows the time-variant specification of parameters. Furthermore, the subjective specification of the system noise gives us one more important point of flexibility in model specification, i.e., the behavioral pattern of

dynamic evolution of the model by the assignments of the above variance levels. This flexibility turns out to be a constraint since more laborious effort, e.g., pre-analysis survey of history to organize data and a trial-and-error run with different initial settings of the above values, is required than the commonly-used, and often substance-ignorant, approach by simple time-invariant input-output modelling. However, such a careful and deeper investigation of data environment is no doubt necessary before one employs any kind of a model analysis. In this regard, we believe that the Kalman Filter leads us to a legitimate course. In fact, it is known that if the model specification is accurate, the above subjective value assignments are not a major constraint [12].

(D) Results of the Kalman Filter Analysis

1. Dataset 1 (Total of Purely Domestic 4-wheelers)

a) Degree of Estimation

FIGURE V-21 shows an extraordinary high degree of the fitness of the model throughout the entire time period. The difference between the actual measurement and the fitted growth rates up to Point 7 (1931) simply indicates that the Kalman Filter has been trying to learn the growth rate trend as an exponentially decreasing curve. The

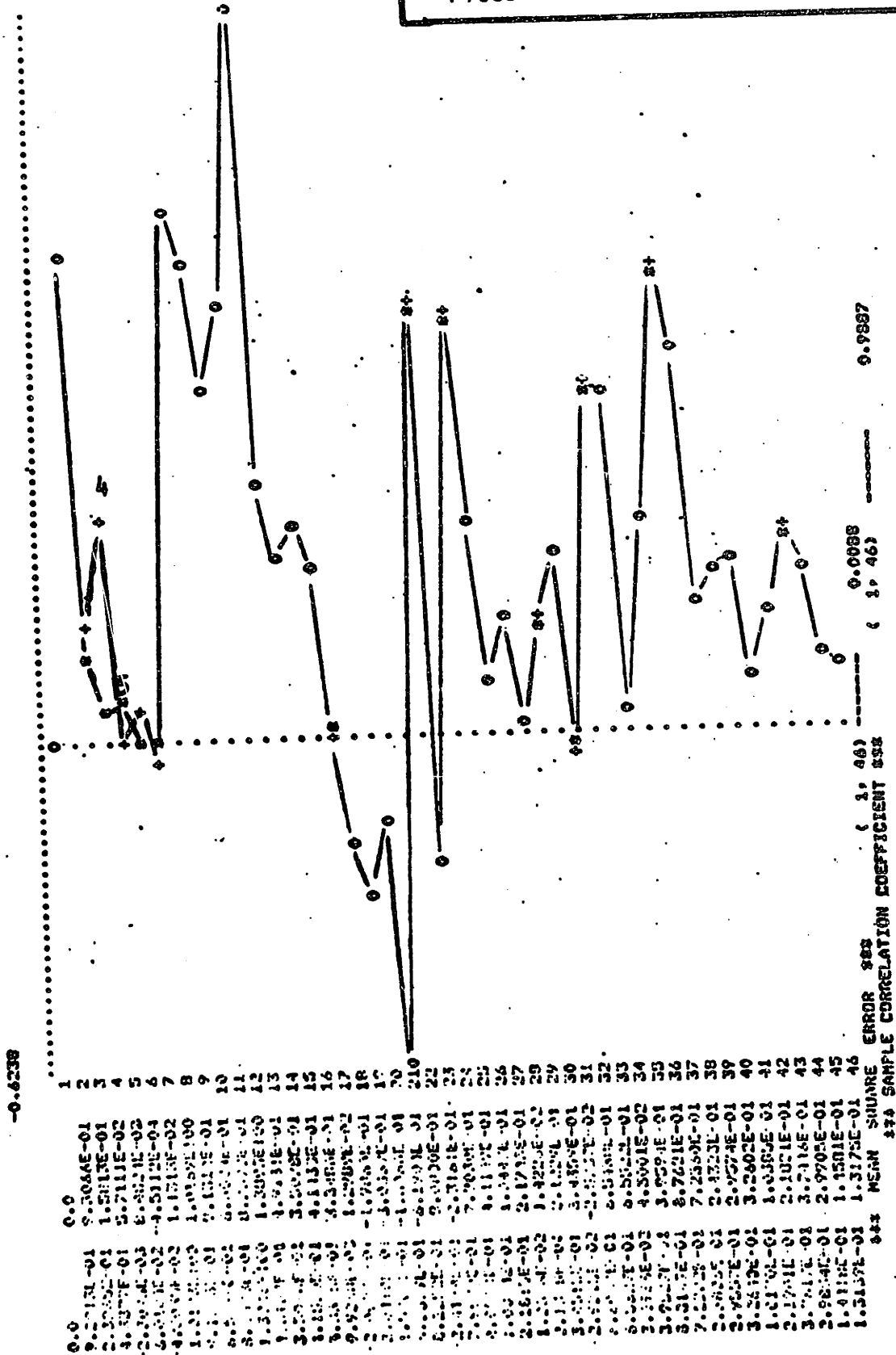
FIGURE V-21

Dataset 1: Total of Purely Domestic 4-Wheelers

Measured Growth Rate (z(t))....(+)

Fitted Growth Rate (g(t/t))....(*)

1.394



exceptional high point of the actual growth rate at Point 4 (1928) puzzled the Kalman Filter so that at the next Point 5 (1929), it proposed the higher growth rate though the actual growth rate turned back to the previous trend line. This process shows exactly how the Kalman Filter learns the system behavior. Interpreting this differently, the Kalman Filter Government had learned that growth rates during industry's independent developmental period declined exponentially [13].

b) Fitted Production [14]

FIGURE V-22 shows the growth curve generated by the fitted growth rates according to the definition of a growth rate, as compared with the actual growth data. Recall that the initial conditions govern the future behavior of a dynamic system. The observed difference between the actual growth and the fitted one seems to be due to a difference between the actual and fitted growth rates at Point 5 (1929), when the former jumps up, but the Kalman Filter has not yet learned the mechanism of this jump. Nevertheless, the resemblance of a growth pattern between the two curves no doubt demonstrates a high degree of the Kalman Filter's estimation capability.

c) Time-variation of Homogeneous and Heterogeneous

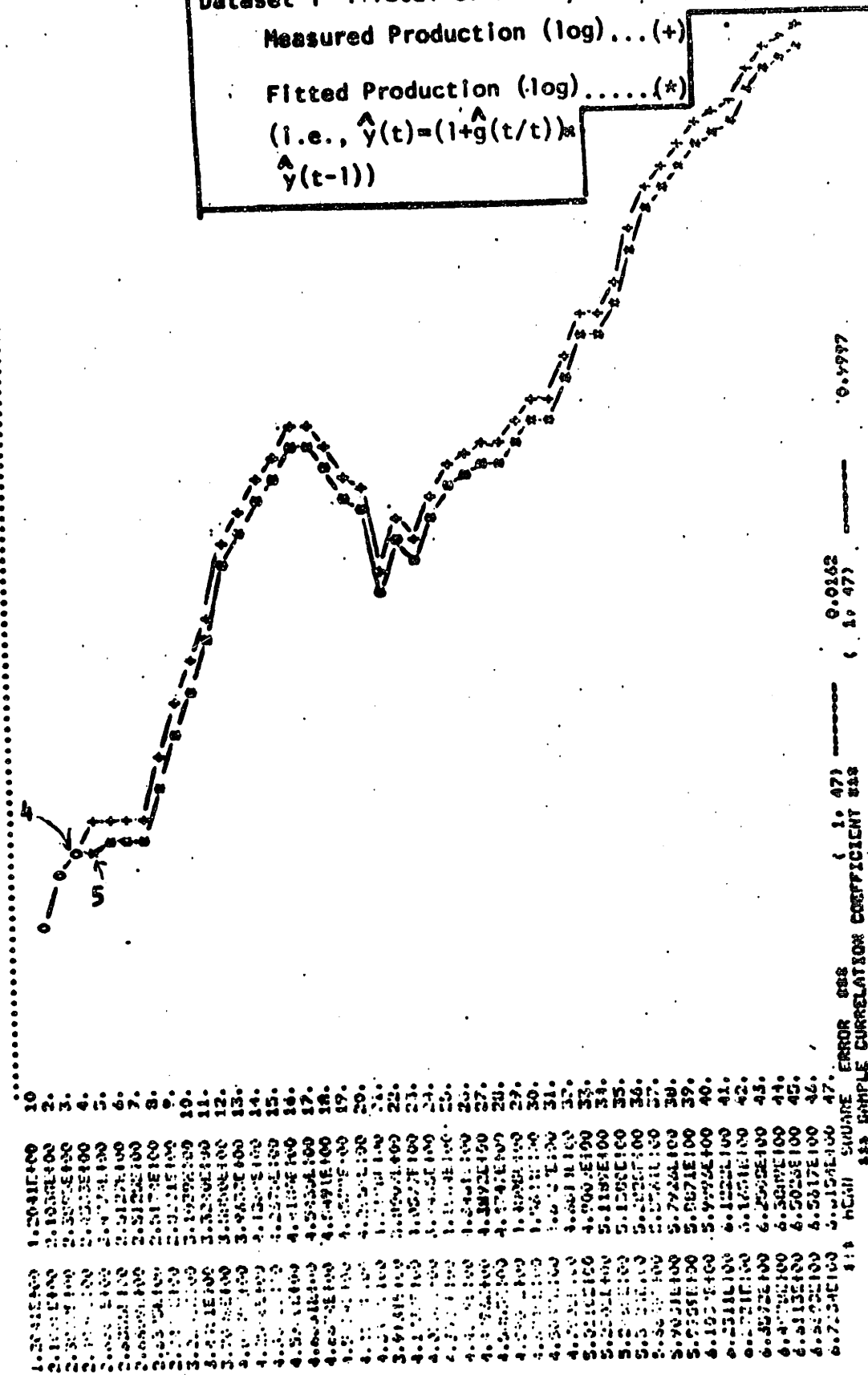
Parameters and the Contribution of Homogeneous Structure

FIGURE V-22

6.723

Dataset 1 : Total of Purely Domestic 4-Wheelers
 Measured Production (log)...(+)
 Fitted Production (log).....(*)
 (i.e., $\hat{y}(t) = (1+g(t/t))^* \hat{y}(t-1)$)

1.2041



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ERROR 0.0162
 (1.47) ----- 0.1997
 *** SAMPLE CORRELATION COEFFICIENT 0.88

Observation of FIGURE V-23

The homogeneous parameter falls in a step-functional form as follows:

- i) from Point 5(1929) to Point 12(1936): declining level,
- ii) from Point 13(1937) to Point 21(1945): lowered steady level,
- iii) from Point 22(1946) to Point 24(1948): sharp decline,
- iv) from Point 24(1948) to Point 31(1955): steady negative level,
- v) Point 32(1956) and thereafter: lowered negative level with a marginal fluctuation,

Observation of FIGURE V-24

Conspicuous patterns of the heterogeneous parameter are:

- i) at Point 8(1932), it surpasses the growth rate,
- ii) from Point 9(1933) to Point 21(1945), it accounts for a majority of the growth rate,
- iii) at Point 22(1946), it again surpasses the growth rate,
- iv) at Point 23(1947) and Point 24(1948), it accounts for a majority of the growth rate,

FIGURE V-23

Dataset 1: Total of Purely Domestic
4-Wheelers

Time-Variation of Estimated
Homogeneous Parameter ($\hat{a}(t/t)$)

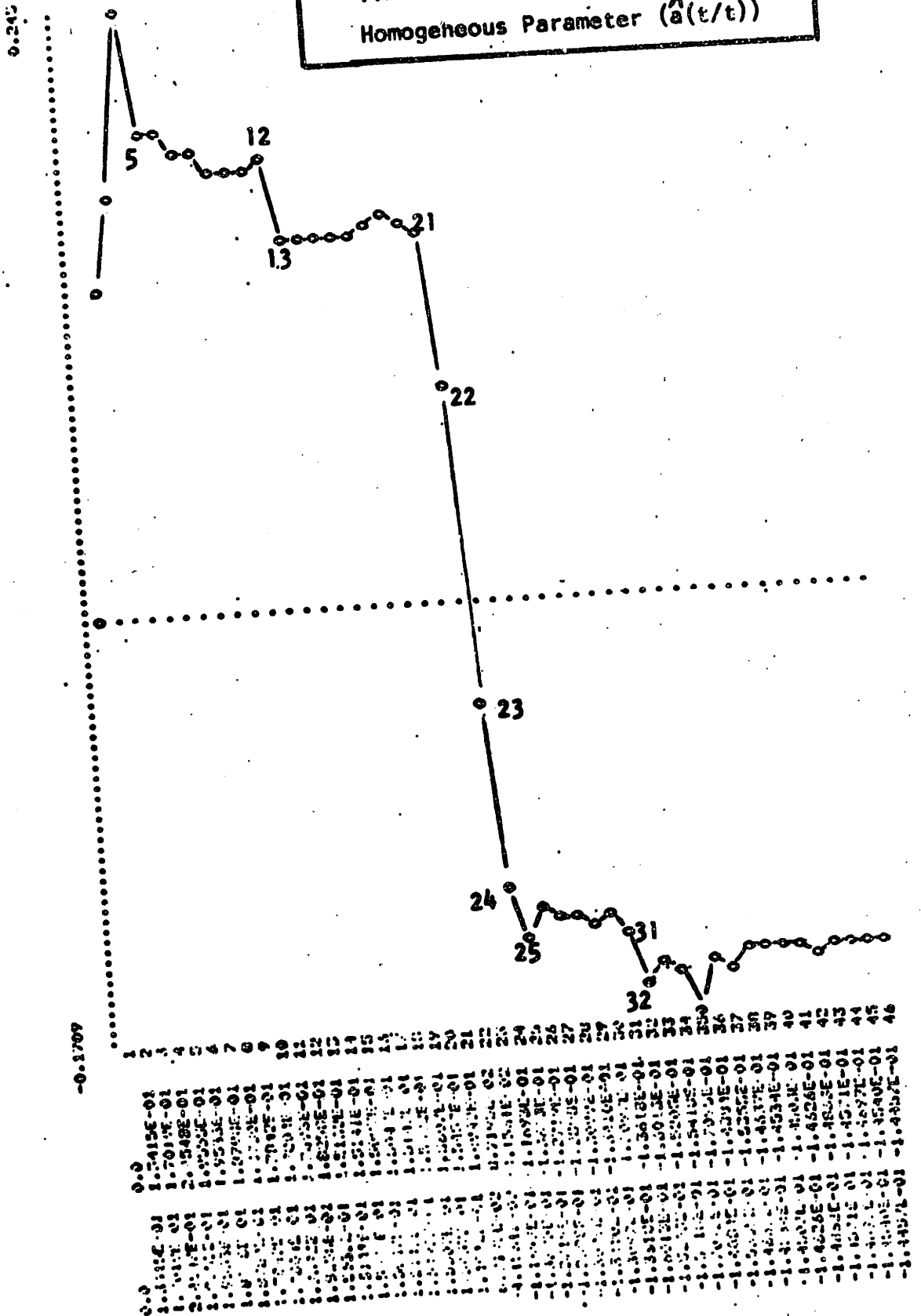
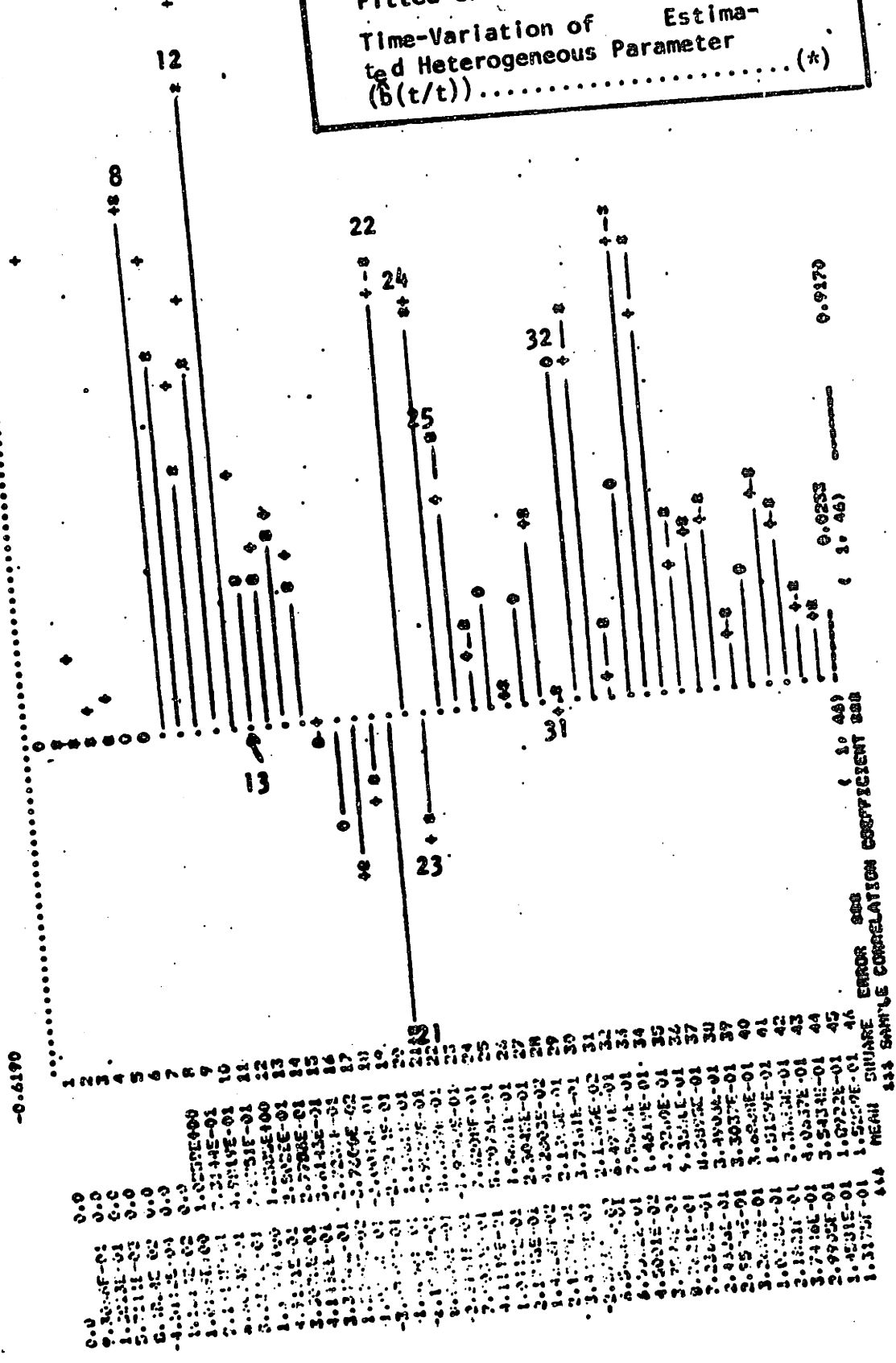


FIGURE V-24

Dataset 1: Total of Purely Domestic 4-wheelers
 Fitted Growth Rate $(\hat{g}(t/t)) \dots (+)$
 Time-Variation of Estimated Heterogeneous Parameter $(\hat{b}(t/t)) \dots (*)$

1.324



v) since Point 25(1949), it exceeds the growth rate.

Observation of FIGURE V-25

The contribution of the homogeneous structure shows the following patterns:

- i) from Point 9(1933) to Point 22(1945): proportional pattern to the growth rate pattern with a one-period time lag,
- ii) Point 23(1946) and thereafter: proportional "mirror-image" pattern to the growth rate pattern with a one-period time lag.

Structural Interpretations

An estimate of the homogeneous parameter stabilizes at Point 5(1929). The stabilized less-than-1.0 level up to Point 12(1936), implies that a growth rate would exponentially decline if no heterogeneous impact appeared. Recall that an exponentially declining growth rate yields to rapid-stagnation in production.

A sharp increase of a growth rate at Point 8(1932) is almost completely accounted for by the heterogeneous parameter while the

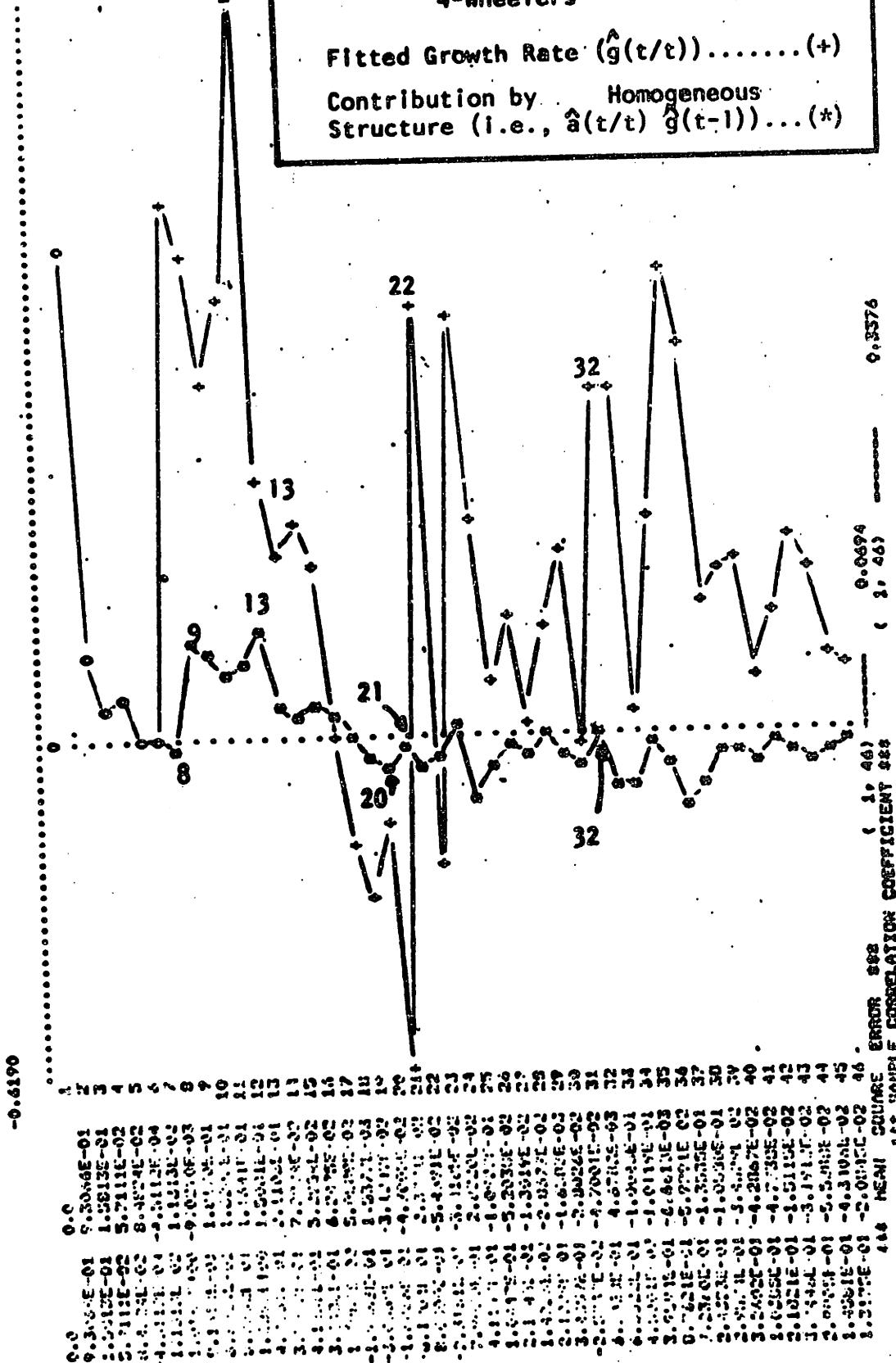
FIGURE V-25

1.709

Dataset 1: Total of Purely Domestic 4-Wheelers

Fitted Growth Rate ($\hat{g}(t/t)$).....(+)

Contribution by Homogeneous Structure (i.e., $\hat{a}(t/t) \hat{g}(t-1)$)...(*)



444 MEAN SOURCE ERROR 988 (1.46)
 444 MEAN CORRELATION COEFFICIENT 988 (1.46)
 444 MEAN CORRELATION COEFFICIENT 988 (1.46)

homogeneous parameter maintains the previous trend. Since Point 9(1933), a proportional impact of the heterogeneous parameter decreases because the rest of the growth rate is contributed by the homogeneous structure as shown in FIGURE V-25. This mechanism corresponds to FIGURE V-7.

A level decline of the homogeneous parameter at Point 13(1937) is due to a sharp decline of the growth rate in this year. Recall that the Kalman Filter estimates parameter values by remembering the past values. If a change happens in system outputs, a due correction of structural estimation is done, but by not damaging the already learned structure. Therefore, a decline of the homogeneous parameter at Point 13(1937) happens to compensate for an otherwise large amount of the heterogeneous parameter change if it alone accounted for a sharp growth rate decline.

A continuous decline of the homogeneous parameter from Point 22(1946) up to, e.g., Point 25(1949) can be explained by the same logic. The Kalman Filter must have proposed a prediction value of the growth rate at Point 13(1949) on the declining trend in the negative region because this trend shows a smooth curve for a relatively long period since Point 12(1936). However, an actual growth rate at Point 22(1946) suddenly jumps up into the positive region. Then in the correction process, a value change has been required for not only the heterogeneous parameter, but also the homogeneous parameter in order

to deal with this unprecedented extraordinary growth rate change. Since a growth rate at previous Point 21(1945) is negative, the homogeneous parameter declines to let a homogeneous contribution increase. This is seen in FIGURE V-25. The resultant homogeneous contribution at Point 22(1946) is still negative, so that the heterogeneous parameter surpasses a growth rate as shown in FIGURE V-24. In the same process, the homogeneous parameter continuously declines and finally stays in the negative region at Point 24(1948). That is, when a growth rate cyclically swings with a large vibration around the zero level, the homogeneous parameter would continuously decline in the negative region in order to cancel out an amplitude. The stabilization of the homogeneous parameter at Point 25(1949) indicates that the growth rate swing around the zero level ceases as shown in FIGURE V-21.

A fact worth noting is that the homogeneous parameter stabilizes in the negative region. Then a contribution of the homogeneous structure becomes negative as indicated in FIGURE V-25, which results in a larger heterogeneous parameter value than an actual growth rate as shown in FIGURE V-24. A further decline of the homogeneous parameter from Point 31(1955) to Point 32(1956) is due to a large increase in the growth rate from a negative value at Point 31(1955) through the same amplitude-cancelling-mechanism as described above.

The Kalman Filter results show the more or less same structural

changes as the ones discussed in SECTION V-1(B), except for the unexpected entering of the homogeneous parameter into the negative region after Point 23(1946). While a growth rate declines exponentially in the pre-intervention period, the homogeneous parameter is the only factor to characterize the resultant rapid-stagnation pattern in production. Therefore, we have assumed that the homogeneous parameter would indicate industry's productive performance while the heterogeneous parameter would indicate the impact of policy intervention. However, productive performance in a negative value is hardly conceptualized. Thus, we need a further elaboration of the meaning of the model structure in Eq(V.1).

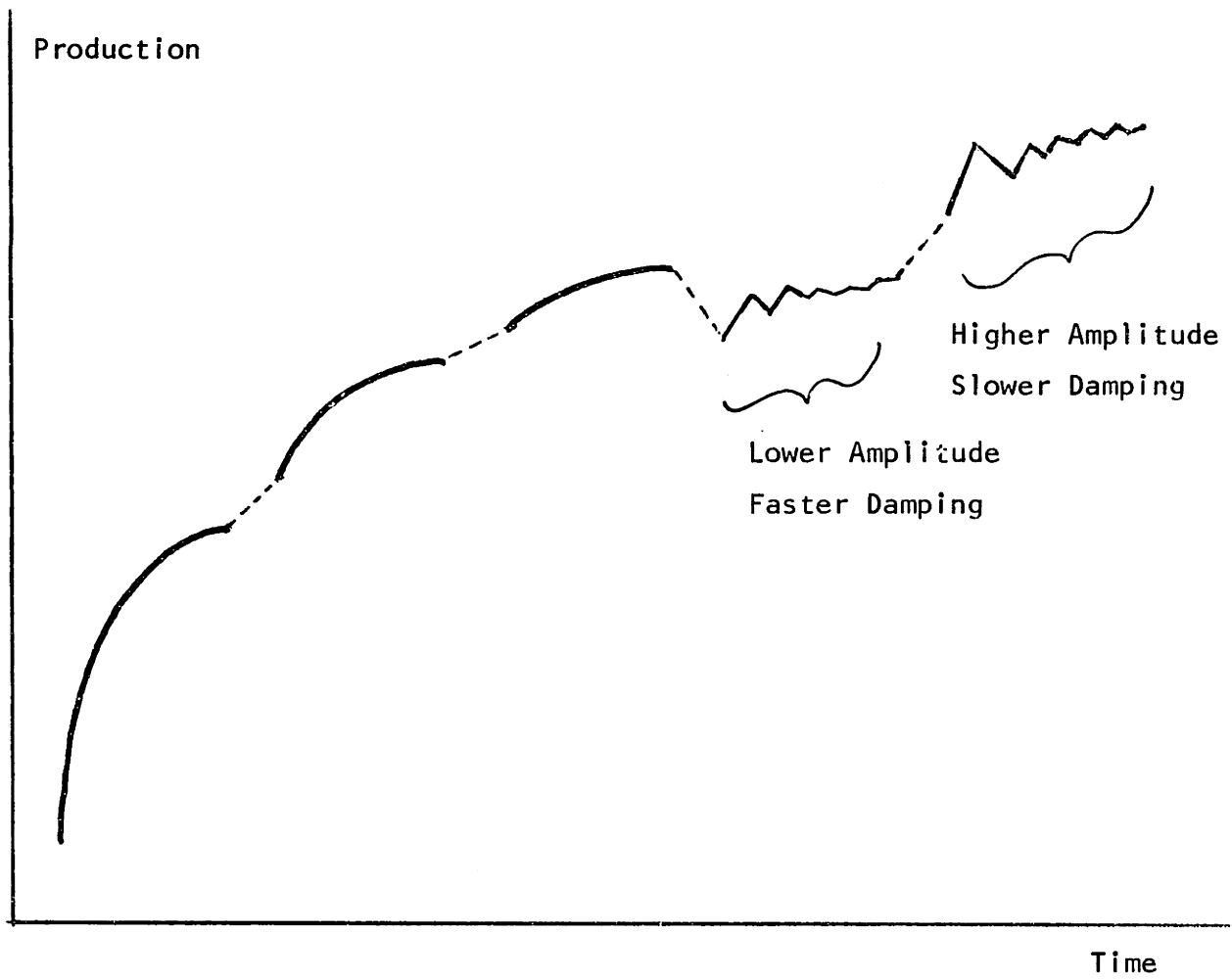
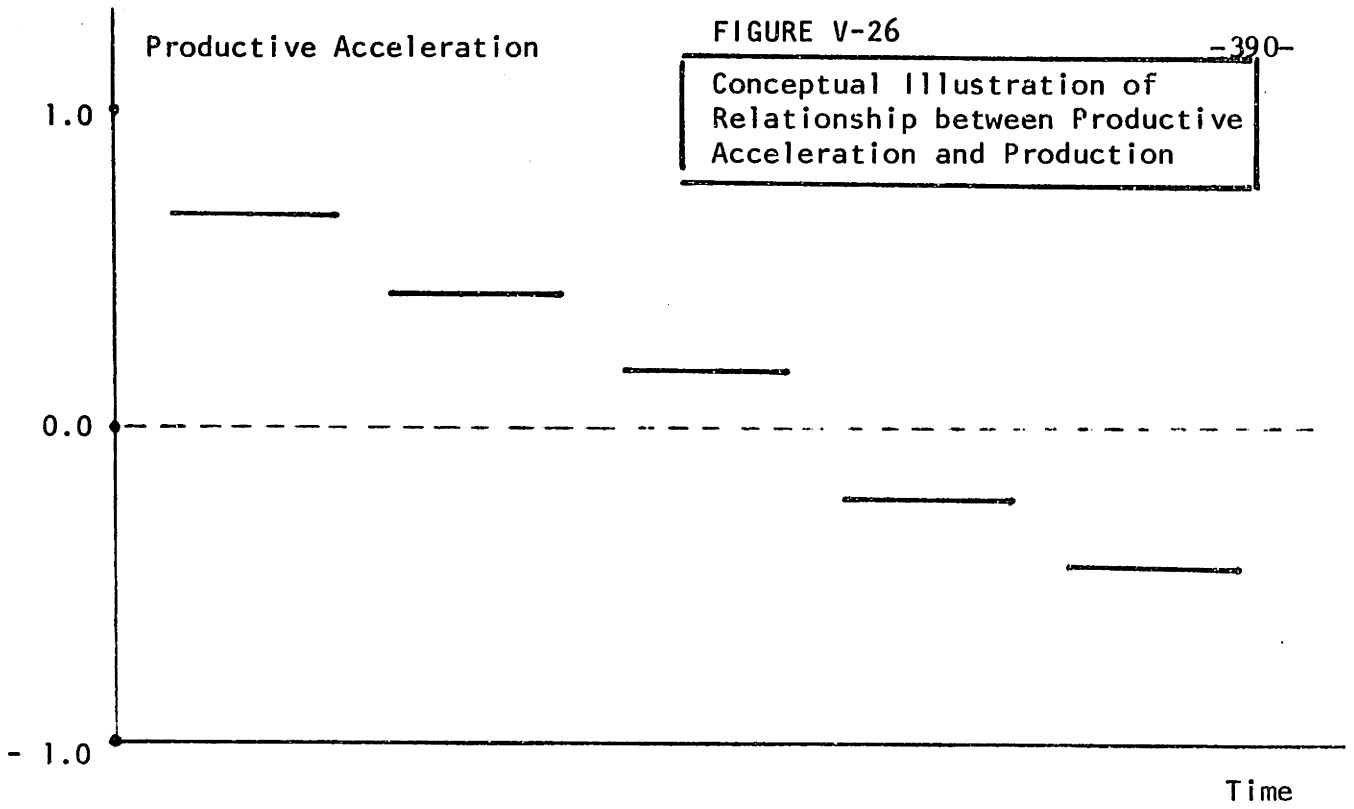
The growth rate model suggests that the homogeneous parameter is an acceleration factor to control the dynamic evolution of a growth rate while the heterogeneous parameter is a direct cause to change a growth rate having the same dimension. We now reconceptualize the homogeneous parameter as the "productive acceleration" which essentially governs the dynamic movement of a growth rate, since the heterogeneous parameter is independent of the past values of a growth rate. The relationship between the productive acceleration and production is then apparent. It gives a fundamental dynamic property to latently characterize the trend of a production curve in the following ways: 1) if the productive acceleration is larger than 1.0, production has a sharply increasing dynamic property in its growth trend; 2) if it is 1.0, production has an exponential dynamic property; 3) if it is

less than 1.0 but larger than 0.0, production has a rapid-stagnation dynamic property; 4) if it is 0.0, production has a stagnation dynamic property; 5) if it is negative, production has a damping oscillation dynamic property. FIGURE V-26 conceptually illustrates these relationships in the light of FIGURE V-23.

As indicated in FIGURE V-26, the meaning of a negative homogeneous parameter is understood as the productive acceleration to yield a pattern of damping oscillation in the production curve. The lesser it becomes, the longer damping lasts and the higher its amplitude is. Then, a further decline of the homogeneous parameter after Point 32(1956) suggests that the dynamic (latent) property of production data once again generates a damping oscillation in order to cancel out a newly-born instability in production.

Policy Implications

The Kalman Filter results show that a high growth rate during a period from Point 8(1932) to Point 12(1936) is mainly accounted for by the heterogeneous parameter, thereby suggesting that the policy intervention by the 1932 MCI Standard Model shifted up the already stagnated production. However, an unchanged homogeneous parameter observed in FIGURE V-23 suggests that industry's fundamental productive acceleration remained the same as before.



Later a growth rate declined in 1937. Then, FIGURE V-24 suggests that intervention impacts declined. This seems to correspond to the industrial reorganization by the 1936 Law Regarding Automobile Manufacturing Enterprise, or of the withdrawal of two big procurement contractors, the Ministry of Army and the Ministry of Railroad, as described in SECTION II-2. Most importantly, the above structural interpretation suggests that, because of this growth rate decline, industry's hitherto-continuing productive acceleration declined for the first time. Recall that the 1936 law created the government-controlled two big manufacturers, Toyota and Nissan. Then, although the new firms were much stronger in terms of a production level, their productive acceleration was lower than that of their predecessors, TGE and Ishikawajima.

The productive acceleration of the newly reorganized industry continued until the end of the war, while a decline of the growth rate is observed to have been primarily caused by negative forces (regulatory interventions in wartime). However, since 1946, industry's productive acceleration had continuously declined and finally became negative in the next year. Until 1949, industry's production acceleration became further negative reflecting the cyclical ups and downs of production. This indicates that industry was in a quite unstable state, which corresponds to the historical evidence of the postwar socio-economic instability of this time. Since 1949, the

productive acceleration stabilized, which indicates that the first industrial reorganization in the post war started in 1949. The Korean procurement seems to be a primary cause for such an industrial reorganization. A stabilized productive acceleration in a negative value implies that industry started cancelling out production instability. Since 1956, the productive acceleration went into a lower negative level, which again suggests that industry strengthened the stabilization "countermeasure" against still on-going stability in production. The emergence of the MITI's peoples' Car Plan and the successful completion of the imports takeover policy (which will be discussed in the next chapter) perhaps marked this new era.

To sum up, the results of the Kalman Filter application to growth rates of Dataset 1 have generated valuable information for assessing policy intervention. First, the changes of industry's state can be indirectly observed by the conspicuous pattern changes of the productive acceleration (i.e., the homogeneous parameter). The Law Regarding Automobile Manufacturing Enterprise of 1936, the Korean War procurement started in 1949, and the period when domestic passenger car production took over foreign imports in 1956, seem to have made a considerable impact on the state changes of industry. However, the 1932 MCI Standard Model might have made little impact. Second, the dynamic patterns of postwar and prewar production are clearly distinguished. Prewar dynamics contained a stable state while the postwar counterpart had twice damping oscillation. The cause which

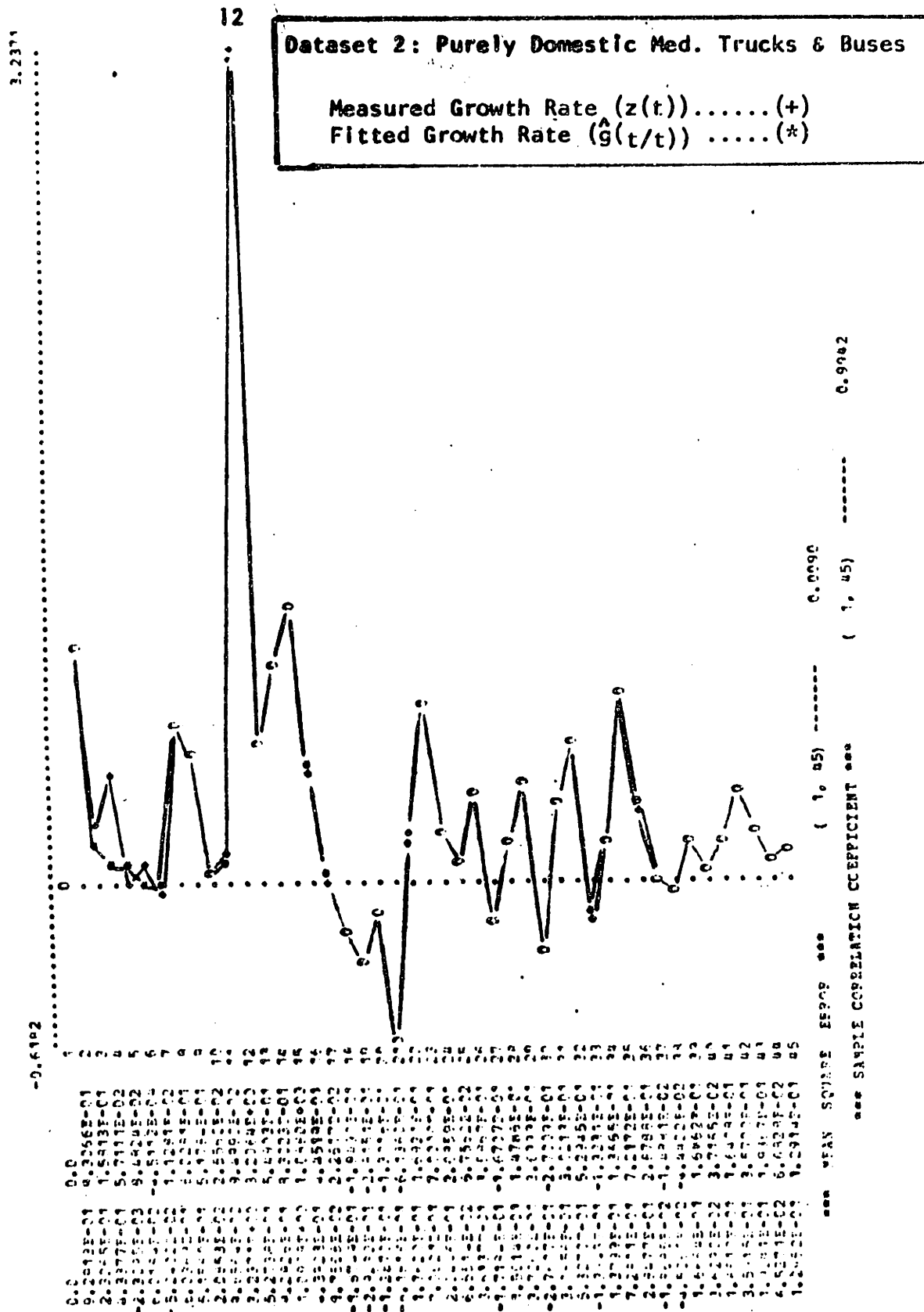
separates the postwar pattern from the prewar one is the period of disorder from the end of war to 1948, when production sharply rose and fell shaking the prewar state of industry. Third, the postwar dynamic property does not mean the instability of industry. The stabilization of productive acceleration, although in a negative value, means that industry was stabilized. That is, industry started systematically cancelling out the instability of production by the counter-instability measure, i.e., a minus-production. Therefore, fourth, the postwar industry would have acted against policy intervention if extraneous forces had made much of an impact on policy intervention. This perhaps indicates an increasing tendency of industry's independence of policy intervention. The united opposition of manufacturers against the MITI's Peoples' Car plan seems to correspond to this. Note that the prewar industry never opposed to government.

2. Dataset 2 (Purely Domestic Large and Medium-size Trucks
and Buses)

a) Degree of Estimation

FIGURE V-27 clearly shows the high degree of estimation of the Kalman Filter for this dataset, too. Since the early part of this

FIGURE V- 27



dataset is the same as that of the previous Dataset 1, the initial learning process is identical to the one shows in FIGURE V-21.

b) Fitted Production

The high degree of estimation can also be observed in FIGURE V-28. As pointed out previously, the differences between actual production and fitted production are due to the estimation error at Point 4(1928).

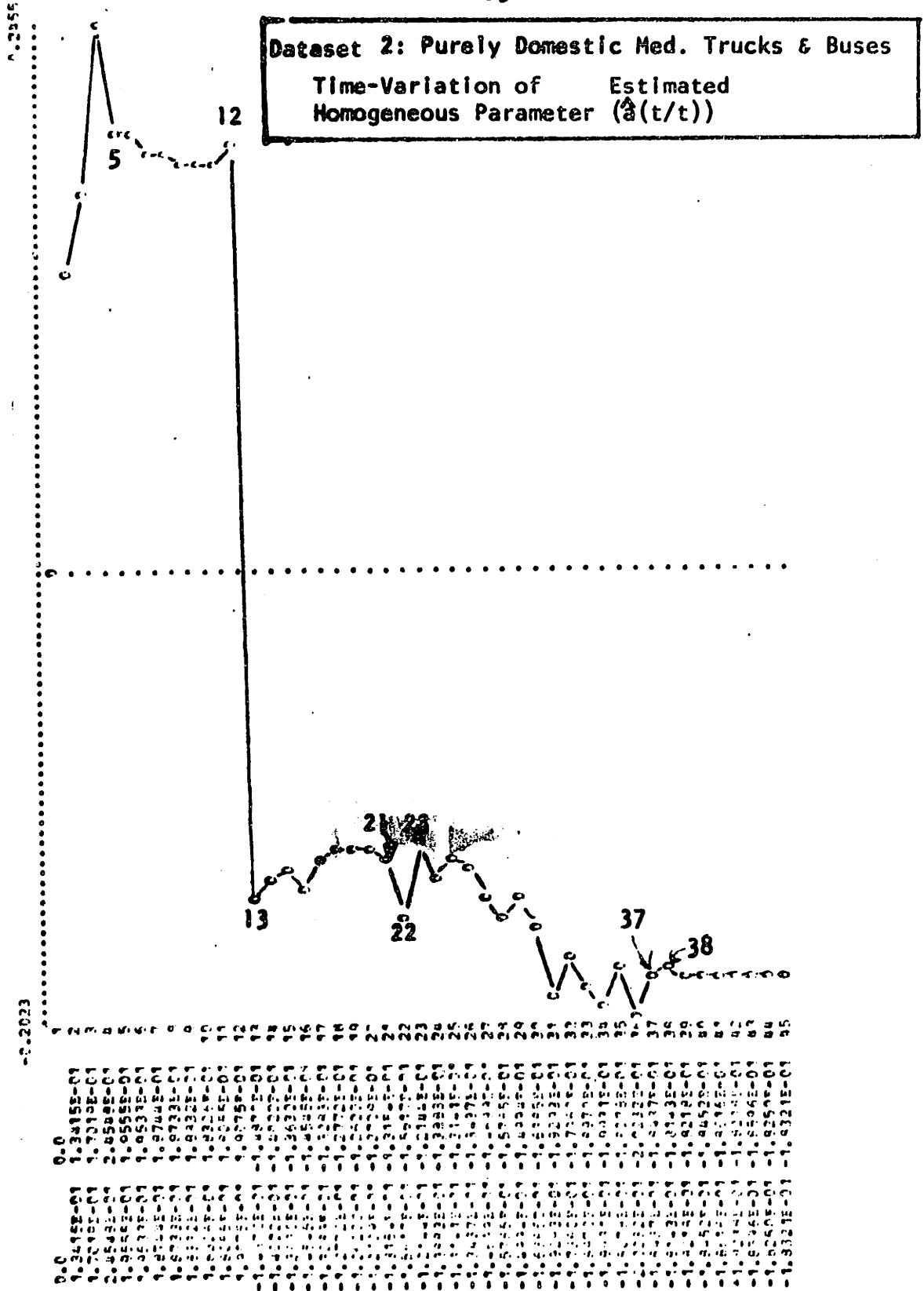
c) Time-variation of Homogeneous and Heterogeneous Parameters
and the Contribution of Homogeneous Structure

Observations of FIGURE V-29

The following conspicuous patterns of the homogeneous parameter can be observed in FIGURE V-29:

- i) from Point 5(1929) to Point 12(1936): stationary level,
- ii) from Point 13(1937) to Point 37(1962): negative parabolic transition,
- iii) Point 38(1963) and thereafter: negative stationary level.

FIGURE V- 29



Observations of FIGURE V-30

FIGURE V-30 shows the following observations of the time-variation of the heterogeneous parameter:

- i) from Point 8(1932) to Point 12(1936), it accounts for a majority of growth rate changes;
- ii) from Point 13(1937) to Point 21(1945), it surpasses the growth rate but its proportional contribution decreases;
- iii) at Point 22(1947), its proportional contribution is small;
- iv) at Point 23(1948), it completely accounts for the growth rate;
- v) after Point 24(1949), it surpasses the growth rate.

Observations of FIGURE V-31

As a result, FIGURE V-31 shows the following patterns of the contribution of the homogeneous structure:

- i) from Point 8(1932) to Point 12(1936), it forms the one-period-delay similar figure to the pattern of the growth rate;

FIGURE V-30

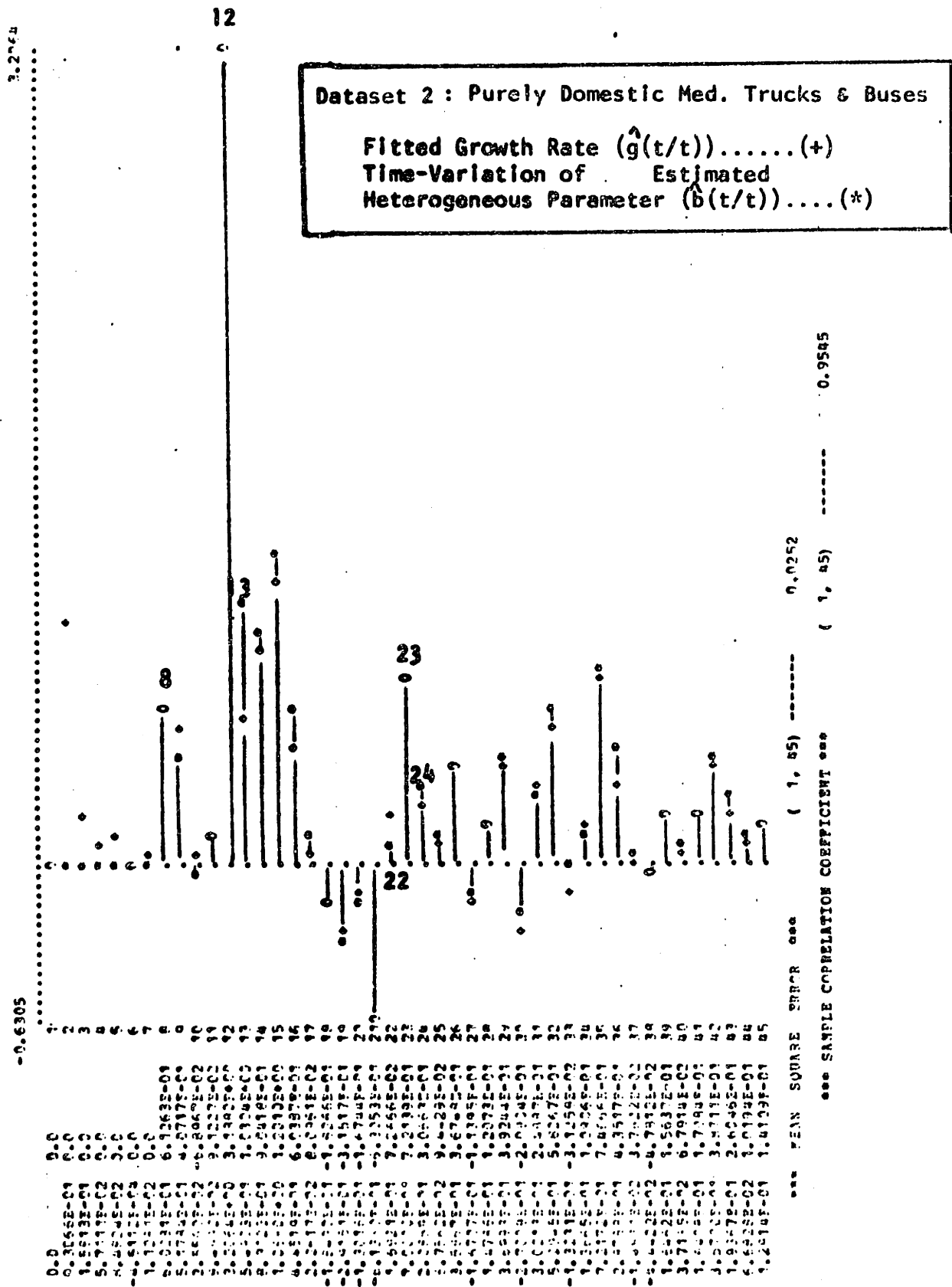
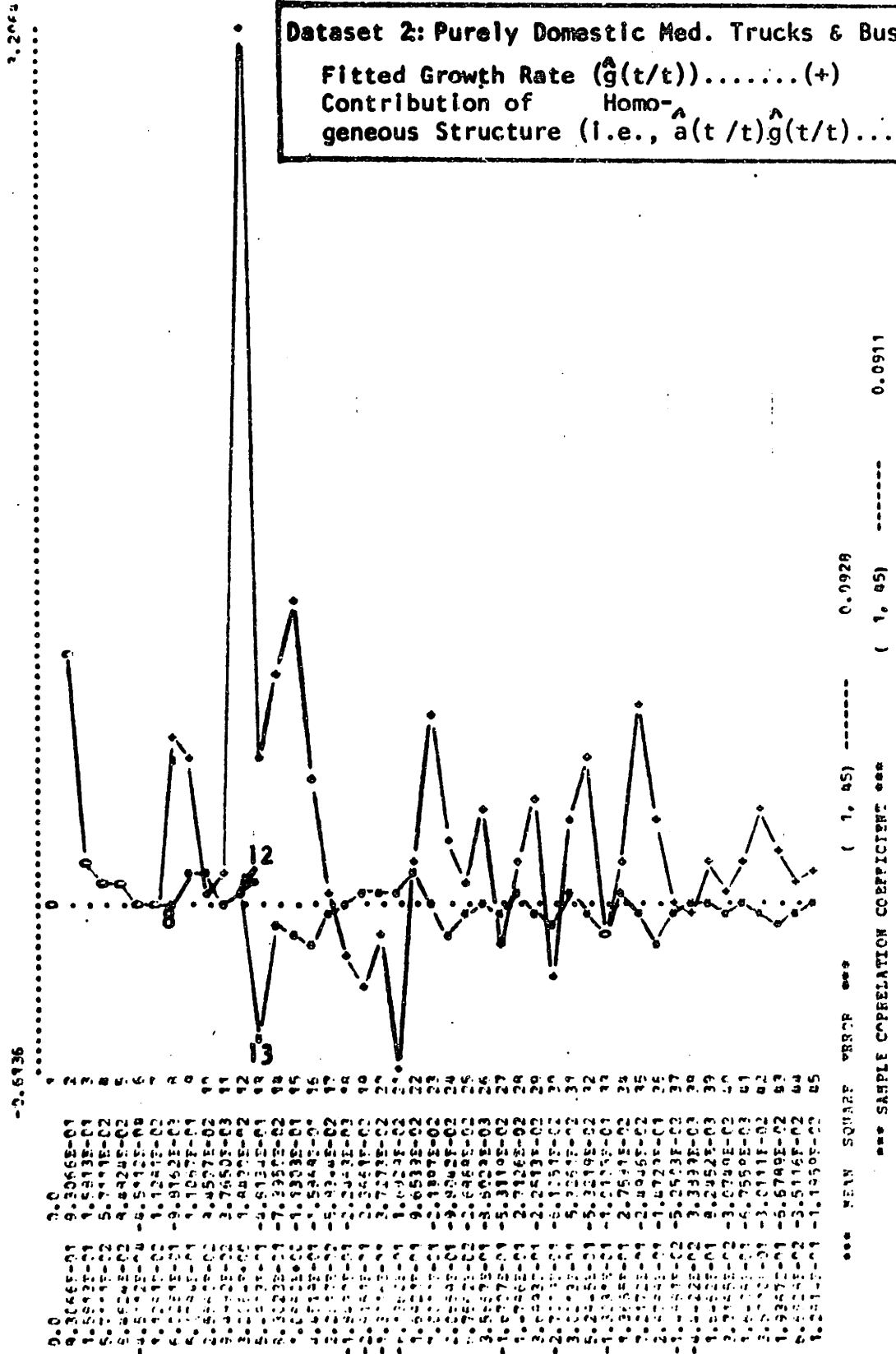


FIGURE V-31

Dataset 2: Purely Domestic Med. Trucks & Buses
 Fitted Growth Rate ($\hat{g}(t/t)$).....(+)
 Contribution of Homo-
 geneous Structure (i.e., $\hat{a}(t/t)\hat{g}(t/t)$)....(*)



ii) from Point 13(1937) and thereafter, it forms the one-period-delay mirror image of the growth rate pattern.

d) Structural Interpretations and Policy Implications

The homogeneous parameter stabilized at Point 5(1929). Since the heterogeneous parameter explains much of the growth rate changes from Point 8(1932) to Point 12(1936), this stabilized homogeneous parameter continues up to Point 12(1936). However, the unprecedented tremendous growth rate change at Point 13(1937) breaks the hitherto stabilized homogeneous parameter and pushes it into the negative region. There, the homogeneous parameter shows a convex increasing trend up to Point 21(1945). This means that the proportional contribution of the heterogeneous parameter increases as shown in FIGURE V-30. Again, at Point 22(1947), the homogeneous parameter further declines due to a large change in the growth rate from a negative value to a positive one. The heterogeneous parameter cannot explain this change in itself. However, a further increase of the growth rate at Point 23(1948) in the same positive region increases the homogeneous parameter. Since then, the homogeneous parameter parabolically declines up to Point 36(1961). This reflects an oscillation in the growth rate around the zero level with an increasing amplitude. Since Point 37(1962), the homogeneous parameter stabilizes due to the fact that the growth rate ceases the previous fluctuations and begins a minor oscillation in the positive region.

The break of the stable state of the afore-defined productive acceleration at Point 13(1937), suggests that the 1936 Law Regarding Automobile Manufacturing Enterprise made a tremendous impact on the the state of industry. From this year up to 1961, the unstable negative productive acceleration implies that an observed growth rate had been overrun by a discretely-entering extraneous force. When a growth rate was positive, it was so because intervention worked to push otherwise decreasing production. When a growth rate was negative, intervention worked coercively to suppress otherwise increasing production. In particular, the parabolic shape of the production of domestic large and medium-size 4-wheelers from, e.g., 1939 to 1945, may be explained by this excessive intervention. The stabilization of productive acceleration since 1962, suggests that industry resumed stability and started systematically stopping a fluctuation of production.

It is worth noticing that the change in the productive acceleration occurred before the end of the war, although it happened after the war in the case of the aggregate production data. This indicates that the impact of the 1936 Law was enormous for large and medium-size trucks and buses. The long instability of productive acceleration up to 1961, suggests that the state of the large and medium-size truck and bus production took nearly 25 years to gain stability, which was broken by the 1936 Law.

