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Structural Transformation and the Sophistication of Production

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Abstract

A new dataset on export sophistication reveals that in many countries the importance of modern services, and the sophistication of manufactured and service exports, has increased over time. However, this trend was less pronounced in LICs. Sophisticated sectors are more likely to act as a catalyst for broad-based economic growth, rather than turning into isolated enclaves, when the economy is liberalized, the exchange rate is not overvalued, and there are good information flows. An educated workforce, external liberalization, and good information flows are important prerequisites for developing sophisticated goods and services. An appropriate macroeconomic policy is particularly important for goods, skilled labor and good information flows for services.

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I. INTRODUCTION¹

In recent years, a small but rapidly growing literature has emerged, arguing that a key component of economic development and the growth process is an increase in the sophistication of a country's production, and in particular of its exports. Fundamentals are important, but do not uniquely determine what a country will produce and export. Further, what a country produces and exports matters for growth: "... not all goods are alike in terms of their consequences for economic performance. Specializing in some products will bring higher growth than specializing in others" (Hausmann and others, 2007, henceforth HHR; see also Lall and others, 2005). Some products may yield greater knowledge spillovers, have a greater potential for backward and forward linkages, or offer an easier pathway toward other products with such characteristics. Ultimately, some products are more "sophisticated," in the sense that they are associated with higher productivity levels, and those countries that latch on to such products will perform better. Over time, the sophistication of a country's production structure may evolve, through either an increase in the quality of previously produced goods, or a move into new, more sophisticated products.

This paper makes four key contributions to the debate. First, it systematically documents changes in export sophistication over the past 20 years in low-income countries (LICs) and middle-income countries (MICs). In particular, it describes differences in the performance of different geographical regions, as well as between natural-resource-rich and other economies.

Second, the paper explicitly analyzes to what extent an increasing sophistication of production and exports translates into overall economic growth. A related question concerns what factors and mechanisms ultimately determine the magnitude of this impact. That is, what determines whether sophisticated sectors act as an engine of growth for the broader economy, or instead turn into isolated enclaves?

Third, the paper examines what enables a country to increase the sophistication of its production. In this context, the paper examines the relative importance of institutional factors, structural reforms, and policy measures (such as exchange rate policy).

Fourth, and perhaps most novel, the analysis moves beyond the usual focus on goods, and also considers services. The existing literature focuses on the sophistication of goods and its role in supporting growth. Yet services are gradually becoming more productive, tradable, and unbundled. Their growing importance is reflected in success stories such as India's software and business-process activities, Nigerian's film industry, Kenya's call centers, Singapore's knowledge-processing offices in legal and business consulting, Sri Lanka's accountancy

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services, Abu Dhabi's HR processing services firms, as well as the growing internationalization of innovation, R&D, design and marketing. Broadly speaking, as countries transition from low- to high-value-added activities, their growth paths can take different forms: manufacturing-intensive development as in China, or service-export-led growth as in India. Reflecting this, the paper uses a new measure of the sophistication of services, in addition to the sophistication of manufacturing and of goods overall, to analyze the transformation of global production (Mishra et al, 2011).²

The analysis yields three broad sets of conclusions. First, starting with the stylized facts, rich and fast-growing economies differ considerably from LICs and from sub-Saharan Africa (SSA) in terms of the composition and evolution of their export basket. Whereas rich and fast-growing countries have moved from resource-based to manufactured exports, the exports of LICs, and of SSA in particular, remain characterized by a relatively high share of natural resources and a relatively low share of manufactures. Further, LICs' export baskets are relatively static, that is, over time they have moved into relatively few new products. In particular, while many countries have witnessed an increase in the relative importance of modern services, and are benefiting from the ongoing globalization of services, the LICs and SSA have largely failed to share in these trends. Ultimately, the sophistication of exports of both manufactures and services has increased over time. However, this trend has been less pronounced in both SSA and natural-resource-rich countries.

Second, increasing sophistication of exports, of both goods and services, can be an important contributor to overall economic growth. Sophisticated sectors are particularly likely to act as an engine of growth for the broader economy, rather than turn into isolated enclaves, if the economy is liberalized, the exchange rate is not over-valued, and there are good information flows.

Third, an educated workforce, external liberalization, and good information flows are important prerequisites for developing sophisticated exports of goods and services. An appropriate macroeconomic policy plays a particularly important role in sustaining sophisticated goods exports. