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Chapter Authors: Philippe Aghion

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Innovation Process and Policy

What Do We Learn from New Growth Theory?

Philippe Aghion

What have new growth theories brought to our thinking about macro and micro issues? On the macro side, these theories (Romer 1990; Aghion and Howitt 1992) have developed frameworks where growth is driven by innovations that are motivated by the prospect of monopoly rents, and where new innovations drive out old technologies. These are frameworks where firms and industrial organization lie at the heart of the growth process. Policy and institutions/organizations affects aggregate growth by affecting entrepreneurs' incentives to innovate, their ability to finance innovations and enter new markets, and by affecting the process of competition with other firms in the market. This in turn delivers a framework that can be used to look at how institutions such as patent systems, contractual enforcement, property right protection, administrative entry costs, universities, the design of constitutions, and policies such as carbon taxes, R&D subsidies, fiscal and monetary policy, and education policy affect the growth process through affecting the economic environment faced by potential innovators.

One can also analyze how different types of policies or institutions affect growth differently for countries at different stages of development: in particular, a country where growth relies primarily upon catching up with (or imitating) more advanced technologies, does not require the same organization of education, of the financial system, of labor and product markets as more advanced countries where growth is primarily driven by frontier innovations.

Also over the past few years, one has witnessed a new wave of research on the role of culture in the growth process, which looks, for example, at the

Philippe Aghion is the Robert C. Waggoner Professor of Economics at Harvard University and a research associate of the National Bureau of Economic Research.

role of trust, social norms, and beliefs in facilitating or delaying growth and the emergence of innovation-enhancing policies and institutions.

More generally, what new growth economics brings to the analysis of how policies affect aggregate growth is the importance of interaction effects: interaction with a country's stage of development, interaction with a country's culture and beliefs, interaction with other institutional variables such as financial development or corruption. We know, for example, that a countercyclical fiscal policy may have a more growth enhancing effect on the average rate of innovation over the cycle, for firms that are more credit constrained.

There is also the interaction between fast-moving and slow-moving institutions. For example, is it good or bad for growth to increase taxes? The answer to this question hinges a lot upon whether the country is one where tax revenues end up being diverted by politicians or whether, as is the case in a country like Sweden, tax revenues are known to be well spent on higher education, infrastructure, and the like. Thus, when analyzing the effects of taxation on innovation, entry, and growth, one has to look at how taxation policy interacts with things that are slower moving—for example, corruption or government efficiency.

What have we brought to microeconomics is a more difficult question, hence my answer here is bound to be more tentative. One main thing we might have brought to the field of industrial organization is the idea of looking at composition effects or other types of general equilibrium effects to determine under which circumstances one partial equilibrium effect dominates another.

For example, in work on competition and innovation (e.g., see Aghion et al. 2001), my coauthors and I have pointed to two opposite effects of increased competition on innovation and growth: first, an escape competition effect whereby more intense competition stimulates innovation (to escape competitors), and second, a Schumpeterian effect whereby more intense competition reduces innovation rents and thereby discourages innovations. In subsequent empirical work (see Aghion et al. 2005), we have shown how the effect of more intense competition (on R&D incentives) on the equilibrium composition of sectors (which we refer to as “composition effect”), implies that starting at low levels of competition the escape competition effect dominates, whereas if starting at a high level of competition the Schumpeterian effect dominates. This in turn gives rise to an inverted U-shaped relationship between competition and innovation. Also using a similar framework, we have shown that the effect of an increased entry threat on innovation in a domestic sector depends upon the sector's distance to its world technological frontier.

Another example of growth analysis affecting our understanding of the innovation process is climate change and green innovations. There, in joint

work with Acemoglu, Bursztyn, and Hemous (hereafter AABH), we show whether dirty or clean technologies are more complements or more substitutes, affect the extent to which policies aimed at avoiding environmental disasters should be temporary or permanent, or should be implemented with or without delay, and also the extent to which the fact that CO₂ intensive activities deplete our oil resources is a good or a bad thing for climate change under *laissez-faire*. One reason is that the degree of substitutability between clean and dirty technologies impacts determines the extent to which (general equilibrium) price effects may or may not counteract more partial equilibrium effects, whereby firms tend to innovate in activities where they already hold a comparative advantage.

