6 Growth and Development from a Schumpeterian Perspective

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Thirty years ago, Peter Howitt and I elaborated a new theory, now known as the "Schumpeterian theory," of economic growth. Why did we need a new theory of economic growth? What did we find unsatisfactory with the dominant theory at the time, both theoretically and empirically?

In this chapter, we shall revisit some current debates about the growth and development process and about growth policy design, using the lenses of the Schumpeterian growth paradigm.

Thus, in the first part of this chapter, I touch on four open questions on which the Schumpeterian approach sheds new light: the relationship between competition and innovation-led growth, the debate on secular stagnation, the recent rise in top income inequality, and firm dynamics.

In the second part of the chapter, I argue that the Schumpeterian growth paradigm can be used to further bridge the existing gap between growth and development economics.

And finally, in a third part, I will show how the paradigm can be used to think about (or rethink) growth policy design.

Why Elaborate a New Theory of Economic Growth?

During my student years, the dominant paradigm in growth economics was the neoclassical growth model, which would be taught first under the assumption of a constant savings rate (the Solow model) and then in the context of an economy where a representative consumer decides about consumption, savings, and investment by maximizing her intertemporal utility (the Ramsey-Cass-Koopmans model).

The Solow model is the true template in growth economics, just as Modigliani-Miller is the benchmark in corporate finance. This is first due

to it being a model of elegance and parsimony: The whole dynamics of the economy is described in two equations. The second reason is that the model shows very clearly why there can be no long-run growth without technical progress. The model was published in 1956 (I was born that same year) and was rewarded by a Nobel Prize to its author in 1987.

No need to go into the details of this model, which economists all know too well. But in a nutshell, the model describes an economy where final output is produced using capital as input, and where therefore it is the accumulation of capital that generates output growth. This corresponds to the first equation of the model. Then the question is: Where does capital accumulation come from? This in turn is answered with the second equation of the model: from savings (aggregate savings equal aggregate investment in equilibrium), and savings in the Solow model are a constant fraction of final output (i.e., of aggregate GDP).

You might think that everything should go well in such an economy: More capital stock financed by savings will produce more final output, which will translate into more savings (as savings are proportional to final output) and therefore in still more capital stock, and so on.

The problem is that we run into decreasing returns when trying to increase output by increasing the capital stock: The higher the existing stock of capital (number of machines) is, the lower will be the marginal increase in output from increasing the stock of capital by one unit (i.e., from adding one more machine). Thus, the lower the increase in savings and therefore the lower the induced increase in capital stock will be.

At some moment, the process of capital accumulation runs out of steam (it stops when capital depreciation catches up with marginal savings), at which point the economy stops growing. To generate sustained long-term economic growth, there must be continuous technical progress to increase the quality (productivity) of machines. But Solow does not tell us where technical progress is coming from.

In addition, if the model predicts conditional convergence, it does not give us the tools to understand why the distribution of per capita income has kept spreading out over time, why some countries converge to the standards of living (per capita GDP) of developed countries whereas other countries do not converge, or why some countries start converging and then stop at midway. It does not explain why some countries with lower capital stocks grow less rapidly than other countries with higher capital stocks,

or why capital does not necessarily flow from rich to poor countries (the so-called Lucas Paradox).

Moreover, the model does not look at growth from the point of view of firms and entrepreneurs: How does growth relate to the size distribution of firms, to the creation and destruction of firms and jobs, to firm dynamics more generally? It does not provide keys to understand how institutions or policies affect growth by affecting innovation and entrepreneurship.

These shortcomings motivated Peter Howitt and I to elaborate a new paradigm.

The Schumpeterian Paradigm

The paradigm Howitt and I formalized in the fall of 1987 revolved around three important ideas laid out by the Austrian economist Joseph Schumpeter.[1]

First idea: Long-run growth is primarily generated by innovations (this is the natural counterpart of Solow's conclusion that no long-run growth can be expected without sustained technological progress).

Second idea: Innovations result from entrepreneurial investments (R&D, training, computer purchase, and so forth), and entrepreneurs respond to the economic incentives (positive or negative) that result from economic policies and economic institutions. Thus, innovation-based growth typically will be discouraged in environments with poor property right protection or with hyperinflation, as these conditions will damage the profitability from innovation. In other words, innovation-based growth is a social process, and we can talk about policies of growth and institutions of growth.

Third idea: creative destruction. New innovations replace old technologies, and Schumpeterian growth is a conflictual process between the old and the new: It tells the story of all these incumbent firms and interests that permanently try to prevent or delay the entry of new competitors in their sector. Hence there is something called "the political economy of growth."

Thus, a first distinctive prediction of the Schumpeterian growth model is that firm or job turnover should be positively correlated with productivity growth. Another distinctive implication of the model is that innovation-led growth may be excessive under laissez-faire. Growth is excessive (resp.

1. See Aghion and Howitt (1992).

insufficient) under laissez-faire when the business-stealing effect associated with creative destruction dominates (resp. is dominated by) the intertemporal knowledge spillovers from current to future innovators.

Four Growth Enigmas

In this section, I show how the Schumpeterian paradigm can be used to shed light on four important enigmas associated with the growth process: (1) the relationship between competition and innovation-led growth, (2) the debate on secular stagnation, (3) the dynamics of income inequality, and (4) firm dynamics.

Competition and Innovation-Led Growth

Our original model predicted that more competition should be detrimental to growth by reducing monopoly rents from innovation and thus entrepreneurs' incentives to invest in innovation in the first place (incidentally, this latter argument has been used by Bill Gates when facing antitrust action). However, Blundell, Griffith, and Van Reenen (1995, 1999) used UK firm-level data to regress firm-level innovation intensity and/or productivity growth on the degree of product market competition in the firm's sector. And they found a positive correlation between competition and innovation/growth.

