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Globalization and Growth†

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How does globalization affect economic growth? The modern literature on endogenous growth provides tools and models that are useful for elucidating some of the mechanisms linking international integration with long-run economic performance.

Up until the mid-1980s, studies of growth focused primarily on the accumulation of *physical capital*. But, capital accumulation at a rate faster than the rate of population growth is likely to meet diminishing returns that can drive the marginal product of capital below a threshold at which the incentives for ongoing investment vanish. This observation led Romer (1990); Lucas (1988); Aghion and Howitt (1992); Grossman and Helpman (1991a); and others to focus instead on the accumulation of *knowledge*, be it embodied in textbooks and firms as "technology" or in people as "human capital." Knowledge is different from physical capital inasmuch as it is often non-rivalrous; its use by one person or firm in some applications does not preclude its simultaneous or subsequent use by others. The non-rivalrous nature of knowledge suggests increasing returns when output is related to all tangible and intangible inputs, which eliminates the inevitability of diminishing returns to the accumulation of some inputs relative to others.

The new models of knowledge accumulation highlight several potential links between international integration and growth. Research has focused on how the international exchange of goods and ideas affects the incentives for knowledge acquisition and on the efficacy of inventiveness and diffusion. Several mechanisms feature prominently in the literature. First, integration of peoples and cultures facilitates the flow of knowledge across national borders. Foreign ideas may be useful for inventing new products, for improving existing products, or for producing goods at lower cost. Second, integration of product markets via international trade affords those who invent or improve products a greater potential market on which to reap returns even as it subjects them to additional competition from foreign rivals. The incentives for innovation may intensify or diminish with integration, depending on whether the scale effect or the competition effect is more powerful. Third, the integration of world markets has general-equilibrium implications for input prices and relative output prices. These price changes affect the cost of innovation as well as the relative attractiveness of alternative directions for industrial research. Finally, international interactions affect not only the incentives for creation of new knowledge, but also those for technological diffusion, with analogous implications for productivity growth. Many authors have examined how one or more of these mechanisms operates in some specific economic environment. Taken together, the literature offers many theoretical insights. Some progress has also been made on the empirical side, although data and methodological impediments have left assessment and measurement lagging behind.

I. International Knowledge Spillovers

The most direct link between globalization and growth arises when knowledge acquired in one country can be used to facilitate research in another. Scientists exchange ideas when they meet at international conferences. Knowledge flows in the course of business transactions and in other human interactions. And learning from abroad can occur without personal contact via publications and reverse engineering. Helpman (2004) reviews a body of empirical research

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that finds evidence of substantial international knowledge spillovers. At the same time, Coe and Helpman (1995); Eaton and Kortum (1999); and others have found that international knowledge spillovers are far from complete, leaving room for further integration of the world economy to raise knowledge stocks around the globe.

Romer (1990) developed a model in which knowledge accumulated in the course of conducting R&D raises the productivity of future innovation efforts. Grossman and Helpman (1991a) allowed for international knowledge flows, whereby either the knowledge stock that determines productivity in inventing new products reflects experience both at home *and abroad*, or else quality upgrading builds on past research successes in all countries. International knowledge spillovers tend to accelerate growth in all countries, as the cost of further innovation declines in every country with advances made elsewhere. Grossman and Helpman (2014) posit an arbitrary pattern of partial knowledge spillovers, whereby research experience in each country contributes somewhat to R&D productivity elsewhere, but not as fully as it does to R&D productivity in the country where the research was carried out. They find that an increase in the extent of spillovers from an arbitrary country to any other raises long-run growth rates everywhere in a many-country world economy.

In much of the literature, the scope for international knowledge spillovers is taken as exogenous. But trade and foreign direct investment (FDI) may be conduits for knowledge transmission. Firms in an importing country gain ideas about new products and new techniques from their suppliers. Similarly, firms in an exporting country acquire information by discussing product specifications or receiving ex post feedback from their customers abroad. And multinational corporations transfer knowledge about products, processes, and management methods to their foreign affiliates. This information may become available to indigenous firms that observe their operations or hire their former employees. Indeed, Coe and Helpman (1995) and Keller (2010) provide evidence that a country's bilateral trade volume with a particular partner helps to explain the extent to which R&D productivity in the country benefits from the partner's prior research experience. Baldwin, Braconier, and Forslid (2005) and Keller (2010) find similarly for FDI.