Let me now build upon the earlier discussion to bring out what I consider to be three fallacies. The first fallacy is more of a “macroeconomic” nature (at least it has mostly influenced macroeconomists): namely, the idea (e.g., see Easterly 2005) that policy *per se* does not matter for growth, that what matters more fundamentally are institutions. Thus Easterly (2005) looks at cross-country panel regressions of growth over a whole range of policy variables (competition, black market premium, inflation, etc.). He first finds significant correlations between these policy variables and growth, but these correlations become insignificant once controlling for institutional variables such as property right protection. In other words, in the horse race between policies and institutions, the latter appear to win over the former. But what Easterly does not do, is to interact policies with institutions. Had he done so, he would have found significant effects of policies on growth, even when restricting the analysis to subset of countries with similar (slow-moving) institutions—for example, the Organization for Economic Cooperation and Development (OECD) countries. The problem with his analysis is that it averages the effects of policies across countries where such policies have very different effects. The positive effect of the policy in one subset of countries, say the more advanced countries, is likely to be offset by the effect of the same policies in other countries.

The second fallacy, which is more “micro,” or at least spurred debates mainly among microeconomists, comes out of a thought-provoking book by Boldrin and Levine arguing that patents are always detrimental to competition and thereby to innovation. To provide support to their analysis these two authors built a growth model where innovation and growth can occur under perfect competition. The model is then used to argue that monopoly rents and therefore patents are not needed for innovation and growth: on the contrary, patents are detrimental to innovation because they reduce competition. That reducing competition can be detrimental to innovation is a sound idea that could not be accounted for in early innovation-based models of innovation and growth (e.g., Romer 1990, or Aghion and Howitt 1992). In these models, competition is detrimental for innovation and growth for

exactly the same reason that makes patent protection (IPRs) good for innovation: namely, in these models competition reduces (post-innovation) rents whereas patent protection increases them.

However, in subsequent step-by-step innovation models (see Aghion et al. 2001, 2005), in which a laggard firm needs to catch up with the current leader in its sector (and therefore go through a neck-and-neck stage) before it can later become a leader itself, not only does competition enhance innovation as in Boldrin and Levine's model, but also and perhaps more importantly, competition and IPRs become complementary. Why? Because entrepreneurs' incentives to innovate depends on the gap between the post-innovation rent and the pre-innovation rent—call it the net innovation rent. And typically, what competition does is to lower pre-innovation rents, also maybe the post-innovation rents, although the difference between post- and pre-innovation rents will typically increase with competition, and all the more so with stronger patents that protect post-innovation rents more. In contrast, in our earlier Schumpeterian model where innovations are made by outsiders who then leap-frog incumbent firms, the pre-innovation rent is always equal to zero, thus all competition does in this case is to reduce the post-innovation rent, which is also equal to the net innovation rent. Thus, it is no wonder why higher competition reduces innovation incentives in this earlier model.

Now, an ex-student of mine, Yi Qian (Northwestern), in a recent paper published in *ReStat*, uses the passage of national pharmaceutical patent law as a natural experiment to test the economic impact of patent. She finds that implementation of patents stimulates innovation, mostly in countries with higher market freedom. Similarly, in current work with Peter Howitt and Susanne Prantl, we look at the effects of implementation of the single market program on R&D expenditures in countries with different degrees of IPR. Thus we look at thirteen manufacturing industries in fifteen OECD countries between 1987 and 2005, and we find that the implementation of the single market program leads to an increasing R&D expenditure in countries with strong IPR, not in others. And the positive response of R&D expenditure to the single market program in strong IPR countries is more pronounced among firms in industries whose equivalent in the United States indicate higher patent intensity. Thus, there truly seems to be a complementarity between IPRs and competition, unlike what Boldrin and Levine suggest.

A third fallacy is that industrial policy is always detrimental to competition and that they should always be precluded. A common argument is that industrial policy boils down to “picking winners,” which in turn directly hurts competition. Moreover, governments are bad at picking winners, and besides they are likely to be subject to lobbying. Thus, the argument goes, any form of industrial policy should be precluded.

