

Advanced Macro: Growth Theory Lecture 4

Marcel Fafchamps

1 Part II. Why Are Not All Countries Rich?

We now have a rich set of models with which to answer our first question: why has prosperity increased in (parts of) the world over the last 200 years. The answer has to do with the accumulation of knowledge and its application to the creation of new consumer goods and capital equipment goods. The process by which knowledge is accumulated and applied to the creation of new goods is thought to be the combination of learning-by-doing and explicit R&D. Some authors model the generation of knowledge as a ("local") externality while others emphasize Schumpeterian competition. More work is needed to clarify the relative roles of non-rival knowledge (e.g., academic publications) versus know-how embedded in workers and organizations. It also unclear whether Schumpeterian innovation without publicly funded pure research creates sufficient externalities to sustain growth over the long term.

In the remainder of the course we focus on the second question, namely, why have the fruits of technology not been shared equally when knowledge is non rival and accessible to all countries at a relatively low cost (e.g, think of very poor countries such as North Korea, India and Pakistan developing nuclear weapons).

Many answers have been proposed. Most of them fall basically into four categories:¹ (1) stagnation as a choice; (2) bad initial conditions for historical or geographical reasons; (3) poverty traps; and (4) perverse country interactions.

The reader should be forewarned, however, that few of the main explanations proposed in the literature focus on technology. Rather the focus is on economic activity as a whole, i.e., the explanations that are provided could also be used to explain differences in prosperity across nations before the industrial revolution, that is, before the application of science to technology. Unless some connection is made with technology, this is obviously a weakness.

1.1 Stagnation as a national choice

I shall not spend much time on the first category because I think it is basically prejudiced. But it is an important component of popular perceptions of under-development. The analogy with individual poverty is perhaps the easiest way to illustrate this. If you ask people in the street why some people are poor,

¹Ignoring racism.

chances are that answers will include things like profligality/spend too much, lack spirit of enterprise, laziness, did not study hard at school, too many children, quarrelous/lack of friends, alcoholism and drug abuse, crime, and other fairly moralistic judgements.

By the same token, if you were to ask people in the street why some countries are poor, you would probably hear similar answers: savings rate too low, lack of entrepreneurs, workers undisciplined and lazy, population illiterate, population growth rate too high, wasteful consumption, lack of ‘social capital’ or trust, corruption, and warfare. According to these views, underdevelopment is basically the result of choice – perhaps not directly about the level of development, which basically all people would prefer to be high, but about the things one needs to do in order to become prosperous. These views are largely reflected in the empirical and policy literatures. The paper by Mankiw, Romer and Weil, for instance, explains growth outcomes in terms of savings rate and education enrollment, implicitly assuming that these reflect national preferences that are regarded as exogenous. Regressions in which growth is regressed on crime, corruption or warfare take basically the same view.

1.2 Historical and geographical causes

The second category focuses on historical or geographical explanations.² Authors who follow this approach typically seek to shift the blame for underdevelopment from the countries themselves to some exogenous cause. They do so typically by demonstrating that the ‘bad’ features of poor countries are ultimately consequences of their geographical location or of their colonial history. For instance, poor governance (corruption, autocratic leaders, warfare) is often blamed on colonial heritage. There is also a literature claiming that countries that have inherited a Roman Law system from the French, Spanish or Portugese, are at a disadvantage relative to common law countries. I do not find these explanations very convincing because they fail to recognize that colonies were not randomly assigned to colonizers: because they were the leading world power of their time, the British often colonized the most promising land, leaving less attractive places to be colonized by the French and others.

Geographical explanations are a priori more promising because geographical features are more likely to be exogenous than historical events (although people’s placement over space is not). For instance, in an early version of their 1999 QJE paper, Hall and Jones (1996) argue that much of the differences in standards of living across countries can be explained by distance from the equator. They also argue that similar differences can be found within the temperate zone (e.g., Northern and Southern Europe, North-East and South in the US) until the advent of cheap air conditioning. They link these findings with health data, the basic idea being that in temperate countries many parasites and parasite vectors are killed by frost. Also soils are better because there is less leaching of

²This approach also has its parallel in explanations for individual poverty, namely, parental background and environmental factors.

nutrients. As a result, agriculture is easier and human health is better. Sachs also have a number of papers on similar issues.

