Prof. Tybout

Economics 404W
Lecture 11
February 14, 2006

Last time—Rosenstein-Rodan (as redone byMurphy, Schleifer and Vishny)

- It's possible that the returns to building factories depend upon whether other build factories too.

- When complementarities (externalities) like this are important, countries may be stuck in low-level equilibria because of coordination problems.

- A big push may get the industrialization/modernization process started, but there is no guarantee it will work.

Another theory of poverty traps: Kremer's O-Ring model
Suppose production involves a set of tasks, $i = 1, \ldots n$, and each must be done properly in order to get the full value of output. Defining q_i to be the quality effort that goes into the i^{th} task, Kremer uses the following production function for a unit of output to represent this premise:

$$F(q_1, q_2, \ldots, q_n) = q_1 \cdot q_2 \cdots q_n$$

Assume that each worker performs one task. You can think of each q_i as representing the probability of success in performing the i^{th} task. Then if outcomes on tasks are independent, you can think of the production function as giving the probability that all tasks are successfully performed.

For example, to produce a bicycle, the metal tubes must be shaped properly, the welds must be done correctly, the wheels must be round, etc. If any one of these tasks is not done well, the value of the bike is severely compromised, and the effort gone into the other tasks will have been largely wasted.

If labor markets are competitive, and firms maximize expected profits, this type of technology leads to assortative matching. That is, high quality workers will want to work together, and low quality workers will end up working together.

Why? Firms with high-skill workers in all but one task receive the greatest benefits from having a high-skilled worker in the remaining task—there is more at stake. Thus they will bid the most for the high skilled workers, and they will get them.

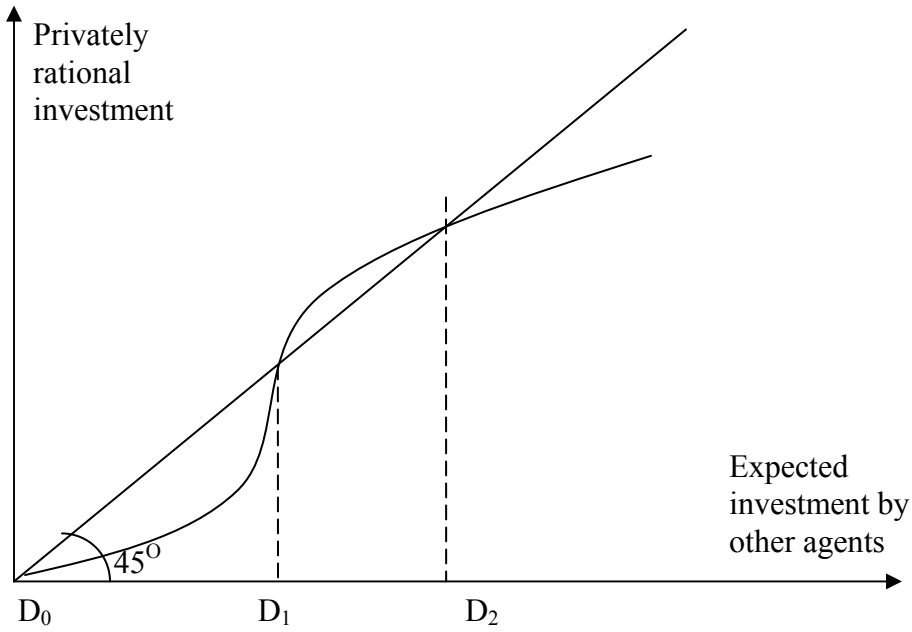
Example: Consider an economy with high quality workers (q_H), and low quality (q_L) workers. Also, let n=2, so that production involves only two stages.

What is the marginal product of a high quality worker if she is paired with another high quality worker versus a low quality worker? q_H^2 versus $q_H q_L$, so the premium for quality at a firm with a high quality worker is $q_H(q_H - q_L)$. By analogous logic, the premium for quality at a firm with a low quality worker is $q_L(q_H - q_L) < q_H(q_H - q_L)$. Accordingly, a firm with one high quality worker will be willing to outbid any firm with a low quality worker for a high quality worker. This leaves the low quality workers to pair up.

Note that assortative matching is efficient here. For example, in an economy with two of each type of worker, total output will be $q_H^2 + q_L^2$. By the previous inequalities we know that this exceed the amount of output attainable with mixed quality production: $q_H^2 + q_L^2 > 2q_H q_L$.)

Do we really see assortative matching? (Examples?)

This type of technology leads to an important complementary (externality) among workers. When others are high skill, the return to being high skill is large, and when others are low skill, the return to being low skill is small. So we are back to the familiar problem of coordination, and low level traps are possible:



Other implications of the O-ring theory:

- Trade and multinational investments may allow countries to trade in key tasks, importing the ones that they don't do well themselves.

- Because of complementarities in worker quality, an economy with workers who are modestly more skilled than those in another economy may be dramatically more productive than the other economy.

- Countries with low skill labor won't want to attempt complicated production activities with risks of failure at many stages in the process.