How could we reconcile theory and evidence? Should we just dismiss the Schumpeterian paradigm and start again from scratch? Should we simply ignore the empirical evidence? I went for a third way: to look more closely at the model and try to identify the assumption or assumptions that generate this counterfactual prediction of a negative relationship between competition and growth.[2]

Having tried several alternative stories,[3] we finally identified the main culprit: In our initial model, only currently inactive firms innovate, not the currently active firms (i.e., not the current technological leaders). Thus, an innovating firm in our model would move from zero profit (pre-innovation) to a positive profit (post-innovation). Then, not surprisingly, competition

2. See Aghion, Harris, and Vickers (1997) and Aghion et al. (2001).
3. For example, see Aghion, Dewatripont, and Rey (1999).

would discourage innovation: Competition reduces the post-innovation profit, which here is equal to the net profit from innovation.

However, in practice we find at least two types of firms in most sectors of the economy, and these two types of firms do not react in the same way to increased competition. You first have what we call "frontier firms," that is, firms that are close to the current technological frontier in their sector. These firms are currently active, and they make substantial profits even before innovating this period. Second, you have what we call the "laggard firms," which are firms far below the current technological frontier. These firms make low profits and try to catch up with the current technology frontier.

To try to understand why these two types of firms react differently to competition, imagine for a moment that what you are looking at are not firms but students in a classroom. And among them, you have the top students and the bottom of the class. And suppose that you are opening the class to an additional student, who turns out to be a very good student. This is how I represent an increase in competition in this context. How will the students react to this new student joining the classroom? The answer (here I refer to important work by Caroline Hoxby, who studied precisely this scenario) is that letting the new student in will encourage the other top students to work harder to remain the best, whereas it will further discourage students at the bottom of the class, as they will find it even harder to catch up.

Quite strikingly, firms react like classroom students: Faced with a higher degree of competition in their sector, firms that are close to the technology frontier will innovate more to escape competition, whereas firms that are far from the technological frontier and try to catch up will be discouraged by the higher degree of competition, and as a result innovate less: the latter firms behave like those in the basic Schumpeterian model.

Overall, the effect of competition on innovation and productivity growth is an inverted U, which synthetizes the positive escape competition effect and the negative discouragement effect. The prediction of opposite reactions of frontier versus nonfrontier firms to competition, and of an inverted U overall, were tested and confirmed in joint work with Richard Blundell, Nick Bloom, and Rachel Griffith (see Aghion et al. 2005) using the same kind of firm-level data as in the empirical studies I mentioned above.

To reconcile theory with evidence, we extended our basic Schumpeterian model by allowing for step-by-step innovation in the Schumpeterian

growth model.[4] Namely, a firm that is currently behind the technological leader in the same sector or industry must catch up with the leader before becoming a leader itself. This step-by-step assumption implies that firms in some sectors will be neck-and-neck. In turn, in such sectors, increased product market competition, by making life more difficult for neck-and-neck firms, will encourage them to innovate to acquire a lead over their rival in the sector. This we refer to as the "escape competition effect." In contrast, in unleveled sectors where firms are not neck-and-neck, increased product market competition will tend to discourage innovation by laggard firms, as it decreases the short-run extra profit from catching up with the leader. This we call the "Schumpeterian effect." Finally, the steady-state fraction of neck-and-neck sectors will itself depend on the innovation intensities in neck-and-neck versus unleveled sectors. This we refer to as the "composition effect."

This extended model predicts that in the aggregate, the relationship between competition and innovation should follow an inverted-U pattern. Intuitively, when competition is low, innovation intensity is low in neck-and-neck sectors; therefore most sectors in the economy are neck-and-neck (the composition effect). But it is in precisely those sectors that the escape competition effect dominates. Thus overall aggregate innovation increases with competition at low levels of competition. When competition is high, innovation intensity is high in neck-and-neck sectors. Therefore most sectors in the economy are unleveled sectors, so that the Schumpeterian effect dominates overall. This inverted-U prediction is confirmed by Aghion et al. (2005), using panel data on UK firms.

The prediction that more intense competition enhances innovation in frontier firms but may discourage it in nonfrontier firms was tested by Aghion et al. (2009a), again using panel data on UK firms.

Another prediction from our extended model is that there is complementarity between patent protection and product market competition in fostering innovation. Intuitively, competition reduces the profit flow of non-innovating neck-and-neck firms, whereas patent protection is likely to enhance the profit flow of an innovating neck-and-neck firm. Both contribute to raising the net profit gain of an innovating neck-and-neck firm;

4. See Aghion, Harris, and Vickers (1997) and Aghion et al. (2001).

in other words, both types of policies tend to enhance the escape competition effect.

That competition and patent protection should be complementary in enhancing growth rather than mutually exclusive is at odds both with our first model and with Romer (1990), where competition is always detrimental to innovation and growth (as we discussed above) for exactly the same reason that intellectual property rights in the form of patent protection are good for innovation: Namely, competition reduces post-innovation rents, whereas patent protection increases these rents. But it is also at odds with Boldrin and Levine (2008), who hold that patent protection is always detrimental to innovation and growth in their model where competition is good for growth.

Our prediction of a complementarity between competition and patent protection was tested by Aghion, Howitt, and Prantl (2013) using OECD country-industry panel data.

The Debate on Secular Stagnation

In 1938, economist Alvin Hansen explained in his presidential address before the American Economic Association[5] that in his opinion, the United States faced inexorable weak growth in the long term. The nation was just emerging from the Great Depression, and Hansen did not anticipate another world war that would stimulate a rebound in public spending and thereby of aggregate demand.

