New Technologies, Global Value Chains, and the Developing Economies

Background Paper

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Pathways for Prosperity Commission
Technology & Inclusive Development

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This paper is part of a series of background papers on technological change and inclusive development, bringing together evidence, ideas and research to feed into the commission's thinking. The views and positions expressed in this paper are those of the author and do not represent the commission.

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1. Introduction

Do new technologies present an opportunity or a threat to developing economies? For the optimists, the knowledge economy, artificial intelligence, and advances in robotics represent a historical chance for developing economies to leapfrog to a more advanced-economy status. Others worry about the ability of poor countries to compete in a world economy in which others have much greater capacity to capitalize on new technologies. In many ways, this debate is similar to the discussion about the impact of technology on labor markets and inequality *within* rich nations. There too, optimists and pessimists are divided about the consequences for low-skilled workers. Will technology lift all boats by providing opportunities for overall productivity gains? Or will those gains be captured by a small minority of highly skilled workers, professionals, and large corporations?

New technologies tend to reduce prices of goods and services to which they are applied. They also lead to the creation of new products. Consumers benefit from these improvements, regardless of whether they live in the developed world or the developing one. Mobile phones represent a clear example: they have enabled easy and cheap communication among people separated by geographic distance. In a clear case of leapfrogging, they give poor people in developing nations access to long-distance communications without their governments having to make costly investments in land lines and other infrastructure. Likewise, mobile banking provided through cell phones extends access to financial services to remote areas without bank branches.

These and similar examples are clear instances of technology working to improve the lives of poor people. But for technology to make a real and sustained contribution to development it must not only provide better and cheaper products, it must also lead to more better-paying jobs. In other words, it must help developing nations qua producers as well as qua consumers. A model of growth that Tyler Cowen (2016) has called "cell phones instead of automobile factories" begs the question: how do people in the developing world afford to purchase the cell phones in the first place? The new products and services may be cheaper, but without ever-more productive jobs, workers in the developing world are bound to lag.

Consider again the examples of mobile telephony and banking. To some extent these are producer services as well as consumer services; communications and finance are inputs into production. Therefore they provide benefits on the production side as well. For example, a well-known study has documented how the spread of mobile phones in the Indian state of Kerala enabled fishermen to arbitrage price differences across local markets, increasing their profits by 8 percent on average as a result (Jensen 2007). Kenya's ubiquitous mobile banking service M-Pesa appears to have enabled poor women to move out of subsistence agriculture into non-farm businesses, providing a significant bump up the income ladder at the very bottom (Suri and Jack, 2016).

New digital technologies have been playing a significant role in transforming large-scale farming in Latin America and elsewhere. Big data, GPS, drones, and high-speed communication have enabled improved extension services; optimized irrigation, pesticide and fertilizer use; provided early-warning systems; and enabled better quality control and more efficient logistics and supply-chain management (Deichmann et al., 2016). These in turn raise farm productivity and facilitate diversification into non-traditional crops with better returns.

2. GVCs, trade, and disappointing impacts

The introduction of these new technologies in production in developing countries often takes place through global value chains (GVCs). GVCs are in effect part and parcel of the new technology. Improvements in communication and information technologies have enabled large firms based in advanced nations, whether retailers or manufacturers, to divide the production chain into specific tasks that can then be dispersed around the globe to take advantage of lower costs. GVCs in turn serve as the vehicle for the dissemination of technology from the lead firms to their suppliers. A common view is that the nature of global trade in modern agriculture, manufacturing and tradable services has been fundamentally transformed by GVCs.

In principle, GVCs benefit developing nations by easing entry into global markets. They allow firms in developing countries to access global markets by producing specific tasks without having to develop side industries as a precondition. The required inputs and services do not have to be locally produced; they can be imported. This makes it easier for international corporations to locate, say, specific auto components or a narrow stage of production in consumer electronics in developing countries.

But the questions hang around all these possibilities. Are the productive gains are large enough? Can they be disseminated sufficiently quickly throughout the rest of the economy? (Note again the parallel with the advanced-country debate.) Any optimism about the scale of contribution by GVCs has to be tempered by three sobering facts. First, the expansion of GVCs seems to have ground to a halt in recent years. Second, developing-country participation in GVCs, and indeed in world trade in general, has remained quite limited, with the notable exception of certain Asian countries. Third, and perhaps most worryingly, the domestic employment consequences of recent trade trends have been quite disappointing.

Consider first global trends in GVCs. As Figure 1 shows, the importance of GVCs in global trade rose steadily since the mid-1990s until the global financial crisis. A noticeable drop occurred in the immediate aftermath of the crisis, as world trade took a big hit. Though some recovery has since taken place, the trend has been essentially flat from 2011 on. This is true for both "simple GVCs" (in which domestic-factor content crosses the border once) to more complex GVCs (in which domestic-factor content crosses the border more than one time). Similarly, Timmer et al. (2016) find that the global fragmentation of production has been in decline since 2011, which has in fact contributed to the reduction in world trade ratios since then. This reversal seems to be due to a number of interrelated factors, including the saturation of possibilities of fragmentation of production, increasing risks and costs associated with trade, the reshoring of Chinese production, and the global shift in demand away from goods and towards (less tradable) services. These recent trends do not seem transitory. Therefore, neither trade levels nor GVC networks are likely to become more buoyant in the near future.

Turn next to trade performance of developing countries. Outside of Asia, trade integration levels have not increased overall; in many countries they have come down. Too many countries depend on commodity exports, and trade shares in GDP still closely follow commodity cycles. Figure 2 shows that export-GDP ratios have fallen in many sub-Saharan African countries in the 1995-2013 period. The list of negative performers on trade includes not only oil exporters but also others such as Kenya, Ethiopia, and Uganda. Participation in GVCs has continued to increase in Vietnam, Bangladesh and India since the global financial crisis, but it has declined in many African countries from already comparatively low levels (Figure 3).

What is curious about this mixed trade performance is that it took place during an era of unprecedentedly high growth among the low-income countries of sub-Saharan Africa. Usually high growth is associated with export-oriented industrialization and integration into global production chains, as in Asia. Clearly, the recent pattern elsewhere has been different. In the most rapidly growing sub-Saharan Africa countries such as Ethiopia, industrialization and trade have barely kept up with GDP. Instead, growth appears to have been driven mainly by domestic demand - spurred by foreign transfers, public investment, or increases in rural incomes due to improved agricultural policies (in infrastructure, fertilizer, irrigation). As my co-authors and I have shown, productivity growth in modern manufacturing and services in aggregate has tended to lag (Diao et al., 2017). In other words, whatever role integration into global production networks may have played in these countries, the aggregate, economy-wide effects have been relatively small.

Nowhere is this clearer than in employment. A database compiled at the World Bank allows us to examine the levels and trends in employment associated with exports in a wide range of countries (Cali et al., 2016). The key novelty in the database is the estimation of the number of directly and indirectly created jobs, through the use of input-out tables. This is especially important in a context in which the production process is significantly fragmented. For example, the employment impact of exports may be underestimated when export-oriented firms outsource the production of some their inputs to other providers in the home economy. The report reveals that manufacturing exports are a significant creator of jobs. Lower-income countries tend to have higher employment per dollar of exports, consistent with more labor-intensive production patterns. In addition, most of the jobs created by exports in the developing countries are in service sectors that export very little themselves. But perhaps the most important finding is that the job intensity of exports has steadily declined since around 2001 in both advanced and developing nations. This is perhaps not very surprising for the advanced nations, where skill-biased technological change has been ubiquitous and the leading cause of declining employment shares in manufacturing industries. It is more puzzling and disappointing in low-income countries, where one would have expected to see the beneficial employment consequences of diversification out of natural resource exports and transition into labor-intensive manufactures.

