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Strategies to Promote Stronger Technology Spillovers from Trade and Investments: Tapping Production Networks, Promoting Services and Linking SMEs

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ABSTRACT

Trade and investment flows into less advanced economies could bring about important technological spillovers that could boost firm-level productivity and bolster their long term economic growth. This brief paper outlines some of the motivations for public sector interventions to support learning by doing and stronger technological spillovers. It then provides a brief discussion of three key areas for policy attention, covering a) the features that make international production networks fertile platforms for these spillovers; b) the opportunities for technology spillovers in the services sector; and c) the challenges associated with policies to link SMEs into these sectors that are fertile ground for technology spillovers and innovation. This paper concludes by presenting a few possible guidelines on innovation and technology policy based on the lessons of industrialization attempts in the last several decades.

1. Introduction

Trade and investment flows into less advanced economies could bring about important technological spillovers that could boost firm-level productivity and bolster their long term economic growth. Eventually, these domestic firms could also begin to climb the technology ladder, by generating their own product and process innovations. However, learning by doing and various forms of innovation activities are typically underprovided in a *laissez faire* policy environment. These activities are generally associated with positive spillover effects for the domestic economy which are not typically internalized by any single firm.

This brief paper outlines some of the motivations for public sector interventions to support learning by doing and stronger technological spillovers. It then provides a brief discussion of three key areas for policy attention, covering a) the features that make international production networks fertile platforms for these spillovers; b) the opportunities for technology spillovers in the services sector; and c) the challenges associated with policies to link SMEs into these sectors that are fertile ground for technology spillovers and innovation.[1]

Policy strategies to promote learning by doing and innovation must be nuanced and responsive to the opportunities presented by an open economic environment and domestic conditions. On top of this, policymakers need to follow strategies that minimize the risk of state capture, while also maintaining strong accountability in the use of state policies and resources. This paper concludes by presenting a few possible guidelines on innovation and technology policy based on the lessons of industrialization attempts in the last several decades.

2. Motivation for Public Sector Support for Learning by Doing

The empirical literature on learning-by-doing through trade and investment links emphasizes three main channels through which these spillovers may take place:

[1] Sections 2 and 3 of this paper draw on Mendoza (2010).

1. **By trade itself**: Firms might be able to increase their productivity due to export and import linkages with buyers and suppliers;
2. **By trading with richer and more technologically advanced partners**: Industrialized countries offer more scope for trade-induced learning; and,
3. **By trading more sophisticated products**: More sophisticated exports with greater variety, or R&D intensive capital goods imports could be linked to more intensive "learning" and implies greater "discovery" of new economic activities.

Nevertheless, these learning channels do not guarantee strong technology spillovers in all cases. In each of these areas, insufficient incentives and opportunity for domestic entrepreneurs could result in weaker technology spillover effects. In fact this is more likely to be the case without public sector support, as the general benefits from strong channels of knowledge and technology transfer cannot be appropriated very easily by firms. The end-result is a tendency for under-investment in these areas.

Clearly, anemic learning is a form of market failure, justifying policy intervention—if interventions do not themselves lead to further distortions. Supporting domestic firms – picking "winners" – has produced mixed results in most countries. The policy experiences of countries that pushed early industrial policy attempts are replete with examples of inefficient and ineffective support policies, resulting in infant industries that failed to "grow up". Instead, policy interventions that have been shown to work are those that help to address critical market failures and increase the economy's flexibility to let go of inefficient sectors whilst constantly searching for new activities (Rodrik 2003; 2006). To this end, policies might be directed at a number of fronts, including those related to enhancing the country's ability to absorb and generate knowledge and new technologies, such as ensuring adequate investments in human capital and in R&D, as well as improving the channels through which trade-induced learning could be transmitted.

The latter might include a broader strategy possibly comprised of tax and other policy incentives, as well as setting-up economic and technological development zones, high-tech industrial zones and export processing zones within the country, in order to attract high-tech export-oriented FDI. Government could play a stronger lead role principally in economic areas with high risk (and also high social and economic returns), significant start-up costs and complex

coordination challenges, perhaps in the beginning to take part in production or R&D, ideally in partnership with the domestic private sector.