II. Scale versus Competition

Globalization affords innovators the opportunity to exploit their new ideas on a larger stage. Firms that develop a new product, improve an old one, or find a better production technique can reap profits not only domestically, but also on sales abroad. This "scale effect" tends to boost the incentive for knowledge acquisition. However, in a more global economy, a successful innovator must share the market not only with other domestic firms, but also with those that produce abroad. The "competition effect" of globalization presents an offsetting disincentive for knowledge acquisition.

Grossman and Helpman (2014) consider a world economy in which individuals differ in ability and successful innovators draw different technologies for producing their varieties.[1] The model incorporates complementarities between the productivity of a technology and the ability of the workers that the firm employs. There are neither fixed costs of production nor of exporting. In this setting, the countervailing forces of scale and competition are quite clear: a reduction in trade costs in some country has no effect on the common rate of long-run growth in any of them. The extra profit opportunities that result from greater aggregate demand are exactly offset by the loss of market share to foreign producers.

The absence of fixed costs is important for this conclusion. Baldwin and Robert-Nicoud (2008) consider an endogenous-growth model with heterogeneous firms and fixed costs of operation and of exporting, as in Melitz (2003). Then, a decline in trade costs raises the cutoff productivity level needed for a firm to survive and reduces the cutoff productivity level that leads it to participate in exporting. The resulting *selection* of more productive firms increases the intensity of competition in the world market. In the Baldwin and Robert-Nicoud environment, if the extent of international knowledge spillovers remains constant after trade costs fall, the expansion of aggregate demand that results from a fall in trade costs is more than offset by growth in the effective competition in the market, leading to a decline in incentives for ongoing R&D.

[1] The model builds on Grossman and Helpman (1991a), but allows for heterogeneous firms, heterogeneous workers, and partial knowledge spillovers.

Competition effects also can dominate when costs of innovation fall with accumulated local research experience, but there are no international spillovers of research knowledge. Feenstra (1996) considers a world economy in which two countries develop and produce varieties of a differentiated product. The cost of innovation is inversely related to a country's own cumulative research experience. One country has greater incentives for innovation than the other and grows faster in the autarky equilibrium. When the countries open to trade, the rapid growth in the number of competitors in the fast-growing country reduces the profitability of innovation in the slow-growing country, and the gap in their innovation rates widens. The consequences for the lagging country can be even more severe in a setting with multiple industries that differ in their potential for innovation and productivity growth. Then, the intensified competition that results from an opening of trade can lead the country with lesser incentives for R&D to specialize in industries that themselves have lesser innovation prospects, thereby exacerbating the initial differences between them. Grossman and Helpman (1991a, ch. 8) and Young (1991) make the further point that, with national knowledge spillovers, history and initial conditions can matter for the effects of globalization on a country's subsequent growth. They consider the opening of trade between two otherwise symmetric countries in which one has an initial advantage in a sector with potential for knowledge accumulation. Thanks to its head start, the leading country has a lower cost of innovation, which allows it to undertake more of this activity while the other country does less. In the extreme, a country that would have continued to innovate and grow in autarky can be led by competition with a more advanced partner to specialize in activities that lack substantial growth prospects.

III. Innovation in General Equilibrium

In a static economy, globalization leads countries to specialize in the activities in which they enjoy a comparative advantage. The same is true in a setting with endogenous growth wherein one of the activities that each country undertakes is the accumulation of knowledge.

Grossman and Helpman (1991a) studied models with two manufacturing sectors. In one sector, profit-seeking entrepreneurs invest human capital and labor either to invent new varieties of a differentiated product or to push existing products to the next wrung of the quality ladder. In the other sector, firms produce a homogeneous good under conditions of perfect competition. The authors posit that countries have exogenous endowments of labor and human capital with different relative quantities, or else that human capital results from private decisions about education. They assume that R&D is the most human capital intensive activity in the economy, followed by production of differentiated products, and lastly by production of the homogeneous goods. In this analysis, international knowledge spillovers are complete, so inventors in every country are equally effective at conducting R&D.

Their findings are reminiscent of the Heckscher-Ohlin model. The country that has the greater relative endowment of human capital—or the one that has the best educational system—specializes relatively in the creation of knowledge. In this country, the cost of innovation is lowest, because the abundance of human capital makes this factor relatively cheap. With invention comes comparative advantage in producing differentiated products, so in the long run the country with an abundance of human capital conducts more R&D, exports differentiated products in exchange for the homogeneous good, and grows faster. The implications for innovation and growth in the labor abundant country are ambiguous: on the one hand, knowledge spillovers from abroad augment its productivity in research; on the other hand, its comparative advantage in the labor-intensive activity causes it to allocate more resources to the production of homogeneous goods. On net, either effect can dominate, and so globalization can cause the growth rate to rise or fall.[2]

[2] Peretto and Valente (2011) tell a similar story about resource abundance. They consider a resource boom in a resource-rich country that processes raw materials to generate intermediate inputs and also invests and produces differentiated products. If the raw material and labor are complements in the processing activity, then the resource boom draws labor into the production of intermediate inputs and away from innovation and manufacturing of differentiated products. On the other hand, if labor and raw materials are substitutes in processing, labor devoted to innovation and manufacturing grows.