Figure 4 displays the experiences of three developing countries at different levels of income: Ethiopia, Philippines, and Thailand. The top panel shows all exports, while the bottom panel shows manufactured exports only. Both pictures tell the same story of a very sharp decline in the job intensity of exports. The periods covered differ due to different availability of data. In the comparatively short period of seven years (2004-2011), the number of jobs created in Ethiopia per

dollar of exports appears to have more than halved from 243 to 110. This is a substantial drop. The drop in job intensity for *manufactures* is similar, though from a higher level: from 419 to 234. The other two countries, which have data for longer periods, also show large declines since 2001, although not as sharp as in Ethiopia. These results are unlikely to be due to the particularities of data sources in these specific countries as other developing countries show similar downward trends as well.

A possible objection to these findings is that they might be a statistical artifact caused by the presence of GVCs. The domestic value added (and hence number of jobs) created per dollar of gross exports naturally declines when countries participate in GVCs and more of the inputs that go into export production are supplied by imports. The reduction in the domestic value-added share in exports is perhaps compensated by higher volume of (gross) exports. This does not seem likely; as we have seen, developing-country participation in GVCs has not increased sharply, and trade shares in GDP have not taken off. More direct evidence is provided in Figure 5, which shows the total number of jobs that go into exports (both direct and indirect) as a share of total employment. In all three countries, the shares go down, and quite significantly. In Ethiopia and the Philippines, the percentage of export-related jobs has been halved. The decline in Thailand, while not as dramatic, is still visible. Again, these countries are not outliers; they seem to be representative of general trends among developing economies. See also Figure 6, which shows the relationship between employment creation and GVC participation across a broad range of countries. The relationship is, if anything, negative.

It appears that exports are creating fewer and fewer jobs, and GVCs are certainly not helping. This is disappointing from a number of perspectives. It puts a damper on the idea of trade as an engine of growth. It suggests that the technological and organizational benefits associated with exports are not being disseminated throughout the economy. And since exports tend to be associated with better-paying jobs, it raises concerns about wage levels and inclusion.

The World Bank recently reported the results of an interesting empirical exercise in which exports were divided into two types of goods, called "GVC products" and "non-GVC products." The former refers to goods that are typically traded within production networks. An export performance index for each group was regressed on a number of country characteristics, including proximity to major markets, natural resources, human and physical capital, institutional quality, logistics/connectivity, and wage competitiveness. For non-GVC products, wage competitiveness was the only item on the list that significantly correlated with export performance. For GVC products, by contrast, all of the factors strongly correlated with export performance – with the glaring exception of wage competitiveness (World Bank 2016, p. 34). These results are a striking indication of GVCs' adverse impact on developing countries' comparative advantage. GVCs demand skills and capabilities that are in short supply in developing countries, and undercut their traditional comparative advantage in unskilled labor.

3. GVCs, skills, and complementarity

Virtually every policy-oriented treatment of GVCs emphasizes the importance of complementary skills and capabilities, if the potential of trade and GVC participation is to be transformed into reality. Developing nations must upgrade their educational systems and technical training, improve their business environment, and enhance their logistics and transport networks in order to make fuller use of GVCs, goes the usual refrain. But such admonishments miss the point. They tend to highlight more the inherent shortcomings of the new technologies and their deployment through GVCs rather than their potential contribution to economic development. Pointing out that developing countries need to advance on all those dimensions is not news; nor is it helpful development advice. It is akin to saying development requires development.

Trade and technology present an opportunity when they are able to leverage *existing* capabilities, and thereby provide a more direct and reliable path to development. To see the point, consider why industrialization has been historically such a forceful engine for economic growth. Manufacturing traditionally had three characteristics that together made it special among all economic activities. First, manufacturing know-how was relatively easy to transfer across countries and, in particular, from rich to poor nations. Manufacturing is probably alone in exhibiting unconditional economic convergence on a long-term basis: countries that start with lower labor productivity in manufacturing tend to exhibit higher productivity growth over subsequent decades. Remarkably, this productivity convergence occurs regardless of a country's policies, institutions, or geography (Rodrik 2013). Better institutions and policies can of course increase the speed of convergence. But what is striking in the data is that even countries with poor economic management experience productivity convergence within their manufacturing sectors. (This raises the obvious question of why entire economies do not converge if manufacturing does. The answer is that the countries that do not converge are those that are unable to pull their labor into manufacturing sufficiently rapidly – i.e., industrialize.)

Second, manufacturing is tradable. There is always an external market, and domestic manufacturing production does not need to be constrained by demand (and incomes) at home. The significance of this is that manufacturing can scale up even if productivity in the rest of the economy remains very low. Non-tradables, by contrast, are constrained by the size of the home market, which in turn depends on productivity in the rest of the economy. A productivity boost in a specific non-tradable sector would eventually fizzle out as the sector's terms of trade turn against it. With manufacturing, growth can continue virtually indefinitely as domestic production supplies world markets.

Third, the industrialization model faced few constraints on the supply side as well. Manufacturing needs physical capital and equipment, which can be scarce in a developing economy. But traditionally the main variable input was unskilled labor. Factories producing simple garments, toys, or even automotive vehicles could operate by employing uneducated workers with few skills other than those acquired on the job, and basic manual dexterity. Developing countries have essentially an unlimited supply of unskilled workers in the countryside. So labor-intensive manufacturing was especially suitable to developing countries and could expand without running into supply-side bottlenecks.

These three characteristics collectively rendered manufactures a fantastic escalator to higher incomes for developing nations. You could start with very poor initial conditions, get a few things right to stimulate the domestic production of a narrow range of labor-intensive manufactures – and voila! You had a growth engine going. There was no need to reform all sectors or improve institutions across the board. That harder work could be done over the course of economic development, as economic growth relaxed budget constraints and capabilities gradually accumulated.

Note, however, that I used the past tense for two of these characteristics: ready access to technological know-how and low-skill intensity of manufacturing production. Manufacturing remains tradable, but technological changes have significantly dampened its other two advantages for developing countries. In the next section I examine these technological changes and their impact more closely.

4. Technology and shifts in comparative advantage

Skill-biased technological progress has been ongoing in the manufacturing sectors of advanced economies for decades. Two immediate consequences of this were a steady loss of jobs in manufacturing (as a share of total employment) and a rise in the skill premium (the wage differential between skilled and unskilled workers). In addition, since productivity growth was more rapid in manufacturing than elsewhere, the relative price of manufactured products fell.

In a world in which markets are globalized, the relative price change in advanced countries is transmitted to developing countries as well. Insofar as developing countries are consumers of manufactures, this represents an improvement in their terms of trade, and is beneficial. For capital goods and many high-tech products, this has been certainly the case. But insofar as developing countries have an existing or latent comparative advantage in manufactured products, this relative decline in prices represents a loss. Moreover, lower relative prices for manufactures depress the profitability of industrial investments in low-income countries, and renders industrialization more difficult. So to the extent that industrialization is already disadvantaged by learning externalities or coordination failures, the adverse impact on developing countries is magnified.