For example, in Singapore, Malaysia and Thailand, the government undertook deliberate policies of attracting transnational corporations involved in manufacturing for export, while in the Republic of Korea the government helped to strengthen the country's own chaebols in its drive to industrialize. In addition, the Taiwanese government supported its budding IT industry through its Industrial Technology Research Institute (http://www.itri.org.tw) which was instrumental in the development of Taiwan's capacity to compete in electronics manufactures. For example, ITRI's Materials Research Laboratories (MRL) and Opto-Electronics & Systems Laboratories (OES) played a key role in the take-off of Taiwan's production of CD-ROM related products.[2] In these economies, one common challenge for domestic firms was to attain scale so that they could compete in international markets. Hence the support government provided was tempered by the requirement to compete in international markets (Mendoza et al. 2012).

Furthermore, efforts to promote stronger knowledge and technology transfer mechanisms that have been cited in the literature imply important roles for policy, including: a) attracting FDI, foreign licensing, and technical consultancies; b) using (and often importing) new machinery and technologies; c) undertaking original equipment manufacturing (OEM) arrangements and contract manufacturing; and d) reverse engineering, imitation, and training (Ernst and Kim 2002).

These and other specific strategies are the subject of a vast body of literature on innovation and industrialization policies.[3] What is interesting in the present context is whether the empirical evidence is beginning to point to a distinct trade structure—reflected in the rise of international production networks—that appears to be more conducive to the types of learning described in this paper and that allows for a more rapid technology and economic catch-up.

[2] For further discussion of these economies' respective innovation and industrialization strategies, see Hobday (2000).
[3] See Mendoza (2010) for a recent review of this literature.

3. International Production Networks and Technology Spillovers

For policymakers, the objective would be to oversee the emergence of a trade structure characterized by numerous "quality" trade linkages (i.e. trading matters), where "quality" is described by trade in more sophisticated products (i.e. what you export matters) as well as with more technologically advanced trading partners (i.e. whom you trade with matters). It is possible that the "ideal" trade structure is approximated by international production networks located in Asia.

Some have argued that the success of the emerging market economies in Asia could be due in part to their more vertically integrated production in some high value added manufactures, whereby each country specializes in a particular stage of production or production component (Gill and Kharas 2007; Hummels, Ishii and Yi 2001; IMF 2007; Mayer et al. 2004). In a typical structure, Japan and the newly industrialized economies (i.e. NIEs: Republic of Korea, Singapore and Taiwan) could be the main sources of technology, including the blue prints and designs, which are then transmitted to their FDI affiliates in developing East Asia (i.e. China, Indonesia, Malaysia, Philippines and Thailand) for production. More complex production sharing networks then begin to characterize the movement of intermediate goods among these economies. In some cases, the components could be sent back to the NIEs for further processing and quality control, before eventually being sent back to developing East Asia as kits for final assembly.

Intra-regional trade in the Asian region has grown markedly. This could be part of a broader trend that involves most industrialized countries, given their strong intra-industry trade. For example, Hummels, Ishii and Yi (2001:77) examine data for 10 OECD countries, plus Ireland, Republic of Korea, Taiwan and Mexico, and find that during the period 1970-1990, the vertical specialization share of the exports from these economies rose by about 30 percent. Exports related to vertical specialization industries accounted for about a third of the total growth in overall exports in these countries during that period.

While trade flows outside Asia tripled between 1990 and 2006, inter-regional trade involving Asia rose five-fold, and intra-regional trade within emerging Asia more than eight-fold (IMF 2007:43).[4] In many cases, Chinese firms would undertake final assembly of various intermediate inputs, for eventual re-export to the rest of the world directly, or through entrepôts

[4] In this analysis, emerging Asia is comprised of the NIEs, China, India and the ASEAN-5 (i.e. Indonesia, Malaysia, Philippines, Thailand and Vietnam).

like Hong Kong or Singapore.[5] Neighboring Asian countries have boosted their intermediate manufactures exports to China. In the last decade, for example, Indonesia's exports of components to China have increased five-fold, Thailand by 15-fold, Malaysia by 19-fold, and the Philippines by 60-fold (Haddad 2007:14).