Acemoglu, Johnson and Robinson 2000 exploit differences in the mortality rates faced by European colonists to estimate the effect of institutions on economic performance. The authors argue that Europeans adopted very different colonization policies in their colonies depending on local conditions. This had an effect on institutions inherited from colonialism. According to the authors, the choice of colonization strategy was, at least in part, determined by whether Europeans could settle in the colony. In places where Europeans faced high mortality rates, they could not settle and they were more likely to set up worse (extractive) institutions that tended to subsist after decolonization. Exploiting differences in mortality rates faced by soldiers, bishops and sailors in the colonies in the 17th, 18th and 19th centuries as an instrument for current institutions, Acemoglu, Johnson and Robinson estimate large effects of institutions on income per capita. The authors claim that differences in institutions explain approximately three-quarters of the income per capita differences across former colonies.

Efforts to blame history and geography for underdevelopment have been met with much skepticism in the profession – I suspect in part because of instinctive resistance to any suggestion that underdevelopment may have been engineered by colonisation. Personally, I am fairly sympathetic to geographical approaches because I believe they are part of the explanation for why some countries were initially in a better position to take advantage of technological advances. Today, however, these forces are less important than they once were. For instance, the development of the Sun Belt in the US and of southern Europe suggests that air conditioning makes a difference. The same observation can be made regarding East Asia and South East Asia where much growth has taken place in tropical areas or at least in fairly hot countries. Put differently, geography probably plays an important role, but a role that evolves over time depending on innovations in health, refrigeration, and transport technology.

1.3 Poverty traps and vicious circles

The idea of poverty traps goes back to the literature on the causes of individual poverty. The basic idea is that people who are poor find it difficult to escape poverty even if they try to. They are in a trap from which it is difficult if not impossible to escape. The typical reasoning is to argue that poor people cannot afford to save and go to school. As a result, they remain poor.

Applied to entire countries, this reasoning becomes an explanation for stagnation: poor countries cannot grow because they do not have the capital necessary either to purchase the technology from abroad (in the form of capital goods or training) or to build the infrastructure and institutional environment necessary to attract foreign private investment. By the same token, poor countries cannot invest enough in educating their population.

Many development assistance interventions can be understood in this context. Because of the conceptual link between poverty at the individual and

national level, this reasoning also justifies development assistance in the form of individual-based anti-poverty programs, such as the provision of micro-finance for villagers or the supply of material and equipment to rural schools.

Strictly speaking, the reasoning above does not really create a ‘trap’ in the sense that it would be impossible to escape from it. Indeed, the poor could save a little bit at a time and, eventually, escape their poverty. This reasoning is therefore more an explanation for persistence in poverty – perhaps for a very long time – rather than as a trap per se.

At the individual level, a poverty trap may nevertheless arise in the presence of a non-divisible investment. Say this investment yields a return $r > \rho$ (the individual’s discount rate). There is a divisible savings instrument with return $s < \rho$. Since $s < \rho$, without the investment the individual decides not to save. Saving may nevertheless be optimal if the individual can accumulate to undertake the non-divisible investment. If the investment is large and the individual is poor, however, accumulating enough to undertake the investment may take so long that it is best not to try to save for it – the individual is discouraged. A similar process may arise at the aggregate level if, for instance, a massive investment in infrastructure is needed to generate the conditions for returns to local individual investments to rise above ρ . If the country/region/locality is poor, it may be discouraged from undertaking the investment.

