As discussed in the report so far, the rise of the global value chain (GVC) production model has modified the paradigm for trade and development policies. An outward orientation remains a key to development prospects, but instead of needing to build up a complete domestic industry in order to engage in exporting, economies can now specialize in one task that forms part of that industry, such as the production of particular components. This expands the scope of industrial development and may significantly shorten the time it takes to become an industrial exporter.

From a development standpoint, as an economy evolves and accumulates human and physical capital, the prospect of moving upwards along the value chain emerges. The early stages of GVC participation typically involve labour-intensive low-value-added operations, such as product assembly. Upon reaching higher levels of development, however, there is the possibility to specialize in higher value-added tasks such as component manufacture, ultimately culminating in research and development (R&D). Higher value-added tasks are beneficial to an economy because they are often accompanied by positive spillovers in terms of technology, productivity and skills upgrading, and will ideally lead to endogenous technology creation. This modified trade and development paradigm therefore focuses on joining GVCs and – crucially – on “moving up” into higher value-added processes. Identifying the policies needed to support moving up is therefore a matter of critical importance to the region.

Among economists there is a consensus that, under the right circumstances outward orientation including through participation in GVCs, is a viable development paradigm, even following the Global Financial Crisis (e.g. Haddad and Shepherd, 2011, or Evenett, Mikic and Ratnayake, eds., 2011). In fact, many policymakers from developing economies emphasize that outward orientation should be linked to participation in GVCs. However, they also express concern regarding the extent to which the GVC model actually allows for industrialization and development, i.e. there is the fear that a country might join a GVC at a low value-added point and become stuck there. Instead of moving up the value chain, it would experience stagnating productivity and income growth. This chapter analyses evidence from firm-level surveys in order to establish whether or not such concerns are justified, and to identify examples of good practice to ensure that GVC participation is conducive to technological upgrading and technology transfer.

GVCs have a variety of economic effects in developing countries; however, not all of them can be discussed in detail here. From a development point of view, however, two processes lie at the core of making GVCs work positively – economic upgrading and “densification”, i.e. the development of strong linkages among GVCs and an ever-widening range of domestic firms. Figure 9.1 shows the various economic mechanisms at work in the broad process of GVC participation, some of which are discussed in the present chapter as they touch on technology transfer. Taglioni and Winkler (2015) provide a complete review.
To provide an empirical point of departure for considering the relationship between GVCs and technology, figure 9.2 examines the association between GVC participation and the sophistication of a country’s export bundle as one measure of its level of technology. The GVC participation index is taken from the OECD-WTO Trade in Value-Added Database; it summarizes the percentage of a country’s gross exports that are accounted for by intermediates used in other countries’ exports as well as imported intermediates used in the country’s own exports. It therefore captures the extent of the backward and forward linkages that lie at the core of the GVC business model. Export sophistication is measured using EXPY (Hausmann, Hwang and Rodrik, 2007), which captures the average income level associated with a country’s actual export bundle.

The line of best fit in figure 9.2 is upward sloping, which indicates a positive association between GVC participation and export sophistication. This result is consistent with a global view in which GVC participation can be associated with production upgrading and technology enhancement. It is important to stress, however, that figure 9.2 is just an association, and cannot be read as implying causation. It is possible that countries with more sophisticated export bundles tend to be more involved in GVCs for other reasons, and it tells us nothing about their movement along the value chain. Nonetheless, an initial review of the macro-data shows that there is certainly a possibility that GVCs can promote technology upgrading in countries that participate in them.
Against this backdrop, this chapter examines the scope for technology transfer within the GVC production model, focusing on empirically verified mechanisms, and the institutional and economic preconditions that need to be in place in the recipient economy to encourage this process. At this point, it is important to note that technology is interpreted broadly to include the process by which inputs of all kinds – factors of production and intermediate goods as well as organizational and management methods – are combined to produce a final output. Subsequently, a broad view of the term “technology transfer” is also taken, more akin to the literature on technology diffusion that encompasses a variety of different mechanisms (figure 9.1) and is not limited to transaction based relationships.

The chapter proceeds as follows. Section A discusses the direct and indirect channels through which GVCs can support technology diffusion, focusing on investment, licensing and import channels. Section B evaluates those mechanisms in a relevant context by discussing developing economies’ capacity to absorb technology, a crucial mediating factor in the relationship between GVC participation and technology. Finally, section C presents the conclusion and discusses policy implications.

