

# Class Four, Part Two: The New Services Challenge from Globalization

William B. Bonvillian  
Director, MIT Washington Office

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FUNDAMENTALS OF SCIENCE AND  
TECHNOLOGY PUBLIC POLICYMAKING

# Offshoring Drivers:

- Services 70%+ of US GDP; offsets US trade deficit in goods
- US now shifting R&D offshore – innovation effect?
- Drivers of Offshore Outsourcing:
  - IT availability worldwide
  - Low labor costs abroad
  - Availability of highly-education labor
  - Foreign gov't subsidies, weak regulatory regimes
  - Offshore partnering mechanisms now widespread
  - Access to new and large markets

# Ron Hira (Rochester Institute of Technology), “Implications of Offshore Outsourcing” (1/23/04)

- Debate: classical economics – offshoring is win-win for US and nations gaining jobs vs.
- Will be winners and losers in the US (Hira’s view)

## Definitions –

- Outsourcing – co. decides to no longer make part or all of product or process in house - will purchase it from another entity
- Offshore Outsourcing – companies outsource overseas
- Offshoring – multinational moves work from domestic sites to foreign sites

# Offshore Outsourcing: (Hira)

- – potentially major shift in how our economy operates (in the service sector)
- Positive: lower costs of products and services by lowering input costs; expand and open new markets abroad
- Negative: jobs created abroad by this are at the expense of domestic employment; domestic jobs are lost and not replaced

## Innovation effects:

- US economic competitiveness dependent on innovation system and innovation capacity – these could be affected
- “blind faith” – if communications, semiconductor mfg. electronic devices, and other key technological capabilities lost, US will move on to “next big thing”
- If next big thing is nanotechnology, China is second largest producer of technical papers in this area behind the US and ahead of Japan

# Hira: Concluding Quotes:

- “growing consensus that offshore outsourcing of high-skills jobs will not only continue but accelerate and expand to include an ever-widening cluster of occupations”
- “these are not low level jobs that no Americans would want but high-skill/high value added positions filled by some of our best and brightest engineers and computer scientists”



Catherine L. Mann, “Globalization of IT Services and White Collar Jobs: The Next Wave of Productivity Growth”, International Economics Policy Briefs, No. PB03-11 (Dec. 2003)

**Basic Points:**

- Globalized production of IT hardware led to lower prices during the 90’s prompting IT investment and transformation.
- This was disruptive to businesses and workers
- But – was key to ’90’s higher trend productivity growth, lower inflation, more employment

# Mann: There will be a Second Wave

- Now: “second wave” of productivity growth through an “international value chain” (ie, produced abroad) will lead to hardware, and now software and services price declines – IT package will be more affordable for firms
- Therefore more firms will adopt IT and further drive productivity gains – and employment will increase because the software and services produced abroad will be “knit together” in the US “close to customers”
- So: high skill jobs designing and tailoring IT packages will increase in the IT sector, as will jobs to use these IT packages effectively will diffuse throughout the US economy
- “Globalization of software and services, enhanced IT use and transformation activities in new sectors, and job creation are mutually dependent. Breaking the links by limiting globalization of software and services or by restricting IT investment ... puts robust and sustainable US economic performance at risk.”

# Mann: When you Cut through Boom/Bust Cycles

## Employment is the Same...

- When you cut through the “boom-bust” peaks and valleys of the current business cycle, comparing end of 99 and end of 03 data on employment nos., “employment in architecture and engineering is stable -and in computer and mathematics fields 6% higher, -and business and financial occupations 9% higher.”
- [Q: but isn't the current “jobless recovery” structurally different re: employment, so is there a basis for these figures?]

