SOME "SCHUMPETERIAN" THOUGHTS

ON GROWTH AND DEVELOPMENT

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INTRODUCTION

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, i.e. what did we find unsatisfactory with the dominant theory at the time, both theoretically and empirically?

In this paper 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 a first part of the paper we shall touch upon 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 a second part of the paper we shall argue that the Schumpeterian growth paradigm can be used to further bridge the existing between growth and development economics.

And finally, in a third part of the paper we 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, like Modigliani-Miller is the benchmark in corporate finance. This is first due to its being a model of elegance and parsimoniousness: 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 the Nobel Prize 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 which 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 in to decreasing returns when trying to increase output by increasing the capital stock: the higher the existing stock of capital (number of machines), the lower 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.

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; or 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 motivated us to elaborate a new paradigm.

THE SCHUMPETERIAN PARADIGM

The paradigm Howitt and I formalized in the fall of 1987, revolved around three important ideas outlaid 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 entrepreneurs respond to the economic incentives (positive or negative) which result from economic policies and economic institutions. Thus typically innovation-based growth will be discouraged in environments with poor property right protection or with hyperinflation as these 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, Schumpeterian growth is a conflictual process between the old and the new: it tells the story of all these incumbents firms and interests which 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. 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 will show how the Schumpeterian paradigm can be used to shed light on four important enigmas associated with the growth process: (i) the relationship between competition and innovation-led growth; (ii) the debate on secular stagnation; (iv) the dynamics of income inequality; (v) 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 as shown in Figure 1 (incidentally, this latter argument has been used by Bill Gates when facing anti-trust action). However Blundell et al (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, as shown in Figure 2.

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[1] See Aghion and Howitt (1992).

How could we reconcile theory and evidence? Should we just dismiss the Schumpeterian paradigm start again from scratch? Should we simply ignore the empirical evidence? I went for a third way: namely to look more closely at the model and try to identify the assumption or assumptions which 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 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", i.e. 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", i.e. firms far below the current technological frontier. These firms make low profits and try to catch up with the current technology frontier.

To try and 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) is that letting the new student in will encourage the other top students to work harder in order to remain the best, whereas it will further discourage students at the bottom of the class, as those will find it even harder to catch up.

Quite strikingly, firms react like classroom students: namely, faced with a higher degree of competition in their sector, firms that are close to the technology frontier will innovate more in order 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: these latter firms behave like in the basic Schumpeterian model (see Figure 3).

Overall, the effect of competition on innovation and productivity growth is an inverted-U, as shown in Figure 4, which synthetizes the positive *escape competition effect* and the negative *discouragement effect*. The prediction of opposite reactions of frontier versus non-frontier firms

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[2] See Aghion-Harris-Vickers (1997), and Aghion-Harris-Howitt-Vickers (2001).
[3] E.g. see Aghion-Dewatripont-Rey (199x).

to competition, and of an inverted-U overall, were tested and confirmed in joint work with Richard Blundell, Nick Bloom and Rachel Griffith using the same kind of firm-level data as in the empirical studies I mentioned above.

In the end, this exercise has been mutually enriching. On the one hand, our empirical colleagues realized that the relationship between competition and growth was more involved and subtle than what they thought based on their initial studies. On the other hand, we understood how to enrich our model so as to bring out, not one but two basic effects of competition on innovation and growth, to identify conditions under which one or the other effect dominates, and why when aggregating across all firms/sectors we obtain the inverted-U relationship which Scherer (1965, 1967) had already anticipated.

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 in order to acquire a lead over their rival in the sector. This we refer to as the escape competition effect. On the other hand, 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 upon 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 precisely it is in 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, Bloom, Blundell, Griffith and Howitt (2005), using panel data on UK firms.

The prediction that more intense competition enhances innovation in "frontier" firms but may discourage it in "non-frontier" firms, was tested by Aghion, Blundell, Griffith, Howitt and Prantl (2009) using again panel data of UK firms.

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[4] See Aghion, Harris and Vickers (1997) and Aghion, Harris, Howitt and Vickers (2001).

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; 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 with both, our first model and Romer (1990), where competition is always detrimental to innovation and growth (as we discussed above) for exactly the same reason that intellectual property rights (IPRs) 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 crisis, which led Larry Summers[6] 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,[7] 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.

By way of example, the arrival of the Boeing 707 on the market in 1958 marked the end of progress in duration of air travel time. Until then, travel time had decreased exponentially; since

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[5] Alvin Hansen, "Economic Progress and Declining Population Growth," *American Economic Review*, vol. 29, n°1, 1939, pp. 1-15.

[6] Lawrence H. Summers, "Why Stagnation Might Prove to Be the New Normal," *Financial Times*, Dec. 15, 2013.

[7] Robert Gordon, "Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds," NBER, Working Papers Series, n° 18315. 2012.

then, not only has travel time ceased to decrease, it has actually increased due to the conjugated effects of energy-saving and cost-optimization.

Schumpeterian economists are more optimistic about the future than Summers and Gordon. A first argument (Jorgenson) is that reason is that the revolution in information and communications technologies (ICT) has radically and durably improved IT-producing technology; meanwhile globalization (which was concomitant with the ICT revolution) 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 last several decades, which has been fully reflected by measured productivity growth.

In particular, Aghion et al (2016) argue that innovation involving creative destruction is not properly taken into account by current measures of TFP growth. Whenever old products in the PPI are replaced by new products by new entrants, the statistical office often uses the price changes of surviving products to infer the price change of the replaced products. More specifically, the statistical office is essentially measuring the size of innovations by averaging inflation across products that were not creatively destroyed, i.e., products that were not innovated upon and products that were innovated upon only by incumbents, and then extrapolate this inflation rate to new products. Hence, to circumvent the absence of a previous period benchmark for a product newly introduced by a new entrant, standard productivity growth measures typically assume that new products have the same quality-adjusted price as non-replaced products, where in fact creative destruction implies that new products must have a lower quality-adjusted price than the older products they evict from the market.

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 (2016) provide an explicit expression for economy-wide 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 U.S. Census on the employment shares of incumbents, entrants, and exiters in all non-farm business sectors. In the second exercise, they use data on the flow and quality of patents (exploiting information from patent citations) to estimate the arrival rates and step-sizes of the various kinds of innovations. These two exercises yield missing growth of comparable magnitudes, from around 0.4 up to 1 percentage point on average per year.

The following figures help motivate this idea that creative destruction partly explains missing growth.

In Figure 6 below, the number of patents correlates positively with productivity growth in American states where there is little creative destruction, but not in states experiencing creative destruction. Similarly, the correlation between the production of patents and productivity growth is more positive in America in sectors with little creative destruction (Figure 7).

Finally, Figure 8 depicts the relationship between the level of creative destruction in a sector at a particular time on the one hand, and the correlation between TFP growth and the annual flow of patents on the other hand. More precisely: (i) each year over the period from 1994 to 2010, we rank 16 sectors, spanning the whole manufacturing industry, according to their level of creative destruction. Here, creative destruction is measured by half the sum of job creation and job destruction rates from the Quarterly Workforce Indicators series from the Census;[8] (ii) for any value x on the horizontal axis, we group all the sector-years with level x on the creative destruction scale, and compute the corresponding within-group average correlation y(x) between current yearly TFP growth and the current yearly number of patents.

Then we see that the correlation between TFP growth and patenting over time is lower in sectors with higher rates of creative destruction.

Third and last: my 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 (GPT), defined as generic technologies which affect most sectors of the economy.[9] Obvious examples include steam energy in the early and mid 19th century, electricity and chemistry in the early 20th century, and the Information and Communication Technology revolution in the 1980s.

And indeed, using annual and quarterly data over the period 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 (Gordon, 2000). The second wave is the ICT wave.

However Cette and Lopez (2012) shows that the Euro Area and Japan experienced the waves with a lag compared to the US. Thus the first wave fully diffused to the current euro area, Japan and the UK only post World War II. As for the second productivity wave, so far it does not show

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[8] See Davis, Haltiwanger, and Schuh (1996)
[9] See Bresnahan and Trajtenberg (199x)

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, compare to the US, is explained by institutional aspects: a lower education 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 of the US ICT diffusion level. The lower quality of research and higher education in the Euro area and Japan compared to the US also appears to matter for explaining the diffusion lag.

Thus Figure 9 contrasts the evolution of TFP in Sweden versus Japan over the past decades. In particular it shows 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: 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 took place in Japan over the past thirty years.

Similarly, Bergeaud, Cette and Lecat (2014) looked at the evolution of TFP growth in four countries which are commonly presented as lead reformers over the past three decades. The reforms initiated in Sweden in the early 1990s made the rate of TFP growth increase from an average of 0.4% over the period 1976-1992 to an average of 1.9% over the period 1992-2008. Similarly, the 1982 reform (Wassenaard agreement) in the Netherlands is associated with a break from an average TFP growth rate of 0.5% over the period 1977-1983 to an average TFP growth rate of 1.5% over the period 1983-2002. The reforms initiated in the early 1990s in Canada are associated with a break from an average TFP growth rate of 0.3% over the period 1974-1990 to an average rate of 1.1% over the period 1990-2000. Finally, the reforms initiated in the early 1990s in Australia are associated with a break from an average TFP growth rate over the period 1971-1990 of 0.4% to an average growth rate of 1.4% over the period 1990-2002.

These findings are in line with cross-country panel regressions suggesting that structural reforms play a key role in speeding up the diffusion of technological waves.

Thus to conclude our discussion on secular stagnation, while we do not question the existence of long-run technological waves, what leads us to be somewhat more optimistic than Gordon is that: (i) the ICT revolution has improved the technology to produced ideas whereas globalization has increased the potential rents to successful innovators; (ii) measured TFP growth does not properly take into account innovation involving creative destruction, which in turn implies that actual current US TFP growth lies close to (or above) 3% per year; (iii) some developed countries, particularly in Europe, have not yet taken implemented the structural reforms that would allow them of fully take advantage of the most recent wave.

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% capturing a rapidly growing share of total income.[10] What explains this evolution?

Figure 10 below 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% of earners). The similarity in the two curves (innovation and the top 1%'s share of income) is striking.

A new study by Antonin Bergeaud, Richard Blundell, Ufuk Akcigit, David Hemous, and myself[11] 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%.

The observation that the observed increase in the top 1% 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.

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 about 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 innovating state of 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% and in terms of social mobility.

The two figures below are especially eloquent. The first figure (Figure 11) 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 upon reaching adulthood (based on the work of Chetty, Saez,

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[10] See Anthony Atkinson, Thomas Piketty, and Emmanuel Saez, "Top Incomes in the Long-Run History'" *Journal of Economic Literature*, vol. 49, n°1, 2011, pp. 3-71; Thomas Piketty, *Le Capital au XXe Siècle*, Paris, Seuil, coll. "Les Livres du Nouveau Monde," 2013.

[11] Philippe Aghion, Ufuk Akcigit, Antonin Bergeaud, Richard Blundell, and David Hemous, "Innovation and Top Income Inequality," mimeo Harvard and National Bureau of Economic Research (NBER), Working Papers Series n° 21247, 2015.

et al.[12]). 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.

The second figure (Figure 12) 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 within of an economy and a perfectly equal distribution.