A GLOBAL VALUE CHAINS AND TECHNOLOGY TRANSFER: DIRECT AND INDIRECT CHANNELS

What basis is there to believe that technology transfer can take place within a GVC production model? Those who are skeptical of GVCs see them as static structures, in which each firm or economy is locked into a particular position and cannot move up into higher value-added activities, because that would mean displacing others who are better established and may have had the opportunity to erect barriers to entry. However, the business reality appears to be quite different in many cases. GVCs are about maximizing profit all the way along the chain.3 The distribution of profits and the ability of some actors to earn higher margins than others are serious issues that need further research, but the static view of GVCs does not fit with commercial reality. The essence of GVCs is to be competitive and therefore dynamic. Each value chain is constantly looking for new commercial
opportunities, both in terms of new markets to serve, and new technologies or methods of production to increase the competitiveness of the chain as a whole.

It is these dynamics that give rise to the rationale for what can be termed explicit (direct) technology transfer, whereby an upwards GVC partner or lead firm (assumed to be located in a developed economy, or North) makes a conscious decision to transfer technology to a firm upstream in the supply chain (frequently presumed to be in a developing economy, or South). The business case for such a transfer is that it can help a developing economy’s firm produce more efficiently, and this in turn has benefits for the lead firm that may source its inputs from the upstream firm.

Technology transfer in this case, although not free from risk from the transferor’s point of view, is a win-win scenario – the developing economy’s firm, and perhaps also its competitors and suppliers, win from a technology upgrade and enhanced productivity, and the lead firm benefits from a more efficient value chain that improves its own competitive position globally. Of course, technology transfers of this type represent a relationship-specific investment, and so will only be undertaken in certain circumstances – in particular, the domestic institutional setting of the recipient firm needs to be strong, especially in the area of contract enforcement and rule of law. More details on this below, in relation to the ability of developing countries to benefit from technology transfer.

In addition to explicit transfers like this, there is also the possibility for technology to diffuse indirectly through GVCs. In essence, the circulation of capital and intermediate goods, and the knowledge that they embody, creates opportunities for technology upgrading, quite apart from the narrow case of an explicit technology transfer. As will be seen, access to imported intermediates in particular can be a spur to domestic productivity upgrading and innovation. This section discusses the main mechanisms – both explicit and implicit – by which GVCs can support technology upgrading in developing countries (figure 9.1; see also Glachant, 2013).

1. Foreign direct investment

One common way in which GVC participation can bring technology transfer and upgrading is foreign direct investment (FDI). When a firm receives FDI, it develops a close relationship with the investor, typically a larger firm, and maybe even a lead firm in a GVC. Technology transfer through FDI relies on the investor having access to globally competitive technologies that it can make available to a developing country partner.

One advantage of FDI for the investing company is greater security that the technology in question – which may be proprietary – will not leave its corporate group. Other arrangements, such as licensing (see below), pose greater risks of technology leakage, which can be advantageous for other producers in the industry, but not for the source of the technology. Direct investment is thus a way of limiting the risk of leakage while maintaining competitive advantage vis-à-vis competitors.

A country’s investment climate is therefore an important determinant of a lead firm’s willingness to assume those risks. Similarly, restrictions on FDI such as a maximum ownership level, or restrictions on legal form such as joint venture requirements, can increase the risk profile of an investment, and will make the lead firm more likely to hang back. Essentially, uncertainty of all types is a major factor that discourages any investment, and technology specific investments in GVCs are no exception to this rule.