For most developing countries these technology-driven, adverse profitability trends have been compounded by the greater openness of their market to imports from China and other Asian manufacturing champions. In earlier decades when transport costs were higher and trade policies more restrictive, domestic markets enjoyed a certain amount of segmentation from global markets. There was more room for import substitution and local entrepreneurship in basic manufactures such as simple consumer products. Today imports from low-cost Asian producers have made it very difficult for new industries to be started at small scale and with initial cost disadvantages.

More recent trends in the technology of production portend more bad news for developing countries. Automation, robotics, and 3D printing are all essentially labor saving. They will increase demand for *skilled labor* to the extent that there is complementarity between these new technologies and skilled labor, and reduce demand for unskilled labor – the one resource that all low-income countries have in abundance[1]. When shoes, say, can be cheaply produced with 3D printing, major brands will be less interested in offshoring to developing countries where labor is cheap. Re-shoring will be more common.

In other words, many if not most of the newest technologies imply that the comparative advantage of low-income countries in standard manufactures will tend to dissipate. Skill-biased technological change requires developing countries to double up their investment in human capital, just to stay where they are. This is the conundrum of "complementary skills and capabilities" that I have already described.

[1] In a production function with two factors of production, skilled and unskilled labor, technological change that effectively augments unskilled-labor is skill-biased (i.e., increases relative demand for skilled labor) as long as the elasticity of substitution is less than 1 in absolute value. See also discussion below.

But a second feature of new technologies, especially those associated with GVCs, also seems noteworthy. The introduction of new technologies also makes it more difficult for unskilled labor to substitute for other production inputs, including skilled labor, capital, and other capabilities. In other words, the elasticity of substitution between unskilled labor and other factors of distribution drops.

Consider a manufacturing operation in a developing economy. Whether or not it is foreign-owned, the technology will normally be imported from advanced countries. It will require certain types of machinery, software, and workers to operate. But the blueprints may allow some flexibility in terms of how different factors of production are combined. In particular, since unskilled workers are relatively cheap, the owners of the factory may want to economize on physical and human capital and use more unskilled workers. Some tasks that are automated in the advanced economies (e.g., packing) may be produced by manual labor in the developing economy. In economics jargon, this is called an adjustment in production *technique* along an isoquant. Using data over the 1973-1990 period, Blum (2010) shows that such adjustments are quantitatively very important. He finds that changes in relative factor endowments across countries are accommodated mainly by shifts in production techniques within sectors rather than output mix per se. In other words, an increase in the supply of unskilled workers results in such workers being used more intensively across the entire economy.

My argument is that newer technologies make it harder for this kind of factor substitution to be made, especially in the more advanced firms where production is integrated in GVCs. This is because of the demanding precision and quality standards associated with these technologies. It is often impossible to satisfy these standards by substituting manual work, which necessarily introduces irregularities in production. GVCs also imply that the governance of production environment shifts from local governments, producers, and consumers to international firms, resulting in local firms becoming more dependent on global firms' requirements. Offshoring increases the ability of producers in the advanced nations to substitute for domestic labor, by moving offshore. But by increasing the stringency of production requirements, it makes unskilled labor in developing countries less substitutable for other capabilities.

This can be true even in activities that are not technologically sophisticated and considered to be labor-intensive. Consider, for example, African horticulture. Standards imposed by purchasers in the advanced countries are very stringent:

> "Standards have been one of them most significant drivers of evolving horticulture GVC and RVC dynamics, in many ways creating the rules for participation and upgrading. Along with the rise of European supermarket GVCs, lead supermarkets have increasingly used standards to govern their supply chains based on Western consumer preferences, such as quality, appearance, hygiene, safety, and traceability. Adherence to supermarket horticulture standards is often a double-edged sword – especially in Africa…. On the one hand, it offers substantial opportunity for producer upgrading into higher value added activities (examples of product, process, cold chain, and functional upgrading can be found in Kenyan FFV chains), and in some cases, social upgrading for workers through increased social protections (examples of more permanent employment contracts, unionization and collective bargaining can be found in Ugandan floral cuttings chains). On the other hand, it limits participation to only those producers with the necessary investments needed for compliance." (Goger et al. 2014; references omitted.)

As the authors observe, this explains why it has been very difficult for agricultural smallholders in general (producing fruits and vegetables) to plug themselves into GVCs. No amount of manual labor can make up for the deficit due to the lack of complementary skills and capabilities. The benefits accrue mostly to the workers employed in established, formal enterprises. (African consumer markets are, by contrast, less demanding. So there are fewer barriers to entry for smallholders serving African retail chains.) Similar difficulties have been noted for labor-intensive manufacturing (AfDB 2014).

An indication that GVCs stimulate convergence in production techniques is that trends in factor shares exhibit very similar patterns in the developed and developing world. Figure 7 shows changes in the value-added shares of capital and three different types of labor (low-skilled, medium-skilled, high-skilled) in manufacturing GVCs for a broad cross-section of countries. In the developed world, the share of skilled labor has increased while the share of low-skilled labor has come down in all of the countries included in the table. This is a familiar pattern, associated with the reduction in relative demand for low-skilled workers in the North. Somewhat more surprisingly, the pattern with respect to the declining share of low-skilled labor is virtually the same in the developing world. If anything, the fall in the low-skilled labor share has been faster outside the developed world than within.

To be more precise, think of a production function with a parametric elasticity of substitution denoted by . This can be expressed as

$$y = A\left[\alpha(aL)^{\frac{\sigma-1}{\sigma}} + (1-\alpha)S^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}},$$

where *y* is output, *L* is unskilled labor, *S* is a composite of other production inputs (capital, skills, capabilities), and α is a parameter capturing the distribution of factor shares. *A* denotes the factor-neutral efficiency level while *a* is a parameter capturing unskilled labor-augmenting technological change. I shall assume σ <1, which means unskilled labor and other production inputs are gross complements. This is consistent with the empirical literature (see Lawrence 2015 and the literature cited therein). The lower limit of σ is 0, at which point there is no substitutability between *L* and *S* and the production function takes the Leontief form with fixed input requirements.

We are concerned with two distinct changes in the shape of this production function: (a) an increase in *a*, and (b) a reduction in σ. The first makes labor more productive and increases relative demand for *S* (under the assumption that σ <1); it stands for conventional skill-biased technological change. The second makes unskilled labor less substitutable for other production inputs, and captures the increasing stringency of production standards just discussed.

It is easiest to see the joint consequences of these changes with some illustrative calculations. Associated with the production function above is a cost function, which can be calibrated to trace out the production costs of firms in advanced and developing economies. This in turn informs us about the viability of production in developing countries as the parameters of interest change. I assume wages of low-skilled workers in developing countries are 20 percent of those in advanced countries and that *A* is half as large in the former on average (and normally distributed with a standard deviation of 40 percent around the mean). Production functions in rich and poor nations are identical otherwise. I start with initial values *a* =1 and σ = 0.8 and calibrate the rest of the parameters such that roughly 50 percent of developing countries are viable in the baseline equilibrium. (Viable means their unit costs are no higher than in advanced countries.)