By taking into account all of the pieces of the puzzle, we can respond to the question of whether we should we 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; rather 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 would 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 on firm size distribution and firm dynamics using micro firm-level data. In particular: (i) the firm size distribution is highly skewed; (ii) firm size and firm age are highly correlated; (iii) 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.

 Instead 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; 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 14).

 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, a firm needs to have succeeded many attempts to innovate in new lines and at the same

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[12] Raj Chetty, Nathan Hendren, Patrick Kline, and Emmanuel Saez, "Where Is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States," *Quarterly Journal of Economics*, vol. 129, n°4, 2014, pp. 1553-1623, DOI: 10.1093/qje/qju022.

survived many attempts by potential entrants and other incumbents at taking over its existing lines, in order to become a large firm. 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 to 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, Akcigit, Bloom and Kerr (2013), Akcigit and Kerr (2014) and Garcia-Macia, Hsieh and Klenow (2014).[13]

In more recent work, Acemoglu, Akcigit, Bloom and Kerr (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[14]. 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

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[13] See Aghion, Akcigit and Howitt (2014 a,b) and Akcigit and Kerr (2010) for references.

[14] Abhijit Banerjee and Esther Duflo, *Repenser la Pauvreté*, Paris, Seuil, coll. "Les Livres du nouveau monde," 2012.

macro development is not fully spelled out. However, my own view is that one cannot disregard macroeconomic and systemic factors, nor 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: for example the rate of poverty in urban zones of India (fraction of the population living on less than $1 per day) fell from 39% in 1987-88 to 12% in 1999-2000. Over the same period, growth took off: from less than 0.8% in the mid- 1980's, it climbed to 3.2% in the 1990's. 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."[15]

But looking at the systemic and macroeconomic aspects of a problem by no means implies we should ignore the microeconomic aspects, in particular at the level of the firm or sector. And in the remaining part of this section I will argue that 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; second, by analyzing how institutional development (or the lack of it) affects firm size distribution and firm dynamics..

APPROPRIATE INSTITUTIONS AND THE MIDDLE INCOME TRAP

In 1890, Argentina enjoyed a GDP per capita approximately 40% 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% of the GDP per capita of the United States through the 1930's. To be precise, Chow's test (a statistical test) shows a break around 1938 (Figure 5), after which Argentina's productivity declines relative to American productivity by approximately 21% 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 institutions to enable them to become innovating economies. As demonstrated in joint work with Daron Acemoglu and Fabrizio Zilibotti,[16] henceforth AAZ, the greater the level of development in a country—*i.e.,* the closer it gets to the technology frontier— the greater the role of cutting edge innovation as the motor of growth, replacing accumulation and technological catch-up.

[15] Philippe Aghion, Robin Burgess, Steve Redding, and Fabrizio Zilibotti, "The Unequal Effects of Liberalization: Evidence from Dismantling the Raj License in India," *American Economic Review*, vol. 98, n° 4, 2008, pp. 1397-1412, DOI: 10.1257/aer.98.4.1397.

[16] Daron Acemoglu, Philippe Aghion, and Fabrizio Zilibotti, "Distance to Frontier, Selection, and Economic Growth," *Journal of the European Economic Association*, vol. 4, n° 1, 2006, pp. 37-74.

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 (MITI) caps the number of import permits, and the State subsidizes investment by the big industrial-financial consortia known a *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 since those have a larger proportion of frontier firms. Similarly, using a cross-country panel of more than 100 countries over the 1960-2000 period, AAZ 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.

   AAZ 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:

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

An indeed Aghion, Boustan, Hoxby and Vandenbussche (2009) show that research-type education is always more growth-enhancing in US states that are more frontier, whereas a bigger emphasis on two-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.[17]

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 more frontier economies.

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 Pete Klenow and Chang-Tai Hsieh[18] illustrate the importance of firm dynamics and firm size distribution in the process of economic development. The first figure (Figure 15) compares the distribution of Indian firms by productivity with the distribution of American firms. We observe that there are many more firms with low productivity in India than in the United States. The second figure (Figure 16) 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 American firms continue to grow whereas the growth of Indian firms drops off. In fact Hsieh and Klenow show that while establishments grow 5 times relative to their entry size by the age of 30, Indian counterparts barely show any growth.

Both of these figures look at microeconomic characteristics. Yet, when placed side by side, they tell a story that has consequences on 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 do not grow in India? Bloom et al. (2013) show that lack of trust and the weak rule of law is a major obstacle 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: (i) production requires managers as owners' time limited and therefore owners face an overload constraint; (ii)

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[17] 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.

[18] Peter Klenow and Chang-Tai Hsieh, "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics*, vol. 124, n° 4, 2009, pp. 1403-1448, DOI: 10.1162/qjec.2009.124.4.1403.

firm owners can be of high or low ability, where high-ability owners being more creative and therefore with the potential of expanding much faster than low ability owners (but this potential for expansion materializes more the higher the scope for delegation).

Their model generates the following predictions:

Prediction 1: The expected number of outside managers is (i) increasing in firm size; (ii) 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. AAP provide empirical support for these predictions using Indian manufacturing establishments.

Prediction 2: The average firm size increases in 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, AAP show that the link between firm size and family size is weaker in high trust regions in India.

Prediction 3: Firm growth decreases in 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, the lower the larger firms' incentive to grow, 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. AAP show that growth decreases faster in firm size in low trust regions in India.

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

Clearly this latter 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 in 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.

We see this approach as potentially quite fruitful. For example one could look at the extent to which characteristics such as the quality of education or the quality of infrastructure or labor market regulations, also affect firm dynamics and the ability of more 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 rather to stay out of the debates and concentrate on basic research. My work lies between these 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 entitled "Growth Diagnostics", Hausmann-Rodrik-Velasco (2005), henceforth HRV, have proposed an attractively simple methodology to design growth-enhancing policy. In this section, we will first summarize the methodology, then point at some of its potential limitations, and then propose an alternative approach based which uses 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, while growth in the US and other industrialized countries over the past ten years, appears to have benefited from market deregulations and privatizations, 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 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 at 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 EU than in the US, which HRV would interpret as an indication that education is the most binding constraint to growth. Rather, they would presumably point at the high European tax rates as the main suspect, and thereby follow Prescott (2006) in advocating lower tax rates as the primary cure to the growth problem in the EU.

The simple and ingenious approach proposed by HRV, raises at least two. First, equilibrium prices do not necessarily reflect a constraint on growth. Consider first 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 (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 foregone wage income of one 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, and in particular 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 (see Aghion et al (2006)), in comparison to the recent study by Acemoglu and Angrist (2004) which pointed at the absence of significant contemporaneous externalities in education.

More generally, current price 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 problem with the HRV approach, is that it cannot lead to growth prescriptions that would affect the demand side and the supply side of markets simultaneously. Thus, for example

HRV would never recommend that a country invests in education (thereby increasing the supply of research labor) and at the same time invests in structural reforms that increase the profitability of innovations (thereby fostering the demand for R&D labor by firms).[19]

A natural alternative to the above methodology, is to use theory to construct growth regressions which 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 favors creative destruction and also incumbent firms innovate to escape competition with their rivals

2. Liberalize labor markets, to make it easier for labor to reallocate from old to new activities; this in turn requires active labor policies which combine unemployment support with retraining programs. This is quite intuitive: the more advanced a country, the more productivity growth relies on frontier innovation. But frontier innovation in turn entails more creative destruction, and thus more job turnover, than technological catch-up.

3. Invest in well-funded and autonomous universities to promote frontier research and innovation-led growth. Indeed, indeed frontier innovation requires frontier researchers and therefore good universities and research centers, whereas good undergraduate education is sufficient for imitation.

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 example of China, India, or the Asian Tigers suggest that reallocation and technology transfers are key, and these in turn appear to benefit from good basic education systems, and from institutional features - access to infrastructure, access to (bank) finance, labor market flexibility- which favor factor mobility and the creation and growth of new business

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[19] 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.

activities. Thus with Aghion, Burgess, Redding and Zilibotti (2008), we showed that the delicensing reforms in India spurred productivity growth particularly in provinces with higher degrees of labor market flexibility.

POLICY AS A TOOL FOR ECONOMETRIC ANALYSIS

Public policy and active public intervention do also serve as tools for econometric analysis. In the context of growth economics, let us illustrate this idea by the following two examples.

Reforms as a Tool: Competition and Innovation/Growth

We looked earlier at the relationship between competition and innovation/growth. How can we be sure that this relationship is causal and not a mere coincidental correlation? The most commonly used method is that of instrumental variables: we utilize a variable that has a direct effect on competition and thereby on innovation, but no direct effect on innovation. In our work with Richard Blundell and his team, we used the creation of the European Single Market (CEE) and the deregulation implemented by Margaret Thatcher as instrumental variables to establish the causal nature of the relationship between competition and innovation-induced growth in the United Kingdom.

Cronyism as a Tool: Innovation-Induced Growth and Higher Education

One of the policies that seem to foster growth in countries close to the technology frontier investment in higher education, especially at the PhD level. Working with Caroline Hoxby from Stanford University, we used political cronyism to instrument for research education.

In the United States, Appropriation Committees in the Senate and the House of Representatives have the power to allocate federal resources to the states to help finance their investments in infrastructure, schools and universities, and R&D.

Aghion et al (2009) show the evolution of expenditures on higher education and research in three American states that are *a priori* at similar levels of development: Alabama, Mississippi, and Georgia. We see that the federal funds allocated to higher education and research for Alabama increased sharply when the senator from this state, Lister Hill, took office as the Chair of the Senate Appropriations Committee. This funding clearly stimulated innovation in the state.

This data provides us with a good tool to analyze the effect of expenditures in higher education and research on innovation and growth in the United States.

With a small dose of irony, we could argue that, even if favoritism in politics is bad, it is a boon for econometricians on the lookout for variables to isolate the causal relationships that they seek to demonstrate. From this point of view, France's immoderate taste for experimentation in taxation makes my country a first-class laboratory for analyzing the effect of various tax policies on innovation and growth.

CHASING FALSE TRUTHS AND FAULTY REASONING

A more direct reason for a research economist to study public policy is that they may influence thinking on the subject. First, they can combat certain false truths and faulty reasoning. (Joan Robinson responded to the question of why one should study economics, "to protect yourself from economists.").

Two examples of false truths in growth policy are:

1. More industrial policy is necessary to achieve competitiveness in an innovation economy.
2. Structural reform(s) and macroeconomic stimulus are mutually exclusive.

Rethinking Industrial Policy in an Innovation Economy

One of the pillars of the French Welfare State during the post-war economic boom was its industrial policy, which supported the large state enterprises and subsidized investment in a small number of large private enterprises (the "national champions").

As we have seen, innovation-induced growth requires not only competition and low barriers to entry, but also the discontinuation of activities that have become unprofitable. A Colbertist model of industrial policy that concentrates on a few national champions necessarily distorts competition and inhibits the entry of new, innovating firms.

This argument led some economists and decision-makers to call for the flat-out abandoning of any industrial policy whatsoever, *i.e*., any sectorial targeting of public investment. They recommended rather that governments limit themselves to horizontal targets, such as schools, universities, research, or SMEs.