Empirical evidence bears out the contention that FDI can be a vector of direct technology transfer at the firm level. Figure 9.3 uses World Bank Enterprise Survey data on firms in developing economies to analyse the labour productivity (value-added per worker) differential between firms that are majority foreign-owned and those that are majority domestically-owned. The kernel density – analogous to a smoothed histogram – is shifted to the right in the case of foreign-owned firms, which indicates that they tend to have a higher level of labour productivity than domestically-owned firms. A simple descriptive regression confirms that after controlling for country, time, and sector specific factors, foreign-owned firms are, on average, 82% more productive than domestically-owned firms. This result is consistent with foreign-owned firms having access to superior technology than do domestic firms. This basic empirical evidence therefore supports the contention that direct investment in a firm, including by a GVC partner or lead firm, can induce technology transfer to it, and lead to productivity upgrading. Such a process is largely confirmed in the empirical literature, and for example Arnold and Javorcik (2009) found evidence of increased labour productivity due to capital investment as well as organizational and management restructuring following acquisition by a foreign affiliate in a sample of Indonesian firms.
The discussion so far has focused on the direct effects of FDI, i.e. on the firm that receives the investment. However, there is also good reason to believe that FDI generates spillovers for other firms – there is always some leakage of technology or people, so although the primary technology shock from FDI accrues to the firm receiving the investment, some of the benefit is also felt by other firms. This indirect mechanism means that FDI is beneficial not just to a single firm that receives an investment, but also to other firms that remain in domestic hands. It is an indirect way in which FDI can act as a vector of technology transfer, including within the context of GVCs. For a detailed discussion of the ways in which such spillovers can occur in the developing country context, see Farole, Staritz and Winkler (2014), reproduced in summary in figure 9.4.

Figure 9.5 shows that the data again bear out the existence of this type of mechanism. The figure shows the productivity differential between firms in cities without any foreign-owned firms and those in cities with at least one foreign-owned firm – closest to the case of horizontal spillovers in the literature. The curve in the latter case is shifted to the right, which is consistent with the existence of technology spillovers outside the firm from FDI. A descriptive regression confirms this result; after controlling for country, sector and year specific factors as well as firm-level foreign ownership, there is a statistically significant relationship between the level of foreign investment in a city and firm productivity. Specifically, a one percentage point increase in the proportion of foreign-owned firms is associated with a productivity increase of around 0.8%. Again, this mechanism highlights that FDI can be a vector for technology transfer, both directly and indirectly. To the extent that GVC participation promotes FDI, it too can therefore be seen as a way in which technology can be upgraded by making use of foreign advances, albeit of a much smaller magnitude.

**Figure 9.5. Productivity differential between firms in cities with FDI and those without FDI**

The empirical evidence presented above focuses primarily on horizontal spillovers to firms in the same sector. However, in large part, the empirical evidence on horizontal spillovers in the context of developing countries actually suggests a negative effect due to foreign competition capturing market share away from domestic producers (see, for example, Aitken and Harrison 1999). In fact, the general empirical evidence is stronger in relation to vertical spillovers to firms that have a supply linkage with the firm owning or receiving the technology.

Vertical spillovers occur in two directions, backwards and forwards, but it is through backwards spillovers that technology transfer is more likely to happen. Backwards spillovers occur if there is a significant technology upgrading effect for suppliers when one of their clients receives foreign investment. The mechanism is that the recipient firm’s demand pattern changes, perhaps focusing more on high standard merchandise required by its foreign partner, and so the supplier needs to upgrade production to meet that demand. In a meta-review of thousands of estimates, Havranek and Irsova (2011) concluded that the data support the view that a 10% increase in foreign presence is associated with a 9% increase in the productivity of local suppliers through the vertical spillover mechanism. This effect clearly has economic and development significance.

Vertical spillovers are of particular importance in the GVC context because of the prevalence of vertical (supply) relationships in those networks. The data suggest that there is scope for developing countries to support technology upgrading on a broad basis by facilitating foreign investment.
in downstream GVC activities. The spillover effect will then lead to productivity increases in suppliers, under appropriate circumstances, which can boost the country’s level of technology more broadly. This type of mechanism can form the basis of an effective strategy for moving up value chains. Of course, it requires a certain amount of industrial depth, in the sense that there need to be upstream industries to benefit from the spillover effect. Other necessary conditions to benefit from technology transfer are discussed in the next section.

Box 9.1. Technology transfer through GVCs in Thailand

Saliola and Zanfei (2007) used data on more than 1,000 Thai firms to analyse the dynamics of technology transfer in the context of GVCs in that country. They found that a greater presence of foreign subsidiaries in a sector is conducive to the type of value chain governance that is associated with suppliers’ involvement in technology, and research and development activities. Their evidence can be interpreted as supporting the FDI spillover mechanism discussed here.

Interestingly, the authors also examined the case in which foreign firms adapted their technology and processes to Thai circumstances. That arrangement demonstrates a strong level of specific involvement in the value chain, and it appears to be consistent with significant technology transfers through the chain.