A permanent poverty trap, in the sense of a indefinite equilibrium, can also arise in the presence of some kind of pernicious externality that creates a vicious circle.³ Many models of such poverty traps have been proposed in the recent literature. Here is a (non-exhaustive) list of some of them:

- Stokey 1988 proposes a learning-by-doing model similar to that of Young in which the economy grows only if it produces goods in which learning takes place. If a poor population only consumes goods with no learning, the economy stagnates.
- Azariadis and Drazen 1991 propose a multiple equilibria OLG model of investment in human capital accumulation. The externality comes from the fact that if the current generation does not invest in a minimum level of education, the next generation finds it unprofitable to invest – hence the economy remains stuck in a low income, zero growth, low human capital equilibrium.
- Banerjee and Newman 1993 propose a multiple equilibria dynamic model in which growth happens when a sufficiently large number of individuals invest in a modern risky activity. They show that if the distribution of

³At the individual level, a poverty trap may also arise in the presence of a non-divisible investment yielding a return $r > \rho$ (the individual’s discount rate) and a divisible savings instrument with return $s < \rho$. Since $s < \rho$, without the investment the individual decides not to save. But saving may be optimal if the individual can accumulate to undertake the non-divisible investment. If the investment is large and the individual is poor, accumulating enough to undertake the investment may take so long that it is best not to try to save for it – the individual is discouraged.

initial wealth is undifferentiated, few individuals are rich enough to risk investing in the modern activity. As a result, the economy stagnates and remains poor.

- Murphy, Shleifer and Vishny 1989 also discuss the relationship between income distribution and growth. In their case, the feedback is through consumer demand. They assume that the very rich consume artisanal products and services while the middle class that consumes manufactured products and mass produced services. In contrast to Banerjee and Newman, they argue that what is needed for growth is a large middle class.
- Becker, Murphy and Tamura 1990 propose a model of human fertility in which parents choose between child ‘quality’ and quantity. Child quality is synonymous with investing in human capital (schooling). If returns to education are high, parents opt for child quality. Since they have limited time and finances, they have to give up on child quantity. This implies a sharp decline in fertility. If returns to education are low, parents opt for having many low educated children. The vicious circle arise if high fertility reduces returns to education, perhaps because with high population growth the capital-labor ratio remains low.
- Murphy, Shleifer and Vishny 1991 argue that when a country is poor and not growing, political entrepreneurship is the surest avenue to personal wealth. In contrast, when a country is rich and growing, business entrepreneurship is a more attractive road to wealth. This generates a feedback between initial poverty, the distribution of ‘talent’ between business and political clientelism, and the quality of governance and institutions. Galor has also written papers where the feedback takes place through institutions.
- Acemoglu and Robinson 2002 construct a simple model where political elites may block technological and institutional development, because of a "political replacement effect." Innovations are assumed to erode elites’ incumbency advantage, increasing the likelihood that they will be replaced. Fearing replacement, political elites are unwilling to initiate change, and may even block economic development. The authors show that elites are unlikely to block development when there is a high degree of political competition, or when they are highly entrenched. It is only when political competition is limited and their power is threatened that elites will block development. They also show that such blocking is more likely to arise when political stakes are higher, and that external threats may reduce the incentives to block. The authors argue that this model provides an interpretation for why Britain, Germany, and the U.S. industrialized during the nineteenth century, while the landed aristocracy in Russia and Austria-Hungary blocked development.
- Acemoglu and Zilibotti 1997 construct a model in which the negative feedback takes place through portfolio diversification of investment – a kind

of risk pooling externality. Their paper offers a theory of development that links the degree of market incompleteness to capital accumulation and growth. Because sectoral indivisibilities limit the extent of diversification, poor economies suffer higher volatility of growth and endogenously lower productivity. As the economy develops, agents hold more balanced portfolios and can take better advantage of high-return production opportunities. Although all agents are price takers and there are no technological spillovers, the decentralized equilibrium is inefficient because individuals do not internalize the impact of their investment decisions on others' diversification opportunities. The results generalize to economies with international capital flows.

1.4 The world as a system

The fourth category of answers to the question 'why are the gains from prosperity shared by all' seeks for an explanation not in the poor countries themselves but in their relationship with rich countries.