## Lagging Sectors:

- There are large sectors in the US economy that are lagging in adopting IT productivity gains
- Example: Small and Medium Size Businesses (SME's) slower in adopting IT



# Mann: Ex. of Lagging Sector: Health

- 372,000 preventable injuries and deaths per year from “Adverse Drug Events” (ADE’s)
- Add between \$1.56b and \$5.6 b in hospital expenses each year
- Bar coding of prescriptions medicines and blood products with electronic medical records could cut ADE’s by 80,000
- Telemedicine improves patient recovery, decreases readmission, cuts costs by 80% by allowing basic medical checks performed at home and transmitted to central data base
- Mann’s theory – lowering IT services costs will speed introduction of these productivity gains into IT lagging health

## [Other ex’s of lagging IT adaptors:

- entertainment (why not email instead of snailmail, netflixs?); government ]
- --Assumption: lagging sectors will be prone to adopt IT based productivity savings if prices cut --- correct??]

# Mann's Conclusions:

- Thesis – IT services will be done abroad, but higher paid jobs demanding IT skills will grow quickly as well in the US with lower costs speeding their introduction (particularly in lagging sectors) and therefore the,
- “potential increase in investment, productivity growth, and job creation from the globalization of IT services and software is even greater than that experienced in the 1990's”

# Questions Re: Mann and Hira:

- Q: Where do you come down in the Mann-Hira debate?
- Q: will lower IT services/software costs from shifting production abroad speed introduction of IT in lagging US IT sectors? Or are there other barriers that explain why lagging sectors haven't adopted?
- Q: Why won't the "high skill" IT services work be done abroad via the internet as well lower skill services, since US has declining talent advantage?
- Q: what about the potential loss in innovation capacity by loss of the engineering design and R&D work related to IT software and services shifted abroad?
- Q: If entry level IT jobs shift abroad, where will workers gain experience to move up the skill chain to higher end IT jobs, even if high end IT jobs don't move abroad?

Paul A. Samuelson, Prof. Of Economics, MIT (Nobel Prize 1972),  
“Where Ricardo and Mill Rebut and Confirm Arguments of  
Mainstream Economists Supporting Globalization”, Jour. of Economic  
Perspectives, Vol. 18, No. 3 (Summer 04)

- Mainstream economists (Alan Greenspan, Jagdish Bhagwati, Gregory Mankiw, etc.) argue re Globalization:
- “Yes, good jobs may be lost in the short run, but still total US net national product must by economic laws of comparative advantage be raised in the long run (and in China, too).... Never forget the real gains of consumers alongside admitted possible losses of some producers in this working out of what Schumpeter called ‘creative capitalist destruction.’
- Correct economic law recognizes that some American groups can be hurt by dynamic free trade. But correct economic law vindicates the word ‘creative’ destruction by its proof that the gains of the American winners are big enough to more than compensate the losers.”
- But Samuelson says: “The last paragraph can only be an innunendo For it is dead wrong about the necessary supply of winnings over losings”



# Samuelson: Capturing Comparative Advantage

- Q: How can the US be a loser in trade with a low cost, low wage competitor like China despite the Ricardo's theory of comparative advantage?
- A: Ex.: If China begins to make productivity enhancing gains in its production, and couples that with its low wages, it can capture some of the comparative advantage that belonged to the US through its productivity dominance [note: US still the most productive economy in the world]
- Then -- in a Ricardo analysis, there is never any unemployment that lasts forever from trade. "So it is not that US jobs are ever lost in the long run; it is that the new labor-market clearing real wages has been lowered by this version of dynamic fair trade."
- In other words, US wages can drop after a time to a point where China's productivity enhancement is offset. The US still has a benefit from lower prices for goods, but there are now "new net harmful US terms of trade"

# Samuelson: Economic history is replete with the story of capturing comparative advantage:

- Example: Farming moves from east US to midwest two centuries ago
- Example: Textile and shoe mfg. moved from new England to the low-wage South early last century
- Example: English mfg. leadership shifted to the US starting in the middle of the 19th century
- “Even where the leaders continued to progress in absolute growth, their rate of growth tended to be attenuated by an adverse headwind generated from low wage competitors and other technical imitators.”