They also examined the case of imported intermediates (discussed below). They found that in cases where firms relied more heavily on domestic intermediates, it was more likely that the value chain was governed in a way that was not consistent with extensive technology transfer. Their results therefore also support the imported intermediates channel discussed here.

Source: Saliola and Zanfei (2007).

2. Technology licensing

Another way in which GVCs can facilitate technology transfer is through the licensing of technology by a foreign firm to domestic producers. In this case, the lead firm or technology supplier does not take an equity position in the firm receiving the technology, but instead allows it to use the technology in return for payment of a fixed sum. Clearly, licensing is risky from the technology supplier’s point of view, because the possibility of leakage is higher; however, equity investment also carries risks, and in countries with strong rule of law and contract enforcement institutions, licensing can be an effective solution to enable technology upgrading while maintaining an arm’s length relationship for other purposes.

Licensing foreign technology can be an effective way of facilitating technology transfer in relation to a specific technique or production method. Unlike FDI, it typically does not involve upgrading of the receiving firm’s organizational technology, but it is limited to the use of particular machinery or production processes. Technology licensing has considerable scope to support productivity upgrading, but FDI is likely to be a stronger means by which involvement with a foreign technology supplier has technology enhancing effects, due to its capacity for direct and indirect gains.

Figure 9.6 shows that firm-level data from developing economies provides evidence that foreign technology licensing can be an effective way of increasing productivity. The kernel density estimate for firms that license technology lies to the right of the curve for firms that do not license technology. This pattern is consistent with a higher level of productivity in firms that license foreign technology. A descriptive regression supports this result; firms that license foreign technology are, on average, 48% more productive than firms that do not license foreign technology after controlling for country, sector and time specific factors. As expected, the productivity-enhancing effect of technology licensing is smaller than that of FDI, but it is still highly significant.
3. Imported capital goods

In addition to relationship-based transactions such as FDI and licensing, it is also possible to gain access to technology within a GVC through transactions in the marketplace. One example is importing appropriate capital goods, such as machinery and equipment. Capital goods will often embody modern technology; therefore, for a developing economy importing capital goods from more advanced countries this implies a direct technology transfer. However, there is also scope for a range of indirect effects.

First, imported capital goods can generate spillovers, as workers learn how to use them, and can take that knowledge with them to other firms that can then acquire the same technology. A related issue is the ability to reverse engineer capital goods; if purchased outright, outside the scope of a licensing agreement, firms can use their own engineering skills to deconstruct and understand the technology they have purchased. That knowledge can be put to work in the development of their own products, and may even support the production of similar capital goods domestically. In addition, once capital goods are imported into an economy, they can circulate subsequently to other firms if the importing firm engages in further technology upgrading that makes the previous technology obsolete. This route raises the potential for additional technology spillovers from the import of capital goods in the developing country context as they are spread beyond the original importing firm.

Empirical evidence on imported capital goods is scarcer than for the other mechanisms examined in this chapter. In part, that is due to the difficulty of classifying goods by end-use based on standard trade categories. Nonetheless, some compelling evidence is available on the importance of capital goods as drivers of technology diffusion and productivity upgrading around the world. Eaton and Kortum (2001), for example, estimated that 25% of cross-country differences in productivity were due to variation in the relative price of equipment, about half of which were attributable to trade barriers affecting the capital goods sector. These estimates make clear that the circulation of capital goods is a potentially important means for developing countries to engage in technology upgrading.
Chapter 9

China has become a leader in the global photovoltaic cell industry. Despite barely deploying the technology at home in 2008, it accounted for more than 35% of world production in 2009. A total of 98% of that production was exported. Although there are sensitive issues of trade policy involved in the development of this industry, the focus here is on the technological component, without evaluating the competing policy claims surrounding the development of this industry, and its international competitive position.

Production of photovoltaic cells can be conceived of as using value chain methodologies (e.g. Sims, Gallagher and Zhang, 2013). Production requires the completion of a number of steps, and specialization in each area is spread across countries. China is relatively specialized in downstream production stages, while developed economies such as the United States, Germany, and Japan account for the bulk of production upstream.

The downstream segments in which China specializes have relatively low technological barriers to entry, and are correspondingly low in value-added relative to other segments. Although investment costs can be high, activities such as module assembly are labour-intensive – an area in which China has a strong comparative advantage.