Again the analogy with explanations for individual poverty is useful. One category of explanations to individual poverty argues that not everyone can be CEO at the same time and someone has to collect garbage. At a given level of economic development, society needs a number of jobs or 'positions' to be filled. For various reasons, some of these positions are paid better than others (e.g., incentive reasons, competition, ability). For instance, it is possible to imagine a world where all individuals initially share the same talent but there is a need for only one boss. For incentive reasons, the boss is paid more. Who serves as boss does not matter. One could imagine selecting the boss at random, or using an arbitrary rule (from high caste, from aristocracy, from superior race, gender, age, etc). Which rule is used determines who gets selected.

Regressing wage on all these determinants would identify the rule that has been used. One could suggest that the rule be changed, for instance, to give equal opportunity to all. But doing so would *not* change the realized distribution of income, only who gets it. This generates a kind of fallacy of composition. Suppose, for instance, that you observe that uneducated people drive a bus while educated people work in an office. Based on this you may recommend that everyone gets an education. But since society still needs bus drivers, in equilibrium a proportion of educated people will work as bus drivers – and get negative returns on their education relative to the initial equilibrium. Looking at the characteristics of individuals cannot serve as a basis for policy unless 'general equilibrium' effects are taken into account. Put differently, general equilibrium feedbacks can defeat policy initiatives based on partial analysis alone (e.g., Duflo on Indonesia).

The same kind of reasoning can be applied to the world distribution of prosperity. If the world is linked in the sense that each region and country has a 'job' or 'position' in a worldwide general equilibrium, the success of policy depends on what other regions and countries are doing. In a world where only few places have export-free zones, having one may be critical. But in a world

where there are lots of empty export-free zones everywhere, having one is a waste – like bus drivers getting an education. By the same token, recommending to all poor countries that they expand primary exports by raising producer prices may in fact reduce their welfare if world demand is inelastic.

There are various kinds of ‘world as a system’ explanations for stagnation in poor countries. Some are of Marxist inspiration – e.g., Emmanuel’s unequal exchange and the Prebisch school in Latin America. Others are grounded in modern trade theory. We have already seen two such models: Young’s trade model with learning by doing; and Grossman and Helpman’s trade model with copying.

2 Poverty traps

The basic insight of development economists of the 50’s was that, if only ‘they could be like us, they would be ok’. In other words, if only poor countries could replicate the economic structure of developed countries, they would be developed countries. These economists were living in a the colonial world where trade was relatively free between colonizers and their colonies, they were implicitly sharing common currencies, common legal systems, common administrative institutions, etc. Yet after many years of living together, colonies and colonizer were not getting any closer economically. One view was to see it as a ploy to keep colonies undeveloped (and there certainly was a lot of truth in this). But even when colonizers tried to develop their colonies, if only for the benefit of settlers, they encountered a lot of difficulties, especially with industrial development.

There are many ways in which poor countries are not ‘like rich countries’. The question is what is the key difference that needs to be removed in order to get them out of the poverty trap. There are about as many answers to this question as there are economists, so we will not be able to resolve this issue here. But what we can do is to illustrate poverty traps with a few important examples.

When poverty traps are modeled as multiple equilibria, this raises the issue of which equilibrium gets selected. In particular, we would like to know what are the respective roles of expectations (which can in principle be molded by propaganda) and history (which cannot). To this we turn later in the course.

2.1 Technology diffusion

Parente and Prescott (JPE 1994) construct an interesting model of growth through technology diffusion. The key equation in their model defines the amount of investment X_{At} that a firm must make to raise its technology level

from A_t to A_{t+1} :

$$X_{A_t} = \pi \int_{A_t}^{A_{t+1}} \left(\frac{s}{W_t} \right)^\alpha ds \quad (1)$$

$$= \pi W_t^{-\alpha} \int_{A_t}^{A_{t+1}} s^\alpha ds \quad (2)$$

where π and α are parameters and W_t denotes world knowledge at time t . What equation (1) says is that the investment needed to raise the technology level of a firm is a decreasing function of the stock of world knowledge W_t and an increasing function of the increment in technology level $A_{t+1} - A_t$.