Asia's success seems intimately tied to its dynamic international or global production networks (GPN).[6] These appear ubiquitous and prolific in the region (Mayer et al. 2004). The literature on research policy suggests that these GPNs have played a critical role in transferring knowledge from technology leaders to followers, as well as facilitating the formation of domestic capabilities among firms in the latter type of countries. The factors behind this include increased competition in manufacturing, trade and investment liberalization in key regions such as in parts of Asia, and advancements in information and communications technologies (ICTs), combined with shorter product life-cycles (i.e. around 6 months and in some cases even less). All these conditions facilitate (and some necessitate) faster and more effective transmission and absorption of knowledge and technology that is critical for cross-border production (Ernst and Kim 2002).

These production sharing arrangements have allowed these emerging market economies in Asia to achieve a higher degree of specialization—one that is driven by cost advantages as well as more rapid technology and knowledge sharing—allowing these countries to import the relevant technology, more quickly expand their export-oriented industries, increase their penetration into the industrialized countries' markets, as well as ascend the export sophistication ladder.

Even within a single production network, there is considerable heterogeneity in the input intensity mix engaged across the production chain. Indonesia, the Philippines and Vietnam, for example, could be involved in the labor-intensive part of the chain (e.g. product assembly), while other countries, such as Taiwan or Republic of Korea, could be part of the more skill- and technology-intensive aspect of production (e.g. product design, management and marketing, R&D). Aggregate export figures could thus be misleading in this sense. Nevertheless, the GPN could serve as a technology ladder over time, as countries on the lower rungs of the chain could

[5] For a fuller analysis of these production networks, see for instance Gill and Kharas (2007), Haddad (2007) and Jongwanich (2007).

[6] These terms are used interchangeably in the literature. We will refer to them as GPNs even as we acknowledge that some of these production networks are primarily intra-regional in nature.

climb in their technological capability and engage in more technology-intensive activities in the production network.

Indeed, it might be possible to describe a "flying geese" pattern of ascending more sophisticated production by the Asian emerging market economies, with the lead goose being Japan which industrialized in the 1960s and 1970s, followed later by Hong Kong, Republic of Korea, Singapore, and Taiwan industrializing, roughly, in the 1970s and 1980s and then followed by the rise of China, India, Indonesia, the Philippines, Malaysia, and Thailand whose take-off from the 1990s thereabouts to the present was briefly interrupted by the Asian financial crisis in the mid-1990s.

Marrying analyses of the rise of GPNs and the possibility that this is resulting in a distinct trade structure that is more conducive to growth could be an interesting area for research. So far, recent empirical studies of the structure of trade and its possible impact on growth have begun to point to a positive link. For example, Lederman and Maloney (2006) used panel data on 65 industrial and developing countries during the period 1980-1999 in order to empirically examine whether countries with higher intra-industry trade also tend to grow faster. They found that higher intra-industry trade was positively linked to growth, but only at marginal significance levels.

Furthermore, using panel data on over 120 industrial and developing countries during the period 1980-2003, Kali, Mendez and Reyes (2007) examined whether a country's trade structure, as indicated by the number of its trading partners as well as the dispersion of its trade among its partners (measured by a Herfindahl-Hirschman-type concentration index of trade), was linked to faster economic growth. These authors found evidence that more trading partners had a positive impact on growth that was independent of the level of trade itself, and that this effect was higher for richer countries. Their results also suggested that higher trade dispersion was negatively correlated with growth. The trade structure was shown to have an independent and significant effect on growth, and the channels through which these effects might be explained included the increased exposure to technological spillovers (from more trading partners) as well as increased competition and scale effects brought about by international trade.

4. Opportunities Technology Spillovers in the Services Sector

Expansion in services trade could offer new avenues for technological catch-up. Although the manufacturing sector has been the focus of most studies related to trade-induced learning, there is also a small but growing number of studies focused on innovation in the services sector. There are several reasons why these studies have emphasized the importance of enhancing learning in the services sector. First, a crucial element in explaining the productivity growth differences in different countries is the total factor productivity (TFP) in services (van der Marel 2011).