Technology transfer has played a crucial role in the development of China’s photovoltaic cell industry. Perhaps the most crucial vector was acquisition of foreign capital goods – production equipment that can produce standardized, high-quality products efficiently and reliably. In downstream sectors where Chinese firms have become competitive, there is a global market for turnkey production systems, so it was possible for Chinese entrepreneurs to effectively import their production processes from a competitive global market. Complementary to the acquisition of equipment is the acquisition of skills by workers – the knowledge needed to work with and maintain the equipment, which also comes from the equipment suppliers on a market basis.

FDI has also been an important vector of technology upgrading in China’s photovoltaic cell sector. In 2009, China had attracted about one third of global FDI inflows in the sector. Interestingly, the first entrants into the market were indigenous Chinese firms. However, the influx of FDI has been associated with increased technology transfer. By contrast, licensing has played almost no role in the industry.

This case study demonstrates the various ways in which value chain participation can be compatible with technology transfer through different means. It has proved particularly effective in this case, and has allowed China to play a major role in the photovoltaic cell market. However, despite this success, it is important to highlight that the next stage of the industry’s development – indigenous technology creation and movement into upstream sectors and higher value-added activities – poses numerous issues for Governments and businesses alike. It will be important to ensure that that transition takes place through the leveraging of market forces and comparative advantage, and not through artificial or distortionary policy interventions.

Source: De la Tour, Glachant and Meniere (2011).

Box 9.2. Technology upgrading in China’s photovoltaic cell industry

China has become a leader in the global photovoltaic cell industry. Despite barely deploying the technology at home in 2008, it accounted for more than 35% of world production in 2009. A total of 98% of that production was exported. Although there are sensitive issues of trade policy involved in the development of this industry, the focus here is on the technological component, without evaluating the competing policy claims surrounding the development of this industry, and its international competitive position.

Production of photovoltaic cells can be conceived of as using value chain methodologies (e.g. Sims, Gallagher and Zhang, 2013). Production requires the completion of a number of steps, and specialization in each area is spread across countries. China is relatively specialized in downstream production stages, while developed economies such as the United States, Germany, and Japan account for the bulk of production upstream.

The downstream segments in which China specializes have relatively low technological barriers to entry, and are correspondingly low in value-added relative to other segments. Although investment costs can be high, activities such as module assembly are labour-intensive – an area in which China has a strong comparative advantage.

Technology transfer has played a crucial role in the development of China’s photovoltaic cell industry. Perhaps the most crucial vector was acquisition of foreign capital goods – production equipment that can produce standardized, high-quality products efficiently and reliably. In downstream sectors where Chinese firms have become competitive, there is a global market for turnkey production systems, so it was possible for Chinese entrepreneurs to effectively import their production processes from a competitive global market. Complementary to the acquisition of equipment is the acquisition of skills by workers – the knowledge needed to work with and maintain the equipment, which also comes from the equipment suppliers on a market basis.

FDI has also been an important vector of technology upgrading in China’s photovoltaic cell sector. In 2009, China had attracted about one third of global FDI inflows in the sector. Interestingly, the first entrants into the market were indigenous Chinese firms. However, the influx of FDI has been associated with increased technology transfer. By contrast, licensing has played almost no role in the industry.

This case study demonstrates the various ways in which value chain participation can be compatible with technology transfer through different means. It has proved particularly effective in this case, and has allowed China to play a major role in the photovoltaic cell market. However, despite this success, it is important to highlight that the next stage of the industry’s development – indigenous technology creation and movement into upstream sectors and higher value-added activities – poses numerous issues for Governments and businesses alike. It will be important to ensure that that transition takes place through the leveraging of market forces and comparative advantage, and not through artificial or distortionary policy interventions.

Source: De la Tour, Glachant and Meniere (2011).

4. Imported intermediates

Access to world markets for intermediate goods gives firms the ability to use high-quality inputs that may not be available domestically. Imported intermediates can be a source for technology upgrading because they facilitate the production of new and enhanced products and provide a boost to firm-level productivity. A relevant example of this proposition in practice was examined by Goldberg and others (2010), who found that when India liberalized its tariff regime, manufacturing firms were able to access a greater range of intermediate goods at lower overall prices, which in turn made them more productive. Evidence of a similar process is also found by Amiti and Konings (2007) in the context of Indonesia.