Since then, we have experienced another major financial crisis, the 2007–2008 crisis, which led Larry Summers (2013) and others to revive the expression "secular stagnation" to characterize a situation that they assimilated to the one described by Hansen in 1938. Summers's argument is that investment demand was so weak that negative interest rates were necessary for a return to full employment.

Robert Gordon (2012), however, believes that the risk of secular stagnation reflects a supply problem. Gordon proposes that the age of great innovations is past. He uses the metaphor of a fruit tree: The low-hanging fruit is the best; after that, the fruit is harder to pick and less juicy.

Schumpeterian economists are more optimistic about the future than Summers and Gordon are. A first argument (Jorgenson) is that the

5. See Hansen (1939).

revolution in information and communications technologies (ICT) has radically and durably improved IT-producing technology; meanwhile, globalization (which was concomitant with the ICT revolution) has substantially increased the potential returns on innovation—the scale effect—as well as the potential downside of not innovating—the competition effect. A second argument against the secular stagnation view is that we have witnessed an acceleration in innovation over the past several decades, which has not been fully reflected by measured productivity growth.

In particular, Aghion et al. (2017) argue that innovation involving creative destruction is not properly taken into account by current measures of total-factor productivity (TFP) growth. Whenever old products in the producer price index are replaced by new entrants, statistical offices typically resort to imputation. For each product category in the economy, imputation uses the rate of quality-adjusted price growth for a set of surviving products in that category (i.e., products that were not subject to creative destruction) to compute the inflation rate for the whole product category.

Using the Schumpeterian growth paradigm, together with the assumption that the statistical office cannot observe the innovation coming from creative destruction and instead computes the aggregate quality-adjusted price growth for the entire economy as being equal to the average price growth over existing products that are not subject to creative destruction, Aghion et al. (2017) provide an explicit expression for economywide missing growth from creative destruction. Then they use this expression to quantify missing growth based on two different approaches. In the first exercise, they use micro data from the US Census on the employment shares of incumbents, entrants, and exiters in all nonfarm business sectors. In the second exercise, they use data on the flow and quality of patents (exploiting information from patent citations) to directly estimate the arrival rates and step sizes of the various kinds of innovations and from there calculate the missing productivity growth from imputation. These two exercises yield missing growth of comparable magnitudes, of about 0.5 percentage points on average per year over the past 30 years.

My third and last argument for optimism regarding future growth prospects is also based on the observation that many countries have taken only belated and incomplete advantage of technological advances (e.g., because of structural rigidities or inappropriate economic policies).

We do not question the existence of long-run technological waves, with their acceleration and slowdown phases. These waves are typically associated with the diffusion of new general purpose technologies, defined as generic technologies that affect most sectors of the economy.[6] Obvious examples include steam energy in the early and mid-nineteenth century, electricity and chemistry in the early twentieth century, and the information and communication technology revolution in the 1980s.

And indeed, using annual and quarterly data for 1890–2012 on labor productivity and TFP for 13 advanced countries (the G7 plus Spain, the Netherlands, Finland, Australia, Sweden, and Norway) plus the reconstituted euro area, Bergeaud, Cette, and Lecat (2014) show the existence of two big productivity growth waves during this period. The first wave culminates in 1941, the second culminates in 2001. The first wave corresponds to the second industrial revolution: that of electricity, internal combustion, and chemistry. The second wave is the ICT wave.

However, Cette and Lopez (2012) show that the euro area and Japan experienced the waves with a lag compared to the United States. Thus the first wave fully diffused to the current euro area, Japan, and the United Kingdom only post–World War II. As for the second productivity wave, so far it has not shown up in the Euro area or in Japan. Moreover, through an econometric analysis, Cette and Lopez show that this lag of ICT diffusion in Europe and Japan, compared to the United States, is explained by institutional aspects: a lower educational level, on average, of the working-age population and more regulations on labor and product markets. This in turn suggests that by implementing structural reforms, these countries could benefit from a productivity acceleration linked to a catch-up to the US ICT diffusion level. The lower quality of research and higher education in the euro area and Japan compared to the United States also appears to matter for explaining the diffusion lag.

One can contrast the evolution of TFP in Sweden versus Japan over the past decades. In particular, there has been a positive break in TFP growth in Sweden after 1990, in contrast with the case of Japan, where we see no such break but instead decelerating TFP growth since 1980. Our explanation is that Sweden implemented sweeping structural reforms in the early 1990s:

6. See Bresnahan and Trajtenberg (1995).

in particular, a reform of the public spending system to reduce public deficits and a tax reform to encourage labor supply and entrepreneurship. No significant reform has taken place in Japan over the past 30 years.

To conclude this discussion on secular stagnation, although we do not question the existence of long-run technological waves, what leads us to be somewhat more optimistic than Gordon is that (1) the ICT revolution has improved the technology to produce ideas, and globalization has increased the potential rents to successful innovators; (2) measured TFP growth does not properly take into account innovation involving creative destruction; and (3) some developed countries, particularly in Europe, have not yet implemented the structural reforms that would allow them to fully take advantage of the most recent wave of innovation.

Innovation, Inequality, and Social Mobility

Over recent decades, developed nations have experienced an accelerated increase in income inequality, especially at the top tier, with the top 1 percent capturing a rapidly growing share of total income.[7] What explains this evolution?

Figure 6.1 compares the evolution of innovation in the United States since 1960 (as measured by the number of patents registered annually with the United States Patent and Trademark Office), with extreme inequality (as measured by the share of income attributed to the top 1 percent of earners). The similarity in the two curves (innovation and the top 1 percent's share of income) is striking.