3. Dataset 3 (Purely Domestic Small Passenger Cars---Trucks
for Prewar Data)

a) Degree of Estimation

FIGURE V-32 no doubt demonstrates the high degree of the Kalman Filter estimation for this dataset. In contrast with the previous two cases, early estimation errors during an initial learning period are quite small.

b) Fitted Production

Due to small estimation errors at an early period, the fitted production curve is closer to the actual data than the previous two cases. This is shown in FIGURE V-33.

c) Time-variation of Homogeneous and Heterogeneous Parameters
and Contributiion of Homogeneous Structure

FIGURE V-32

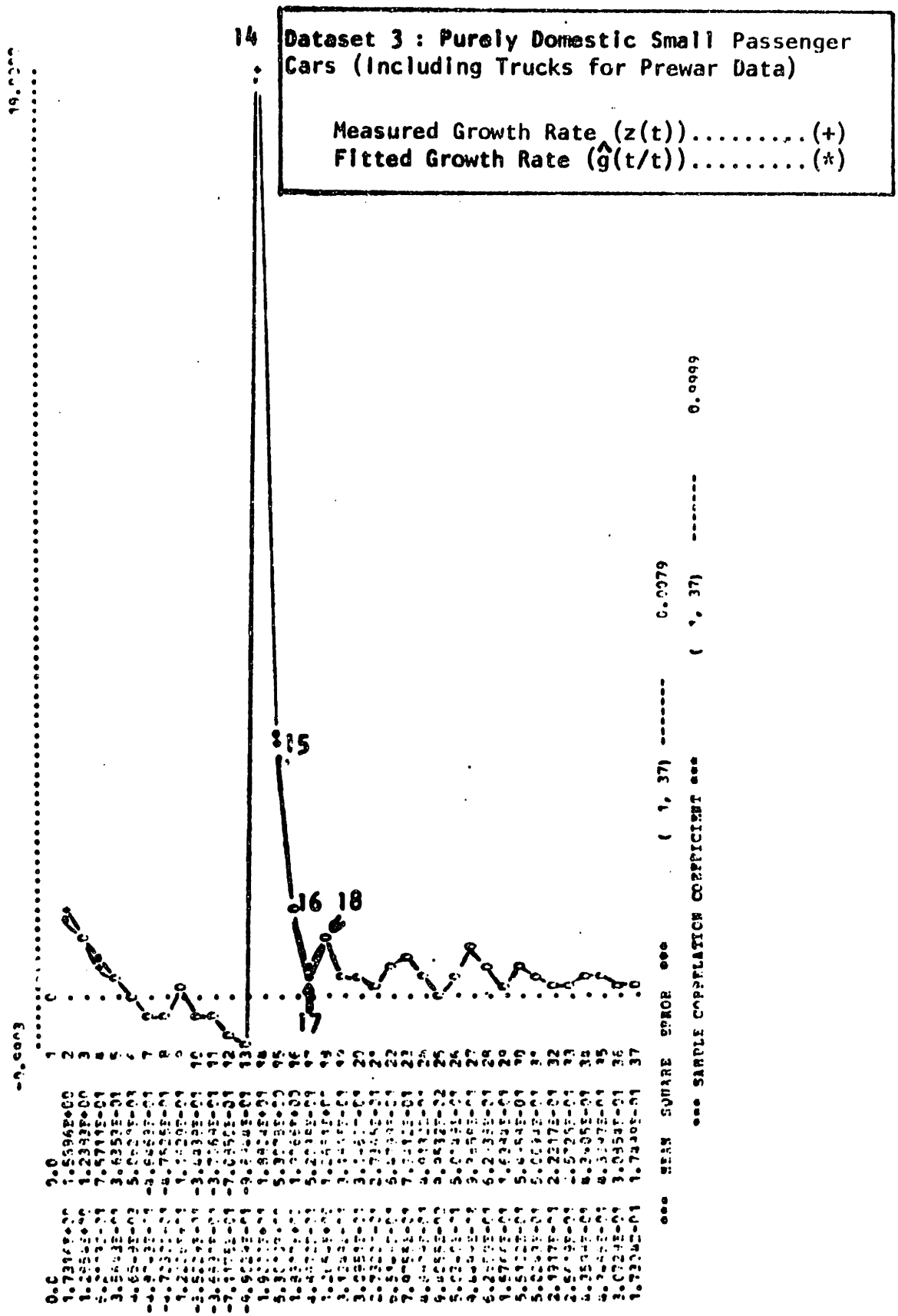
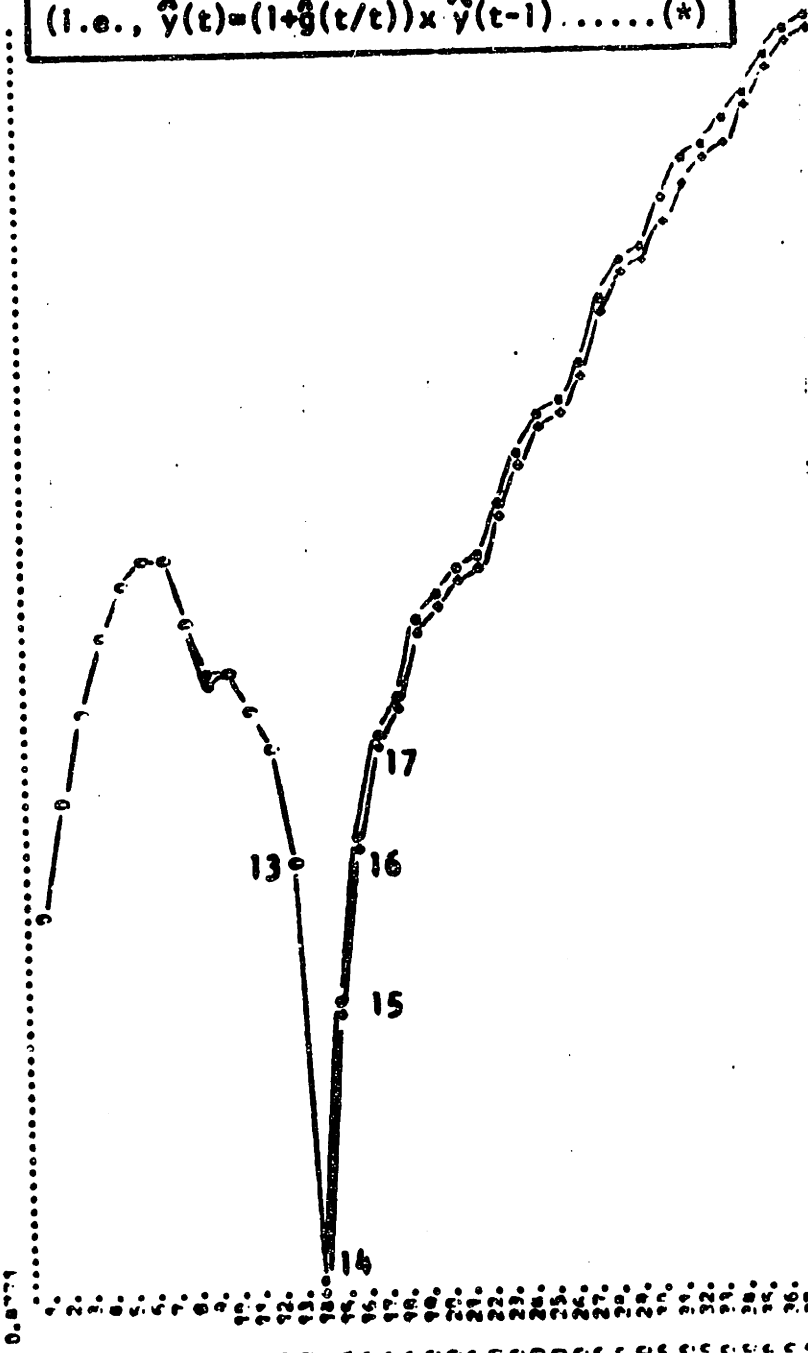


FIGURE V-33

Dataset 3: Purely Domestic Small Passenger Cars
 (Including Trucks for Prewar Data)

Measured Production (log).....(+)
 Fitted Production (log)
 (i.e., $\hat{y}(t) = (1+g(t/t)) \times y(t-1)$(*)

S. UNCS



2.7682E+00	2.2982E+00
2.7066E+00	2.7966E+00
2.7292E+00	2.2104E+00
3.5577E+00	3.5577E+00
3.0645E+00	3.0645E+00
3.9372E+00	3.9372E+00
3.0323E+00	3.0323E+00
3.6525E+00	3.6525E+00
3.7476E+00	3.7476E+00
3.5522E+00	3.5522E+00
3.2372E+00	3.2372E+00
3.0272E+00	3.0272E+00
3.0272E+00	3.0272E+00
2.5372E+00	2.5372E+00
2.5372E+00	2.5372E+00
1.8221E+00	1.8221E+00
2.6221E+00	2.6221E+00
3.0072E+00	3.0072E+00
3.2072E+00	3.2072E+00
3.6221E+00	3.6221E+00
3.7821E+00	3.7821E+00
3.0672E+00	3.0672E+00
3.9672E+00	3.9672E+00
4.9221E+00	4.9221E+00
4.8349E+00	4.8349E+00
4.6122E+00	4.6122E+00
4.6512E+00	4.6512E+00
4.8221E+00	4.8221E+00
5.1155E+00	5.1155E+00
5.3177E+00	5.3177E+00
5.3212E+00	5.3212E+00
5.5221E+00	5.5221E+00
5.7672E+00	5.7672E+00
5.8772E+00	5.8772E+00
5.9447E+00	5.9447E+00
6.0322E+00	6.0322E+00
6.9045E+00	6.9045E+00
6.3042E+00	6.3042E+00
6.3745E+00	6.3745E+00

SEE MEAN SQUARE ERROR SEE (1, 38) ----- 0.0987
 SEE SAMPLE CORRELATION COEFFICIENT SEE (1, 38) ----- 0.9998

Observations of FIGURE V-34

As indicated in FIGURE V-34, the homogeneous parameter has two easily-identifiable levels such as:

- i) from Point 4(1936) to Point 13(1945): stationary level,
- ii) from Point 17(1950) and thereafter: stationary level.

Observations of FIGURE V-35

The two conspicuous patterns of the heterogeneous parameter are apparent in FIGURE V-35 as follows:

- i) from Point 6(1938) to Point 13(1945), it explains a majority of the growth rate;
- ii) from Point 14(1947) and thereafter, it overruns a growth rate.

Observations of FIGURE V-36

FIGURE V-34 and FIGURE V-35 result in the two conspicuous patterns of the contribution of the homogeneous parameter as follows:

FIGURE V-34

Dataset 3 : Purely Domestic Small Psg. Cars
 (incl. Trucks for prewar data)

Time-Variation of Estimated Homogeneous
 Parameter $\hat{a}(t/t)$

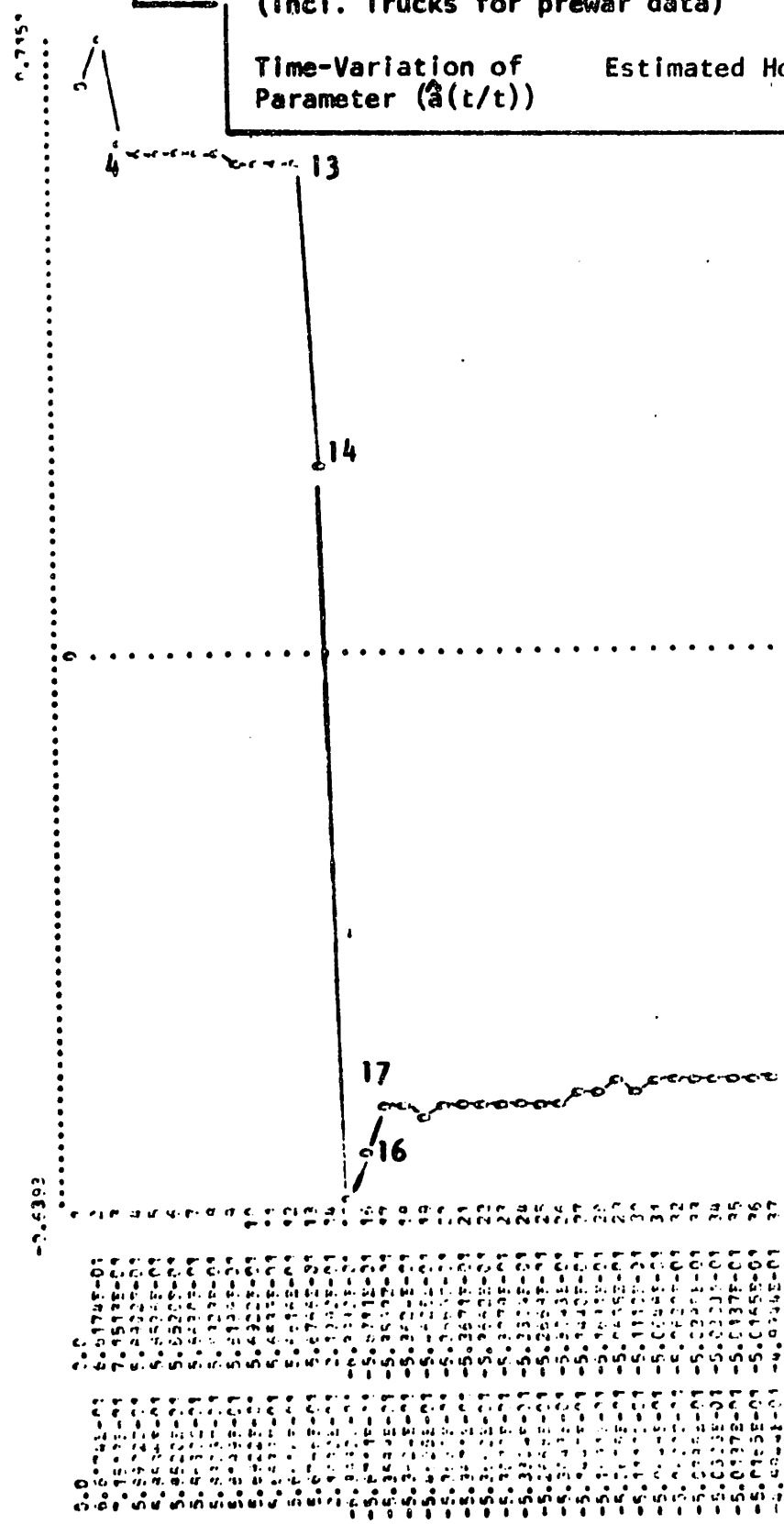
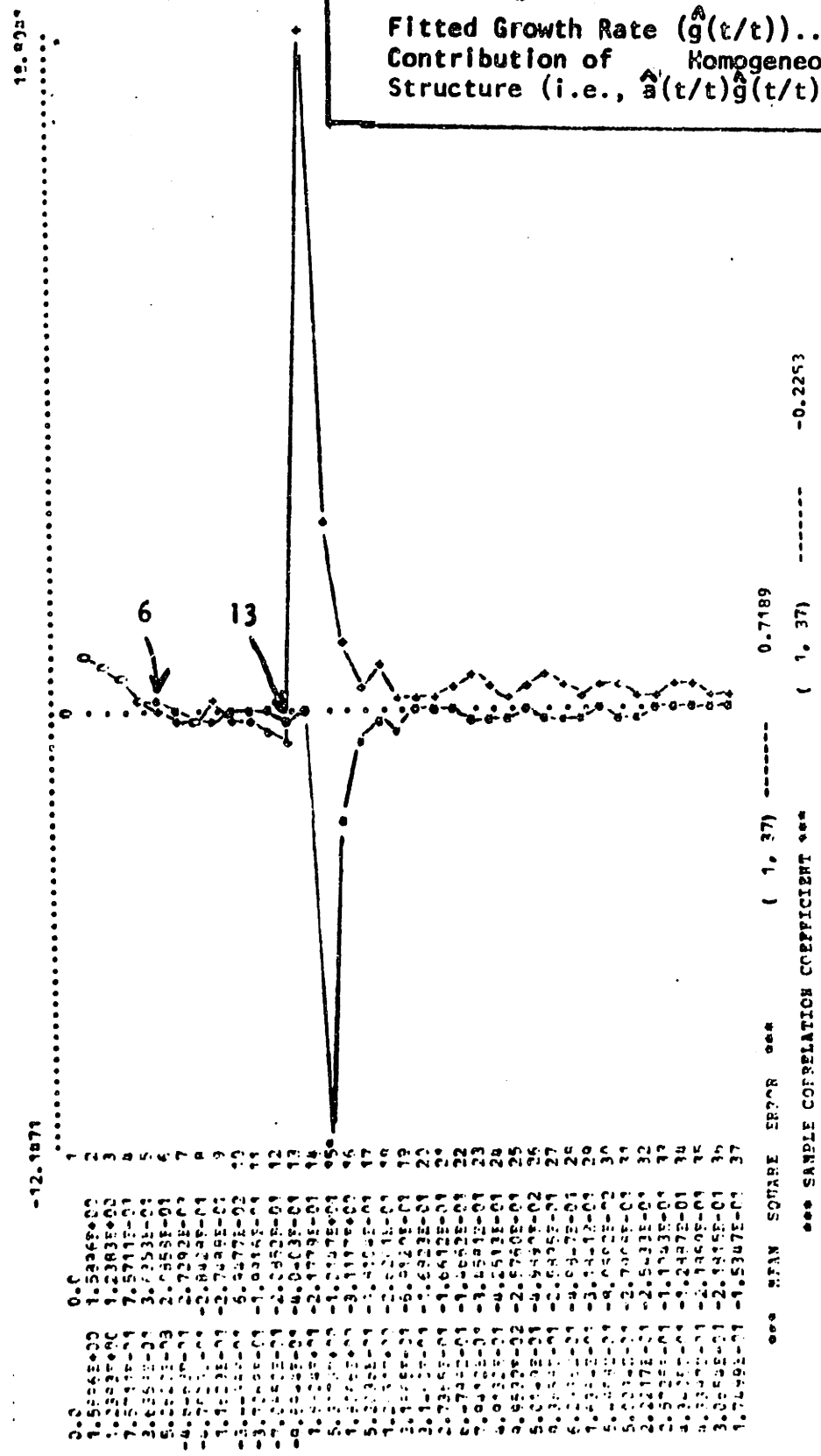


FIGURE V-36

Dataset 3 : Purely Domestic Small Passenger
 (Including Trucks for Prewar Data)
 Fitted Growth Rate $\hat{g}(t/t)$(+)
 Contribution of Homogeneous
 Structure (i.e., $\hat{a}(t/t)\hat{g}(t/t)$(*)



- i) from Point 6(1938) to Point 13(1944), it indicates a typical pattern of the gradual transition of production in a parabolic shape as depicted in FIGURE V-9;
- ii) from Point 15(1948) and thereafter, it forms a one-period-delay mirror image of the growth rate curve.

d) Structural Interpretations and Policy Implications

A sharp decline of the homogeneous parameter at Points 14(1947) and 15(1948) is due to a radical change of the growth rate from Point 13(1945) to Point 14(1947), and from Point 14(1947) to Point 15(1948). If the growth rate at Point 15(1948) did not decrease so severely, the homogeneous parameter at this point would not have entered into the negative region. By the same logic, if the growth rate at Point 14(1947) was not so high, the homogeneous parameter at Point 15(1948) would not have entered into the negative region. A moderate decrease of the growth rate at the next Point 16(1949) stops a further decline of the homogeneous parameter. The stabilization of the homogeneous parameter since Point 17(1950) indicates that the internal dynamic property of the production system becomes stabilized and starts systematically cancelling out a growth rate oscillation in the positive regions as shown in FIGURE V-36.

In comparison with the previous two dataset cases, a swift

resumption of the productive acceleration of Dataset 3 is unique. Such a quick stabilization and the simple two-level pattern suggest that the state of the production of small passenger cars had been relatively stable throughout the entire period. The impacts of both the technology contract of 1952 and the MITI's Peoples' Car Plan of 1955 on productive acceleration cannot be observed. On the other hand, as indicated in FIGURE V-35, an increase of the heterogeneous parameter at Point 22(1954) seems to weakly indicate some possible impact of these interventions. However, this is still speculative so that no positive conclusion is possible.

(E) Remarks

Several important lessons are drawn from the above Kalman Filter analysis. The Kalman Filter dynamic parameter estimation has been applied to the growth rate determination model under the assumption that the production system (i.e., industry's own efforts plus extraneous causes to affect production) preserves much of the past state even if a structural change occurs in the production trend. If the growth rate (hence, production, too) moves smoothly along the past trend, the system is regarded as stabilized. Such stabilization can be observed in the time-invariant substructures (i.e., the homogeneous and heterogeneous parameters in the growth rate model). When a growth rate departs from the past trend, the system begins changing its

substructures to accommodate a new situation and finally arrives at the next stability. However, most importantly, the substructural changes are successively done under the strong constraint that the past system state should be preserved as much as possible. This constraint links the past to the present of industrial activity.

The above points indicate a profound policy implication. If the government (like the "Kalman Filter Government" discussed in SECTION V-2 (B)) exercises far greater intervention than the previous one so as to realize a drastic change in the growth rate (hence, production), the consequence is obvious: i.e., the current state of industry is broken and enters into an unstable state. Our results show that this seems to have happened in two cases: 1) during a short period after the Pacific War in the production of all kinds of 4-wheel vehicles and the production of small passenger cars (Dataset 3) in particular, and 2) after the Law Regarding Automobile Manufacturing Enterprise was promulgated in 1936, in the production of large and medium-size trucks and buses (Dataset 2). Furthermore, the results show that the instability period of the production of small passenger cars (Dataset 3) was shortest among the three datasets.

Starting with the heuristic observations of the peculiar changes in production data, we have employed a hypothetical interpretation for these structural changes with a simple first-order difference equation model on the growth rate variation in which the homogeneous parameter

is assumed to represent industry's independent productive performance and the heterogeneous parameter is assumed to show the intervention impact. However, the results of the Kalman Filter have suggested that these assumptions need some corrections. First, the heterogeneous parameter would more appropriately indicate the stability of industry than productivity. Therefore, it is a key variable for the assessment of the intervention impact. Second, although the prewar results have demonstrated, to some extent, the validity of the pre-analysis argument of the structural changes, the meaning of the heterogeneous parameter should comprise not only the intervention impact, but also other kinds of impacts such as the one by economic causes. Third, the complexity of data fluctuations in the postwar era necessitates a further refinement of the current growth rate model to differentiate the impact of intervention from others. However, because of the unsuccessful data collection of relevant economic indicators and because of the time constraint, we have adopted the simplest model under rather bold assumptions in order to demonstrate the applicability of the Kalman Filter to the assessment of policy intervention.

SECTION V-3

APPLICATION OF A FIRST-ORDER HETEROGENEOUS DIFFERENCE EQUATION MODEL TO PRODUCTION DATA AND STRUCTURAL TRANSFORMATION

(A) Direct Application of The Kalman Filter to Production Data

1. Model

So far, we have placed our focus on the growth rate curve for extracting the properties of structural changes of production data on the ground that the growth rate is normally recognized as the most important reference to assess industry's productive performance regardless of a growth level. In this section, we directly apply the Kalaman Filter to production data.

Now, consider the same model as one in FIGURE V-13:

$$(V.21) \quad z(t) = a(t)y(t-1) + b(t)u(t-1) + w(t).$$

The meanings of these variables are the same as those in FIGURE V-13, except:

$z(t)$: measurement of production

$y(t)$: "true" (without measurement error)
production.

Note that the "dimension" of $b(t)$ is equivalent to that of production, which means that a value in the heterogeneous term is large enough to make a substantial impact on $y(t)$ or $z(t)$.

For a pre-intervention period, the model has a homogeneous structure such that:

$$(V.22) \quad z(t) = a(t)y(t-1) + w(t).$$

Note that $a(t)$ is the sum of a growth rate and 1.0 since the system is first-order homogeneous. After a unit-step input enters, the model becomes heterogeneous as:

$$(V.23) \quad y(t+1) = a(t+1)y(t) + b(t+1) + w(t).$$

2. Datasets

Datasets to be used are the same as the ones that have calculated the previous growth rate datasets [15].

3. Initial Conditions

With respect to the initial assignments of the variances $\text{var}(e(t))$ and $\text{var}(s(t))$ to specify the behaviors of $a(t)$ and $b(t)$, a small value is assigned for $\text{var}(e(t))$ while a large value is assigned for $\text{var}(s(t))$. This is in recognition of the fact that the homogeneous parameter is comparable to the growth rate, which would not change too much and taking account of the fact that the heterogeneous parameter $b(t)$, whose dimension is the same as that of production, is a variable intervention effect [16].

(B) Results of the Kalman Filter Analysis

1. Dataset 1 (Total of Purely Domestic 4-wheelers)

a) Degree of Estimation

FIGURE V-37 demonstrates that the fitted production curve almost perfectly resembles the actual production curve on a log scale. The early differences up to Point 3(1926) suggest that the Kalman Filter tried to learn a trend of production data by correcting the arbitrarily assigned initial conditions. A high degree of fitness now

FIGURE V-37

Dataset 1: Total of Purely Domestic
4-Wheelers
Measured Production (z(t)).....(+)
Fitted Production ($\hat{y}(t/t)$).....(*)

6.723

Log Scale

0.0

0.0	1.1305E+00	10
2.1018E+00	1.3651E+00	11
2.2872E+00	2.5003E+00	12
2.4306E+00	2.5327E+00	13
2.6165E+00	2.6439E+00	14
2.8355E+00	2.6400E+00	15
2.8875E+00	2.5116E+00	16
2.9495E+00	2.9455E+00	17
3.2255E+00	3.2252E+00	18
3.4181E+00	3.1151E+00	19
3.7021E+00	3.7021E+00	20
4.0257E+00	4.0257E+00	21
4.3377E+00	4.3377E+00	22
4.5881E+00	4.5881E+00	23
4.8671E+00	4.8671E+00	24
5.1701E+00	5.1701E+00	25
5.5021E+00	5.5021E+00	26
5.8671E+00	5.8671E+00	27
6.2621E+00	6.2621E+00	28
6.6871E+00	6.6871E+00	29
7.1421E+00	7.1421E+00	30
7.6271E+00	7.6271E+00	31
8.1421E+00	8.1421E+00	32
8.6871E+00	8.6871E+00	33
9.2621E+00	9.2621E+00	34
9.8771E+00	9.8771E+00	35
1.0527E+01	1.0527E+01	36
1.1227E+01	1.1227E+01	37
1.1977E+01	1.1977E+01	38
1.2777E+01	1.2777E+01	39
1.3627E+01	1.3627E+01	40
1.4527E+01	1.4527E+01	41
1.5477E+01	1.5477E+01	42
1.6477E+01	1.6477E+01	43
1.7527E+01	1.7527E+01	44
1.8627E+01	1.8627E+01	45
1.9777E+01	1.9777E+01	46
2.0977E+01	2.0977E+01	47

MEAN SQUARE ERROR ### (1, 47) 0.0165
CORRELATION COEFFICIENT ### (1, 47) 0.9972

guarantees the following discussion on the structural changes of production data with the estimated parameters.

b) Time-variation of Homogeneous and Heterogeneous
Parameters and Structural Interpretations

Observations of FIGURE V-38 and FIGURE V-39

FIGURE V-38 identifies six conspicuous behavioral patterns of the homogeneous parameter. These are:

- i) up to Point 9(1932): concave approach to the 1.0 level,
- ii) from Point 9(1932) to Point 13(1936): concave growth,
- iii) from Point 14(1937) to Point 17(1940): constant level with a small fluctuation,
- iv) from Point 18(1941) to Point 24(1947): concave decline beyond the 1.0 level,
- v) from Point 23(1946) to Point 38(1961): concave growth
- vi) Point 39(1962) and thereafter: constant level with a large fluctuation.

On the other hand, FIGURE V-39 shows four level changes of the heterogeneous parameter. These are:

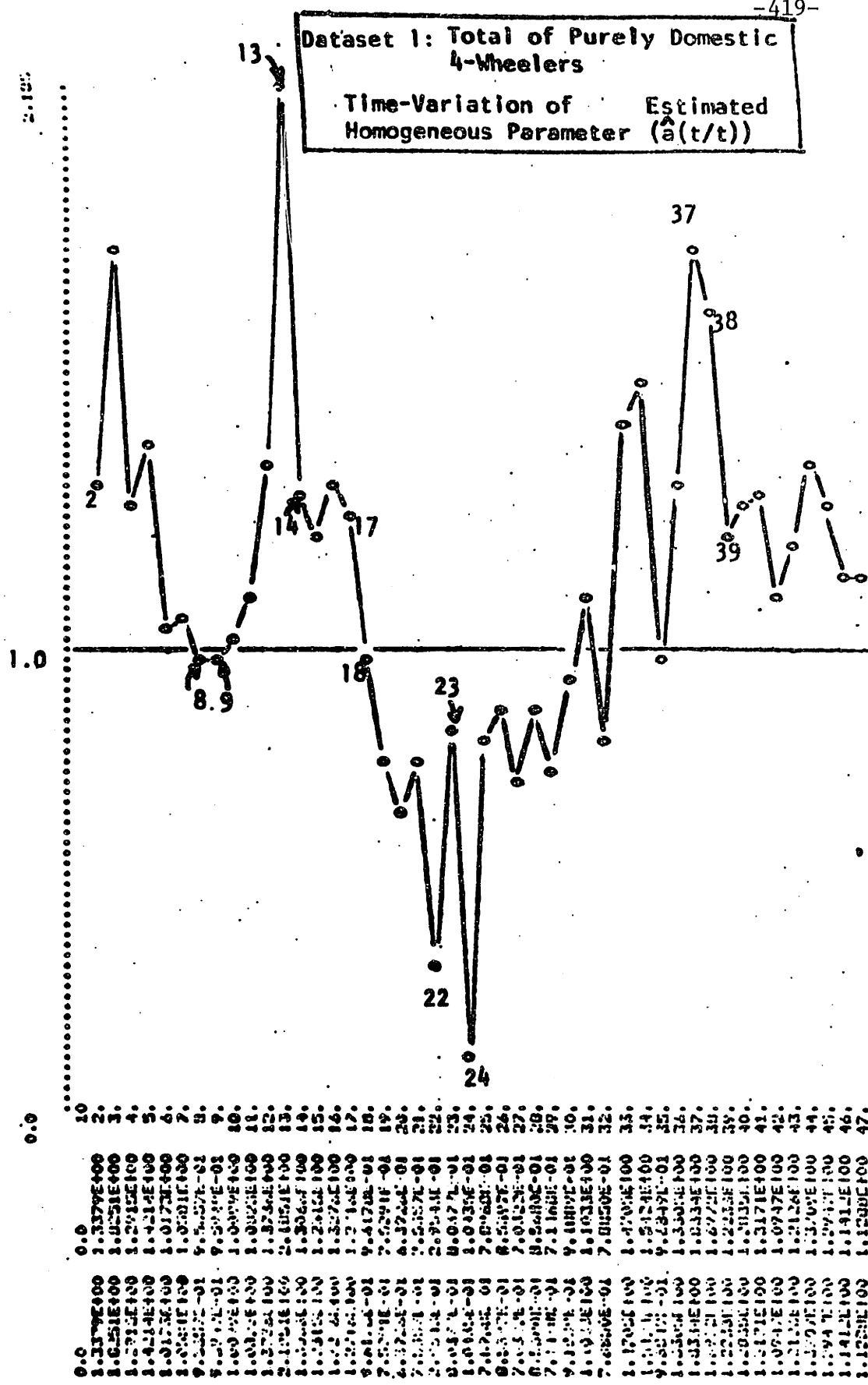
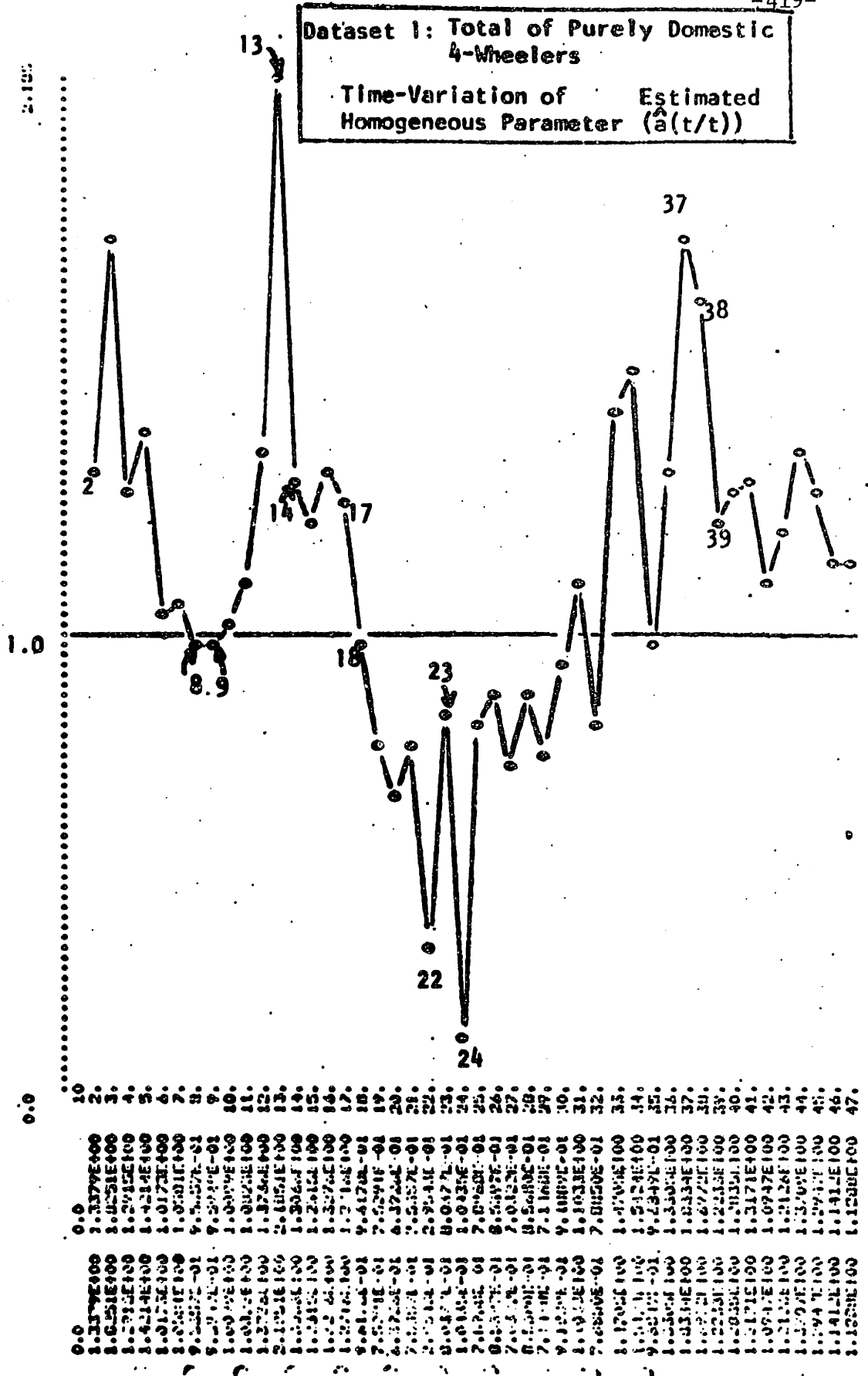


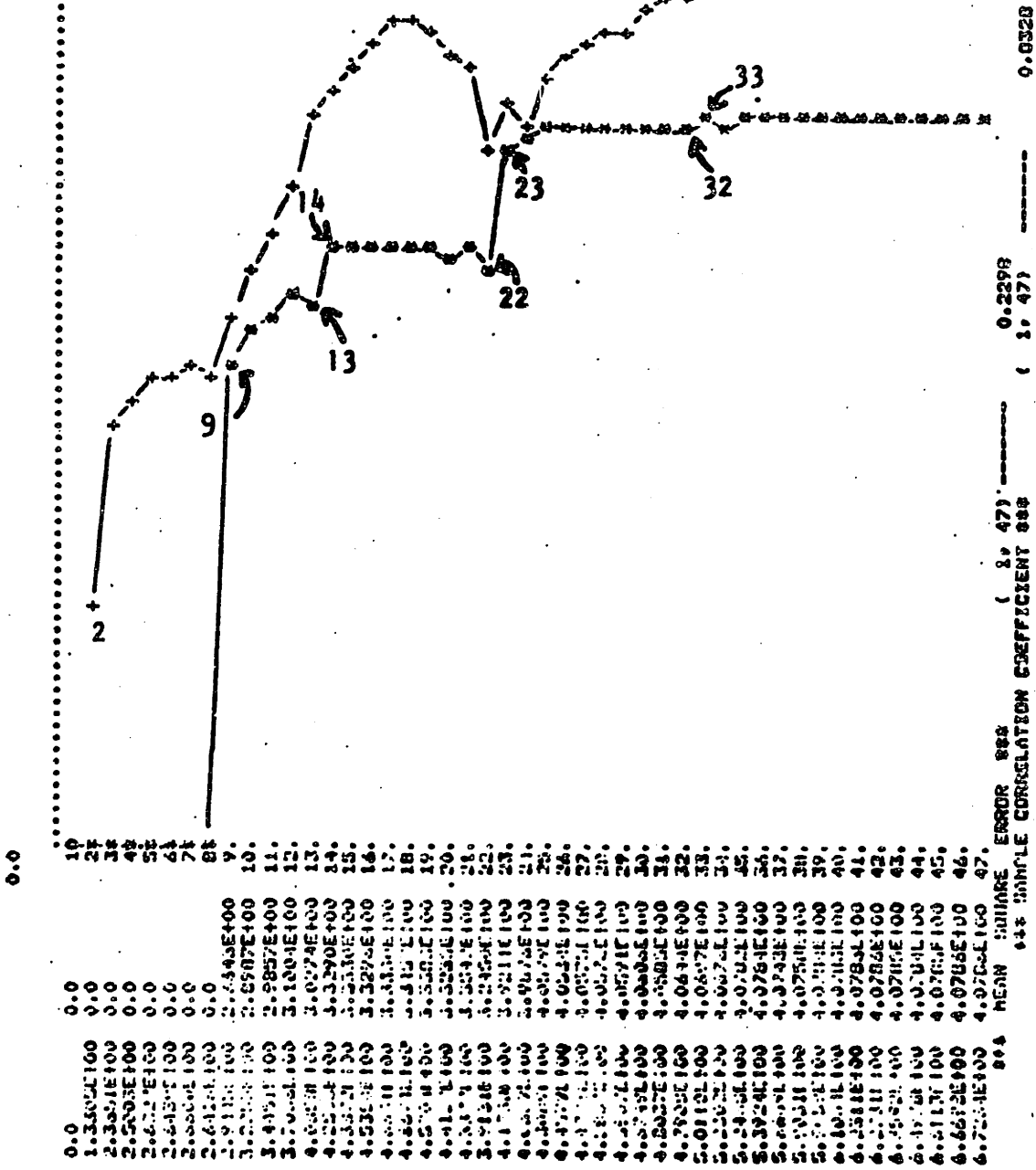
FIGURE V-38



Dataset 1: Total of Purely Domestic 4-Wheelers
 Fitted Production $\hat{y}(t/t)$(+)
 Time-Variation of Estimated
 Heterogeneous Parameter $b(t/t)$(*)

6.7:3

Log Scale



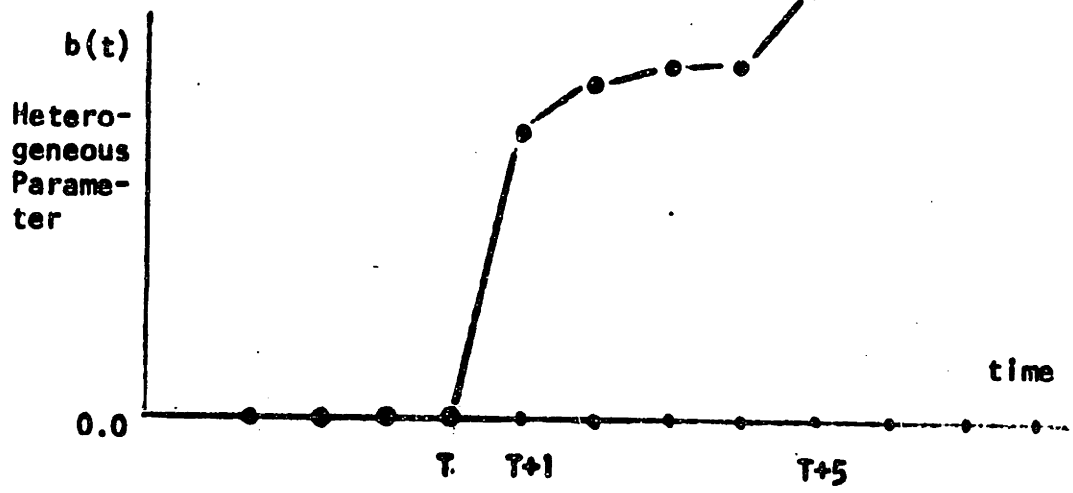
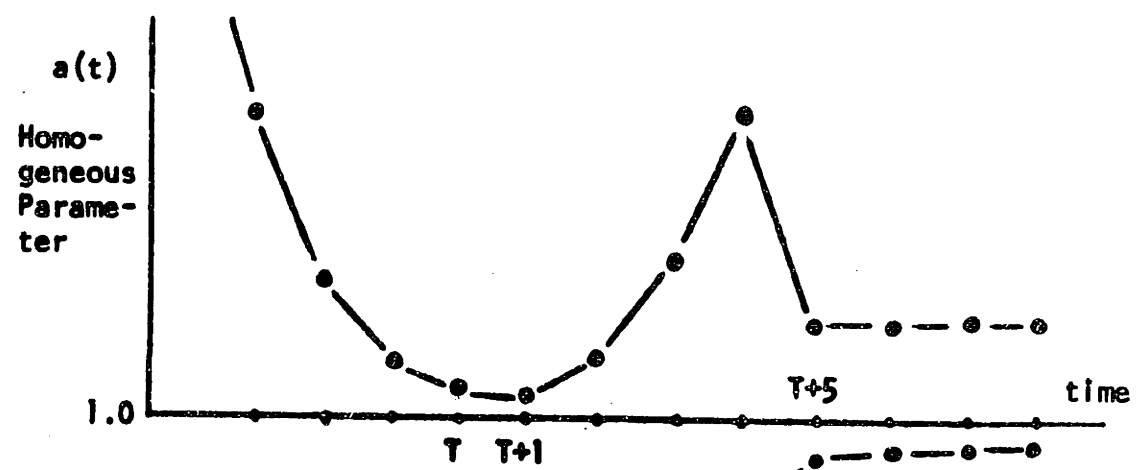
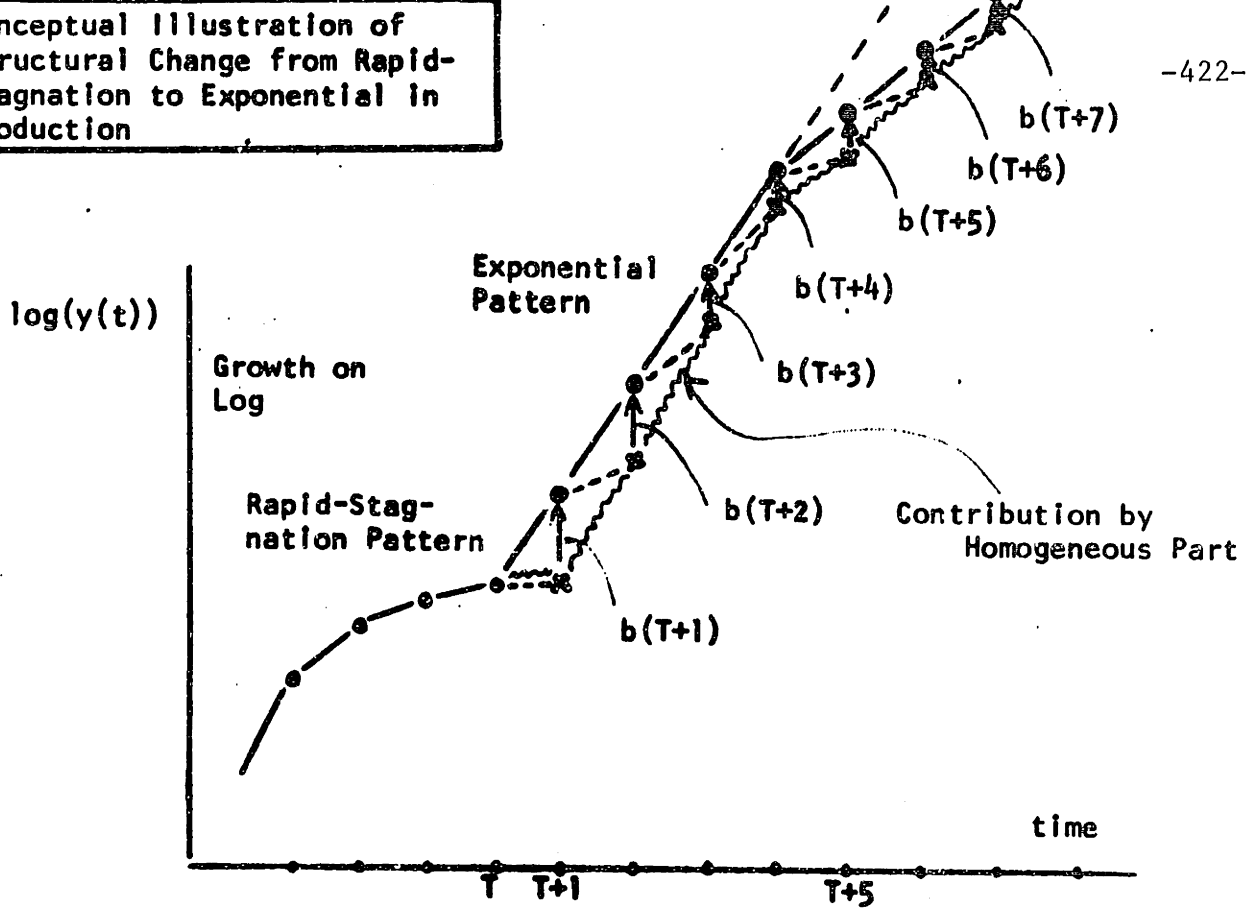
- i) from Point 9(1932) to Point 13(1936): convex level increase,
- ii) from Point 14(1937) to Point 22(1945): flat level,
- iii) from Point 23(1946) to Point 32(1955): convex level,
- iv) Point 33(1956) and thereafter: flat level.

Structural Interpretations

The first concave approach of the homogeneous parameter to the 1.0 level simply means that production grows in the form of rapid-stagnation during this pre-intervention period. Recall that the model during this period is homogeneous. Thus, this concave declining curve corresponds to an exponential decline.

The heterogeneous parameter at Point 9(1932) makes production escape from stagnation, although the homogeneous parameter is still stagnated at this point. If the homogeneous parameter is not improved beyond Point 10(1933) to thus continue the previous stagnation level, the heterogeneous parameter would have to increase to let the resultant production curve form an exponential trend. That is, the same length of the heterogeneous contribution on a log scale (indicated by an arrow line in FIGURE V-40) which is geometrically derived by the horizontal line (the stagnated homogeneous parameter) and the oblique line (the resultant exponential trend) means an increase of the heterogeneous parameter value.

Conceptual Illustration of Structural Change from Rapid-Stagnation to Exponential in Production



However, a rapid improvement of the homogeneous parameter up to Point 13(1936) is observed. As shown in FIGURE V-40, as the homogeneous parameter is improved to take over the exponential trend, the relative importance of the heterogeneous parameter becomes marginal. Then, the heterogeneous parameter can stay on a constant level. This means that, although the structure is heterogeneous, the real function of the system becomes homogeneous to yield an exponential growth.

1932 is the year when the MCI Standard Model was specified by the government which involved public procurement (SECTION II-2). Then, our conjecture follows: this intervention created a high level of the heterogeneous parameter at Point 9(1932); this intervention seems to have encouraged industry to increase its annual growth rate. Perhaps due to these two factors, i.e., an increase of industry's annual growth rate and a high-level public procurement, thus production grew exponentially.

However, a sudden decline of the homogeneous parameter at Point 14(1937) before it reached a high constant level shows that the above takeover process terminated for some reasons. Recall that 1937 is one year after the Law Regarding Automobile Manufacturing Enterprise was promulgated. It is conceivable that the enactment of this law would have terminated the previously increasing trend of the homogeneous

parameter because, by this law, the government discarded the hitherto cooperative manufacturers and thus switched to the two larger firms, Toyota and Nissan (SECTION II-3).

An increase in the heterogeneous parameter at Point 14(1937) indicates that a decrease of the homogeneous parameter at this point is so severe. As illustrated in FIGURE V-40, if the same magnitude of the heterogeneous parameter as the previous ones continued to appear at T+5, the resultant production curve would decline drastically. Therefore, in order to stop a drastic decline of production, an increase in the heterogeneous parameter is perhaps needed. Since the homogeneous parameter remains around a constant level up to Point 17(1940), the heterogeneous parameter is also stabilized on this increased level to yield an exponential trend. This is a structural explanation of the decline of the log-linear production data slope of all 4-wheel vehicles which occurred since 1937.

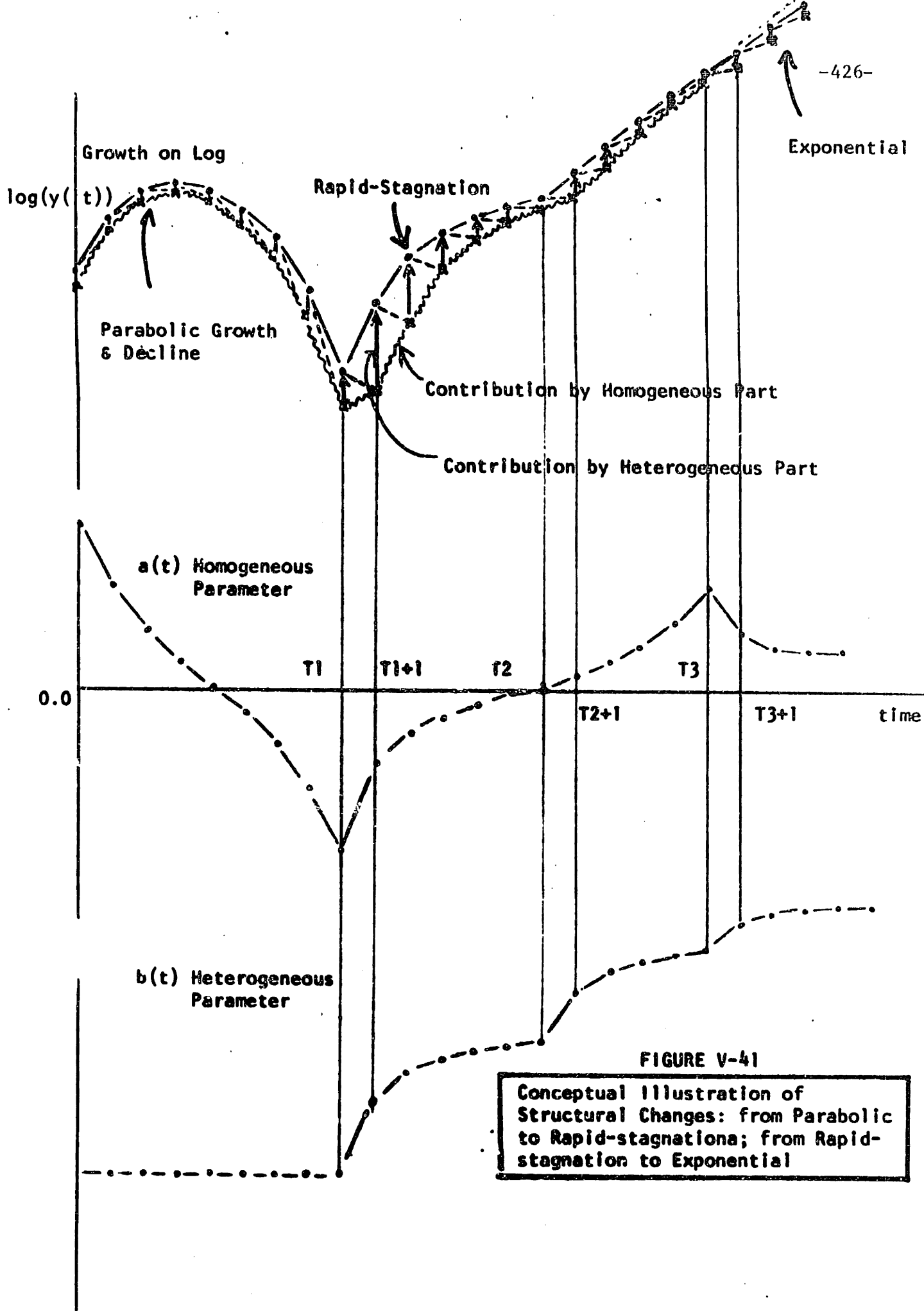
Interestingly enough, the decline in the exponential slope is not due to a decline in the heterogeneous parameter, but to a decline of the homogeneous parameter. This implies that this slope change would be primarily due to a decline in the productive performance of industry because of the reorganization of industry by the Law of Automobile Manufacturing Enterprise of 1936. Hence the government would have to have strengthened an external support to compensate for

such a decline.

Now, FIGURE V-38 shows that the homogeneous parameter started declining from Point 18(1941) up to Point 24(1947) while the heterogeneous parameter remains constant up to Point 22(1945). This indicates that the parabolic decline of production is due to a decline in the homogeneous parameter beyond the 1.0 level. The structure of this mechanism is illustrated in FIGURE V-41.

1941 is the year when Japan entered the Pacific War against the Allied nations; and 1945 is the year when the war ended. The Kalman Filter results suggest that during the war period an annual increase rate of production declined continuously while external support was sustained at a constant level. The fact that a decline in the homogeneous parameter continues till 1947 indicates that the productive performance deteriorated continuously after the end of war, despite the phenomenal increase at Point 23(1946). Such a sharp decline in productive performance perhaps results from a strong regulatory intervention on the part of the military government (SECTION II-4).

Now in the fourth behavioral pattern, the homogeneous parameter gradually goes up from Point 23(1946) to, e.g., Point 38(1961). The corresponding behavioral pattern of the heterogeneous parameter is an increased level from Point 23(1946) to Point 32(1955). As illustrated



in FIGURE V-41, these two patterns jointly yield a rapid-stagnation trend of production.

An improvement in the homogeneous parameter suggests the following interpretation: the end of regulatory intervention on the part of the military government simply freed industrial activity so that industry started gaining in productive performance up to 1961. However, a change in the production trend from a parabolic decline to rapid-stagnation can not be realized without an increase in the heterogeneous parameter at Point 23(1946), because an improvement of the homogeneous parameter starts from the negative region. Interpreted differently, this means that productive performance of industry still contained war damages, so that an increase of production needed outside support. As discussed in SECTION III-1, materials allocation by the GHQ seem to correspond to this increase of the heterogeneous parameter at Point 23(1946).

A discernible level increase of the heterogeneous parameter at Point 33(1956) is observed. This suggests that production enters into a new phase; from a rapid-stagnation to an exponential pattern. The structure of this change is equivalent to the same structural change at Point 10(1933) discussed above. That is, while the homogeneous parameter increases gradually, if the system receives an increase of the heterogeneous parameter, a resultant output can get out of stagnation.

There was no major specific policy event in 1956. However, the government announced the Peoples' Car plan in 1955; and the assembly of foreign cars through technological contracts started making a significant impact on overall production of 4-wheel cars about this year. In addition, as discussed in the next chapter (SECTION VI-2), import restriction was relaxed in this year in recognition of the fact that domestic production of small passenger cars could take over the dominance of foreign imports.

The behavioral change of the homogeneous parameter from the above fifth pattern to the sixth pattern is comparable to the one from the second pattern to the third pattern discussed above. That is, the hitherto increasing trend of the homogeneous parameter ceases and starts stabilizing around a low level, which consequently yields to a declined trend of an exponential growth of production. However, no such increase of the heterogeneous parameter as the one which happens at Point 14(1837) is observed. This is perhaps because of the specification of $\text{var}(s(t))$. In other words, the initially specified range of a change in the heterogeneous parameter by $\text{var}(s(t))$ allows no further change once it reaches this level. In recognition of this, FIGURE V-41 illustrates the same mechanism of structural changes as the one in FIGURE V-40.

Since the historical investigation in PART I does not cover a

period beyond the eighth intervention of the Peoples' Car plan in 1955, no interpretation for the 1961 change of the homogeneous parameter is possible.

c) Contribution of Homogeneous Structure

For an empirical demonstration of the wave line in FIGURES V-40 and V-41, which indicates the contribution of the homogeneous structure $a(t)y(t-1)$ to production $y(t)$, FIGURE V-42 is presented. This figure simply demonstrates the process in which the homogeneous structure takes over production under an increase of a heterogeneous input, which enters at the beginning of each structural change.

2. Dataset 2 (Purely Domestic Large & Medium-size Trucks and Buses)

a) Degree of Estimation:

FIGURE V-43 shows again a high degree of resemblance between the fitted production curve by the Kalman Filter and the actual production curve. The Kalman Filter took time up to Point 5(1928) to learn data trend.

FIGURE V-42.

Dataset 1: Total of Purely Domestic
4-Wheelers

Fitted Production $(\hat{y}(t/t))$(+)
Contribution by Homogeneous Structure $(\hat{a}(t/t) \times y(t-1))$(*)

6.723

Log Scale

0.0	0.0	10
1.3305E+00	1.3305E+00	10
2.3651E+00	2.3651E+00	2.
2.5003E+00	2.5003E+00	3.
2.6327E+00	2.6327E+00	4.
2.7439E+00	2.7439E+00	5.
2.8509E+00	2.8509E+00	6.
2.9514E+00	2.9514E+00	7.
3.0451E+00	3.0451E+00	8.
3.1321E+00	3.1321E+00	9.
3.2124E+00	3.2124E+00	10.
3.2861E+00	3.2861E+00	11.
3.3531E+00	3.3531E+00	12.
3.4134E+00	3.4134E+00	13.
3.4671E+00	3.4671E+00	14.
3.5141E+00	3.5141E+00	15.
3.5544E+00	3.5544E+00	16.
3.5881E+00	3.5881E+00	17.
3.6151E+00	3.6151E+00	18.
3.6354E+00	3.6354E+00	19.
3.6491E+00	3.6491E+00	20.
3.6561E+00	3.6561E+00	21.
3.6571E+00	3.6571E+00	22.
3.6521E+00	3.6521E+00	23.
3.6411E+00	3.6411E+00	24.
3.6241E+00	3.6241E+00	25.
3.6011E+00	3.6011E+00	26.
3.5721E+00	3.5721E+00	27.
3.5371E+00	3.5371E+00	28.
3.4971E+00	3.4971E+00	29.
3.4521E+00	3.4521E+00	30.
3.4031E+00	3.4031E+00	31.
3.3501E+00	3.3501E+00	32.
3.2931E+00	3.2931E+00	33.
3.2321E+00	3.2321E+00	34.
3.1671E+00	3.1671E+00	35.
3.1001E+00	3.1001E+00	36.
3.0311E+00	3.0311E+00	37.
2.9601E+00	2.9601E+00	38.
2.8871E+00	2.8871E+00	39.
2.8121E+00	2.8121E+00	40.
2.7351E+00	2.7351E+00	41.
2.6561E+00	2.6561E+00	42.
2.5741E+00	2.5741E+00	43.
2.4891E+00	2.4891E+00	44.
2.4011E+00	2.4011E+00	45.
2.3101E+00	2.3101E+00	46.
2.2161E+00	2.2161E+00	47.