In developing countries, the effects of spillovers from services can even be likened to the effects of spillovers from trade in goods. One way to look at this is by understanding the intermediate role of services in the production process in other sectors. Improving the quality of services, such as transportation and financial services, can lead to higher overall productivity (Ruotinen 2008). Clemes and Gani (2003) also find evidence on the two-way spillover effect of the services sector to the manufacturing sector, and vice versa.

Second, learning in the services sector may also lead to process and product innovation (Guerrieri et al. 2005; Mann 2007; van der Marel 2011). The services sector is a channel where diffusion of innovative production can occur (van der Marel 2011). Moreover, by making the services involved in the production process efficient enough, such as investing in ICT for routine business processes, firms are freer to focus on other things (Mann 2007).

Other studies go further to examine the ways to fully seize the potential benefits from services trade. Many of these studies deal with services trade regulations. Van der Marel (2011), for instance, identifies whether it is services trade or the regulation of services trade that determines TFP. He uses four indicators for services trade (FDI inward stock, services imports, domestic sales of foreign affiliates and FDI inflows and the regulations related to each indicator) to show that services trade affects services TFP, but its effects are restrained once the regulatory variables, such as entry and conduct restrictions, are added in. Compared to entry barriers, it is the regulation on operational procedures that act as a greater hindrance to services TFP. He further notes that domestic regulation is a greater barrier for those sectors lying further away from the technology frontier, i.e. less innovative firms, while FDI restriction causes more hindrance to those closer to the frontier, i.e. firms dependent on innovation. It is then easy to conclude that a virtuous cycle of output growth, technology accumulation and provision of

services could be triggered by improving the regulatory environment, integrating deeper into the service markets, and increasing technology diffusion (Guerrieri et al. 2005).

5. Participation of SMEs in Global Production Networks

Technological transfer, whether through the manufacturing or services sector, has an important implication to the growth of SMEs. Latest trends show the increasingly vital role of SMEs to the world economy. First, they are drivers of sustainable development in terms of resilience against economic fluctuations and the creation of employment. And second, global production networks (GPNs) have increased opportunities for the participation of SMEs through outsourcing and subcontracting (Aldaba 2008; Punyasavatsut 2009; Lim and Kimura 2010). Guerrieri and Pietrobelli (2006) point out that because the last two decades brought about technological changes and the internationalization of economic activities, GPNs have become a way of accessing foreign knowledge or capabilities while still retaining a link to local ones. Their paper compares Taiwanese and Italian industrial districts (ID), which are composed mostly of SMEs. The IDs in Taiwan seems to be adapting better to these recent changes compared to their Italian counterparts. One of the main reasons why Taiwan can successfully compete in a high-tech international market is that its local clustering and international networking have given the necessary externalities for local firms to overcome the disadvantage of size. These authors concluded that international linkages are no longer secondary to domestic ones and are even a source of knowledge that can reinforce domestic ties.

Taiwan's impressive technological catch-up is probably best reflected by its electronics industry. For instance, research by Liu and Ray (2012) point out how Taiwan's flat panel industry overcame collective action challenges through a "triple alliance" model that whereby the state, domestic business groups and multinational corporations interacted closely in order to facilitate rapid transfer and absorption of new technology. This process underpinned Taiwan's ascent from relatively less sophisticated cathode ray tubes (CRT) technology for computer monitors to much more sophisticated liquid crystal display (LCD) technologies (notably for notebook computers). Initially Taiwan was an importer of this technology from firms in Japan and the United States; and eventually, Taiwan shifted from being an importer of display monitors to a dominant player in the global production of TFT-LDC screens, with national champions like Chi Mei Optoelec (http://www.chimei.com.tw/en/) and AU Optronics (http://auo.com/). The key

elements here included participation in international production networks, along with technology collaborations between domestic firms and multinational corporations from Japan and the US that were set-up in Tainan Science Industrial Park.

Indeed, the advantages of participating in GPNs include diffusion of new technology, skills and management, and access to world markets (Aldaba 2008). The survey of SMEs in Aldaba's study showed the reason that most of the interviewed subcontractors gear 100% of their production to subcontracted work is "their knowledge about foreign markets and to attain long term growth and profitability."