The consequences of changes in a and σ can be seen graphically in Figure 8. The percentage of developing country firms that are viable steadily declines as a increases and σ falls. Equally important, the two effects are multiplicative and reinforce each other. Consider the impact of labor-augmenting technological change that increases a from 1 to 3. When $\sigma = 0.8$, the percentage of viable firms is reduced modestly from 55 percent to 46 percent. But when $\sigma = 0.4$, the percentage of viable firms is more than halved from 42 percent to 19 percent. Similarly, reductions in σ imply a much bigger competitive penalty for developing countries when a is higher. Note that these calculations are undertaken for a fixed set of wages in developing countries (relative to rich nations). Equilibrium will require wages to be adjusted so as to increase the viability of developing country firms. So another way to interpret these results is they give us orders of magnitude about the scale of the (downward) adjustment in wages needed to restore developing country competitiveness in the aftermath of technological changes.

Labor-augmenting (and skill-biased) technological change has been well documented in the literature. Is there similar evidence about the reduction in the elasticity of substitution I have posited? There isn't a whole lot of systematic evidence about such a trend over time, in part because empirical analyses tend to treat as a deep parameter that does not change. However, in unpublished work, Robert Lawrence has shown that σ is lower in post-2000 U.S. manufacturing compared to the pre-2000 period (Lawrence, forthcoming). It is also possible to infer something from the cross-sectional studies. These studies can be read as suggesting that technologically more sophisticated activities tend to have lower σs. Raval (2108, Fig. 4) finds that σ is significantly larger in garments and textiles than it is in electrical machinery (but still well below unity). Baccianti's (2013) estimates provide a broadly similar rank ordering. Oberfield and Raval (2014, Fig. 9) find (industry-level) σ is much lower in the United States than in three developing countries, with India having the highest σ. In light of these results, it is reasonable to suppose that adoption of the technologies used in advanced economies will tend to lower σ in developing economies.

A complementary perspective to this line of argument is offered by Acemoglu and Zilibotti's (2001) work on inappropriate technologies. These authors start from the same observation that developing countries need to import their technologies from advanced nations. They posit that the direction of technological change depends on relative factor prices. Since skills are relatively abundant in rich countries, new technologies will tend to be optimized for use with skilled workers. When they are used with low-skilled workers, their productivity will be lower. Developing countries will therefore pay a productivity penalty even when they have costless access to the most recent technologies. As Acemoglu and Zilibotti show, such a technology-skill mismatch is not a disadvantage that can be fully remedied by deploying additional low skill workers.

None of this is to suggest that the deployment of new technologies will not have a direct positive role on productivity growth, and perhaps also employment generation, in developing countries. The potential for productivity gains from digitalization in Africa is very well described in Banga and te Velde (2018), which also offers an optimistic take on job prospects. But the discussion here suggests that new technologies disproportionately favor rich economies, well-endowed in skills and capital, rather than developing economies. So they make it harder for poorer economies to latch on to more advanced products, and they also weaken their comparative advantage in the older, more traditional industries. The net effects remain uncertain in practice.

5. Can services be the new escalator?

I discussed previously the features of manufacturing that turned it into an escalator for low-income countries, at least before recent technological trends. What will replace it if manufacturing becomes increasingly skill- and technology-intensive and can no longer absorb unskilled labor? GVCs encompass agriculture and services in addition to manufacturing. With respect to agriculture, no doubt developing countries have significant potential for productivity increase in the countryside through better use of inputs, application of new technologies, and diversification into new crops. But it is very unlikely that agriculture could absorb labor, rather than release it, during the process of economic development – even if the new technologies were not labor-saving. The budget shares of food and other agricultural products tend to decline during economic growth. One way or another, growing economies have to create jobs for unskilled workers outside of agriculture and in urban areas.

One consequence of premature industrialization in developing countries (Rodrik 2015) is that employment in urban services has been expanding much faster and at lower levels of income. Can services substitute for weak industrialization (or deindustrialization) and drive economic growth? Ghani and O'Connell (2014) state the case for services. Services are increasingly traded, and the volume of trade has been expanding more rapidly than in trade for goods. Second, thanks in part to GVCs, productivity in services is often no longer stagnant and can increase rapidly. Third, many services are able to absorb large amounts of employment. Finally, services are friendlier to the environment, and a service-led growth pattern would be greener.

In most developing countries services do tend to exhibit, on average, higher labor productivity than traditional agriculture. The movement of labor from the countryside to urban services improves economy-wide productivity. As we show in Diao et al. (2017), this has been an important source of high economic growth in low-income countries recently. However, services are a hodgepodge of very diverse activities. Some, such as tourism, IT, or finance, are indeed highly tradable. They share with manufacturing the feature that they are technologically dynamic, offering possibilities of (unconditional) productivity convergence with advanced nations. Others, such as many personal and retail services, are non-tradable, technologically stagnant, and dominated by small informal enterprises. The trouble is that very few in the first category can absorb significant amounts of unskilled labor. Business services, which offer great potential in trade and GVCs, are easily the most skill-intensive across GVC categories (Figure 9). They do not have much potential for generating employment for low-skilled workers.

With respect to traditional services such as retail and wholesale, some countries have had success in increasing productivity, often by allowing foreign firms in. But the consequent reorganization of these activities around larger, more capital-intensive producers often tends to be detrimental to employment. A large part of the problem in such services (e.g. retail trade) is the preponderance of small, low-productivity firms that absorb the excess supply of labor. When these firms are driven out, employment is hit. Figure 10 shows the correlation between labor productivity growth and

employment generation across countries for two major service sectors: wholesale and retail trade and personal and community services. The negative correlation in both sectors is striking: service sectors that have the best productivity performance typically shed labor; labor-absorbing sectors typically have the worst productivity performance. This regularity dovetails with the finding in Diao et al. (2017) on high-performing low-income countries. The problem with labor moving into urban services is that too often the expansion of services comes at the cost of lagging productivity over time. African countries that had the higher rates of labor movement into services were also those that had the worse productivity performance in services (Diao et al. 2017).

So we are back in the same conundrum: where will the jobs come from?

6. Concluding remarks

It is often said that GVCs and new technologies increase opportunities for developing countries to access global markets by making it easier for them to engage in production of particular tasks without developing domestic supply chains. While that may be true, GVCs and new technologies also exhibit features that limit the upside and may even undermine developing countries' economic performance. In particular, I have argued that new technologies present a double whammy to low-income countries. First, they are generally biased towards skills and other capabilities. This bias reduces the comparative advantage of developing countries in traditionally labor-intensive manufacturing (and other) activities, and decreases their gains from trade. Second, GVCs make it harder for low-income countries to use their labor cost advantage to offset their technological disadvantage, by reducing their ability to substitute unskilled labor for other production inputs. From an economic standpoint, these are two independent shocks that compound each other. In other words, each shock increases the costs of the other. The evidence to date, on the employment and trade fronts, is that the disadvantages may have more than offset the advantages.

GVCs have of course made inroads in developing countries, in manufacturing, services, and agriculture. Many of the exports of developing countries are channeled through GVCs, which also act as conduits for new technologies. But the affected sectors and activities remain a very small part of the domestic economy. New capabilities and productive employment remain limited to a tiny sliver of globally integrated firms.