A new study by Antonin Bergeaud, Richard Blundell, Ufuk Akcigit, David Hemous, and myself[8] shows that this strong correlation reflects a causal link between innovation and extreme inequality: Income from innovation contributes significantly to the increase in the share of income going to the top 1 percent.

The observation that the observed increase in the top 1 percent results in part from innovation, and not solely from returns from real estate and speculation, provides an important insight, because innovation has virtues that the other sources of high income do not necessarily share.

7. See Atkinson, Piketty, and Saez (2011) and Piketty (2013).
8. See Aghion et al. (2015a).

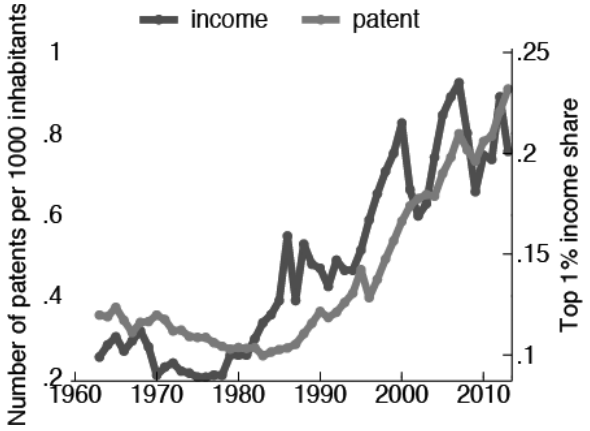

Figure 6.1
Evolution of top income share and patents per capita in the United States
Source: Aghion et al. (2015b).

First, as previously mentioned, innovation is the main motor of growth in developed economies. Second, although in the short term innovation benefits those who generated or enabled the innovation, in the long term its returns are dissipated due to imitation and creative destruction. In other words, the inequality induced by innovation is temporary. Third, because of the link between innovation and creative destruction, innovation generates social mobility: It enables new talent to enter the market and to displace (partially or totally) the firms in place. Thus in the United States, California (currently the most innovative state in the union) far outpaces Alabama (which is among the least innovating states) both in terms of the inequality of income going to the top 1 percent and in terms of social mobility.

The two figures below are especially eloquent. Figure 6.2 describes the relationship between innovation and social mobility by comparing American municipalities. Social mobility is defined as the probability that an individual from a modest background (i.e., one whose parents were in the lowest quintile in the earnings scale between 1996 and 2000) will reach the highest quintile in 2010 on reaching adulthood (based on the work of Chetty et al. (2014)). Innovation is measured by the number of patents filed with the United States Patent and Trademark Office per resident in the municipality. The resulting graph shows a strong positive correlation between innovation and social mobility.

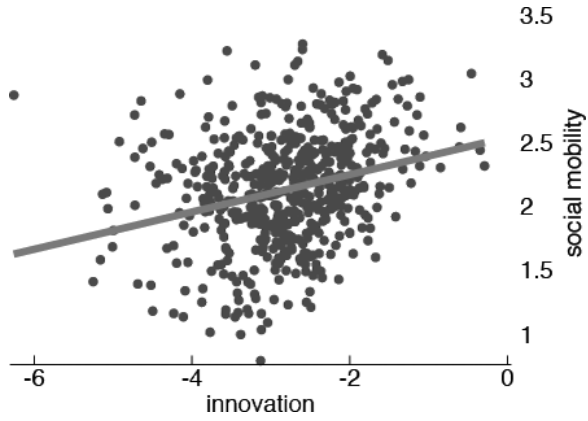

Figure 6.2
Relationship between innovation and social mobility across municipalities in the United States
Source: Aghion et al. (2015b).

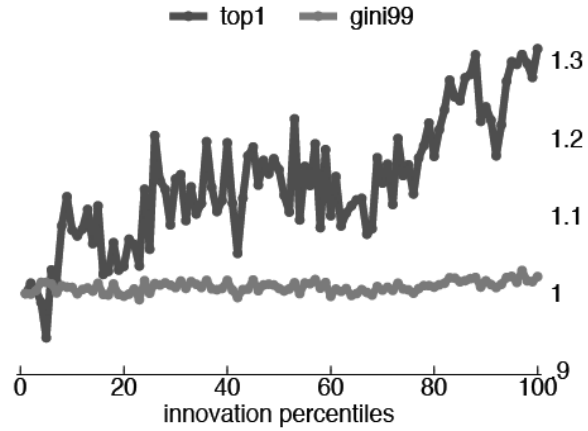

Figure 6.3
No correlation between innovation and the Gini measure of inequality
Source: Aghion et al. (2015b).

Figure 6.3 shows that there is no correlation between innovation and the broader measures of inequality, such as the Gini coefficient, which measures the deviation between the actual distribution of income in an economy and a perfectly equal distribution.

By taking into account all pieces of the puzzle, we can respond to the question of whether we should object to innovation on the grounds that it

contributes to income inequality. The response is no, because innovation generates growth. It does not increase inequality in broader terms; instead, it stimulates social mobility. As a corollary to this discussion, tax policy must differentiate between innovation and other sources of top income. Put differently, we must distinguish between a Steve Jobs and a Carlos Slim. Tax policy that discourages innovation would not only inhibit growth but also reduce social mobility, whereas innovation does not increase inequality measured broadly.

Firm Dynamics and Economic Development

The empirical literature has documented various stylized facts about firm size distribution and firm dynamics using micro firm-level data. In particular: (1) the firm size distribution is highly skewed; (2) firm size and firm age are highly correlated; and (3) small firms exit more frequently, but the ones that survive tend to grow faster than the average growth rate.