The model reverts around π , a parameter that indexes the size of barriers to technology adoption. The authors think of this parameter as varying between countries, perhaps because of geographical and social proximity, institutional set-up, or government intervention. Countries with a high π find it difficult to upgrade their technology.

Parente and Prescott build an economy ‘around’ equation (1) and show that, with suitable assumptions, there exists a balanced growth path in which output per capita grows at a constant rate. Presenting the model in details would take too long because the model has a lot of notation and additional assumptions. The authors then proceed to calibrate the model on real data and calculate the values that π must take in order to explain differences in growth rates and levels between countries. They show that the model can reproduce many stylized facts with values of π that vary relatively little, e.g., between 1 (the normalized value for the US) and 3.5 (for South Korea in the 1950’s).

The attraction of this model is that it formalizes the idea that certain countries are poor because they are unable to adopt the best technology, and they are unable to adopt this technology because the cost of doing so for individual firms is too high. This problem arises even though the world stock of knowledge W_t , from which firms draw to upgrade their own technology, is non-rival. The poverty trap arises when the cost of adopting the best technology is too high. Poverty is driven by an inability to modernize.

I find this approach intuitively appealing because it is immediately clear, from casual observation, that the technology used in poor countries is further away from the frontier (e.g., old machines, hand-made tools, obsolete forms of organization). The drawback is that Parente and Prescott do not tell us where π comes from, i.e., they do not tell us why π is higher in poor countries.

Benhabib and Spiegel (2005) investigate this issue further by estimating the technology catching-up function. They show that this catching-up function is logistic, which implies that countries with a small capital stock (physical and human) may exhibit slower TFP growth than the leader nation. They find support for this in their analysis of cross-section GDP data. Parente and Prescott (2005) revisit this issue. They develop a model in which catching-up only begins once a country has reached a minimal level of efficiency. This feature is related to the concept of ‘take-off’ attributed to economic historian

Rostow. The authors present past and recent historical evidence in support of the existence of a take-off threshold.

Aghion and Howitt (2005) present a model of catching up, but this time based on the Schumpeterian framework they pioneered. They show that the Schumpeterian model can accommodate a variety of reasons for lack of catching-up. In their theoretical analysis, divergence can happen for instance from insufficient financial development (an idea initially pioneered by Gerschenkron in 1962) to low levels of human capital (a point initially made by Schultz in 1961).

Some of the poverty trap models reviewed earlier can be revisited as efforts to endogenize π . For instance, in Acemoglu and Robinson (2002) the resistance of the elite to modernization is likely to lead to policies that increase entrepreneurs' cost π of upgrading their technology. In Azariadis and Drazen (1991), the actions of past generations could affect the incentives to the new generation not only to acquire human capital but also to invest in learning new technologies, if the old generation holding managerial and governments posts does not have the capacity to direct the use of it.

2.2 Pecuniary externalities and the role of demand

One interpretation of the 'if only they could be like us, they would be ok' was initially written by Rosenstein-Rodan in 1943 thinking about reconstruction in Eastern Europe after the war. His basis insight was that industrial investment in poor countries was not taking place because the market was too small. Rosenstein-Rodan obviously had in mind the presence of increasing returns in manufacturing. He proposed the so-called shoe-factory parable. Suppose, he said, that a shoe factory was set up in Romania. Although shoe factory workers would purchase some of the factory's output, the rest would have to be sold to the population which is too poor to purchase industrially manufactured shoes. But, says Rosentein-Rodan, if all factories are set up at the same time, workers in other factories will purchase shoes while shoe factory workers will purchase output from other firms. The end result, RR argued, would be a Romania that looks just like the UK. [Obviously, RR regarded countries as closed economies, otherwise domestic demand would not matter.] This led RR to identify insufficient demand as the source of poverty trap and to recommend a big push strategy of investment in all industries at the same time.