A direct implication of this line of reasoning is that development strategies should focus somewhat less on international economic integration and considerably more on what we might call "domestic integration." The key challenge is to disseminate throughout the rest of the economy the capabilities already in place in the most advanced parts of the productive sector. Improving the economy's fundamentals through investment in human capital and governance certainly helps. But, in addition, countries may require more proactive policies of government-business collaboration targeted at strengthening the connection between the highly productive global firms, potential local suppliers, and the domestic labor force. This collaboration would be underpinned by a simple quid pro quo: government assistance in removing specific bottlenecks these firms face in return for their greater use of domestic resources, including most importantly, domestic labor. The principles governing such proactive policies have been laid out in discussions of "new industrial policy" (e.g., Rodrik 2007, 2008), though, of course, the policies in question would not concentrate exclusively on manufacturing.

The hallmark of this new industrial policy is that it focuses on getting the process right. Good policies are more likely to come out of the appropriate institutional setting than from a top-down, technocratic framework. Incentive systems that select sectors for promotion and apply pre-designated interventions – such as export subsidies, credit allocations, etc. – have served some East Asian countries well. But they have not produced many successes elsewhere.

Instead, we need to think of productive policies as an on-going process of strategic collaboration between private and public sectors, with the following goals in mind:

- learning: what are the constraints faced by firms in different activities?
- experimentation: what are the best ways of removing/compensating for the constraints?
- coordination: are all relevant branches of government around the table and on board?
- monitoring and evaluation: how well are the policy changes/interventions doing?
- policy revision: does the learning get incorporated into new policies?

Under this model of decision-making, the government's relationship to firms does not take an arms' length form, as in the top-down model. But neither is the government captured by rent-seeking firms. The firms are responsible for developing plans of action that are in line with public objectives (e.g., employment expansion). In return, the government helps unblock private-sector constraints, while remaining accountable to society at large.

This is a tough balance to strike, but there are examples of it working. See for example the sectoral round tables in Peru, as discussed by Ghezzi (2017). What remains unclear, however, is whether such policies can be implemented at sufficient scale to make a big enough dent in the challenge of domestic productive integration.

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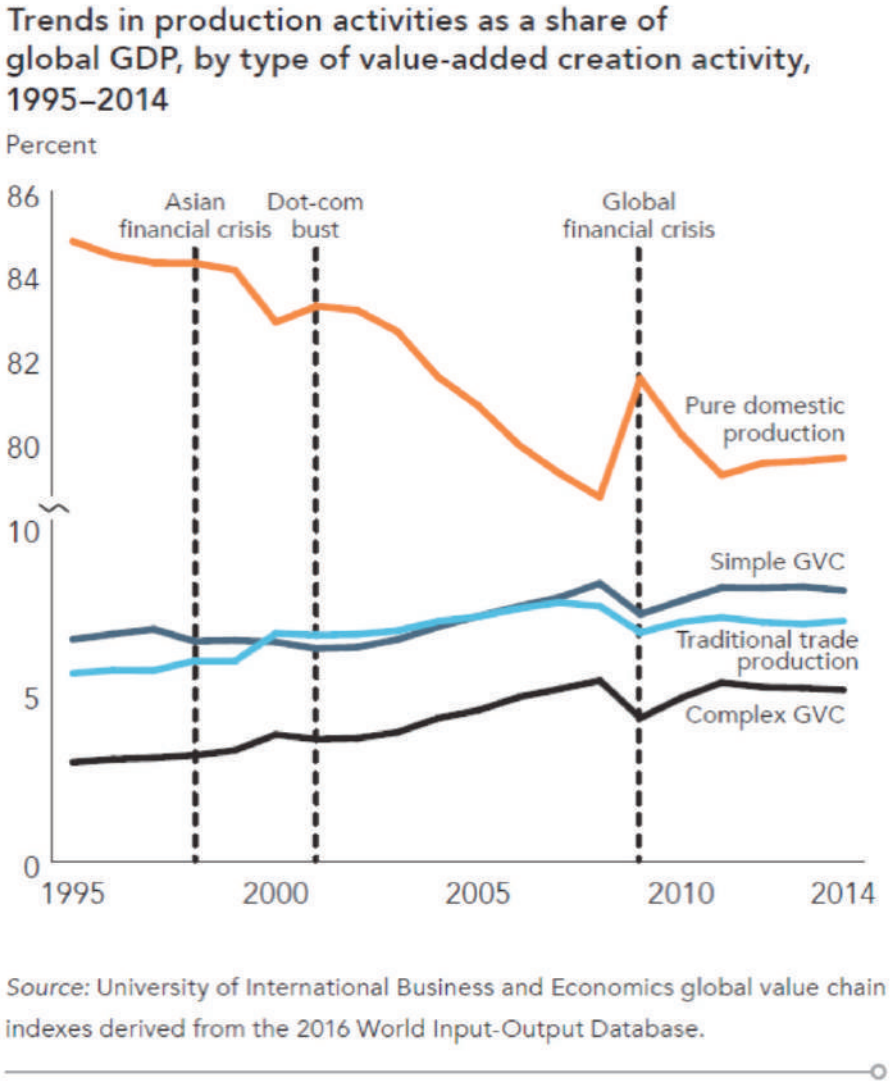
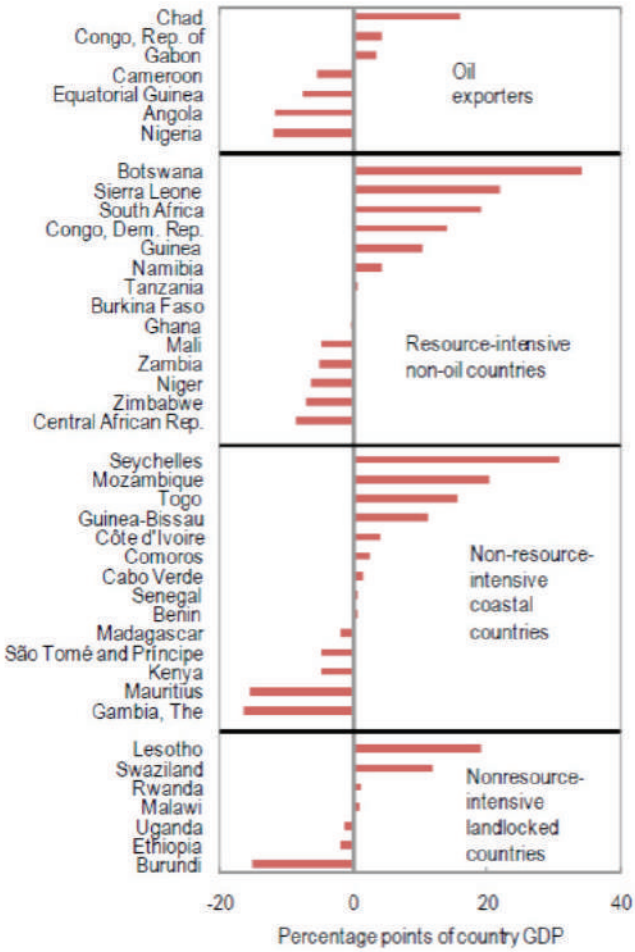
Figure 1: Trends in GVCs



Source: World Bank et al., 2017, p. 43.