MEAN SQUARE ERROR 888 (1, 47) 0.6285
 S+T SAMPLE CORRELATION COEFFICIENT 888 (1, 47) 0.9948

b) Time-variation of Homogeneous and Heterogeneous
Parameters and Structural Interpretations:

Observations of FIGURE V-44 and FIGURE V-45

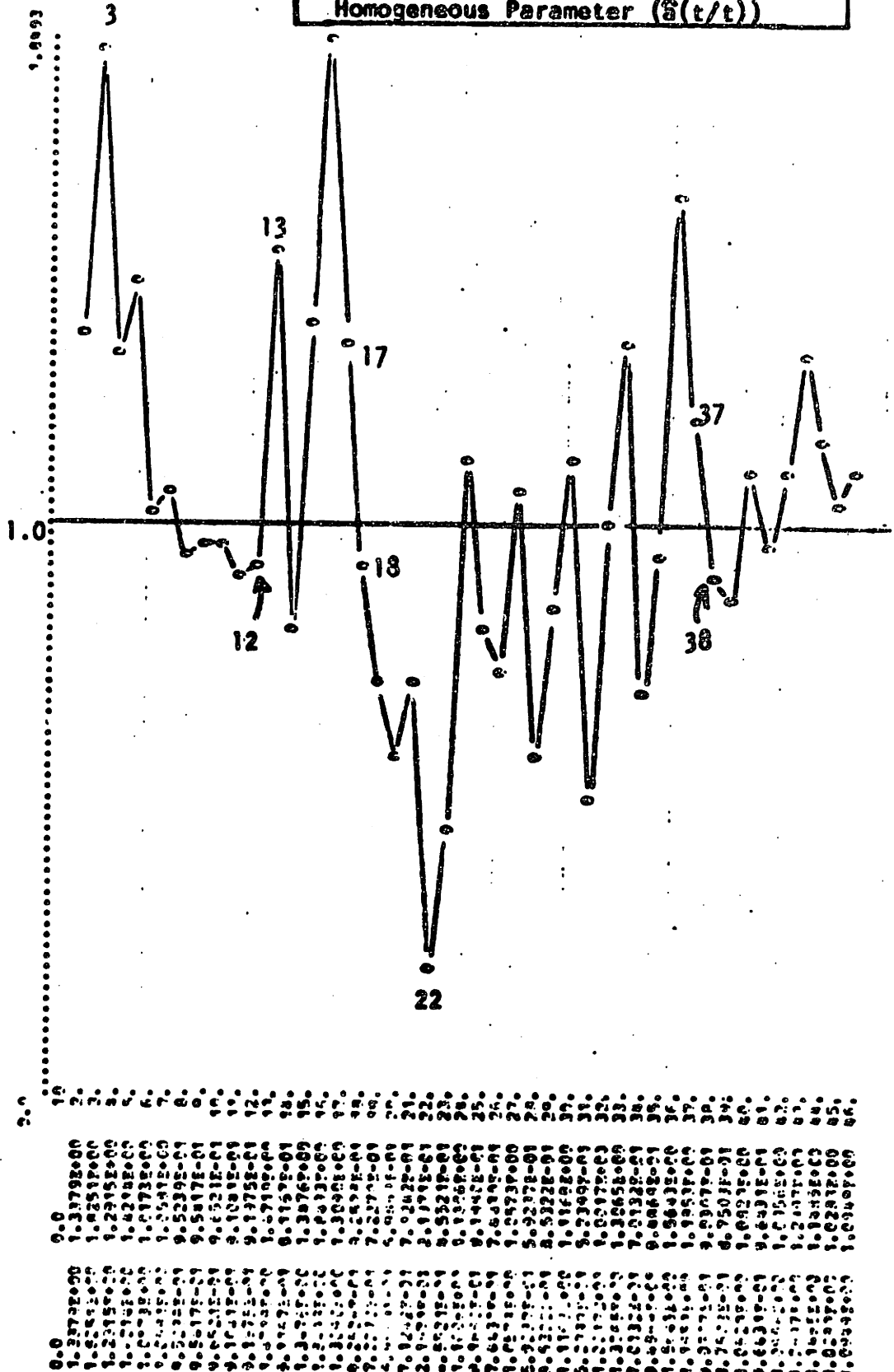
Five conspicuous behavioral patterns of the homogeneous parameter are identified in FIGURE V-44. These are:

- i) from Point 3(1926) to Point 12(1935): concave decline,
- ii) from Point 13(1936) to Point 17(1940): large fluctuation around a high level,
- iii) from Point 18(1941) to Point 22(1945): sharp concave decline,
- iv) from Point 23(1947) to Point 37(1961): gradual increase with a large fluctuation,
- v) Point 38(1962) and thereafter: gradual increase with a small fluctuation.

On the other hand, at least three conspicuous level changes of the heterogeneous parameter are observed in FIGURE V-45. These are:

- i) from Point 9(1932) to Point 12(1935): level with a large fluctuation,
- ii) from Point 13(1936) to Point 22(1945): stationary level,
- iii) Point 23(1947) and thereafter: step-functional level increases.

Time-Variation of Estimated Homogeneous Parameter ($\hat{\delta}(t/t)$)



Structural Interpretations

A concave decline of the homogeneous parameter up to Point 12(1935) suggests that, although production departed from the first stagnation in 1932 and formed the second pattern of rapid-stagnation, the productive performance of industry was not improved and hence continued to decline. If there was no appearance of the heterogeneous parameter, production would have formed a parabolic decline. Therefore, an increase of production in 1932 seems to be due to the appearance of the heterogeneous parameter. As discussed in the previous case, if production grew at a constant rate, the heterogeneous parameter would have to increase until the homogeneous parameter would start increasing. On the contrary, a decrease of the heterogeneous parameter at Point 11(1934) is observed, so that production stagnates.

This is one possible interpretation of an impact of the MCI Standard Car of 1932. That is, upon the government's standardization of a particular size of automobiles, production departed from stagnation because of the accompanying government procurement; but the productive performance of the industry was not improved. Therefore, production stagnated again in 1934 and 1935, because an external support, i.e., procurement, declined. The withdrawal of MOR and MOA from the MCI Standard Model Committee perhaps corresponds to this decline in external support, since they switched procurement to a

different size (SECTION II-2).

A tremendous increase in production at Point 13(1936) coincides with the enactment of the Law of Automobile Manufacturing Enterprise in 1936. At this point, both the homogeneous and the heterogeneous parameters increase. The homogeneous parameter around a high level from Point 13(1936) to Point 17(1940) sustains an exponential growth of production given a constant level of the heterogeneous parameter. However, a large fluctuation indicates that the takeover process of exponential growth by the homogeneous parameter is difficult.

Thus, a sharp decrease of the homogeneous parameter occurs till Point 22(1945), while the heterogeneous parameter maintains a constant level. This means that a parabolic decline of production is due to a decrease of the homogeneous parameter. If a decrease in the homogeneous parameter is observed to start from Point 19(1939) in FIGURE V-44, a parabolic pattern can be said to have started since 1939.

As is the case of the previous dataset, a decrease in the homogeneous parameter seems to be due to a regulatory intervention of the military government during the war.

A shift of the heterogeneous parameter is observed at Point 23(1947). As discussed in the previous case, an increase of production after the war perhaps needed such a shift because the homogeneous

parameter is still low in the negative region.

Materials allocated by the GHQ in recognition of a shortage of means of transportation corresponds to this level increase of the heterogeneous parameter.

As observed in the previous dataset, the homogeneous parameter starts the upward movement from, e.g., Point 23(1947) up to Point 36(1960) with a large fluctuation.

This again perhaps indicates an increase in productive performance of industry after the war. A large fluctuation suggests that improvement of productive performance was not smooth. Nonetheless, a general dynamic trend in productive performance went up.

However, from Point 38(1962), the homogeneous parameter enters into a different pattern, terminating a hitherto upward movement with a large fluctuation. It failed to maintain a constant level. In the meantime, there is no clear observation of a level shift of the heterogeneous parameter during this period. This phenomenon indicates that the exponential trend of production is characterized by the homogeneous structure given a constant level of the heterogeneous parameter.

Again, since a historical investigation in PART I does not cover a

period beyond, e.g., 1960, an interpretation of the above change cannot be made.

c) Contribution by Homogeneous Structure

To compare with FIGURE V-42, FIGURE V-46 shows a marked difference. That is, a contribution by the homogeneous structure has not merged with production, thereby implying the lasting significance of the heterogeneous parameter. In FIGURE V-42, the relative significance of the heterogeneous parameter becomes smaller in each structural pattern, which implies the process of the homogeneous structure to take over production.

If the heterogeneous parameter is considered as an extraneous support by government intervention, the above observation suggests that intervention played an important role to shape production of domestic large and medium-size trucks and buses. This seems to correspond to the previous historical investigation in PART I, which we found that up to, e.g., 1955, government policy had been primarily directed to this type of motor vehicle.

3. Dataset 3 (Purely Domestic Small-size Passenger Cars
Including Trucks for Prewar Data)

5.8000

Log Scale

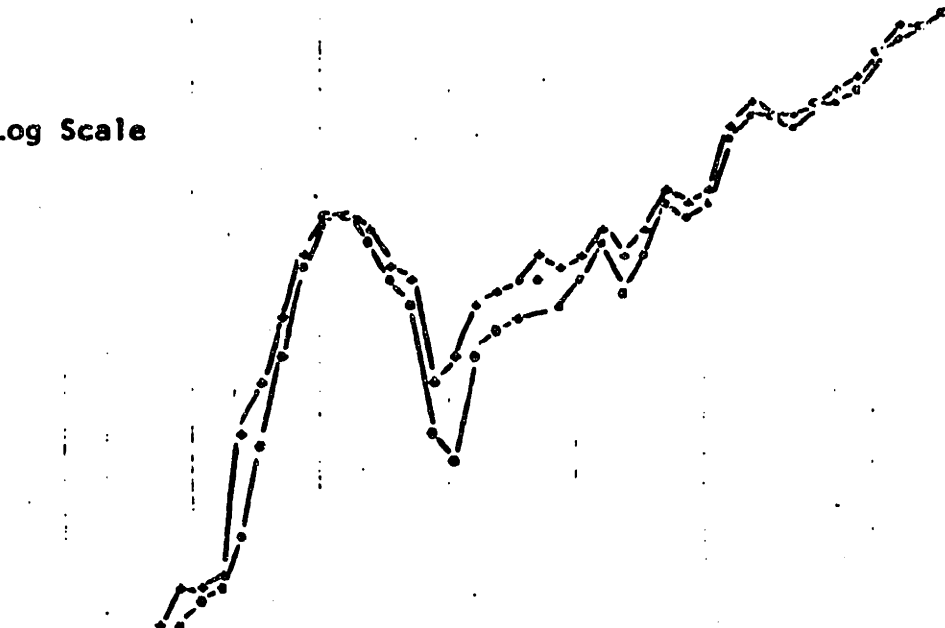


FIGURE V-46

Dataset 2: Purely Domestic Large & Medium
& Buses

Fitted Production ($\hat{y}(t/t)$).....(+)
Contribution by Homogeneous Structure ($S(t/t)y(t-1)$)...(*)

0.0	1.3305E+00
1.0	2.3651E+00
2.0	2.5071E+00
3.0	2.6377E+00
4.0	2.6891E+00
5.0	2.6501E+00
6.0	2.6377E+00
7.0	2.6377E+00
8.0	2.6377E+00
9.0	2.6377E+00
10.0	2.6377E+00
11.0	2.6377E+00
12.0	2.6377E+00
13.0	2.6377E+00
14.0	2.6377E+00
15.0	2.6377E+00
16.0	2.6377E+00
17.0	2.6377E+00
18.0	2.6377E+00
19.0	2.6377E+00
20.0	2.6377E+00
21.0	2.6377E+00
22.0	2.6377E+00
23.0	2.6377E+00
24.0	2.6377E+00
25.0	2.6377E+00
26.0	2.6377E+00
27.0	2.6377E+00
28.0	2.6377E+00
29.0	2.6377E+00
30.0	2.6377E+00
31.0	2.6377E+00
32.0	2.6377E+00
33.0	2.6377E+00
34.0	2.6377E+00
35.0	2.6377E+00
36.0	2.6377E+00
37.0	2.6377E+00
38.0	2.6377E+00
39.0	2.6377E+00
40.0	2.6377E+00
41.0	2.6377E+00
42.0	2.6377E+00
43.0	2.6377E+00
44.0	2.6377E+00

*** MEAN SQUARE ERROR *** (1, 06) ***** 0.2201

*** SAMPLE CORRELATION COEFFICIENT *** (1, 05) ***** 0.9961

a) Degree of Estimation

FIGURE V-47 shows a nearly perfect resemblance between the fitted production curve by the Kalman Filter and the actual production curve throughout an entire period. Thus, the following argument on the structural changes of parameters is guaranteed.

b) Time-variation of Homogeneous and Heterogeneous
Parameters and Structural Interpretations

Observations of FIGURE V-48 and FIGURE V-49

Three conspicuous behavioral patterns of the homogeneous parameter are observed in FIGURE V-48. These are:

- i) from Point 2(1933) to Point 16(1948): sharp concave decline,
- ii) from Point 16(1948) to Point 22(1954), except for Point 19(1951): linear increase,
- iii) Point 23(1955) and thereafter: stabilizing vibration around a positive level,

In contrast to the previous two cases, the heterogeneous parameter

FIGURE V- 47

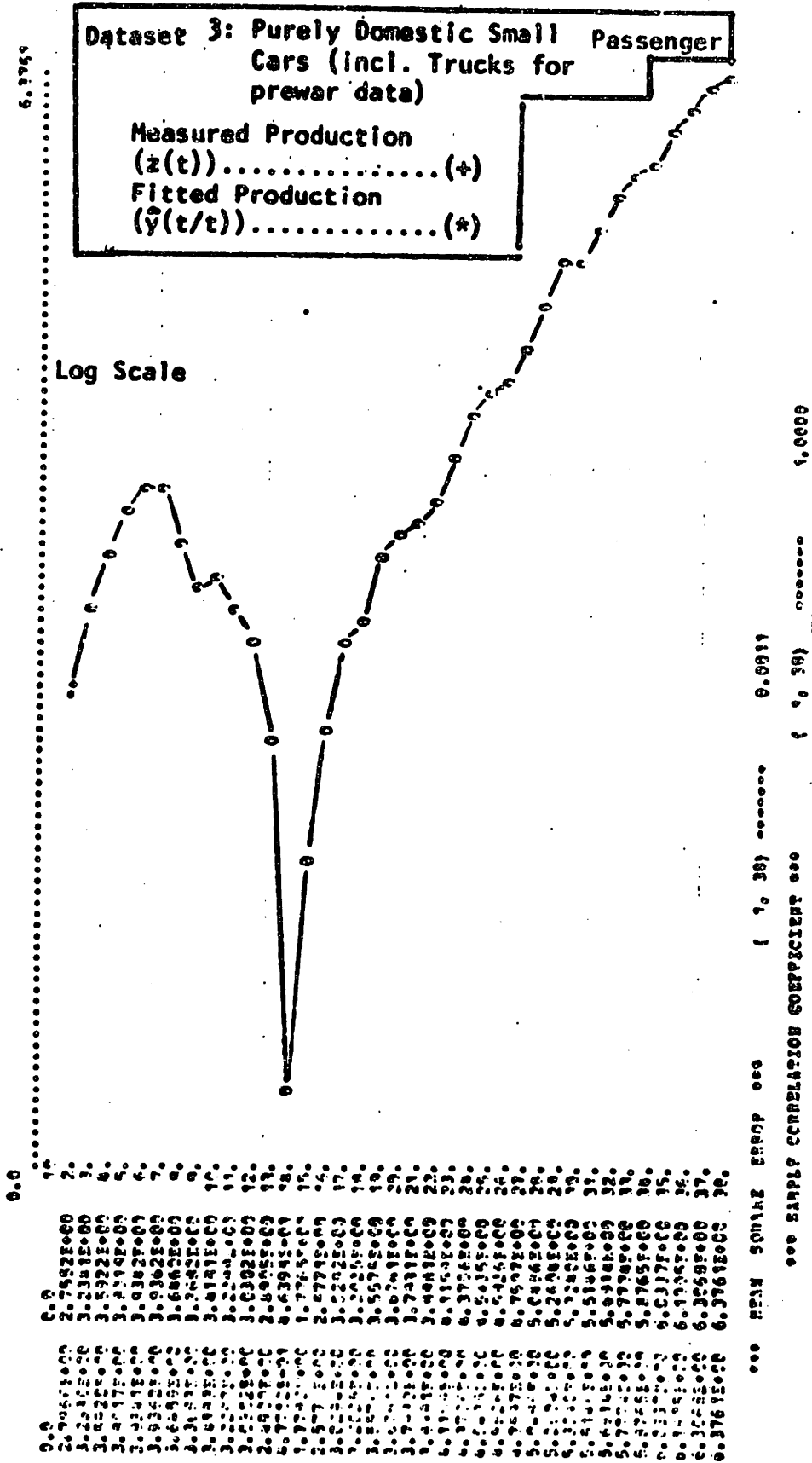
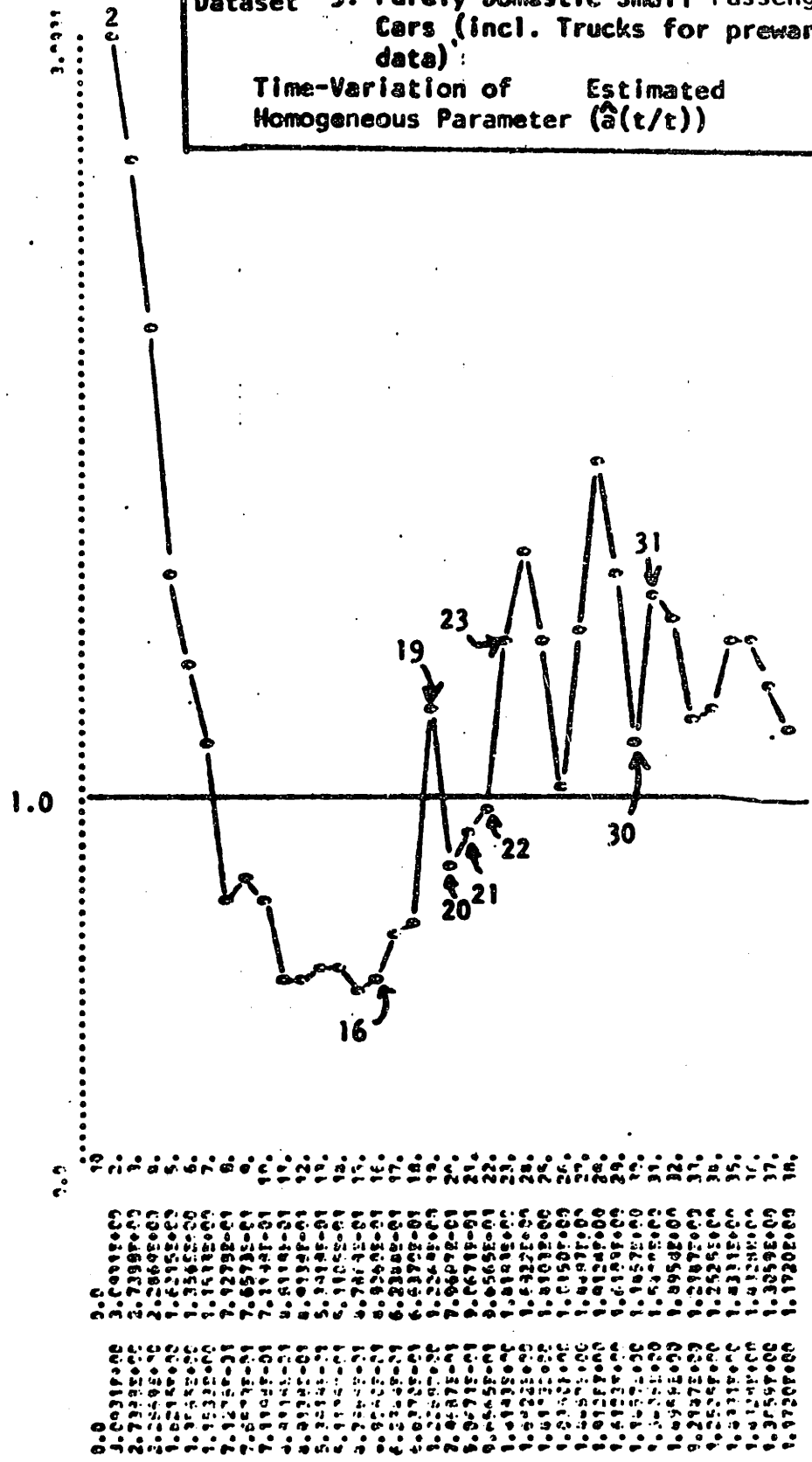
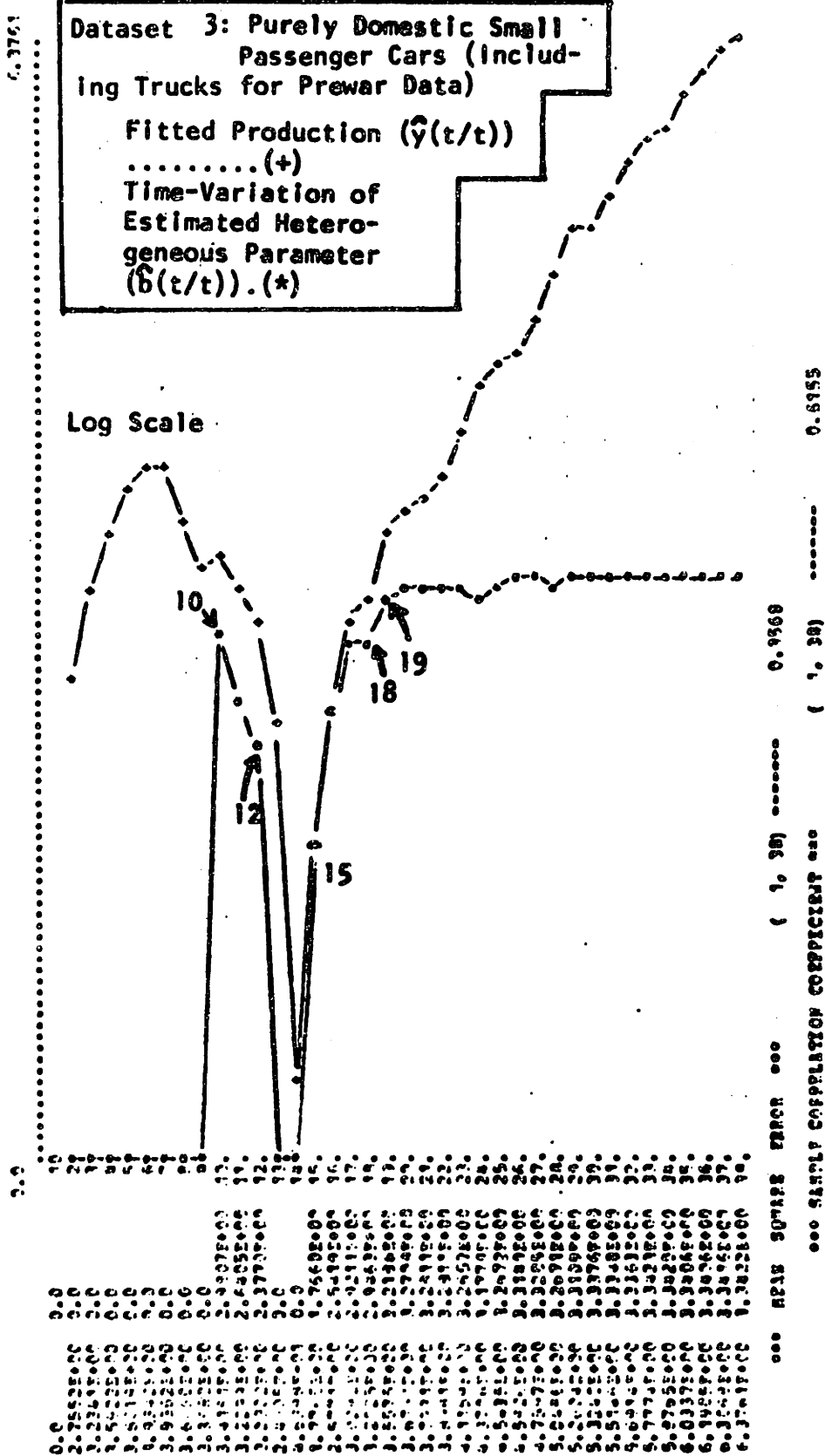


FIGURE V-48

Dataset 3: Purely Domestic Small Passenger Cars (incl. Trucks for prewar data):
 Time-Variation of Estimated Homogeneous Parameter ($\hat{a}(t/t)$)





behaves very uniquely. FIGURE V-49 in conjunction with FIGURE V-50 shows the following conspicuous patterns:

- i) from Point 7(1938) to Point 9(1940): negative level,
- ii) from Point 10(1941) to Point 12(1943): sharp convex decline,
- iii) from Point 13(1944) to Point 14(1945): large negative decline,
- iv) from Point 15(1947) to Point 18(1950): sharp convex increase,
- v) Point 19(1951) and thereafter: step-functional level with a convex fluctuation.

Note that the first and the third patterns are not identified in FIGURE V-49 since a negative value cannot be defined on a logarithmic scale. These negative heterogeneous parameter values are technically replaced by zero in FIGURE V-49. Keeping in mind the fact that when a contribution of the homogeneous structure surpassed production a difference between two values results in a negative heterogeneous parameter. The first and the third patterns characterized above are thus identified from FIGURE V-50.

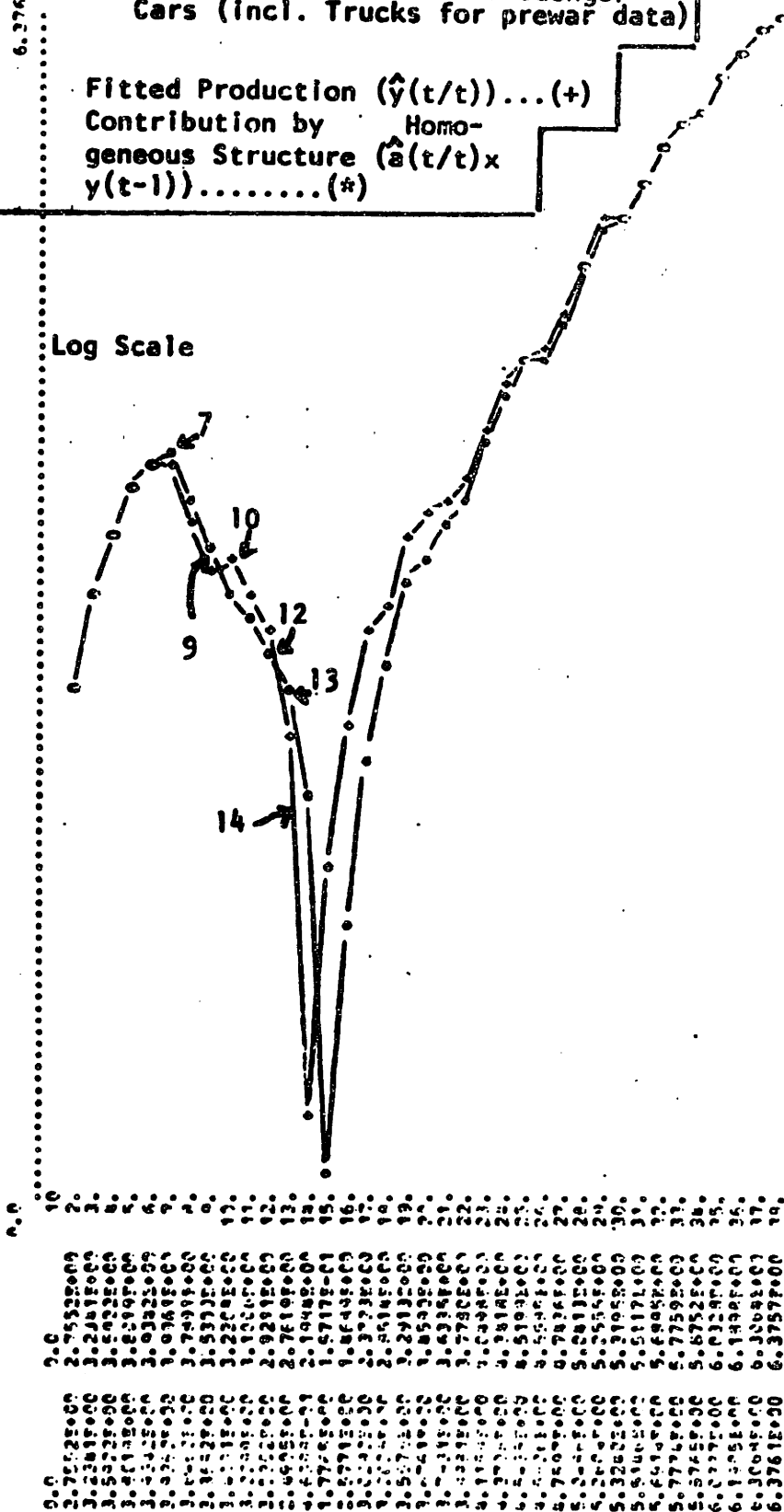
Structural Interpretations

A continuous concave decline of the homogeneous parameter up to Point 16(1948) suggests that an ever-declining trend of productive performance of small cars continued beyond the end of war, until 1948.

Dataset 3: Purely Domestic Small Passenger Cars (incl. Trucks for prewar data)

Fitted Production $(\hat{y}(t/t)) \dots (+)$
 Contribution by Homogeneous Structure $(\hat{a}(t/t) \times y(t-1)) \dots (*)$

Log Scale



*** MEAN SQUARE ERROR *** (1, 38) ***** 0.0734 (1, 38) ***** 0.9557

*** SAMPLE CORRELATION COEFFICIENT ***

This corresponds to the historical fact that the GHQ permitted the reopening of passenger car production in 1947 within a limit of prewar autopart stocks (SECTION III-1).

A negative value in the heterogeneous parameter exactly corresponds to the historical fact that Minister of Commerce and Industry banned production of passenger cars starting in 1938 (SECTION II-4). Without such a regulatory intervention, production would have formed a more gradual parabolic pattern as suggested in FIGURE V-50. It seems that a negative intervention forced a production decline more steeply.

However, the heterogeneous parameter suddenly becomes positive at Point 10(1941). This temporarily stops a decline of production and lets it increase for a while. During the war, supply of passenger cars was exclusively used for military command cars. Therefore, this heterogeneous parameter increase probably reflects an increase of military procurement in 1941. However, as the war went on, such a procurement might have declined, thereby making production decline continuously.

A negative value in the heterogeneous parameter at Point 13(1944) and Point 14(1945) would simply indicate the war regulations to restrict production of small cars.

Early increases of production after the war are caused by a sharp

increase of the heterogeneous parameter since the homogeneous parameter still stays in the negative region until Point 18(1950). However, the heterogeneous parameter soon gets stagnated at Point 18(1950). Then, production forms a rapid-stagnation pattern because of this stagnation and a prolonged negative value of the homogeneous parameter at Point 18(1950).

Both the homogeneous and the heterogeneous parameters increase at Point 19(1951). The economic boom triggered by a vast Korean War procurement seems to correspond to these increases. Although the heterogeneous parameter stays on this level thereafter, sharp decreases of the homogeneous parameter are observed. However, as shown in FIGURE V-52, these decreased values at Point 20(1952), Point 21(1953) and Point 22(1954) ride on an extended trend started from Point 16(1948) or Point 17(1949). Therefore, it is more plausible to interpret that an increase at Point 19(1951) is exceptional due to the post-Korean War economic boom and that an increasing trend of the homogeneous parameter is more or less linear from Point 16(1948) to Point 22(1954).

Then, at Point 23(1955), the homogeneous parameter sharply increases. This perhaps indicates that an impact of technological contracts started in 1952 (SECTION III-3) had been made explicit.

A stabilizing vibration around a positive level of the homogeneous

parameter from Point 23(1955), coupled with a steady level of the heterogeneous parameter, consequently yields a macroscopic exponential trend of production with repeated small rapid-stagnation patterns.

c) Contribution of Homogeneous Structure

In contrast to the previous two cases, a contribution of the homogeneous structure twice surpasses production in the prewar period. This indicates that a negative intervention was exercised, because the government saw small vehicles, primarily passenger cars, as an extravagant commodity in the war period (SECTION II-4). In the postwar era, FIGURE V-50 vividly demonstrates that the homogeneous structure gradually takes over a production trend.

(C) Remarks

The marked feature of the Kalman Filter is, as discussed in APPENDIX 3, to estimate time-variant parameters (regarded as the system "states") by learning and memorizing their past trends. We believe that this is a reasonable assumption regarding the dynamics of industrial production.

In the production model of Eq(V.21), the homogeneous parameter

implies (not exactly) an annual growth rate. It is reasonable to assume that an annual increase in production indicates industry's productive performance and would not change very drastically but moves based upon past precedents. This incrementalism assumption implies a smooth dynamic change of the homogeneous parameter. The Kalman Filter tries to learn it. On the other hand, in Eq(V.21), the heterogeneous parameter means a potential level of productive performance. It also would not change so often, but rather also moves according to past precedents. The Kalman Filter tries to learn it, too.

In CHAPTER IV, the high degree of correspondence between a historical investigation of policy intervention in PART I and a superficial observation of a conspicuous structural change of production data has been examined. In this section, a further investigation has been made to penetrate into the internal structural change caused by policy intervention which does not appear on the production level. The obtained results have demonstrated the high degree of correspondence between historical accounts of policy interventions and the internal structural change of production data.

Generally speaking, policy intervention has been identified as causing a level change of a productive potential, i.e., the heterogeneous parameter. However, policy intervention does not always affect the hitherto continued productive performance of industry represented by an annual increase rate, i.e., the homogeneous

parameter. Sometimes it is gradually improved; sometimes it is radically improved; and sometimes it is not improved at all. The dynamic growth of production is simply the composite of these internal structural changes.

The significance of the above Kalman Filter application, in light of the purpose of this thesis, is apparent. The results can serve as valuable information to assess policy impact. If a similar structural change is caused by a similar historically-identified policy intervention, it is possible to conclude that there is a consistency between intervention and its impact.

CHAPTER VI
STRUCTURAL ANALYSIS OF IMPORT POLICY

SECTION VI-1
A CONJECTURAL ANALYSIS OF IMPORT SUPPRESSION POLICY
DURING THE WAR PREPARATION PERIOD

(A) Exponential Takeover Policy

The historical investigation of the third intervention (the Law Regarding Automobile Manufacturing Enterprise of 1936) in SECTION II-3 has illuminated the fact that the main policy objective of this law was to replace the dominance of foreign medium 4-wheelers by Japan's own products as quickly as possible. The imperative to place a policy priority on this objective is best evidenced by the argument of the Ministry of Army (MOA) and other government agencies. It simply insisted that Japan would not be able to pursue the war objective if the nation would depend upon military vehicles supplied by foreigners (particularly Americans).

As we have identified from prewar production data in CHAPTER IV, the specification of the MCI Standard models of 1932 functioned to pull the once-stagnated production of medium 4-wheelers upward and

placed it on an exponential trend in 1932. However, as shown in FIGURE VI-1, 1934 and 1935, production once again stagnated due to the unsuccessful attempt of the MCI standardization. In 1936, production grew at a tremendously high growth rate, perhaps helped by the aforementioned law enforcement. Until 1938, production went up almost log-linearly with an impressively high growth rate. Given this observation of domestic production, FIGURE VI-2 of the relative share of the foreign supply [1] of medium 4-wheelers in total supply shows that in fact the Japanese products eliminated the long-predominant foreign cars in the medium 4-wheeler category within an amazingly short period. The share started to decline with a discernible magnitude in 1932 resulting from two factors, i.e., the revitalization of domestic production in this year and the decrease in foreign supply in the next year. However, in 1935, the share curve went up because domestic production stagnated when foreign supply grew sharply. It seems reasonable to speculate that because of this alteration of the share curve, the government arrogantly conceived the most radical law in 1936. Remember that foreign cars assembled by two foreign companies, Japan Ford and Japan General Motors, accounted for more than a 90% of the foreign supply and that the government had no specific policy toward them until 1932.

Now let us speculate about what is the approximate government view of the future behavior of the domestic contribution to total supply. Perhaps at the beginning the share could not increase sharply,

FIGURE VI-1

Domestic Production,
Foreign Supply and
Total Supply of Med.
Trucks and Buses:
on Log Scale

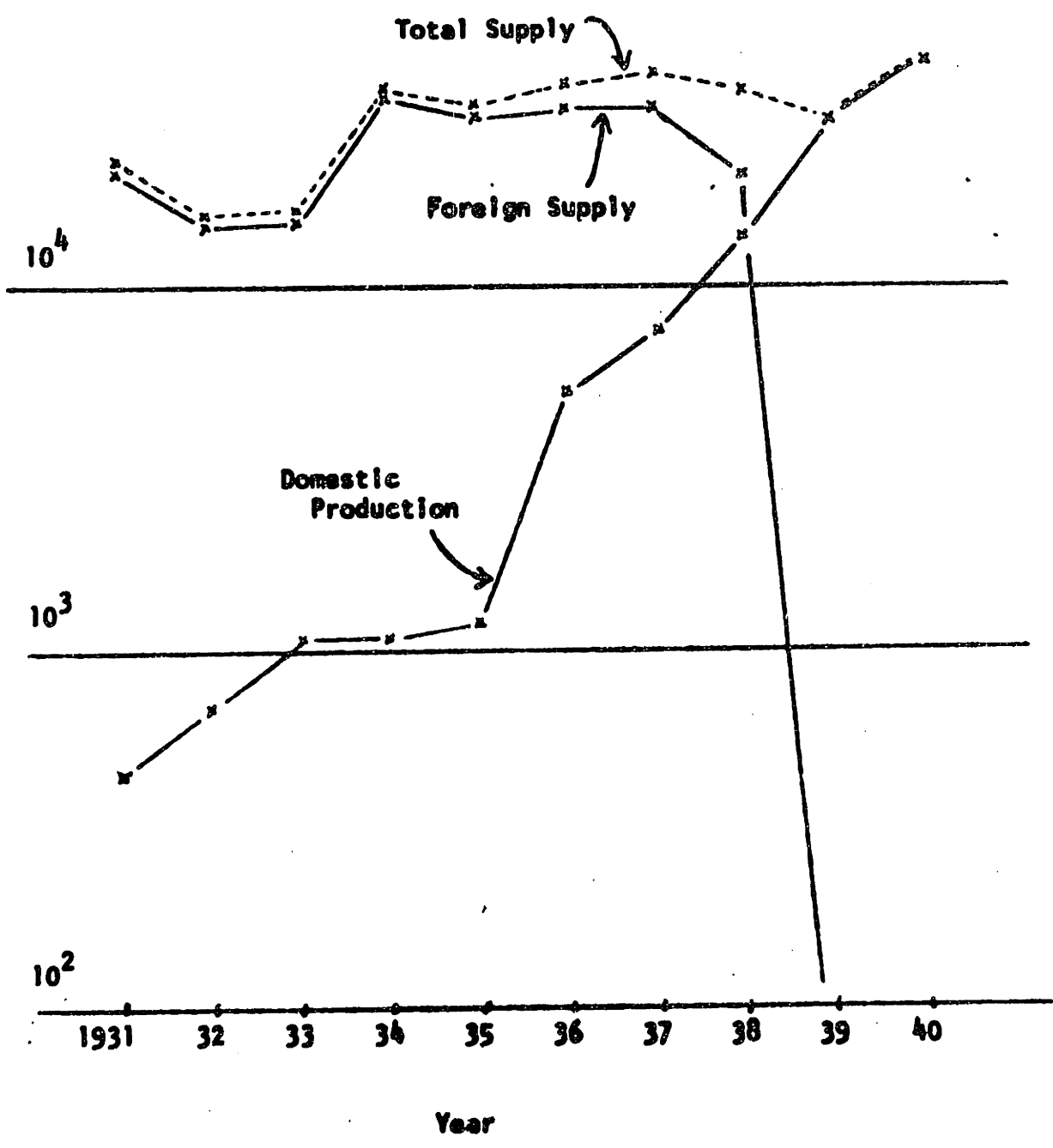
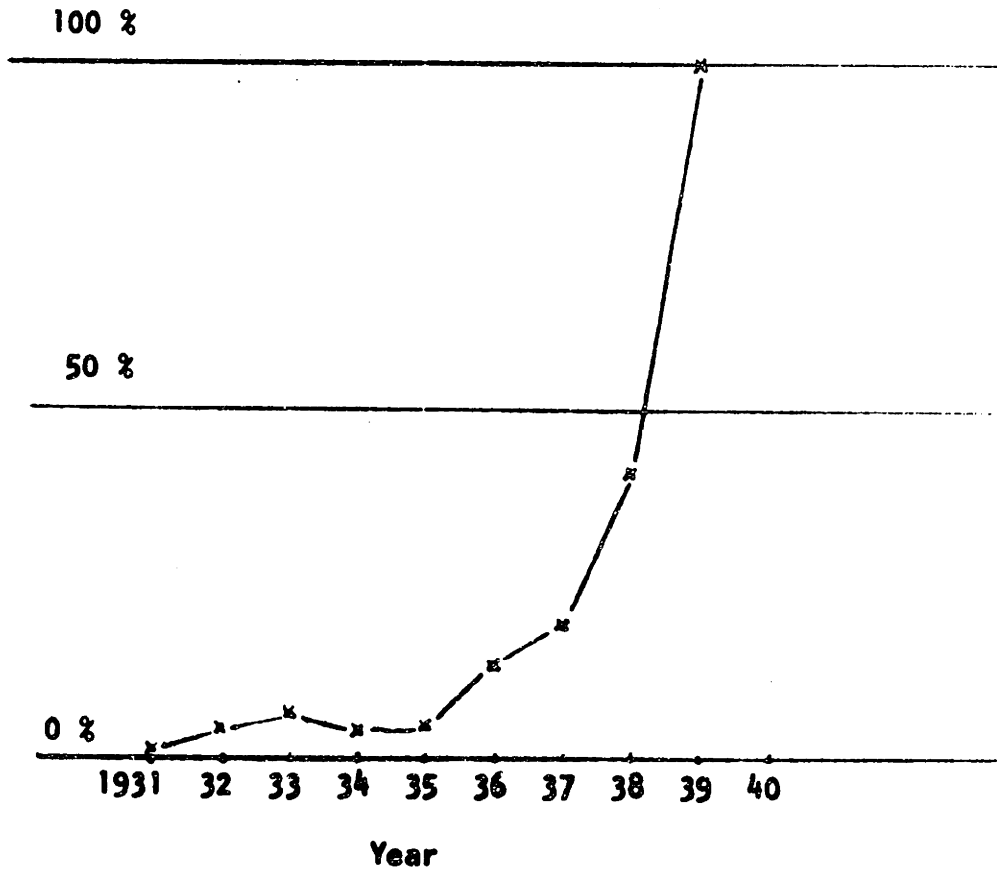


FIGURE VI-2

Relative Share of Domestic Production in Total Supply of Medium Trucks & Buses



reflecting the still overwhelming strength of foreign supply. However, as domestic production increases exponentially, its relative share would grow sharply attaining the short-term takeover if an appropriate measure is taken to decrease foreign supply. This process implies a rapid increase of the relative share of domestic production in total supply, i.e., exponential takeover. The actual data in FIGURE VI-2 in fact supports the above speculation.

Aside from the empirical evidence, two patterns can be hypothetically considered regarding the short-run takeover of total supply by domestic production: a convex share curve (i.e., the rapid-stagnation takeover) and a concave share curve (i.e., the exponential takeover). The convex pattern means that the share of domestic production rapidly increases at the early stage and later saturates. However, when the level of domestic supply was extremely low, as it was actually, the convex pattern would obviously cause a sharp decline of total supply at an early stage. Therefore, it is quite reasonable for government to choose a concave curve, i.e., the exponential takeover pattern. Assuming that this logic is rational, the following policy question arises:

1) Recognition of

Situation.....Domestic production grows log-linearly.

2) Policy Criterion.....The relative share of domestic production
in total supply increases log-linearly.

3) Policy Question.....How much should the government control
foreign supply?

By interpreting the above statements into mathematical language, the
policy question is solved in the following manner.

Letting $D(t)$ and $Rd(t)$ be domestic production and the relative
share of domestic production in total supply, respectively; above 1)
and 2) are formulated as:

$$(VI.1) \quad D(t) = ca^t \quad (\text{where } a \text{ is greater than } 1)$$

$$(VI.2) \quad Rd(t) = CA^t \quad (\text{where } A \text{ is greater than } 1)$$

Since $Rd(t)$ varies within a range from 0 to 1, the time range
intercepts:

$$0 < t < \log(1/C)/\log A.$$

By definition

$$(VI.3) \quad Rd(t) = D(t)/S(t)$$

where $S(t)$ denotes total supply. Substituting Eq(VI.1) and Eq(VI.2)
into Eq(VI.3) yields

t

$$(VI.4) \quad S(t) = (c/C)(a/A).$$

Eq(VI.4) means that if domestic production grows exponentially and if the government controls foreign supply in order to realize the exponential takeover, total supply has three courses, as follows:

Case a..... $S(t)$ will grow exponentially, if a (the slope of domestic production on a log scale) is greater than A (the slope of the relative share of domestic production in the total supply on a log scale) (i.e., $a/A > 1$).

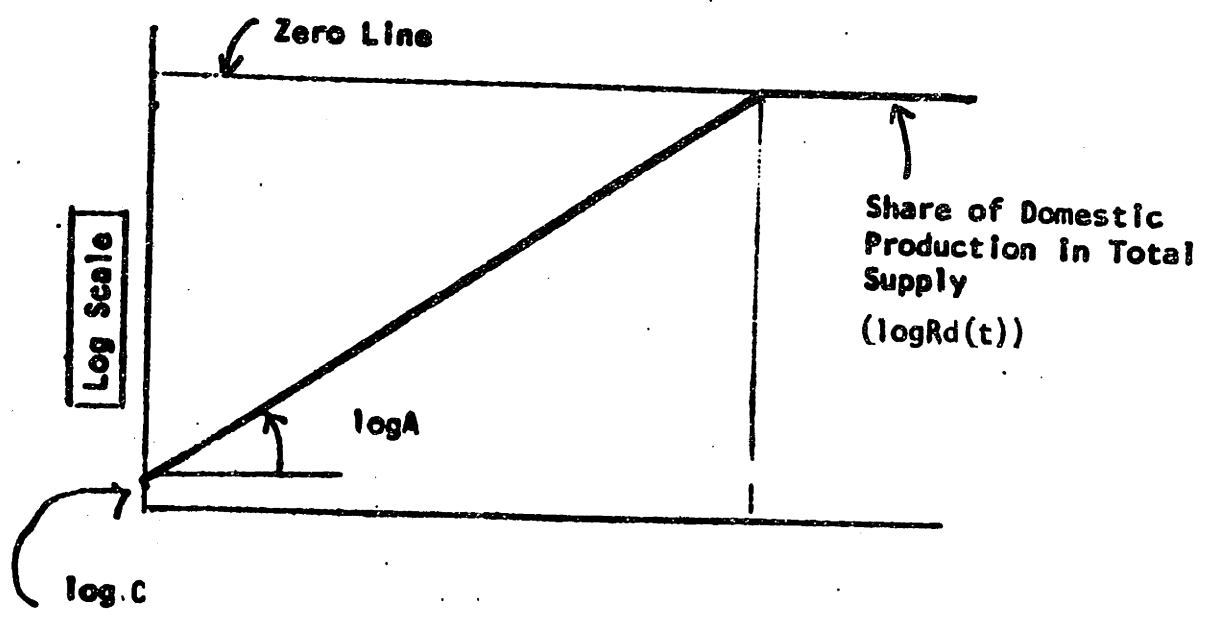
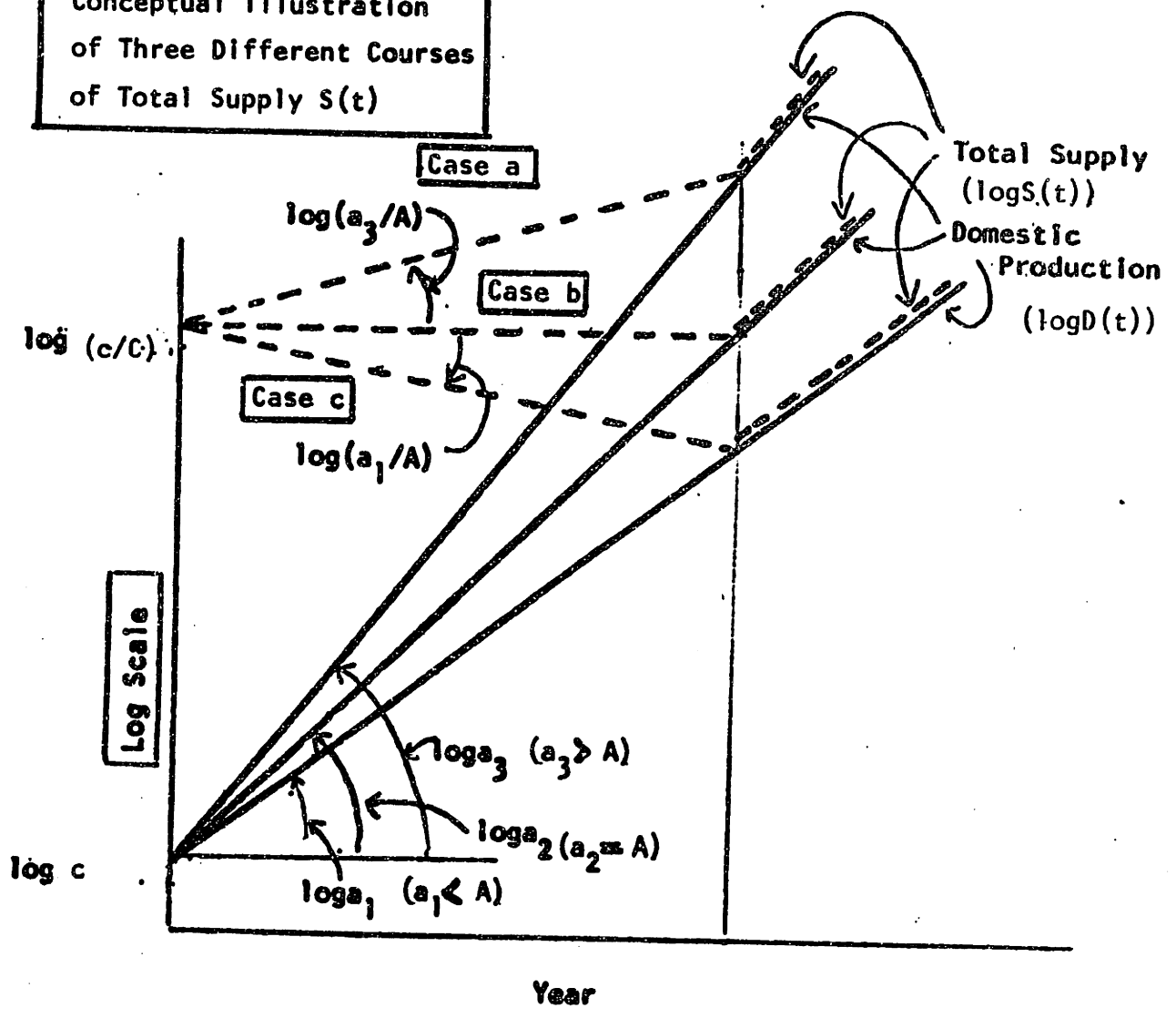
Case b..... $S(t)$ will remain constant, if $a = A$ (i.e., $a/A = 1$).

Case c..... $S(t)$ will decrease, again exponentially, if a is smaller than A (i.e., $a/A < 1$).

These three cases are illustrated in FIGURE VI-3.

Given the constraints of the above three possibilities of the total supply pattern and given the recognition that domestic production would grow exponentially, the time-trend of foreign supply is uniquely determined. Such a foreign supply pattern is the answer to the policy question raised above. By definition, foreign supply denoted by $I(t)$ is:

Conceptual Illustration of Three Different Courses of Total Supply $S(t)$



(VI.5) $I(t) = S(t) - D(t).$

Eq(VI.5) shows that $I(t)$ behaves differently since $S(t)$ takes a different course depending upon the relative magnitude of "a" vis-a-vis "A." Then, the argument focuses on how to find the unique pattern of $I(t)$ for each case. First, taking the first derivative of $I(t)$,

(VI.6) $I'(t) = S'(t) - D'(t)$

$$= c/C(a/A)^t (\ln(a/A) - \ln a.CA)^t.$$

From Eq(VI.6), when $a = A$ (Case b), $I'(t) = (c/C)(-\ln a.CA)^t$, which is obviously negative. When $a < A$ (Case c), $\ln(a/A)$ is negative, so that $I'(t)$ is also negative. When $a > A$ (Case a), $I'(t)$ changes its plus-minus sign before and after the time at which $I'(t)$ equals to zero. Therefore,

Case a.....i) When $0 < t < \log((1/C)(\ln(a/A)/\ln a)/\log A,$

$$I'(t) > 0.$$

ii) When $\log((1/C)(\ln(a/A)/\ln a)/\log A < t <$

$$\log(1/C)/\log A,$$

$$I'(t) < 0.$$

Case b..... $I'(t) < 0.$

Case c..... $I'(t) < 0.$

Next, take the second derivative in order to check the convex/concave shape of $I(t)$

$$(VI.7) \quad I''(t) = (c/C)(a/A)^t ((\ln(a/A))^2 - (\ln a)^2 CA)^t$$

Therefore,

Cases a & c.....i) When $0 < t < \log((1/C)(\ln(a/A)/\ln a)^2)/\log A$,

$I(t)$ is concave.

ii) When $\log((1/C)(\ln(a/A)/\ln a)^2)/\log A < t <$

$\log(1/C)/\log A$,

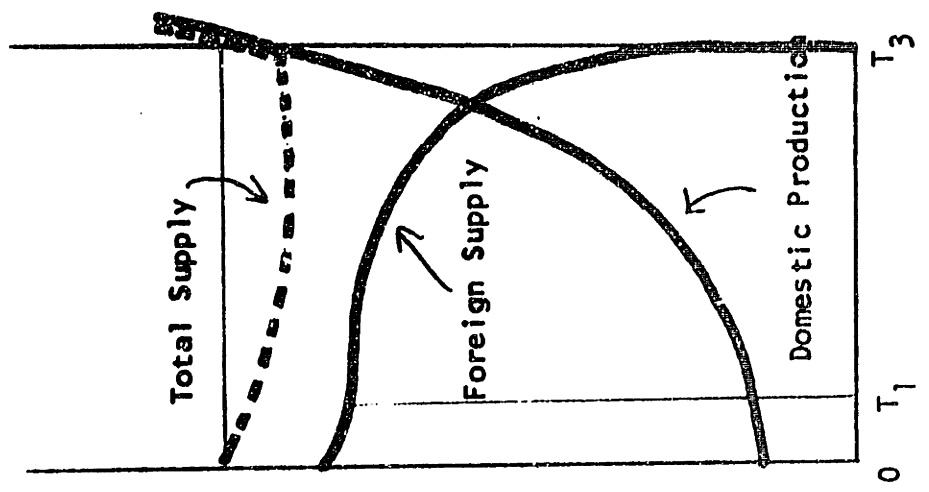
$I(t)$ is convex.

Case b..... $I(t)$ is always convex.

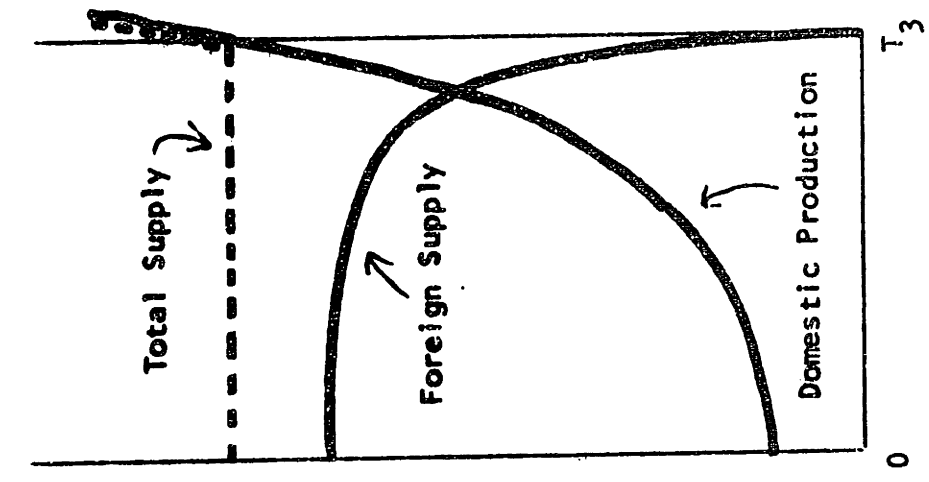
Then, the conceptual illustrations of the relationship among domestic production, foreign supply, and total supply for three different cases are shown in FIGURE VI-4.

Conceptual Illustration of Three Different Courses of Total Supply of Medium Trucks and Buses under Exponential Takeover Policy

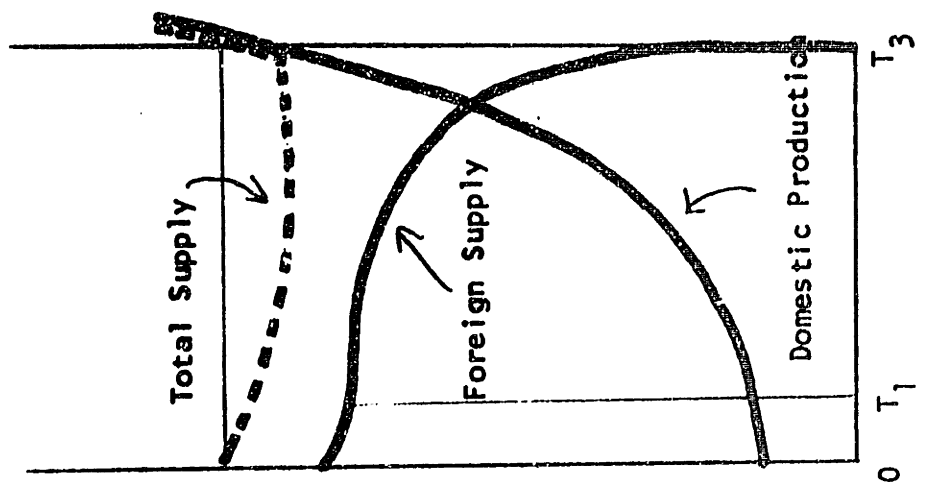
FIGURE VI-4



[Case a]



[Case b]



[Case c]

(B) Search for Government's Logic: De Facto Projections

The two implications are drawn from the preceding discussion. First, the relative difference in slope between the exponential trend of domestic production and that of the exponential takeover curve (i.e., the relative share of domestic production in total supply) determines the slope of the total supply curve. If the slope of the log-linear growth of domestic production is greater than that of the exponential takeover curve, total supply increases. If both slopes are identical, total supply remains constant. If the former slope is lower than the latter, total supply decreases. Second, these three cases are uniquely related to the shape of the foreign supply curve.

