

**Economics 404W**

**Lecture 9**

February 7, 2006

Current reading: Chapter 4

Our next objective is to investigate: What might be causing  $A$  to grow besides improvements in the quality of the labor force?

Today we'll begin discussing models that explain for cross-country differences in per capita income without relying on differences in savings/capital accumulation (physical and human) or differences in population growth rates.

Unlike the HD and SS theories, the models we'll discuss also provide an explanation for the "take-off" period, when economies move beyond subsistence, with little or no growth in per capita incomes, to "extensive growth" (sustained development)—escaping from poverty traps.

**C. Complementarities, History, and Expectations**

**1. Complementarities and poverty traps**

**Externalities** are the key ingredient of models that describe threshold effects. Generally, a positive externality occurs when the actions of one economic agent, say agent  $X$ , generate benefits for others (say agents  $Y$  and  $Z$ ), and the beneficiaries are not obligated to compensate agent  $X$ . Under these circumstances,  $X$  will tend to do too little of the activity that generates positive externalities. (Positive externalities are "complementarities" in your book's terminology)

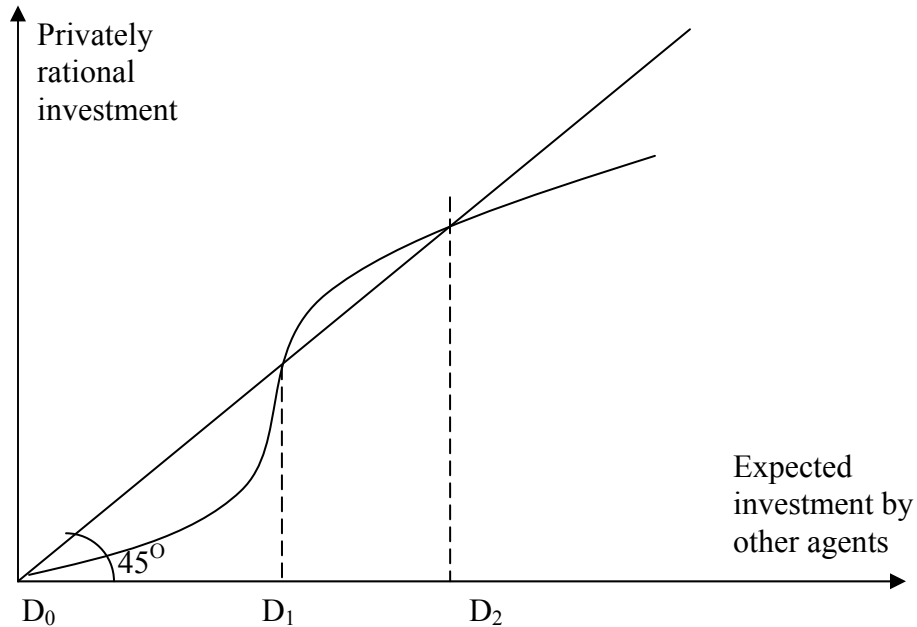
*example 1:* Suppose that to establish the first modern factory, an entrepreneur (playing the role of agent  $X$ ) must train machinists and other skilled workers to maintain and operate the plant. Other entrepreneurs (playing the roles of agents  $Y$  and  $Z$ ) could then come along and hire workers from an experienced labor pool without having to pay for the training process that  $X$  did. They need to pay workers only slightly more than  $X$  because, once the workers have experience, they can be induced to leave with only slightly higher wages. Hence no one wishes to go first because the first mover is under-compensated.

*example 2:* Suppose that the first entrepreneur to establish a shipping firm ( $X$ ) must dredge the harbor. But other shipping firms that follow ( $Y$  and  $Z$ ) can freely use the channel that firm  $X$  created. No one wants to be the first shipping firm. Nor does anyone want to be in a consortium that shares the cost of dredging the channel, because by refusing to share the cost, latecomers can come along and freely use the channel the consortium created.

**example 3:** Suppose that the more experience a country acquires producing industrial products, the more efficient it becomes. (Learning by doing). Further, those who do the early production (*X* types) generate knowledge about production techniques that can be observed and exploited by those who come later (*Y* and *Z* types). The early producers are not compensated for the knowledge spillovers they generate, so they underproduce, or fail to produce altogether.

**example 4** Suppose that to operate efficiently, a modern industrial sector requires supporting sectors like utilities, transport services, communication services, legal “services”, and financial intermediaries. Further, suppose these supporting sectors are more efficient when operated on a large scale. (This certainly characterizes the sectors listed here.) Then, since a few modern sector firms (*X* types) will demand only small quantities of support services, the supporting service sectors will be inefficient or non-existent when the modern sector first emerges. But if many modern sector firms have already been established, efficient supporting sectors will be available to late-coming (*Y* and *Z* type) producers.

All of these examples suggest that externalities can make the marginal product of resources larger when the amount of resources devoted to the new activity grows. Or, in some sense, latecomers enjoy a higher marginal product. (How is this phenomenon different from internal returns to scale?) We can represent this phenomenon graphically:



This diagram shows the rational reaction of a single entrepreneur to the investment choices of the other entrepreneurs. The curved line implies that people are induced to undertake more of an activity that is subject to positive externalities when others do more of this activity.

If all entrepreneurs behave the same way, the economy is in a symmetric Nash equilibrium when each individual's reaction to the investment choice of others is to make the same investment choice. That is, equilibria occur where the (curved) reaction function crosses the 45° diagonal. Elsewhere, individual choices (i.e., privately rational investments) are lower or higher than expected investments, so adjustment must occur.