# Samuelson's conclusions:

- So: “a productivity gain in one country can benefit that country alone, while permanently hurting the other country by reducing the gains from trade possible between the two countries” – all this is “long run Schumpeterian [the creative destruction of capitalism] effects”
- There is a roulette wheel of evolving comparative advantage in a world of free trade
- “Comparative advantage cannot be counted on to create...net gains greater than the net losses from trade”
- But if you respond with tariffs and protectionism, you may be breeding “economic arteriosclerosis”

William J. Raduchel (VP, CTO, AOL-Time Warner, former CSO, Sun), “The Economics of Software” (2004-draft report for National Academies of Sciences STEP Board)

- Software: core of most modern organizations
- Largest single class of assets in the world
- Operating, maintaining and creating software is the largest class of expenses for the modern corp. other than direct labor
- Software and the business practices it supports are the biggest driver of productivity growth
- “Software embodies the knowledge and practice by which the organization performs its mission, and consists of both design and implementation”
- Software determines the enterprise planning systems that set how a factory will run



# Raduchel: Key Role of Software

- Harvard economist Dale Jorgenson: for most OECD economies software was the major source of increased investment in knowledge during the past decade
- US Labor Dept. Bur. of Labor Stat's anticipated that 8 of the 10 fastest US occupations will be computer related, with software engineers comprising the largest group
- --This prediction is at risk given the way India and China are upgrading their economies by outsourcing these jobs from the US, where computer science continues to decline in popularity as a field of study
- A firm is an information system – of highly decentralized computing by fallible agents (people) -- software defines the information system, so the value of a firm is largely embedded in its information system

# Raduchel: Software looks remarkably easy...

- but the problem is making it error free, robust against change, scaleable to high volumes, and seamlessly integrated with many other firm software system in real time
- The software stack on a modern PC is probably the most complex good every created by man – average corporate IT system is far more complicated than the Space Shuttle or Apollo project
- Bill Joy – the spiraling complexity of putting “Star Wars” scale software on the desktop
- There is no other item we own that is as confusing and unreliable as our PC – the hardware works well, it's the software

## Software is a “Stack”

- Software is a “stack” composed of multiple layers of software created by different teams over time for different purposes and brought together for the unique task at hand
- individual parts of the software don't matter, it's the entire stack – and EVERY part of the stack has to function very well otherwise it's worthless

# Raduchel: Software development

- -The best software developers are orders of magnitude better than the average developer
- -About 100 to 200 developers worldwide end up writing the software we use
- -Maurice Halstead: one attribute of the human brain drives programming ability
- no one can solve a programming problem he or she can't understand
- Average developer has about 250 "Halstead lengths"
- Wizard programmers have Halstead lengths of 65,000

## Economics of software

- -Different from anything else
- -Not a factor of production like labor or capital
- -Instead it defines the production function
- -It improves by making itself more complex - raising risk of catastrophic loss
- -Economists, lawyers, accountants don't properly value or account for software
- -It is a tool without value in itself, but it creates huge potential value through in the systems it is built for
- -We account for it as a periodic expense but in reality it adds assets and liabilities

# Raduchel: Making software

- The specification for the software is without meaning – the only specification is the stack itself
- Quality of the designer is 90% of the quality of the software design
- Best way to cut software costs and improve features is to increase the quality of the designer
- Cutting the development schedule requires a many fold increase in staff
- Adding more staff guarantees later delivery
- Value of software is often unrelated to cost
- Cost of maintaining and modifying software increases over time and with accumulated changes
- Has to be replaced every 7 to 10 years because of accumulated changes and platform evolution
- Source code, is the least valuable part of software so giving it away is good strategy because it is irrelevant and can promote new innovation [IBM-Microsoft Linux vs. Windows open source battle]



# Raduchel: Software – value/liability enabler:

- -Software programming phase is only 10% of the software – the implementation is an intangible asset of potentially enormous value
- -its value grows with the operations and prospects of those business operations
- – it is also a huge potential liability

Richard B. Freeman, Harvard Eco. Chair,  
“Does Globalization of the Scientific  
Engineering Workforce Threaten US  
Economic Leadership? (6/05 NBER)

- US has been world sci/tech leader since WW2
- Only 5% of world population, US employs 1/3 of world science and engineering researchers
- US accounts for 40% of world R&D, 35% of S&E articles
- 17 of top 20 world universities in the US
- US exports are disproportionately from tech sectors