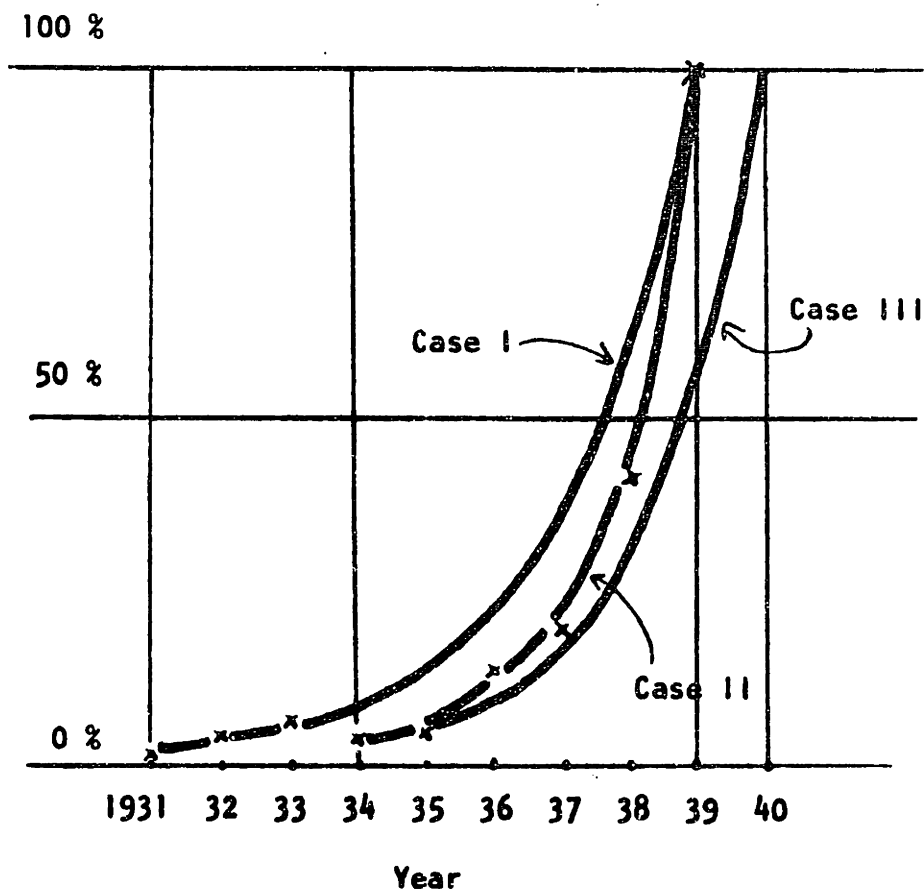
Hence, if the government specified a target year in which domestic production would completely eliminate foreign supply and if the government in the meantime did not want to decrease total supply, the log-linear slope of the exponential growth of domestic production must be higher than or identical to that of the takeover curve. From a policy point of view, the slope of the exponential takeover curve is perhaps first specified as a policy target, and then government has to do every possible measure to keep the log-linear slope of domestic production higher than this target slope. The policy toward foreign supply is derived from the specification of the takeover curve and the log-linear slope of domestic production. If the government forgets production policy and thus focuses only on the takeover curve and on

the suppression of foreign supply, the consequence is obvious: a decrease in total supply. Whether or not the Japanese government which was dominated by the military during the war preparation period in the 1930s had recognized this point is worth investigating.

In 1931, the relative share of domestic production in the total vehicle supply was 1.9%, while the share became 100% (the completion of takeover) in 1939. However, as shown in FIGURE VI-5, the actual share data suggests a different takeover curve: from 1934 (7.5%) to 1939. Which year the Japanese government regarded as the starting year is not certain from the historical investigation in PART I. 1931 is the year when the government began to take serious consideration of the nation's automobile policy due to the antecedent "Buy-Japanese" campaign and to the massive inflow of American cars which resulted in the decision of the official standardized model in 1932 (SECTION II-2). At the same time, this is the year when the Manchurian Incident broke out. On the other hand, 1934 is the year when the Ministry of Army recognized the necessity of a new law enforcement which later led to the Law of Automobile Manufacturing Enterprise in 1936 (SECTION II-3). With respect to "the ending year," there are also two possibilities. Actual data in fact shows 1939 as "the ending year." However, Japan entered into the war in 1941, so that it would be a possible conjecture that although the Japanese government aimed at 1940 as the ending year, the foreign supply became zero a year earlier because of the Law of Automobile Manufacturing Enterprise against the

FIGURE VI-5

Three Different Projections
of The Relative Share of
Domestic Production in Total
Supply of Medium Trucks &
Buses



government's initial plan (SECTION II-3). As mentioned in SECTION II-4, whether or not the military government had deliberately planned to start the war in 1941 became a controversial issue at the Far East War Criminal Court after the war. Therefore, it seems to be a realistic proposition to regard 1940 as the planned ending year. Each of the above three cases is thus separately considered as the most plausible takeover period the Japanese government might have assumed.

The results of the comparison between the hypothetical projection and the actual data are shown in FIGURES VI-6, VI-7 and VI-8 for each of the three cases. All of the projection curves are drawn in the following procedures. First, draw an interpolated curve of domestic production by intercepting the production points of the starting year and of the ending year so as to represent most of production points during the takeover period. This interpolation scheme is not based upon any rigorous statistical log-linear regression. It relies on visual pattern recognition. Second, draw an interpolated line of the total supply by intercepting the total supply of the starting year and the point of the interpolated domestic production of the ending year. The rationalization of the above two procedures rests on FIGURE VI-3. The interpolated curve of foreign supply is thus calculated as the difference between the interpolated total supply curve and the interpolated domestic production curve.

FIGURE VI-6

Projection and Actual Data [Case 1]

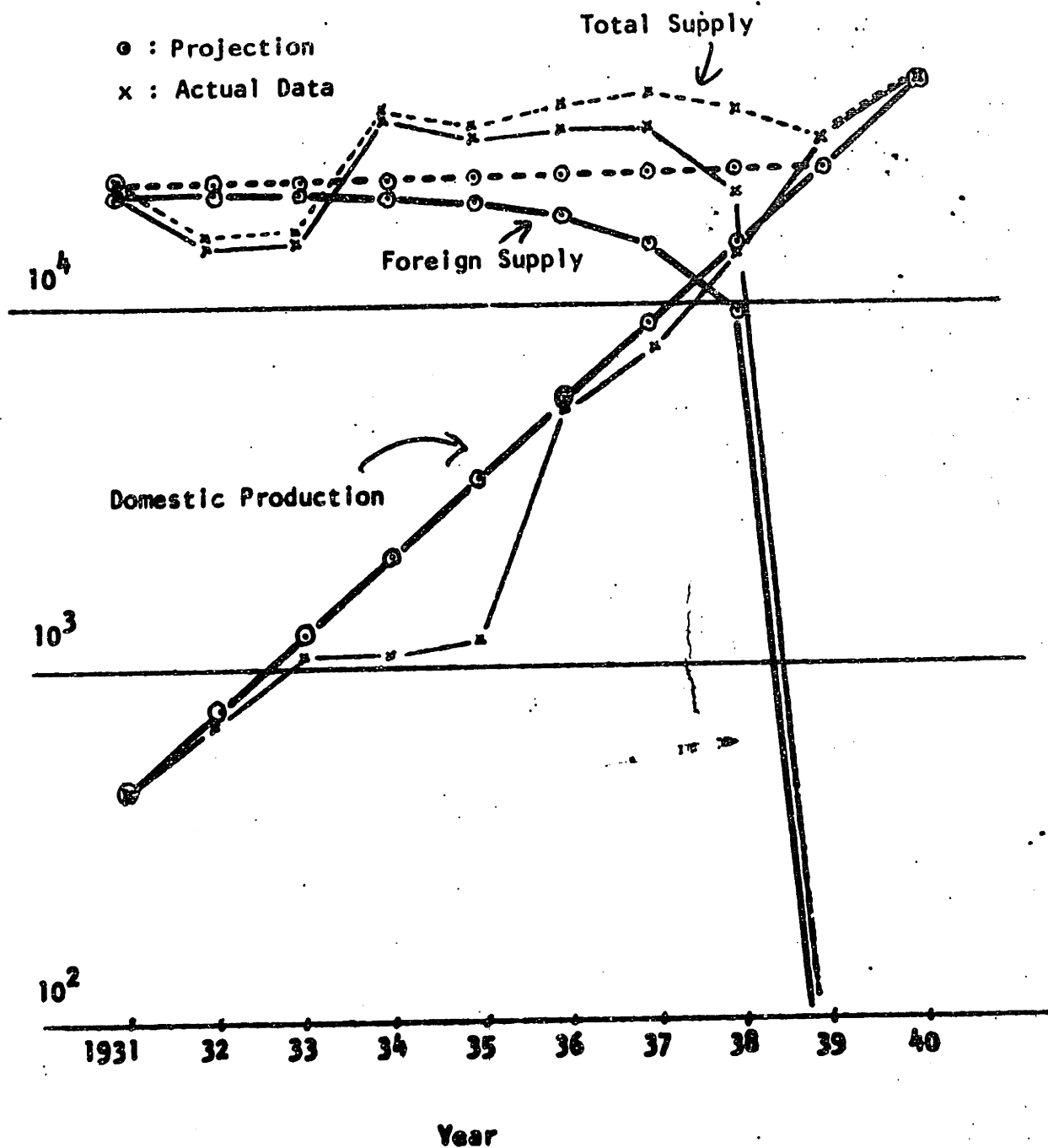


FIGURE VI-7 **Projection and Actual Data [Case II]**

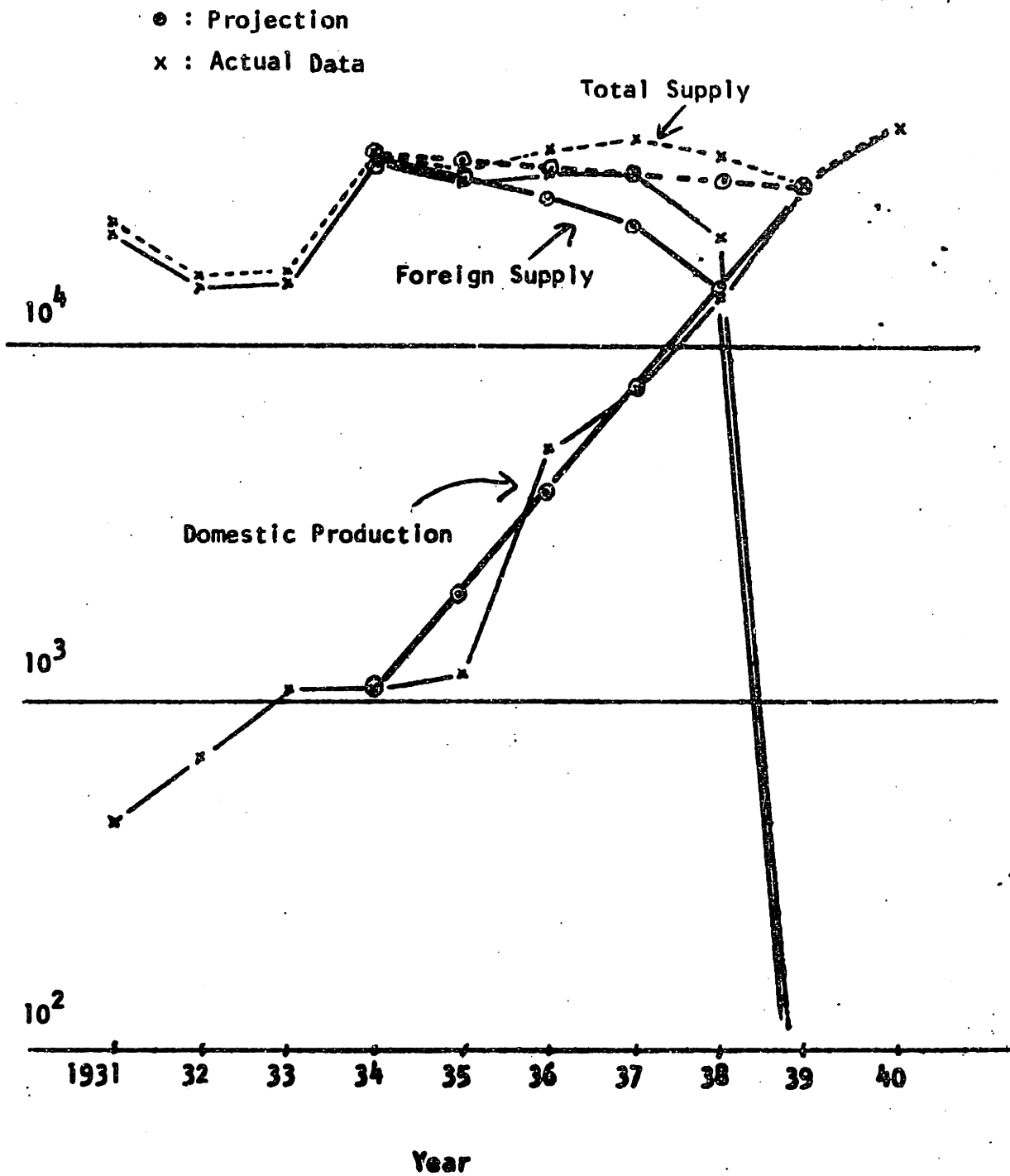
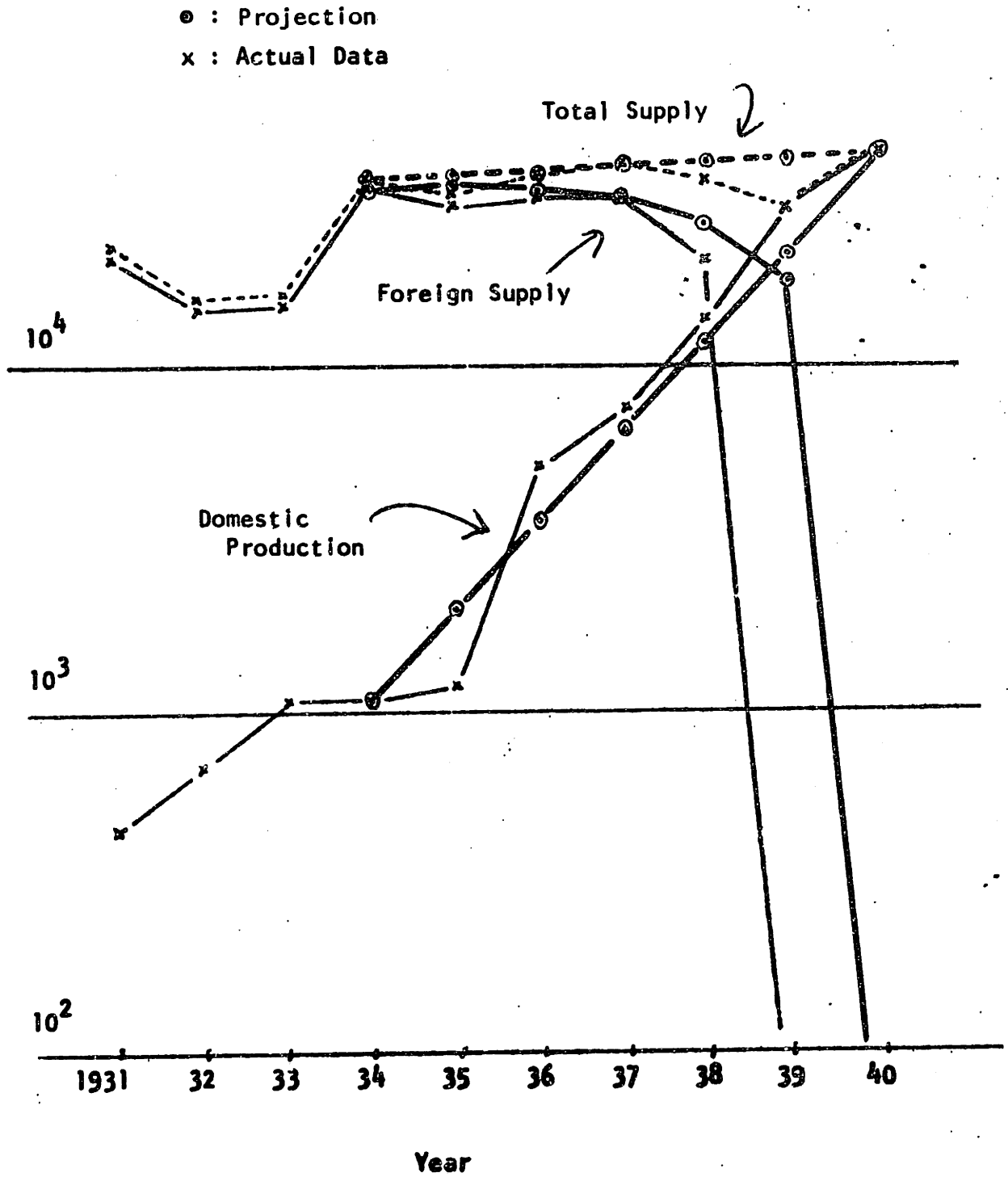


FIGURE VI-8

Projection and Actual Data [Case III]



Case I

This takeover projection guarantees an exponential increase of total supply if domestic production is on the projection curve as shown in FIGURE VI-6. However, the actual production in 1934 and 1935 became stagnated, which would endanger the projected exponential takeover. Coincidentally, in these years, the actual foreign supply sharply increased, perhaps by filling the decrease of domestic production. Then, the resultant share of domestic production in the total supply became lower than the projection as shown in FIGURE IV-5. This means that the original exponential takeover was no longer possible. Even the actual domestic production resumed the previous log-linearity since 1936, its contribution to total supply was well below the projected takeover curve.

Case II

As FIGURE VI-7 shows, this takeover projection leads to an exponential decline of the total supply. However, the actual data of the total supply are kept aloof above the declining projection due to the fact that the actual foreign supply is well above the projection. Therefore, it seems to be a possible speculation that in order to avoid a decrease of total supply, the nation had to rely on foreign supply, which is contradictory to the original purpose of the

elimination of foreign dominance. One possible reason why this contradiction occurred despite the well-behaving domestic production is the misspecification of the year of the takeover completion. As discussed in next Case III, if the takeover duration had been expanded further, the situation would be different.

Case III

This is a hypothetical projection violating the fact that foreign supply ended in 1939. As FIGURE VI-8 shows, if this projection had been taken, total supply would have increased even eliminating foreign dominance. The closeness of the actual data of domestic production to the projected curve indicates that this projection is not too unrealistic. However, the actual total supply of 1938 and 1939 is lower than the projection due to the rapidly vanishing foreign supply. From a policy point of view, the too early embargo on foreign supply would have caused a decline of the total supply when the takeover approached the end.

(C) Summary of Analysis and Policy Implications

The observation of the relative share curve of domestic vehicle production in total supply suggests that domestic production seemed to

take over, by drawing an exponential share curve, the dominance of foreign supply, which was primarily composed of American cars assembled in Japan. In the mean time, domestic production of medium-size vehicles shows the exponential growth during the 1930s. The exponential takeover policy is in fact realistic as a strategy to take over the overwhelming predominance of foreign supply by domestic production. The gradual increase of the relative share of domestic production in total supply at an early stage and the swift takeover when domestic production becomes matured is realistic.

However, mathematically speaking, unless the slope of the log-linear curve of domestic production is steeper than that of the exponential takeover curve, the total supply would eventually decline. Therefore, in order to exponentially take over foreign dominance without a decrease in the total vehicle supply within a specified period, there is only one choice, i.e., let domestic production increase so that its log-linear slope is steeper than that of the projected exponential takeover curve. If this can not be realized, the takeover period must be extended until the log-linear slope of the takeover curve would become lower.

The above three hypothetical projections have shown that although the exponential takeover seemed to be implemented, the dominance of foreign supply did not vanish as smoothly as prescribed by the takeover projection. This leads to some important policy questions. If

the government sticks to only the takeover and neglects total supply, it would be possible that total supply would fluctuate when domestic production cannot maintain the log-linearity. On the other hand, if the government regards the maintenance of total supply as the first policy priority, it must rely on foreign supply when domestic production deteriorated (i.e., off an exponential trend), which results in the difficulty of eliminating foreign dominance. The Japanese case during the 1930s seems to contain this policy dilemma. On one hand, the government could not let total supply decrease because of the nature of products, i.e., medium-size trucks for military use. On the other hand, the government had to eliminate foreign dominance by domestic production as soon as possible. The above projection exercises have shown that if the government had set the completion of the takeover a year later, in 1940, a smoother exponential takeover would have been possible. Whether or not the Japanese government had recognized this point is uncertain. However, the fact is simply that foreign dominance was eliminated by 1939 without a serious setback of the total supply, because domestic production could maintain a more or less exponential growth during the takeover period.

SECTION VI-2

A CONJECTURAL ANALYSIS OF GOVERNMENT'S IMPORT POLICY OF PASSENGER CARS DURING THE 1950S

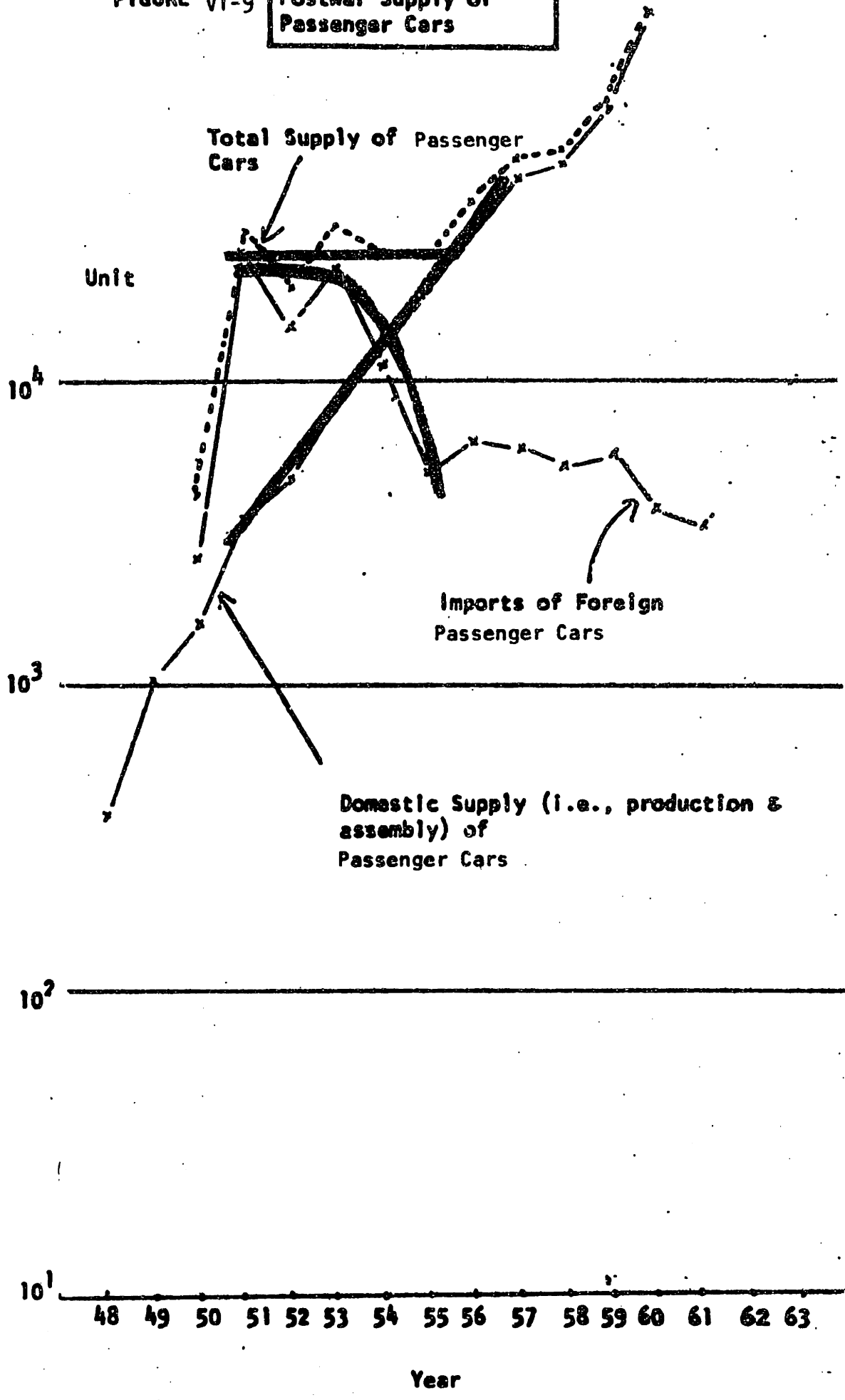
(A) Convex-Declining Imports Policy

The following conjectural analysis is heuristically motivated by the observation of somewhat strange data phenomenon, i.e., the total supply curve of passenger cars during the five-year period from 1951 to 1955 fluctuates around a constant level as shown in FIGURE VI-9.

The importation of foreign cars started in 1948, the first time after the war and in 1951, approached the highest level of the prewar supply level of foreign medium 4-wheelers. However, FIGURE VI-9 shows that imports since 1952 had never reached the highest level of 1951. Furthermore, it went down in 1954 and 1955 and had remained flat for a couple of years since then. Remember that the import policy was an extremely important policy setting for the prewar government which consequently promulgated the most drastic and controversial Law of Automobile Manufacturing Enterprise in 1936. What this lesson of the prewar government's automobile policy suggests is the fact that it was the foreign cars importation the government was most seriously concerned about and hence regarded it as one of the most important policy areas to manipulate. In fact, the discussion in SECTION III-2

FIGURE VI-9

Postwar Supply of Passenger Cars



has revealed that imports had been strictly controlled by the government's quota allocation of foreign currency reserves.

In FIGURE VI-9, the growth curve of the production of domestic passenger cars goes up log-linearly during the period from 1951 to 1957. Assume that this exponential growth was the desirable forecast of the Japanese government at the time of 1951 when the government formulated an import strategy (as discussed in SECTION III-2, which lead to the Regulation Regarding Conveyance of Foreign Vehicles of 1951). Putting aside the argument of how the government or industry (or both) actually realized it [2], suppose that this growth pattern was the government's recognition, or "confident short-term forecast." Then, at the time point of 1951:

Recognition: Government assumes that the domestic production of passenger cars will grow exponentially.

Constraint: The total supply of passenger cars will be fixed around the 1951 level until domestic production surpasses this level.

Policy Question: How should foreign passenger cars imports be controlled?

Denote

$D(t)$: the domestic production of passenger cars,

$I(t)$: foreign passenger cars imports,

S : the constant level of total passenger cars supply.

Then, the above recognition and constraint are expressed as:

Recognition

$$(VI.8) \quad D(t) = ca^t \quad (a \text{ is greater than } 1)$$

Constraint

$$(VI.9) \quad S \text{ is constant.}$$

The policy problem is simply to find the functional curve of $I(t)$ under Eq(VI.8) and Eq(VI.9). By definition,

$$(VI.10) \quad S = D(t) + I(t).$$

Then, substituting Eq(VI.8) into Eq(VI.10),

$$(VI.11) \quad I(t) = S - ca^t$$

Eq(VI .11) suggests that imports decrease in the form of a convex-declining curve. In fact, FIGURE VI-10 shows that the general trend of the imports curve from 1951 to 1955 forms this convex-declining pattern [3].

Next, we will proceed to investigate the behavior of the relative share of imports in the total passenger cars supply under Eq(VI.8) and Eq(VI.9). By definition, the relative share of imports denoted by $R_i(t)$ becomes:

$$(VI.12) \quad R_i(t) = I(t)/S.$$

Then, from Eq(VI.11)

$$(VI.13) \quad R_i(t) = 1 - (c/S)a^t.$$

Eq(VI.13) suggests that the relative share of foreign imports in the total supply of passenger cars would decline sharply, also in the shape of a convex-declining curve. In fact, FIGURE VI-10 shows the sharp decline of the actual $R_i(t)$ ratio for the period up to 1955. FIGURE VI-11 assists the visual understanding of the relationships among $D(t)$, $I(t)$, S and $R_i(t)$.

FIGURE VI-10
Relative Share of Foreign Imports in Total Annual Supply of Passenger Cars: Postwar

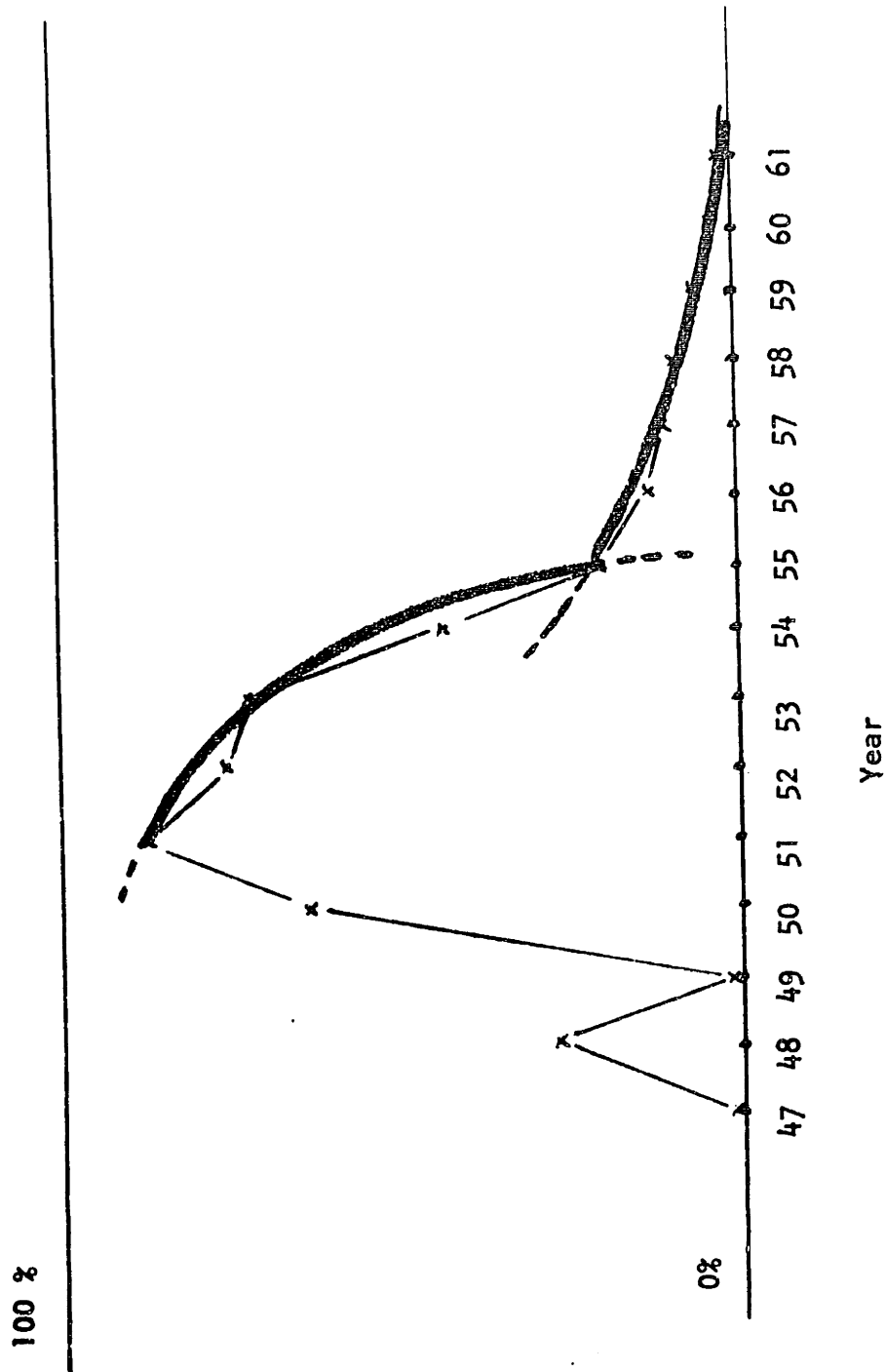
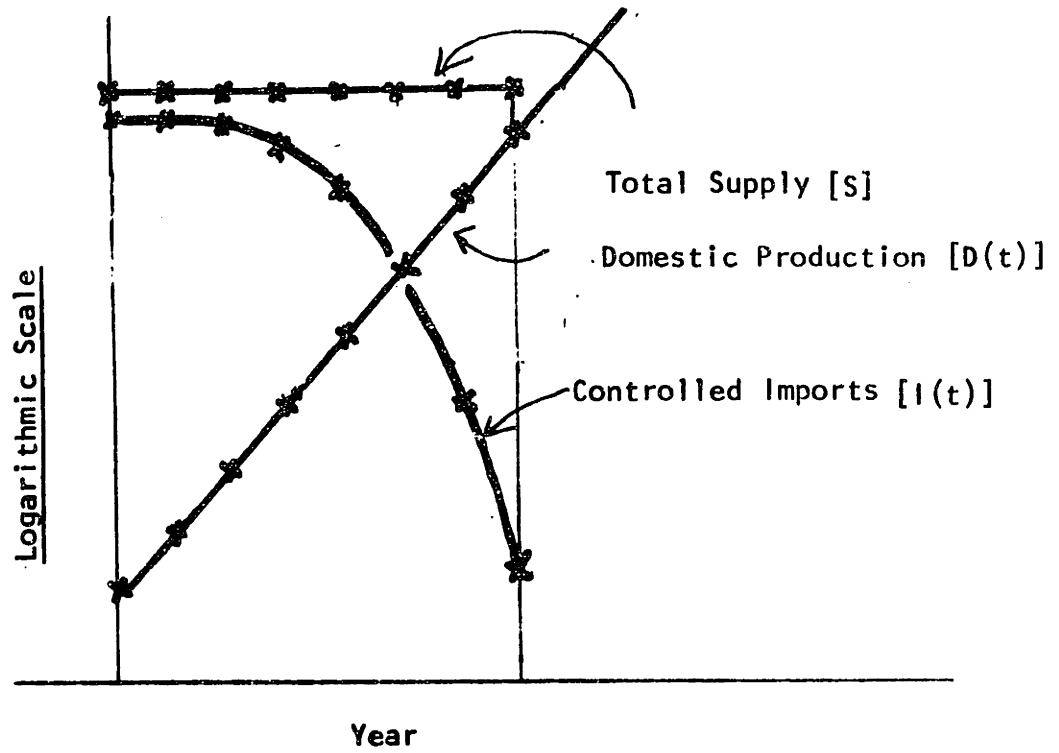
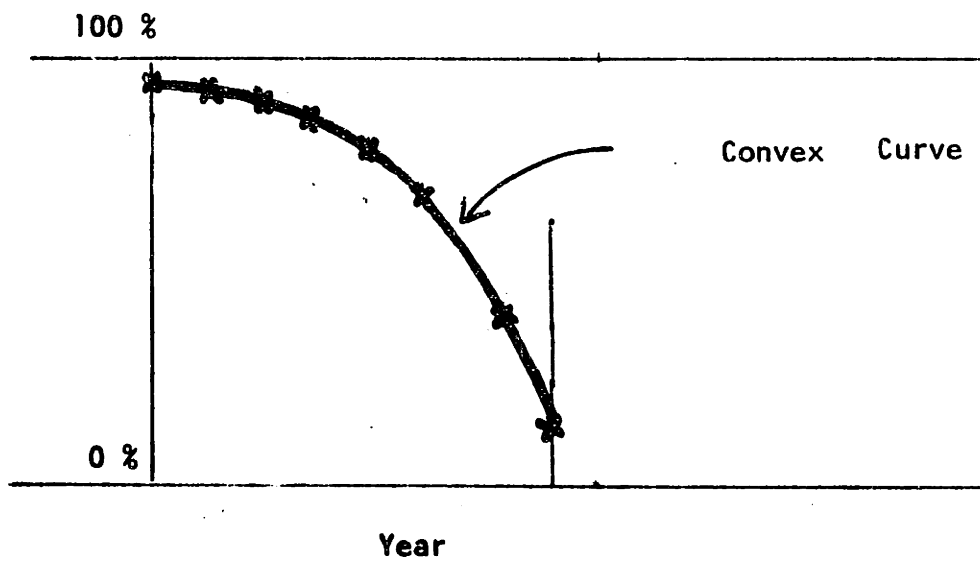


FIGURE VI-11 Convex-declining Imports Policy



Relative Share of Imports [Ri(t)]



(B) Policy Implications: A Comparison with the Prewar Precedent

The implication drawn from this import policy strategy is quite striking. First of all, government could eliminate the dominance of foreign cars in total supply quickly within a very short period without decreasing the total supply level. However, the sacrifice paid for this policy was freezing the total supply itself, which might have violated the welfare on the demand side if the nation's economy grew steadily with increasing demands of the new car supply. Note that this policy is valid only if domestic production grows log-linearly (i.e., exponentially). Therefore, this policy should have been coupled with the production policy of domestic passenger cars. Among other policy implications, the most important of all is the fact that this postwar policy has a strong similarity with the prewar precedent discussed in the preceding SECTION VI-1.

Structurally speaking, this convex-declining imports policy is identical to Case b in SECTION VI-1. That is, the log-linear slope of the curve of the domestic passenger cars production is identical to the log-linear slope of the takeover curve (a mirror image of FIGURE VI-10), which yields a constant total supply level. However, caution must be paid to the structural similarities vs. the differences in policy implications.

In the prewar case, the takeover was a mandatory requirement

reflecting the war preparation. The exponential takeover pattern would have been the most plausible choice. Under this policy requirement, the government tried to maintain the steep log-linear slope of domestic production by the two major interventions, the MCI Standard Model of 1932 (SECTION II-2) and the Law Regarding Automobile Manufacturing Enterprise of 1936 (SECTION II-3). Hypothetically speaking, the government could have controlled foreign supply (which consisted of not only imports but mainly of American cars assembled in Japan) by fixing total supply on a certain level, as was the case of the postwar restriction on passenger cars imports. The actual data in FIGURE VI-1 suggests that the government seemed not to do so. Total supply was always above the interpolated curve for the three different projections employed, thereby suggesting that the restriction on foreign supply was in fact very difficult. Such a difficulty might be due to the nature of products, i.e., medium-size vehicles, particularly trucks which had a military potential. Perhaps, the nation required an increase in this type of a vehicle, so that the arrogant suppression of the total supply curve could not be possible even though domestic production was believed to grow exponentially.

The situation of the postwar import policy is different. This is the case of passenger cars, not military-usable medium-size trucks. As discussed in SECTION III-2, the massive inflow of American-used passenger cars through an informal transaction channel threatened the viability of the Japanese Manufacturers who had been producing the

low-quality truck-chassis-based passenger cars. Therefore, from a policy point of view, the suppression of imports seemed to come first as a mandatory policy requirement. The products to be suppressed were not the military-used trucks the nation needed in the prewar case, but the passenger cars for a small economic sector, i.e., the taxi industry (SECTION III-2), so that the government could arrogantly oppress the total supply curve on a constant level for a while. Hence, the convex-declining curve in FIGURE VI-10 or FIGURE VI-11 is the consequence of the above import suppression policy, not a policy projection. This is the marked difference between the prewar case and the postwar case in light of policy logic. Nevertheless, it is an important observation that Japan could eliminate foreign dominance twice with the identical pattern.

(C) Technology Introduction Policy [4]

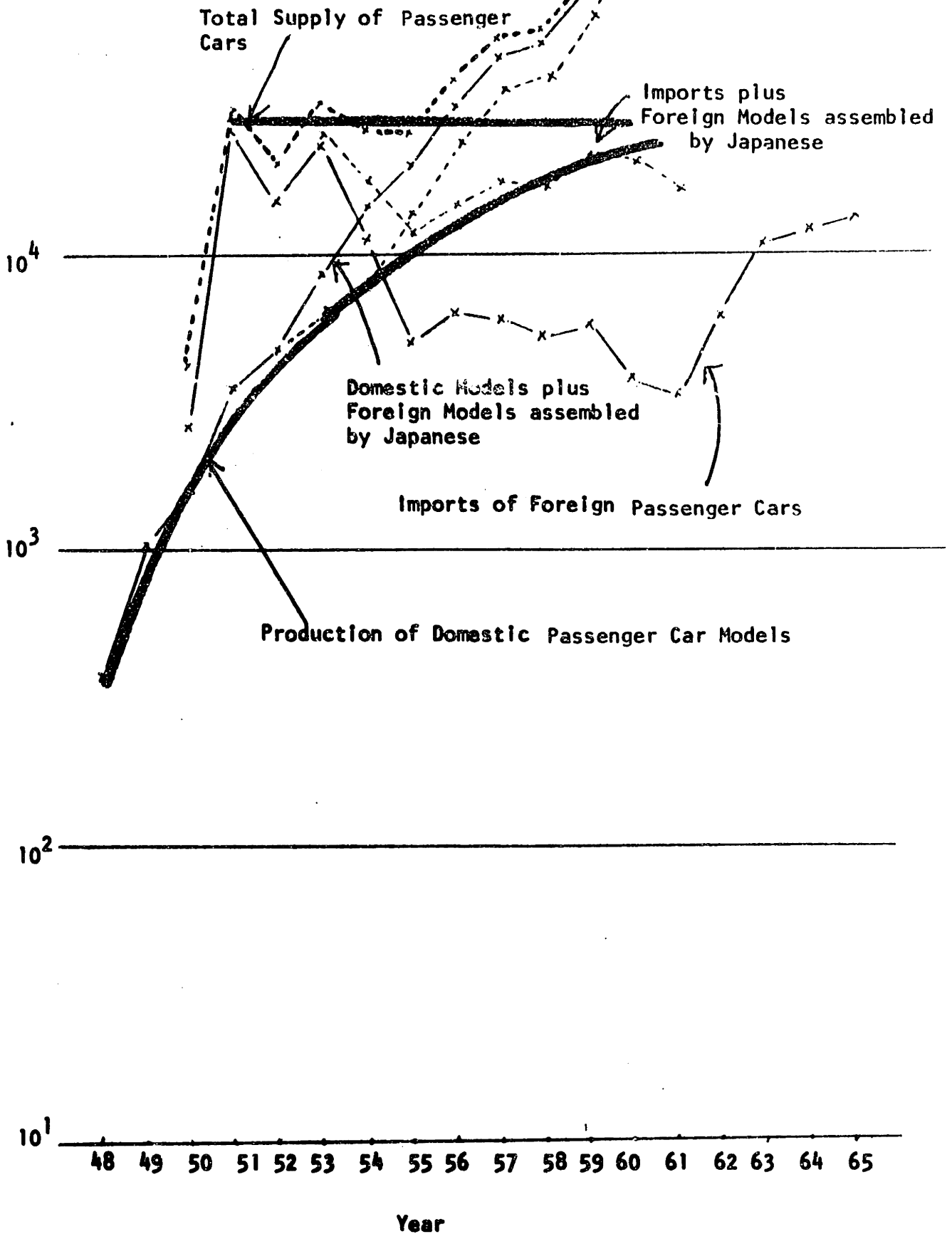
As conceptually illustrated in FIGURE VI-11, the duration of the suppression of the total supply of passenger cars on a fixed level depends upon the steepness of the log-linear slope of domestic production. In short, the steeper the slope, the earlier the restriction would be released. Then, if the government wanted a shorter duration in order to avoid criticism from the demand side, it should take every possible measure to maintain the slope as steep as possible. Therefore, imports policy is directly related to production

policy.

In the prewar case, the guaranteed public procurement measure by the 1932 MCI standardization and the creation of Toyota Motors as well as the incorporation of Nissan Motors into the medium-size truck production by the 1936 Law Regarding Automobile Manufacturing Enterprise helped the slope maintain a log-linearity. The postwar counterpart measure was the technology introduction policy of 1952 (SECTION III-3). As seen in FIGURE VI-9, the domestic production of passenger cars in fact grew exponentially and surpassed the suppressed total supply level in about 1956. However, recall that this curve contains both the production of purely domestic passenger car models and the assembly of foreign models under the technology contracts (SECTION IV-3).

As shown in FIGURE VI-12, if these assembled cars are subtracted, the slope of the production curve significantly declined. Quite importantly, this declined slope already started in 1951 and continued up to 1954, i.e., before and after the assembly started. Now, if the production curve is traced from the starting point of 1948 and projected beyond 1954, it is apparent that the curve forms a ubiquitous rapid-stagnation pattern. If production in fact had followed this trend, the duration of the suppression of the total supply curve would have been quite long, perhaps until the mid-1960s. However, thanks to the start of the assembly of foreign models under

FIGURE VI-12 Postwar Supply of Passenger Cars



the Japanese brand names in 1953, the superficial production curve in this year and the next year could ride on the previous exponential trend. Furthermore, thanks to the conditions of technology contracts to permit Japanese manufacturers to transfer foreign technology into their own models (SECTION III-3), the production curve of the purely domestic models could resume the previous steep trend since 1953. Coupled with the still on-going assembly of foreign models, the resultant growth curve later continued a steep slope without a significant decline, thereby minimizing the duration of the total supply suppression. As seen in FIGURE VI-12, the severe imports control was eased in 1956 when the domestic production curve already reached this level.

SECTION VI-3
A CONJECTURAL ANALYSIS OF TECHNOLOGY
TRANSFER POLICY

(A) Production of Domestic Models vs. Assembly of
Foreign Passenger Cars

As indicated in FIGURE VI-13, we have observed that, although the initial growth patterns are similar, the postwar production curve of small passenger cars continuously grows in an exponential trend while the prewar production soon becomes stagnated and starts declining in 1938. Then, the question arises: how could the postwar production maintain an exponential growth?

Recall that the assembly of foreign passenger cars under the government-backed technology contracts started in 1953 (SECTION III-3). These technology contracts were strictly required to include the manufacturing license. Therefore, the domestic production data we have observed contains these foreign models. In order to have a more precise picture, we need a new production curve in which the assembly of foreign models are subtracted. FIGURE VI-14 thus shows the relationships among the production of domestic model, the assembly of foreign models and the total yields of passenger cars.

FIGURE VI-13

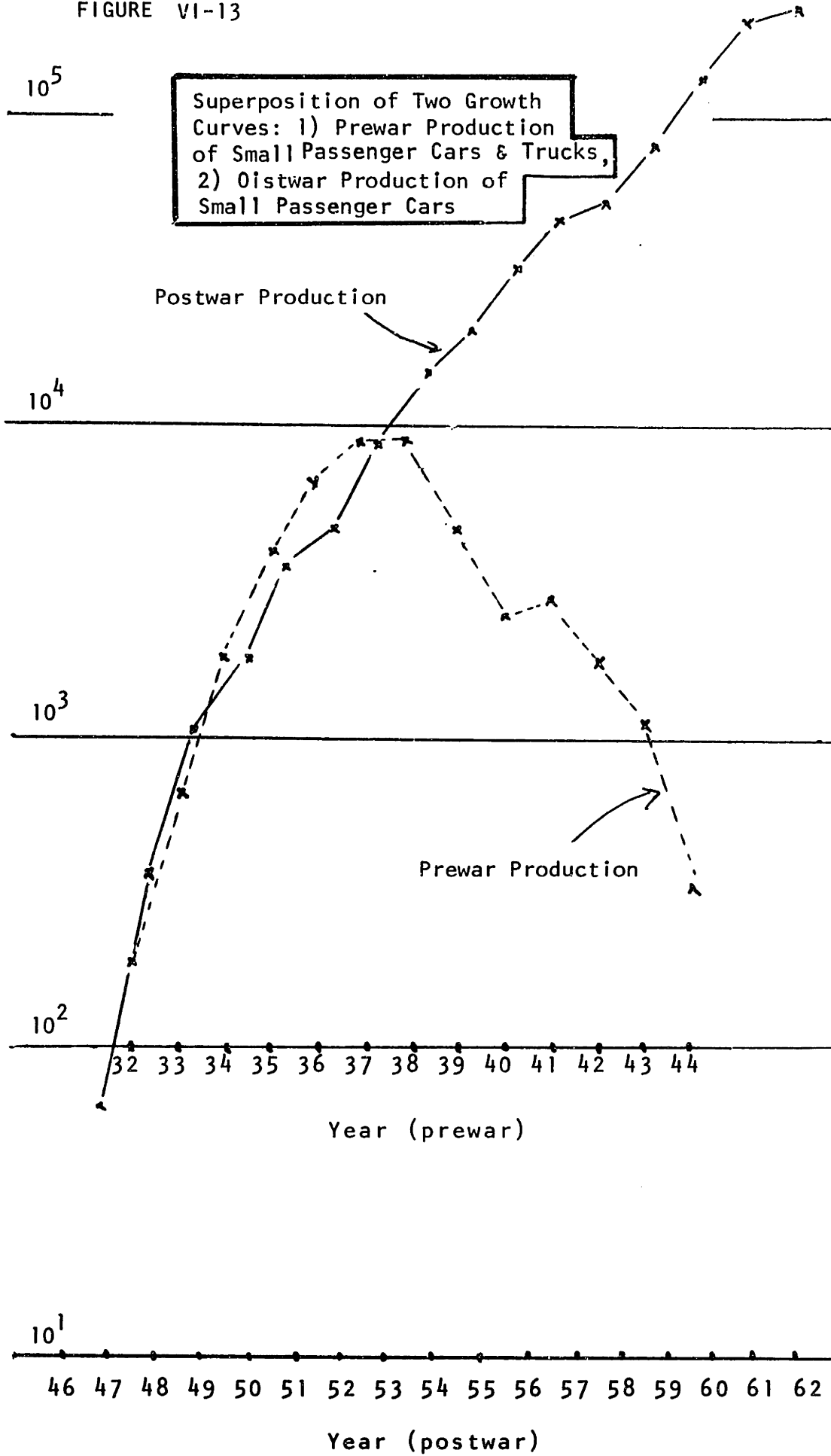
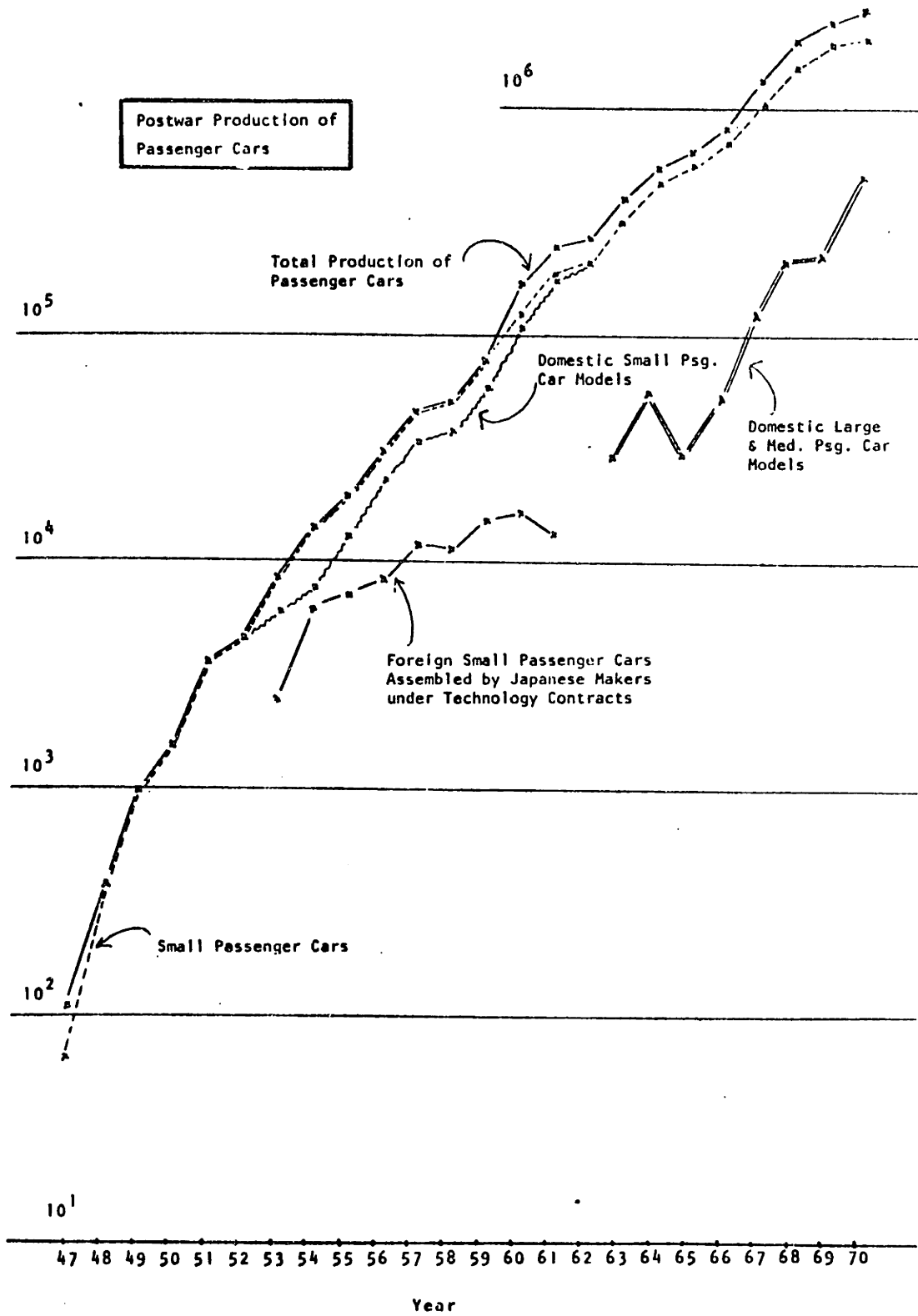


FIGURE VI-14



Interestingly enough, the once-stagnated production of domestic models starts an upward growth in 1955, and eventually takes over the total yields curve. FIGURE VI-15 also demonstrates this process. Thus, it is almost certain that the technology contract policy shifted the once-stagnated production curve up and placed it on a desirable exponential trend.

With regard to the process of the domestic takeover of the total yields of passenger cars, FIGURE VI-16 gives an interesting observation. According to this figure, the relative share of the foreign models declines almost linearly.

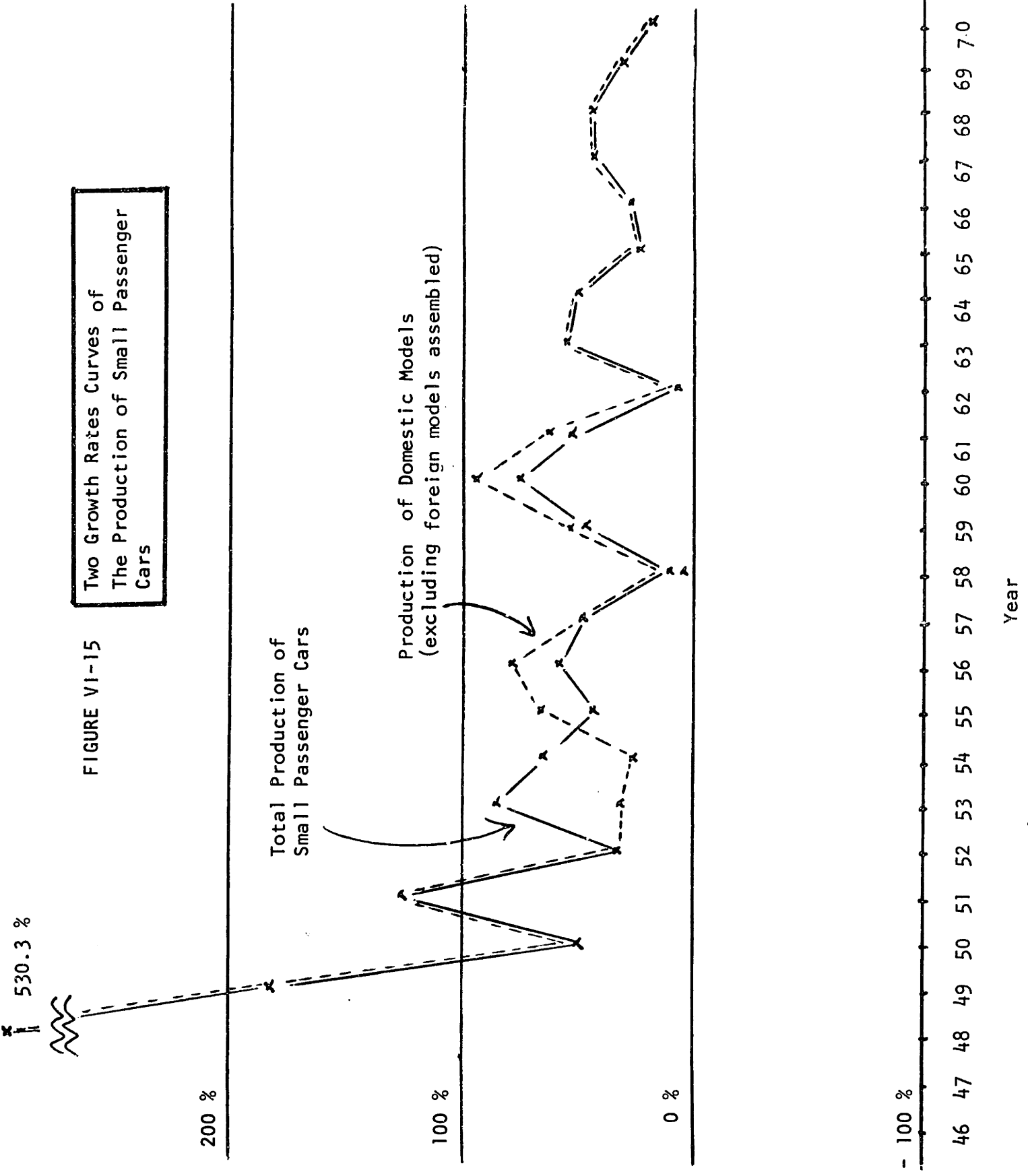
Given these two observations, i.e., 1) the exponential growth of the total yields of passenger cars and 2) the linear decline of the relative share of foreign models, we will employ the following post-hoc policy analysis.

(B) Linear Technology Transfer Policy

In the previous section, we have argued that the government (MITI, in particular) could implement the stringent and somewhat controversial import suppression policy under only one condition: the domestic supply would grow exponentially so that the suppression of the total supply around a certain level would be released after a

Two Growth Rates Curves of The Production of Small Passenger Cars

FIGURE VI-15



Year

- 100 %

200 %

100 %

0 %

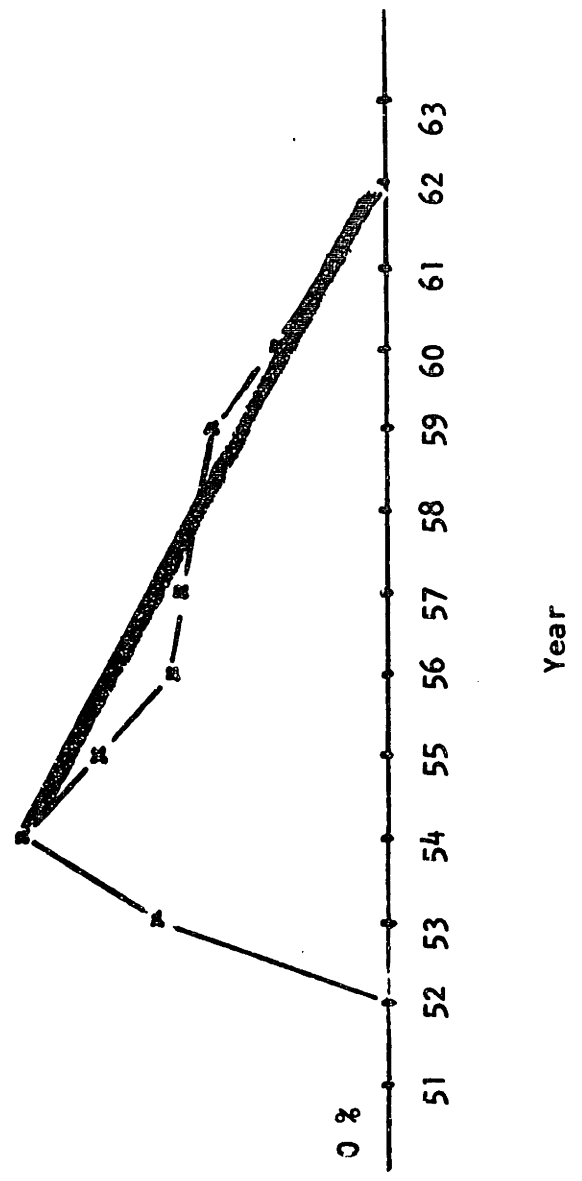
**Relative Share of Foreign
Small Passenger Cars Assembled
by Japanese Makers in Total
Production of Small Passenger
Cars**

FIGURE VI-16

100 %

50 %

0 %



Year

short period. Under this policy requirement, it is likely that the government would have set the policy criterion of linear decline of the relative share of foreign models. Then, we formulate this policy in the following order:

Policy Requirement

Total yields of passenger cars must grow exponentially.