Between a nostalgic attachment to Colbertism and an absolute banishment of the slightest tendancy in that direction, there is room for a new type of industrial policy, more favorable to competition and less biased in favor of a small number of existing firms. For example, recent research[20] based on data from Chinese firms shows that an industrial policy that focuses on more competitive sectors (and not firms) and distributes subsidies in a transparent and egalitarian fashion within a sector, including new entrants, fosters growth and innovation.

Put briefly, the approach to industrial policy should not be "yes or no" but rather to seek a new form of governance of industrial policy more compatible with innovation-induced growth. I hope this goal will inspire young generations of economists.

Structural reforms and proactive macroeconomic policies

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[20] Philippe Aghion, Mathias Dewatripont, Luosha Du, Ann Harrison, and Patrick Legros, "Industrial Policy and Competition," NBER, Working Paper Series, n° 18048, 2012.

Faced with a recession, some economists support stimulus policies (via public deficit and spending) and others argue for disengagement of the State, except to ensure well-functioning markets.

Thus, to explain the resilience of the American economy compared to the European economy following the crisis of 2007-2009, some blame the lack of macroeconomic reactivity in Europe, while others point to the delay, by France and other European nations, to implement necessary structural reforms

I believe that these two factors played a simultaneous and intertwined role: the persistent rigidities in the markets for goods and labor inhibited the impact of proactive macroeconomic policy. This opinion echoes the words of Mario Draghi, the Director of the European Central Bank (ECB), who declared at Bretton Woods in 2013 that he could only do half the work by relaxing monetary policy and that Member States would have to do the other half by making reforms.

Preliminary results from a joint research with Gabriel Chodorow and Emmanuel Farhi from Harvard University, and Enisse Kharroubi from the Bank for International Settlements, suggest that structural reforms and countercyclical monetary policy (lower interest rates during periods of recession and higher interest rates in periods of expansion) *actually complement each other*. In other words, by being more audacious with respect to structural reforms not only do we incite our economic partners and the BCE to adopt more flexible macroeconomic policies, but more importantly we increase those reforms' positive impact on growth.

REDEFINING THE TERMS OF A POLICY DEBATE

Using theory, and in our case the Schumpeterian growth paradigm, can also help elucidate the terms of a very confused debate. Here we shall focus on the debate surrounding the notion of "inclusive growth" policy.

How to Reconcile the Goals of Growth and Reducing Inequality

Researchers and policy-makers continually ask how we can make growth more inclusive and less inegalitarian. Many of my colleagues have attempted to analyze the correlation between income inequality broadly measured and the rate of growth of the GDP or the per capital GDP. These attempts, such as those of Abhijit Banerjee and Esther Duflo, have failed to show a clear relationship between inequality and growth. I would argue that a more promising approach is to (i) identify growth drivers in the economy being studied; (ii) analyze the effect of each of these drivers on phenomena such as the various measures of inequality: broad measures (such as the Gini coefficient), the share of income going to the top 1%, and social mobility. As we have seen, innovation affects these measures in different ways.

In particular, recent studies have pointed to some main growth drivers for a developed economy: education (especially higher education), competitive markets for goods and services, and a dynamic labor market. How do these drivers affect social mobility?

Education is "inclusive" in that it tends to increase social mobility[21] and to reduce income inequality broadly measured. Indeed Chetty et al show[22] that social mobility correlates positively with performance on education tests.

More surprisingly, the flexibility of the labor market and the market for goods seems to favor social mobility (see Aghion and Roulet, 2015).

These results are encouraging: the growth levers for innovation also stimulate social mobility. In light of our earlier remarks, we can state with certainty that using an inappropriate tax policy to discourage innovation inhibits not only growth, but also social mobility.

CONCLUSION

In this paper, we saw how Schumpeterian growth theory can generate distinctive predictions, in particular on the relationship between innovation-led growth on the one hand, and competition, firm dynamics, and income inequality on the other hand. We also 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; second, by looking at how institutional development shapes the relationship between firm size distribution, reallocation, and growth. Finally, we showed how Schumpeterian growth theory can be used as a tool for growth policy design: departing from the "Washington consensus" view whereby the same policies should be recommended everywhere, and also from the growth diagnostics approach where prices determine the binding constraints on growth, the theory helps revisit growth policy debates.

Numerous paths are 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 society as a whole, because we are less fearful of what we understand.

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[21] Raj Chetty, Nathaniel Hendren, Patrick Kline, and Emmanuel Saez, "Where Is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States," *op.cit.*

[22] Philippe Aghion and Alecandra Roulet, "Réformes structurelles et mobilité sociales," mimeo College de France, 2015.

BIBLIOGRAPHY

Acemoglu, D., Aghion, P., and Zilibotti, F (2006), "Distance to Frontier, Selection, and Economic Growth," *Journal of the European Economic Association*, 4, 37-74.

Acemoglu, D. and Robinson, J (2012). *Why Nations Fail*, Crown Business.

Aghion, P., Akcigit, U., Bergeaud, A., Blundell, R., and Hemous, D (2015) "Innovation and Top Income Inequality," *NBER Working Papers Series n° 21247*.

Aghion, P, Akcigit, U., and Howitt, P (2014), "What Do We Learn From Schumpeterian Growth Theory?" In *Handbook of Economic Growth*. Edited by P. Aghion and S. Durlauf. Vol. 2, 515-563. Amsterdam, Elsevier.

Aghion, P., Akcigit, U., Toivanen, O., and Vaananen, A (2015), "Living "American Dream" in Finland: The Social Mobility of Innovators", mimeo LSE

Aghion, P., Bergeaud, A., Boppart, T., Klenow, P., and Li, H, "Missing Growth from Creative Destruction," in progress.

Aghion, P., Bloom, N., Blundell, R., Griffith, R., and Howitt, P (2005). "Competition and Innovation: An Inverted-U Relationship*", Quarterly Journal of Economics*, 120, 701-728.

Aghion, P., Blundell, R., Griffith, R., Howitt, P., and Prantl, S (2009). "The Effects of Entry on Incumbent Innovation and Productivity*", Review of Economics and Statistics*, 91, 20-32.

Aghion, P., Boustan, L., Hoxby, C., and Vandenbussche, J (2009), "The Causal Impact of Education on Economic Growth: Evidence from the U.S." mimeo Harvard.

Aghion, P., Burgess, R., Redding, S., and Zilibotti, F (2008), "The Unequal Effects of Liberalization: Evidence from Dismantling the Raj License in India," *American Economic Review*, 98, 1397-1412.

Aghion, P., Cette, G., Cohen, E., Pisani-Ferry, J (2007) *Les Leviers de la croissance française,* Paris, La Documentation Française.

Aghion, P., Dewatripont, M., Du, L., Harrison, A., and Legros, P (2012) "Industrial Policy and Competition," *NBER, Working Paper Series, n° 18048*.

Aghion, P. and R. Griffith. (2006). Competition and Growth: Reconciling Theory and Evidence, MIT Press.

Aghion, P., Harris, C., Howitt, P., and Vickers, J (2001). "Competition, Imitation and Growth with Step-by-Step Innovation," *Review of Economic Studies*, 68, 467-492.

Aghion, P., C. Harris, and J. Vickers. (1997). "Competition and Growth with Step-by-Step Innovation: An Example." European Economic Review, Papers and Proceedings, 771-782.

Aghion, P. and Howitt, P (1992). "A Model of Growth Through Creative Destruction." *Econometrica*, 60, 323-351.

Aghion, P., and Howitt, P (1998), *Endogenous Growth Theory*, MIT Press.

Aghion, P., and Howitt, P (2009*), The Economics of Growth*, MIT Press.

Aghion, P., Howitt, P., and Prantl, S (2013), "Patent Rights, Product Market Reforms and Innovation*", NBER Working Paper 18854*.

Aghion, P., and Roulet, A (2015), "Structural Reforms and Social Mobility", mimeo College de France, 2015.

Akcigit, U., Alp, H. and Peters, M (2014), "Lack of Selection and Limits to Delegation: Firm Dynamics in Developing Countries," mimeo University of Pennsylvania.

Atkinson, A., Piketty, T., and Saez, E (2011), "Top Incomes in the Long-Run History", *Journal of Economic Literature*, 49, 3-71.

Banerjee, A., and Duflo, E (2012) *Repenser la Pauvreté*, Paris, Seuil.

Bergeaud, A., Cette, G., and Lecat, R (2014), "Productivity trends from 1890 to 2012 in advanced countries", Banque de France, Working Paper, N° 475, February.

Blundell, R., Griffith, R., and Van Reenen, J (1995). "Dynamic Count Data Models of Technological Innovation*", Economic Journal*, 105, 333-344.

Blundell, R., Griffith, R., and Van Reenen, J (1999). "Market Share, Market Value and Innovation in a Panel of British Manufacturing Firms", *Review of Economic Studies*, 66, 529-554.

Boldrin, M., and Levine, D (2008), *Against Intellectual Monopoly*, Cambridge University Press.

Bourguignon, F (2015), *Pauvreté et développement dans un monde globalisé*, Paris, College de France, Fayard.

Cette, G., and Lopez, J (2012), "ICT demand behavior: an international comparison", Economics of innovation and New Technology, Taylor and Francis Journals, vol. 21(4), June, pp. 397-410.

Chetty, R., Hendren, N., Kline, P., and Saez, E (2014), "Where Is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States," *Quarterly Journal of Economics*, 129, 1553-1623.

Davis, S., Haltiwanger, J., and Schuh, S (1996), *Job Creation and Destruction*, MIT Press.

Gordon, R (2012), "Is U.S. Economic Growth Over? Faltering Innovation Confronts the Six Headwinds," *NBER, Working Papers Series, n° 18315.*

Grossman, G., and Helpman, E (1991), "Quality Ladders in the Theory of Growth*", Review of Economic Studies*, 58, 43-61.

Hansen, A (1939), "Economic Progress and Declining Population Growth," *American Economic Review*, 29, 1-15.

Hsieh, C., and Klenow, P (2009), "Misallocation and Manufacturing TFP in China and India." *Quarterly Journal of Economics*, 124, 1403-1448.

Klenow, P., and Hsieh, C (2009), "Misallocation and Manufacturing TFP in China and India," *Quarterly Journal of Economics*, 124, 1403-1448.

Nelson, R., and Phelps, E (1966). "Investment in Humans, Technological Diffusion, and Economic Growth*", American Economic Review*, 61, 69-75.

Piketty, T (2013), *Le Capital au XXe Siècle*, Paris, Seuil.

Romer, P (1990), "Endogenous Technical Change*", Journal of Political Economy*, 98, 71-102.

Summers, L (2013), "Why Stagnation Might Prove to Be the New Normal," *Financial Times*, December 15, 2013.

De Tocqueville, A (1835), *De la Démocratie en Amérique,* published by Gallimard, Bibliothèque de la Pleiade, Paris, 1992.

Vandenbussche, J., Aghion, P., and Meghir, C (2006), "Growth, Distance to Frontier, and Composition of Human Capital*", Journal of Economic Growth*, 11, 97-127.

