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Facets of Innovation and Stages of Development

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Innovation has been redefined as the implementation of a new product, process or organization. Adoption from a developed economy is considered innovation. The mirror image is that productivity growth accounts not only for technical change, but also efficiency change. The latter component is more important to developing economies. R&D pertains more to technical change and competition and free trade to efficiency change. Empirical studies confirm that R&D is more potent in developed economies and that competition and free trade spur development.

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1. Introduction

It seems a natural idea to connect the distinction between technical change and efficiency change in the literature on innovation and productivity growth with the distinction between developed and developing economies. Since the two facets of innovation have different sources—with R&D driving technical change and competition and free trade driving efficiency change—developing and developed economies have different stakes in the latter. The purpose of this paper is to interrelate the two facets of innovation with the two stages of development.

This paper proceeds as follows. In the next section I discuss the recent redefinition of innovation, which accounts for other elements than technical improvements. The components of technical change and efficiency change are related to the distance to the production possibility frontier and, in turn, to competition in section 3. The relationship with free trade is discussed in section 4 and implications for developing economies are drawn in section 5. Section 6 corroborates the role of free trade for development and section 7 concludes.

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2. Innovation, broadly speaking

Innovation is a fad that has reached development economics. If taken in the narrow sense, the act of pushing out the technology frontier, this creates some mixed feelings. When I was invited to lecture in South Africa about R&D, spillovers and technical progress, my instinct was that this subject would be less relevant to my hosts. I mean, what is the point of engaging a developing economy in the costly process of R&D in new products and processes? I must admit, however, that OECD (2005) redefines innovation broadly as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations." In other words, a new product, process or organization may be adopted from a developed economy and *be implemented*, and we are still in the ball game of innovation.

In a sense, recent productivity analysis accommodates this broad perspective. While in the old days economic growth was understood to be the outcome of the combination of size effects (demographics and investment driving labor and capital growth) and productivity growth (the Solow residual between output and input growth, representing technological change), nowadays organizational improvements are accounted for in the measurement of factor productivity growth. More precisely, the fruits of innovation are measured by total factor productivity growth but the latter consists of two components, namely technical change *plus* efficiency change. An economy may grow by shifting the production possibility frontier or by *catching up* with the frontier. Clearly, it matters where an economy stands relative to the frontier. This observation takes us to the recent literature on competition and performance.

3. Distance to the world frontier and virtues of competition

What is the role of competition in the latter two components of productivity growth? The traditional, neoclassical point of view is that competition is good, because it eliminates slack and allocates resources where they are most productive. This view has been countered by Schumpeter, who argued that monopoly power, a departure from competition, is the source of profit, and profit is indeed the main funding for R&D. Both mechanisms seem to be at work and the overall effect of competition is mixed indeed. ten Raa and Mohnen (2008) studied the panel of Canadian industries and found that it matters who benefits from prices in excess of competitive costs: labor or capital. If it is capital Schumpeter's argument flies and competition may thwart innovation indeed, but if it is labor—such as managerial rents—the neoclassical argument gets some support.

A comparison of competition effects on innovation between developed and developing economies is facilitated by a disentanglement of the effects on the technical change and

efficiency change components of productivity growth. It seems to me that the Schumpeterian argument pertains more to the technical change component of productivity growth and the neoclassical argument to the efficiency change component. Not surprisingly, Acemoglu, Aghion and Zilibotti (2006) document that R&D is more important in industries or countries closer to the world technology frontier. But surprisingly, they also find that competition becomes more important close to the frontier. However, in my view their latter finding is a consequence of their model design—they define competition as cost proximity between the leader and the fringe in an industry. One would expect that when there is cost proximity that the stakes of innovation would increase in a competitive game between profit maximizing players. The model is full with assumptions. On the other hand, its partial equilibrium nature precludes an important source of inefficiency, other than the use of out-of-date technology, namely the wrong mix of production in countries, in violation of the international trade theoretic principle of comparative advantage.

4. The role of free trade

ten Raa and Mohnen (1994, 2002) decompose the efficiency change component of productivity growth further into three components: the elimination of waste (X-inefficiency, the use of excessive inputs), reallocations of resources to the better companies, and comparative advantage gains. Free trade obviously helps to capture the third gains, but may also be helpful in checking the first two inefficiencies. An effect of free trade is that it puts competitive pressure on local producers. It forces weak domestic companies out of business and frees resources to more efficient ones. This competitive role is particularly important to inefficient economies, i.e. the ones remote from the frontier, the developing economies. The harmful effect of competition on the appropriability of the returns to innovation pertains to frontier economies.