Policy Criterion

The relative share of the assembly of foreign models in the total yields will decline linearly starting with a 50% level.

Policy Questions

- 1) How should the production of domestic models grow?
- 2) How should the assembly of foreign models be controlled?

By definition,

$$(VI.14) \quad A(t) = B(t) + C(t), \text{ and}$$

$$(VI.15) \quad r(t) = C(t)/A(t).$$

where $A(t)$: total yields of passenger cars,
 $B(t)$: production of domestic models,
 $C(t)$: assembly of foreign models,
 $r(t)$: relative share of the assembly foreign models in
the total yields

Then,

$$(VI.16) \quad B(t) = [1-r(t)]A(t), \text{ and}$$

$$(VI.17) \quad C(t) = r(t)A(t).$$

Since we have been consistently arguing the situation in terms of the logarithmic scale, Eq(VI.16) and Eq(VI.17) are transformed as:

$$(VI.18) \quad \log[B(t)] = \log[1-r(t)] + \log[A(t)], \text{ and}$$

$$(VI.19) \quad \log[C(t)] = \log[r(t)] + \log[A(t)].$$

As shown in FIGURE VI-17, the first term on the right-hand side of either Eq(VI.18) or Eq(VI.19) is negative. This means that, on the logarithmic scale, both the production of domestic models and the assembly of foreign models are drawn by subtracting a certain value (i.e., adding the negative value shown in FIGURE VI-17) from the linear curve $\log[A(t)]$. The fact that $\log[1-r(t)]$ looks more or less linear while $\log[r(t)]$ declines sharply and non-linearly gives a rough

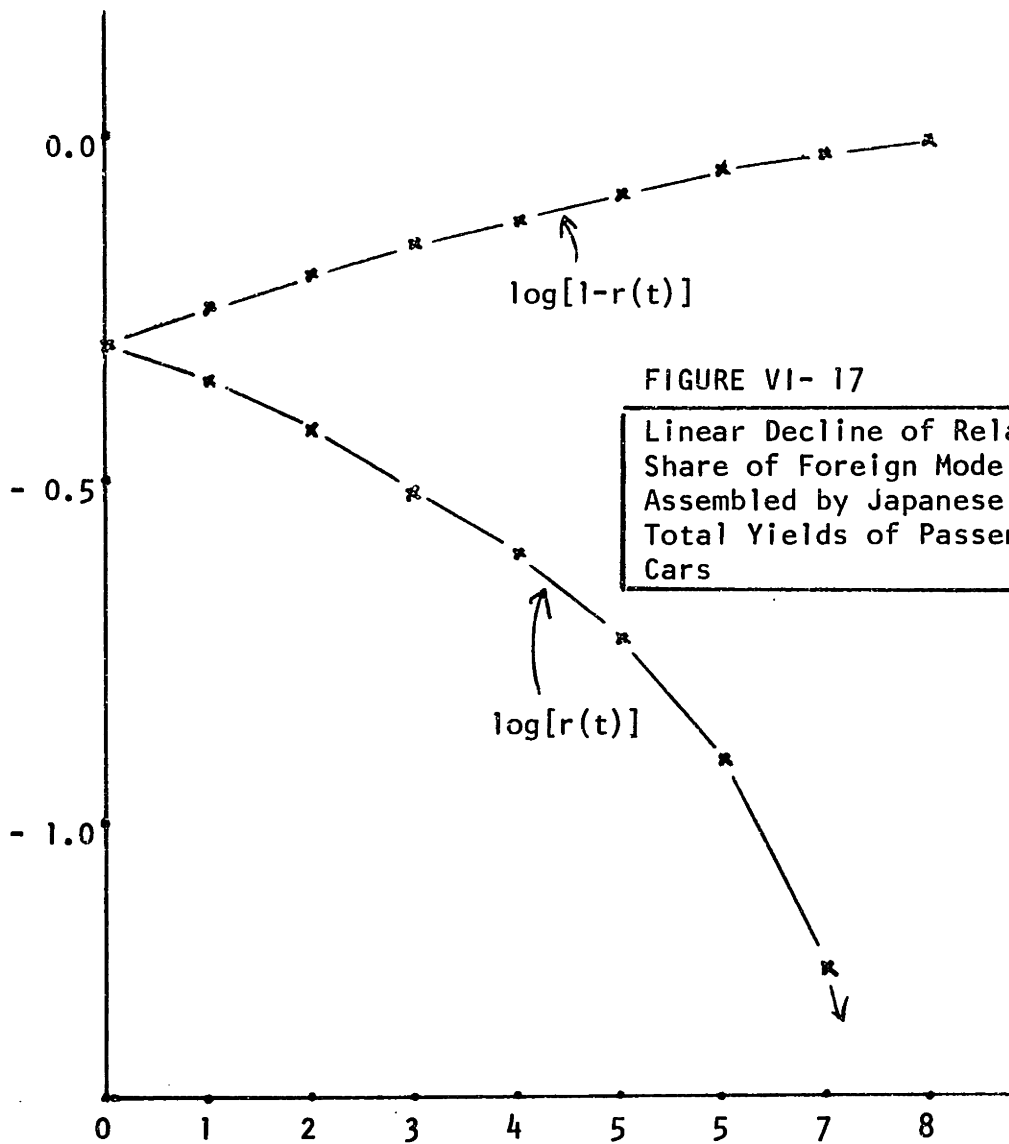
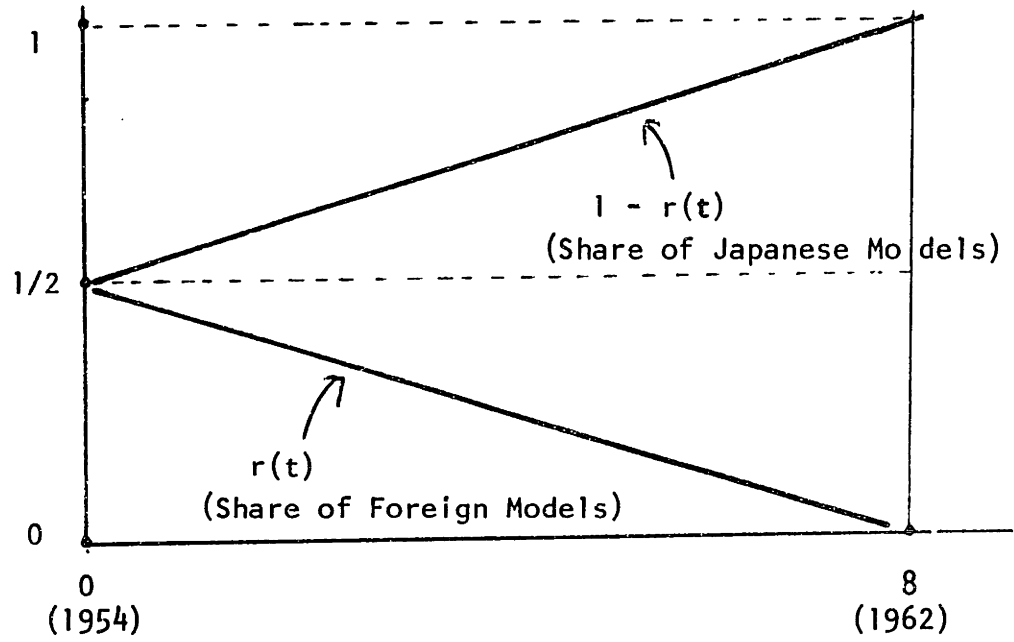


FIGURE VI-17
Linear Decline of Relative Share of Foreign Models Assembled by Japanese in Total Yields of Passenger Cars

idea about the shapes of $B(t)$ and $C(t)$ on the logarithmic scale. That is, the production of the domestic model seems to take over the total yields almost linearly on the logarithmic scale, while the amount of assembled cars would form a parabolic shape. FIGURE VI-14 supports these conjectures.

(C) Comparison between Projection and Actual Data and
Policy Implications

In order to examine the above argument, we will show the difference between the projection based upon Eq(VI.18) and Eq(VI.19) and the actual data. The results are shown in FIGURE VI-18. The log-linear slope of the projected $A(t)$ has been made by taking the $A(1952)$ and $A(1957)$. The initial condition is taken by the actual value of 1954 in recognition that since this year the share curve starts the linear decline (FIGURE VI-16). With respect to the specification of the share curve of $r(t)$, the following equation is adopted from the observation of FIGURE VI-17:

$$(VI.20) \quad r(t) = (8-t)/16.$$

Substituting the projection curve of $A(t)$ and this share curve into Eq(VI.18) and Eq(VI.19), the projection curves of $B(t)$ and $C(t)$ are thus obtained.

o: Projection
x: Actual Data

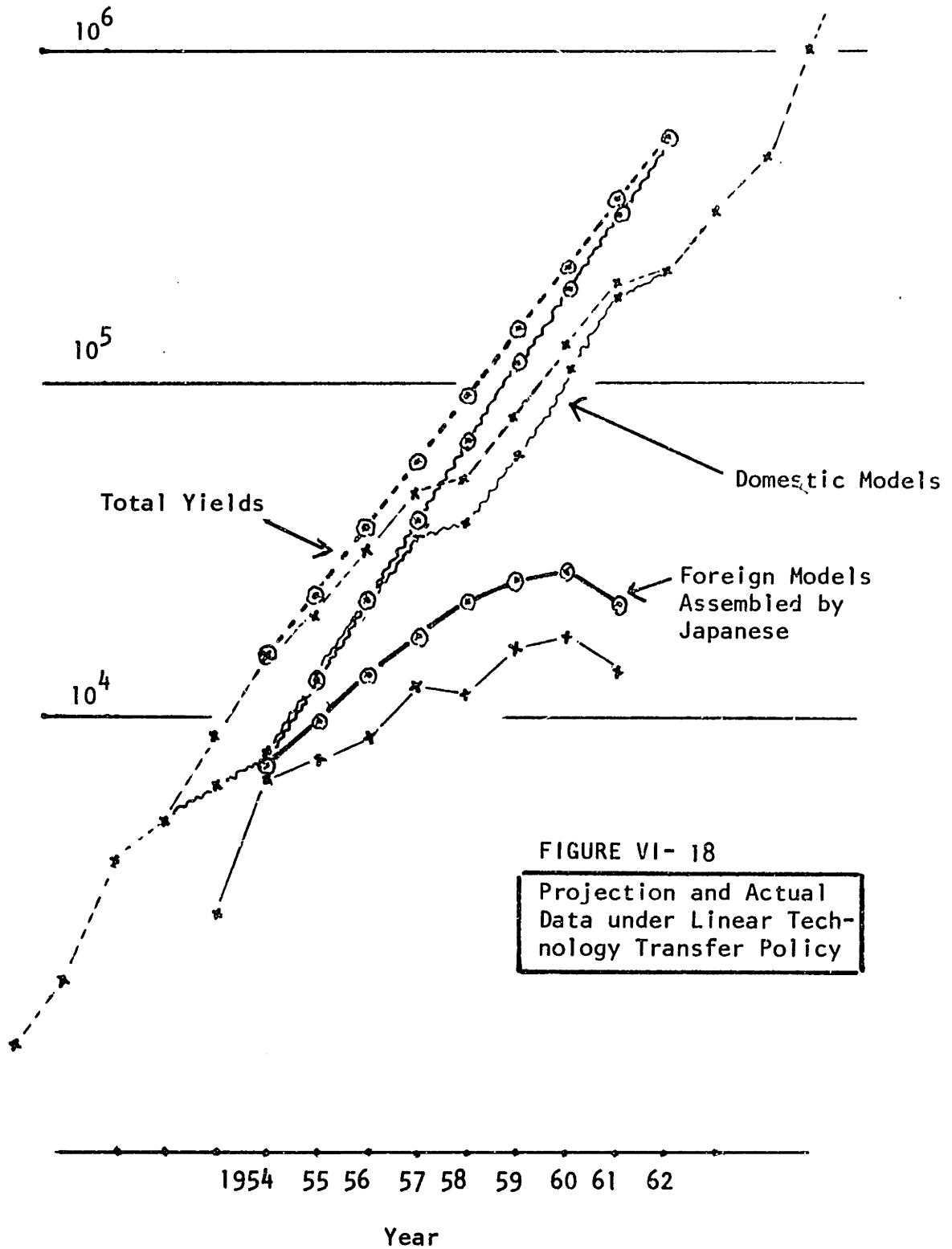


FIGURE VI- 18
Projection and Actual
Data under Linear Tech-
nology Transfer Policy

The extremely high degree of resemblance between the projection "pattern" and the actual data "pattern" for all of three variables draw out the following policy implications. First, the Japanese government needed the exponential growth of the total yields of passenger cars in order to implement the import suppression policy discussed in SECTION VI-2. Second, then, the government instituted the technology contract policy in 1952. Third, the policy criterion was the "linear technology transfer," which meant that the relative share of the assembly of foreign models would decline linearly within a contract period. The government specified seven years or so as such a contract period (SECTION III-3). Fourth, under these policy formulations, the amount of assembled cars had been yearly specified and the production of domestic cars were yearly specified.

The success of this policy is based upon the realization of the technology-assimilating production of domestic models meeting the exponential-total-yields/linear-share-increase requirement. The high degree of pattern resemblance between the projections and actual data simply indicates that the production of domestic models met this government requirement. If the production of domestic models could be not met, the assembly of foreign models must have increased more to maintain the exponential trend of the total yields. Thus, the share curve would have no longer become linear. In fact, the linear share curve in FIGURE VI-16, rather than a convex shape like a mirror image of FIGURE VI-5, demonstrates the strong assimilation capability of the Japanese automobile industry.

SECTION VI-4

R.VERNON'S PRODUCT CYCLE MODEL AND

JAPANESE AUTOMOBILE CASE

(A) The Structural Characteristics of Product Cycle Model and Japanese Automobile Case

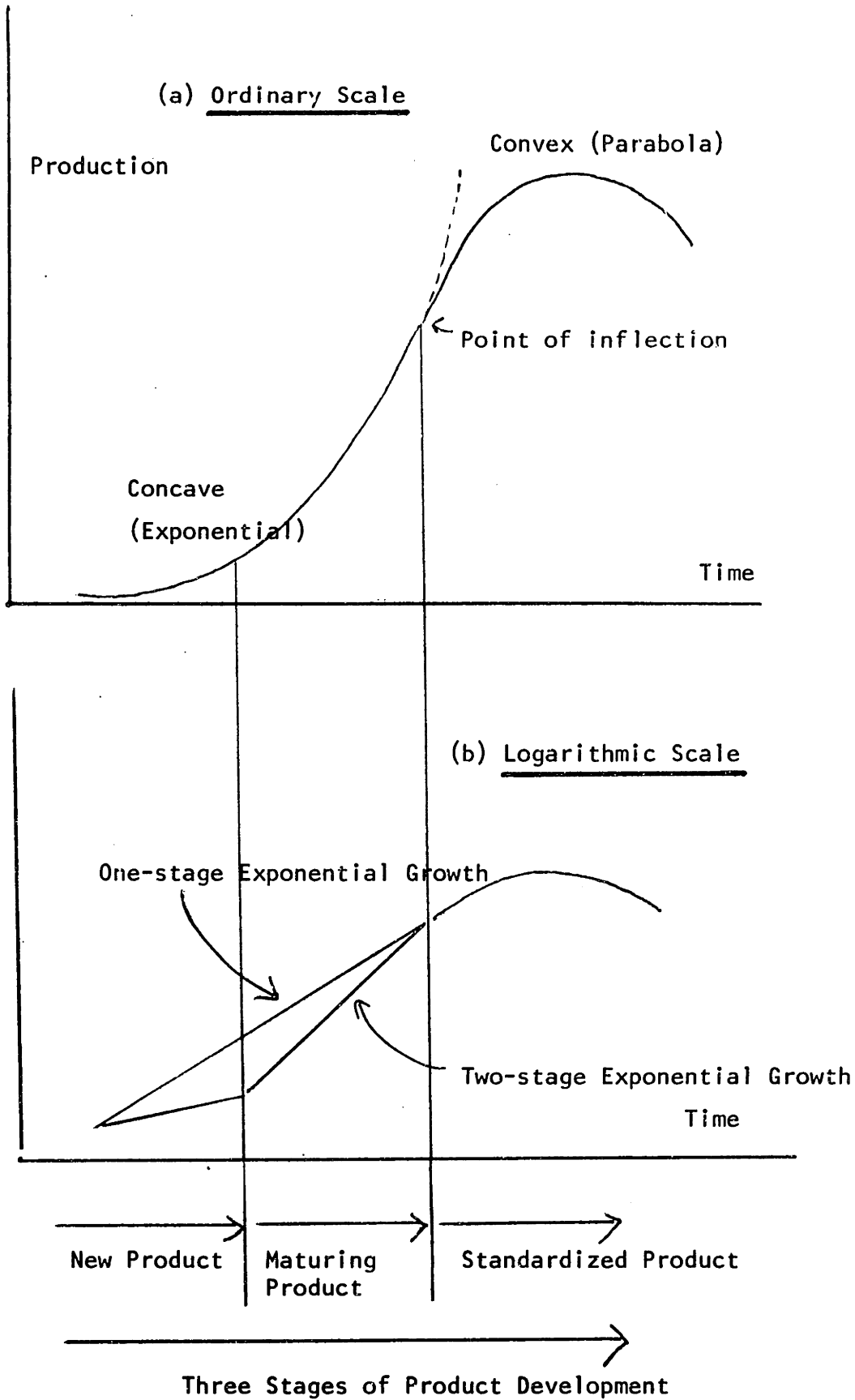
The essence of the product cycle model proposed by Raymond Vernon is succinctly represented by a time-function curve whose dynamics may be described as follows:

- a) before reaching a point of inflection, it slowly increases in concave,
- b) after this point of inflection, it still increases, but in convex,
- c) and, finally it reaches a saturation point followed by a decrease in convex.

This process is conceptually illustrated in FIGURE VI-19(a). The product cycle curve is often accounted for by the maturation transition of industrial products and the responses to a consumer market [5]. During the first stage of a new product development, the production curve goes up rather exponentially with a moderate increase ratio. When industry enters into the stage of matured products, the

FIGURE VI-19

The Product Cycle Curve



curve still goes up exponentially, following the previous trend or with an improved exponent factor; but at the end of this stage it encounters a point of inflection. Thus, the stage of product standardization begins as the trend changes to be in a parabolic growth and then decline.

CHAPTER IV has already discussed the structural property of this two-stage trend change. That is to say, the product cycle curve corresponds to the second structural change of the case dealt with in SECTION VI-2 (i.e., from a exponential trend to a parabolic growth and decline). Recall that an exponential trend implies a constant growth rate in the homogeneous incremental process and the parabolic trend has the dynamic homogeneous mechanism in which the growth rates (which has the same dimension as the homogeneous parameter) decrease in convex, or, roughly speaking, of a linear decline (FIGURE VI-19(b)).

In search of the similarity of the trend pattern of the product cycle model in our data, we may find the similar pattern in the data of the production of all 4-wheel vehicles from 1931 up to 1945 (FIGURE IV-4), which has the structural change from the two-stage exponential growth to the parabolic decline in 1940.

The crucial assumption of the product cycle model is the natural or smooth transition of the stages of product development. As we have pointed out by both the deterministic model and the Kalman Filter

identification for the stochastic model version, it is highly likely that the exponential trend after 1932 was caused by the outside force, i.e., government intervention. Before this intervention occurred, the growth trend had already stagnated. That is to say, the stage of a new product development had a rapid-stagnation mechanism in its structure reflecting the immature fragility of Japan's automotive industry. It is hence a quite possible conjecture that if the intervention had not entered, the growth trend would have declined leading to the ultimate end--the collapse of the industry. The deteriorated financial situation of the manufacturers at this period supports such a doom-forecast (See SECTION II-2).

The Kalman Filter applications to both the growth rate curve and the growth curve have suggested two possible explanations in regard to the question of how the exponential trend after 1932 was attained. The first application explains that the government created such a trend and the industry's production performance had not been significantly improved but remained more or less the same as that of the stagnation period. The second application explains that stimulated by the government intervention of 1932 (MCI Standard Model), production performance had gradually improved and finally rode on an exponential trend by itself. None of these accounts supports the natural transition of product development.

Turning our focus on a parabolic trend at the stage of maturing

products, the Japanese case differs from the product cycle model. It is in fact true that since 1937, the previous steep-slope exponential growth trend slowed its pace and eventually entered into a parabolic decline. Whether or not this indicates that the Japanese automobile products entered into the maturation stage is answered by the historical fact that the unsatisfactory performance of domestic trucks in the war front were reported (SECTION II-3). Furthermore, the historical survey in SECTION II-4 has found that the parabolic decline was caused by the so-called war fatigue as well as the mandatory order of the military government to spare production facilities for weapons production, particularly aircraft manufacturing. The most salient example can be found in the case of the production of passenger cars when the Minister of Commerce and Industry notified the auto-makers of the ban on the production of civilian-use passenger cars in 1938. Since then, the growth curve started forming an exact parabolic decline.

The idea that a new product would be gradually developed at an increasing pace seems to indicate a reasonable course of industrial development. It assumes that industrial products start small scale production and later attain a high level when they become matured. However, one must pay attention not only to this growth process but also to the internal growth-generating mechanism, i.e., growth rate. As repeatedly argued, if a growth rate is a positive constant, its corresponding growth trend always looks like the first two stages of

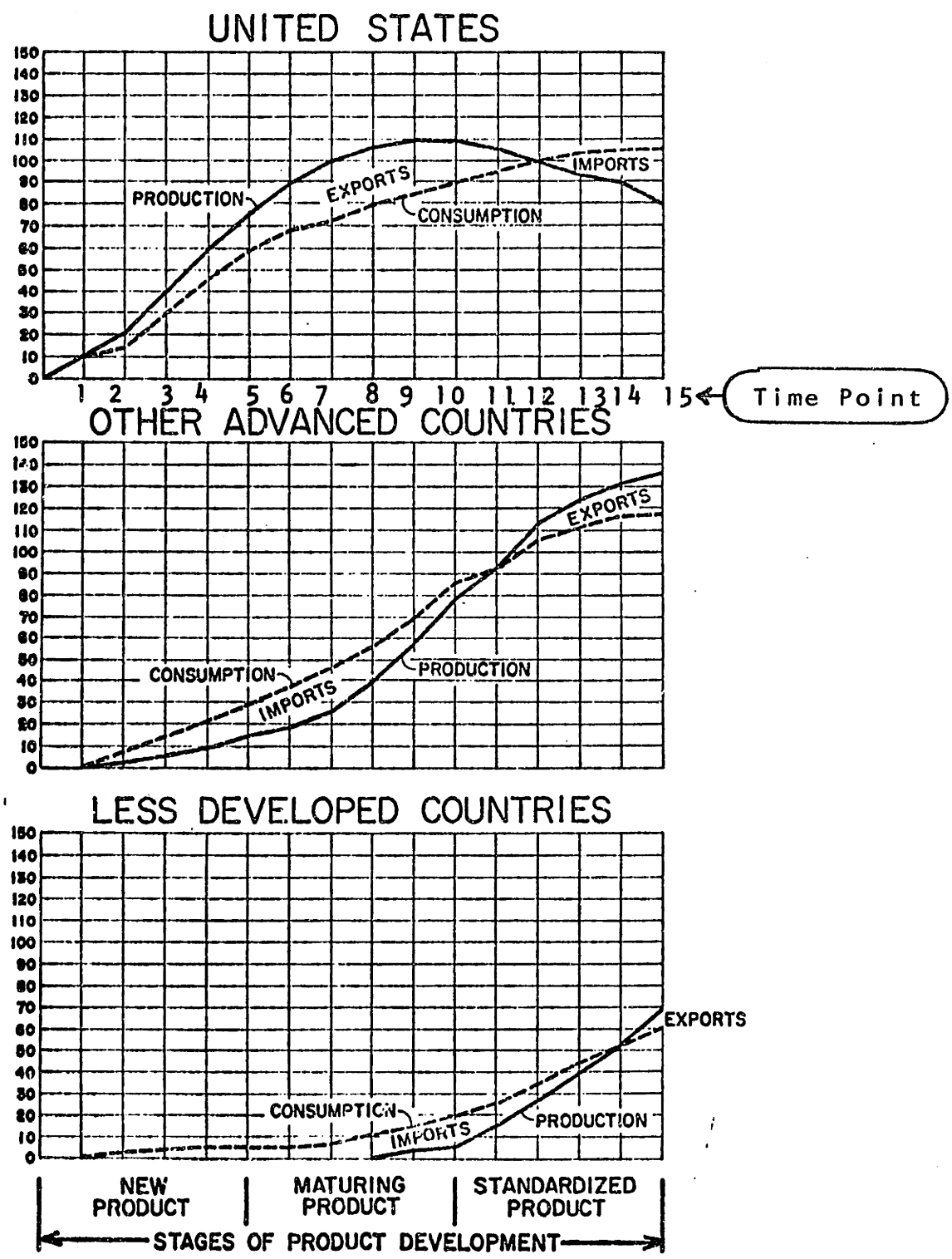
the product cycle model whatever its magnitude may be. Then the question arises: "Is it really possible for a newly-born industry to keep a positive constant growth rate for a relatively long period?" If it is possible, industry must be exceptionally successful and would no longer be an immature industry. The case of the Japanese automobile industry is not in such a category since it constantly repeated a rapid-stagnation pattern in a different scale and at a different time. For example, the production data of medium trucks and buses after the MCI's standardization again formed a small scale rapid-stagnation before the Law Regarding Automobile Manufacturing Enterprise was enacted in 1936. The major products during this period were exactly a new product called the "MCI Standard Model." Instead of a gradual increase, the production started with an impressively high growth rate which later sharply declined. The data of small passenger cars also illuminates that the production of the postwar new passenger cars was about to be stagnated before the MITI's principle of technology contracts was announced in 1952. Evidence simply suggests that the immaturity of the Japanese automobile industry is rapid-stagnation production trend with sharply decreasing growth rates. Whether or not our case is a special deviation from the generally agreed product cycle model is not certain. If the cases of other countries or of other industrial products comply with the product cycle model, the Japanese automobile case perhaps has its own uniqueness. However, structurally speaking, the relevancy of the constant and positive growth rate from the very beginning remains questionable. If the

situation of the Japanese automobile industry were in such a case, the government would not have needed intervention, except that the nation necessitated a higher exponential pace in order to take over and overwhelming appearance of foreign imports for military purposes (SECTION VI-1).

(B) The International Trade and Investment Model and the Japanese Automobile Case

R. Vernon [6] describes the mechanism of international trade and investment by applying his product cycle model. He argues in the first place, that the difference in the stages of industrialization by country corresponds to the difference in the shapes of the product cycle curve as shown in FIGURE VI-20.

The two obvious implications are readily deduced from FIGURE VI-20. One, the definite integrals of production minus consumption yield either exports or imports. The positive integrals mean exports, while the negative ones correspond to imports. Two, the production curve and the consumption curve form the same pattern as the product cycle curve illustrated in FIGURE VI-19(a); and hence the patterns of the both curves essentially remain the same regardless of the different industrial stages; but the more industrially advanced a country is, the earlier the point of inflection (from an exponential trend to a parabolic one) of both the production and consumption curves stay on a



(Note) Reproduced from:
Vernon, R., "Int'l.
Investment and Int'l.
Trade in the Product
Cycle," Quarterly Journal
of Economics, 80(2), pp.190-207.

FIGURE VI- 20
R. Vernon's Model on
Stages of Product Development

higher level. Keeping in mind the relationship between the two product cycle curves, one on an ordinary scale and one on a semi-logarithmic scale shown in FIGURE VI-19, FIGURE VI-20 can be transformed into a semi-logarithmic pattern, in order to more clearly observe the structural difference of three country cases. The transformation is shown in FIGURE VI-21. The salient structural implications of this figure are as follows:

The United States

First, production enters into a parabolic trend quite early, at the late stage of the new products development, departing from an exponential trend with a high growth rate. On the other hand, consumption grows in the same trend pattern, being pulled by the production curve, thereby yielding exports for a long period. Since production starts declining somewhere between the stages of maturing product and standardized products while consumption still grows, the US would eventually start importing at some stage of standardized product.

Other Advanced Countries

Imports from the US (or the equivalent countries) first arouse a consumer market which later stimulates domestic production. Therefore, consumption surpassed production until a stage enters into

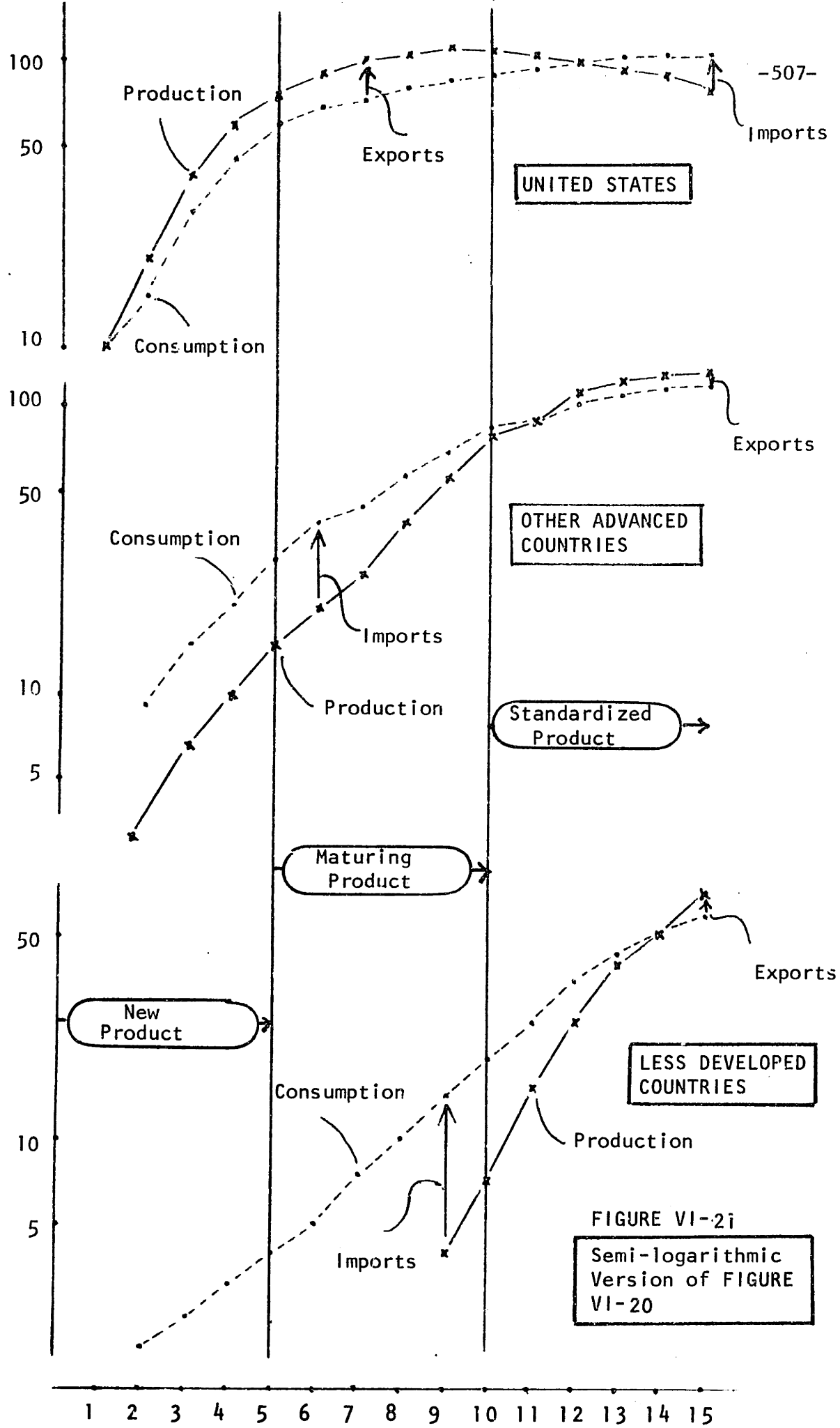


FIGURE VI-2i
Semi-logarithmic
Version of FIGURE
VI-20

standardized products, thereby holding a long period of imports. Production grows somehow exponentially at a lower pace than that of the US for the first two stages; and later becomes a rapid-stagnation pattern. The same level of stagnation as that of the US indicates that this stagnation would go on to a parabolic decline ultimately. A more careful observation of the production curve reveals that production grows with three convexes; from Point 1 to Point 7, from Point 7 to Point 11, and Point 11 to Point 15. This suggests that domestic production stimulated by imports is not so smooth as the US case. The long duration of the imports period is due to the more or less parallel slopes of both the production and consumption curves.

Less Developed Countries

The relationship between consumption and production for the case of less developed countries is the same as that for other advanced countries. That is, consumption surpasses production at the beginning when imports flow into a market. However, domestic production starts quite late, at the latter stage of maturing products. But, it grows very fast at a similar pace to that of the US. On the other hand, the slope of the exponential growth of consumption is quite low, indicating a small scale of market of less developed countries. This also leads to the fact that the period of imports ends earlier after domestic production starts, and hence surplus production goes into exports relatively early. The above characteristics are due to the

structural similarity and difference between the pattern for other advanced countries and that for less developed countries. In short, they resemble each other in the relative locations between the consumption and production curves; but differ in the scales of Y-coordinate (the level of products) and X-coordinate (the time interval).

Given the above understanding of R. Vernon's model of international investment and trade dynamics, the Japanese case is examined by FIGURE VI-22 as follows:

First, macroscopically speaking, the prewar pattern resembles the case of the less developed countries. In fact, imports started at a quite high level and were antecedent to domestic production. The slope of the consumption (regarded in this graph as the total domestic flow of 4-wheel cars) curve is more gradual than that of the production curve. Second, domestic production, however, grew not so smoothly but once stagnated during the period from 1929 to 1932. The previous historical analysis (SECTION II-2) has revealed that this stagnation caused the government intervention of the Ministry of Commerce and Industry's Standard Model in 1932. Third, consumption became stagnated since 1929. The reason is, as seen already, partly due to the slowdown of the flow of the US cars assembled in Japan and partly to the government import suppression policy before and after the promulgation of the Law Regarding Automobile Manufacturing Enterprise in 1936.

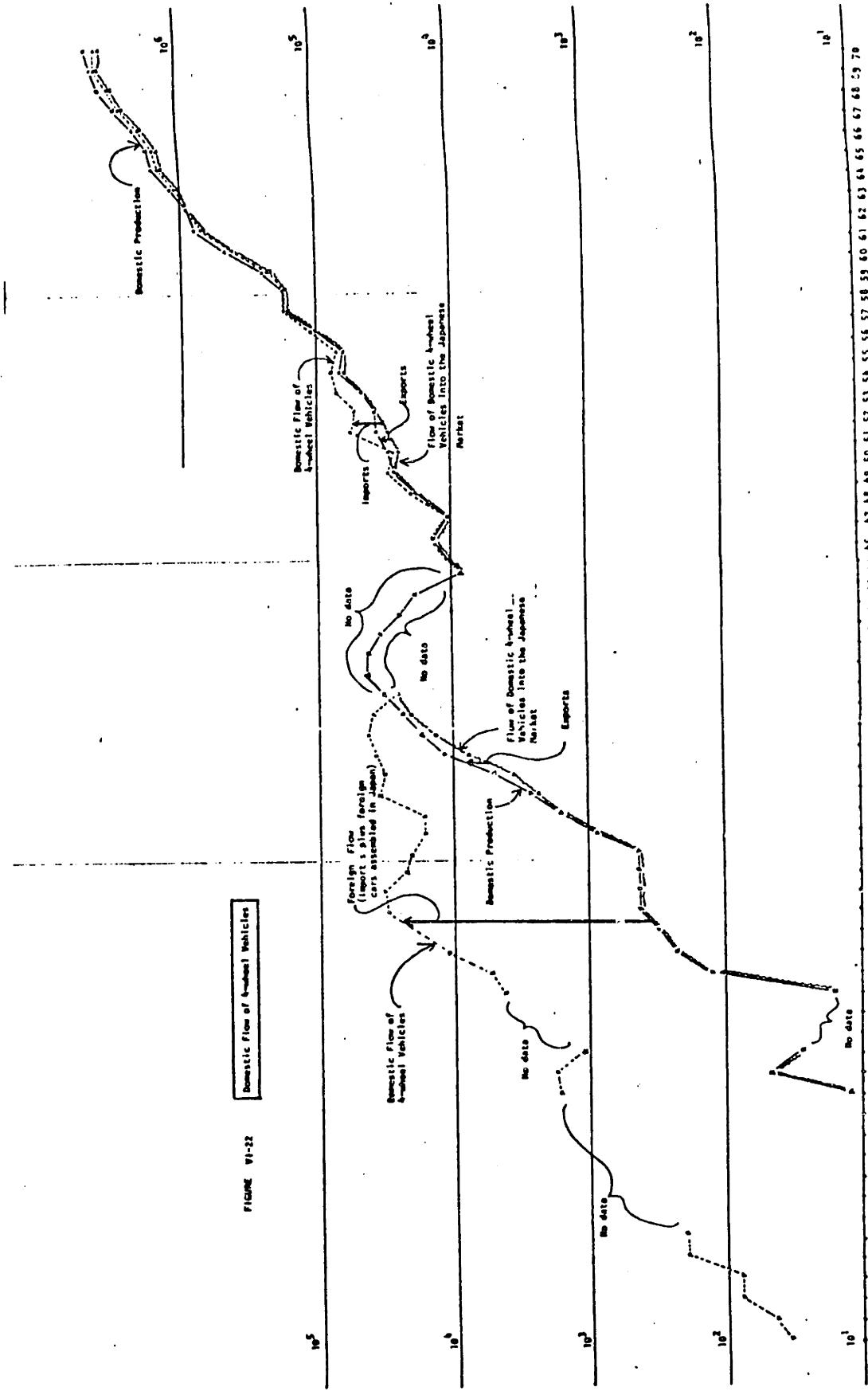


FIGURE VI-22
Domestic Flow of 4-wheel Vehicles

Year

Then, the consumption curve entered into a rapid-stagnation pattern since 1929, departing from the previous high-pace exponential trend. Fourth, despite the intersection of the consumption and production curves in 1939, no exports were yielded since then. The reason is due to the fact that the end of imports was forced by the above law. Fifth, the Vernon pattern started again in 1945 after the war. However, up to 1951, imports were marginal, reflecting the special period of economic reconstruction and the shortage of foreign currency reserves. The real pattern thus started in 1952, due to the massive inflow of American used cars through the Occupation Army without foreign exchange transactions. Sixth, due to the special military procurement of the Korean War, phenomenally large exports appeared from 1950 to 1953. Seventh, consumption approached production very soon in about 1956, thereby implying a drastic decrease in imports. However, production discernibly surpassed consumption in 1960. The reason for this phenomenon is the government's import suppression which started in 1952 (SECTION III-2). Eighth, for both unit levels and the graph pattern, the postwar pattern since 1952 resembles the case of other advanced countries.

As long as graphical pattern recognition is concerned, the prewar pattern seems to resemble the case of the less developed countries (FIGURE VI-23), while the postwar pattern looks similar to the case of other advanced countries (FIGURE VI-24). Whether or not this means a certain structural change of the state of system is examined with

FIGURE VI-23

Conceptual Superposition of
Prewar Pattern on Less Developed
Countries' Case

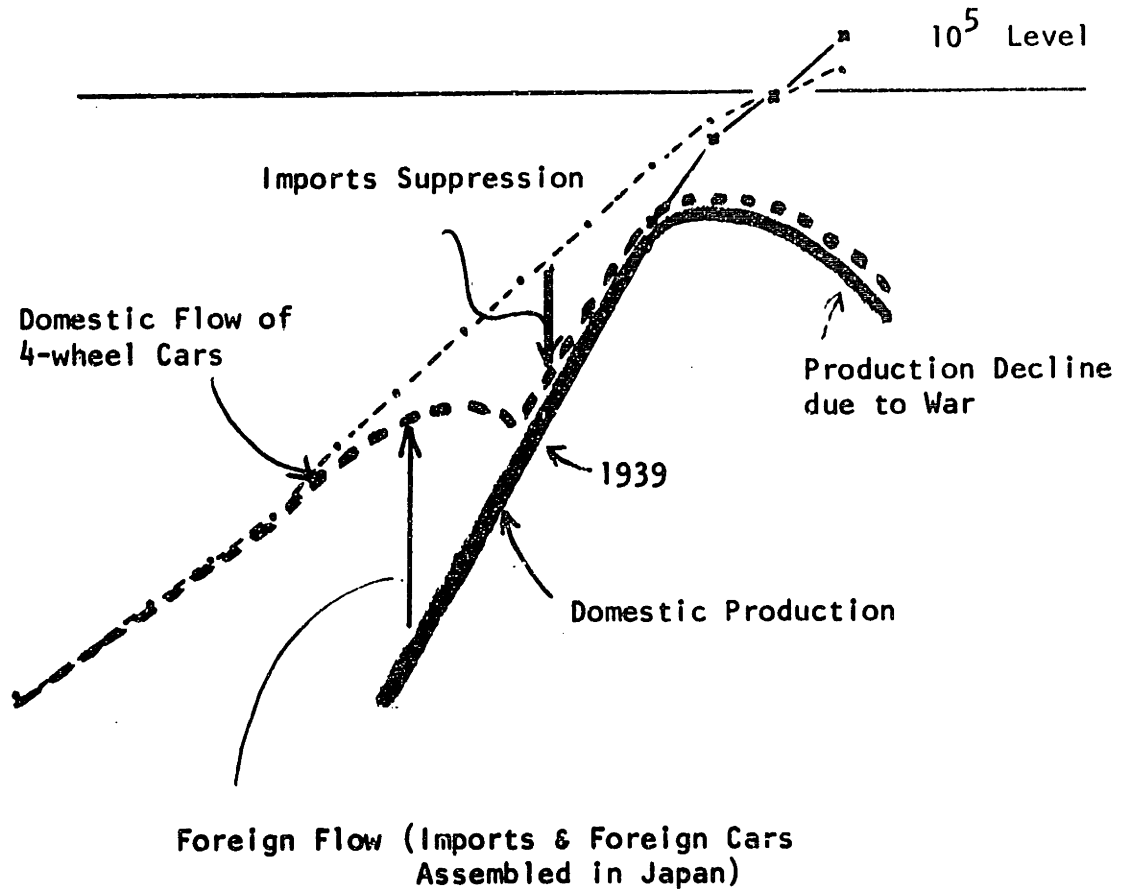


FIGURE VI-24

Conceptual Superposition of Postwar
Pattern on Other Advanced Countries'
Case

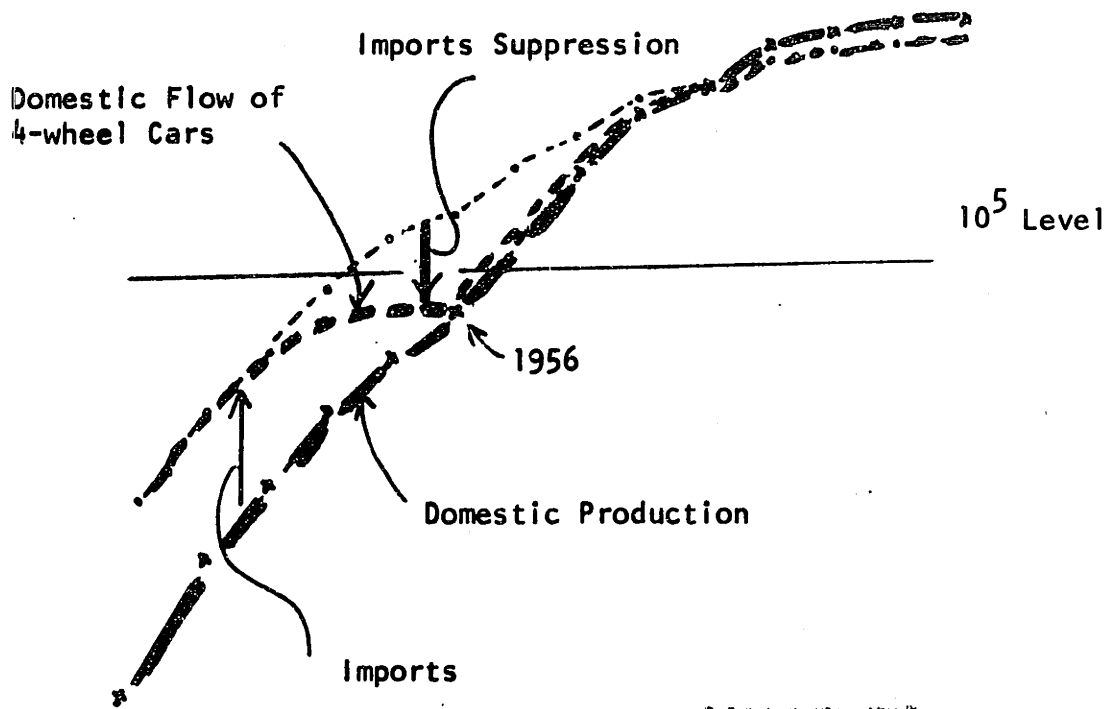


FIGURE VI-24

Conceptual Superposition of Postwar
Pattern on Other Advanced Countries'
Case

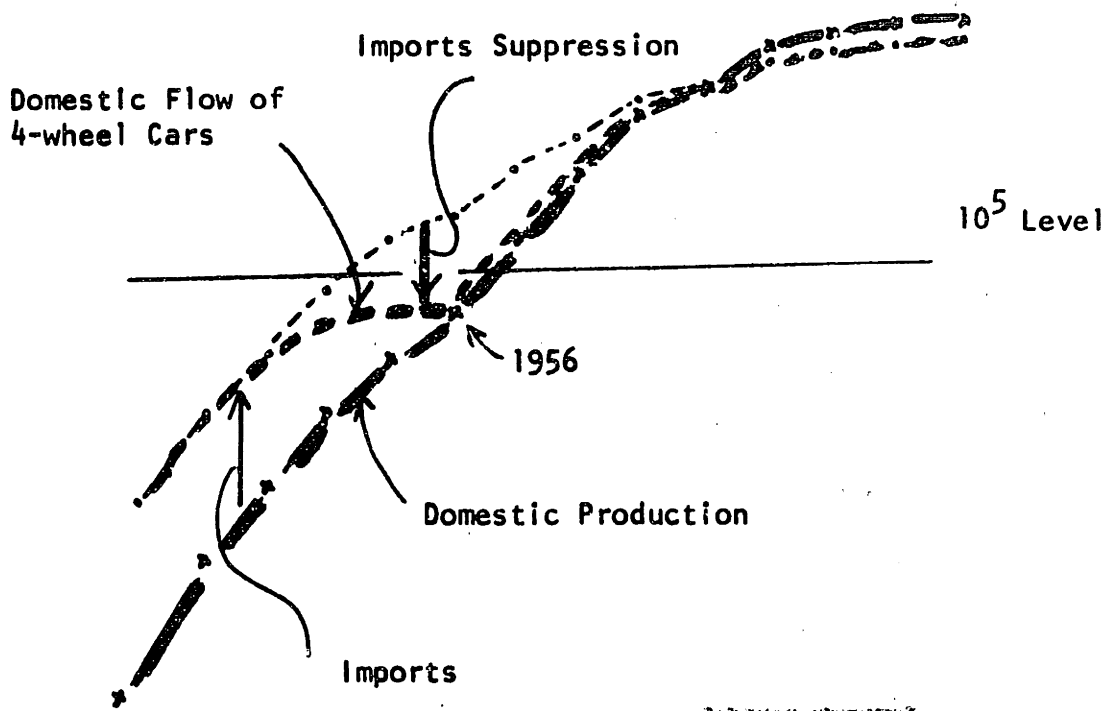
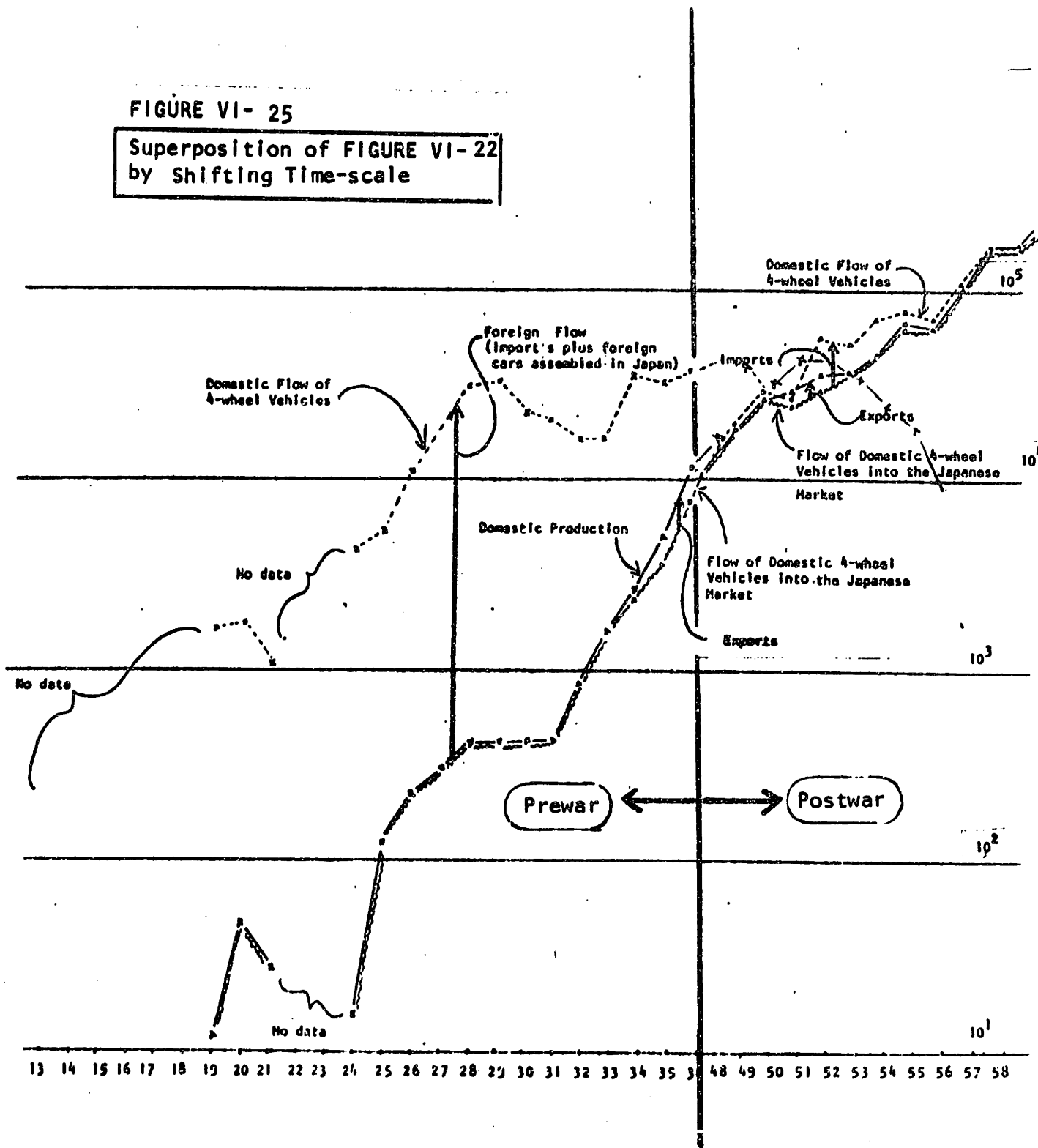


FIGURE VI-25. This graph is artificially created by shifting the postwar curves to the left until both the level and the slope of the prewar and postwar production curves can be overlapped. This superposition is based upon the reasoning that since production during a period from the war to the occupation was under severe regulation (SECTIONS II-4 and III-1), the state of the automobile industry was resumed at the 1936 level in 1947. Two provocative findings are drawn. First, not only the production curve, but also the consumption curve more or less shows the continuous trend from prewar to postwar with respect to both the level of units and the slope of the curve. Second, the combined pattern looks essentially the same as that of less developed countries. That is, the slope of production is considerably steeper than that of consumption. Hence, there seems no structural change from prewar to postwar. Now, a further question arises as to whether or not the Japanese case can be in fact categorized into the case of less developed countries. The answer to this question needs careful elaboration of the case in the context of the government's import suppression policies.

After the enactment of the Law of Automobile Manufacturing Enterprise of 1936, the government specified the amount of assembled cars by Japan Ford and Japan GM, which consequently lead to the closing of assembly operations in these American subsidiaries (SECTION II-3). On the other hand, the Regulation Regarding Conveyance of Foreign Motor Vehicles of 1952 directly focused on the suppression of

FIGURE VI- 25

Superposition of FIGURE VI- 22
by Shifting Time-scale



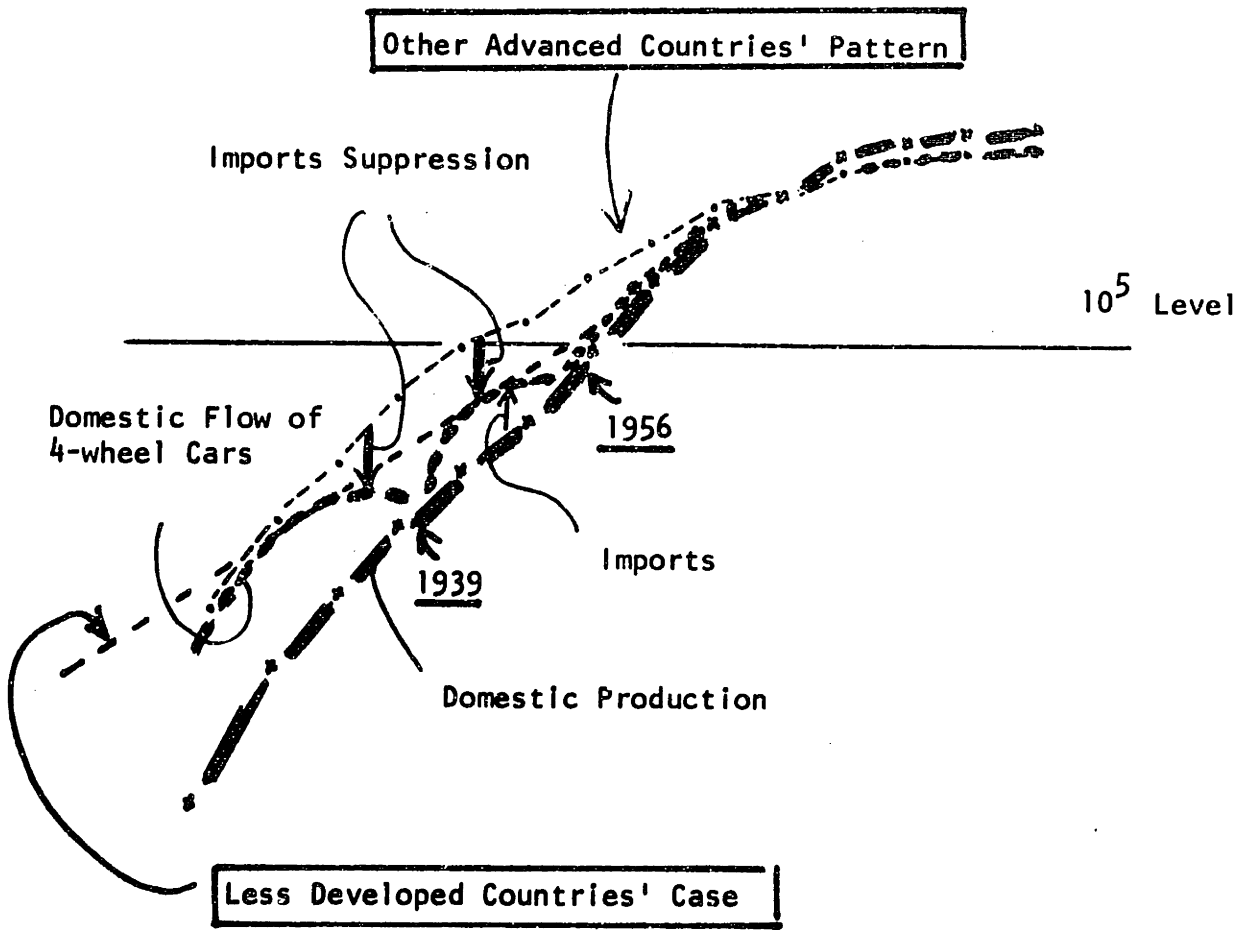
infiltration of foreign cars into the Japanese market (SECTION III-2). Given these two historical facts and the two conjectural analyses in previous SECTION VI-1 and SECTION VI-2, an entirely opposite view is possible.

Although no data is available concerning how much government suppressed foreign imports during the above two periods, the evidence of import suppression itself makes it plausible to conjecture that the real consumption curve would be well above the actual curve as shown in FIGURE VI-26. In particular, if the postwar suppression had been greater than the prewar precedent, the real consumption curve would become more parallel with the production curve, thereby implying that the Japanese latent pattern since the 1930s would be essentially the case of other advanced countries. The crucial assumption for this view is that Japan's scale of economy would have been latently large so that the slope of the consumption curve would be higher to be parallel to that of the production curve.

If the above conjecture is true, a question arises concerning why the actual pattern resembles the case of less developed countries. Following is one answer to this question. As discussed in SECTION VI-1 and SECTION VI-2, the desperate hope of the government was to fill the vehicle supply with domestic production as soon as possible by eliminating foreign imports. In other words, the slope of the consumption curve must be lower than that of the production curve.

FIGURE VI- 26

Conceptual Superposition of Both
Prewar & Postwar Patterns on Other
Advanced Countries' and Less Developed
Countries' Cases



Therefore, the Japanese government seemed to choose the pattern of less developed countries but on a high level. If the Vernon model is true, this is possible only when consumption is suppressed and hence sacrificed. This strategy arouses the controversial question regarding economic welfare at large. The historical evidence that the MITI's import restriction policy received serious oppositions (exemplified by the speech of President Ichimada of the Bank of Japan in 1950; SECTION III-2) is directly related to this important question.

