

Princeton Encyclopedia of the World Economy

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Technological Progress in Open Economies

Long-run economic growth is driven by technological progress which in general takes two forms: product innovations and process innovations. The former refers to introduction of new or better quality products and the latter refers to implementation of resource-saving technologies. Diffusion of new products/technologies via imitation and direct technology transfer also promotes economic growth. This is especially valid for developing countries which are further away from the world technology frontier. The question of whether openness stimulates technological progress is important since openness is to a large extent determined by policy choices. Openness of an economy is measured by the degree of barriers to international trade, investment, labor flows as well as by the volumes of these indicators.

Theory

Openness can affect technological progress through a variety of channels. First, open economies can more easily acquire the state-of-the-art technologies available abroad via imports, Foreign Direct Investment (FDI), and immigration. Second, exposure to international trade promotes competition among domestic firms. On the one hand, this can accelerate the pace of technological progress by motivating firms to escape competition via innovation. On the other hand, more intense competition can hurt profits, reduce the returns to research and thereby discourage innovation. Third, entrepreneurs in open economies have access to larger markets and thus enjoy larger returns on successful innovation. This raises the profitability of innovation and

boosts growth. Fourth, open economies can avoid duplicating research conducted abroad and thus allocate their innovation resources more effectively. Fifth, under certain initial conditions, lowering trade barriers may reduce the relative price of skilled labor and render research and development—which is a skilled labor intensive activity—less costly and thus stimulate growth. Finally, economies open to labor flows can experience higher growth by attracting human capital from abroad, brain gain. The opposite holds when human capital leaves the country, brain drain. It should be noted that all of these mechanisms exert a short-run influence on economic growth but not necessarily a permanent influence on growth rates.

Case studies

Economists first investigated the linkages between growth and openness using case study techniques. These studies were conducted in the 1970s under the auspices of the World Bank, Organization for Economic Co-operation and Development and the National Bureau of Economics Research. The basic methodology involved comparing the outcomes of import substitution (IS) strategies, as practiced in Argentina, Chile, Ghana, Mexico, Turkey, and other countries, with those of export promotion (EP) strategies, as implemented by Korea, Taiwan, Hong Kong and Singapore. The premise of the IS policy was that developing countries need to protect their infant manufacturing industries by quotas and import tariffs in order to foster capital and technology accumulation. Proponents also suggested that by pursuing IS strategies developing countries would be able to avoid the adverse terms of trade effects associated with exporting raw materials. The premise of the EP policy was to provide market discipline to domestic firms by encouraging them to compete with foreign firms while keeping tariffs on imports at low levels. The case studies documented that pursuing EP strategies was a much more

effective policy tool in fostering growth compared to IS strategies. These studies also underscored the need to complement trade liberalization with other fiscal, monetary and structural changes such as stable government debt, market determined exchange rates, and an improved education system.

Cross-country openness growth regressions

Since the advent of broad international data sets in the early 1990s, economists have used cross-country growth regressions to investigate the openness-growth link. The basic statistical methodology involves running regressions to identify the impact of openness on economic growth while controlling for other factors that are known to affect growth such as initial income per capita, investment in physical and human capital, political stability indicators, and so on. These studies can be classified into two categories based on their choices of openness indicators.

Trade volumes regressions: The first group of these studies has used total trade share, import share, and export share in gross domestic product as openness measures. In general, these cross-country growth regressions have established a positive and statistically significant link between growth and trade volumes. They have been criticized on two accounts, however. First, statistically significant correlations do not necessarily imply a causality from trade to growth. Second, trade is an endogenously determined variable that responds to income per capita. To tackle these issues, economists have used geographic indicators –that is, variables that affect trade but are not influenced by policy and income– as instruments, and have obtained predicted values for total trade flows. They then regressed income per capita on these predicted values in the presence of control variables. The instrumental variable (IV) estimates have shown that the empirical findings from the standard cross-country growth regressions continue to hold to a large

extent. The robustness of these IV estimates, however, have also been challenged by economists who incorporated institutional quality and geographic indicators in the regressions.