Aggregate productivity can be decomposed in company productivities and market share effects. Company innovations boost aggregate productivity, but so do market share gains of the better companies. Companies can be innovative in the narrow sense of technical change or they can catch-up (company efficiency change), while the market share effect reflects competition between companies (market efficiency change). At least in principle, trade orientation may impact all these components. The overall correlation between export intensity and productivity is strong, 80 percent for the UK; non-exporters show 1 percent productivity change between 2000 - 2001 and exporters 4.5percent. Rizov and Walsh (2007) also find that the decompositions differ. For non-exporters it is company change, while for exporters the bulk (some two-thirds) is the market share effect. Since the non-exporters happen to be the followers, I ascribe their productivity growth to company efficiency change. The exporters show technical change, but the bulk of their performance is a result of the competitive selection of winners. Indeed, they must overcome obstacles to penetrate foreign markets. Only the best succeed.

5. Implications for developing economies

What do these results imply for developing countries? I do acknowledge that the neoclassical recipe of competition is not always effective. In fact, our research of the Canadian economy lends some support to the Schumpeterian point of view. Capital rents driven technical change shifts the world production possibility frontier. This mechanism is important in the OECD economies. But remember, there is more to innovation and growth than technical change. In fact, the *other* components of productivity growth are important to developing countries: Company catch-up with modern technology and the market share effect—the weeding out of less productive companies. Both are forms of efficiency change and, therefore, benefit from an open, competitive climate.

Indeed, developing economies have much to gain from free international trade and much opposition comes from the EU and the US, be it in agriculture, clothing, or light manufacturing. At least in principle, this policy division could be rationalized by the appropriability problem of innovation—which affects primarily the OECD economies. I am afraid, however, that short-sighted protection considerations weigh more. Impediments to free trade not only harm consumers—who buy unnecessarily expensive home produce—but also reduce the pressure on developing countries companies to compete and thus to reduce inefficiency. Though efficiency improvements are the less spectacular component of innovation, they are the important ones, particularly to developing countries.

6. Trade and growth

There is an astounding relationship between international trade and economic growth. In fact, Lewer and Van den Berg (2003) have shown that a one percentage point increase in the growth of exports is associated with a one-fifth percentage point increase in economic growth. The average coefficient on export growth for high income countries is 0.43, 0.15 for upper-middle, 0.22 for lower-middle, and 0.21 for low income. The seemingly smallness of the trade effect for developing economies reflects dramatic trade differences between open and closed economies. On average, during the 1980s all East Asian economies, most of which would be classified as 'open,' increased exports by 11.1 percent per year, while Sub-Saharan Africa and its mostly 'closed' economies increased its exports by just 2.4 percent per year. It just takes a lot of trade to grow.

Schneider (2005) conducts an empirical investigation of the role of trade in determining the rate of innovation and economic growth in developed and developing countries, and investigates the importance of intellectual property rights and foreign direct investment in these processes. Confirming my observation that company catch-up and competitive pressure are more important than technical change to developing countries, she finds that domestic innovation in the narrow technological sense is a significant source of growth *for developed*

countries only. Not surprisingly, the main source of growth is physical capital accumulation (per capita). The second strongest impact comes from the growth of high-technology imports (also per capita). Intellectual property rights have distinct effects on developed versus developing countries; again the positive effects are confined to the developed countries. Once more this confirms an earlier observation, namely that technical change and the appropriability of the returns is a frontier economy issue and less of a concern to developing countries. Even the other traditional sources of innovation—human capital and R&D—are less pronounced in the developing world, especially when infrastructure is included in the regression equation. This final point suggests that infrastructure plays an important role in the innovative capacity of developing countries. Stiglitz (2007) even argues that India may use part of its foreign exchange reserve to finance infrastructure.

Greenwald and Stiglitz (2006) argue that trade restrictions may help infant economies to spur productivity growth. Their argument is that industry drives technology, even in agriculture. This spillover structure is embedded by assumption in their two sector model, which they "could easily extend". In fact, ten Raa and Wolff (2000) have solved the intersectoral spillover structure of the U.S. economy and identified the key sectors with spillover effects, including computers, communications and automotive. This finding seems to underscore the role of infrastructure.

7. Conclusion

Innovation is the engine of long run growth and free markets may not be the best way to promote innovation in all cases. Restrictive policies have been suggested: import substitution, infant industry support, royalties, and government supply of infra-structure. Not surprisingly, a closer inspection of the literature shows that market failures plague the eye catching facet of innovation—the pushing out of the technological frontier—but not the other facets—corporate catch-up and the market share effect. The latter reflect efficiency improvements and benefit from access to markets and competitive pressure. By their very nature, developing countries innovate more through the latter channels and, therefore, stand to gain from free trade.

The literature also reveals another asymmetry. Traditional sources of innovation seem less potent in developing countries, overwhelmed by the role of infrastructure. This is a key sector indeed and its development deserves full attention. One of the impediments has been the lack of public funding. Luckily this problem is partly being overcome by computer based technologies, which facilitate direct payments by users of the infrastructure. For example, quite a few developing countries now build highways with electronic tolls.

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