These are all facts that non-Schumpeterian growth models cannot account for. In particular, the first four facts listed require a new firm to enter, expand, then shrink over time, and eventually be replaced by new entrants: These and the last fact on the importance of reallocation are all embodied in the Schumpeterian idea of creative destruction.

The Schumpeterian model by Klette and Kortum (2004) can account for these facts. This model adds two elements to the baseline model: First, innovations come from both entrants and incumbents; and second, firms are defined as a collection of production units where successful innovations by incumbents will allow them to expand in product space (see figure 6.4).

This model allows us to explain the above stylized facts:

Prediction 1: The size distribution of firms is highly skewed.

Recall that in this model, firm size is summarized by the number of product lines of a firm. Hence, to become large, a firm needs to have succeeded in many of its attempts to innovate in new lines and at the same to have survived many attempts by potential entrants and other incumbents at taking over its existing lines. This is turn explains why there are so few very large firms in steady-state equilibrium (i.e., why firm size distribution is highly skewed), as shown in a vast empirical literature.

Prediction 2: Firm size and firm age are positively correlated.

In the model, firms are born with a size of 1. Subsequent successes are required for firms to grow in size, which naturally produces a positive

correlation between size and age. This regularity has been documented extensively in the literature.

Prediction 3: Small firms exit more frequently. The ones that survive tend to grow faster than average.

In the above model, it takes only one successful entry to make a one-product firm exit, whereas it takes two successful innovations by potential entrants to make a two-product firm exit. The facts that small firms exit more frequently and grow faster conditional on survival have been widely documented in the literature.

Various versions of this framework have been estimated using micro-level data by Lentz and Mortensen (2008), Acemoglu et al. (2013), and Akcigit and Kerr (2010).[9]

In more recent work, Acemoglu et al. (2013) analyze the effects of various industrial policies on equilibrium productivity growth, including entry subsidy and incumbent R&D subsidy, in an enriched version of the above framework. Their extended framework also sheds new light on whether or how one should conduct industrial policy. In particular, allowing for high- and low-ability innovators, they argue that subsidizing incumbent firms has a detrimental effect on aggregate innovation and productivity growth by inducing a bias in favor of (low-ability) incumbents at the expense of high-ability entrants.

Growth Meets Development

Michael Kremer, Abhijit Banerjee, and Esther Duflo have revolutionized development economics by introducing experimental random methods of analysis drawn from pharmaceutical science to evaluate the effectiveness of new medicines and vaccines.[10] In particular, their work has enabled us to understand better the behavior of individuals and households in extreme poverty and to see how they react to different policies of aid and assistance.

However, this line of research suffers from two main limitations. First, firms and firm dynamics play little role in these analyses of the development process. Second, the link between micro and macro development is

9. See Aghion, Akcigit, and Howitt (2014) and Akcigit and Kerr (2010) for more references.

10. See Banerjee and Duflo (2012).

not fully spelled out. However, my own view is that one cannot disregard macroeconomic and systemic factors, or the effects of firm dynamics and resource reallocation, when the goal is to eradicate poverty at a national or regional level.

To see why macroeconomics matters, consider the following example. The rate of poverty in urban zones of India (the fraction of the population living on less than $1 per day) fell from 39 percent in 1987–1988 to 12 percent in 1999–2000. Over the same period, growth took off: From less than 0.8 percent in the mid-1980s, it climbed to 3.2 percent in the 1990s. This upswing in growth in India resulted less from local actions than from systemic reforms, such as the liberalization of trade and of the market for goods and services, with the suppression of the "raj license."[11]

But looking at the systemic and macroeconomic aspects of a problem by no means implies that we should ignore the microeconomic aspects, in particular, at the level of the firm or sector. Specifically, our discussion of growth enigmas in the previous section has implications for how Schumpeterian growth theory can help bridge the gap between growth and development economics: first, by capturing the idea that growth-enhancing policies or institutions vary with a country's level of technological development; and second, by analyzing how institutional development (or the lack of it) affects firm size distribution and firm dynamics.

Appropriate Institutions and the Transition Trap

In 1890, Argentina enjoyed a GDP per capita approximately 40 percent that of the United States, which made it a middle-income country. This level was three times the GDP per capita of Brazil and Colombia and equivalent to that of Japan at the time. Argentina sustained this level of 40 percent of the GDP per capita of the United States through the 1930s. To be precise, Chow's test (a statistical test) shows a break around 1938, after which Argentina's productivity declines relative to American productivity by approximately 21 percent per year. What explains this drop-off?

Schumpeterian growth theory offers the following explanation. Countries like Argentina either had institutions or had implemented policies (in particular, import substitution) that fostered growth by accumulation of capital and economic catch-up. They did not, however, adapt their

11. See Aghion et al. (2008).

institutions to enable them to become innovating economies. As demonstrated in joint work with Daron Acemoglu and Fabrizio Zilibotti,[12] the greater the level of development is in a country (i.e., the closer it gets to the technology frontier), the greater the role of cutting edge innovation becomes as the motor of growth, replacing accumulation and technological catch-up.

This phenomenon also exists in Asia. Japan, where the state has always tightly controlled competition, is another example: Japan's Ministry of Economy, Trade and Industry caps the number of import permits, and the state subsidizes investment by the big industrial-financial consortia known as keiretsu. It is thus not surprising that from an extremely high level between 1945 and 1985—the envy of other developed countries—Japan's growth has fallen to a very low level since 1985.