Competition and growth: theoretical prediction
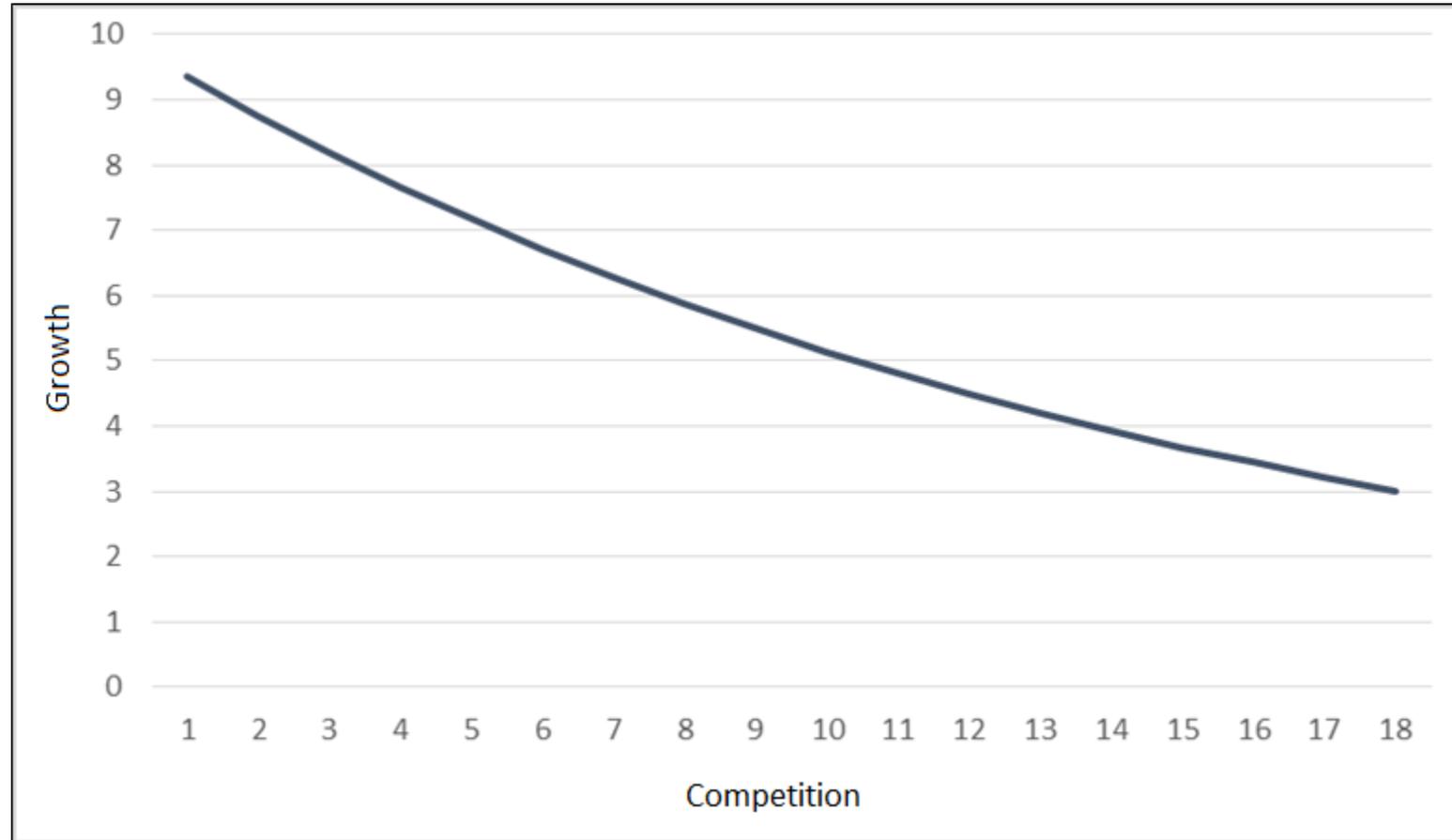
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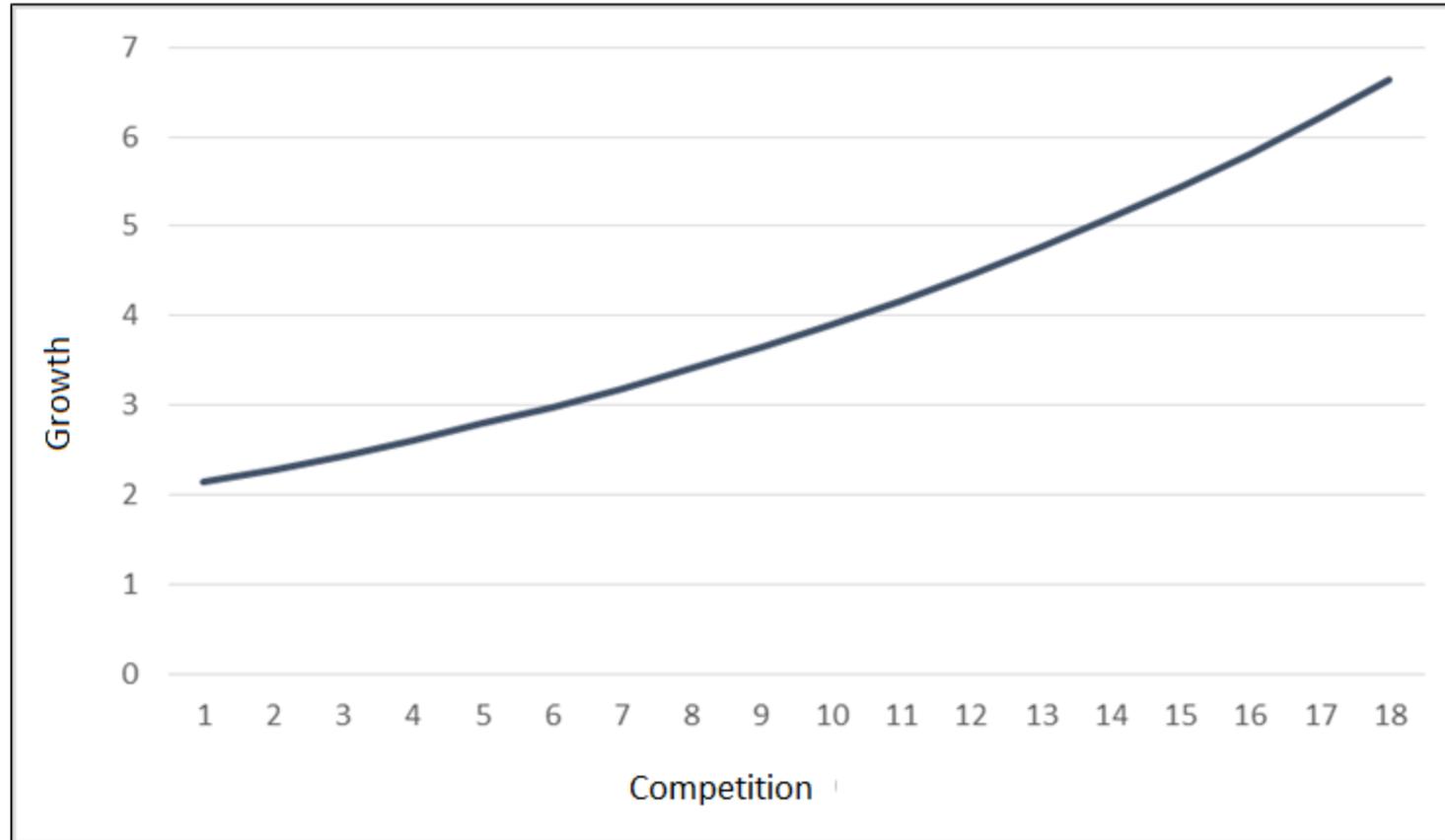
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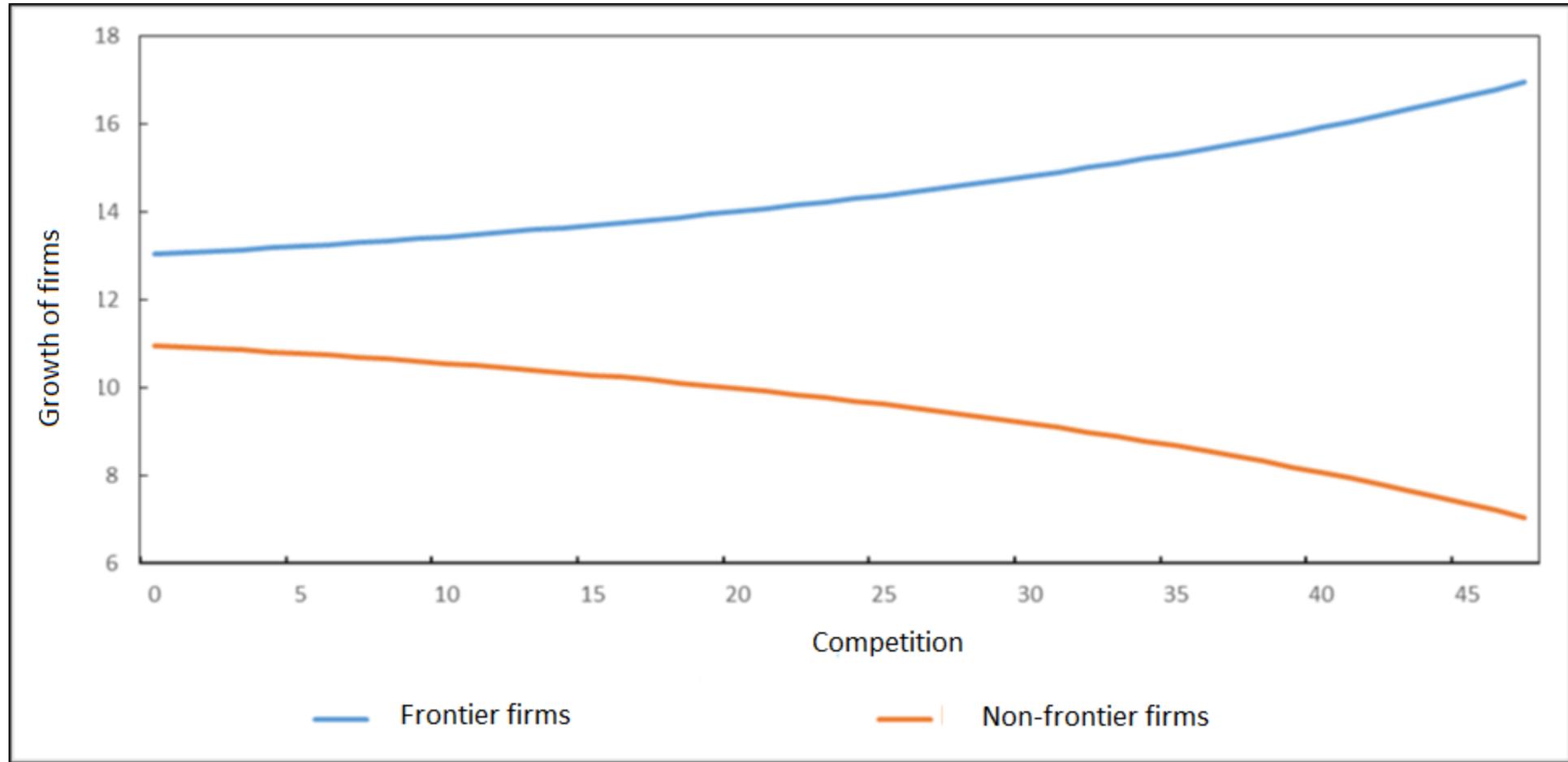