(C) Summary of Discussion

The Japanese automobile case in general corroborates R. Vernon's model of international investment and international trade. However, structurally speaking, his assumption on the exponential growth at an early stage of product development for the countries other than the US is controversial. The exponential growth assumes a constant increase of production, which is difficult to apply to an immature industry in the midst of imports. The Japanese case gives evidence to this fact. The more plausible growth pattern is rapid-stagnation defined in SECTION IV-2. An immature industry seems to face an early stagnation or even decline. The prewar automobile industry of Japan shows this pattern. Furthermore, in the case of Japan, the government intervened into the automobile industry in order to keep production on an exponential trend of what R. Vernon assumes. In other words, in the

case of the Japanese automobile industry, the exponential growth trend at an early stage is not due to the natural transition of product development, but due to the strong productive policy of the government in conjunction with the imports restriction policy.

With respect to the similarity between R. Vernon's three cases of the relationship among consumption, production, imports and exports and the Japanese automobile case, there are three different interpretations. First, the prewar pattern resembles the case of less developed countries while the postwar pattern resembles the case of other advanced countries. Second, the entire pattern essentially resembles the case of less developed countries, provided that the period from war through the occupation was abnormal. Third, the entire pattern essentially resembles the case of other advanced countries. The first and the second interpretations are based upon the actual data which might contain the intervention effects of the Japanese government's severe import suppression, whereas the third interpretation is speculative, hypothetically leaving out the existence of such an import restriction and hence assuming the more or less natural transition implied in R. Vernon's original model. The comparative examination in the structural properties between the second interpretation and the third interpretation yields a significant policy implication that the Japanese government might have chosen the pattern of less developed countries but on a high level by strong import suppression to protect the automobile industry and hence by sacrificing consumption.

CHAPTER VII
SUMMARY AND CONCLUSION

SECTION VII-1
INTEGRATION OF HISTORICAL AND NUMERICAL
INTERVENTION ANALYSES INTO
THE WORKING MODEL MATRIX

This study has commenced with the proposition of a working model (FIGURE I-1) according to which both historical analysis on the eight major policy interventions (PART I) and numerical analysis on the intervention impacts (PART II) have been conducted. With the results of these two analyses, we now fill the matrix shown in FIGURE I-2 in our attempt to examine two basic hypotheses for the working model that: 1) the multiple interventions form the cause and effect iterative cycles over time, and 2) the government learns from past policy interventions to exercise subsequent new interventions. The completed matrix is presented in FIGURE VII-1.

(A) The first hypothesis: The multiple interventions form the cause and effect iterative cycles over time.

The first intervention created the automobile industry in an organized form. However, its production soon became stagnated, so that the second intervention entered. Although this second

The first half of FIGURE VII-1
is shown on the bach page.

MAJOR INTERVENTIONS INTERVENTION PROCESS		FIRST MAJOR INTERVENTION (THE LAW REGARDING SUPPORT FOR MILITARY VEHICLES (LSMV): 1918)	SECOND MAJOR INTERVENTION (THE MINISTRY OF COMMERCE & INDUSTRY'S (MCI) STANDARD MODEL: 1932)	THIRD MAJOR INTERVENTION (THE LAW REGARDING AUTOMOBILE MANUFACTURING ENTERPRISES: 1936)	FOURTH MAJOR INTERVENTION (WARTIME CONTROL: c. 1939 - 1945)
NEW SITUATION		X		Shanghai Incident (1932), which used the Ford trucks	The Pacific War broke out (1941).
DETERMINATION OF POLICY TARGET	VERBAL STATEMENT	Assurance of the supply of military vehicles (in particular, for the possible military deployment in Manchuria)	<ul style="list-style-type: none"> To establish the auto industry To concentrate on the production of trucks and buses 	<ul style="list-style-type: none"> For national defense, to establish the domestic supply system of all kinds of vehicles Automobile manufacturing enterprise must be undertaken by the Japanese firms. 	To carry out the war objectives
	NUMERICAL SPECIFICATION	Unidentified	To attain the production scale of 5,000 units per year by 1935.	<ul style="list-style-type: none"> 6,000 - 8,000 units per company per year The planned level of the nation's net production was unclear. 	70,000 - 80,000 units per year
	POLICY INITIATOR	The Ministry of Army (MOA)	<ul style="list-style-type: none"> The Committee for Promotion of Domestic Products (led by the Ministry of Railroads (MOR)) The Committee for Establishment of Automobile Industry (led by MCI) 	MCI (Department of Engineering headed by Nobusuke Kishi) backed by MOA	MCA and the Ministry of Munitions (MCI was dissolved into this ministry during the war.)
PAST POLICY LEARNED		The British, French and German precedents of the civilian possession of military vehicles for the emergency requisition	<ul style="list-style-type: none"> Technical Standardization (The same as the 1st intervention) Manufacturing subsidy (The same as the 1st intervention) 	<ul style="list-style-type: none"> Although the secret mission was dispatched to Germany, it is not clear whether the German case was learned or not Tariff control (The same as the 2nd intervention) 	<ul style="list-style-type: none"> Manufacturing license (The same as the 3rd intervention) Price control (The same as the 3rd intervention) Sales control (The same as the 3rd intervention)
SELECTION OF POLICY INSTRUMENTS (Only the new ones are listed)		<ul style="list-style-type: none"> Manufacturing subsidy Purchase subsidy Maintenance subsidy Requisition subsidy Technical standardization 	<ul style="list-style-type: none"> Public procurement (New) Manufacturing division of labor by different companies (New) Mandatory use of the domestic cars by public offices (New) Tariff rate revision (New) 	<ul style="list-style-type: none"> Manufacturing license by law (New) Tax incentives for manufacturers (New) Mandatory order by government on sales and pricing (New) Financial provision not by monetary supports but by the special application to the commerce laws (New) 	<ul style="list-style-type: none"> Law order to establish the trade union (consortium) (New) Material rationing (New) Corporate account control (New) Control over the products to be produced (New)
CAUSE OF INTERVENTION	NATURE OF INTERVENTION	The subsidy measure with technical standardization (No procurement)	The public procurement of the government-standardized cars	The government's direct control by manufacturing licensing	The complete national control over all areas in manufacturing, sales and distribution, by law enforcement
	EXTERNAL DISTURBANCES	No specific disturbance occurred.	<ul style="list-style-type: none"> The policy shift of MOA (the principal procuring agency) to a different size model from the MCI Standard Model Due to the Manchurian Incident, the Army (another principal procuring agency) changed its policy to a large heavy-duty military trucks. 	No specific disturbance occurred.	<ul style="list-style-type: none"> Material shortage MOA's order to manufacture aircrafts, aircraft engines, and weapons
ASSESSMENT OF INTERVENTION	OBSERVATION OF REACTION OF FIRMS	<ul style="list-style-type: none"> The hitherto small inventive firms were cleared (i.e., bankrupted). Three LSMV companies emerged. The complaint about the complication of the Army's technical specification and of the administrative procedure for the application to the subsidies was heard from these companies and purchasers. 	<ul style="list-style-type: none"> The three LSMV companies which were near bankruptcy were financially rescued by the government procurement order. Tsubata Cast Iron (the predecessor of Nissan) joined the auto industry, criticizing the government intervention. 	<ul style="list-style-type: none"> Toyota suddenly entered into the auto industry. Nissan finally complied with the government due to Toyota's entry. Other existing (LSMV) firms specialized in the military large vehicles. 	<ul style="list-style-type: none"> Nissan, in particular, opposed the military government's intervention, but was forced to comply with it. The automobile consortium (the Association of Control of Automobile Industry) was presided by the ex-military president of Diesel Motor Industrial under the Army's pressure. His nomination did not reflect the general view and desire of the industry at large.
	NUMERICAL POLICY IMPACTS	The hitherto random fluctuating production data in a small scale ceased. Since 1931, the smooth growth in a rapid-stagnation pattern started.	<ul style="list-style-type: none"> The production of trucks and buses departed from the previous stagnation, but soon stagnated again. The production of small vehicles started growing with the high growth rate. 	<ul style="list-style-type: none"> The stagnated production of trucks & buses started an exponential growth. The production of small vehicles ceased the hitherto continuing growth. The relative share of foreign supply which was primarily accounted for by the assembly of the Ford and Chevrolet models started declining in a convex form. The incremental factor of the growth rate for total production was lowered. The incremental factor of the growth rate for trucks & buses entered into the negative region. The incremental factor of the total production sharply improved. 	All kinds of automobile production started declining parabolically. The incremental mechanisms to yield both growth rate and production were not significantly affected.
	ASSESSMENT OF INTERVENTION	<ul style="list-style-type: none"> The previous concept of an automobile as a luxurious commodity was upheld to the concept for practical use. Upon the entries of three large LSMV companies, the automobile industry, for the first time, emerged as an organized industry. By this intervention, the automobile production was incorporated into the recursive system, i.e., the smooth incremental process mechanism. 	<ul style="list-style-type: none"> By this intervention, the previous policy orientation to the special military vehicles was broadened to the inter-ministerial national policy with the emphasis on the production of civilian-use vehicles. The nationalistic-minded MCI's policy initiative emerged and was established. Although the production of trucks & buses resumed the growth, the pattern of a rapid-stagnation was the same, thereby implying that the intervention operated merely to change the production level (initial conditions), not the internal incremental structure 	<ul style="list-style-type: none"> The auto industry was once again organized by the entry of Nissan and Toyota under the government control. The foreign assembly plants were eliminated by this law. The domestic production took over the predominant position in the net auto supply within a short period. By this law, the hitherto incremental mechanism to yield auto production was changed. And, the new mechanism started. 	<ul style="list-style-type: none"> This intervention affected both growth rate and production of all kinds of automobiles to decline in a parabolic form. However, the essential structures to incrementally yield both growth rate and production were not affected, and hence preserved the previous structures. The conflict between the government and the industry (particularly, Nissan) was first observed. MCI's leadership retreated, and was taken over by MOA, so that the policy orientation shifted from the industrial objective to the war objective.

FIFTH MAJOR INTERVENTION (THE CHQ CONTRACT: 1945 - c.1950)	SIXTH MAJOR INTERVENTION (THE REGULATION REGARDING CONVEYANCE OF FOREIGN VEHICLES: 1951)	SEVENTH MAJOR INTERVENTION (MITI'S GUIDELINE REGARDING FOREIGN TECHNICAL & ASSEMBLY CONTRACT FOR PASSENGER CAR PRODUCTION: 1952)	EIGHTH MAJOR INTERVENTION (MITI'S PEOPLES' CAR PLAN: 1955)
<ul style="list-style-type: none"> Japan was defeated in the Pacific War. The occupation lapsed; and the CHQ's political control of Japan began. 	<ul style="list-style-type: none"> The American used passenger cars were disposed to the taxi companies. These cars quickly occupied a majority of the supply market of passenger cars. Due to the Ministry of Transportation's unlimited licensing of taxi companies, the demand of passenger cars largely increased. 	<ul style="list-style-type: none"> The increasing fashion of ratifying the foreign technical contract to allow the Japanese producers to assemble foreign vehicles (in particular, passenger cars) 	<ul style="list-style-type: none"> The movement of the industrial rationalization
<ul style="list-style-type: none"> To give permission to reopen automobile production in consideration of the shortage of transportation and industrial materials 	<ul style="list-style-type: none"> Restrict foreign imports of passenger cars in order to protect the domestic producers 	<ul style="list-style-type: none"> To stop the unprincipled fashion of the technical contracts with foreign producers which would weaken the competitive position of the Japanese firms and foreign currency reserves 	<ul style="list-style-type: none"> To uphold the status of a passenger car from the currently recognized production goods (i.e., for the taxi and office use) to a consumer durable
<ul style="list-style-type: none"> With respect to the production scale of trucks and buses, no specific ceiling was determined by the CHQ. 500 units per year of small passenger cars with less than 1,500 cc engine 50 medium passenger cars (Toyota's prewar 1000s) 	<ul style="list-style-type: none"> Unidentified 	<ul style="list-style-type: none"> No specific numerical target, except for the so-called "11 items" of the foreign auto parts for complete naturalization (The number of assembly was proposed by the producers and scrutinized by the MITI.) 	<ul style="list-style-type: none"> 24,000 units per year
<ul style="list-style-type: none"> The CHQ (The Economic and Scientific Section (ESS)) 	<ul style="list-style-type: none"> The Ministry of International Trade and Industry (MITI) and the Ministry of Finance (MOF) 	<ul style="list-style-type: none"> MITI and MOF 	<ul style="list-style-type: none"> MITI
<ul style="list-style-type: none"> Material rationing (The same as the 4th intervention) Technical specification, i.e., the restriction of the engine size (The same as the 1st and 2nd interventions) Manufacturing license (The same as the 3rd and 4th interventions) 	<ul style="list-style-type: none"> Sales control (The same as the 3rd and 4th interventions) "Buy-Japanese" campaign (The same as 2nd intervention), i.e., mandatory use of the domestic passenger cars by public offices 	<ul style="list-style-type: none"> The technical contract with foreign companies was the MITI's general strategy at that time. This strategy was applied to other industries, too. 	<ul style="list-style-type: none"> Manufacturing license (The same as the 3rd, 4th and 5th interventions) Financial arrangement (The same as the 3rd and 7th interventions) Tax provisions (The same as the 3rd intervention) Technical standardization (The same as the 1st, 2nd, 5th, 7th interventions) Price control (The same as the 4th intervention)
	<ul style="list-style-type: none"> Import restriction by the quota allocation of foreign currency reserves (New) 	<ul style="list-style-type: none"> Contract licensing (New) Special revision of the allocation of foreign currency for the foreign technical contract (New) Technical specification of the parts for naturalization (New, but somewhat similar to the 1st intervention) 	<ul style="list-style-type: none"> Government selection of the single manufacturer (New)
<ul style="list-style-type: none"> The manufacturing licensing with respect to both production scale and the time to re-start the postwar production 	<ul style="list-style-type: none"> Import restriction to protect the domestic industry 	<ul style="list-style-type: none"> The government-backed technological ossillation policy 	<ul style="list-style-type: none"> The government-authorized manufacturing license by the single manufacturer
<ul style="list-style-type: none"> Due to the Korean War, the CHQ's regulatory policy shifted to the armament policy (i.e., the vast military procurement). 	<ul style="list-style-type: none"> Criticism by President Ichimeda of the Bank of Japan on MITI's stern import restriction Opposition by taxi companies and the Ministry of Transportation 	<ul style="list-style-type: none"> No specific disturbance occurred. 	<ul style="list-style-type: none"> This plan was leaked through the newspapers and became the serious political controversy debated at the Diet.
<ul style="list-style-type: none"> The existing firms formed several trade unions to politically lobby the CHQ for the relaxation of the regulations. Several producers started the manufacturing the 1,500-cc small passenger cars. Nissan introduced the "camouflage" passenger cars (mounting a passenger car body on the former Datsun truck-chassis) 	<ul style="list-style-type: none"> Several manufacturers started seeking technical contracts with foreign producers which included the assembly of foreign passenger car models. 	<ul style="list-style-type: none"> Nissan, Suzuki, Hino and Mitsubishi Toyota failed the negotiation with Ford, and hence decided to take the "pure-domestic" technology policy. 	<ul style="list-style-type: none"> The existing major producers unanimously opposed this plan. However, one firm which had no previous experience in auto manufacturing expressed its intention to produce the Peoples' Car. Toyota covertly started the R&D on the Peoples' Car.
<ul style="list-style-type: none"> All kinds of auto production ceased the growth decline and started the postwar growth. Due to the radical change of the trend from the declining inertia to the growing inertia, the incremental structures to yield both growth rate and production were completely changed. The new structure contained the damping oscillation in production. 	<ul style="list-style-type: none"> The net supply of passenger cars was kept constant for the period from 1951 to 1955. 	<ul style="list-style-type: none"> The production of passenger cars which was about to stagnate regained the exponential growth since 1954. This production of domestic passenger cars and the assembly of foreign passenger cars jointly caused an exponential growth of the net yields of passenger cars by the Japanese firms. Since the net supply level of passenger cars was held constant by the sixth intervention, the relative share of the domestic supply went up exponentially. 	<ul style="list-style-type: none"> The production of the mini passenger cars which had been made by several small inventive firms in a small scale since 1952 abruptly increased from the 0.5% level in 1955 to the 50% level in 1960 of the production of small vehicles.
<ul style="list-style-type: none"> This intervention operated to eliminate the wartime regulations imposed on the auto industry. The 1,500-cc passenger cars with which Japan today enjoys its superior position in the world export market originated from this intervention. However, the reopening permission caused the consistent damping oscillation in the production trends of all kinds of automobiles in the postwar era. The industry experienced the collective bargaining towards the intervention initiator with common interests. The Korean War procurement vitalized the industry. 	<ul style="list-style-type: none"> With respect to the nature of the import restriction, this intervention resembles the third intervention. However, the way to restrict imports by the quota allocation of foreign currency reserves was the new approach. The third intervention had both import restriction and production policy, while this intervention centered solely on import restrictions. The real impact of this intervention must be understood in conjunction with the next intervention. 	<ul style="list-style-type: none"> Coupled with the sixth intervention, this intervention made the same effect as that of the third intervention, i.e., the exponential take over of the supply market by the domestic products. The mandatory requirement of the application of the foreign technology to the domestic passenger models without the further royalty payment and the complete naturalization of the 11 items of the key foreign auto parts jointly helped the production of the domestic models increase exponentially. 	<ul style="list-style-type: none"> This intervention could not be implemented because of the strong opposition by the existing manufacturers for its strong resemblance to the prewar military intervention (i.e., the 3rd and 4th interventions). However, this intervention greatly encouraged several new small firms which had no prior experience in the large-scale auto production to enter into the auto manufacturing industry.

FIGURE VII-1

Summary Matrix of Historical & Numerical Intervention Analyses

intervention was able to terminate stagnated production, industry again faced a second stagnation. The increasing militaristic nature of government intervention due to the Manchurian Incident necessitated a strong intervention to solve simultaneously the current stagnation of the production of trucks and buses of military importance and the almost complete occupation of foreign cars in the auto supply market. Then, the most radical third intervention entered. Based upon the complete control of industry by this intervention, the military government exercised a wartime intervention to let industry participate fully in the war operation. The postwar shortage of motor vehicles as a means of transportation, aggravated by the wartime production decline, made the GHQ remove the reparation occupation of automobile plants at an early stage and finally grant the permission to reopen postwar production. The lack of R&D on passenger cars due to the wartime ban on the production of civilian passenger cars made it impossible for the auto industry to compete with foreign producers when the massive amount of American used passenger cars rapidly infiltrated the taxi market from the occupation force. Then, the sixth and seventh interventions entered to vitalize the production of domestic passenger cars, while the government halted further increase of foreign imports. After domestic production successfully took over foreign dominance, the government then arrogantly entered the eighth intervention, to create a new consumer durable market for the mini car. This is a brief scenario to be narrated along eight columns in Figure VII-1. Now, it is apparent that these eight major

interventions formed the cause and effect iterative cycles for nearly 60 years. Each new situation (the first row of the matrix) accelerated the speed and intensity of each intervention cycle.

(B) The Second Hypothesis: Government learns from past policy interventions to exercise subsequent new interventions.

1. Observation of Rows of the Matrix

To examine this hypothesis, we first look at each row of the matrix.

i) New Situation (1st Row)

The second column and the sixth column almost resemble each other. The vast amount of foreign cars abruptly entered into the Japanese market. The same "Buy-Japanese" campaign appeared 20 years later.

ii) Verbal Statement of Policy Target (2nd Row)

In the prewar period, there appeared a consistent policy target: i.e., the assurance of the domestic supply for military purposes. In the postwar era, this military objective was dropped; but the objective to guarantee the domestic auto supply was persistently preserved.

iii) Numerical Specification of Policy Target (3rd Row)

In most cases, the government's numerical specifications were unclear. But, with respect to the second, third, and eighth interventions, the targets were more or less met. As shown in FIGURE IV-9, the accomplishment of the targets was due to industry's spontaneous efforts which might not have been anticipated by the government. For example, the 5,000-unit-per-year level by 1935, expected in the course of the second intervention, was primarily contributed to by the large production of small cars. In the meantime, despite the fact that the eighth intervention failed to be implemented, mini-car producers attained the level of what MITI expected without much government help.

iv) Policy Initiator (4th Row)

Several ministries joined in the government automobile policy. However, it is clear that the inter-ministerial struggles for leadership are attributed to MCI (and MITI). This transition of political power coincides with the transition of the national emphasis on the kind of motor vehicles, i.e., from military trucks to civilian passenger cars through civilian trucks and buses for mass and cargo transportation.

v) Past Policy Learned and New Policy Instruments (5th and 6th Rows)

These rows vividly illuminate the increasing knowledge acquired by the government in successive policy interventions. Starting with the knowledge assimilated from foreign experiences, the government simultaneously used the old policy instruments and innovated the new ones.

vi) Nature of Intervention (7th Row)

The nature of intervention by the Japanese government over 60 years can be summarized as the direct control of industry by means of two powerful techniques, i.e., technical standardization and manufacturing licensing.

vii) External Disturbances (8th Row)

Despite some inter-ministerial conflicts (2nd, 3rd, and 6th interventions) and the leak of the government plan before announcement was made (8th intervention), no major external disturbances were observed. This fact facilitated government policy implementations.

viii) Observation of Reaction of Firms (9th Row)

Except for Nissan's vigorous opposition to the military government, the degree of compliance of auto producers with the government interventions was extremely high until the eighth intervention received unanimous opposition from the industry. This phenomenon is perhaps due to the fact that it was the government which established the industry; it helped the entries of the new firms, like Toyota; and it continuously stood by the producers' side. The industry's strong opposition to the eighth intervention marked the end of this long government-industry's honeymooning period.

ix) Numerical Policy Impacts (10th Row)

This row is a brief summary of the numerical analysis in PART II. It is thus true that each intervention (except for the fourth one) successively upheld the scale of production of all kinds of motor vehicles. But, we must also recognize that these interventions latently changed the internal structures of both the growth rate and production incrementing dynamics.

x) Assessment of Intervention (11th Row)

The eight major intervention operated in two areas, i.e., productive enhancement and the restriction of foreign supply, by

changing the public concept of an automobile, i.e., from an extravagant plaything, munitions, a means of public and cargo transportation, a taxi cab, to that of a consumer durable. The military recognition of the practical use of an automobile initialized the long-enduring government interventions, which no doubt characterizes the special situation of the Japanese automobile industry for more than 60 years since its inception. The history of this industry evidences the effectiveness of the government's goal-seeking to establish a domestic supply of automobiles even though the nation had constantly faced the danger of foreign occupation. But, the price paid for the policy effectiveness was the government's manipulation of the consumer market.

2. Examination of the Second Hypothesis

With respect to the question as to whether or not the Japanese Government learned from past policy interventions for exercising future interventions, the answer seems positive. The government constantly applies past precedents to the new intervention for managing the new situations. The pair of the sixth and seventh interventions and the eighth intervention itself, are the replicas of the third intervention. Furthermore, since transition from the second intervention to the third one was quickly carried out, and the similar import policy logic appeared in both third intervention and in the combination of the sixth and seventh interventions (in the different

instrumental disguises), the government had been a crisis-manager and goal-seeker not with random policy interventions, but with the deliberately-prepared interventions based upon past learning.

SECTION VII - 2

SUMMARY AND CONCLUSION

(1) A Non-Economic Policy Intervention Analysis

In 1972, the total production of the Japanese automobile industry (including the automobile manufacturing industry, the automobile parts manufacturing industry and the automobile body manufacturing industry) accounted for 27.5% of the total production of the nation's machinery industry (1). In this year, automobile exports accounted for 14.0% of the nation's total exports (2). The workers associated with the automobile industry (including those engaged in automobile sales, automobile part sales, automobile maintenance service, passenger transportation service and cargo transportation service) accounted for 6.2% of the nation's total work force in 1972 (3). These workers were nearly all dependent on domestic automobile production since, in 1972, foreign imports accounted for only 0.52% of the domestic production by volume (4). These facts no doubt demonstrate that the automobile industry has attained the key position in the Japanese industries.

International comparative data (5) show that the patterns of auto markets of countries become more and more similar to the U.S. pattern as real per capita income levels of these countries approached the U.S. level. The salient features of the U.S. auto market can be

characterized by two factors. First, the income elasticity of auto demand is low. This appears in the stagnation of the per capita automobile ownership (6). Second, the registration of new vehicles is greatly influenced by the business cycle. The first feature is explained by the empirical evidence that the high level of per capita income is generally associated with the low income elasticity of demand. The second feature is explained by consumer behavior on transitory income (i.e., a temporary deviation from the trend of permanent income). In the U.S., many consumers purchase durable goods rather than saving, then their transitory income rises because of the upsurge of the business cycle. An automobile is a good example of consumer durables of this sort. Since the upward trend of the business cycle also enhances the permanent income level, new car registrations (the new additions to stocks minus scrappage) sharply increase as the joint effect of both transitory and permanent income increases. When the downtrend of the business cycle starts, the transitory income level declines more sensitively than the permanent income, thereby decreasing new car registration. The fact that the auto markets of other countries become more and more similar to the U.S. pattern means that their markets become more and more influenced by economic factors. The above international comparative data show that the Japanese market entered this pattern in 1971 (6). Then the question arises: What were the major factors controlling the auto market in Japan before 1971? The present thesis was an attempt to provide an answer to this question from the viewpoint of a policy intervention analysis.

(2) Analytical Framework

First, we proposed a working model, which represented the conceivable steps the government might take in intervening in the auto industry. The basic hypotheses for this model were: 1) the government learns from the success or failure of the past policy interventions, and 2) the successively entering interventions form the cause-and-effect iterative cycles over time. Second, for applying this working model to the case of the Japanese government and the automobile industry, we adopted D.T. Campbell's quasi-experimental design as the general research framework to investigate the causal relationship between policy interventions and their impact on industrial performance. Instead of thoroughly examining all of the threats (i.e., the false conclusions on the cause/effect relationship with a single intervention case, and the false generalizations from one intervention case to the other) proposed by D.T. Campbell, we mainly focused on the history and maturation threats, because these two threats are the most crucial ones to which other threats are inter-related.

(3) The First Finding (History)

We found that the Japanese Government exercised eight major policy interventions to the automobile industry for the period from c. 1900 - c. 1960. These are:

- i) The Law Regarding Support for Military Vehicles of 1918, which was essentially the military procurement, and subsidy measure and which eventually functioned to create the organized industry of automobile manufacturing by eliminating small firms that existed before 1918, and by encouraging the entries of three large firms into the automobile manufacturing enterprise.

- ii) The Ministry of Commerce and Industry's Standard Model of 1932, which aimed to enhance the quality of domestic automobile models under public procurement to replace the overwhelming numbers of foreign cars from the Japanese market.

- iii) The Law Regarding Automobile Manufacturing Enterprise of 1936, which made the continuing operation of automobile assembly of two American subsidiaries in Japan illegal, and reorganized the industry by incorporating and creating two powerful manufacturers, Nissan and Toyota, under the government's reign.

- iv) The Wartime Control from 1939 to 1945 which regulated the automobile industry in almost all areas, such as in the specification of vehicle types to be produced, material rationing, price control, and even the management of companies.

v) The GHQ Control from 1945 to 1950, which eliminated all of the wartime government regulations, instituted the new regulation of the material rationing and controlled the decision of when to reopen postwar automobile production.

vi) The Regulation Regarding Conveyance of Foreign Vehicles of 1951, which aimed at stopping the rapid inflow of foreign used passenger cars into the taxi market through the channel of non-foreign currency transactions, by setting the quota allocation of foreign currency reserves.

vii) The Ministry of International Trade and Industry's Guidelines Regarding Foreign Technical and Assembly Contracts for Passenger Car Production of 1952, which assisted and controlled the technical contracts to assemble foreign vehicles, particularly passenger cars, by the Japanese firms.

viii) The Ministry of International Trade and Industry's People's Car Plan of 1955, which, although it failed, tried to create a large passenger car market at home and boost passenger car exports abroad.

(4) The Second Finding (Maturation)

We found that after the major interventions occurred, the maturation patterns (i.e., the trends of time-series data) of the related data (to the interventions) entered a new phase. These patterns were visually observed on the logarithmic scale. The observed correspondence between the major interventions and the maturation patterns is as follows:

- i) After the first major intervention, the previous randomly fluctuating production set forth smooth growth, but in a rapid-stagnation pattern.

- ii) After the second major intervention, the stagnated production (of trucks and buses) again started growing but soon saturated.

- iii) After the third major intervention, the saturated production of trucks and buses started growing more or less exponentially. However, the production of small passenger cars and trucks ceased the hitherto consistent growth and started declining. After this intervention occurred, the long-predominant share of the foreign supply in the total vehicle supply market started, for the first time, to decline.

- iv) During the wartime period when the fourth major intervention was in effect, almost all production started declining parabolically.

V) After the fifth major intervention, almost all production started growing again.

vi) Before the sixth major intervention, the foreign supply of passenger cars sharply increased. But after this intervention occurred, the share rate in the total vehicle supply declined, first gradually and later rapidly.

vii) After the seventh major intervention, the production of passenger cars which was approaching the stagnation pattern was revitalized and started an exponential growth pattern.

viii) After the eighth major intervention, the production of mini cars started growing with unprecedented high growth rates and quickly reached the 50% level of the small vehicle production.

(5) Linkage between History and Maturation

The further historical investigation of each major intervention made it clear that the above correspondence between the interventions and the maturation changes is not a mere coincidence but a causal consequence for the following reasons:

- i) The first major intervention created three major automobile manufacturers whose production accounted for nearly all of the nation's vehicle production at that time. The complication of the government's technical specification did not further increase the purchasers of the products of these companies despite the purchase subsidy given by the government.

- ii) The second major intervention guaranteed the public procurement of the MCI Standard Model cars. The financially-ailing above three companies could borrow the advancement of bank loans upon the government procurement order. However, the policy shift to a different size car of two primary procuring agencies, the Ministry of Railroad and the Ministry of Army discouraged the production of the MCI Standard Model cars.

- iii) The third major intervention replaced the existing manufacturers by two new large producers, Nissan and Toyota, with the government mediation over the financial assistance from the major banks.

- iv) The fourth major intervention forced the industry to engage in different manufacturing, i.e., the production of weapons and aircraft engines. It restricted the material allocation for automobile production and banned the production of civilian passenger cars.

- v) The fifth major intervention eliminated all wartime restrictions and allowed the manufacturers to start automobile production but under the condition that they limit the production scale.
- vi) The sixth major intervention instituted the strict quota allocation system of foreign currency for the purchase of foreign cars.
- vii) The seventh major intervention permitted auto producers to ratify the technical contract with foreign producers only if it included the manufacturing license and the naturalization of auto parts.
- viii) The eighth major intervention was not realized. However it encouraged small firms which had no experience in large-scale automobile manufacturing to enter into the automobile industry with a mini car.

(6) The First Conclusion

From both historical and numerical facts, we conclude that the major government interventions operated to change the maturation patterns of automobile production and foreign supply.

(7) Dynamic Analysis of Intervention Impacts

Based upon this conclusion, we went further to investigate how

these major interventions affected industry and the auto supply market by analyzing the structural changes in the dynamic trends of production data and foreign supply data. For the structural analysis of the impact on production, we employed the assumption that the past state of the growth rate incrementing mechanism and production incrementing mechanism were preserved, even when the sharp change of the data trends occurred. In other words, we assumed that the Japanese automobile industry had grown based always on the past achievements of productive performance. For the structural analysis of the impact on the supply market, we assumed that foreign supply (imports plus assembly) was controlled on the basis of neither the market demand nor the condition of foreign currency reserves, but the nationalistic desire to eliminate foreign dominance from Japan.

(8) The Second Conclusion

As long as production drew a smooth curve (whatever is is), the state of the industry was stable. When, the unprecedented radical change occurred in the growth rate, the current stable state terminated and the new stable state began. However, this new stable state had a lower incremental factor to determine the growth rate, so that production got stagnated sooner than the previous state. When such a radical change frequently occurred, the industry eventually entered into the state of an unstable damping oscillation of production. Therefore, if policy intervention tries to affect the

growth rate of production, it should be one which gradually changes the growth rate incrementing mechanism. Otherwise, the policy will create a lower factor to increment the growth rate, or lead production into an unstable damping oscillation. Among eight major interventions by the Japanese Government, the third intervention made the most profound impact on the state of the growth rate incrementing mechanism. It lowered the incremental factor of total vehicle production. It led the production of trucks and buses into an unstable state. However, it made little impact on the growth rate incrementing mechanism of passenger car production. Large fluctuations in production during the fifth intervention caused the origin of the consistent damping oscillation in postwar automobile production. Relatively speaking, other interventions made less impact on the growth rate incrementing mechanism.

The dynamic trends of the automobile production evolved with two components: 1) the incremental factor to draw the current production up from the past production scale, and 2) the potential level to support the current production scale. When a radical change in production occurred taking off the stagnation or decline, the potential level was sharply upheld and the incremental factor started gradually changing to catch up with the increased growth rate. In this regard, the third intervention operated to improve the incremental factor rather quickly. In particular, it radically improved the incremental factor of the truck and bus production. The

fifth intervention also improved very fast. However, other interventions did not make a significant impact on the incremental factor. They operated only to change the potential level.

(9) The Third Conclusion

With respect to the impact on the auto supply market, we conclude that the third intervention and the pair of the sixth and seventh interventions operated identically. They helped domestic production eliminate foreign dominance from the supply market within a short period, by not sacrificing the total supply level. These interventions intentionally chose the pattern of less developed countries according to Raymond Vernon's model on international investment and trade, i.e., at the expense of suppressed consumption.

(10) The Fourth Conclusion

With respect to the hypotheses for the working model, they are generally valid as long as the case of the Japanese government's interventions to the automobile industry is concerned. The government learned the successes and failures of past policy interventions and later applied them to similar situations. Since the industry was greatly affected by government interventions, the government exercised the next intervention based on the reactions of industry to the previous intervention. Therefore, the multiple interventions formed the cause/effect iterative cycles.

11) Policy Suggestions

To learn of not to learn the Japanese experience in the establishment of the automobile industry rests on an individual country's own judgement. If it intends to learn and apply it to its own industry, not necessarily the automobile industry the following guidelines are perhaps of some help.

i) To make a typological formula of the relationship between policy instruments and their observed functions from foreign experiences is necessary, but not sufficient. Such a structural-functionalistic approach gives little practical information for actual policy implementation since the function of policy intervention is conditional: i.e., policy intervention operates in a particular environment. In the case of the Japanese automobile industry, the environment included the existence of immature and fragile firms as compared to overwhelming foreign competitors, strong political power bestowed in government, strong nationalism over economic and market rationality, nationalistic, highly-qualified manpower on the decision-making level, government and industry having the keen interest in technical assimilation, public tolerance of market supply shortages, and of low quality domestic products until the government relaxes the market control, etc.

ii) In developing countries, the market at the early stage is normally shaped by foreign imports. Domestic production comes later. However, reflecting the immaturity of industry, domestic production naturally becomes stagnated. Unless a proper measure is taken to let domestic production escape from this stagnation, the market will eventually become occupied by foreign imports. The Japanese experience simply demonstrates that the coexistence between domestic products and foreign imports is difficult when domestic production is immature and hence can only produce low quality products. In this situation, the government can take at least two approaches. First, help domestic production grow once again by employing every possible measure like subsidy, procurement, technical standardization, financial arrangement, tax provision, technological contracts to include both manufacturing license of foreign brands and complete naturalization of foreign parts. But, most importantly, the government should not intervene too much to radically alter the current state of production. A Strong intervention would lead industry into an unlabel state. Second, once domestic production starts growing in an exponential pattern to indicate that industry's own productive performance is improving, then foreign supply should be suppressed to maintain the total supply level. When takeover is completed, the suppression should be relaxed in order to minimize the sacrifice on the demand side. The way to control foreign supply ranges from a radical measure---such as the promulgation of a law to ban foreign

operation ---to a moderate one---such as the quota rationing of foreign currency stressing the national shortage of currency reserves. The tariff measure should not be heavily relied upon. It is sometimes an ineffective approach since, despite the high tariff barrier, foreign products ultimately infiltrate the market to fill the strong market vacuum if the net supply level is well below the demand level. The sharp difference in quality between advanced foreign products and "shoddy" domestic ones cancels the demerit of higher prices for foreign products. Furthermore, once consumers have established the behavior to prefer foreign products, it is hard for domestic industry to develop and enhance the quality of its products to satisfy those consumers. Therefore, if a country in fact wants to establish its own new industry, action must be taken before the situation becomes too serious to ameliorate.

(12) Orientation for Future Research

Since we analyzed the above case with a particular focus and by a particular approach, our conclusion remain tentative until further research will be conducted to compensate for the shortcomings of the present research. The orientation for future research must include:

Framework

An extension of research to different industries in Japan or foreign countries in order to comply with D.T. Campbell's external validity question.

Data

- i) A more comprehensive historical investigation by an interview survey of what happened in each firm after the interventions occurred.
- ii) A numerical data collection of interventions such as the time-series changes of subsidy, tax credits, grant-in-aids, etc., so as to let the analysis in CHAPTER V become a formal input/output dynamic optimal control problem.

Model

- i) A sophistication of the difference equation models in CHAPTER V, by incorporating more time-lag terms and by introducing more rigorous statistical assumptions.
- ii) A validation check of the initial conditions we used for the Kalman Filter analysis, by specifying different conditions.
- iii) An examination of the proper economic theory to be adopted for the dynamic models for a formal Kalman Filter analysis whose state and output equations are not the "noise" models but contain substantial as well as theoretical meanings.

APPENDIX 1

MATHEMATICAL BASES FOR THE PATTERN RECOGNITION OF THE FOUR BASIC CURVES FROM SEMI-LOGARITHMIC GRAPHS AND THEIR STRUCTURAL IMPLICATIONS IN TERMS OF APPROXIMATED FIRST-ORDER DIFFERENCE EQUATIONS

1. Semi-Logarithmic Data Plotting and Graphical Identification of Four Basic Growth Patterns

a) Exponential Growth Curve

Needless to say, this is the most common pattern in any growth observations. It simply depicts a rapid increase in value of any arbitrary data variable. A conventional form to express exponential growth is:

$$(1.1) \quad y(t) = ca^t$$

where c is an initial value $y(0)=c$, and a is greater than 1. Taking logarithm on both sides of Eq(1.1) gives

$$(1.2) \quad \log(y(t)) = \log(c) + \log(a)t,$$

which indicates a linear curve on a logarithmic scale with $\log(c)$ as a vertical axis intercept when $t=0$ and $\log(a)$ as a slope of this line. Numerical examples for Eqs(1.1) and (1.2) are shown in FIGURE AI-1 (a).

b) Linear Growth Curve

If a linear trend in a data variable is observed, we may conjecture that it might have a structure of the form

$$(1.3) \quad y(t) = at + b$$

where a is a positive slope and b is a vertical axis intercept of positive value. On a semi-logarithmic scale, Eq(1.3) behaves as

$$(1.4) \quad \log(y(t)) = \log(at + b).$$

As shown in FIGURE AI-1 (b), the plot of Eq(1.4) looks like the upper-left part of an oval.

c) Rapid-Stagnation Growth Curve

The behavior of this growth curve is somewhat similar to that of the first half of a parabolic growth pattern. The crucial difference

is the fact that this curve never reaches a ceiling but tends towards it as time tends to infinity. The conventional expression for a rapid-stagnation curve is [1]

$$(1.5) \quad y(t) = y^* - ca^{-Tt}$$

where y^* , c , a and T are all positive constants. Eq(1.5) shows that as t increases $y(t)$ tends towards a saturation value y^* . How fast it reaches this value (i.e., "stagnates") depends upon the value of T . The greater this value, the faster it approaches y^* . If we assume that $c=y^*$, $T=1$ and a is less than 1, we can simplify Eq(1.5), without losing the basic behavioral pattern of this curve, as

$$(1.6) \quad y(t) = y^*(1 - a^t).$$

The semi-logarithmic behavior of Eq(1.6) such as

$$(1.7) \quad \begin{aligned} \log(y(t)) &= \log(y^*(1 - a^t)) \\ &= \log y^* + \log(1 - a^t) \end{aligned}$$

is also similar to that on an ordinary cardinal scale as shown in

FIGURE AI-1 (c).

d) Parabolic Growth Curve

This curve has the following behavioral pattern:

- i) in the initial period, growth is very fast,
- ii) but later on growth becomes ever slower until it reaches a saturation point.
- iii) after it is saturated, values decline first gradually and then very fast.

The above behavior is best illustrated by the form

2

$$(1.8) \quad y(t) = at + bt + c$$

where a has a negative value allowing an upwardly convex parabola and c is the initial value at $t=0$. This second-order time function becomes

2

$$(1.9) \quad \log(y(t)) = \log(at + bt + c)$$

on a semi-logarithmic scale, and its shape can still be identified as

a parabola, though in a flatter mountain shape due to logarithmically "shrunk" values in the peak region. The trajectories of Eqs(1.8) and (1.9) are illustrated in FIGURE AI-1 (d)

2. Growth Rate Curves for Structural Identification

In looking at growth curves, we will concentrate on four basic patterns which have very important structural implications. Practically speaking, the identification of either an exponential or a parabolic growth curve is rather easy because each has a distinct shape even on a semi-logarithmic scale. However, as one may see from FIGURE AI-1 (b) and (c), it is fairly difficult to visually differentiate linear growth and rapid-stagnation curves on a logarithmic scale. An effective method is to use a growth rate curve. Now let us discuss the relationship of a growth curve and the corresponding growth rate curve.

a) Growth Rate of Exponential Growth Curve

Again, using a continuous function to simplify the discussion, the growth rate of Eq(1.1) becomes

$$(2.1) \quad \frac{dy(t)}{dt} = c(\ln a)a^t,$$

which yields a similar exponential curve to that of Eq(1.1) as shown in FIGURE AI-2 (a), but "shrunk" by a factor of $\ln 2$.

b) Linear Growth Curve

Differentiating Eq(1.3) yields

$$(2.2) \quad dg(t)/dt = a.$$

Then, the corresponding growth rate curve of a linear growth trend in $y(t)$ is a horizontal line at a level a which is, of course, the slope value of $y(t)$.

c) Rapid-Stagnation Growth Curve

Differentiating Eq(1.6), we get

$$(2.3) \quad \frac{dy(t)}{dt} = -y^t \cdot (\ln a) a$$

Since $\ln a$ is negative (Note: a is less than 1), Eq(2.3) is a downward exponential curve starting at $-y*(\ln a)$ when $t=0$.

d) Parabolic Growth Curve

The first derivative of Eq(1.8) is

$$(2.4) \quad dy(t)/dt = 2at + b,$$

giving a simple linear trend in a growth rate curve.

These four growth rate patterns are illustrated in FIGURE AI-2, using the same numerical examples as those in FIGURE AI-1. In fact, the visual difficulty in separating a linear growth pattern on a logarithmic scale from a rapid-stagnation growth trend is easily solved if one examines the corresponding growth rate curves. The former has a constant growth rate curve, while the latter has an exponential downward trend in growth rate.

3. Growth and Growth Rate Curves in Discrete Data Cases and
Approximations by Simple Difference Equations for Structural
Interpretation

In the previous discussion, we have assumed a continuous function for a data variable for the simplicity of our argument. However, the data we will actually plot are hardly continuous but discrete. In addition, most data we will look at are those collected on an annual time basis, which implies that they are aggregated or accumulated for each year. In a mathematical sense, it is something like

$$Y(i) = \int_{t=i-1}^{t=i} y(t)dt$$

where t is defined as a continuous variable, while i is a discrete one, meaning the number of years which defines a discrete variable $Y(i)$. It should be noted that our plotted data can be on the continuous growth curves we have discussed in the previous part, although there is no definition as to values between two plotted data. Therefore, the differentiability question within those interval regions arises.

In this part, we will discuss how we convert the previous four growth patterns expressed in a continuous form into the simple discrete counterparts.

a) Exponential Growth Curve in Discrete Form

Now let us consider the conventional definition of the growth rate such that:

$$(3.1) \quad (y(t+1) - y(t)) / y(t) = g(t+1)$$

where $y(t)$: discrete value at time t (hereafter,
variables t and y are discrete)
 $g(t+1)$: growth rate at time $t+1$.

Eq(3.1) is rewritten as a first-order homogeneous difference equation such that:

$$(3.2) \quad y(t+1) - (1+g(t+1))y(t) = 0.$$

If the annual incremental growth rate $g(t)$ remains a constant value, e.g., g , over time, Eq(3.2) is a constant-parameter difference equation, of which the general solution is known as:

$$(3.3) \quad y(t) = c(1+g)^t$$

where c is an initial condition to be set when $t=0$, such that

$$(3.4) \quad c = y(0).$$

As is evident, Eq(3.3) is identical to Eq(1.1) of an exponential growth curve. Therefore, if we confidently believe that a data trend on a semi-logarithmic scale is linear, we analogously believe that this trend has a latent structure such as Eq(3.2), with a constant growth rate g . This implies that the annual growth rates of this trend form a horizontal line as shown in FIGURE AI-3 (a).

b) Linear Growth Curve

The structure of linear growth is identical to Eq(1.3), except that both variables y and t are discrete. However, the discrete growth curve is quite different from Eq(2.2), as discussed below.

Substituting Eq(1.3) into Eq(3.1), we get

$$\begin{aligned} (3.5) \quad g(t+1) &= (a(t+1)+k) - at+k)/(at+k) \\ &= a/(at+k) \\ &= 1/((at+k)/a) \\ &= 1/(t + k/a). \end{aligned}$$

Then,

$$(3.5') \quad g(t) = 1/(t + (k/a-1)).$$

Eq(3.5') simply means a hyperbola, starting at $a/(k-a)$, when $t=0$.

Therefore, if our annual growth rate curve looks like a hyperbola, we

;

may conjecture that its original growth trend might be linear. Note that, in a linear growth trend, an annual growth rate decreases sharply as time goes on, as illustrated in FIGURE AI-3 (b).

c) Rapid-Stagnation Growth Curve

Consider the following recursive system:

$$(3.6) \quad y(t+1) = ay(t) + k, \text{ or}$$

$$(3.7) \quad y(t+1) - ay(t) = k.$$

Eq(3.6) simply means that the value at $t+1$ is determined by a ratio of the previous value $ay(t)$ plus a constant level value k . This dynamic process differs from that of Eq(3.1), which indicates an incremental increase in the growth ratio every year. Eq(3.7) is a first-order constant-parameter heterogeneous difference equation whose general solution is:

$$(3.8) \quad y(t) = ca + \nabla^{t-1} (k/a)$$

$$\begin{aligned}
 &= ca + k \frac{1 - a^{-t}}{1 - a^{-1}} \\
 &= ca + k \frac{1 - (1/a)^t}{1 - (1/a)} \\
 &= ca + k/(1-a).
 \end{aligned}$$

It is a reasonable assumption that the value in $y(t)$ starts with k when $t=0$, i.e., $y(0)=k$. Substituting this initial condition into Eq(3.8), we get:

$$(3.9) \quad c = -ak/(1-a).$$

From Eqs(3.8) and (3.9), the behavior of $y(t)$ finally becomes

$$\begin{aligned}
 (3.10) \quad y(t) &= (k/(1-a))(1 - a^{-t}) \\
 &= y^*(1 - a^{-t})
 \end{aligned}$$

where $y^*=k/(1-a)$. If a is less than 1, it is obvious that Eq(3.10) approaches a convergence value $y^* = k/(1-a)$. This y^* can also be known by the following logic. Assuming that the dynamic process has already reached such a convergence value, we can write

$$y^* = ay^* + k,$$

which yields: $y^* = k/(1-a)$.

Structurally speaking, Eq(3.10) has an equivalent behavior to that of Eq(1.6). Thus, it is highly likely that the process has such a dynamic discrete structure as expressed in Eq(3.6) if one observes a rapid-stagnation growth curve.

Substituting Eq(3.10) into the definition of the incremental growth rate Eq(3.1), we get

$$(3.11) \quad g(t+1) = (y(t+1) - y(t))/y(t) = (1-a)/(a^{-t} - 1)$$

Then,

$$(3.11') \quad g(t) = (1-a)/(a^t - 1)$$

Eq(3.11') indicates that the annual growth rate decreases exponentially as shown in FIGURE AI-3 (c).

d) Quasi-Parabolic Growth Curve

Substituting Eq(1.8) into Eq(3.1) yields:

2

$$(3.12) \quad g(t+1) = (2at+a+b)/(at + bt + c)$$

Then,

2

$$(3.12') \quad g(t) = (2at+3a+b)/(at + (2a+b)t + a + c).$$

By calculating the first and second derivatives, we know Eq(3.12') behaves as a third-order function as shown in FIGURE AI-3 (d).

Practically, this figure can be numerically drawn from FIGURE AI-1 (d). Comparing it with the continuous growth rate curve in FIGURE AI-2 (d), one might have known that the discrete version of growth rates for a parabolic growth pattern is no longer linear but, more complicated in its shape.

As attempted in the previous cases, our primary interest is to identify a basic growth pattern in terms of a simple and easily interpretable first-order difference equation. Now, let us consider how to express a parabolic growth curve, or one which possesses the basic properties of a parabola, by a simple difference equation.

Keep in mind that the first derivative of a parabolic curve is linear for a continuous function as shown in Eq(2.4). Our strategy is simply to apply this linear trend in growth rates for a discrete case. In fact, if a hypothetical discrete linear growth rate curve is an

approximation of the above third-order function for a continuous growth rate curve, it would be possible to obtain a quasi-parabola in a simple first-order difference equation.

In the first place, we propose the following discrete dynamics

$$(3.13) \quad g(t) = at + b$$

where

i) a is negative, and

ii) $g(t)$ varies between -1 and b .

$$(3.14) \quad (y(t+1) - y(t))/y(t) = g(t+1).$$

Substituting Eq(3.13) in Eq(3.14) yields the following variable-parameter homogeneous difference equation:

$$(3.15) \quad y(t+1) - A(t)y(t) = 0 \quad \text{where}$$

$$(3.16) \quad A(t) = g(t+1) + 1 = at + a + b + 1.$$

Then, the general solution of Eqs(3.15) and (3.16) is

$$(3.16) \quad y(t) = c \prod_{i=0}^{t-1} A(i)$$

$$= c \prod_{i=0}^{t-1} (a_i + a + b + 1)$$

FIGURE AI-4 illustrates the results we have obtained using the above method. The constraints in specifying the parameters of Eq(3.13) are important. They must meet the following conditions:

$$(3.17) \quad g(t_1) = 0,$$

$$(3.18) \quad g(t_2) = -1.$$

t_1 in Eq(3.17) is the time at which growth stagnates. t_2 in Eq(3.18) is the time at which value in $y(t)$ becomes zero. As shown in the figure, the original growth curve becomes a bell-shape rather than a parabola. However, the logarithmic trend forms a perfect parabola. Hence, if a parabolic growth pattern on a logarithmic scale is observed, there would be two possible interpretations. One is a perfect parabolic dynamic with a non-linear discrete growth rate curve. The other is a bell-shape dynamic with a linear discrete growth rate trend.