In the previous subsection, I discussed the prediction that competition and free entry should be more growth enhancing in more frontier firms, which implies that they should be more growth enhancing in more advanced countries, because such countries have a larger proportion of frontier firms. Similarly, using a cross-country panel of more than 100 countries over the 1960–2000 period, Acemoglu, Aghion, and Zilibotti (2006) test the following predictions from the Schumpeterian prediction between imitation and innovation-driven growth:

Prediction 1: Average growth should decrease more rapidly as a country approaches the world frontier when openness is low.

Acemoglu, Aghion, and Zilibotti (2006) repeat the same exercise using entry costs faced by new firms instead of openness. They show:

Prediction 2: High entry barriers become increasingly detrimental to growth as the country approaches the frontier.

These two empirical exercises point to the importance of interacting institutions or policies with technological variables in growth regressions: Openness is particularly growth enhancing in countries that are closer to the technological frontier; entry is more growth enhancing in countries or sectors that are closer to the technological frontier.

Next, to the extent that frontier innovation makes greater use of research education than imitation, the prediction is:

12. See Acemoglu, Aghion, and Zilibotti (2006).

Prediction 3: The more frontier an economy is, the more growth in this economy will rely on research education.

And indeed, Aghion et al. (2009b) show that research-type education is always more growth enhancing in US states that are more frontier, whereas a bigger emphasis on 2-year colleges is more growth-enhancing in US states that are farther below the productivity frontier. Similarly, using cross-country panel data, Vandenbussche, Aghion, and Meghir (2006) show that tertiary education is more positively correlated with productivity growth in countries that are closer to the world technology frontier.

In the same spirit, one can look at the relationship between technological development, democracy, and growth. An important channel is Schumpeterian, namely, democracy reduces the scope for expropriating successful innovators or for incumbents to prevent new entry by using political pressure or bribes. In other words, democracy facilitates creative destruction and thereby encourages innovation.[13]

To the extent that innovation matters more for growth in more frontier economies, the prediction is:

Prediction 4: The correlation between democracy and innovation/growth is more positive and significant in economies that are closer to the frontier.

This prediction is confirmed by Aghion, Alesina, and Trebbi (2007) using employment and productivity data at industry level across countries and over time.

Innovation, Institutions, and Firm Dynamics in Developing Countries

The two figures below, from the work of Chang-Tai Hsieh and Peter Klenow (2009), illustrate the importance of firm dynamics and firm size distribution in the process of economic development. Figure 6.4 compares the distribution of Indian firms by productivity with that of American firms. Note that many more firms have low productivity in India than in the United States. Figure 6.5 represents the evolution of the average size of a company as a function of its age in India, Mexico, and the United States. It shows that US firms continue to grow, whereas the growth of Indian firms drops

13. Acemoglu and Robinson (2006) formalize another reason, also Schumpeterian, as to why democracy matters for innovation, namely, new innovations do not only destroy the economic rents of incumbent producers, they also threaten the power of incumbent political leaders.

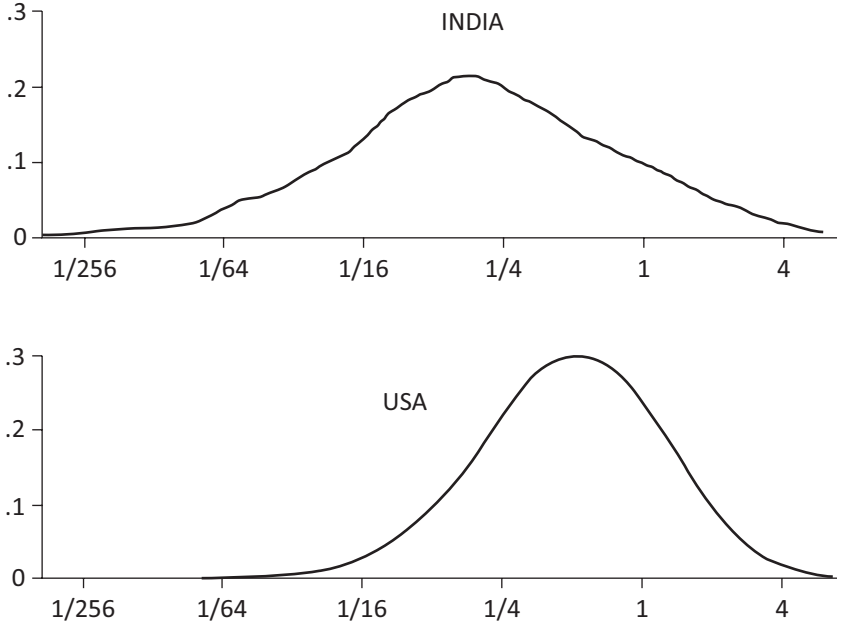

Figure 6.4
Distribution of firm productivity, India and the United States
Source: Hsieh and Klenow (2009).

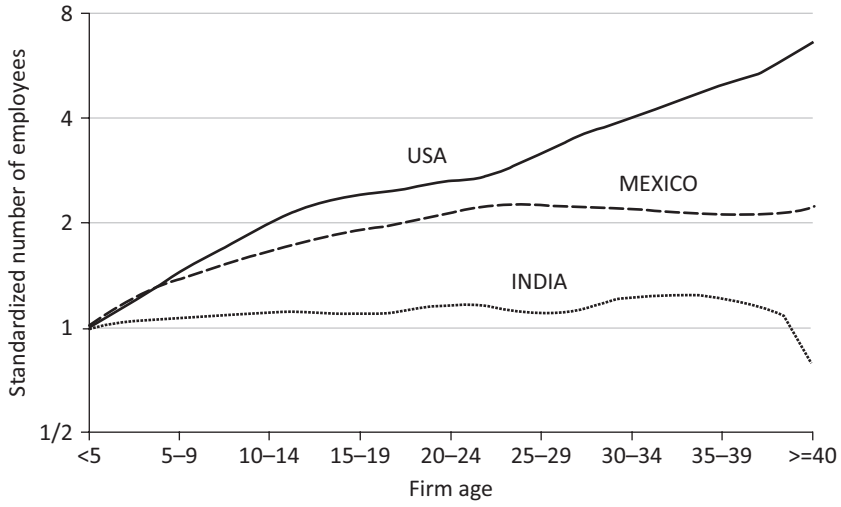

Figure 6.5
Link between the age and size of firms
Source: Hsieh and Klenow (2009).

off. In fact, Hsieh and Klenow show that although US establishments grow five times relative to their entry size by the age of 30, Indian counterparts barely show any growth.