This chapter’s empirical evidence also shows that imported intermediates can boost the productivity of the importing firm, such a producer importing inputs within a GVC. Figure 9.7 shows that firms using some imported intermediates are
generally more productive than firms that use only domestically sourced varieties. As in previous figures, the curve for the former is shifted right relative to the latter, which is indicative of higher levels of productivity, as Goldberg and others (2010) found in the case of India. A descriptive regression confirms this result—firms that import at least some intermediates are, on average, 38% more productive than firms that use only domestic intermediates, after controlling for country, sector, and time specific factors.

The discussion above assumed that firms would simply include imported intermediates in their production process, which leads to productivity gains. However, it is also possible to upgrade technology by reverse engineering imported goods and either by learning how to manufacture them domestically, or putting the embodied technology to use in the production of other products. There is, therefore, considerable scope for access to imported intermediate goods to act as a spur to domestic innovation, in addition to static technology upgrading.

5. Demand effects

A final indirect way in which GVCs can promote technology upgrading is through consumer demand effects. When producers serve the domestic market of a developing country, demand may often coalesce around low-quality, low-cost items that adhere to local standards, but which are not globally competitive. GVCs, by definition, are interested in global and regional markets. They produce goods that appeal to a wide range of consumers, and tend to emphasize quality and uniformity through the use of product standards, which are often internationally harmonized and recognized. The growing literature on product quality and export patterns establishes this aspect empirically; for example, Manova and Zhang (2009) and Bastos and Silva (2010) found that firms in China and Portugal, respectively, exported higher quality goods to more developed destinations. Another compelling piece of evidence is provided by Atkin and others (2014), in a large, randomized controlled experiment granting export licenses to small Egyptian carpet producers. The authors maintained records of all the interactions between foreign customers in rich countries and local producers, and found that the local producers improved the subsequent quality of the carpets along various different metrics following complaints from foreign costumers, thus highlighting a feedback mechanism between buyers and sellers.
Demand from GVC lead firms can therefore be an incentive for developing firms to endogenously upgrade their production technology, which indirectly supports technology diffusion. This mechanism is consistent with the empirical evidence referred to in the previous sections, related to the fact that firms which are internationalized, including through GVCs, tend to be more productive. This is because unmeasured quality will manifest itself as a higher markup, which will artificially increase the calculated productivity since productivity is calculated as the residual between output and input values.

Demand effects from integration into GVCs can also occur as a result of having access to a larger market, which creates opportunities for reaping economies of scale. Van Biesebroeck (2005) and De Loecker (2007), in the case of Sub-Saharan Africa and Slovenia, respectively, attributed increases in productivity following entry into export markets to such a mechanism. Thus access to larger foreign markets, where payment is more reliable than in the relatively small and inefficient domestic markets, can lead to greater opportunities to scale up operations and achieve a more consistent inflow of profits. For many developing country firms facing large fixed costs that are barring them from entering international markets, integration into GVCs can provide important opportunities to take advantage of established networks and reliable customers.

Clearly, firms and workers in developing economies can only benefit from new technology diffusing through GVCs if the circumstances at home and within the firm are right. An economy’s absorptive capacity is going to be a crucial mediating factor in shaping these factors, which will determine the scope of the set of value chain relationships that are established as well as the extent to which technology upgrading can take place within this set of relationships. For example, in the case of FDI, the domestic environment must provide incentives for foreign firms to first engage in meaningful relationships with domestic agents and then in deepening those domestic linkages. For example, an economy with a relatively skilled labour force will be a more attractive destination for FDI with scope that extends beyond merely seeking cheap labour, while a skilled workforce is most likely to increase transfers of technology through channels such as the training of domestic workers, the transfer of complementary high-tech capital etc. This will come, in a large part, from a combination of factors that encompass both policy and business environments; however, there will also be a role for other more contextual factors such as geographic location and closeness to major markets, factor endowment and comparative advantage, political and social considerations etc. A detailed analysis of all of these factors is beyond the scope of this paper. Instead, the focus here is on a small number of broad policy areas that are of particular importance to the creation of an environment that is conducive to taking advantage of technology transfers and which facilitates such transactions to the mutual benefit of the transferor and receiver. Figure 9.8 shows the basic mechanism at work, where the absorptive capacity encourages the establishment of the channels of technology transfer, and then the firms’ absorptive capacity determines the extent to which they benefit from these flows of technology. Although it is not obvious here, it will be seen that there is a strong interrelationship between the absorptive capacity of an economy as a whole and that of the firms concerned.