Trade restrictions regressions: The second group of econometric studies has used tariffs and nontariff barriers as openness indicators. These studies offer mixed results on the relationship between openness and growth and are plagued with measurement problems and data availability issues. These problems led economists to construct “trade restrictiveness indexes” that combine tariff and nontariff barriers with other indicators that are known to adversely affect international trade and investment. The most popular among these is the Sachs and Warner (SW) index, which combines information on tariff rates, quotas, political control of exports, exchange rate distortions, and market structure. Although many studies have found this index to have a positive correlation with economic growth, the index is too broad to interpret as a measure of trade or investment policy. Further, it was shown that when one uses specific trade-related subcomponents of the SW index—in particular tariff rates and nontariff barriers—the relationship between openness and economic growth becomes statistically insignificant.

As an alternative to cross-country studies, recent work has focused on within-country effects of trade liberalization. The methodology involved comparing the pre- and post-trade liberalization growth rates using econometric techniques. One study that determined the timing of trade liberalization based on the SW index calculates that on average countries that switch from being closed to being open experienced a large and statistically significant increase in their growth rates. Obviously, not all of the gain in growth can be attributed to opening up the economy, because in most cases trade liberalization is accompanied by other policy changes that may foster growth such as financial reform, privatization and investment in infrastructure.

International technology diffusion via imports and FDI

Empirical studies have also examined the magnitude of technology diffusion via imports by accounting for the stock of knowledge embodied in imported products. These studies show that knowledge-intensive imported goods—in particular differentiated capital goods and high-technology imports— exert a large and significant influence on domestic productivity. This is consistent with endogenous growth theory which predicts that openness increases access to new technologies and specialized high-quality intermediate inputs and thereby stimulates productivity growth.

Technology spillovers can also take place through FDI and Multinational Firm (MNF) activity. MNFs can bring new technologies that can be diffused to the local economy via labor training, labor turnover, and provision of high-quality intermediate products. Interactions between MNFs and domestic firms in the form of vertical production relationships can further contribute to technology diffusion. A number of industry- and plant-level studies have found that the presence of foreign-owned firms leads to technology spillovers, but the nature and magnitude of these spillovers may differ across countries. For instance, a study focusing on Venezuela finds that the intensity of foreign ownership adversely affects the productivity of domestic firms. Another study focusing on the United States reports that 11 percent of U.S. manufacturing productivity growth is accounted for by inward FDI to the United States. The number of industry- and plant-level studies has been quite limited so far, but recently there has been a call for such studies and more work appears to be on the horizon. In the meanwhile, cross-country growth regressions have found that the growth-promoting effects of FDI materialize only for countries that attain a threshold level of human capital and financial development.

Implications for policy

Even though there is substantial empirical evidence that supports the view that trade promotes growth, most economists caution that it is not necessarily and exclusively policy-induced trade that serves as the magic bullet. Changes in national trade and investment policies brings forth a reallocation of resources within an economy. Growth-promoting effects of trade liberalization can be reaped fully only when complemented with appropriate fiscal, monetary and structural policies that facilitate the allocation of resources to their most productive use. These include but are not limited to stable government budget positions, low inflation, market-determined exchange rates, an improved education system, a well-functioning legal system, and reduced corruption.

Further Reading

Baldwin, Robert E. 2003. "Openness and Growth: What is the empirical relationship?" NBER Working Paper, No:9578. Cambridge, MA: National Bureau of Economic Research.

Provides an overview on the theory and empirics of openness-growth relationship.

Frankel, Jeffrey A. and David Romer. 1999. "Does trade cause growth?," *American Economic Review*, 89(3): 379-399. The first model to investigate the impact of trade on income per capita levels taking into account the endogeneity of trade.

Keller, Wolfgang. 2004. "International Technology Diffusion." *Journal of Economic Literature*, 62: 752-782. Provides an extensive survey of technology diffusion across borders through investment and trade.

Helpman, Elhanan. 2004. *The Mystery of Economic Growth*. Cambridge, Massachusetts and London, England: The Belknap Press of Harvard University Press. Provides a summary

of the evolution of growth theory with a chapter on the role of interdependence in affecting growth.

Rodriguez, Francisco and Dani Rodrik. 2001. "Trade policy and economic growth: A skeptic's guide to cross-national evidence." In Ben Bernanke and Kenneth Rogoff, eds., *NBER Macroeconomics Annual 2000*. Cambridge, MA: MIT Press, 261-325. Provides a critical evaluation of the cross-country studies on growth and trade.

Wacziarg, Romain and Karen Welch. 2003. "Trade Liberalization and Growth: New Evidence," NBER Working Paper, No:10152. Cambridge, MA: National Bureau of Economic Research. Empirically investigates the change in within country growth patterns due to trade liberalization

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