FIGURE A1-1(continued)

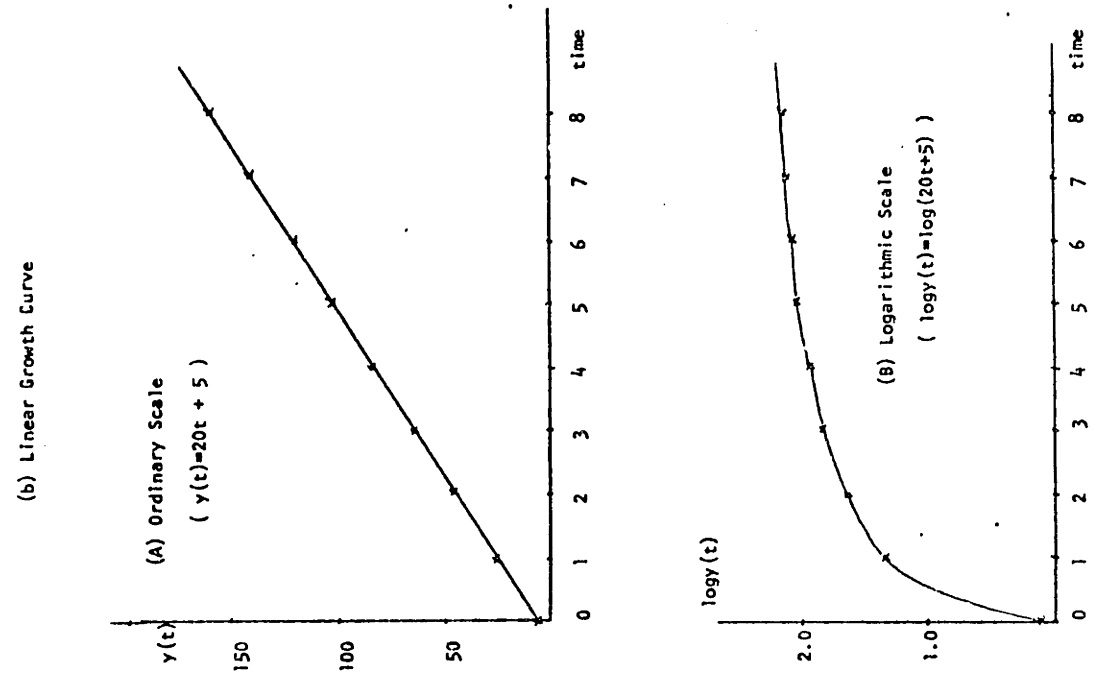


FIGURE A1-1
Behaviors of Four Basic Growth Patterns on Ordinary Scale and Logarithmic One

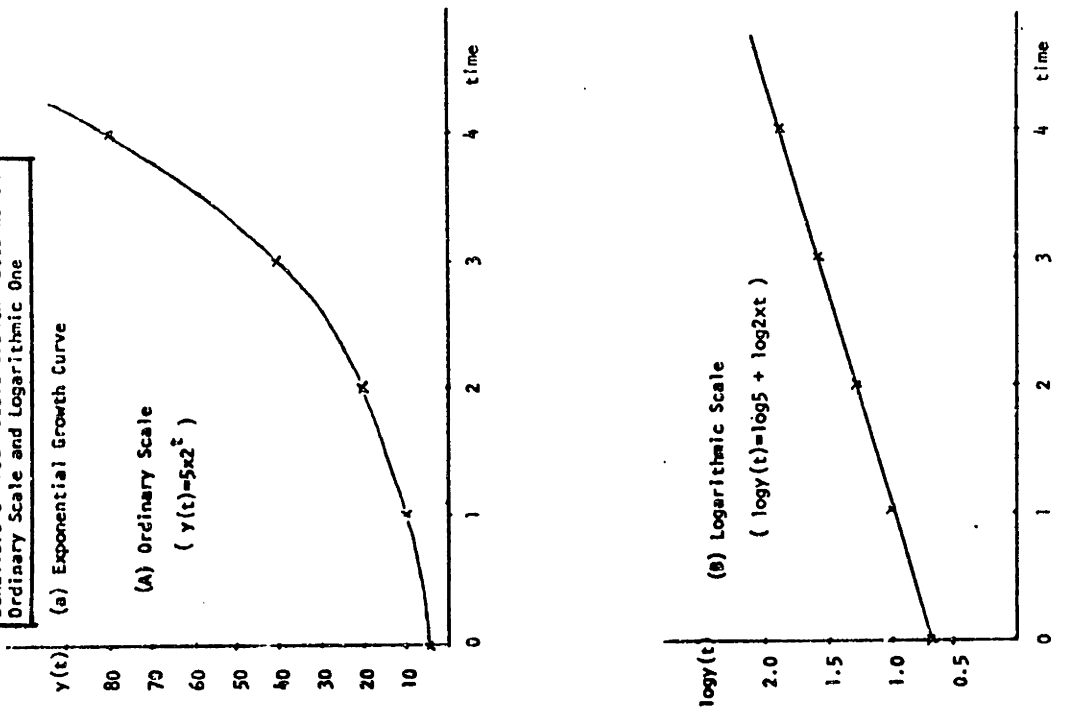


FIGURE A1-1 (continued)

(c) Rapid-Stagnation Growth Curve

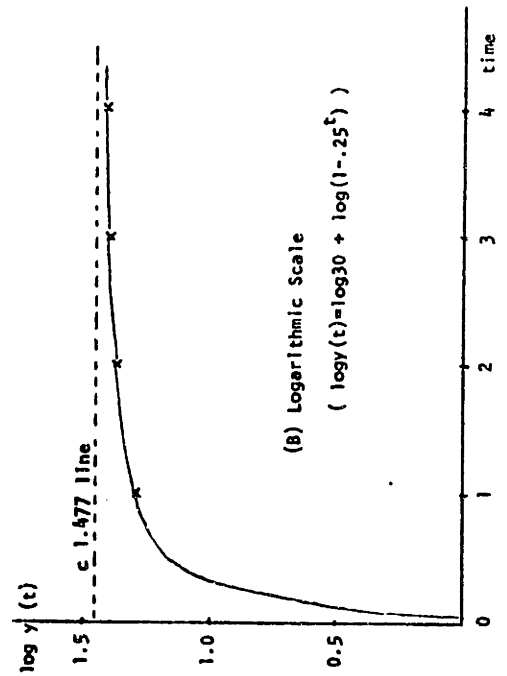
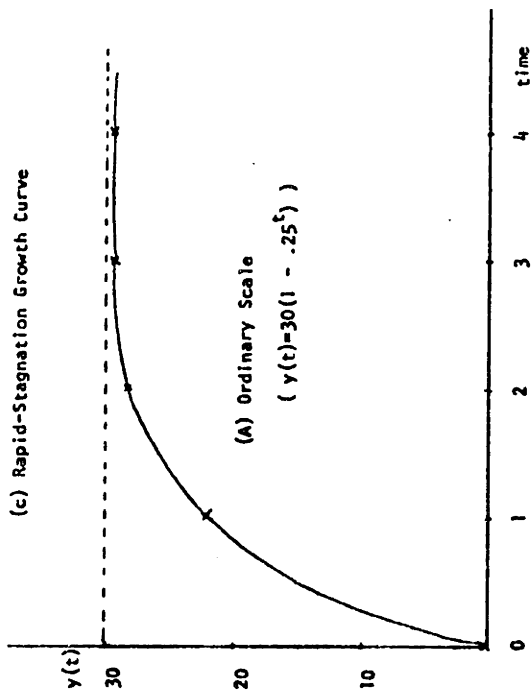


FIGURE A1-1 (continued)

(d) Parabolic Growth Curve

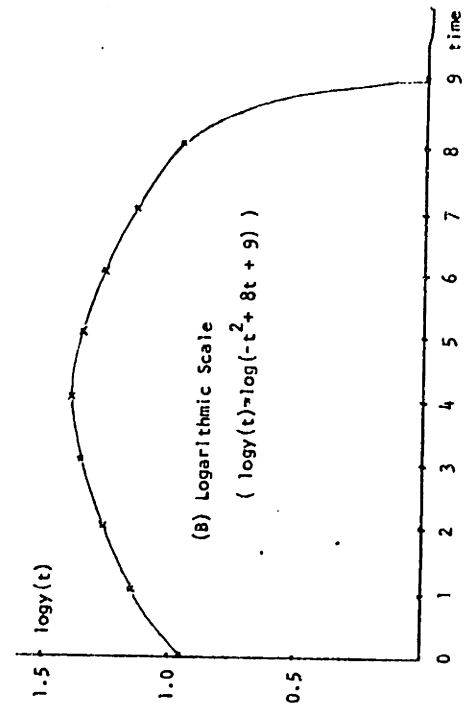
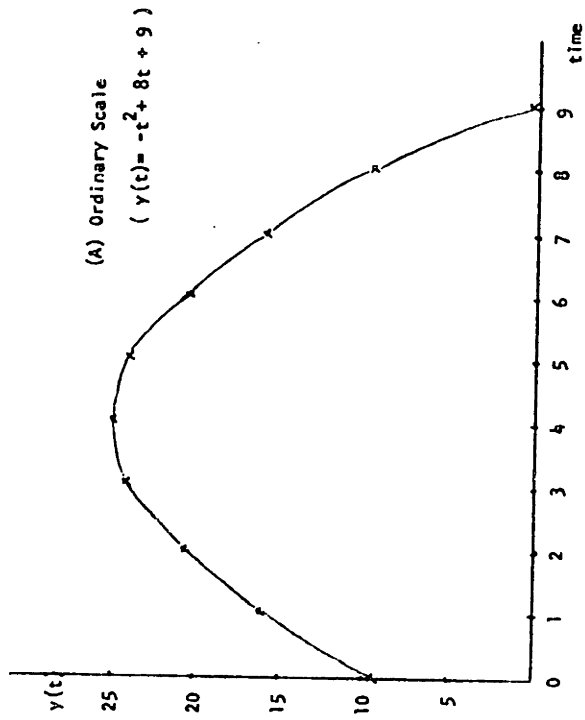


FIGURE A1-2 Continuous Growth Rate Curves of Four Basic Growth Patterns

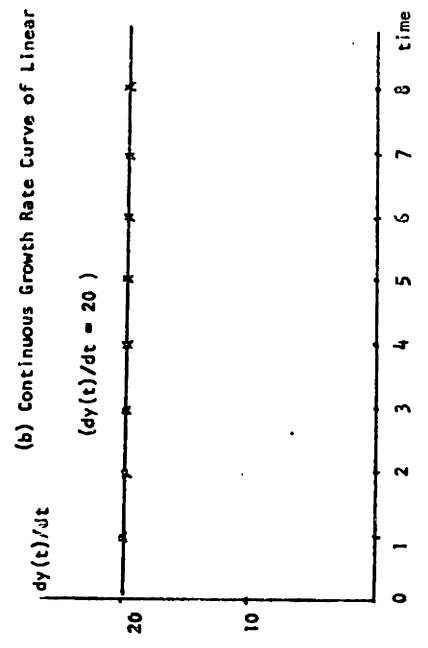
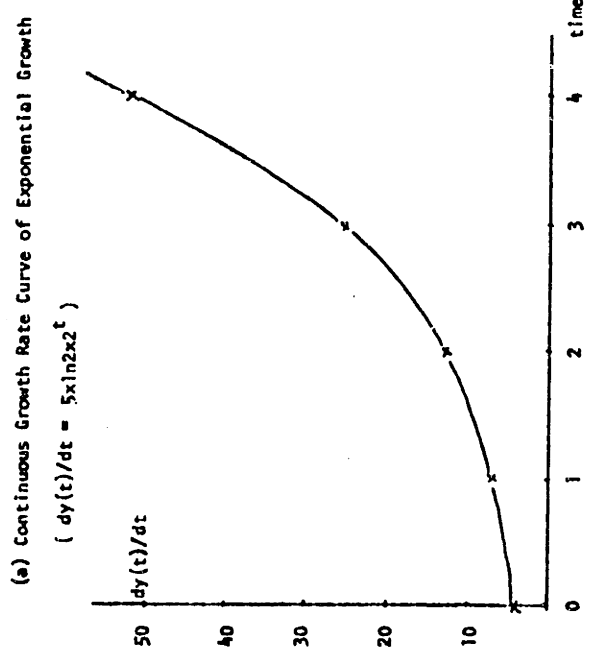


FIGURE A1-2 (continued)

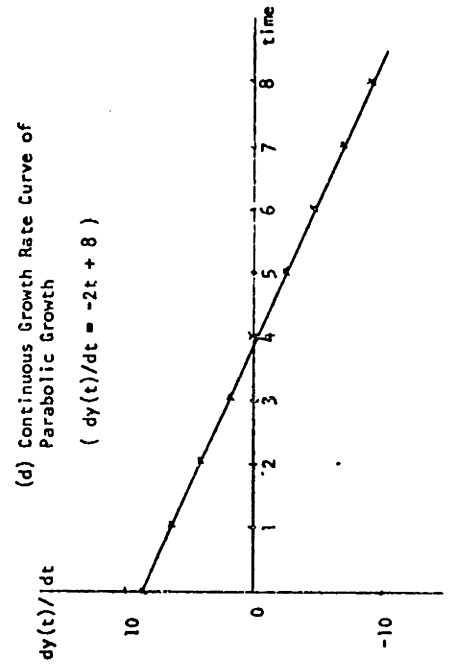
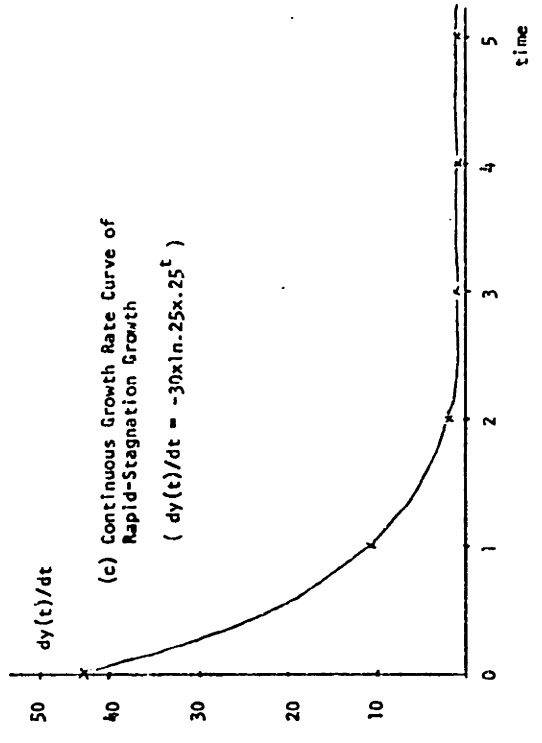


FIGURE A1-3 Discrete Growth Rate Curves of Four Basic Growth Patterns

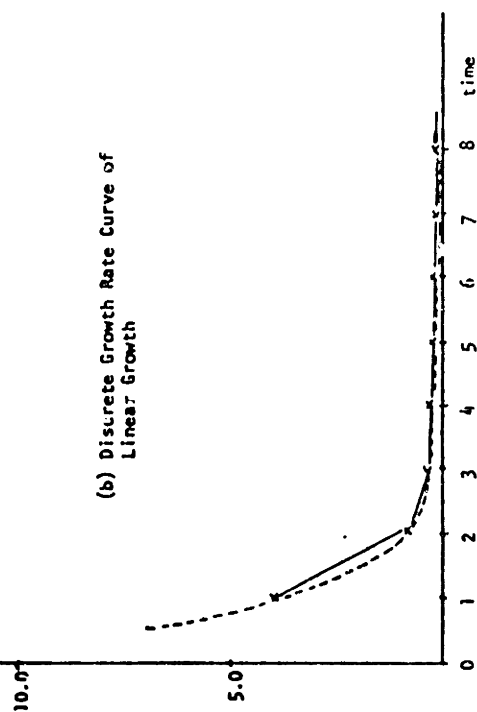
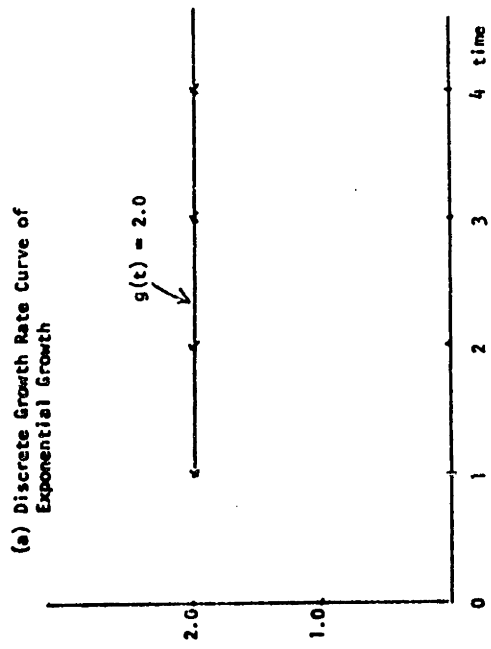


FIGURE A1-3 (continued)

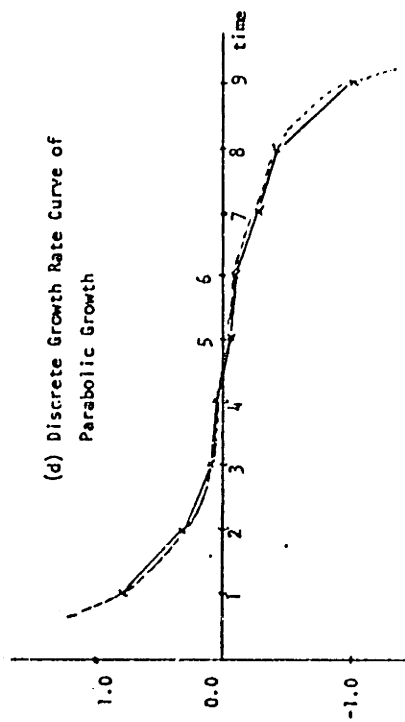
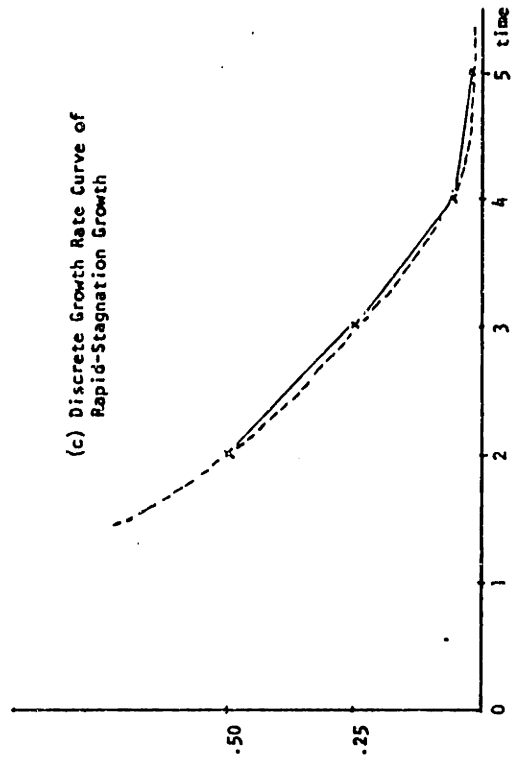


FIGURE A1-4 Fitting of a First-Order Time-Variant-Parameter Difference Equation into a Parabola

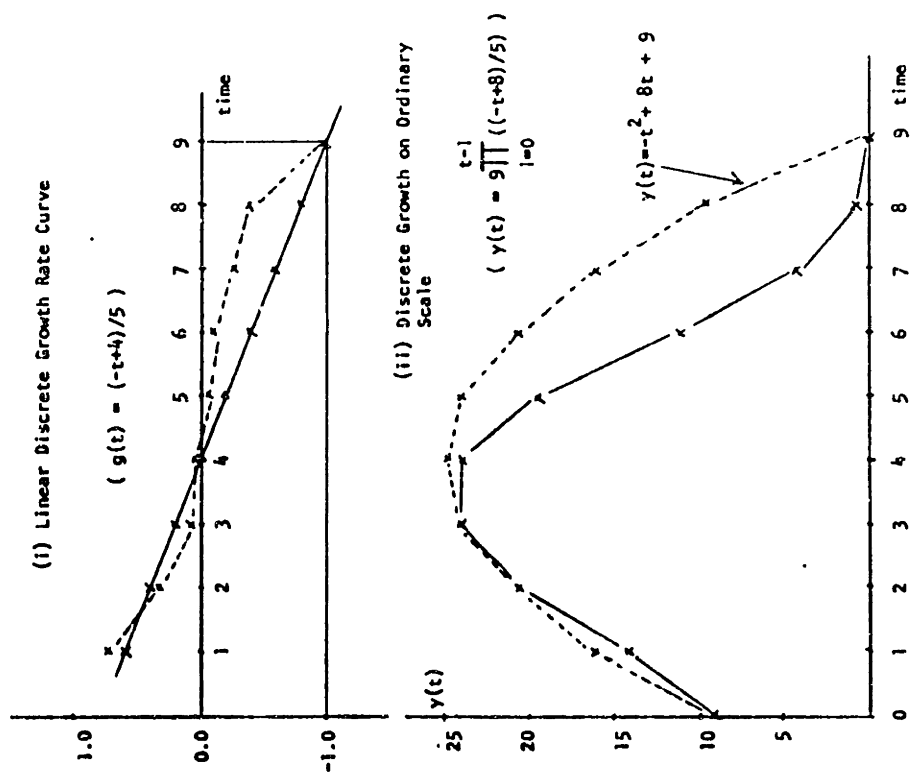


FIGURE A1-4 (continued)

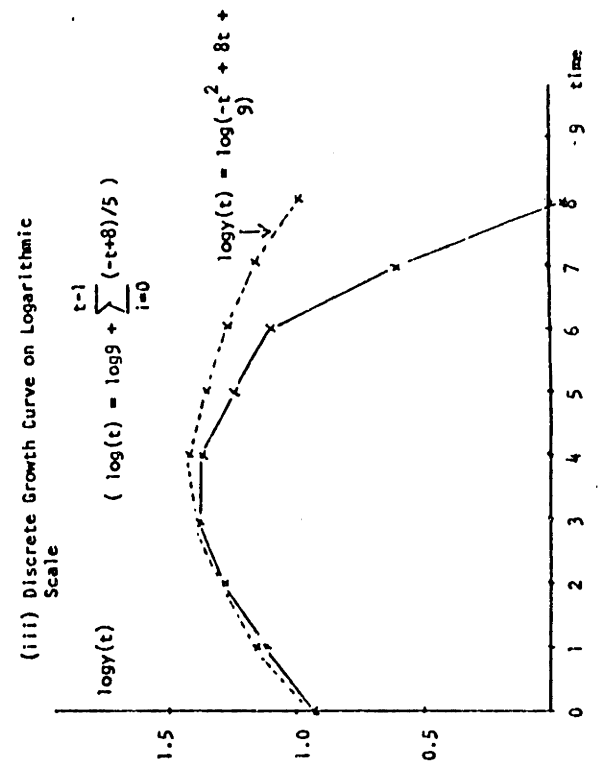


FIGURE A1-5

Least-Square Fitting of Discrete Growth Rate Curve for Parabolic Growth Curve

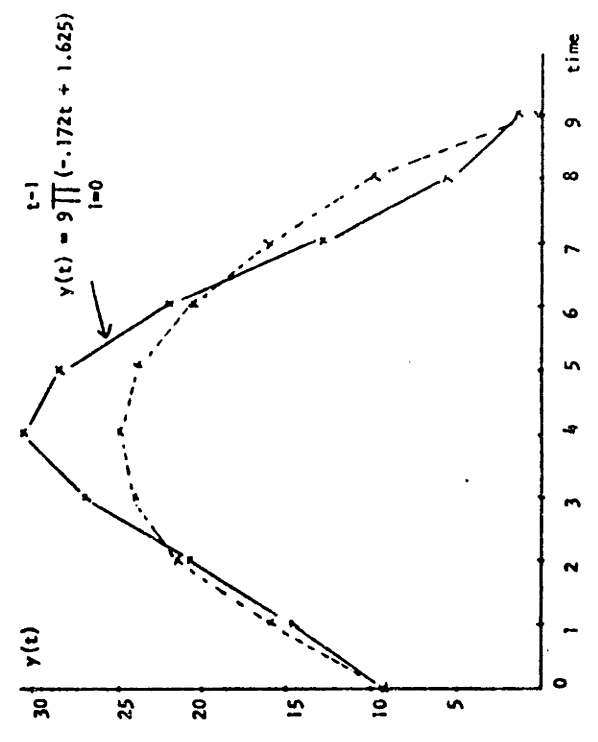
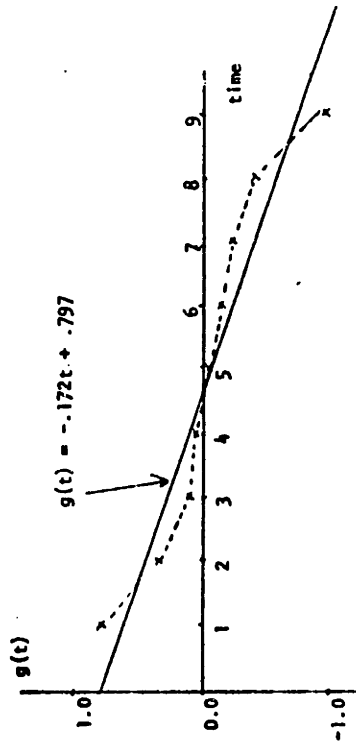
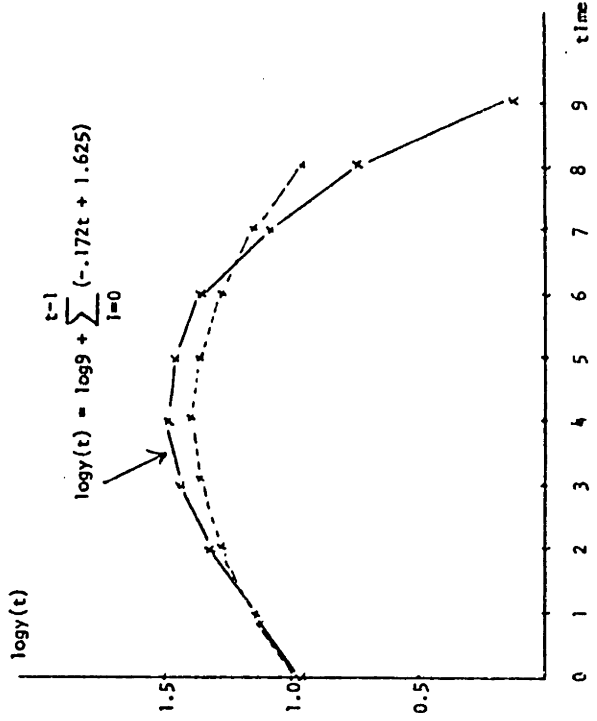


FIGURE A1-5 (continued)



APPENDIX 2

DATA BASE

This research has encountered many problems of data gathering. Among these, the most difficult was the problem of categorical inconsistency between prewar and postwar data publications, perhaps reflecting the transition of the organizations publishing automotive data. In addition, the data are inconsistent between different organizations, such as the Ministry of Commerce, Ministry of Transportation, the Japan Automobile Manufacturers Association, etc. However, our best effort to organize these data through long and hectic investigations by a desk calculator results in the following tables. Growth rates are not listed here because of space constraints. The reasons for presenting data in this appendix, rather than in the main text of the thesis have already been stated in CHAPTER I.

TABLE 1: PREWAR PRODUCTION BY TYPE:

Column 1: Trucks and Buses
 Column 2: Medium-Size Passenger Cars
 Column 3: Small-Size Passenger Cars and Trucks
 Column 4: Total of 4-wheel Vehicles (Sum of Cols. 1, 2, 3,)
 Column 5: Tricycle Motor Cars
 Column 6: Total of 4-Wheel and Tricycle Cars (Sum of Cols. 4 and 5)

Year	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
1907				12		
1908				3		
1909				5		
1910				6		
1911				5		
1912				6		
1913				no data		
1914				no data		
1915				no data		
1916				no data		
1917				no data		
1918				no data		
1919				12*		
1920				49*		
1921				28*		
1922				no data		
1923				5*		
1924				161*		
1925				127*		
1926				245*		
1927				302*		
1928				433*		
1929				432*		
1930	458			458	300	758
1931	434		2	436	552	988
1932	696		184	880	1,511	2,391
1933	1,055		626	1,681	2,372	4,053
1934	1,077		1,710	2,787	3,438	6,225
1935	1,181		3,908	5,089	10,358	15,447
1936	5,004	847	6,335	12,286	12,840	25,026
1937	7,643	1,819	8,593	18,055	15,236	33,291
1938	13,981	1,774	8,633	24,388	10,685	35,073
1939	29,233	856	4,425	35,514	8,194	42,708
1940	42,073	1,633	2,335	46,041	8,252	54,293
1941	42,813	1,065	2,620	46,498	4,666	51,164
1942	34,786	705	1,697	37,188	3,821	41,009
1943	24,600	207	1,072	25,879	2,259	28,138
1944	21,434	19	309	21,762	1,338	23,100
1945	8,184		3	8,187	380	8,567

Source: See FOOTNOTE (1).

TABLE 2: POSTWAR PRODUCTION BY TYPE

Column 1: Large and Medium Size Trucks
 Column 2: Small Size Trucks
 Column 3: Mini Trucks
 Column 4: Total of Trucks
 Column 5: Buses
 Column 6: Medium Size Passenger Cars
 Column 7: Small Size Passenger Cars

Year	Col. 1.	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
1945						
1946				14,914	7	
1947	9,522	1,584		11,106	104	
1948	15,649	3,562		19,211	775	3
1949	17,712	7,848		25,560	2,070	
1950	17,576	8,925		26,501	3,502	
1951	24,633	8,184		30,817	4,062	
1952	19,595	10,365		29,960	4,169	
1953	22,490	11,657		36,147	4,842	
1954	31,767	18,085		49,852	5,749	
1955	22,352	21,505		43,857	4,807	
1956	29,433	43,424	101	72,958	6,052	
1957	46,352	80,083	385	126,820	8,036	
1958	39,265	90,303	498	130,066	7,594	
1959	46,594	129,417	1,474	177,485	6,731	
1960	83,709	182,789	41,522	308,020	8,437	
1961	107,405	262,753	183,232	553,390	10,981	
1962	104,968	345,780	259,968	710,716	11,206	
1963	97,996	450,902	313,833	862,781	12,920	3,627
1964	115,726	633,938	359,478	1,109,142	13,673	5,963
1965	114,747	647,176	398,167	1,160,090	19,348	3,139
1966	135,349	780,883	471,626	1,387,858	20,885	5,301
1967	184,982	1,026,193	532,193	1,743,368	27,363	12,652
1968	214,605	1,169,163	607,639	1,991,407	38,598	23,606
1969	227,888	1,236,528	557,175	2,021,591	41,842	24,967
1970	258,100	1,253,861	551,922	2,063,883	45,555	51,619

TABLE 2 (continued): POSTWAR PRODUCTION BY TYPE

Column 7: Small Size Passenger Cars
 Column 8: Mini Passenger Cars
 Column 9: Total of Passenger Cars
 Column 10: Total of 4-Wheel Motor Vehicles (Sum of Cols. 4 and 9)
 Column 11: Tricycle Cars
 Column 12: Total of 4-wheel and Tricycle Cars (Sum of Cols. 10 and 11)

Year	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12
1945			0	8,187	380	8,567
1946			0	14,921	2,692	17,613
1947	60		110	11,320	7,432	18,752
1948	378		382	20,367	16,852	37,219
1949	1,070		1,070	28,700	26,727	55,427
1950	1,594		1,594	31,597	25,498	67,095
1951	3,611		3,611	38,490	43,802	82,292
1952	4,743	94	4,837	38,966	62,224	101,190
1953	8,687	104	8,789	49,778	97,484	147,262
1954	14,350	122	14,472	70,073	98,081	168,154
1955	20,220	48	20,268	68,932	87,904	156,836
1956	31,968	88	32,056	111,066	105,409	226,003
1957	47,045	76	47,121	181,977	114,937	296,914
1958	50,039	604	50,643	188,303	98,877	287,180
1959	73,487	5,111	78,598	262,814	158,042	420,856
1960	128,984	36,110	165,094	481,551	278,032	759,583
1961	195,930	53,578	249,508	813,879	224,595	1,038,474
1962	210,849	57,935	268,784	990,709	144,167	1,134,876
1963	327,031	77,772	407,830	1,283,531	117,190	1,400,721
1964	491,343	82,354	579,660	1,702,475	80,048	1,782,523
1965	599,030	94,007	696,176	1,875,614	42,944	1,918,558
1966	752,494	119,861	877,656	2,286,399	33,364	2,319,763
1967	1,080,567	282,536	1,375,755	3,146,486	26,453	3,172,939
1968	1,550,459	481,756	2,055,821	4,085,826	21,794	4,107,620
1969	2,026,899	559,633	2,611,499	4,674,932	17,082	4,692,014
1970	2,377,639	749,450	3,178,708	5,289,157	14,061	5,303,218

Source: See FOOTNOTE (2).

TABLE 3: PRODUCTION OF PREWAR "DATSUN" MODELS

Column 1: "DATSUN" Passenger Cars
 Column 2: "DATSUN" Trucks
 Column 3: Total Production of All "DATSUN" Model (Sum of Cols. 1 and 2)
 Column 4: % Growth Rate of Production of Passenger Car Models (Col. 1)
 Column 5: % Growth Rate of Production of Truck Models (Col. 2)
 Column 6: % Growth Rate of Production of All "DATSUN" Models (Col 3)
 Column 7: % Share of "DATSUN" Production to Nation's Total Production of Small Passenger Cars (Col. 3/(Col 3 of TABLE 1))

Year	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
1931	10	0	10				*
1932	150	0	150	1400.0		1400.0	81.5
1933	202	0	202	34.7		34.7	32.3
1934	880	290	1,170	335.6	24.8	479.2	68.4
1935	1,631	1,169	3,800	85.3	30.8	224.8	97.2
1936	2,562	3,601	6,163	57.1	58.4	62.2	97.3
1937	3,578	4,775	8,353	39.7	57.2	35.6	97.2

Source: See FOOTNOTE (3).

TABLE 4: FOREIGN CARS ASSEMBLED IN JAPAN (By Company), 1925-35

Column 1: Japan Ford
 Column 2: Japan GM
 Column 3: Kyoritsu Motors

Year	Col. 1	Col. 2	Col. 3	Related Events
1925	3,437			Japan Ford Founded
1926	8,677	0		Japan GM Founded
1927	7,033	5,635		Japan Ford slowed down assembly due to the model change from the Model T to the Model A.
1928	8,850	15,491		
1929	10,674	15,745	1,251	
1930	10,620	8,049	1,015	
1931	11,505	7,478	1,201	
1932	7,448	5,893	760	
1933	8,156	5,942	998	
1934	17,244	12,322	2,574	
1935	14,865	12,492	3,612	
1936	no data	no data	no data	Law Regarding Automobile Manufacturing Enterprise
1937	no data	no data	no data	
1938	no data	no data	no data	
1939	no data	no data	no data	
1940	no data	no data	no data	
1941				Japan-U.S. Pacific War began.

Source: See FOOTNOTE (4)

TABLE 5 : PASSENGER CAR PRODUCTION THROUGH TECHNOLOGY CONTRACTS

Column 1: Nissan Motors
 Column 2: Isuzu Motors
 Column 3: Hino Motors
 Column 4: Total Production of Three Companies (Sum of Col. 1, 2, 3)
 Column 5: Production of Domestic Passenger Cars (Col. 9 of TABLE 2, Col.4)
 Column 6: Production of Domestic Small Passenger Cars (Col. 7 of TABLE 2 minus Col. 4)
 Column 7: % of Assembled Cars vis-a-vis Total Small Passenger Cars (Col. 4/ Col. 6)

Year	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
1953	749	453	1,272	2,474	6,315	6,211	28.5
1954	1,682	2,127	2,633	6,442	8,030	7,908	44.9
1955	1,949	2,031	3,180	7,160	13,092	13,060	35.4
1956	2,718	2,134	3,640	8,492	23,564	23,486	26.6
1957	5,785	2,752	3,550	12,087	35,034	34,958	25.7
1958	3,935	3,443	4,415	11,793	38,850	38,246	23.6
1959	4,443	5,263	6,282	15,988	62,610	57,499	21.8
1960	0	9,953	7,196	17,149	147,945	111,835	13.3
1961	0	12,041	1,756	13,797	235,711	182,133	7.0

Source: See FOOTNOTE (5).

TABLE 6: PREWAR ANNUAL SUPPLY OF FOREIGN CARS

Col. 1: Import of Foreign Cars
 Col.2: Foreign Cars Assembled in Japan
 Col. 3: Total Supply of Foreign Cars (Col.1 + Col.2)
 Col. 4: % Increase in Imported Cars
 Col. 5: % Increase in Assembled Cars
 Col. 6: % Increase in Foreign Car Supply

Year	Col.1	Col.2	Col.3	Col.4	Col.5	Col.6
1907	c25			NA		
1908	c40			60.0		
1909	c70			75.0		
1910	c70			0.0		
1911	c180			157.1		
1912	c190			5.6		
1913	ND			NA		
1914	94			NA		
1915	30			-68.1		
1916	218			626.7		
1917	860			294.5		
1918	1,653			92.2		
1919	1,579			-4.5		
1920	1,745			10.5		
1921	1,074			-38.5		
1922	752			-30.0		
1923	1,938			157.7		
1924	4,063			109.7		
1925	1,765	3,437	5,202	-56.6		
1926	2,381	8,677	11,058	34.9	152.2	112.6
1927	3,895	12,668	16,563	63.6	46.0	49.8
1928	7,883	24,341	32,224	102.4	92.2	94.6
1929	5,018	29,338	34,356	-36.3	20.5	6.6
1930	2,591	19,678	22,269	-48.4	-32.9	-35.2
1931	1,887	20,109	21,996	-27.2	2.2	-1.2
1932	997	14,087	15,084	-47.2	-30.0	-31.4
1933	491	15,082	15,573	-50.8	7.1	3.2
1934	896	33,458	34,354	82.5	121.8	120.6
1935	934	30,787	31,721	4.2	-8.0	-7.7
1936	1,117	30,997	32,114	19.6	0.7	1.2
1937	1,100	31,000	32,100	-1.5	0.0	-0.0
1938	500	20,000	20,500	-54.6	-35.5	-36.1

1939 and thereafter, no foreign supply.

Source: See FOOTNOTE (6).

TABLE 7: POSTWAR ANNUAL IMPORTS OF FOREIGN VEHICLES

Col.1: Imports of Trucks and Buses
 Col.2: Imports of Large Size Passenger Cars
 Col.3: Imports of Medium Size Passenger Cars
 Col.4: Imports of Small Size Passenger Cars
 Col.5: Total Imports of Passenger Cars
 Col.6: Total Imports of Foreign Cars

Year	Col.1	Col.2	Col.3	Col.4	Col.5	Col.6
1945	0	0	0	0	0	0
1946	0	0	0	0	0	0
1947	0	0	0	0	0	0
1948	953	0	0	144	144	1,097
1949	3,519	0	0	0	0	3,555
1950	94	0	2,233	258	2,791	2,855
1951	1,314	765	24,594	1,728	27,087	28,419
1952	536	2,685	9,239	3,485	15,413	15,988
1953	1,471	4,180	13,962	5,577	23,719	27,406
1954	1,331	1,383	6,813	3,423	11,620	16,317
1955	1,358	793	3,351	1,042	5,186	6,748
1956	2,410	1,279	4,399	1,006	6,684	9,103
1957	515	1,260	4,291	628	6,179	6,718
1958	1,153	1,073	3,528	848	5,449	9,702
1959	1,048	901	2,435	2,658	5,994	7,111
1960	526	ND	ND	ND	3,917	4,546
1961	1,587	ND	ND	ND	3,439	5,251
1962	6,091	403	3,686	2,280	6,369	13,173
1963	1,584	398	4,391	6,640	11,429	13,749
1964	483	312	3,592	8,608	12,512	14,234
1965	242	377	4,595	8,663	13,635	13,998
1966	321	420	5,516	9,474	15,410	15,951
1967	259	413	4,636	9,597	14,646	15,142
1968	250	451	4,672	8,773	13,896	14,416
1969	184	676	5,672	11,410	17,758	18,113
1970	245	715	6,429	10,025	17,169	17,692

Source: See FOOTNOTE (7).

TABLE 8: PREWAR ANNUAL EXPORTS

Col.1: Total Export of Assembled Cars
Col.2: Assembled Car Exports to the "Yen Block" (Manchuria,
Kanto Province, China)
Col.3: Total Exports of Car Shasses
Col.4: Chassis Exports to the "Yen Bloc"
Col.5: Total Export of Assembled Cars and Shasses

Year	Col.1	Col.2	Col.3	Col.4	Col.5
1934	349	ND	0	NA	349
1935	626	542	735	664	1,361
1936	1,731	1,588	2,267	2,035	3,998
1937	1,495	1,363	1,918	1,851	3,413
1938	1,311	1,308	807	906	2,118
1939	5,684	5,677	1,380	1,380	7,064

The publication of data was prohibited thereafter.

Source: See FOOTNOTE (8).

TABLE 9: POSTWAR EXPORTS

Col. 1: Trucks
 Col. 2: Buses
 Col. 3: Small Passenger Cars
 Col. 4: Total Passenger Cars
 Col. 5: Total 4-Wheelers

Year	Col.1	Col.2	Col.3	Col.4	Col.5
1945	0	0	0	0	0
1946	0	0	0	0	0
1947	1	0	1	1	1
1948	6	0	1	1	7
1949	463	6	10	10	479
1950	5,409	93	7	7	5,509
1951	6,580	153	0	0	6,733
1952	681	184	0	0	865
1953	689	409	0	0	1,089
1954	679	308	1	1	988
1955	907	322	2	2	1,231
1956	1,884	517	46	46	2,447
1957	5,512	632	410	410	6,554
1958	7,540	346	2,357	2,357	10,243
1959	13,959	442	4,884	4,884	19,285
1960	31,028	768	6,944	7,013	38,809
1961	44,529	977	11,152	11,531	57,037
1962	49,871	808	15,606	16,011	66,690
1963	65,877	1,240	30,975	31,447	98,564
1964	81,721	1,735	66,745	66,965	150,421
1965	90,923	2,529	100,240	100,716	194,168
1966	100,900	1,744	152,309	153,090	255,734
1967	135,687	3,067	221,492	223,491	362,245
1968	201,290	4,889	384,933	406,250	612,429
1969	290,872	6,765	552,274	560,431	858,068
1970	351,610	9,579	715,451	725,587	1,086,776

Source: See FOOTNOTE (9).

APPENDIX 3

KALMAN FILTER: ITS BASIC IDEA [1]

The Kalman Filter has been employed in this thesis research only for identifying the system structure of the proposed model, i.e., of estimating the time-variant parameters. However, in CHAPTER V, the application of the Kalman Filter has consequently yielded much valuable insight into the dynamic learning behavior of government which has been assumed to have a feedback mechanism to correct for the past learning error. In fact, the Kalman Filter is not just another kind of ordinary dynamic regression technique, but an entirely new approach to data analysis with a strong emphasis on the feedback-based structural learning of trajectories of moving objects.

The Kalman Filter is the estimator to recursively generate an optimal estimate of system state (The "state" implies a visible or invisible internal structure which completely governs the system output) for any given time, e.g., $t+1$, with the system output measurement at a prior time, e.g., t . If t denotes present time, the estimation is called "prediction." If both $t+1$ and t are time points in the past, the estimation is called "filtering." The recursive process of estimation and the somehow unique view to regard the system output measurement as input and the optimal state estimate as output

are the two most important functional characteristics of the Kalman Filter. These characteristics result from the necessity of controlling a "noisy" system.

This appendix will consist of two parts. The first part will discuss why the Kalman Filter is indispensable in the area of stochastic controlling. The second part will show how to arrive at the the Kalman Filter algorithms for a very simple model in attempt to demonstrate a dynamic recursive process of state estimation by the Kalman Filter.

(A) Deterministic Control, Stochastic Control and Need for
the Kalman Filter

a) State-Recursive Modelling

It is a natural motivation to model a phenomenon in order to enhance better understanding of how it works. The first attempt is perhaps to propose a deterministic linear model for the sake of simplicity. Now, suppose that this deterministic model is written in a recursive form:

$$(A3.1) \quad x(t) = f(x(t-1), u(t-1)) \quad [\text{called the "state equation"}]$$

$$(A3.2) \quad y(t) = g(x(t)). \quad [\text{called the "output equation"}]$$

where

- $u(t-1)$: the system input at $t-1$,
- $x(t)$: the system state at t ,
- $y(t)$: the system output at t ,
- f, g : the linear function.

The above model specification might be somewhat unfamiliar to social scientists. It implies that: 1) the system state at t is jointly determined by the previous system state at $t-1$ and the previous system input at $t-1$, and 2) the current system output is determined by the current system state. The introduction to a new concept, the system state, marks the clear difference from the commonly-used input/output modelling. The meaning of the system state depends on the modeller's understanding of an actual system. It can be anything as long as the recursiveness in Eq(A3.1) and the simultaneity in Eq(A3.2) can hold. For example, if the constant parameters in a linear regression equation are redefined to be time-variant, and $u(t)$ in Eq(A3.1) is assumed to be null, such a regression equation becomes a dynamic system model in which the system state is a set of the time-variant parameters.

b) Deterministic Control

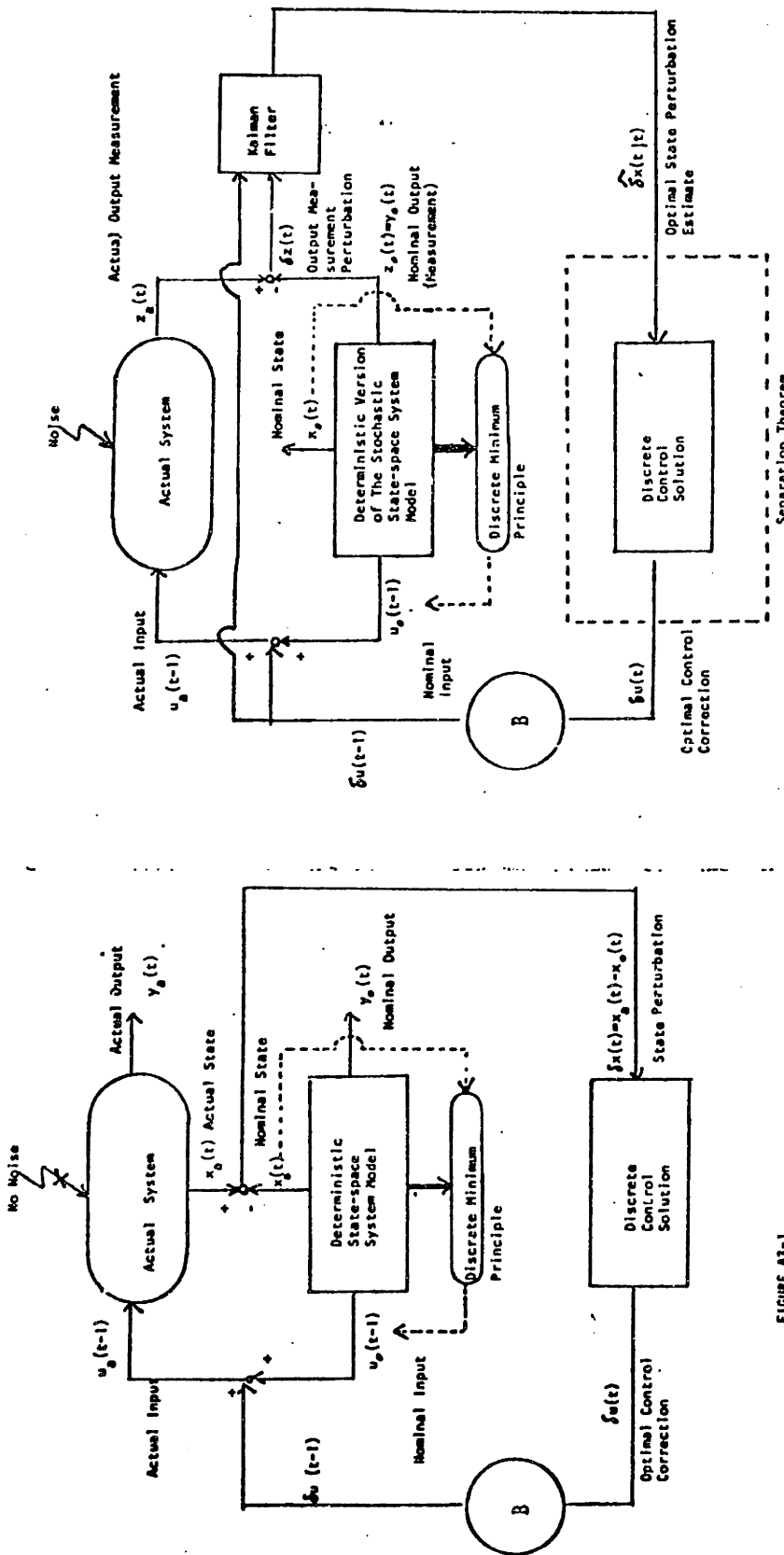
Suppose that the functional forms of f and g in Eq(A3.1) and Eq(A3.2) are known a priori so that a particular value in $y(t)$ is

determined by a particular value in $u(t-1)$ through a particular value in $x(t)$. Now, consider the problem of how to find a proper input $u_0(t-1)$, which will yield the prespecified state $x_0(t)$. This question is motivated by a desire to realize a certain system output. Note that according to Eq(A3.2) the desired output, e.g., $y_0(t)$, is expressed by the desired state $x_0(t)$. Since the model is time-recursive, the solution to this problem is not so easy as the mathematical problem to find the value in the independent variable for a given value in the dependent variable. The easiest approach is a computational trial-and-error simulation to input many arbitrary values into $u(t-1)$ and find the right value for the prespecified $x_0(t+1)$. However, this approach requires an enormous amount of computational work. In this regard, there exists a powerful mathematical tool called the "discrete minimum principle." This method finds a unique value $u_0(t-1)$ for given $x_0(t)$. That is, applying the discrete minimum principle, a unique pair of $u_0(t-1)$ and $x_0(t)$, hence a unique pair of $u_0(t-1)$ and $y_0(t)$, for a given recursive model can be found.

Now, suppose that $u_0(t-1)$, which is computed by the discrete minimum principle given $x_0(t)$, is input into an actual system. If a model is totally accurate, the actual output $y_a(t)$ should be identical to the desired output $y_0(t)$ precomputed with $x_0(t)$ from Eq(A3.2) . However, it is hardly possible that $y_0(t) = y_a(t)$ because of a possible modelling error. It is particularly important to note that the inequality is not due to the measurement error since this

discussion assumes that the model is deterministic, implying that all variables are assumed to be deterministic and completely measurable. Then, the question arises of how to correct this modelling error. This question is called the "deterministic control problem."

There are two contrasting viewpoints on the correction of the modelling error. One viewpoint is to change the model. The other is to augment the precomputed nominal input $u_0(t)$, but keep the current inaccurate model. The former view is based on the belief that the totally accurate model will be eventually found by changing the model structure. The second view admits the human imperfection of modelling and hence makes effort to find the best compensation measure for model inaccuracy. The modern control theory takes the second view and defines the deterministic control problem as one which must find the optimal amount of input augmentation. The solution to this problem is called the "discrete control solution." The solution gives the optimal input correction $\delta u(t) = u_a(t) - u_0(t)$ which minimizes, on an appropriate criterion, the next state perturbation $\delta x(t+1) = x_a(t+1) - x_0(t+1)$ by utilizing a maximum amount of information on the current modelling errors, i.e., $\delta x(t) = x_a(t) - x_0(t)$. The reason why the error information relies on the state variable rather than on the system output variable, results from the two model assumptions that: 1) the system state completely governs the system output, and 2) this variable is deterministic and hence completely observable. As shown in FIGURE A3-1, this correction process involves a feedback loop.



Note: B is the lag operator.

FIGURE A3-1
Deterministic Control Process

FIGURE A3-2
Stochastic Control Process

c) Stochastic Control

If all variables in the above model are not deterministic but stochastic, it is necessary to reconsider the control problem. First of all, the model needs a revision including the additional assumptions that there is system noise, which disturbs the system state and the measurement error, which disturbs the true measurement of system output. Then, the new stochastic version of the previously proposed deterministic model becomes:

$$(A3.3) \quad x(t) = f(x(t-1), u(t-1), v(t))$$

$$(A3.4) \quad y(t) = g(x(t))$$

$$(A3.5) \quad z(t) = y(t) + w(t). \quad [\text{called the "output measurement equation}]$$

where

$v(t)$: the system noise entering at t ,
 $w(t)$: the output measurement error at t ,
 $z(t)$: the system output measurement at t .

The control objective for the stochastic model is essentially the same as that for the deterministic model: i.e., to compensate for the inaccurate model specification by finding the optimal input correction $\delta u(t) = u_a(t) - u_o(t)$, which will minimize the future state perturbation $\delta x(t+1) = x_a(t+1) - x_o(t+1)$. Recall that the aforementioned discrete

control solution has two constraints: 1) it is a system of mathematical algorithms which generates the optimal input correction as output but only with the known state perturbation as input, and 2) it is valid only under the assumption that all variables are deterministic. Unfortunately, the stochastic case violates both constraints because all variables are random and hence unobservable. Therefore, the discrete control solution seems to be no longer applicable. However, the modern control theory has attained the epochmaking solutions for this problem. These solutions are known as the "Kalman Filter" and the "separation theorem."

The Kalman Filter is a system of mathematical algorithms which can recursively generate the optimal estimate of the state variable $x(t)$ as output with the current output observation $z(t)$ and the previous input $u(t-1)$ as inputs, under the assumption that all model variables are stochastic. The optimal estimate generated by the Kalman Filter is the conditional mean of the state variable when a priori measured information is available. It is thus evident that the Kalman Filter aims at solving the first constraint of the discrete control solution. Since the value in the state variable can now be assigned by the Kalman Filter, then the discrete control solution can have its input value.

The separation theorem permits the use of the deterministic discrete control solution as an optimal controller for the stochastic

model only if the conditional mean value of the state variables is used as its input.

Coupling the Kalman Filter as the conditional mean generator with this separation theorem, the control problem for the stochastic case can be solved. As shown in FIGURE A3-2, the stochastic control process has two additional components, the Kalman Filter and the separation theorem, while the essential feedback structure of the process of the model correction and the discrete control solution remain the same. Worth noticing is the fact that although the original function of the Kalman Filter is the optimal estimator of the system state, it is interlockingly related to the concept of "control." In the control theory literature, this fact is called the "dual" nature between estimation and controlling.

(B) Kalman Filter Algorithms

Following is a brief description of how the Kalman Filter algorithms are obtained. As discussed below, the algorithms are based upon a set of mathematical theorems. However, reflecting the nature of this thesis as not a mathematical paper, the following description will avoid the precise mathematical proofs of these theorems. Instead, emphasis will be placed upon the basic understanding of the Kalman Filter algorithms for social scientists without advanced mathematical

knowledge.

The following discussion will consist of two stages. First, a set of mathematical theorems which play a key role in arriving at the Kalman Filter algorithms will be presented. Second, the process of obtaining the Kalman Filter algorithms will be shown in the form of mathematical problem-solving.

1) The Key Mathematical Theorems for Kalman Filter Algorithms

Theorem 1

The optimal estimate $\hat{x}(t)$ of a random variable $x(t)$ is defined to be one which minimizes the mean of an appropriate loss function $L(x(t) - \hat{x}(t))$.

If the conditional probability distribution of $x(t)$, when any past value $z(t')$; $t' \ll t$ is given, such as

$$p(x(t) / z(t')) \text{ for } t' \ll t,$$

is symmetric around the conditional mean m and convex in the region $x(t) \ll m$, and if the loss function $L(x(t) - \hat{x}(t))$ is symmetric and

$$\|r_1\| \ll \|r_2\| \rightarrow L(r_1) \ll L(r_2)$$

where $r = x(t) - \hat{x}(t)$,

then the optimal estimate $\hat{x}(t)$ is completely independent of the form of the loss function L and always results in the conditional mathematical expectation of $x(t)$, such as:

$$(A3. 6) \quad \hat{x}(t) = E[x(t) / z(t')] \text{ for } t' \leq t.$$

Theorem 2

If the random vectors x , v , w are jointly Gaussian, and if v and w are orthogonal to each other, then the following equation holds:

$$(A3. 7) \quad E[x / v, w] = E[x / v] + E[x / w].$$

Theorem 3 (Projection theorem)

If the random vectors x and z are jointly Gaussian, then the vector z and the composite vector $x - E[x / z]$ are orthogonal to each other, i.e.,

$$(A3. 8) \quad E[z, x - E[x / z]] = 0.$$

Furthermore, the conditional probability distribution $p(x / z)$ has the conditional mean

-1

$$(A3.9) \quad E[x / z] = E[x] + \text{cov}(x, z) \cdot \text{var}(z)^{-1} \cdot (z - E[z]),$$

and the conditional covariance

$$(A3.10) \quad E[(x - E[x / z])(x - E[x / z])' / z]$$

-1

$$= \text{var}(x) - \text{cov}(x, z) \cdot \text{var}(z)^{-1} \cdot \text{cov}(z, x).$$

From above Theorem 1, $E[x / z] = \hat{x}$, so that $x - E[x / z] = x - \hat{x}$ is the estimation error vector. This theorem thus means that the estimation error vector is orthogonal to the vector z . FIGURE A3-3 shows the geometrical meaning of this projection theorem.

Theorem 4 (Innovation theorem)

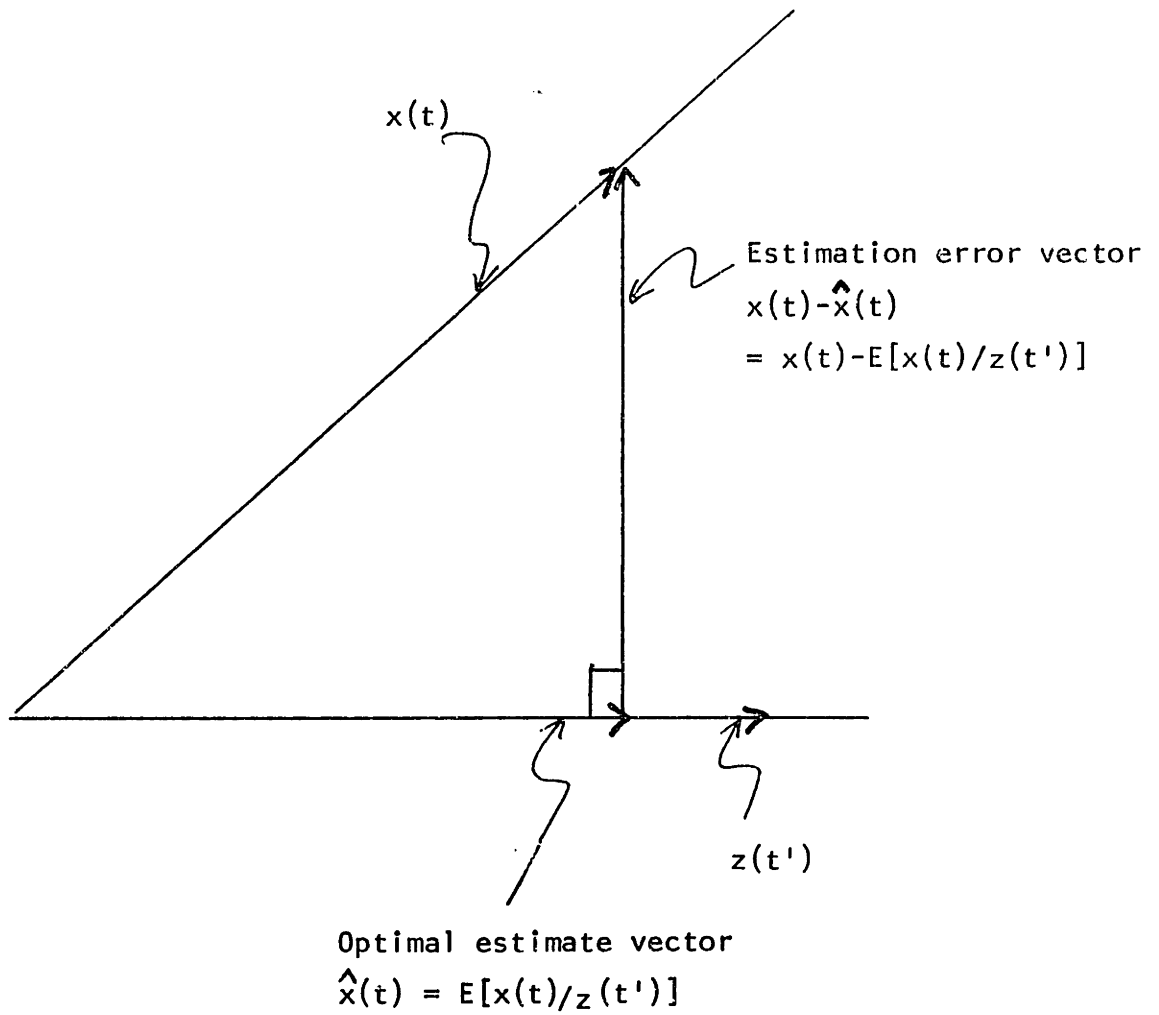
Let $z(t)$ and $Z(t)$ be a measurement variable vector at t and a set space of the past measurements $z(0), z(1), \dots, z(t-1)$, respectively. Then, the value

$$(A3.11) \quad r(t) = z(t) - E[z(t) / Z(t-1)]$$

has a linear relation with the vector $z(t)$. In other words, insofar as a linear algebraic operation is concerned, $r(t)$ and $z(t)$ have an equivalent amount of statistical information, for example:

FIGURE A3-3

Geometrical Illustration of
Projection Theorem



$$y(t) \perp z(t) \Leftrightarrow y(t) \perp r(t).$$

Since the second term on the right-hand side of Eq (A3.11) means the optimal estimate of $z(t)$ based on the past information $Z(t-1)$ according to Theorem 1, $r(t)$ is simply an estimation error or a residual.

ii) Deduction of Kalman Filter Algorithms

The standard Kalman Filter algorithms are the ones which show how to recursively obtain the next state prediction $\hat{x}(t+1/t)$ with the previous prediction $\hat{x}(t/t-1)$. However, practically speaking, this recursive process is divided into two processes as follows:

- a) Prediction cycle: predict $\hat{x}(t/t-1)$ with the previous updated estimate $\hat{x}(t-1/t-1)$.
- b) Update cycle: update (or correct) the prediction when the measurement at t is obtained.

Both algorithms, one which computes $\hat{x}(t+1/t)$ with $\hat{x}(t/t-1)$ and one which computes $\hat{x}(t/t)$ with $\hat{x}(t/t-1)$, are derived by the same mathematical operation.

Statement of Problem

Given the following discrete linear recursive state-space model:

$$(A3.12) \quad x(t) = Ax(t-1)+v(t) \quad [\text{state equation}]$$

$$(A3.13) \quad z(t) = Bx(t)+w(t) \quad [\text{output measurement equation}]$$

where $x(t)$: the system state vector which is assumed to be Gaussian,

$v(t)$: the system noise vector which is assumed to be Gaussian,

$z(t)$: the system output measurement vector which is assumed to be Gaussian,

$w(t)$: the output measurement error vector which is assumed to be Gaussian and independent of any of the above vectors,

A, B: constant coefficient matrices,

find the recursive algorithms to obtain the optimal update estimate $\hat{x}(t/t)$ with the previous optimal prediction $\hat{x}(t/t-1)$. The solution consists of the following steps.

[Prediction Cycle]

Since $x(t)$ is Gaussian, the conditional probability in Theorem 1 holds. Now, suppose that the form of an appropriate loss function meets the requirement in Theorem 1. Then, the optimal prediction, when the past measurements of the system output are given, becomes

$$(A3.14) \quad \hat{x}(t/t-1) = E[x(t) / Z(t-1)]$$

where $Z(t-1)$ is a set of the past measurements of the system output, $z(0), z(1), \dots, z(t-1)$.

Substituting Eq(A3.12) for $x(t)$,

$$\begin{aligned} \hat{x}(t/t-1) &= E[A(t-1)+v(t) / Z(t-1)] \\ &= E[Ax(t-1) / Z(t-1)] \\ &\quad [\text{since } v(t) \text{ is orthogonal to } Z(t-1) \\ &\quad \text{by assumption}] \\ &= AE[x(t-1) / Z(t-1)] \\ &\quad [\text{since } A \text{ is a constant coefficient matrix}] \\ &= A\hat{x}(t-1/t-1). \\ &\quad [\text{from Theorem 1}] \end{aligned}$$

Then, the optimal prediction of $x(t)$ is

$$(A3.15) \quad \hat{x}(t/t-1) = A\hat{x}(t-1/t-1)$$

when the optimal updated estimate at the previous time $t-1$ is known.

[Update Cycle]

Step 1

From Theorem 1,

$$\begin{aligned} \text{(A3.16)} \quad \hat{x}(t/t) &= E[x(t) / Z(t)] \\ &= E[x(t) / Z(t-1), z(t)]. \end{aligned}$$

The term on the right-hand side is successively transformed by applying the above theorems.