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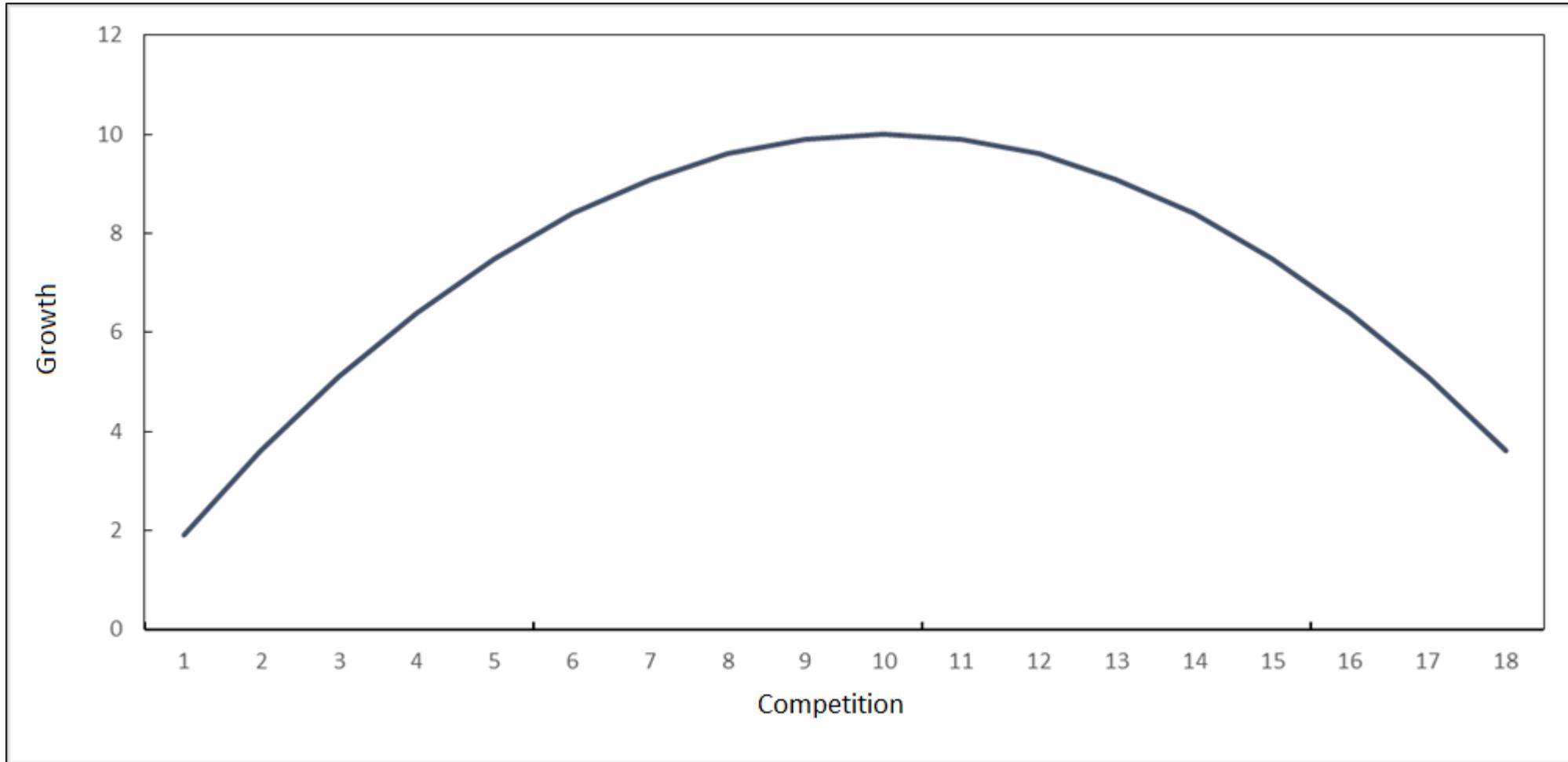
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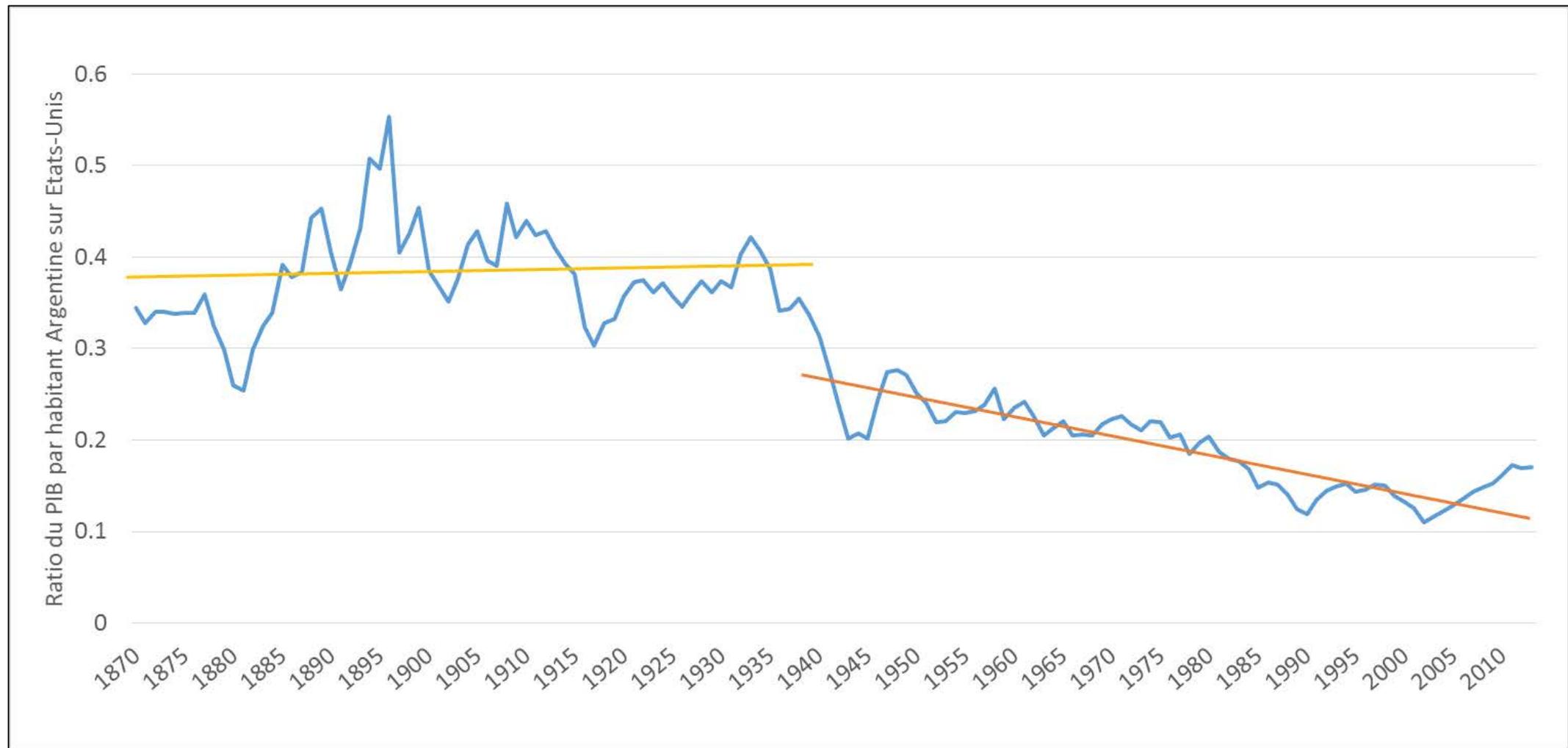
# Correlation between patenting and labor productivity growth