Figure 2: Trade integration trends in Sub-Saharan Africa

Figure 2. Change in Export Shares, 1995–2013

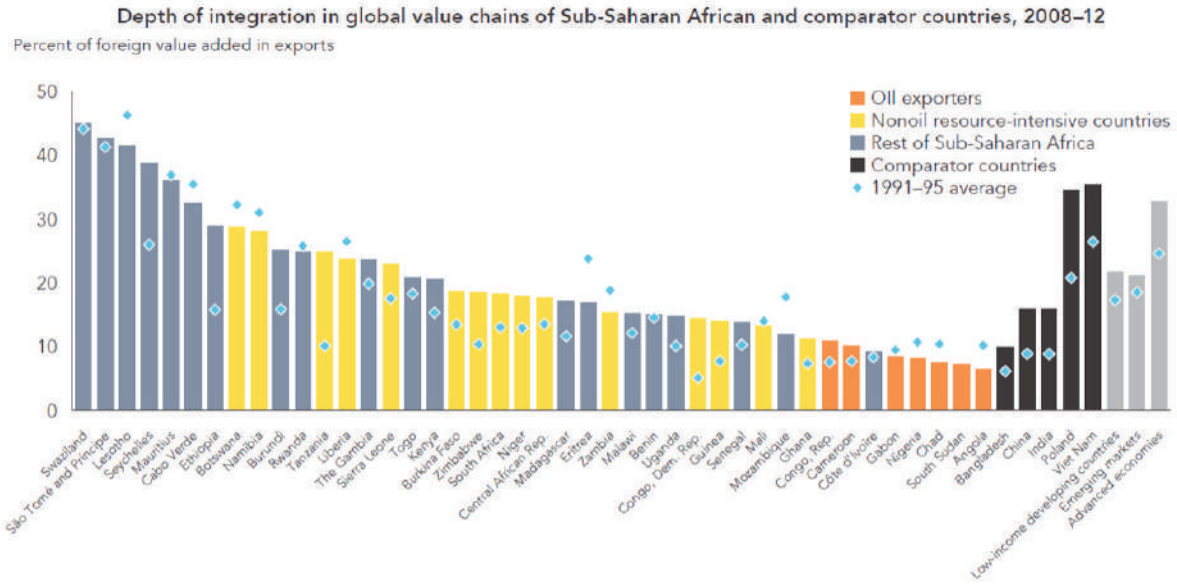


Sources: IMF, *Direction of Trade Statistics*; and World Economic Outlook database.
Note: Excludes South Sudan due to data availability.

Source: IMF, 2016

https://www.imf.org/en/Publications/Departmental-Papers-Policy-Papers/Issues/2016/12/31/Trade-Integration-and-Global-Value-Chains-in-Sub-Saharan-Africa-In-Pursuit-of-the-Missing-43673

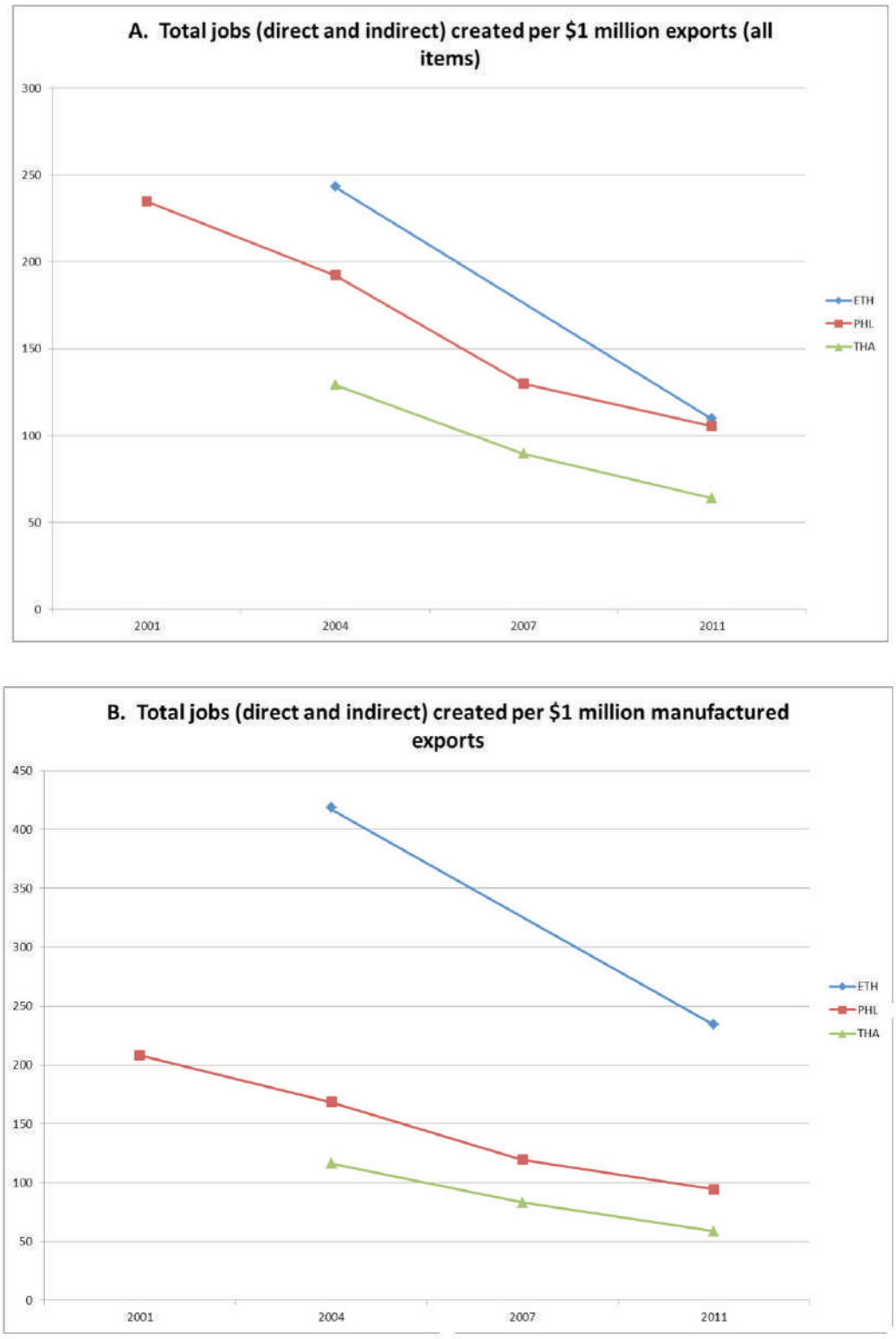
Figure 3: GVCs in Africa and comparator countries