Many authors of the time picked up on the idea and refined it in different ways. Hirshman, for instance, argued that investing in all industries was too difficult; he advocated targeting instead, hoping to generate larger demand for intermediate inputs by focusing on industry clusters. There followed a debate between the balanced growth proponents [note the different meaning from constant growth rate], who argued that targeting was unnecessary or infeasible, and unbalanced growth proponents who developed targeting tools such as input-output matrices and early CGE's. Implicit in this entire literature is the concept of pecuniary externalities, first coined by Skitovsky around the same period: in contrast with Marshallian or technological externalities which take place through physical processes (e.g. bees and apple trees), pecuniary exter-

nalities take place through market interaction. However, because authors of the time did not know how (or did not want) to model these ideas precisely, the concepts remained vague and the discussion confusing.

Even in those early days, one dissenting voice argued that the shoe factory parable did not hold water. Fleming [in an article well worth reading because its carefulness and apologetic tone is a scary reminder of how hard it is to go against the dominant paradigm of one's time] made the following point. Suppose the shoe factory was forced to invest. By RR's assumptions, it would make losses and thus subtract from demand instead of adding to it. Forcing other factories to invest as well would only generate further losses and further subtract from demand. Consequently, argued Fleming the shoe factory parable is a fallacy: a big push would only generate massive losses and result in disaster, white elephant style. Fleming's critique went unnoticed until it was vindicated by in a very simple paper by Murphy, Shleifer and Vishny.

2.2.1 Final demand externalities (MSV): First model

MSV assume a closed economy with a representative consumer. Her utility is $\int_0^1 \ln x(q) dq$ where $x(q)$ is the quantity of goods indexed by q . [All goods have the same expenditure shares which is equivalent to assuming that goods are measured in utils.] With the $[0, 1]$ interval normalization, the consumer with income y spends y on each good (since $\int_0^1 y dq = y$). This is a static model. There is no growth as the attention is entirely on pecuniary externalities.

The economy is endowed with L units of labor. The representative consumer gets all wage labor and profits. The wage rate is taken as numeraire. There are two technologies, a CRS technology whereby one unit of labor produces one unit of output; and an increasing returns technology whereby a monopolist incurs a fixed labor cost F and produces α units of output with one unit of labor. The monopolists represent industrial firms while the CRS sector stands for an artisanal/informal sector of microenterprises. The CRS sector can produce even for very small demand while the IRS sector requires sufficient demand for profits to be made. Monopolists invest/enter if they expect $\pi > 0$. Once they have entered, they charge a price of one, which is the price that the CRS competitive fringe would charge. [Note that since the elasticity of demand is one, the price would be infinite in the absence of competitive fringe.] We have, for each firm:

$$\begin{aligned}
 \pi &= pQ - wL - wF \\
 &= pQ - L - F \text{ since } w = 1 \\
 &= y - L - F \text{ since } y = pQ \\
 &= y - \frac{y}{\alpha} - F \text{ since } \alpha L = Q \\
 &= \frac{\alpha - 1}{\alpha} y - F \\
 &\equiv ay - F
 \end{aligned}$$

where a is a mark-up parameter.

We can now turn to general equilibrium. Suppose a proportion n of firms industrializes/IRS firms enters. Since CRS firms make no profits, aggregate profits are $n(ay - F)$. Aggregate income is thus wages plus profits:

$$y(n) = L + nay(n) - nF$$

We are now in a position to examine Fleming's prediction, namely, does income rise with entry or not? Totally differentiating with respect to n and y , we get $dy = nady + (ya - F)dn$, which leads to:

$$\frac{dy}{dn} = \frac{\pi}{1 - na}$$

where $0 \leq n \leq 1$ and $0 < a < 1$: the denominator is thus positive and smaller than 1 – it operates like a multiplier/amplifier. Fleming's conjecture was thus correct: if profits are negative for n firms, forcing more firms to enter can only reduce demand and thus further reduce profits. We thus have two possible equilibria only: either $\pi > 0$ and all firms enter, or $\pi < 0$ and no firm enters. There are no multiple equilibria in this model. A big push strategy would be a disaster if $\pi < 0$ for $n = 1$.