Both these figures look at microeconomic characteristics. Yet when placed side by side, they tell a story that has consequences for the Indian economy as a whole: The inability of Indian firms, even the most innovative and productive ones, to grow beyond a certain size enables firms with low productivity to survive. But in the aggregate, innovation, and thereby the growth of the Indian economy overall, suffers.

To explain these two figures, we must consider the systemic characteristics of the Indian economy. Why do establishments not grow in India? Bloom et al. (2013) show that lack of trust and the weak rule of law are major obstacles to firm growth.

More recently, Akcigit, Alp, and Peters (2014) extend the Klette-Kortum model of firm dynamics discussed in the previous section by adding two major ingredients: (1) production requires managers, as owners' time is limited, and therefore owners face an overload constraint; (2) firm owners can be of high or low ability, where high-ability owners are more creative and therefore have the potential to expand much faster than can low-ability owners (but this potential for expansion materializes more when the scope for delegation is higher).

Their model generates the following predictions:

Prediction 1: The expected number of outside managers is (1) increasing in firm size and (2) increasing in the rule of law.

Larger firms involve a higher degree of overload for firm owners, which in turn increases the returns from hiring outside managers. Finally, stronger rule of law implies higher net return to delegation. Akcigit, Alp, and Peters (2014) provide empirical support for these predictions using Indian manufacturing establishments.

Prediction 2: The average firm size increases with the rule of law.

Firm value is increasing in owner time, and therefore the firms are willing to innovate and expand more when firm value is higher. The empirical support for this prediction is provided by Bloom et al. (2013). The positive link between firm size and the rule of law has been extensively documented in the literature (see, for instance, Bloom, Sadun, and Van Reenen (2012) for a detailed discussion). Finally, Akcigit, Alp, and Peters (2014) show that

the link between firm size and family size is weaker in high-trust regions in India.

Prediction 3: Firm growth decreases with firm size, and the more so the weaker the rule of law.

Indeed in larger firms, the span of control is larger, and therefore the owner has less time to allocate to each product line. This in turn implies that any constraint limiting the scope for delegation will have more dramatic effects on large firms. In particular, the weaker the rule of law is, the lower the larger firms' incentive to grow will be, which in turn implies that the difference in growth incentives between large and small firms will be higher in countries with weaker rule of law. Akcigit, Alp, and Peters (2014) show that growth decreases faster in firm size in low-trust regions in India.

Prediction 4: Everything else being equal, creative destruction and reallocation among firms will be higher in economies where the rule of law is stronger.

Clearly this last prediction is in line with the main findings of Hsieh and Klenow's work, which showed the missing growth and reallocation in developing countries. Understanding the reasons behind the lack of reallocation and creative destruction is essential when designing the right development policies. The Schumpeterian growth framework provides a useful framework to conduct counterfactual policy exercises, which can shed light on this important debate.

I see this approach as potentially quite fruitful. For example, one could look at the extent to which characteristics (such as the quality of education, infrastructure, or labor market regulations) also affect firm dynamics and the ability of better performing firms to grow faster. More generally, a better understanding of the process of growth of firms and the reallocation of resources among firms or sectors would undoubtedly provide new keys to understand the relationship between growth and development and to find lasting remedies for underdevelopment and poverty in the world.

Rethinking Growth Policy

Economists have responded in different ways to the question of whether to get involved in economic policy debates or to stay out of the debates and concentrate on basic research. My work lies between these two attitudes.

Although I am first and foremost a researcher and a teacher, I find economic policy debates compelling for two reasons. First, as a strictly scientific matter, analyzing public policy and action enables us to better understand the mechanisms of growth. Second, theoretical and empirical economic analysis combats "false good ideas" by clarifying the terms of the policy debate, and it helps suggest guidelines for growth policy design.

The Growth Diagnostics Approach

In an influential paper titled "Growth Diagnostics," Hausmann, Rodrik, and Velasco (2005), henceforth HRV, have proposed an attractively simple methodology to design growth-enhancing policy. In this section, I first summarize the methodology, point out some of its potential limitations, and then propose an alternative approach based on growth regressions that are themselves suggested by the theory, particularly the Schumpeterian paradigm outlined above.

HRV start from the relevant observation that growth-enhancing policies should vary from one country or region to another. For example, growth in the United States and other industrialized countries over the past 10 years appears to have benefited from market deregulations and privatizations. However, in Asian countries (including China) high growth rates have been promoted under limited competition or limited privatizations. The next question then is: Can one use existing new growth theory to provide a flexible guide to growth policy making, one that fully takes cross-country variability into account? HRV provide a positive and attractively simple answer to this question: namely, to use price comparisons to infer the importance of each potential constraint to growth. To illustrate their methodology, HRV consider a few Latin American examples, including Brazil and El Salvador.