Source: Brookings Institution, 2017

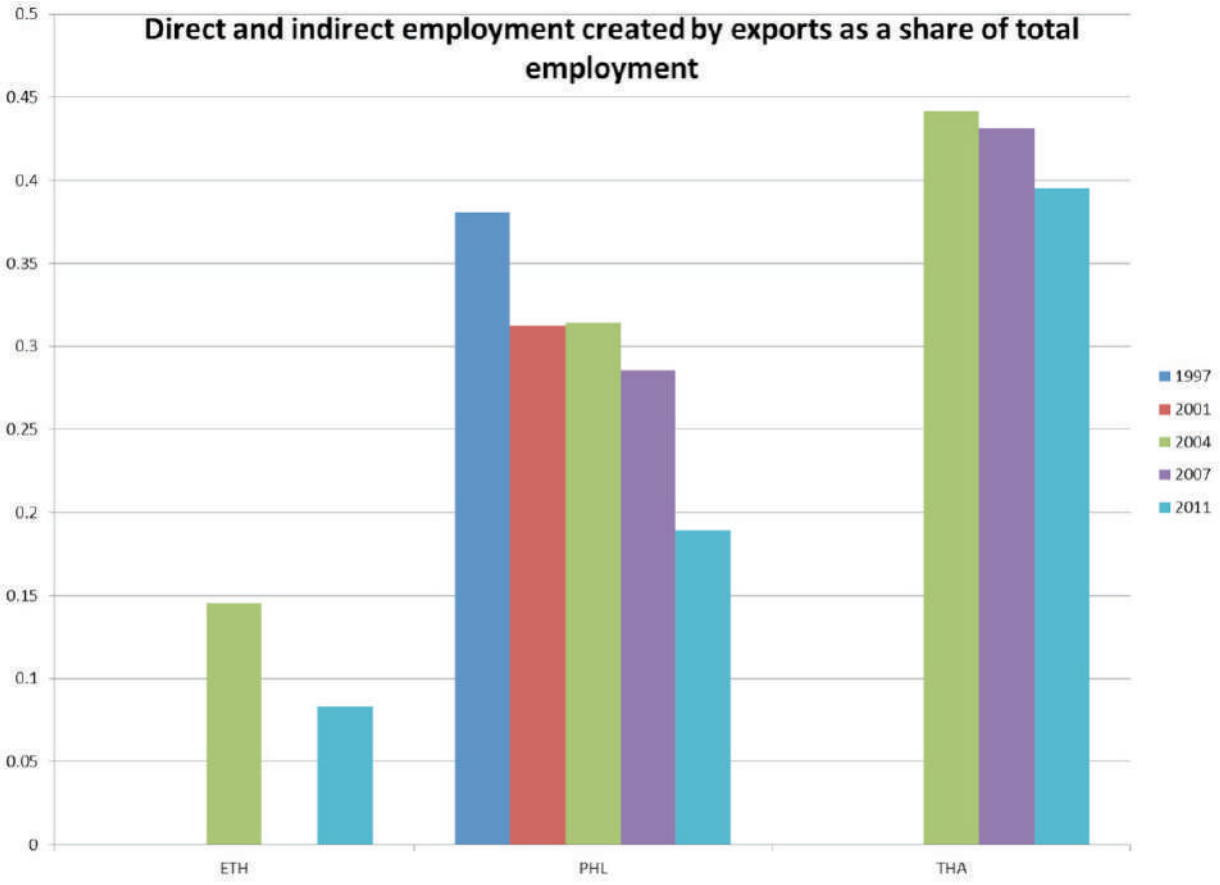
https://www.brookings.edu/wp-content/uploads/2017/08/africagvcfig2.png

Figure 4: Employment associated with exports in three countries



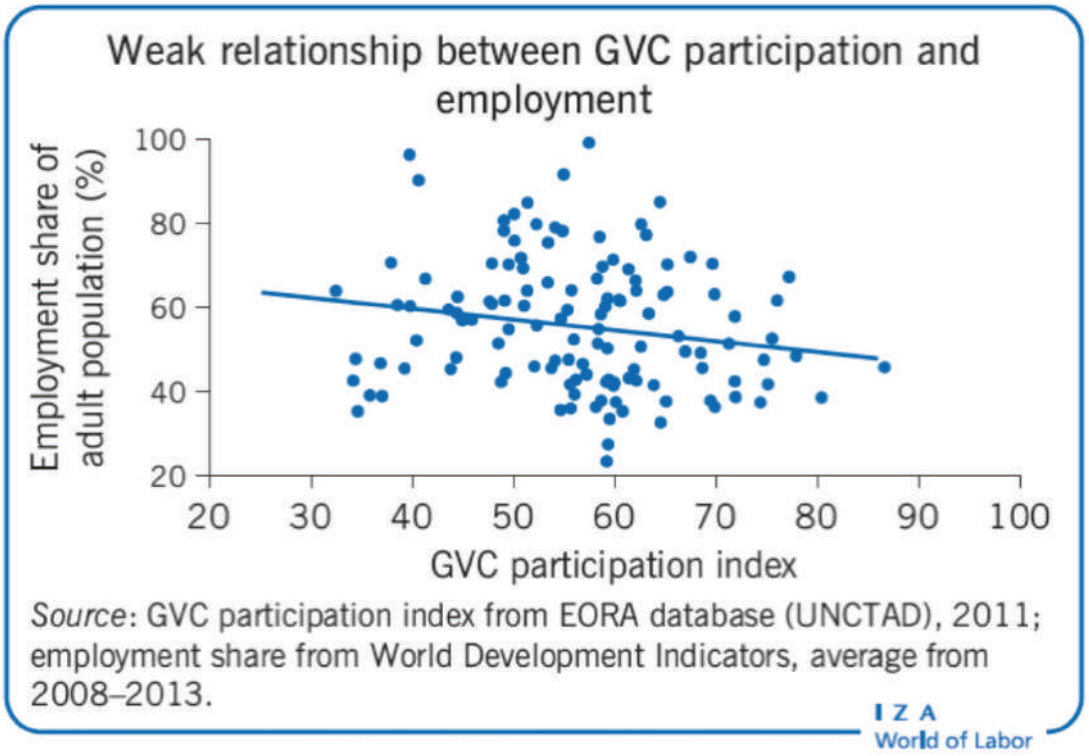
Source: Author's calculations from World Bank Labor Contents of Exports Database (Cali et al., 2016)

Figure 5: Jobs that go into exports as a share of total employment



Source: same as Figure 4.

Figure 6: Relationship between GVCs and employment creation



Source: Farole, 2016.