As drawn, the diagram implies that there can be multiple equilibria. One with little or no investment ( $D_0$ ), and one where everyone invests a lot ( $D_2$ ). Each is a “Nash equilibrium.” (Example in textbook of mañana mentality in Ecuador—cost perhaps 5 percent of GDP.)

Note that the equilibria at  $D_1$  is unstable. Speaking crudely, we can see this by imagining sequential moves. A small increase in expected investment by others leads to a more than proportionate increase in own investment for each individual producer. So next period, overall investment is even bigger. This triggers a still bigger adjustment in own investment, et cetera.

When the economy is in a “bad” (low investment) equilibrium, it might be possible to move to a “good” (high investment) equilibrium if everyone were simply to coordinate behavior. But escaping a bad equilibrium may be more than just a coordination problem:

- There may be period of losses for movers. Feeling one's way with the new technology; establishing the new products in the market.
- This creates an incentive to hang back, let the others go first; defect from any coordinated agreement.
- Poorly functioning credit markets exacerbate the problem. Suppose short run losses will be more than covered by long term gains, even for the first mover. Without access to loans to cover the losses, the first mover can't get started.
- Thus a country's history may condemn it to a “low level equilibrium,” or a poverty trap.

To break out of this type of trap, Rosenstein-Rodan (1943) and others envisioned a “big push” from government in the form of public investment (perhaps financed through foreign aid) and/or protection of the industrial sector from foreign competition (tariffs and quotas). Of course, the problems with this are:

- Could require tremendous resources; can't know in advance how much is needed
- One has no way of being sure whether it will work—maybe this characterization of equilibrium is wrong
- Big time handouts always create incentives for big time rent seeking.

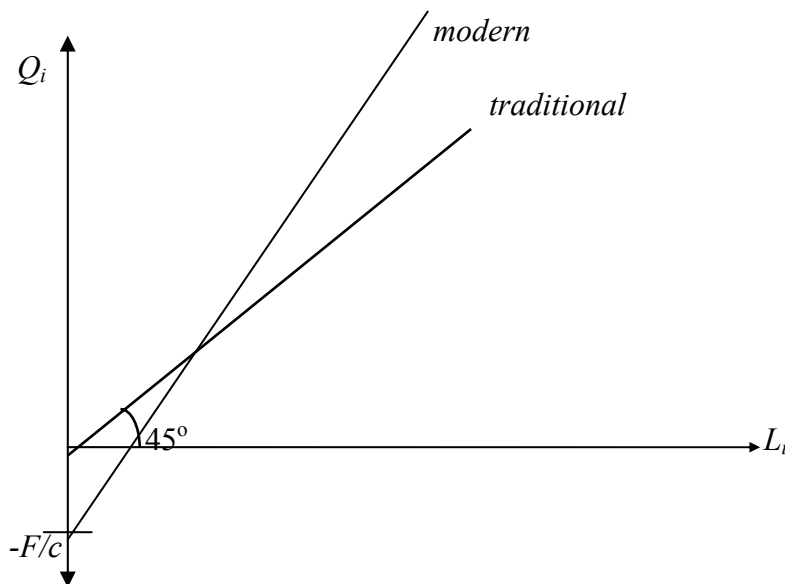
## 2. Market Size Externalities: Rosenstein-Rodan and Murphy et al

Rosenstein-Rodan emphasized a special kind of (pecuniary) externality. Efficient modern sector production involves significant, lumpy capital investments. A modern factory can only be built so small and still be efficient. The fixed capital costs associated with building a factory must be spread over a large volume of production if factories are to be more profitable than traditional cottage techniques. So, unless there is large demand for output—that is, unless *other* efficient producers are generating lots of income—it doesn't pay to go modern.

Murphy, Schleifer and Vishny (1989) restated Rosenstein-Rodan's arguments in terms of a simple mathematical model, and Krugman (1992) made the exposition even simpler with a graph.

### Technology

Let the total labor requirement of a modern factory that produces  $Q_i$  units of good  $i$  be given by:  $L_i = F + cQ_i$ , where  $F$  represents the fixed costs of setting up the factory (measured in terms of units of labor) and  $c < 1$  is the marginal labor requirement of producing each unit the good. In contrast, let the labor requirements of a traditional producer be simply one unit of labor per unit of output. These assumptions guarantee that the cottage producer will be more efficient for small output levels, and the modern factory producer will be more efficient for large output levels:



### Consumer behavior

Also, assume that demand for each good is isoelastic, so that the amount consumers spend on each good is independent of price, and when income goes up, spending on all goods goes up proportionately.

*aside:* Those who know calculus should be able to prove that these assumptions follow from the Cobb-Douglas utility function  $U = \prod_{i=1}^N q_i^\gamma$ , given the budget constraint

$Y = \sum_{i=1}^N p_i q_i$ , where there are  $N$  goods produced and  $p_i$  is the price of the  $i^{\text{th}}$  good.

### **Pricing behavior**

Each good is produced either by competitive cottage shops, or by a single modern sector monopolist, depending upon which type of production is cheaper. (Economies of scale ensure that only one modern sector producer will survive in each industry.)

The cottage shops price competitively at average (and marginal) cost, so if the unit price of cottage labor is \$1, the price of all goods produced using traditional techniques is 1.

Modern factories cannot price above 1 because they would be undercut by cottage producers if they did. Also being monopolists, they have no incentive to price below 1. (Reducing price below 1 and increasing quantity leaves revenue unaffected, but increases cost.) So the price of *all* goods will be 1 and we can ignore prices hereafter.