Step 2

From Theorem 4, substituting $r(t)$ for $z(t)$ in Step 1,

$$\text{(A3.17)} \quad \hat{x}(t/t) = E[x(t) / Z(t-1), r(t)]$$

where $r(t)$ is the output residual such that

$$\begin{aligned} r(t) &= z(t) - \hat{z}(t/t-1) \\ &= z(t) - E[z(t) / Z(t-1)] \\ &= Bx(t) + w(t) - E[Bx(t) + w(t) / Z(t-1)] \end{aligned}$$

$$\begin{aligned}
 &= Bx(t)+w(t)-BE[x(t) / Z(t-1)] \\
 &= Bx(t)+w(t)-B\hat{x}(t/t-1) \\
 \text{(A3.18)} \quad &= \tilde{x}(t)+w(t)
 \end{aligned}$$

[where $x(t)$ is the state estimation error, i.e.,

$$\text{(A3.19)} \quad \tilde{x}(t) = x(t) - \hat{x}(t/t-1).]$$

Step 3

When the system output at t is observed as $z(t)$, this $z(t)$ is new information to correct the prediction $\hat{x}(t/t-1)$. Then, $z(t)$ is orthogonal to $Z(t-1)$. In other words, only a new measurement which is entirely independent of the past measurement can be used to correct the previous prediction. In short,

$$z(t) \perp Z(t-1).$$

Therefore, Theorem 2 can be applied to Eq(A3.17), i.e.,

$$\begin{aligned}
 \text{(A3.20)} \quad \hat{x}(t/t) &= E[x(t) / Z(t-1)] + E[x(t) / r(t)] \\
 &= \hat{x}(t/t-1) + E[x(t) / r(t)].
 \end{aligned}$$

From Eq(A3.9), the second term becomes:

$$(A3.21) \quad E[x(t) / r(t)] = E[x(t)] + \text{cov}(x(t), r(t)) \cdot \text{var}(r(t))^{-1} \cdot (r(t) - E[r(t)])$$

$$= \text{cov}(x(t), r(t)) \cdot \text{var}(r(t))^{-1} \cdot r(t)$$

[E[x(t)]=0 since x(t) is Gaussian;
E[r(t)]=BE[x(t)]+E[w(t)]=0+0 since
x(t) and w(t) are Gaussian]

By definition, the covariance in Eq(A3.21) becomes:

$$\begin{aligned} \text{cov}(x(t), r(t)) &= E[x(t)r'(t)] \\ &\quad [{}' \text{ means a transpose}] \\ &= E[x(t)(B\tilde{x}(t)+w(t))'] \\ &\quad [\text{from Eq(A3.18)}] \\ &= E[x(t)\tilde{x}'(t)B'] \\ &\quad [\text{since } w(t) \text{ is orthogonal onto } x(t)] \\ &= E[(\hat{x}(t/t-1)+\tilde{x}(t))\tilde{x}'(t)B'] \\ &\quad [\text{from Eq(A3.19)}] \\ &= E[\tilde{x}(t)\tilde{x}'(t)]B' \\ &\quad [\text{From FIGURE A3-2, } \hat{x}(t/t-1) \text{ is} \\ &\quad \text{orthogonal onto } \tilde{x}(t)] \\ (A3.22) \quad &= P(t)B'. \end{aligned}$$

where

$$(A3.23) \quad P(t) = E[\tilde{x}(t)\tilde{x}'(t)].$$

In Eq(A3.23), $E[\tilde{x}(t)\tilde{x}'(t)]$ means the estimation error covariance of the state prediction $\hat{x}(t/t-1)$.

By definition, the variance in Eq(A3.21) becomes:

$$\begin{aligned} \text{var}(r(t)) &= E[r(t)r'(t)] \\ &= E[(B\tilde{x}(t)+w(t))(\tilde{x}'(t)B'+w'(t))] \\ &\quad [\text{from Eq(A3.18)}] \\ &= E[B\tilde{x}(t)\tilde{x}'(t)B'+w(t)w'(t)] \\ &\quad [\text{since } w(t) \text{ is orthogonal onto } x(t)] \\ &= BE[\tilde{x}(t)\tilde{x}'(t)]B'+\text{var}(w(t)) \\ (A3.24) \quad &= BP(t)B'+\text{var}(w(t)). \\ &\quad [\text{from Eq(A3.23)}] \end{aligned}$$

Substituting Eq(A3.22) and Eq(A3.24) into Eq(A3.21) yields:

-1

$$(A3.25) \quad E[x(t) / r(t)] = P(t)B' \cdot [BP(t)B'+\text{var}(w(t))] \cdot r(t).$$

Then, substituting Eq(A3.25) into Eq(A3.20), the updated (corrected) estimate is obtained in a recursive form as:

$$(A3.26) \quad \hat{x}(t/t) = \hat{x}(t/t-1) + K(t)r(t)$$

where

$$(A3.27) \quad K(t) = P(t)B'[BP(t)B' + \text{var}(w(t))]^{-1}$$

[called the "Kalman Filter gain"]

$$r(t) = z(t) - B\hat{x}(t/t-1).$$

[output prediction error or residual]

However, this form is incomplete because it still involves the uncomputable variable $x(t)$ which appears in the prediction error covariance of the state prediction, $P(t)$ (From Eq(A3.19), $\tilde{x}(t) = x(t) - \hat{x}(t/t-1)$). So that $\tilde{x}(t)$ contains the uncomputable $x(t)$). In the following step, the recursive process to compute this covariance with the previous value will be derived.

Step 4

From Theorem 1, the optimal state prediction at the next period $\hat{x}(t+1/t)$ is computed given the model in Eq(A3.12) as

$$(A3.28) \quad \hat{x}(t+1/t) = E[x(t+1) / Z(t)].$$

Then, $\hat{x}(t+1/t) = E[Ax(t)+v(t) / Z(t)]$
 [from Eq(A3.12)]
 $= E[Ax(t) / Z(t)]$
 [since $v(t)$ is orthogonal to $Z(t)$]
 (A3.29) $= \hat{Ax}(t/t).$

Eq(A3.29) simply means that the optimal prediction at the next period is directly given by the currently updated estimate in Eq(A3.26). By definition, the estimation error of this prediction is

$$\begin{aligned} \tilde{x}(t+1) &= x(t+1) - \hat{x}(t+1/t) \\ &= x(t+1) - \hat{Ax}(t/t) \\ &\quad \text{[from Eq(A3.29)]} \\ &= Ax(t)+v(t) - A[\hat{x}(t/t-1) + K(t)r(t)] \\ &\quad \text{[from Eq(A3.12) and Eq(A3.26)]} \\ &= \tilde{Ax}(t)+v(t) - AK(t)(B\tilde{x}(t)+w(t)) \\ &\quad \text{[from Eq(A3.18) and Eq(A3.19)]} \\ \text{(A3.30)} \quad &= A[1-K(t)B]\tilde{x}(t)+v(t) - AK(t)w(t). \end{aligned}$$

By definition, the estimation error covariance of the state prediction at $t+1$ is

$$\begin{aligned} P(t+1) &= E[\tilde{x}(t+1)\tilde{x}'(t+1)] \\ &= E[(A[1-K(t)B]\tilde{x}(t)+v(t) - AK(t)w(t)) \\ &\quad (A[1-K(t)B]\tilde{x}(t)+v(t) - AK(t)w(t))'] \end{aligned}$$

$$\begin{aligned}
 & \text{[from Eq(A3.30)]} \\
 & = A[[1-K(t)B]P(t)[1-K(t)B]' + \\
 & \quad K(t)\text{var}(w(t))K'(t)]A' + \text{var}(v(t)) \\
 & \quad \text{[from Eq(A3.23)]} \\
 \text{(A3.31)} \quad & = A[P(t) - K(t)BP(t) - P(t)B'K'(t) + K(t)P(t)B'K'(t) + \\
 & \quad K(t)\text{var}(w(t))K'(t)]A' + \text{var}(v(t)).
 \end{aligned}$$

Eq(A3.31) is further simplified in the following operation:

First, compute the fourth and the fifth terms in the parenthesis $A[\dots]A'$ as

$$\begin{aligned}
 & K(t)BP(t)B'K'(t) + K(t)\text{var}(w(t))K'(t) \\
 & = K(t)[BP(t)B' + \text{var}(w(t))]K'(t) \\
 & = P(t)B'K'(t). \quad \text{[from Eq(A3.27)]}
 \end{aligned}$$

This value is identical to the third term in the parenthesis.

Therefore, the estimation error covariance of the state prediction is obtained in the following recursive process:

$$\text{(A3.32)} \quad P(t+1) = A[[1-K(t)B]P(t)A' + \text{var}(v(t))], \text{ or}$$

$$\text{(A3.33)} \quad P(t) = A[[1-K(t-1)B]P(t-1)A' + \text{var}(v(t-1))].$$

Special attention should be paid to the fact that the estimation error covariance of state prediction does not depend on the output measurements. It depends only on the value settings of the two noise variances, $\text{var}(v(t))$ and $\text{var}(w(t))$. So that, given an appropriate initial condition $P(0)$ and these variances, $P(t)$ can be recursively computed on a "off-line" basis. The term "off-line" implies that no "on-line" (or recursive) measurement data supply is necessary.

As a result, the Kalman Filter algorithms are finally obtained for the model Eq(A3.12) and Eq(A3.13):

Prediction Cycle:

$$\hat{x}(t/t-1) = A\hat{x}(t-1/t-1) \dots \dots \dots [\text{Eq}(A3.15)]$$

Update Cycle:

$$\hat{x}(t/t) = \hat{x}(t/t-1) + K(t)r(t) \dots \dots \dots [\text{Eq}(A3.26)]$$

-1

where $K(t) = P(t)B' \cdot [BP(t)B' + \text{var}(w(t))] \dots \dots \dots [\text{Eq}(A3.27)]$

$$P(t) = A[1 - K(t-1)B]P(t-1)A' + \text{var}(v(t-1)) \dots \dots \dots [\text{Eq}(A3.33)]$$

$$r(t) = z(t) - Bx(t/t-1) \dots \dots \dots [\text{Eq}(A3.11)]$$

The most important feature of this Kalman Filter state estimation process is the dynamic "learning" based upon the successively entering observation data at each time point. First, the previous updated

estimate is used to propose a prediction for the next time. Next, the accuracy of this prediction is checked by comparing the actual data when time lapses to the next period. The deviation between the predicted output and the actual observation, $r(t)$, is stored as an important information. Then, third, based upon this $r(t)$ and the off-line computed gain $K(t)$, the Kalman Filter corrects the past prediction and proposes a new update estimation.

Recall that the problem solution has started with Theorem 1. Mathematically speaking, both the optimal prediction and the optimal update estimates of the system state are directly derived as the conditional means (Here, the condition is the existence of a complete collection of the past or past-and-present observation data, Eq(A3.14) and Eq(A3.16).). This means that the prediction and the update correction are based on the knowledge of the entire data history, $Z(t-1)$ and $z(t)$. Suppose that the past data showed a part of a circle curve. The recognition of a circle is a learning; and this learning is possible only if the entire data history, not a segment of the past data, is examined. In other words, as long as the curve is being learned as a circle, the memory of the entire data history is used. Then the prediction is proposed on an extended point of the circle. Therefore, the prediction uses the entire memory of the past, too. However, the Kalman Filter recursive algorithms maintain simply that it is not necessary to always memorize the entire past data to arrive at the same conclusion of Theorem 1. What the Kalman Filter needs for

forecasting the system state for the next period $t+1$ are the present data $z(t)$ and the previous prediction $\hat{x}(t/t-1)$. The knowledge of all the past measurement data is guaranteed in the prediction and update processes shown above.

FOOTNOTES

CHAPTER I

(1) By formal language, we mean not only "systems analysis" but also other analyses in terms of a "difference" or differential equation. For a text-like discussion by political scientists, see: F. Cortes, A Przeworski and J. Sprague, Systems Analysis for Social Scientists, N.Y.: John Wiley & Sons, 1974.

(2) His original article is reproduced in: L. F. Richardson, Arms and Insecurity, Chicago: Quadrangle Press, 1960.

(3) For example, see: P. Smoker, "Fear in the Arms Race: Mathematical Study," in The Journal of Peace Research, I, (1964), pp.55-63.

(4) A. Przeworski and D. A. Sores, "Theories in Search of a Curve: A Contextual Interpretations of Left Vote," in APSR, Vol. 65, (1971), pp.51-68.

(5) A. Przeworski and F. Cortes, "Systemas partidistas, mobilizacion electoral y la estabilidad de sociedades capitalistas," Revista Latino-Americana de Ciencia Politica, Vol. 11, No. 2, 1971.

(6) O. Lange, Introduction to Economic Cybernetics, Oxford: Pergamon Press, Ltd., 1970.

(7) R. D. Brunner and G. O. Brewer, Organized Complexity, New York: Free Press, 1971.

(8) J. W. Forrester, World Dynamics, Cambridge, Mass.: Wright-Allen Press, Inc., 1971.

(9) W. D. Nordhaus, "World Dynamics: Measurement without Data," The Economic Journal, Vol. 83, No. 332, (December), 1973, pp. 1156-1183.

(10) O. A. Davis, M. A. H. Dempster and A. Wildavsky, "A Theory of the Budgetary Process," APSR, Vol. LX, (September), 1966, No. 3, pp.529-547.

(11) J. P. Crecine, Governmental Problem-Solving: A Computer Simulation of Municipal Budgeting, Chicago: Rand McNally, 1969.

(12) N. Choucri and R. C. North, Nations in Conflict: National Growth and International Violence, San Francisco: W. H. Greeman, 1975.

- (13) W. D. Nordhaus, "The Political Business Cycle," in Review of Economic Studies, 1972.
- (14) D. A. Hibbs, Jr., Economic Interest and the Politics of Macroeconomic Policy, Working Paper, Cambridge, Mass: Center for International Studies, MIT, 1975.
- (15) See J. P. Grecine, op. cit., or O. A. Davis, M. A. H. Dempster and A. Wildavsky, op. cit.
- (16) Customarily, the impacts on the economy have been dealt with separately by economics.
- (17) Talcott Parsons, The Social System, New York: The Free Press, 1951, and Talcott Parsons and Neil E. Smelser, Economy and Society, Glencoe, Illinois: The Free Press of Glencoe, 1956.
- (18) The use of this term is often found in Parsons' writings. For example, see: Talcott Parsons, "On the Concept of Political Power," Proceedings of American Philosophical Society, CVII, (June., 1963), p.260.
- (19) The concept of "money" as a communication medium is discussed in his Theories of Society, (co-editor with Edward Shils, Kaspar D. Naegele, and Josse R. Pitts), New York: The Free Press of Glencoe, 1961, p.66.
- (20) See: T. Parsons and N. E. Smelser, op. cit., p.77.
- (21) The interpretation of the theorems into political phenomena is given in: Franklin M. Fisher, Albert Ando and Hubert A. Simon, Essays on the Structure of Social Science Models, Cambridge: MIT Press, 1963.
- (22) A theoretical discussion of the "homeostasis" question is found, for example, in: A. L. Stinchombe, Constructing Social Theories, New York: Harcourt Brace & World, Inc., 1968.
- (23) In this regard, we share the same view with Chandler Morse. See: C. Morse, "The Functional Imperatives," in Max Blank (ed.), The Social Theories of Talcott Parsons, N.J.: Prentice-Hall, Inc., 1961, p.150.
- (24) Robert A. Dahl, "The Concept of Power," Behavioral Science, 23, July, 1957, pp.201-215.
- (25) Harold D. Lasswell and Abraham Kaplan, Power and Society, New Haven: Yale University Press, 1950.

- (26) In fact, Parsons does not compare political priority and economic optimality on the same level. He seems to argue that each of them be taken in different contexts: the economic rationality in the market context and political optimality in the political-value context. On this point, refer to the discussion by C. Morse, op cit., pp.141-143.
- (27) Deutsch, Karl W., The Nerves of Government, New York: The Free Press, 1963, pp.110-127.
- (28) In terms of the language of control theory these external disturbances imply the "system noise." A discussion on system noise will appear in CHAPTER V and APPENDIX 3.
- (29) The diagram of Parsons' "in's" and "out's" in the context of the polity-economy interchange is drawn in: T. Parsons, "On the Concept of Political Power," op. cit., p.260.
- (30) See his diagram in: T. Parsons and N. E. Smelser, op. cit., p.77.
- (31) K. Deutsch, op. cit.
- (32) See: D. T. Campbell, "Quasi-experimental design," in D. L. Shills (ed.), International Encyclopedia of the Social Sciences, New York: Macmillan and Free Press, 1968, Vol. 5, pp.259-263; or D. T. Campbell, "From description to experimentation: Interpreting trends as quasi-experiments," in C. W. Harris (ed.), Problems in Measuring Change, Madison: University of Wisconsin Press, 1963, pp.212-242.
- (33) Campbell, D. T., "Reforms as Experiments," American Psychologist, Vol. 24, (1969), pp.409-429.
- (34) Campbell, Ibid., p.411.
- (35) Campbell, Ibid., p.411.
- (36) Campbell, D. T. and J. C. Stanley, "Experimental and quasi-experimental designs for research on teaching," in N. L. Gage (ed.), Handbook of Research on Teaching, Chicago: Rand McNally, 1963.
- (37) For a concise argument on the difference between the two approaches, see: Hibbs, Douglas A., Jr., On Analyzing the Effects of Policy Interventions: Box-Jenkins vs. Structural Equation Models, A Working Paper, Center for International Studies, No. C/74-33, December, 1974.
- (38) Campbell, D. T. and H. L. Ross, "The Connecticut crackdown on speeding: Time-series data in quasi-experimental analysis," Law and Society Review, 1968, 3(1), pp.33-53.

(39) Glass, G. V., "Analysis of data on the Connecticut speeding crackdown as a time-series quasi-experiment," Law and Society Review, 1968, 3(1), pp.55-76.

(40) A discussion of the following two dynamic models can be found in any introductory text book in economics. For example, see: Allen, R. G. D., Mathematical Economics, London: Macmillan, 1956; or Allen, R. G. D., Mathematical Analysis for Economists, London: Macmillan, 1968.

(41) A detailed argument on the Kalman Filter method and its bibliography will appear in CHAPTER V and APPENDIX 3.

(42) Vernon, R., "International Trade in the Product Cycle," Quarterly Journal of Economics, 1966, Vol. 80, No. 2, pp.190-207.

CHAPTER II

(1) Due to the virtual lack of research funds for this research and the physical constraint that it be done in the U.S., the historical intervention analysis was based upon secondary data sources. A documentary collection for Part II was facilitated through special provisions to use the library facilities by both the Yenching Library of Harvard University and the Documentary Collection Room of the Japan Automobile Manufacturers Association in Tokyo to which I am grateful. Because of the aforementioned research constraints, a historical investigation in the Part I would not refer to a good amount of original sources. In particular, an investigation of the prewar politics in Chapter II is much indebted to a single source, i.e., Ozaki, Masahisa, The Japanese History of Automobiles, Tokyo: Jikensha, 1955. His work, which consists of two volumes, is regarded as the most comprehensive description of the development of the Japanese automobile industry in the prewar period, and hence is referred to by many books and reports. The second valuable source is the Association of the Promotion of the Automobile Industry (APAI), ed., Interview Records of the History of the Japanese Automobile Industry, Tokyo: The Association of the Promotion of the Automobile Industry, 1973 (Vol. 1), 1975 (vol. 2). These two volumes contain the interviews with government officials and company executives and engineers who actually shaped the prewar government policies and the industry's development. The interviews started since 1957, but due to the highly sensitive disclosures of the past government policies and companies' reaction, the publication of these interviews was halted for a decade and a half. Although admitting such data constraints, we made a maximum effort to do cross reference checks in writing Part I in order to increase the reliability of the limited data sources.

The emphasis in writing historical accounts is placed on the event-by-event follow-ups so as to understand the process of development of the Japanese automobile in the policy context. Such a story-telling approach intends to bring out a fairly detailed account in English of the development of the Japanese industry from its inception. Generally speaking, the state of the Japanese automobile industry has often been discussed by economists at home. Examples are: 1) Arisawa, Hiromi, et. al., Today's Industrial Structures of Japan, Vol. V, Tokyo: Iwananishoten, 1959; 2) Ueno, Hiroya and Hiromichi Muto, "Automobiles," in Hisao Kumagai (ed.), Industrial Organization of Japan, Vol. 1, Tokyo: Chuo-Koron-Sha, 1973, pp. 119-181; 3) Iwakoshi, Tadahiro, On the Japanese Motor Industry, Tokyo: Tokyo University Press, 1968; 4) Okamoto, Tetsuji, et. al., Forecasting of Motor Vehicle Demands, Tokyo: Japan Productivity Center, 1968; 5) Kodaira, Katsumi, Automobiles, Tokyo, Aki-shobo, 1968). Some of economists' works are available in English (for example, above Ueno and Muto (1973) is translated as: Ueno, H. and H. Muto, "The Automobile Industry of Japan," Japanese Economic Studies, Vol. III, No. 1 (Fall), New York: International Arts & Sciences Press, Inc., 1974.), but very limited in number. Furthermore, those English written articles and reports primarily focus on the postwar period which include the most update issues such as trade liberalization and pollution control. Almost none of them discuss the details of how the Japanese automobile industry has been developed with strong government supports from the prewar period to the postwar one (Note: 1) A brief English description of the prewar period can be found in: Tsururi, Yoshihiro, Technology Transfer and Foreign Trade: The Case of Japan 1950 - 1966, Ph.D. Dissertation, Harvard Business School, 1968, pp. 123-130; 2) The relationship between the Japanese Government and the motor vehicle industry is briefly described in English in Kaplan, Eugene J., Japan: The Government-Business Relationship, Washington, D.C.: The U.S. Department of Commerce, 1972, pp. 42-54, 104-136.).

(2) Before the first importation of four-wheelers came to Japan, history records that a tricycle electric car, called the "Progress," was imported by a foreigner in 1889. This three-wheeler was solely for his private use. In 1890, a Japanese immigrant community in San Francisco gave the Crown Prince an electric four-wheel car as a gift. However, insofar as the general public is concerned, the Orient was the first imported four-wheel car in Japan. Source: Ozaki, op.cit., Vol. 2, pp. 1-40.

(3) Ozaki, M., op. cit., Vol. 1, pp. 61-64.

(4) Ozaki, M., op. cit., Vol. 1, pp. 69-81.

(5) Ozaki, M., op. cit., Vol. 1, p. 48.

(6) Episodes of the early attempts of automobile manufacturing are described in APAI, op. cit., Vol. 1, pp. 3-22.

- (7) Data sources of this company are: 1) Ozaki, op. cit., Vol. 1, pp. 190-197; 2) Yamamoto, Naokazu, Japanese Automobiles, Tokyo: Sogensha, 1959, pp. 8-10; 3) Shirosawa, Teruo, Automobile Industry, Tokyo: Kyoiku-sha, 1975, p. 169.
- (8) The following reasons are observed by Ozaki, op. cit., Vol. 1, p. 198.
- (9) Ozaki, op. cit., Vol. 1, p. 208.
- (10) Ozaki, op. cit., Vol. 2, pp. 285-288; Kimura, Toshio, Automobile Industry of Japan, Tokyo: Nihon-hyoron-shin-sha, 1959, p. 64.
- (11) An account on the early automobile tax can be found in: Ozaki, op. cit., Vol. 2, p. 2890.
- (12) Data sources of this part are: 1) Ozaki, _____ Vol. 1, pp. 225-235; 2) Automobile Almanac: 1929, Tokyo, Jiken-sha, 1929, pp. 58-62.
- (13) A text of this law is found in one of the following: 1) Ozaki, op. cit., Vol. 1, pp. 236-281; 2) Kimura, op. cit., p. 80; 3) MITI, The History of Commercial & Industrial Policies, Vol. II (Industrial Regulations), Tokyo: MITI, 1964, pp. 33-35; 4) Nissan Motors, Ltd. (ed.), The 30-Year History of Nissan Motors, Tokyo: Nissan Motors, Ltd., 1965, pp. 5-7.
- (14) This law was the first industrial policy which had clear military objectives. Later, many others of this kind were promulgated, particularly during World War II. They will be discussed in SECTION II-4.
- (15) Source: Nissan Motors, Ltd., op. cit., p.8.
- (16) Kimura, op. cit., p. 80; Ozaki, op. cit., Vol. 1, pp. 275-284.
- (17) In fact, we do not have the data for companies' applications. Then, the government's expected LSMV designation is assumed to be nearly equal to the number of applications. In other words, we assume that companies would have submitted as many applications as the number of the government's expected designation.

(18) This fact can be simply calculated by the previous table. Denote K to be a fixed criterion for the percentage of yearly designation. Then,

$$\begin{aligned} B(k) &= kA(t) \\ C(t) &= \sum_{i=1}^t A(i) \\ D(t) &= \sum_{i=1}^t B(i) = K \cdot \sum_{i=1}^t A(i) \\ D(t) / C(t) &= K. \end{aligned}$$

(19) Ozaki, op. cit., Vol. 1, pp. 450-451.

(20) This statement is valid provided that all trucks produced by these companies applied for the LSMV designation.

(21) Source: Shirozawa, op. cit., p. 170; Nissan Motors, Ltd, op. cit., pp. 3-7; Ozaki, op. cit., Vol. 1, pp. 210-212.

(22) Source: Ozaki, op. cit., Vol. 1, pp. 291-292; 2) Nissan Motors, Ltd, op. cit., Vol. 1, pp. 8-12; 3) APAI, op. cit., Vol. 2, pp. 59-03.

(23) Source: Ozaki, op. cit., Vol. 1, pp. 282-284; 2) APAI, op. cit., Vol. 2, pp. 13-49.

(24) Source: Ozaki, op. cit., Vol. 1, pp. 285-290; 2) Nissan Motors, Ltd., op. cit., p. 9; 3) APAI, op. cit., Vol. 2, pp. 1-13.

(25) Source: Ozaki, op. cit., Vol. 1, pp. 213-220.

(26) Ozaki, op. cit., Vol. 2, pp. 450-451.

(27) The above account is based upon: APAI, op. cit., Vol. 1, pp. 46-49, 74-76.

(28) Ozaki, op. cit., Vol, p. 293.

(29) Kimura, op. cit., p. 77.

(30) According to the Japan-France preferential tariff agreement, a tariff is levied as:

chasses: 35% ad valorem,

parts: 25% ad valorem,

as of 1929. At that time, France imposed a 180% ad valorem tariff on a complete car import. Italy banned the import of foreign cars. Source: Ozaki, op. cit., Vol. 1, pp. 295-297.

(31) The assembly cost was equivalent to the unpacking cost of a complete car. Source: Kimura, op. cit., p. 75.

(32) This statement means an ideal situation. According to the data of Japan Ford, Inc., only 5.2% of the Ford parts were substituted by the Japanese made. Source: Kimura, op. cit., p. 75.

(33) The capital of Japan Ford, Inc. was 6 million yen, while a sum of capital of the three LSMV companies was 5.96 million yen. Source: Ozaki, op. cit., Vol. 1, p. 295.

(34) Data will be shown in SECTION II-3.

(35) A text of this inquiry is found in: 1) Ozaki, op. cit., Vol. 1, p. 310; 2) Nissan Motors, Ltd., op. cit., p. 220; 3) Yamamoto, Naokazu, Japanese Automobiles: The History of the Growth of the "Toyopet", Tokyo: Sogen-sha, 1959, p. 230.

(36) A complete text of the committee's recommendations is recorded in Nissan Motors, Ltd, op. cit., pp. 22-23. Also a summary of the text can be found in Ozaki, op. cit., Vol. 1, p. 312.

(37) The process of determining the MOR bus model is extensively described including the long-hidden anecdotes of those who were involved in the policy making process, in: 1) APAI, op. cit., Vol. 1, pp. 40-45, Vol 2, pp. 43-44; 2) Ozaki, op. cit., Vol. 1, p. 312.

(38) Although Kumabe could not become a regular member due to his lower status as associate professor, he no doubt played an important role in shaping the government automobile policy at that time. In particular, he helped Toyota Motors emerge as a key automaker later on. This point will be discussed in SECTION II-3.

(39) Source: Yamamoto, op. cit., p. 48.

(40) Source: Yamamoto, op. cit., pp. 47-48; Ozaki, op. cit., Vol. 1, p. 317; Nissan Motors, Ltd., op. cit., p. 25.

(41) Ozaki, op. cit., Vol. 1, p. 317.

(42) The following account is based upon the sources: 1) Ozaki, op. cit., Vol. 1, p. 314; 2) Nissan Motors, Ltd., op. cit., p. 170.

(43) An unsuccessful attempt by the MCI standardization can be shown in production data which will be presented in CHAPTER IV.

(44) Source: Yamamoto, op. cit., pp. 55-56; Ozaki, op. cit., Vol. 1, p. 322.

(45) Source: APAI, op. cit., Vol. 1, pp. 70-73.

(46) Only data this research found regarding the MOR buses are in Nissan Motors, Ltd., op. cit., p. 17, which records the number of the MOR buses in each year. These data are the so-called "stock" data. In order to find some ideas about MOR procurement, we converted the stock data into the "flow" data which is shown below. The above data conversion has assumed that scrappages were marginal.

(47) The following account is based upon the data source: Ozaki, op. cit., Vol. 1, pp. 320-321, 327.

(48) APAI, op. cit., Vol. 1, p. 63.

(49) APAI, op. cit., Vol. 1, p. 67.

(50) APAI, op. cit., Vol. 1, p. 64

(51) APAI, op. cit., Vol. 1, , p. 67.

(52) Ozaki, op. cit., Vol. 1, p. 377.

(53) Nissan Motors, Ltd., op. cit., p. 54.

(54) An account on this committee is based on: Ozaki, op. cit., Vol. 1, p. 377.

(55) The above account on the secret policy-making of a handful of MCI officials is based upon the following history records: 1) APAI, op. cit., Vol. 1, pp. 65-66; 2) Ozaki, op. cit., Vol. 1, p. 377.

(56) The following account and data are largely based upon: MITI, op. cit., Vol. 5 (International Trades: Book 2), Tokyo: MITI, 1971.

(57) MITI, op. cit., 1971, p. 46.

(58) MITI, op. cit., 1971, p. 45.

(59) MITI, op. cit., 1971, p. 51.

(60) MITI, op. cit., 1971, p. 124.

(61) MITI, op. cit., 1971, p. 125.

(62) MITI, op. cit., 1971, p. 141.

(63) Nissan Motors, Ltd., op. cit., p. 153.

(64) The following data are based upon two sources: 1) Ozaki, op. cit., Vol. 2, p. 234-235; 2) Automobile Almanac: 1939, Tokyo: Automobile-sha, 1939, p. 118.

(65) Ozaki, op. cit., Vol. 2, p. 228.

(66) Ozaki, op. cit., Vol. 2, p. 234.

(67) The main sources of the following account are: 1) Nissan Motors, Ltd., op. cit., pp. 27-29, 32, 38, 39-41; 2) APAI, op. cit., Vol. 1, p.62; Vol. 2, pp. 93-105; 3) Ozaki, op. cit., Vol. 1, pp. 324-326, 331-332.

(68) Ayukawa's entrepreneurship was always directed not to the government automobile policy but to two American assembly plants in Japan. While he achieved a contract of part manufacturing with Japan Ford, Inc., he started negotiations with Ford Motors (in the U.S.) on the merger between his company and Japan GM, Inc. since April 1934. But the Army intervened and strongly opposed this merger plan on the grounds that a large-scale automobile manufacturing plant with American participation would be dangerous since during World War I some automobile plants were converted to aircraft manufacturing in European countries. As a result, this merger plan failed and the negotiations were terminated in December 1934. This historical fact is not described in Nissan's company history (i.e., Nissan Motors, Ltd., op. cit.) but disclosed in: 1) APAI, op. cit., Vol. 1, pp. 62-65; 2) Ozaki, Oo. cit., Vol. 1, pp. 331-332.

(69) A complete text of this law appears in: Ozaki, op. cit., Vol. 1, pp. 350-365.

(70) Before this law, Japanese legislations did not contain the article of purposes or law objectives. This law was the first case in this regard. Before the promulgation of the law, both the Ministry of Foreign Affairs and the Cabinet Legislative Bureau warned that this law would violate the Japan-U.S. Treaty of Commerce and Navigation. Then, MOA and MCI decided to an article which emphasized national defense in order to make the law be a defense legislation and hence not in conflict with the aforementioned treaty. On this point, see: APAI, op. cit., Vol. 1, pp. 66-67.

(71) The sources of this part are: 1) Yamamota, op. cit., pp. 36, 87-88, 105-118; 2) Kumaki, Keisaku, Toyota Motors, Tokyo: Tembo-sha, 1959, pp. 50, 62-63; 3) Ozaki, op. cit., Vol. 1, pp. 375, 378-380.

(72) In order to compete against Mitsubishi's aircraft industry, Mitsui financed Toyoda Auto Weaving Machinery's automobile manufacturing. Source: Ozaki, op. cit., p. 380.

(73) As seen in Footnote (66), Nissan failed in the merger plan with Japan GM, Inc. under equal partnership because the Army strongly opposed any American participation in a new company. The choice of such a second-rate U.S. producer might indicate Nissan's second approach to assimilating American technology without American participation in business operation which could satisfy the Army as well as the Law regarding Automobile Manufacturing Enterprise.

(74) Nissan Motors, Ltd., op. cit., pp. 61-64.

(75) Nissan Motors, Ltd., op. cit., p. 58.

(76) Nissan Motors, Ltd., op. cit., Table of Nissan Products (Page unspecified).

(77) Source: 1) Ozaki, op. cit., Vol. 1, p. 380-381; 2) Nissan Motors, Ltd., op. cit., p. 60.

(78) Ozaki, op. cit., Vol. 1, pp. 383-385; Vol. 2, p. 290.

(79) Source: Ozaki, op. cit., Vol. 1, p. 383; Vol. 2, p. 28.

(80) MITI, op. cit., Vol. II (Industrial Regulations), 1964, pp. 98-99.

(81) MITI, op. cit., 1964, pp. 100-112.

(82) MITI, op. cit., 1964, pp. 125, 127.

(83) MITI, op. cit., 1964, pp. 134-135.

(84) A complete text of this law and its implementation procedures appears in: MITI, op. cit., 1964, pp. 135, 174-192.

(85) Source: 1) MITI, op. cit., 1964, pp. 141-148, 193-204; 2) Nissan Motors, Ltd., op. cit., p. 93.

(86) Source: 1) MITI, op. cit., 1964, pp. 213-235; 2) Nissan Motors, Ltd., op. cit., p. 80.

(87) The previous price controls were based upon the Law Regarding Temporary Measures for Exports and Imports of 1937. The new control changed its legal basis to the more powerful Law of National Mobilization of 1938. Source: 1) MITI, op. cit., 1964, pp. 331-332; 2) Nissan Motors, Ltd., op. cit. p. 95.

(88) MITI, op. cit., 1964, pp. 420-425.

(89) MITI, op. cit., 1964, pp. 435-442.

- (90) MITI, op. cit., 1964, pp. 454-466.
- (91) Nissan Motors, Ltd., op. cit., p. 93.
- (92) MITI, op. cit., 1964, p. 215.
- (93) MITI, op. cit., 1964, pp. 123-124.
- (94) Nissan Motors, Ltd., op. cit., p. 80.
- (95) Nissan Motors, Ltd., op. cit., p. 94.
- (96) Nissan Motors, Ltd., op. cit., p. 95.
- (97) Nissan Motors, Ltd., op. cit., pp. 105, 107.
- (98) Source: 1) Nissan Motors, Ltd., op. cit., p. 96; 2) Ozaki, op. cit., Vol. 1, pp. 402-403; 3) Automobile Almanac: 1943, pp. 1-16.
- (99) FIGURE II-6 is based upon the following data sources: 1) Nissan Motors, Ltd., op. cit., p. 45; 2) Japan Automobile Association (JAMA), Japanese Automobile Industry: 1969, Tokyo: JAMA, p. 54; 3) Ozaki, op. cit., Vol. 1, pp. 446-447, pp. 631-632.
- (100) Nissan Motors, Ltd., op. cit., Chronological Table (Page 2).
- (101) Nissan Motors, Ltd., op. cit., Chronological Table (Page 3).
- (102) Source: 1) APAI, op. cit., Vol. 2, pp. 114-115; 2) Nissan Motors, Ltd., op. cit., p. 96.
- (103) Source: 1) Kumaki, op. cit., pp. 81-82; 2) Nissan Motors, Ltd., op. cit., p. 132, Chronological Table (Pages 2-3); 3) APAI, op. cit., pp. 119-120.

CHAPTER III

(1) Source: 1) The Japanese Chamber of Automobile Industries (JCAI), The General Chronology of Japanese Automobiles, Tokyo: JCAI, 1967, pp. 2-5; 2) Nissan Motors, Ltd., op. cit., Chronological Table (Page 3); 3) MITI, The Quarter-Century Policy Steps by MITI, Tokyo: MITI, 1975, pp. 108-111.

(2) The Congress to Reconstruct Ordinary (Non-special type) Motor Vehicles (CROMV), The Policy for the Reconstruction of Automobile Industry, Working Report (June 18, 1947), p. 2.

(3) Ibid.

(4) CROMV, op. cit., p. 7.

(5) JCAI, op. cit., p. 9.

(6) Nissan Motors, Ltd., op. cit., P. 139.

(7) Yamamoto, op. cit., pp. 206-207.

(8) Ibid.

(9) Nissan Motors, Ltd., op. cit., p. 156; JCAI, op. cit., p. 8.

(10) Nissan Motors, Ltd., op. cit., pp. 158-159.

(11) In spite of the intensive measures to rehabilitate the war-devastated economy through this unique Tilting Production System, their efficiency is very doubtful. See the following statistics:

Increase Rates of Major Production

	<u>UNIT</u>	<u>A(1946)</u>	<u>(B)1949</u>	<u>B/A %</u>
Pig Iron	1,000t	5.558	5.558	100
Copper	"	105	102	97
Electricity	" KW	10,228	10,456	102
Cotton	"	2,046	3,701	179
Rayon	" /day	43		307
Paper	" m lb	958	1,544	161

Source: The Economic Planning Agency, Capital Accumulation and Industrial Management in Postwar Japan (Reproduced in Nakamura, Seiji, The Postwar Japanese Economy and Technological Development, Tokyo: Hyonon-sha, 1968, p. 690.

(12) Source: 1) Nissan Motors, Ltd., op. cit., p. 168; 2) JCAI, op. cit., p. 23; 3) Kogata-jidosha-shinbun-sha, ed., The Development of Small-sized Motor Vehicle Industry, Tokyo: Kogata-jidosha-shimbunsha, 1961 pp. 35-40.

(13) Yamamoto, op. cit., p. 207; CROMV, Op. cit., p. 15.

(14) Nissan Motor, Ltd., op. cit., pp. 156-158.

(15) CROMV, op. cit., p. 16.

(16) CROMV, op. cit., p. 15.

(17) Source: Ibid. The production in calender year 1946 were 14,921 units (Source: Japan Automobile Manufacturers Association (JCMA), Japanese Automobile Industry: 1975, Tokyo: JAMA, p. 46).

(18) Our calculations are based upon the following simple formula:

$$C = B / 14.154$$
$$D = A / C = A \times (14.154) / B$$

(19) The seriousness of workers strikes during this period is extensively delineated in 1) Nissan Motors, Ltd., op. cit., pp. 189-196; 2) Yamamoto, op. cit., pp. 216-221.

(20) Source: Nissan Motors, Ltd., op. cit., p. 138.

(21) Source: 1) Nissan Motors, Ltd., op. cit., Technical Specification of Nissan Cars (Page unspecified); 2) JCAI, op. cit., p. 12.

(22) Source: 1) Yamamoto, op. cit., pp. 227-228; 2) JCAI, op. cit., p. 120.

(23) CROMV, op. cit. p.1.

(24) Center for Economic Stabilization (CES), The Present and Future State of Automobile Industry, CES Report No. 355, August 3, 1948.

(25) Source: 1) Automobile Almanac: 1950, p. 140; 2) JCAI, op. cit., p. 18; 3) Nissan Motors, Ltd., op. cit., pp. 179-180.

(26) Nissan Motors, Ltd., op. cit., p. 226.

(27) The Japanese postwar economic cycles are extensively analyzed by: Shinohara, Miyoei, Growth and Cycles in the Japanese Economy, Tokyo: Kimokumiya-shaten, 1962.

(28) Nissan Motors, Ltd., op. cit., p. 229.

- (29) JAMA, op. cit., p. 46.
- (30) Automobile Almanac: 1952, p. 282.
- (31) Nissan Motors, Ltd., op. cit., p. 235.
- (32) Caution should be paid to the naming of the third major policy intervention. As discussed below, the Regulation Regarding the Conveyance of Foreign Vehicles of 1951 lapsed a year later. However, since 1954, the government resumed the same stringent import restriction policy without major legislation. Thus we adopt the name of this short lasting law for indicating the government import policy throughout this period.
- (33) Source JCAI, op. cit., pp. 19, 24-25, 29.
- (34) Vehicles imported by the U.S. Army and its personnel were exempted from a 40% tariff and a 30% commodity tax under the Import and Trade Control Ordinance of 1949. Source: 1) Kimura, op. cit., p. 119; 2) Nissan Motors, Ltd., op. cit., pp. 308-309.
- (35) Nissan Motors, Ltd., op. cit., p. 121.
- (36) Automobile Almanac: 1951, p. 420.
- (37) JCAI, op. cit., p. 28; Nissan Motors, Ltd., op. cit., p. 220, 222.
- (38) MITI was established on May 24, 1949. Source: MITI, op. cit., p. 130.
- (39) Kimura, op. cit., p. 121.
- (40) Automobile Almanac: 1951, p. 420.
- (41) Ibid.
- (42) Automobile Almanac: 1951, p. 191-192.
- (43) Muramatsu, Ichiro, et al. (ed.), Development History of Japanese Modern Industries, Vol. XXII (Transportation & Communication), Tokyo: Kojyun-sha, 1965, p. 152.
- (44) The following data are extracted from: 1) JCAI, op. cit., pp. 25, 37, 49; 2) Muramatsu, op. cit., pp. 273-274.
- (45) Automobile Almanac: 1957, p. 291.
- (46) Automobile Almanac: 1952, p. 910.

(47) Source: 1) Nissan Motors, Ltd., op. cit., p. 308; 2) JCAI, op. cit., p. 35; 3) Ozaki, op. cit., Vol 2, pp. 189-191.

(48) Automobile Almanac: 1952, p. 91.

(49) Automobile Almanac: 1954, p. 177.

(50) Automobile Almanac: 1958, pp. 316-317.

(51) Automobile Almanac: 1954, pp. 181-182

(52) Automobile Almanac: 1953, p. 316.

(53) Automobile Almanac: 1954, p. 182.

(54) Ibid.

(55) The following text is based on: Automobile Almanac: 1952, pp. 46-47; 2) Nissan Motors, Ltd., op. cit., pp. 310-311. However, before MITI asked, in February, these three companies lobbied MITI and expressed their strong opposition to the policy for facilitating the transfer of American used cars to Japanese buyers .

(56) Automobile Almanac: 1954, p. 182.

(57) Ibid.

(58) Automobile Almanac: 1955, pp. 180-181.

(59) Automobile Almanac: 1955, p. 41.

(60) Source: 1) Automobile Almanac: 1955, pp. 33-35; 2) Automobile Almanac: 1956, p. 135.

(61) Automobile Almanac: 1956, p. 76.

(62) Ibid.

(63) Source: 1) Automobile Almanac: 1956, p. 35; 2) Automobile Almanac: 1954, p. 39.

(64) Automobile Almanac: 1952, pp. 34-35.

(65) Automobile Almanac: 1953, pp. 77-78.

(66) Source: 1) Ozaki, op. cit., Vol. 1, pp. 423-425; 2) Automobile Almanac: 1953, pp. 315-316.

(67) Source: 1) Nissan Motors, Ltd., op. cit., pp. 312-314, 354, List of Nissan Products (Page unspecified); 2) Kawamata, Katsuji, My Personal Vitae, Tokyo: Nihon-Keizai-shinbun-sha, 1954, pp. 129-135; 3) Koiso, The 20-year Development of Japan's Light Motor Vehicles, No. 4. p. 20. (This report is filed at the document room at the Association for the Promotion of the Automobile Industry. However the publisher and the published year are not recorded); 4) Automobile Almanac: 1954, p. 40; 5) Automobile Almanac: 1963, p. 32.

(68) Nissan Motors, Ltd., op. cit., p. 309.

(69) Source 1) Isuzu Motors, Ltd., History of Isuzu Motors, Tokyo: Isuzu Motors, Ltd., 1957, pp. 28, 122, 123, 127; 2) Automobile Almanac: 1954, pp. 40-41; 3) Automobile Almanac: 1963, p. 32.

(70) Source: 1) Automobile Almanac: 1954, p. 40; 2) Himo Motors, Ltd., Himo News, No. 48, pp. 4-5; 3) Automobile Almanac: 1963, p. 32.

(71) Source: 1) Automobile Almanac: 1954, p. 41; 2) Automobile Almanac: 1963, p. 32.

(72) Muramatsu, op. cit., p. 278.

(73) Chronologically speaking, this plan was made public a month later than the newspaper leak of the People's Car Plan. However, we speculate that this plan was preceded to the People's Car Plan in the order of MITI's legislative process because MITI was not ready to announce the People's Car Plan at the time when it was leaked to the press. This is the reason why we first mention the Plan for the Rationalization of the Automobile Industry as pre-intervention environment.

(74) Automobile Almanac: 1956, pp. 132-134.

(75) Koiso, op. cit., p. 27.

(76) JAMA, op. cit., 1970, p. 30.

(77) Koiso, op. cit., No. 1, pp. 23-24; Automobile Almanac: 1955, p. 62.

(78) Nihon-Keizai-shinbun, May 18, 1955.; 2) Nikkan-Kogyo-Shinbun, May 18, 1955.

(79) The following text appears in: Nissan Motors, Ltd., op. cit., pp. 349-35.

(80) Source: 1) Automobile Almanac: 1956, pp. 33-36; 2) Nissan Motors, Ltd., op. cit., p. 350; 3) Koiso, op. cit., No. 3, p. 24-25; 4) Yoshida, Nobuyoshi, Uproaring Japanese Auto Industry, Tokyo: Tokuma-shoten, 1967, p. 16; 4) JCAI, op. cit., p. 57.

(81) Source: 1) Toyota Motors, Ltd., The 30-Year History of Toyota Motors, Toyota, Aichi Prefecture: Toyota Motors, Ltd., 1967, pp. 494-495; 2) Suzuki, Toshio and Masahiro Okada, The Personal History of Shotaro Kamiya, Tokyo: Diamond-sha, 1975, pp. 17-21; 3) Nissan Motors, Ltd., op. cit., p. 350.

(82) Source: Yoshida, op. cit., p. 16. Ironically, Nissan's company history did not contain much of the company's own views of the Plan.

(83) Source: Suzuki Motors, Ltd., The 50-year History of Suzuki Motors, Shizuoka: Suzuki Motors, Ltd., 1970, pp. 48-51.

(84) Source: 1) Car Top, pp., 106-110. (Note: This journal excerpt is filed at the document collection of APAI, Tokyo. However the publisher and publishing year were not recorded); 2) Koiso, op. cit., No. 3, p. 20-25.

(85) Source: Mazda Motors, Ltd., The 40-year History of Mazda Motors, Hiroshima: Toyo Kogyo, KK., 1960, pp. 331-333, 345-348.

(86) Koiso, op. cit., No. 3, p. 25.

(87) Koiso, op. cit., No. 1, p. 29.

(88) Ibid.

(89) MITI, Japanese Automobile Industry, Tokyo: MITI, 1958, pp. 150-159.

CHAPTER IV

(1) See FOOTNOTE (37) of CHAPTER I.

(2) Source: 1) Campbell, op. cit., 1969; 2) Glass, op. cit.; 3) Box, G.E.P. and G.U. Jenkins, Time Series Analysis: Forecasting and Control, San Francisco: Holden-Day, Inc., 1970; 4) Box, G.E.P. and G.C. Tiao, "Intervention Analysis with Applications to Economic and Environmental Problems," Journal for the American Statistical Association, March 1975, Vol. 70, No. 349, pp. 70-79; 5) Hibbs, op. cit.

(3) A mathematical basis of the section is in APPENDIX 1.

(4) Data bases for PART II are shown in APPENDIX 2.

(5) See: Allen, op. cit. An application of the Cobweb model to a policy analysis can be found in: Freeman, Richard B., "Legal 'Cobwebs': A Recursive Model of the Market for New Lawyers," The Review of Economics and Statistics, Vol. LVII, No. 2, May 1975, pp. 171-179.

CHAPTER V

(1) For a mathematical basis of the argument in this section, see APPENDIX 3.

(2) Strictly speaking, the following model is not a general form since it has already been linearized. A more general non-linear model can be linearized by, for example, the Taylor expansion. See: Athans, Michael, "The Discrete Time Linear-Quadratic-Gaussian Stochastic Control Problem," Annals of Economic and Social Measurement, Vol. 1, No. 4, 1972, pp. 449-491.

(3) See: Athans, Michael, "The importance of Kalman Filtering Methods for Economics Systems," Annals of Economic and Social Measurement, Vol. 3, No. 1, 1974, pp. 49-64. However, the above article does not contain the mathematical derivation of the following results. For a complete solution, refer to R.E. Kalman's original work (Kalman, R.E., "A New Approach to Linear Filtering and Prediction Problems," Journal of Basic Engineering, Transactions of the ASME, March 1960, pp. 35-45; Kalman, R.E. and R.S. Bucy, "New Results in Linear Filtering and Prediction Theory," Journal of Basic Engineering, Transactions of the ASME, March 1961, pp. 95-108), or to Miyatake, Nobuharu, Kalman Filter Theory and Its Applications, Working Paper, The Mitsubishi Research Institute (Tokyo), 1975. We have derived a solution for a simple case (See FOOTNOTE (6) of this chapter).

(4) See the definition of $K(t)$ in APPENDIX 3.

(5) In this sense, the model is similar to Box and Jenkins' ARMA model. In fact the ARMA model can be derived by incorporating the state equation into the output equation. Thus, we can say that the ARMA model is one special case of the recursive state/space Kalman Filter model. However, the marked difference is that the estimation of the structure of the ARMA model needs time-series data over an entire period while the estimation of the state/space model structure is done by "on-line" data feeding. See 1) Chow, J.C., "On the

Estimation of the Moving-average Parameters," IEEE Transactions on Automatic Control, Correspondence No. 2, Vol. AC-16, 1972, pp. 268-269; 2) Young, P.C., S.H. Shellswell and C. T. Neethely, "A Recursive Approach to Time-Series Analysis," Internal Report No. CUED/B-Control/TRIB, Department of Engineering, Cambridge University, 1971; 3) Young, P.C., "Comment on On-line identification of Linear Dynamic Systems with Application to Kalman Filtering," IEEE Transactions on Automatic Control, Correspondence, Vol. AC-16, 1971, pp. 269-270; 4) Krange, D.J. and D. Granpe, "Identification of Predictor and Filter Parameters by ARMA Model," International Journal of Control, Vol. 7, 1973, pp. 1021-1027.

(6) A derivation of the following results is shown in APPENDIX 3.

(7) A dynamic extrapolation of the part trend by the Kalman Filter is discussed in APPENDIX 3.

(8) Structurally speaking, this means that the current parameter estimates will remain in the next period.

(9) Numerical data are presented in APPENDIX 2.

(10) More rigorously, we checked historical evidence as to which month the policy impact appeared. If intervention occurred early in a certain year, impact would appear in the data of such a year. On the other hand, if it occurred in a latter half of a year, impact would appear in the next year. Such a careful inquiry about the input starting time emphasizes the importance of historical knowledge for a Kalman Filter application.

(11) As presented in the remaining part of this chapter, we have employed the Kalman Filter dynamic parameter estimation for both growth rate and growth data models. After numerous trial runs with different assignments of initial conditions, we have adopted the following settings:

A. For the growth rate model

1) Initial parameter estimates

$$\begin{aligned}\hat{a}(0/0) &= 0.150 \\ \hat{b}(0/0) &= 0.000\end{aligned}$$

2) Initial parameter estimation error variances

$$\begin{aligned}\text{var}(a(0) - \hat{a}(0/0)) &= 0.010 \\ \text{var}(b(0) - \hat{b}(0/0)) &= 0.00\end{aligned}$$

3) System noise variances

$$\text{var}(e(t)) = 0.005$$

$$\text{var}(s(t)) = 1.000$$

4) Measurement error variance

$$\text{var}(w(t)) = 0.010$$

B. For the growth data model

1) Initial parameter estimates

$$\hat{a}(0/0) = 1.000$$

$$\hat{b}(0/0) = 0.000$$

2) Initial parameter estimation error variances

$$\text{var}(a(0) - \hat{a}(0/0)) = 0.010$$

$$\text{var}(b(0) - \hat{b}(0/0)) = 0.000$$

3) System noise variances

$$\text{var}(e(t)) = 0.010$$

$$\text{var}(s(t)) = 9000.$$

4) Measurement error variance

$$\text{var}(w(t)) = 100.$$

These initial settings are in common for all datasets. Our experience with different initial settings on trial runs has drawn the following comments:

1) Initial parameter estimates:

For the purpose of setting the Kalman Filter quickly track the trend of the initial policy-off period, we first assigned the value for $\hat{a}(0/0)$ which was the log-linear regression estimate for the initial exponential curve having the homogeneous structure (i.e. $\hat{b}(0/0) = 0.$). However, we have found that this pre-run off-line calculation was not important since the curve was smooth and the tracking of the Kalman Filter was so fast. In other words, we may assign a subjective value unless it is too unrealistic.

2) Initial parameter estimation error variances:

As discussed in APPENDIX 3, these values control the accuracy of the Kalman Filter's tracking throughout an entire period of time-series data. Recognizing that all data sets show very smooth curves, we assigned small values.

3) System noise variances:

For the growth rate model, the estimation results were very sensitive to the difference between $\text{var}(e(t))$ and $\text{var}(s(t))$. We determined values for these by judging the degree of the fitted growth rates. For the growth data model, $\text{var}(e(t))$ should be very small since it sensitively effects the output production value. On the other hand, $\text{var}(s(t))$ must be very large because its square root (i.e., standard deviation) has the same demension as that of production. Our experience showed that the overall pattern of the heterogenous parameters were not affected by defferent variance settings, while the level changed greatly.

Numerous trial runs have been done at both M.I.T. and the Mitsubishi Research Institute (Tokyo) with the computer program originally written by Mr. Nobuhara Miyatake of the Mitsubishi Research Institute and slightly modified by the author to fit his computational purposes. Mr. Miyatake gave the author valuable and insightful suggestions for computer runs. The author is thus greatly indebted to him for his computational assistance, supply of the comprehensive literature of the Kalman Filter theory and superb teaching on this quite innovative method.

(12) Athans, op. cit., 1974, p. 56.

(13) The word "independent" needs some caution. As already discussed, the first intervention (the Law Regarding Support for Military Vehicles of 1918) established for the first time an organized motor vehicle manufacturing industry. Thus, strictly speaking, the industry was not independent from the beginning. However, we recognize that the first intervention operated to give the initial conditions with which the industry started its evolution. This view is based on systems theoretical understanding of the dynamic development of the Japanese motor vehicle industry.

(14) Because of the built-in numbering feature of the plotter program subroutine, the numbering of FIGURES V-18, V-19, and V-20 and that of computer printouts of fitted production have a one year difference.

(15) The same rule as that in FOOTNOTE (14) of this chapter is applied in regard to the inconsistency in numbering between FIGUREs V-18, V-19, and V-20 and the following computer printouts.

(16) See FOOTNOTE (11) of this chapter.

CHAPTER VI

- (1) As previously defined, foreign supply consisted of the import of complete cars and those assembled by Japan Ford and Japan GM.
- (2) We have already described how the government strengthened import restrictions after the lapse of the Regulation Regarding the Conveyance of Foreign Vehicles. See SECTION III-2.
- (3) In FIGURE V-10, one may draw a concave curve starting from the point of 1953. However, our argument focuses on the short period from 1951 to 1955 which is of greater policy significance. Thus we regard the trend over this particular period as convex as drawn in the figure. The trend change after 1955 in fact shows the change of the import restriction policy. Rather than the sharp end of foreign supply which occurred in the prewar case, the relative share of foreign supply gradually diminished. This suggests that the postwar civilian government had no urgent imperative to crack down foreign supply since 1956 because of its confident recognition of the stable exponential increase of domestic production.
- (4) Argument on this part will further be elaborated in next SECTION VI-3.
- (5) See: 1) Utterback, James M., "Innovation in Industry and Diffusion of Technology," Science, February 15, 1974, Vol 183, pp. 620-626; 2) Utterback, James M. and William J. Abernathy, "A Dynamic Model of Process and Production Innovation," OMEGA, Vol. 3, No. 6, 1976, pp. 639-656.
- (6) Vernon, op. cit.

CHAPTER VII.

- (1) JAMA, op. cit., 1974, pp. 48-49.
- (2) This figure was calculated based on two sources: 1) Ibid.; 2) MITI, White Paper International Trade and Industry, Vol. 2, 1974, pp. 2, 878.

- (3) This figure was calculated based on two sources: 1) JAMA, op. cit., p.2; 2) Sirosawa, op. cit., p. 29.
- (4) This figure was calculated based on two sources: 1) JAMA, op. cit., 1974, pp. 8-9; 2) MITI, White Paper, 1974, Vol. 2, p. 289.
- (5) CITIBANK, ed., Monthly Economic Letter, July 1976, pp. 5-8.
- (6) This view adopts H. Wold's definition of the price elasticity of demand in which demand is considered as "stock" such as automobile ownership.
- (7) CITIBANK, op. cit.

APPENDIX 1

(1) Following Eq(1.5) is popularly known by electrical engineers as the current curve of the "R-L Circuit" under constant voltage. See, for example: Kreyszig, E., Advanced Engineering Mathematics, New York: John Wiley & Sons, Inc., 1962, p. 69. Also it is call the "Investment multiplier effect" curve in economics.

APPENDIX 2

- (1) JAMA, op. cit., 1969, p. 54; Ozaki, op. cit., Vol. 1, pp. 446-7, 631-2. Note: "*" means the total production of three companies, Tokyo Gas & Electric (TGE), Ishikawajima Motors and DAT Motors. There was no public record on the data for the period 1913-1929.
- (2) JAMA, op. cit., 1969, 1975.
- (3) Nissan Motors, Ltd., op. cit., p. 45.
- (4) Nissan Motors, Ltd., op. cit., p. 16.
- (5) MITI, The Current Status and Problems of Technology Contracts, Tokyo: MITI, 1968, p. 797.
- (6) Automobile Almanac: 1947, pp. 215-216; Nissan Motors, Ltd., op. cit., p. 16; Ozaki, op. cit., Vol. 1, pp. 66-7, 305; Vol. 2, pp. 182-5.
- (7) The Ministry of Finance, Custom Bureau, Survey Data (unpublished).
- (8) Ozaki, op. cit., Vol. 2, p. 206.
- (9) See FOOTNOTE (2) of this appendix.

APPENDIX 3

(1) Although a great amount of literature on the Kalman Filter are available in engineering, almost none of them are suited for social science purposes (except for mathematical economists) because the available literature is too technical and mathematically advanced. In writing this appendix, we have mainly referred to: 1) Athans, op. cit., 1972; 2) Luenberger, David G., Optimization by Vector Space Methods, New York: John Wiley & Sons, Inc., 1969, pp. 79-102; 3) Astrom, Karl J., Introduction to Stochastic Control Theory, New York: Academic Press, 1970; 4) Boudarel, R., J. Delmas, and P. Guichet, Dynamic Programming and Its Application to Optimal Control, New York: Academic Press, 1971, Appendix, et. seq.

(2) As supplemental to the above literature sources, we cite: 1) Ozkan, Turgay and Michael Athans, Application of Kalman Filtering Methods to Parameter Estimation of Macroeconomic Models, Working Paper ESL-598, Electronic Systems Laboratory, M.I.T., May 1975; 2) Young, P.C., "Discussion on Dr. Brays' Paper, " Journal of the Royal Statistical Society, No. 3, Series A (General), Vol. 134, No. 2, 1971, pp. 220-222. The former paper applies the more or less technique as our approach to R. Pindyck's U.S. economy model by assuming that the structure model is known (i.e., the Pindyck model). The latter paper restates the ordinary least square regression technique in terms of the Kalman Filter's recursive parameter estimation.

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AUTHOR'S NOTES:

- 1) Numerous other anonymous books, reports, and articles than those listed below have been referred to in this research. However, complying with the standard rule of scientific honesty and responsibility and avoiding the aesthetic distastefulness of bulky reference lists, only those cited in footnotes are presented here.
- 2) "*" means the sources in Japanese.

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