Figure 7: Changes in factor composition in manufacturing GVCs

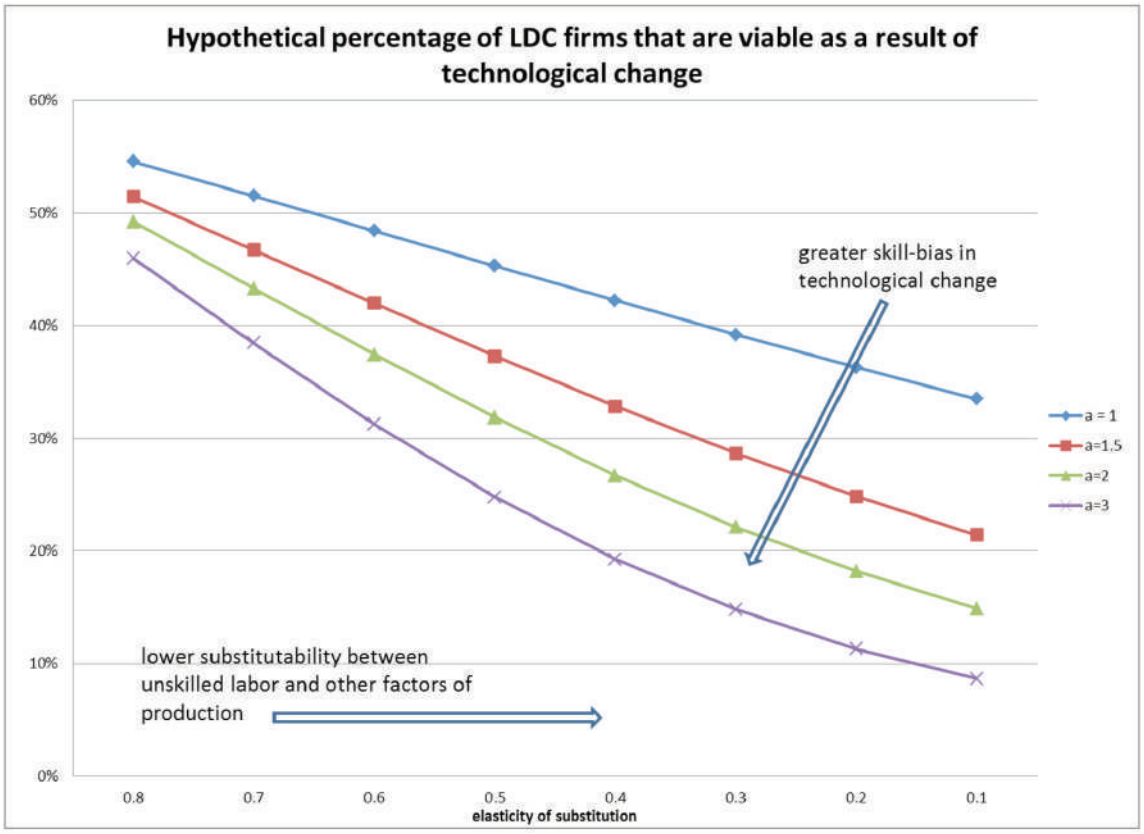
Changes in Factor Shares over 1995–2008 in Global Value Chains of Manufactures, by Country

(in percentage points)

	Capital	*Low-skilled labor*	*Medium-skilled labor*	*High-skilled labor*
United States	3.9	−1.9	−5.9	4.0
Japan	4.5	−5.4	−2.1	3.1
Germany	6.8	−2.8	−7.4	3.4
France	0.2	−8.7	0.1	8.4
United Kingdom	−3.4	−8.0	1.2	10.2
Italy	−1.1	−14.8	10.4	5.5
Spain	0.1	−12.9	4.7	8.1
Canada	1.8	−2.0	−4.6	4.8
Australia	6.0	−8.4	−0.9	3.3
South Korea	9.3	−11.6	−5.6	8.0
Netherlands	5.5	−7.3	−7.1	8.9
Total all high-income	**2.9**	**−4.9**	**−3.0**	**5.0**
China	9.3	−9.3	−2.1	2.0
Russian Federation	1.1	−1.6	−2.4	2.8
Brazil	−6.7	−4.8	7.5	4.0
India	4.5	−5.9	−1.7	3.1
Mexico	6.4	−4.2	−0.5	−1.7
Turkey	−12.7	4.5	5.2	3.1
Indonesia	5.3	−8.1	1.3	1.6
World minus all high-income	**3.2**	**−6.3**	**1.4**	**1.7**
World	**6.5**	**−3.8**	**−4.2**	**1.5**

Source: Authors' calculations based on World Input-Output Database, November 2013 Release.
Notes: See Table 3. In this table, the percentage point changes in factor shares are given for each country. Changes in four factors for each country add up to zero by definition, but here they may not due to rounding. Countries are ranked by GDP.

Figure 8:

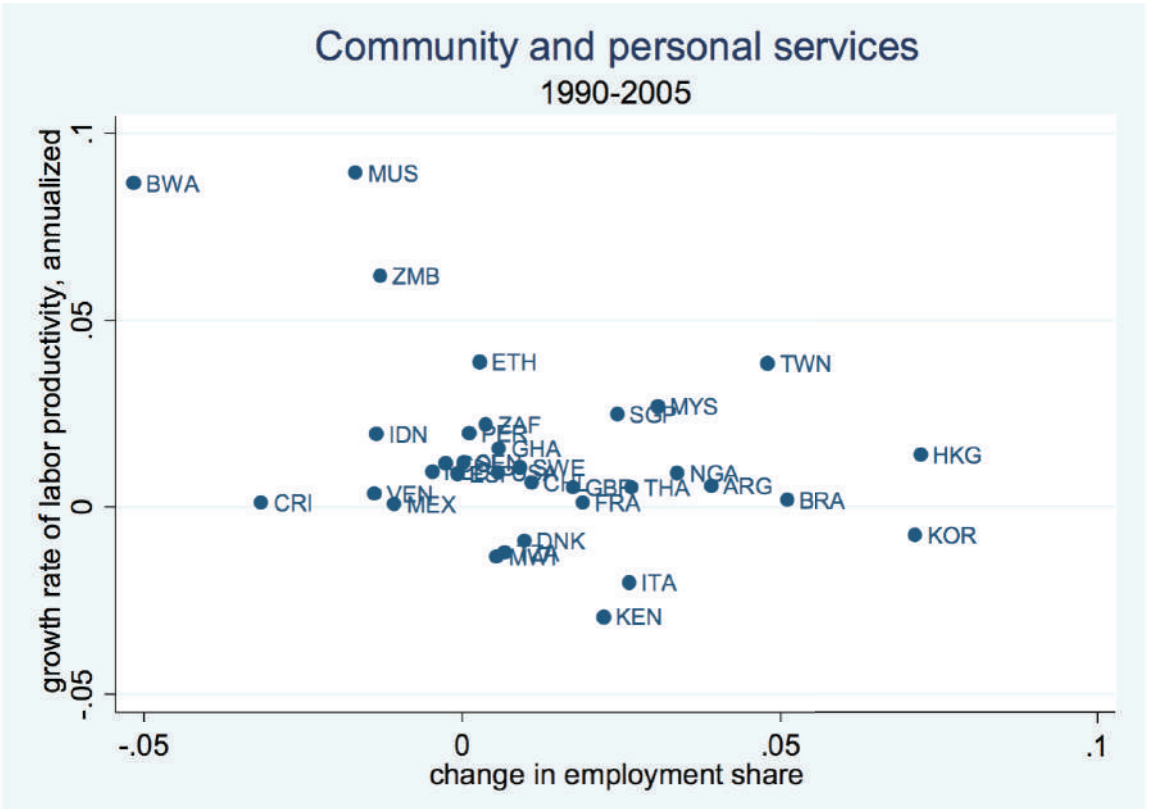


Notes: The calculations are based on a CES production function with an elasticity of substitution that is less than 1 (in absolute value). The chart shows the consequences of changes in two parameters: (i) the elasticity of substitution σ, on the horizontal axis; and (ii) the labor augmentation parameter for unskilled labor, a (which makes technological progress increasingly skill-biased), as downward shifts in the curve. The calculations assume fixed wages and an overall, factor-neutral productivity differential in favor of developed countries of 100%. Share of firms that are viable is calculated by comparing unit costs in developed and developing countries, assuming factor-neutral productivity in the developing world is distributed normally with standard deviation of 40% around the mean. Wages are calibrated so that 55% of developing country firms are viable in an initial equilibrium where $\sigma = 0.8$ and $a = 1$.

Figure 9: Skill intensity across GVC types

Source: Gereffi and Fernandez-Stark (2016).

Figure 10: Productivity growth and employment shares in two service sectors



Source: Author's calculation from Timmer et al. (2014b)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