# Freeman, Con't

- US share of sci/engineering degrees of all types is falling fast
  - S&E PhD's from Europe and Asian Univ's increased, while US PhD's nos. stagnate
  - US reliance on foreign born PhD's increased
- Job market for young scientists/engineers worsened compared to other high level job occupations - discourages US students from entry, but attracts foreign born to fill ranks
- By increasing no. of sci/engineers lower income countries like China and India can compete with US in technically advanced industries
  - Threatens to undo traditional north/south pattern of trade where advanced dominate high tech

# Freeman, Con't

- Declining comparative advantage in high-tech will create serious adjustment problems for the US
  - Offshoring of IT jobs to India, growth of high tech imports from China are harbingers
  - US faces a long transition to a less dominant position in science and engineering-associated tech industries, around which we have centered our comparative advantage of the past half-century



# Carl Dahlman & Anuja Utz, India and the Knowledge Economy (World Bank 2005)

- India's poverty incidence down from 44% in 80's to 26% in '00
- Foreign Direct Investment - 3rd in world, \$4.6b in '03 (China #1 = \$55b)
- India's GDP growth; 8.2% in 02-03
- From 97-03: Agriculture down to 22% off GDP, Mfg. steady at 17% (mfg. job growth only 2% a year); Services up to 50.8%
- India=17% of world pop., 2% of world GDP

# Dahlman & Utz, Con't

- Global knowledge economy - knowledge has become key driver of economic success
- India's advantages:
  - Base of well-educated, skilled talent in sciences
  - Democratic system
  - Stable macroeconomic factors
  - Widespread use of English
  - Sound financial sector
  - Diversified S&T sector
- Growing IT services sector and capability
  - Software & IT services exports+\$12.5b/yr. in 04
  - IT is now over 4% of India's GDP

# Dahlman & Utz, Con't

- India's IT services - unique strategy; difference from traditional low then high end mfg. tried by Taiwan, Korea, China - India trying totally new model focused on services exports
  - Hyderabad is "cybercity"
  - India destination for R&D for 100 multinationals - ex., GE: 1800 tech ee's, 600 are PhD's
  - New S&T funds for India to spur innovation and R&D
  - Biotechs and pharmas emerging in drug discover
  - New IP laws
  - New "National Innovation Foundation" for R&D

# Dahlman & Utz

- India still well below Brazil and China on “Knowledge Economy Index” of World Bank
- Four Pillars of this Index:
  - Economic and institutional regime - tariffs, regulatory climate, rule of law, corruption
  - Education and human resources - literacy, secondary school and college enrollment
  - Innovation system - researchers in R&D, patent ap’s approved by US, sci and tech articles
  - Information infrastructure - phones and computers per 1000 people, internet users
- India: no sign. improvements in 1 & 2, growth in 3 & 4 - like China, running different economies



# Class Four, Part Two - Wrap-Up

## ■ Offshoring Drivers:

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# Wrap-Up, Continued:

- Hira, Mann, Samuelson – new debate over what **globalization** does to the 200-year old economic doctrine of **comparative advantage**, where all players win in trade
  - Growth economics teaches that **innovation capability is key to a nation's growth**.
  - But with a global market emerging in high skilled jobs, including services, most of the US **workforce is in global competition**, including its innovation capacity.
  - Can one nation now quickly displace another's innovation capacity and so **capture its comparative trade advantage**?
  - Bhagwati: **"immiserating"** – where high skill nation loses from slashed prices resulting from trade / this forces downward wage competition

# Services Wrap-Up, Continued:

- **Raduchel:** Software is key to the way a modern company deploys its competitive advantage
  - Software is now the heart of corporate value
  - But it's not just the software, it's the way you use software to organize your business model
- **Freeman:** US losing talent base leadership
- **India** understands key role of software and IT services -
  - Developing countries historically focus on manufacturing, moving upscale from low to high end manufacturing
  - India has a whole **new model** – low and high skill IT-based services
  - World software power, then high end IT services power – at the center of corp. power worldwide?

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Resource: Science Policy Bootcamp  
William Bonvillian

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