This is a relatively robust result that does not depend on many of the model's assumptions. For instance, the result – single equilibrium – carries through if all firms have different costs of production and different fixed costs; the only difference in this case is that interior equilibria are possible, but they are unique. It is also possible to allow for trade: just add a traded CRS good (e.g., agriculture) and regard the competitive fringe as potential imports. The result also goes through: either a location/country/economy industrializes or it does not. No multiple equilibria.

2.2.2 Second model

MSV then add another ingredient, which they borrow from Lewis, namely the idea that workers in the modern sector require a wage premium. The source of the premium is irrelevant for the model (e.g., don't like working for a boss, dislike living in town, etc). What is important is that wage workers spend more on the market than CRS workers. [My favorite explanation is that urban living is more market oriented so that fewer products are self-provided. Congestion in cities also raises the cost of living.]

MSV thus assume that factory wage $w = 1 + v$ where v is a compensation for the lower utility from wage work. We have:

$$\pi = y\left(1 - \frac{1+v}{\alpha}\right) - F(1+v)$$

where $\alpha - 1 > v$. We now verify that, with this additional assumption, two equilibria are possible. For no entry to be an equilibrium, we need profit from entry to be 0. Consider a marginal entrant. No one else has entered so that $y = L$. Profit for a potential entrant is thus:

$$\pi_N = L\left(1 - \frac{1+v}{\alpha}\right) - F(1+v) \text{ which we want to be } < 0$$

On the other hand, if all firms enter, total production is $\alpha(L - F)$ and total wage bill is $L(1 + v)$. Consequently aggregate/individual profit is:

$$\pi_A = \alpha(L - F) - L(1 + v) \text{ which we want to be } > 0$$

It is easy to verify that there exist parameter values such that both inequalities are satisfied at the same time, e.g., $L = 1, v = .25, a = 1.6, F = .2$. This is a very simple example of pecuniary externalities: higher wages in manufacturing hurt firms individually but benefit them collectively because it raises demand/income spent on manufactured goods.

2.2.3 Alternative models

Once the principle is understood, it is relatively easy to construct alternative models with multiple equilibria driven by pecuniary externalities. Two are presented in Fafchamps and Helms, for instance. The first model is exactly like MSV, except that manufacturing goods have high income elasticity. Multiple equilibria are possible in which either only basic goods are produced, with insufficient demand for manufactures to trigger investment; or only manufactured goods are produced, with sufficient demand for firms to make profit. The second is a model with intermediate inputs a la Hirshman. That model is capable of generating many equilibria, a situation that the authors illustrate with a simple general equilibrium model. In all cases, the structure of demand varies with the structure of production in a way that can validate a change of production structure.

All these models, however, are static. Of course, it would be straightforward to overlay any of them with the kind of mechanics used in the Matsuyama model we discuss later in the course, i.e., assume that at any point in time a proportion p of firms makes a decision about entering or not and let the interest rate be given (or tie it using the discount rate; there is no accumulation in any of these static models since the fixed cost is not a sunk cost of investment but a fixed operation cost). The same kind of qualitative conclusions should apply as to the respective roles of history and expectations.

Ciccone and Matsuyama 1996 propose a dynamic model in which pecuniary externalities operate through demand for intermediate inputs. They generate multiple perfect foresight equilibrium paths, some of which are quite exotic.

2.2.4 Conclusion on pecuniary externalities

This short excursion into the world of pecuniary externalities illustrates the role that demand can play at the early stages of growth: small markets have problems because insufficient demand serves as a disincentive to investment in modes of production that involve fixed costs of production. In the presence of externalities, multiple equilibria become possible. Equilibrium selection depends on initial conditions and expectations, with the mix between the two depending partly on rigidity of production (see later).

Much work remains to be done, however. In particular, the issue of sunk costs (as distinct from fixed periodic costs) still needs to be modeled properly. Also our models of complexification/diversification do not account for industrial deepening, that is, the fact that production takes place in a more and more roundabout manner with added layers of intermediate inputs. There has been some work in this issue (e.g. Rodriguez-Clare, Ciccone) but the issue is far from settled.