In Brazil, returns to capital are high (with a net interest margin equal to 11.5 in 2001). This leads HRV to point to the low level of local savings (with very negative public savings) and the high tax rates as the main constraints on growth (the importance of the former is further supported by the positive and significant correlation between the interest rate and the current account deficit over time). The rate of return on education is also high in Brazil, which suggests that the rate of return on capital, and thereby growth, could be further increased by investing more on education. However, the argument goes, the already high rate of return on capital suggests that investing in education may not be a priority in Brazil.

In El Salvador, interest rates are low (a net interest margin equal to 3.7 in 2001), but so is the tax rate on capital. Is the lack of education responsible for the rate of return on capital? The HRV answer is no, given that the rate of return on education in El Salvador is low. Nor is there a lack of contractual enforcement that would reduce profitability. Lack of savings cannot be the binding constraint either, otherwise the interest margin would be high. Having failed to identify true obstacles to growth in El Salvador, HRV mention the "absence of profitable investment opportunities" as yet another potential suspect to consider.

Now suppose we used the same growth diagnostic approach to deal with the slow EU growth problem. The return to education is lower in the European Union than it is in the United States, which HRV would interpret as an indication that education is the most binding constraint to growth. Instead, they would presumably point to the high European tax rates as the main suspect, and thereby advocate lower tax rates as the primary cure to the growth problem in the European Union.

The simple and ingenious approach proposed by HRV raises at least two concerns. First, equilibrium prices do not necessarily reflect a constraint on growth. Consider interest rates. A low interest rate does not mean that the local credit market is not constrained. In fact, low interest rates may reflect a high degree of credit rationing, as shown by Aghion and Bolton (1997). Indeed, the more restricted the access to credit is (that is, the more individuals are barred from undertaking their own projects), the more supply of loanable funds there will be in the economy, as all credit-rationed individuals will end up lending to a few entrepreneurs. But this in turn should result in a lower domestic equilibrium interest rate. Next, consider the rates of return on labor, which are measured by the so-called Mincerian wages, that is, by the forgone wage income of 1 more year in education at different levels of education. Mincerian wages of course provide some useful indication on the marginal value of private investments in education in different fields and at different levels of education. However, a big shortcoming of the Mincerian approach is that the Mincerian wage does not account for externalities. In particular, it does not account for the intertemporal knowledge externalities that lie behind the positive relationship between education and growth. That intertemporal externalities matter is evidenced by the large effects of education on growth.

More generally, current prices reflect a current state of the economy. They do not inform directly about the growth dynamics that would result for various types of policies.

A second concern with the HRV approach is that it cannot lead to growth prescriptions that would affect simultaneously the demand side and the supply side of markets. Thus, for example, HRV would never recommend that a country invest in education (thereby increasing the supply of research labor) and at the same time invest in structural reforms that increase the profitability of innovations (thereby fostering the demand for R&D labor by firms).[14]

An alternative to the above methodology is to use theory to construct growth regressions that are meant to inform us directly about the impact of different institutions or policies on growth.

Pillars of Innovation-Led Growth

To enhance innovation-led growth and thereby avoid the middle-income trap, the Schumpeterian paradigm and our discussion in the previous two sections suggest policy priorities such as:

1. Liberalize entry and increase competition among existing firms. This policy favors creative destruction and also encourages incumbent firms to innovate to escape competition from their rivals.
2. Liberalize labor markets to make it easier for labor to reallocate from old to new activities. This policy in turn requires active labor policies that combine unemployment support with retraining programs. This approach is quite intuitive: The more advanced a country is, the more productivity growth will rely on frontier innovation. But frontier innovation in turn entails more creative destruction, and thus more job turnover, than does technological catch-up.
3. Invest in well-funded and autonomous universities to promote frontier research and innovation-led growth. Indeed, frontier innovation requires frontier researchers and therefore good universities and research centers, whereas good undergraduate education is sufficient for imitation.

14. Incidentally, HRV would never recommend more active competition policies whose effect in the simple growth paradigm they consider is simply to reduce the rate of return on capital.

4. If a bank-based financial system enhances productivity growth more for less advanced countries, a more market-based financial system enhances productivity growth more in more frontier countries where growth is driven by frontier innovation. Intuitively, frontier innovation, which breaks new ground, entails a higher level of risk than imitation activities, which are already well defined. But this in turn implies that outside financiers involved in frontier innovation will ask for a higher share of upside revenues and also for higher control rights: hence the role of equity in financing frontier innovation.

To enhance productivity growth based on imitation or adaptation in less developed (catching up) countries, the examples of China, India, or the Asian Tigers suggest that reallocation and technology transfers are key. These properties in turn appear to benefit from good basic education systems and from institutional features—access to infrastructure, access to (bank) finance, and labor market flexibility—that favor factor mobility and the creation and growth of new business activities. Thus Aghion et al. (2008) showed that the delicensing reforms in India spurred productivity growth particularly in provinces with higher degrees of labor market flexibility.

Conclusion

In this chapter, we have seen how Schumpeterian growth theory can shed light on key growth enigmas: in particular, the relationship between competition and innovation-led growth; the existence of transition traps; secular stagnation; the relationship between growth and inequality; and the relationship between growth and firm dynamics. We also discussed how growth theory can guide growth policy design. Finally, I argued that the theory can further contribute to reconciling growth with development economics: first, by bringing out the notion of appropriate growth institutions and policies; and second, by looking at how institutional development shapes the relationship among firm size distribution, reallocation, and growth.

Numerous paths have yet to be explored to better understand the enigmas of growth, the relationship between growth and innovation, and the role of institutions and economic policy in the process of development. Understanding this process will benefit not only science but also society as a whole, because we are less fearful of what we understand.

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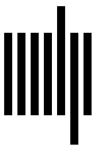

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