Number of patent applications (y-axis)
Average growth rate of labor productivity (x-axis)

States below median in terms of creative destruction

States above median in terms of creative destruction
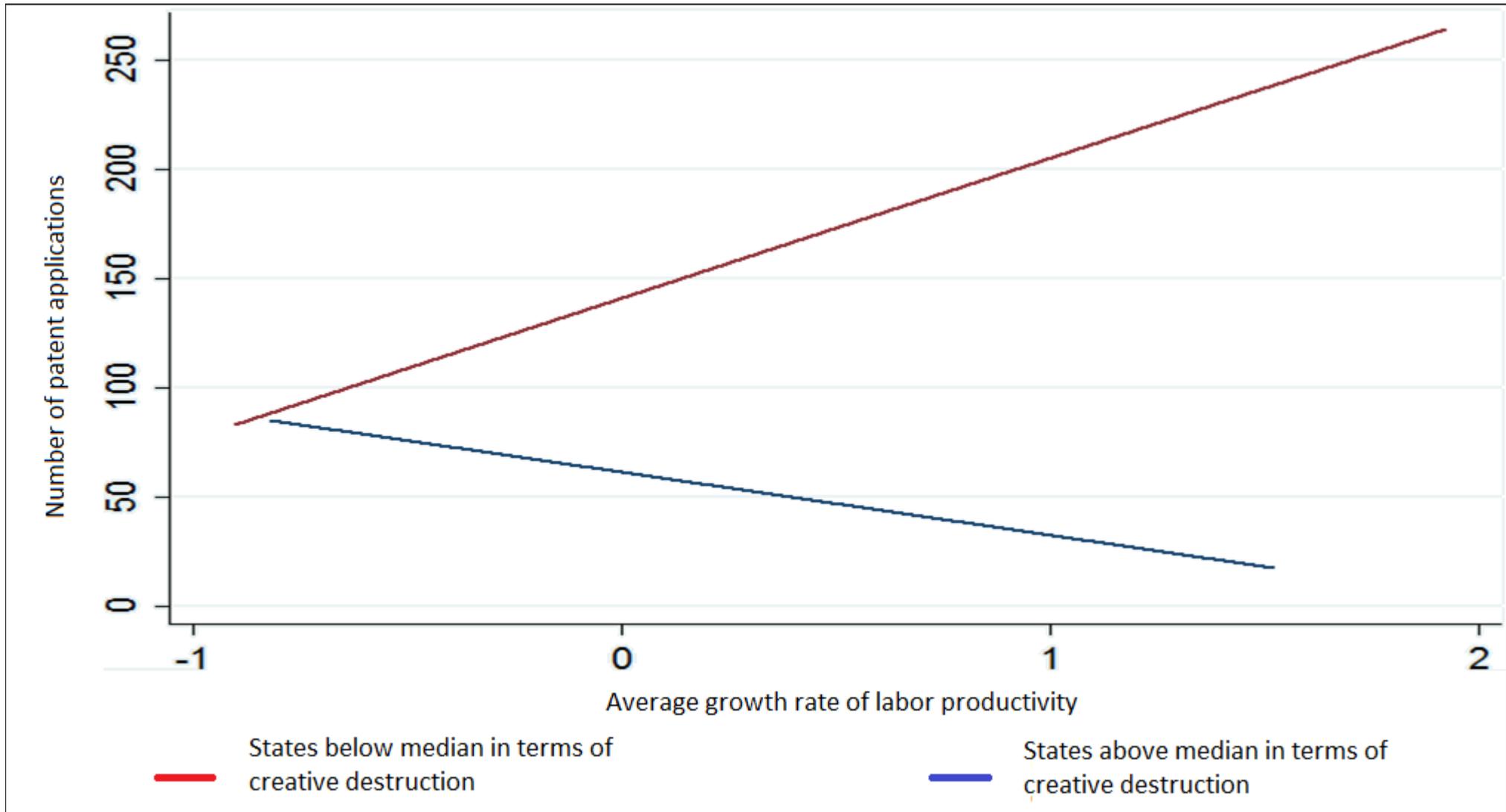
Correlation between patenting and labor productivity growth