However, a first case in favor of sectoral policy is to redirect technical

change. An example is the environment and climate change (see our discussion of AABH earlier): under *laissez-faire*, firms that have innovated in “dirty technologies” in the past will tend to continue innovating in these same technologies in the future (current work looking at clean versus dirty innovations in the automotive industries worldwide confirm this path-dependence in the direction of innovation). This in turn suggests a role for sectoral policies such as subsidizing clean innovation in order to redirect innovation toward clean technologies.

A second argument (see Aghion et al. 2011) in favor of sectoral policy is that it may induce firms that would otherwise differentiate themselves horizontally in order to avoid competition to locate in the same sector. Doing so would both enhance competition between firms now within the same sector, and also induce communication between these firms now that they are involved in more similar activities. This in turn may end up fostering aggregate innovation.

More generally, on the relationship between competition and industrial policy: one might think that anything that looks like a sectoral policy goes against competition. However, in current work with Ann Harrison, using a panel data set of Chinese firms, we looked at the effect of subsidies, of sectoral subsidies interacted with competition, on product innovation and total factor productivity (TFP) growth. What we find is that the higher the degree of competition in a sector, the more positive the effect of subsidies on average TFP in that sector; and the overall effect of subsidies on TFP are positive if competition is sufficiently high and/or if subsidies are sufficiently diffused among enough firms in the sector. In other words, if sectoral policy is more “competition-friendly” then it is more likely to deliver more innovation and growth.

To conclude this discussion, if I have two directions for future research on growth economics and the design of growth policies to propose, I would first suggest looking at the organization of firms and universities and their impact on the growth process. For example, we know that the incentives of academics are different from the incentives of private researchers. In particular academic researchers value openness; that is, the informal exchange of ideas with other researchers. Openness goes in fact beyond academia, for example, IBM has greatly benefited from its partnership with Linux. How does this change our views of the effects of firm boundaries and proprietary versus nonproprietary knowledge on innovation and growth? Another interesting question concerns the interplay between formal and informal contracting affecting the flow and nature of innovation. My student David Hemous has a very interesting paper explaining that informal contracting is not so good because it does not provide economic agents with the same flexibility to switch contracting partners upon innovating.

The second direction is to explore the relationship between institutions and beliefs. How much can we change beliefs through policies? How much

can we transpose policy from a country to another one? For example, we tried to convert some countries in the Middle East to a Western model of values many times. It often failed because we were unable to accommodate local beliefs. This, incidentally, leads me to question the provocative idea, put forward by Paul Romer, of setting up cities (or knowledge hubs) that would be built on the same institutional model, with the expectation that the effects on innovation and growth would be the same no matter the local culture and beliefs.

References

- Acemoglu, D., P. Aghion, L. Bursztyn, and D. Hemous. Forthcoming. "The Environment and Directed Technical Change." *American Economic Review*.
- Aghion, P., N. Bloom, R. Blundell, R. Griffith, and P. Howitt. 2005. "Competition and Innovation: An Inverted U Relationship." *Quarterly Journal of Economics* 120:701–28.
- Aghion, P., M. Dewatripont, L. Du, A. Harrison, and P. Legros. 2011. "Industrial Policy and Competition." Cambridge, MA: Harvard. mimeo.
- Aghion, P., C. Harris, P. Howitt, and J. Vickers. 2001. "Competition, Imitation and Growth with Step-by-Step Innovation." *Review of Economic Studies* 68:467–92.
- Aghion, P., and P. Howitt. 1992. "A Model of Growth through Creative Destruction." *Econometrica* 60:323–51.
- Boldrin, M., and D. Levine. 2008. *Against Intellectual Monopoly*. Cambridge: Cambridge University Press.
- Easterly, W. 2005. "National Policies and Economic Growth." In *Handbook of Economic Growth*, edited by P. Aghion and S. Durlauf. Amsterdam, Neth.: North-Holland.
- Qian, Y. 2007. "Do National Patent Laws Stimulate Domestic Innovation in a Global Patenting Environment?" *Review of Economics and Statistics* 89:436–53.
- Romer, P. 1990. "Endogenous Technical Change." *Journal of Political Economy* 98:71–102.