Homework Assignment 6

Development Economics 14.771 / 2390b

Problem 1 *Efficient technology adoption*

Farmers may learn by experience (learning by doing) and from neighbors (knowledge spillovers) how to best use a new technology. Since early adoption is risky, this leads to a strategic game between neighbors over technology adoption. Would land reform tend to spur or slow technology adoption in this setting? Why?

Problem 2 *Appropriate Technology and Growth*

(based on Basu and Weil, QJE 113(4), 1998)

In their model, Basu and Weil assume that when a country produces at a (log of) capital labor ratio k, learning by doing improves *equally* the level of all technologies that use a capital labor ratio which is in a *symmetric* neighborhood around k. In particular, they assume that the level of technology at j improves in such a way that:

$$\frac{dA(j,t)}{dt} = \beta \left(A^*(j) - A(j,t) \right)$$

when $k - \gamma < j < k + \gamma$, and it is not improved otherwise. $A^*(j)$ is the highest level of technology attainable at a capital labor ratio j.

The goal of this problem is to investigate how important are these *uniformity* and *symmetry* assumptions to their results.

A] Assume instead that spillovers effects are higher for technologies that use a (log of) capital labor ratio that is closer to k, the capital intensity of the country at time t:

$$\frac{dA(j,t)}{dt} = \beta \left[1 - \theta |k - j| \right] \left(A^*(j) - A(j,t) \right)$$

when $k - \gamma < j < k + \gamma$, and it is not improved otherwise. Assume that $0 \leq \theta < \frac{1}{\gamma}$.

1) In the one-country case, assume that in steady state, the capital labor ratio and the output per capita grow at a constant rate g.

a) Find the steady state level of technology, $A(k)$. How does it vary with respect to g ? What is the effect of θ ? Explain.

b) Assuming a savings rate s and a discount rate δ, find the equilibrium growth rate g. How does it compare to the uniform case ($\theta = 0$) ?

2) Assume now that the world is composed of two countries and that technology freely flows between them, as well as (local) learning by doing spillovers:

$$\frac{dA(j,t)}{dt} = \beta\left(A^*(j) - A(j,t)\right)\sum_{i=1}^{2}\left[1 - \theta|k_i - j|\right] I\left(k_i - \gamma < j < k_i + \gamma\right)$$

Where $I(.)$ is the indicator function and i designates the country.

Assume first that the two countries end up in a steady state where they both grow at the same rate g. Let d be the steady state difference between the leader country's (log of) capital labor ratio k_1 and the follower's k_2.

a) Write down the law of motion for the level of technology corresponding to the capital labor ratio k_1, $A(k_1, \tau)$, depending on whether country 1, country 2, or both countries exert a spillover effect on this k_1-technology.

b) Compute the steady state level of technology in country 1, $A(k_1)$.

c) Compute the steady state level of technology in country 2, $A(k_2)$. What must be the relation between s_1 and s_2, the savings rate of the two countries, so that they grow at the same rate g. Discuss the effect of θ on the technology steady state values compared to the uniform case. Discuss.

d) Derive the steady state growth rates g_1 and g_2 when the countries end up on different growth paths. How does θ affect the likelihood that there will be convergence in growth rates between the two countries ?

B] Assume now that spillovers are uniform but that they affect a different range of "future" and "past" technologies (alternatively, we could have assumed a different β for "future" and "past" technologies):

$$\frac{dA(j,t)}{dt} = \beta\left(A^*(j) - A(j,t)\right)$$

when $k - \gamma_1 < j < k + \gamma_2$, and it is not improved otherwise.

Without deriving any equation, answer carefully the following questions:

1) What is the effect of γ_1 in a one-country world ?

2) What drives endogenous growth in the model ? What happens when γ_2 gets very small ?

3) In a multi countries world, discuss the likelihood of endogenous growth and growth convergence or divergence as a function of the relative values of γ_1 and γ_2.