Figure 9.8. From technology diffusion to national upgrading – the role of absorptive capacity
There are four broad policy areas that are essential both to the initial establishment of the channels for technology transfer and to maximizing the magnitude and likelihood of technology diffusion.

First, and perhaps most importantly is institutional capacity, including governance, the rule of law and contract enforcement, as well as respect for intellectual property rights. All types of technology transfer within GVCs rely on some form of legal relationship between the source and the recipient. The relationship can be one of FDI, a licensing arrangement or simply a contract to supply a particular intermediate or capital good; the ability to enforce its terms is a crucial determinant of the willingness of a technology source to engage in this relationship. The importance of institutional development as a determinant of economic growth is widely accepted (e.g. Acemoglu, Johnson and Robinson, 2001); however, this is one area in which institutional development plays a particularly important role. Just as value chains depend on contract enforceability for their ability to operate on a day-to-day basis, so too does technology transfer within those structures depend on the rule of law and the level of development of governmental institutions. Some evidence for such a process comes from the discussion of intellectual property rights. Javorcik (2004) found that weaker protection of intellectual property rights encouraged international investors to undertake investments in distribution and sales rather than production or R&D. In this example, the strength of the institutional environment makes it safer for foreign firms to engage in investments that capture higher value-added, and in turn these investments are more likely to result in significant technology transfer to domestic actors. Focusing on institutional development should therefore be a priority for policymakers who are keen to promote technology transfer within GVCs.

Second is openness to FDI, which is one of the most important and beneficial vectors for technology transfer within GVCs. Many countries have liberalized their foreign investment regimes to some extent during recent years but restrictions remain; these are sometimes sector specific, particularly in services. Appropriate relaxation of foreign investment rules – which includes restrictions on foreign ownership and legal form – can encourage GVC partners and lead firms to make relationship-specific investments with local firms that can include technology transfer. Again, it is important to understand technology broadly – not just as the machines that produce a particular product, but the organizational techniques used to blend inputs of different types together so as to produce an output in a reliable, cost-effective, high-quality way.

Third, developing economies need to maintain an open stance in relation to international trade, especially intermediate inputs and capital goods. Availability of both classes of goods has the capacity to boost domestic technology, and movements of both take place within the scope of GVCs, although the emphasis is primarily on inputs. A liberal trade policy stance, particularly in these sectors, facilitates movements of goods that bring technology embedded in them. If economies make it more expensive for their firms to import such products by maintaining tariff and non-tariff barriers to trade, they implicitly hold back the rate of technological advance that can take place. There is extensive empirical evidence that lower trade costs are associated with firm- and sector-level productivity growth (e.g. Pavcnik, 2002) through a variety of mechanisms including the ones discussed here.

The fourth and final, country-level area overlaps with the issue of absorptive capacity from a more micro perspective – the development of human capital. For technology transfer to be fully effective, the new machines or techniques need to be understood and internalized, as well as potentially adaptable to domestic conditions, both by workers and by local engineers. Human capital is therefore a crucial mediating factor in the relationship between GVC participation and effective technology transfer. If a skilled workforce is available, it also becomes attractive for a GVC partner or lead firm to engage in technology transfer; therefore, causality runs both ways, as human capital is valuable for developing absorptive capacity as well as for attracting FDI in the first place.

Development of human capital is an important prerequisite for moving up in value chains, and leads to a strong policy emphasis on education and training at appropriate levels given an economy’s economic development status. In poorer developing countries, the emphasis should be on basic (primary and secondary) education, with attention then turning to post-secondary education (tertiary and professional) in an organic way. Continuous development of human capital is one way in which policymakers can create a national environment that attracts foreign technology and is conducive to technology transfer. Moreover, well-developed human capital is complementary to improved physical and organization technology, as it makes it possible for them to work optimally in the context of production within value chains.