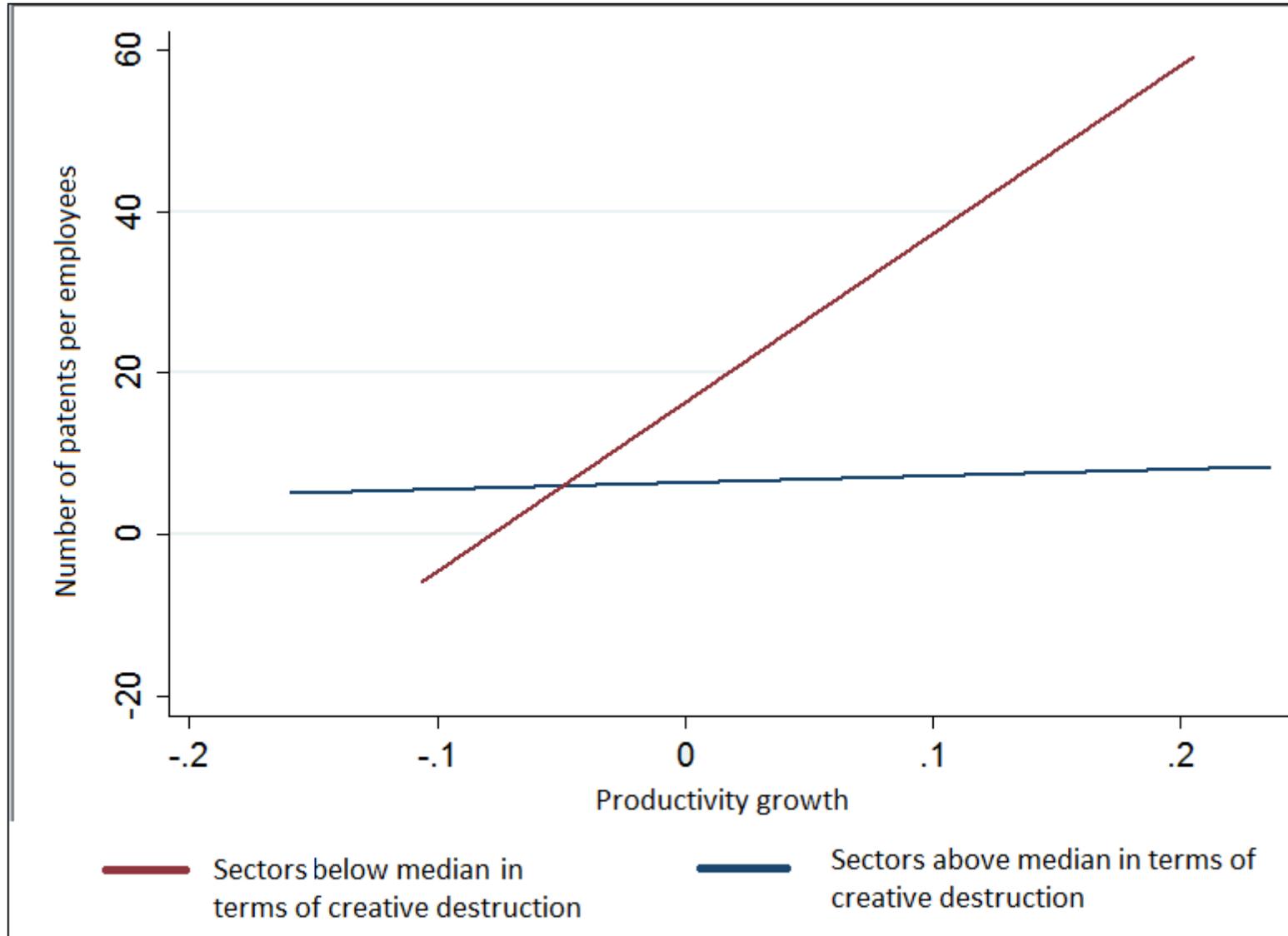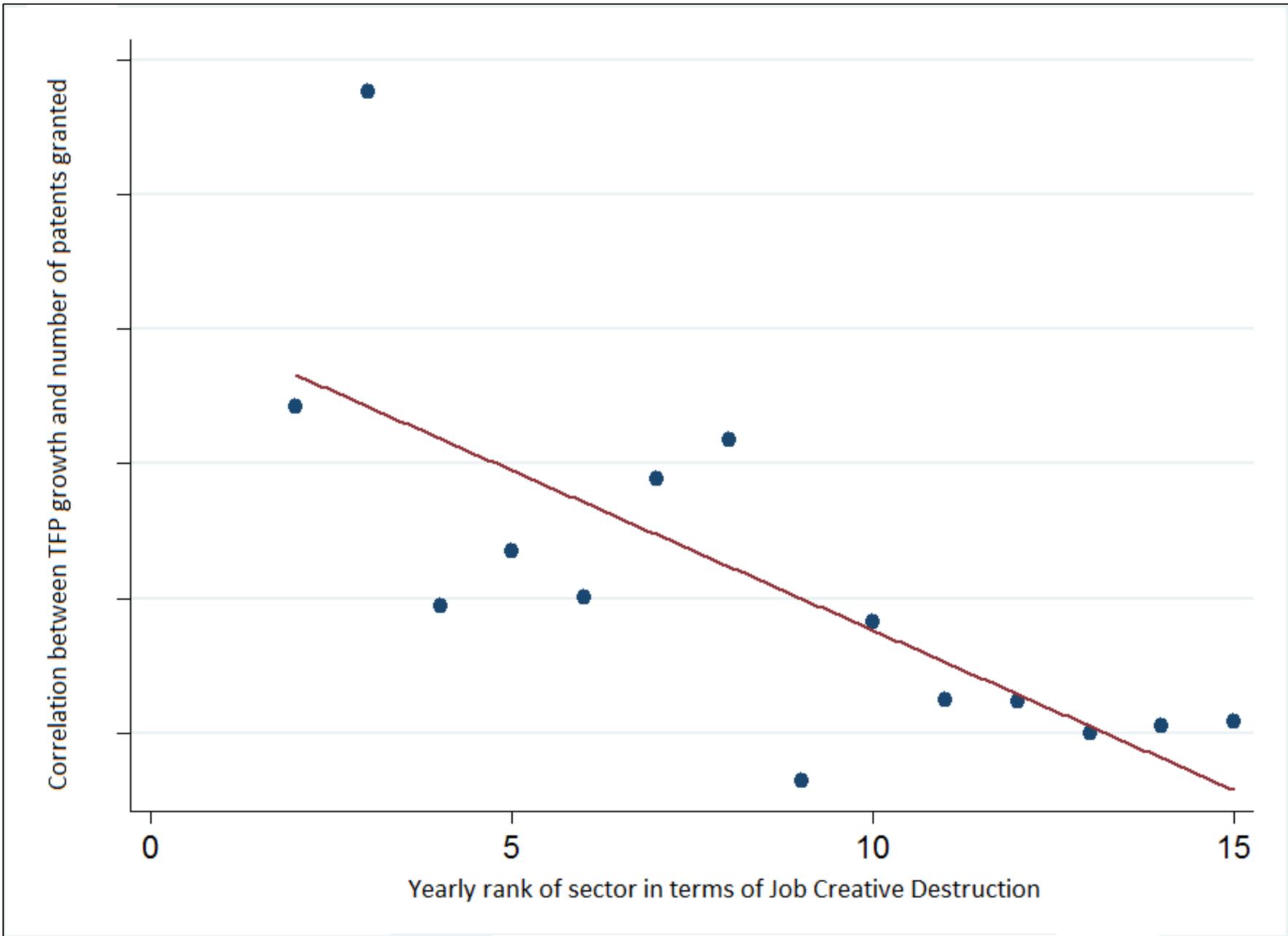
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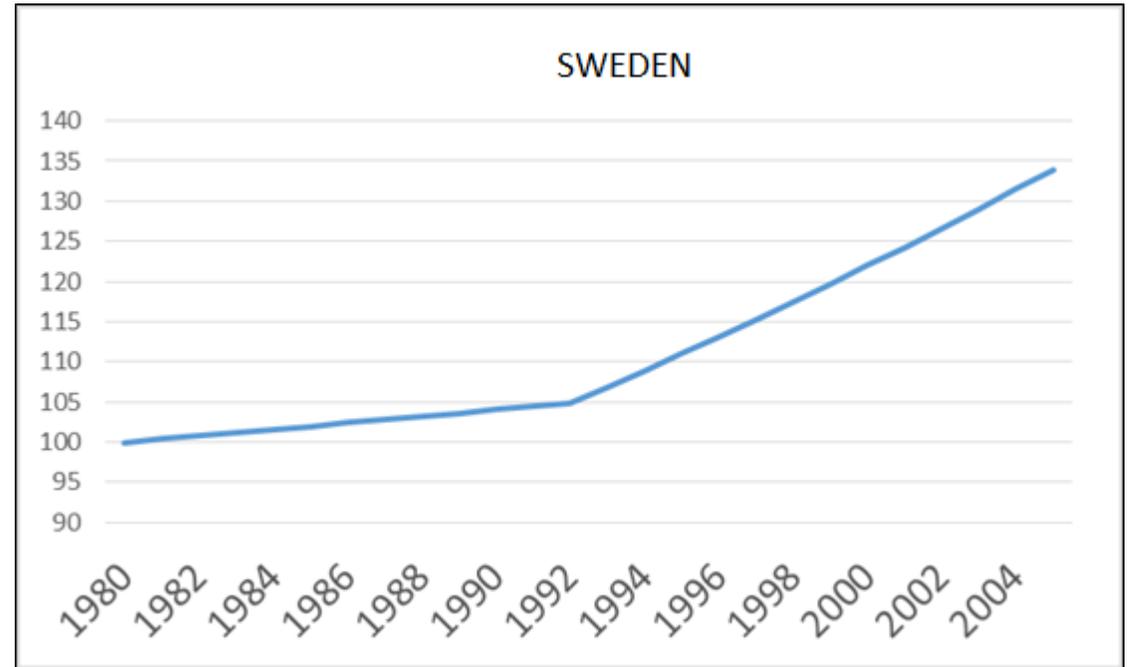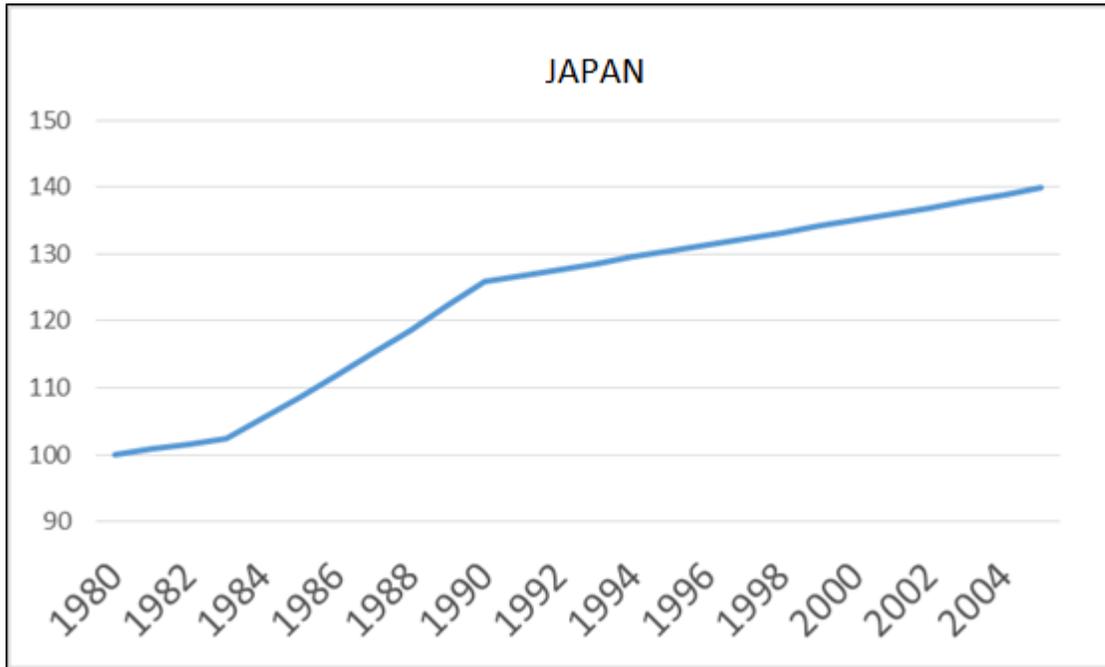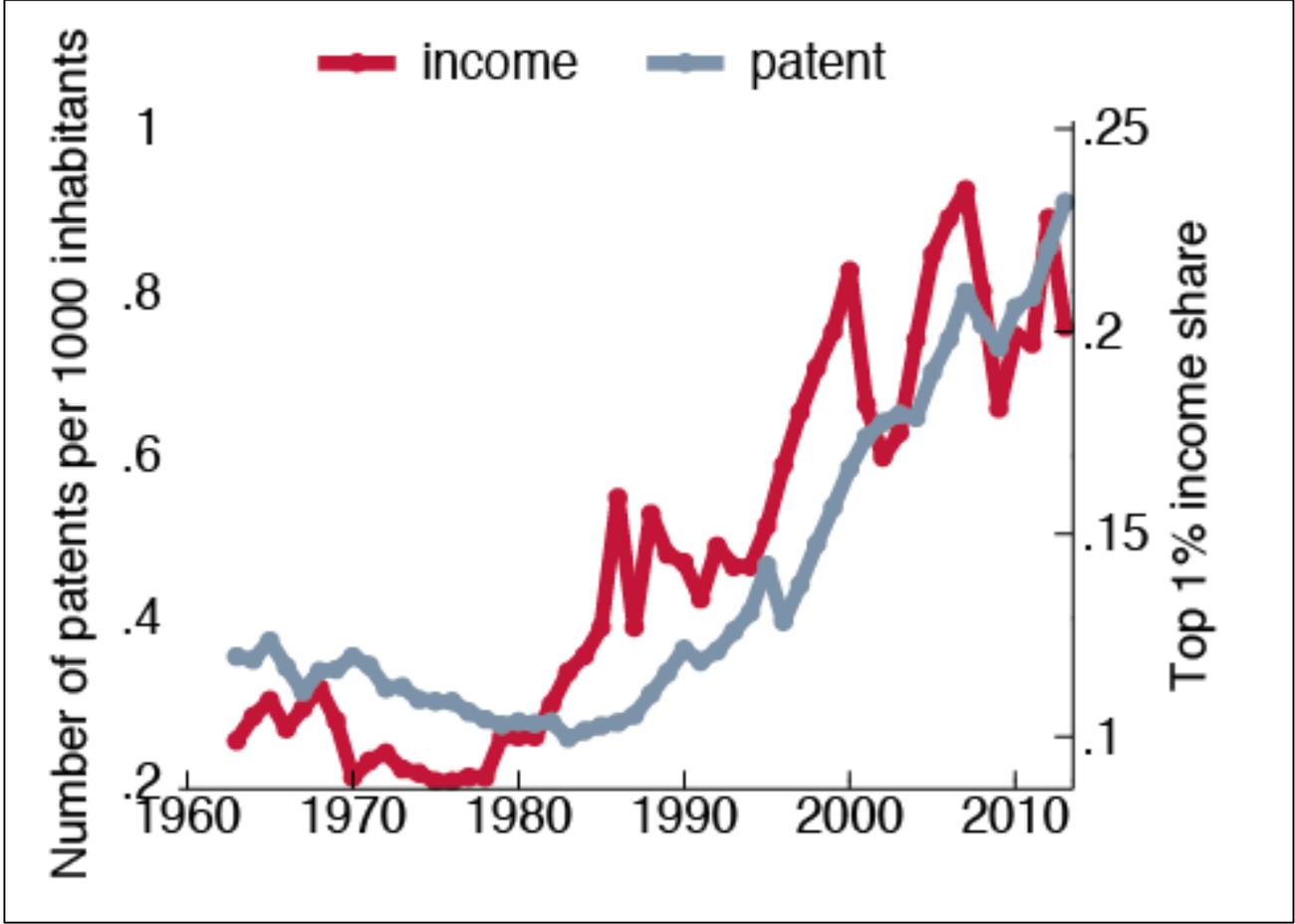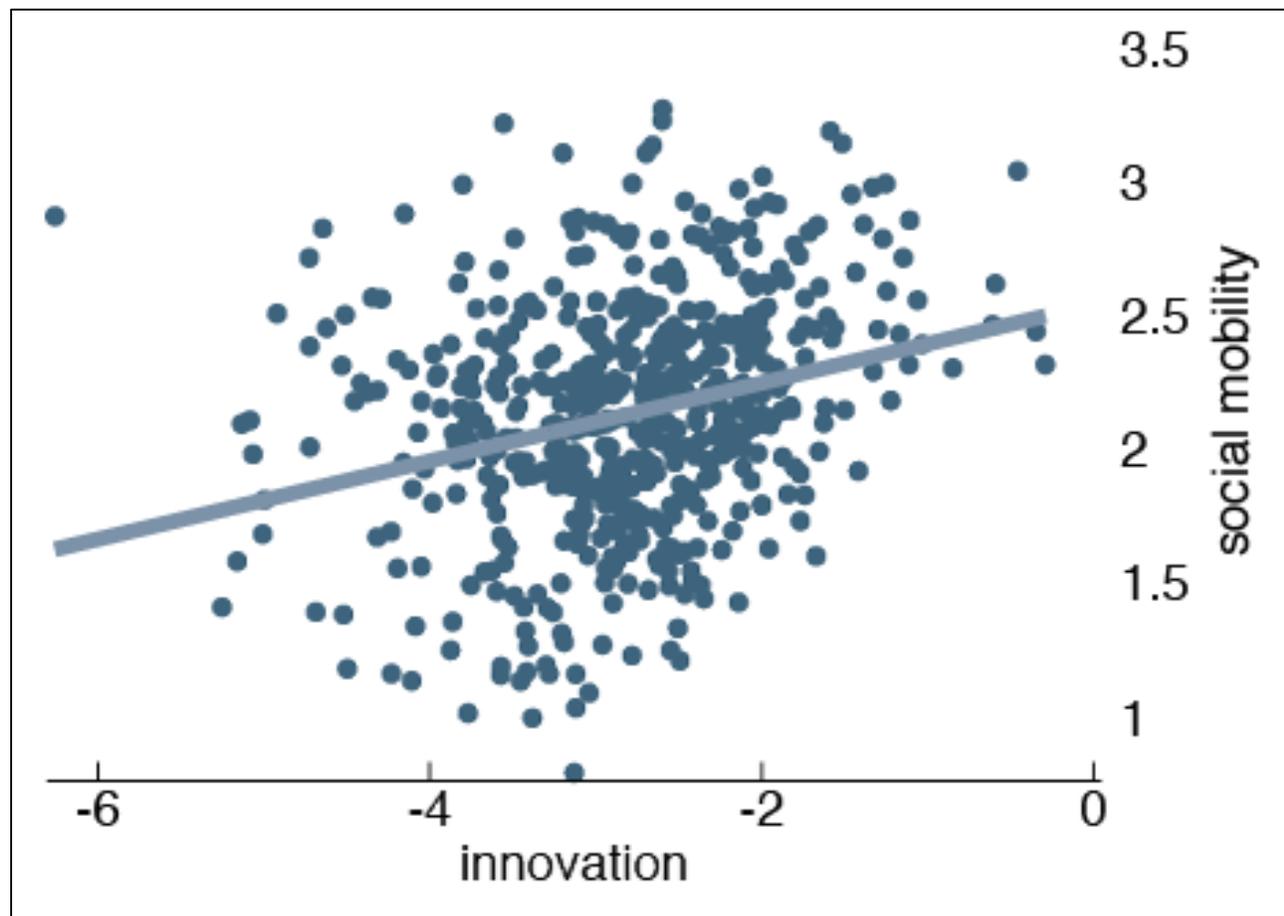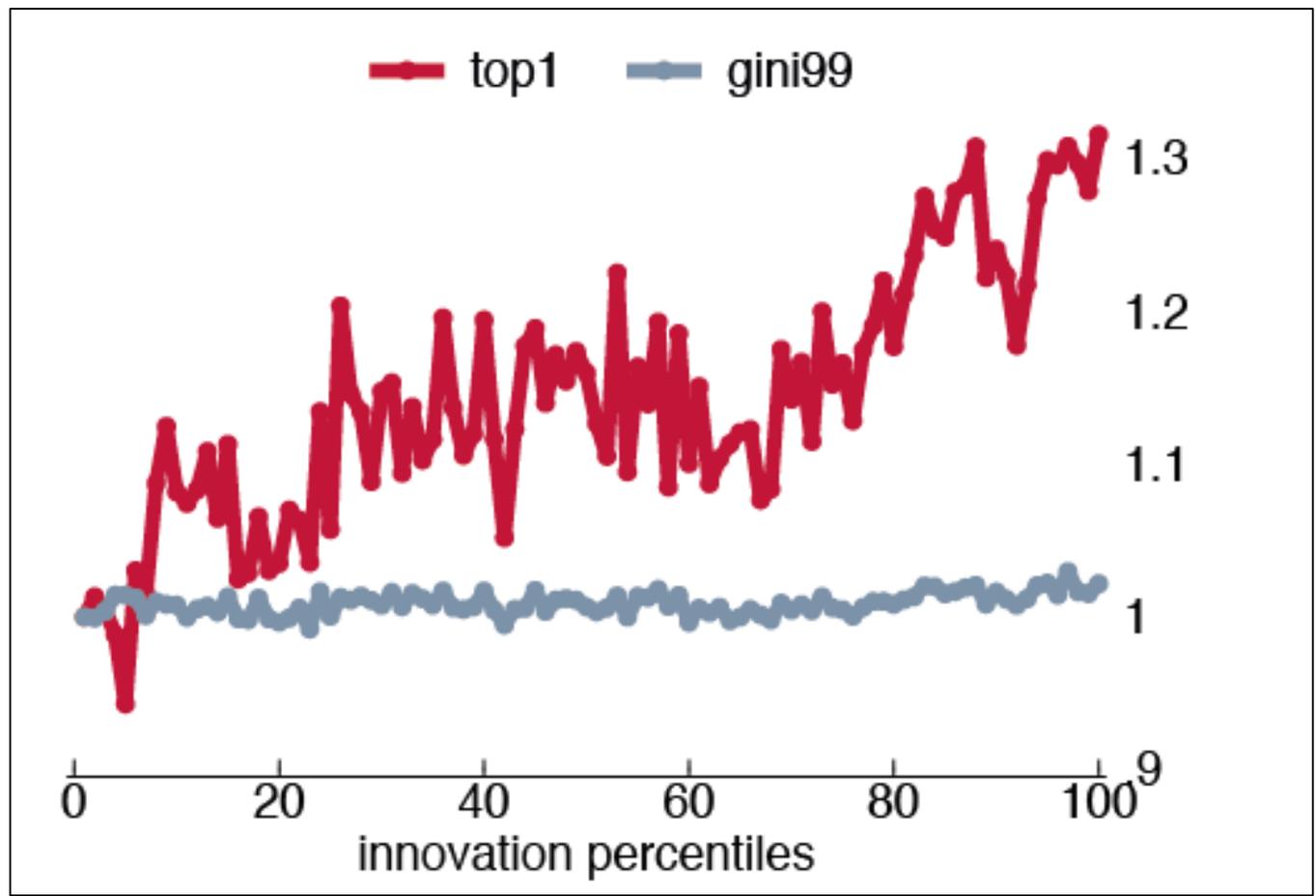