D. Dual Economy Models

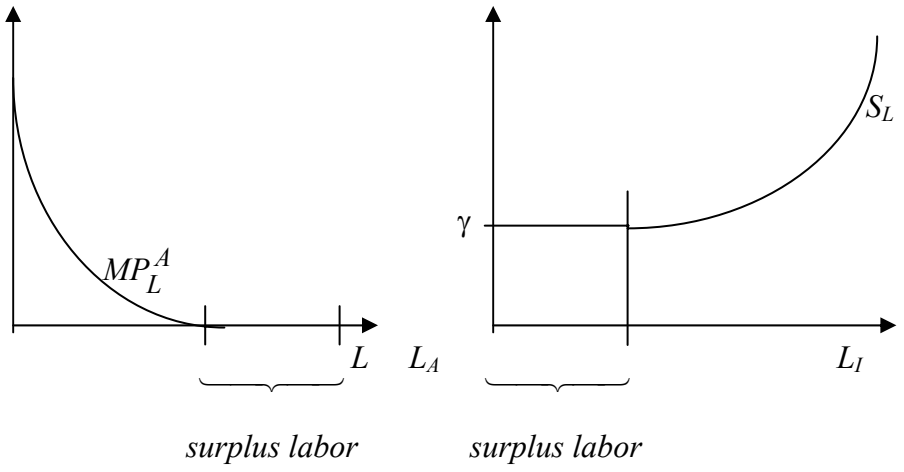
Now I want to consider an alternative explanation for the emergence of industry. This vision of the transition dates back to Arthur Lewis (1955), and was refined in the 1960s by John Fei and Gustav Ranis (1964), as well as Dale Jorgenson (1963).

Rather than overcoming a coordination problem, these models describe development as a continual process of moving labor from traditional agricultural uses—where its marginal product is low—to modern industrial uses.

Production technologies: $Y_A = F_A(L_A, R) \quad Y_I = F_I(L_I, R) \quad L = L_A + L_I$

There are two variants of the dual economy model, one that presumes surplus labor exists, and one that does not. We'll consider the version with surplus labor.

Surplus labor means, for our purposes, that workers can be removed from the agricultural sector without causing agricultural production to fall. Unless remaining workers increase their effort when a worker is removed, this implies that the marginal product of labor is zero:

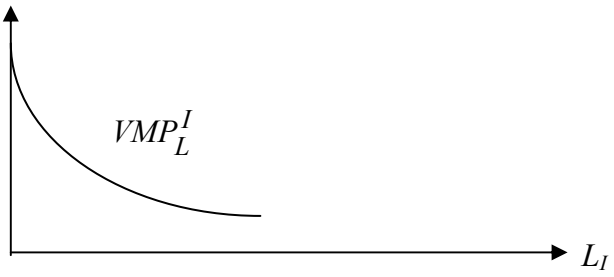


Of course, this means that some workers in agriculture survive without producing anything. Lewis, Fei and Ranis offered several ways that might happen. Benevolent landlords might provide for the entire families of workers, even when some aren't productive. Alternatively, extended farm household might provide food and shelter to unproductive relatives.

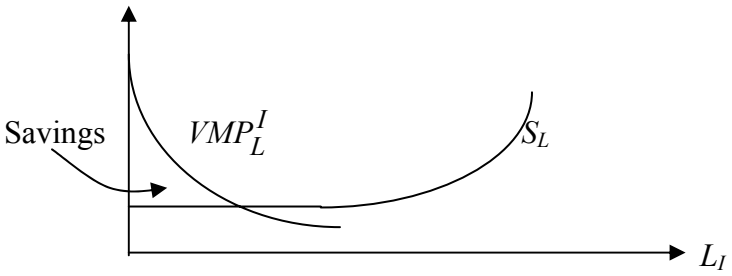
If the superfluous workers are simply given enough food to subsist (γ), then they should be willing to move to the city and take an industrial sector job whenever these jobs pay more. This should characterize the labor supply schedule up to the point at which so much labor has been removed that the marginal product of labor is positive. Then, to remove workers means reducing agricultural output, so the price of agric. goods is pushed up relative to the price of industrial goods (our numeraire), and the wage that industrialists must pay workers (to cover subsistence) rises. Eventually, everyone in agriculture is sufficiently productive to earn his or her value of marginal product, and the transition phase is complete.

What do migrants eat? They trade their payments in industrial products for the food that was left behind when they migrated (now held by households or landlords).

It remains to characterize the behavior of industrialists. Suppose one rich family has the resources to build a factory. They will want to hire workers to work in it, and the profit maximizing rule is to employ all who contribute more to revenues than to costs. Given that the industrial production function is neoclassical so that there are diminishing returns to labor. Then, given the initial capital stock (K_0), the VMP_I is downward sloping:



Combining this with the labor supply schedule, the amount of labor that will be attracted to the industrial sector when the first factory is built will be L_I^0.



Finally, to characterize the capital accumulation process, assume that industrialists (i.e., the capitalist family) save all their income, while workers save nothing. (Actually, an

positive savings rate for industrialists will do.) This means that next period they will re-invest the return on the capital from the first period, and the demand for labor will shift out as the capital stock expands.

As the process unfolds we observe:

- Emergence of an industrial sector, which grows in importance relative to agriculture.

- Urbanization, given that factories cluster together (because of the need to share infrastructure and transport services, exchange inputs, and draw on a trained labor pool

- A rising savings rate as a fraction of GDP

- Growth acceleration, as the industrial sector becomes more important, then slowdown when surplus labor is exhausted and wages start to rise:

$$\frac{\Delta Y}{Y} = \frac{\Delta Y_A}{Y} + \frac{\Delta Y_I}{Y} = \frac{Y_A}{Y} \cdot \left(\frac{\Delta Y_A}{Y_A} \right) + \frac{Y_I}{Y} \cdot \left(\frac{\Delta Y_I}{Y_I} \right)$$

- Potential for rising then falling income inequality.