Firms themselves also need to be able to absorb the new technology that becomes available to them. Some factors that determine this ability include the pre-existing level of technology, including management competence. Clearly, a firm can only move so far in terms of taking up new technology, and the scope of its upgrading is determined at least in part by its existing technology, including its organization and use of resources. In addition, businesses need to be competently managed so as to use resources efficiently and be able to take full advantage of the new
This chapter examines the ways in which technology transfer can take place within GVCs. A number of vectors are identified, ranging from inward FDI, imported intermediates and capital goods, to demand effects. The empirical evidence strongly suggests that, under appropriate circumstances, GVC participation can be compatible with the workings of economic forces that support technology upgrading in developing countries.

However, technological progress and movement into higher value-added activities are not an automatic process that occurs regardless of whatever else is happening in the broader economy and social structure. Developing economies need to put in place the right policy and institutional environment to favour technology transfer, and to exert an influence on the type of transfer that takes place. Together, such interventions can be considered to be a type of industrial policy – a position that aims to support industrial development and upgrading – but the emphasis of such policies in the current environment must be on non-discriminatory measures that reinforce, not go against, basic economic processes. There is no role for Governments to “pick winners” as a means of trying to encourage moving up in value chains, as such policies have repeatedly been found wanting, particularly in environments of weak governance. Such a policy stance is therefore often referred to as a “soft” industrial policy.

Indeed, perhaps the most crucial intervention to support technology transfer is building up domestic governance institutions, particularly the rule of law and contract enforcement. Without these institutions in place, foreign businesses will be reluctant to transfer technology through arrangements such as FDI and licensing. In any case, boosting performance in this broad area is a priority for many economies, as it is well-known to be associated with economic growth and development potential over the medium term. Fostering technology transfer, particularly through FDI and licensing, is nevertheless a primary reason why this is an area that deserves priority on a policy level.

Factors affecting a firm’s absorptive capacity are highly correlated with the determinants of a country’s absorptive capacity. It implies that policies to strengthen the host country’s domestic absorptive capacity can also influence the firms’ absorptive capacity. Therefore, the willingness and credibility of a Government to undertake deep and meaningful reform is likely to go a long way in stimulating trade and investment flows and the technology such flows carry along with them.

Openness to international trade and investment flows is also a crucial policy priority for fostering technology transfer through FDI as well as imports of intermediates and capital goods. Appropriately, liberal trade and investment policy settings – backed by stability and certainty in their administration – can encourage foreign counterparts to engage in mutually beneficial technology-based transactions with firms of developing economies. The movement of goods and capital is a crucial vector by which technology is transferred, including within GVCs, and the ability to move up in a GVC to higher-value-added activities depends on this factor.

It is important to stress the value of openness in order to counteract the view that industrial policy considerations would operate in favor of protection of “new” value chain activities that represent the potential for higher value added retention. Infant industry arguments, although theoretically plausible under certain circumstances, have proved in practice to be difficult to administer effectively – it is hard to make infants “grow up” and become globally competitive. Instead, the approach suggested in this chapter is in line with an incentive neutral trade and investment policy that allows goods and capital – including those with embodied technology – to flow freely across borders and be put to their optimal use.

A final factor to which developing countries need to pay special attention – all the more so as we move into the era of sustainable and inclusive growth – is the development of human capital. Foreign technology can only be put to use if workers and engineers are available who can understand how to operate, maintain and adapt the technology that is at their disposition. Developing countries need to redouble their efforts to develop their human capital stocks in appropriate ways, depending on their level of per capita income. Physical technology and human capital are strong complements, so it is important to move forward on both fronts simultaneously. Companies operating in GVCs frequently cite an educated workforce as a strong factor in
their location decisions, so Governments of developing economies need to be responsive to that fact.

ENDNOTES

1 This chapter was prepared by Ben Shepherd, Principal of Developing Trade Consultants. The author is grateful to Olivier Cattaneo and Deborah Winkler for helpful exchanges as well as to Luca Parisotto for additional work on the chapter.

2 See Brach and Kappel (2009) for a general discussion of the issues in a development context.

3 Presumably profit maximization could be subject to meeting socially responsible business criteria.

4 Taglioni and Winkler (2015) provide a more complete review.

5 Technology transfer could be in a form of inter-firm provision of training (i.e. training among local and non-local firms connected by domestic and international productions networks). See, for example, Kimura, Machikita and Ueki (2015).

REFERENCES