Firm Size Distribution with Multiproduct Firms
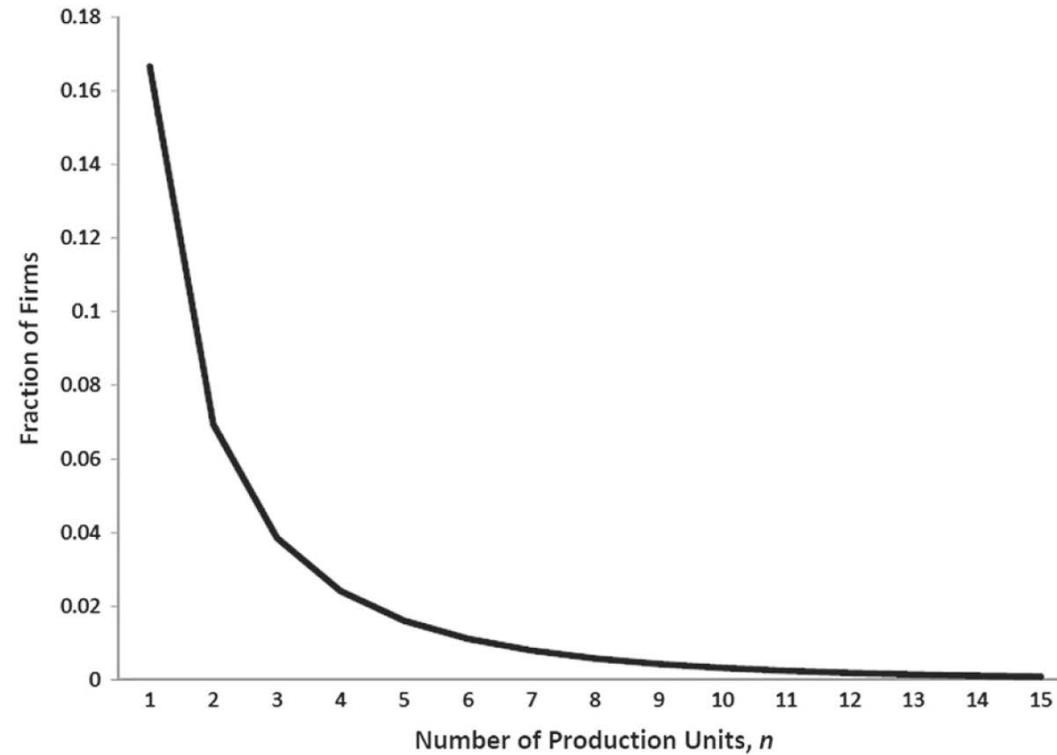
**Figure 1.4** Firm size distribution.
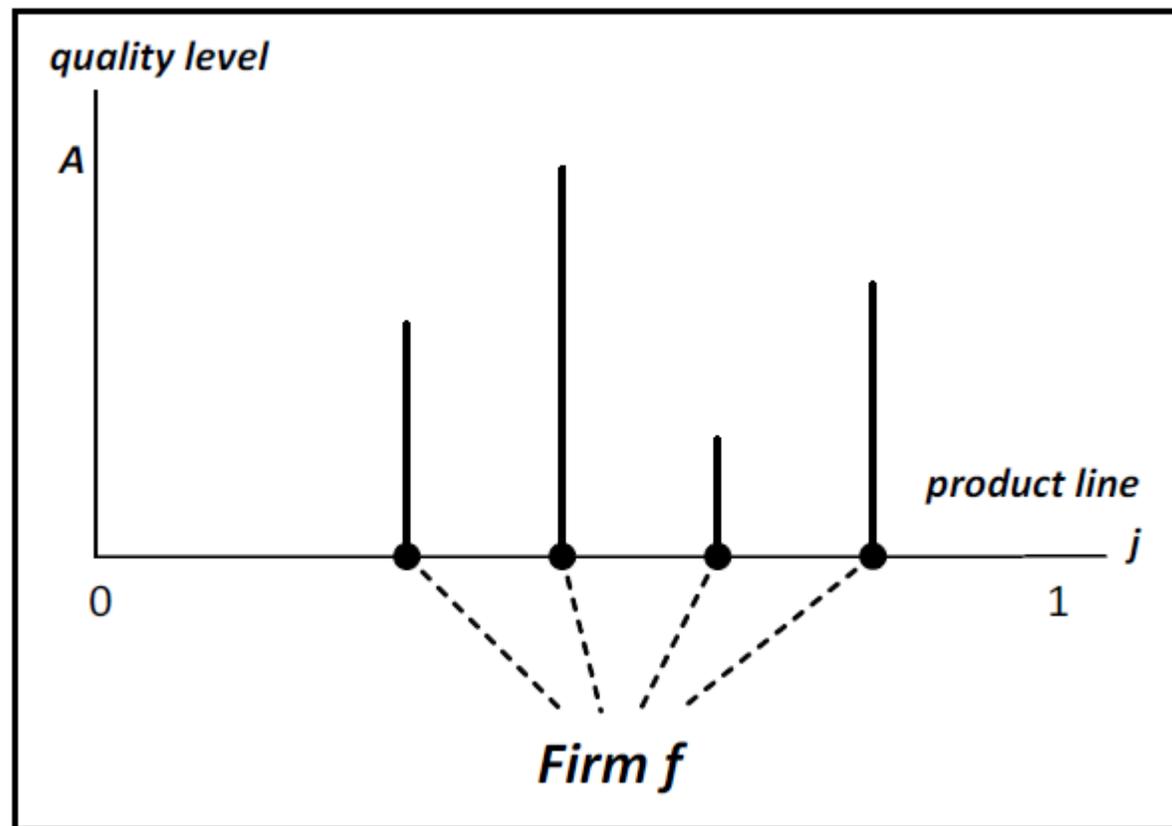
Distribution of firms productivity
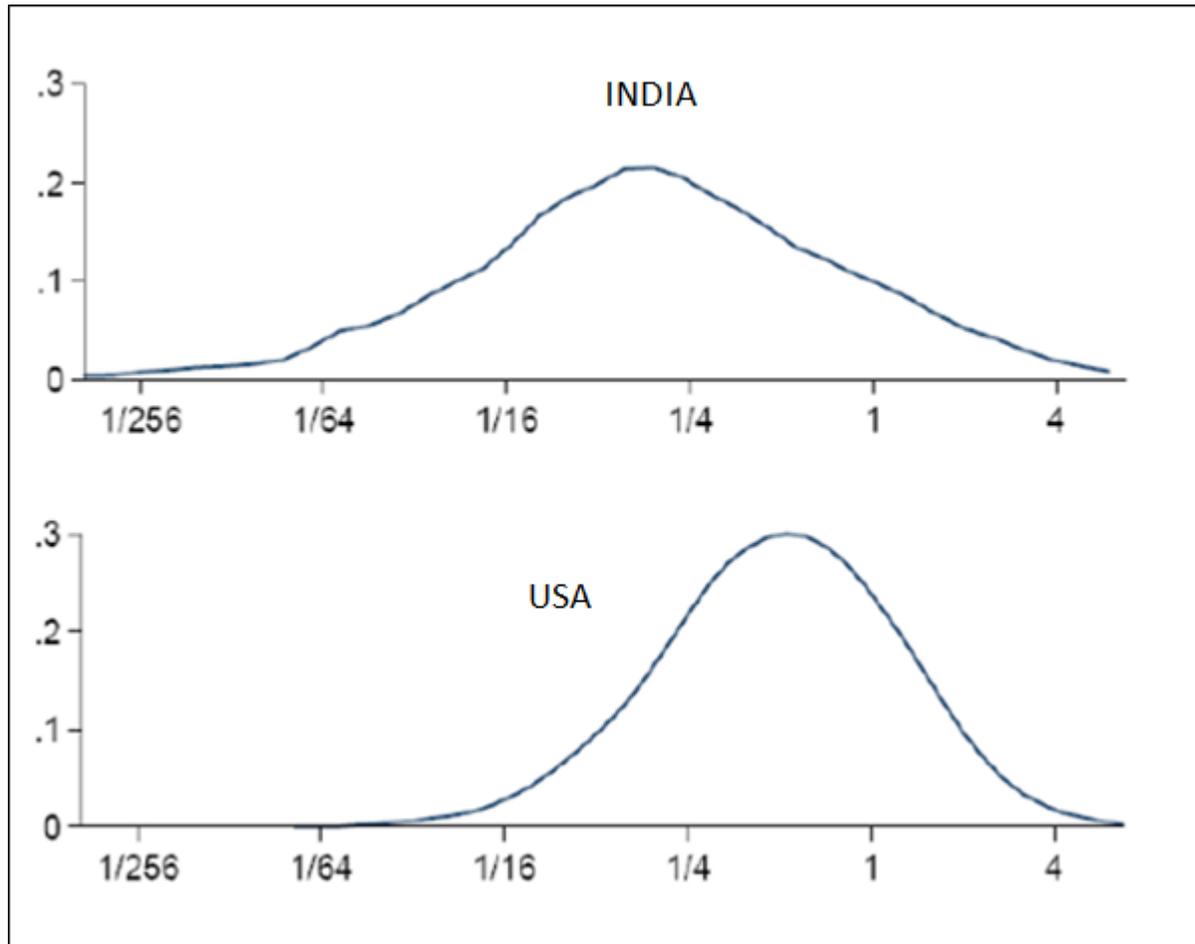
Link between the age and the size of firms