IV. Technological Diffusion

Much research of late has been directed at the process of technological diffusion. Ongoing diffusion, like the creation of new technologies, can be a source of sustained growth in some environments. International integration affects the incentives for investment in activities that foster diffusion as well as in the productivity of those activities. This provides another link between globalization and growth.

In Perla, Tonetti, and Waugh (2014) heterogeneous firms continuously face a choice whether to produce a variety of a differentiated product or to search for a better technology. If a firm produces, it can pay a fixed cost in order to export. If it elects to try to upgrade its technology, it pays a cost in exchange for a random draw from the distribution of domestic technologies in use at the time. In this setting, a set of the least productive firms opt to search rather than produce. A fall in trade costs raises the relative profitability of high-productivity firms that exercise the opportunity to export relative to low productivity firms, that at best sell to the domestic market and face more intense competition there. As in Grossman and Helpman (2014), a fall in trade costs is neutral with respect to the incentives for knowledge acquisition if the fixed costs of exporting are nil. Otherwise, diffusion can accelerate or decelerate in response to globalization, depending on the nature of the cost function for searching for new technologies. If, for example, the cost is paid by hiring labor in a setting with a fixed labor supply, then the rise in the real wage that ensues from an opening of trade spells an increase in the cost of technology adoption and a fall in the rate of diffusion. If, instead, the cost is paid in units of the final good, then the widening of the gap in relative profitability between high and low productivity firms encourages a speed-up in diffusion.

Sampson (2014) tells a related but different story. In his model, there is free entry by new inventors of differentiated products. They draw their technologies for producing their inventions from a distribution that reflects the technologies found among incumbent producers. Sustained growth is driven by perpetual improvement of technologies for production, as each new technology builds on the others. In this setting, the positive selection induced by globalization improves the productivity draws for new firms; lower trade costs induces exit by low-productivity producers and expansion by high-productivity producers, which improves the distribution of technology draws and so encourages further entry. Globalization speeds growth despite an absence of any scale effect and an absence of international knowledge spillovers.

Alvarez, Buera, and Lucas (2014) explore yet another mechanism that links globalization to diffusion in their model of idea flows. They start from the supposition that firms learn from those with whom they conduct business. Each country has a current best-practice for producing each good, à la Eaton and Kortum (2002). Product managers meet others at some exogenous rate. When a meeting occurs, the manager observes the technology of her contact and adopts that technology if it is better than her own. The distribution of contacts depends upon the distribution of productivities among active producers. In autarky, the source distribution for the learning reflects the distribution of productivities in the domestic economy. Trade improves the source distribution by replacing some less efficient domestic sellers with more efficient foreigners. In other words, trade is the vehicle for endogenous international knowledge spillovers, as in Grossman and Helpman (1991b).

V. Concluding Remark

The theoretical literature identifies a number of different potential links between globalization and growth. Unfortunately, the empirics have not kept pace. We still know relatively little about which mechanisms are operative and their quantitative significance. There are several reasons for this. Empirical work on trade and growth is hampered by a dearth of natural experiments and by the limited number of observations we have on what might be considered "the long run." The cross-country regression methodology is flawed in this context, not only because there are many endogenous variables and few instruments, but also because trade implies that countries' experiences cannot meaningfully be treated as independent observations. Moreover, the relationship between integration and knowledge accumulation ought to vary depending upon the fundamental characteristics of a country, including its factor and resource endowments and its history. Few empirical studies linking growth outcomes to openness or trade policy have allowed for such a dependence. Although many regressions using cross-country data have been computed, they teach us little about mechanisms at work. More promising have been the studies, such as those reviewed by Helpman (2004) and Keller (2010), that shine a light on a single, mediating variable, such as the existence and size of international knowledge spillovers. While we may be reasonably confident now that such spillovers exist, we still do not know very much about how to encourage more of them, or how important they are compared to other factors in determining a country's overall growth performance. And the question of what policies can be used to promote growth in particular countries and settings is far from settled.

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