However, becoming a part of GPNs is not without drawbacks—eliminating trade and investment barriers and the entry of competitive players in the domestic market will put smaller domestic firms at risk (Aldaba 2008). To illustrate, the SMEs who are also low-tier suppliers in the Thai automotive and parts industry experienced how foreign-affiliated firms can easily replace them (Punyasavatsut 2009).

SMEs face a wide range of obstacles that keep them from fully engaging in GPNs. Some of the commonly cited barriers to their growth are limited access to finance, restrictive and inconsistent regulation, insufficient government support, difficulty in meeting government or foreign firm requirements, low level of skills of entrepreneurs, and minimal networking between SMEs and large firms (Lim and Kimura 2010; Punyasavatsut 2009; Aldaba 2008). For a country to be competitive amidst lower cost neighbors with better technology and supply chains, it is essential to address these issues and create substantial improvements in technology (Aldaba 2008). These issues are all important, but other key factors of growth must not be forgotten. Guerrieri et al (2005) points out that although it is stronger technology accumulation that drives growth in the long run, growth depends more on a better regulatory environment, investment in ICT, and availability of business services in the medium term.

6. Conclusion

Economic openness poses risks for uncompetitive firms on the one hand, and opportunities for technological spillovers, productivity improvements and innovation opportunities for firms fit to compete on the other. Extensive policy experience and empirical evidence now point to the need for a more nuanced strategy to promote more of these benefits from trade and investment linkages. There is strong evidence that these types of outcomes are sub-optimally produced due to a variety of collective action challenges and market failures.

Promoting technological spillovers and participation in GPNs have been proven to be an effective means to close the technological gaps of developing countries. However, technological spillovers greatly depend on a country's ability to absorb technology (Ruotinen 2008), which in turn requires the improvement of several other factors including a larger availability of skilled human capital (Guerrieri et al 2005). Furthermore, a country's ability to participate in GPNs also depends on firm level factors, such as the need to climb up the technology scale, and macro level factors, such as good governance, positive business climate, and trade negotiations (Mann 2007; Aldaba 2008; Ruotinen 2008). In the Philippines, for example, foreign suppliers only achieved minimal linkages with local suppliers because of the poor quality of output and high costs of outsourcing (Aldaba 2008). Hence, a variety of bottlenecks must be addressed before firms can be better placed to absorb technology, and then also (perhaps eventually) undertake innovation activities.

These challenges are not insurmountable and concrete policy strategies are already well supported by empirical evidence on more effectively promoting learning and boosting productivity outcomes. Policymakers, however, must create institutions that not only promote robust R&D activities so that these are responsive to industry demands and nascent opportunities. Governments have had a mixed record as far as "picking winners" so providing support for R&D activities should be carefully framed. Public sector support—and notably various forms of public sector subsidies for R&D—should remain accountable and focused on transparently structured and monitored policy objectives. Drawing on the lessons of industrial policy, Rodrik (2004), for example, outlines the following general characteristics for more successful industrial policy writ large. These, in turn, could be used to similarly guide R&D policies where these are appropriate.

1. Incentives should be provided only to "new" activities—since generating new activities is the crux of the innovation.
2. There should be clear benchmarks and criteria for success and failure—so that progress and accomplishments from policy support are clearly measurable and tracked.
3. There must be a built-in sunset clause on government support—so as to ensure strong incentives to compete without policy support.
4. Public support must target activities, not sectors (nor firms)—so as to focus the policy support on the market failure while lessening the possibility of state capture.
5. Subsidized activities must have potential for providing spillovers and demonstration effects—so as to ensure that the policy support produces externality benefits that justify intervention in the first place.
6. Industrial policy must be carried out by agencies with demonstrated competence—so as to increase the probability of success and minimize the risk of state capture.
7. The implementing agency must be monitored by an official with a clear stake in its outcome, and with political authority at the highest level—so as to ensure strong accountability for industrial policy design and implementation.

For many developing countries, R&D should be featured as one activity under a broader set of industrial policies to promote higher growth and productivity, economic diversification and broader economic competitiveness.[7] These policies need to be smartly designed so that the risks—such as policy failure and state capture—are mitigated.

[7] See among others Devlin and Moguillansky (2012) and Rodrik (2004).

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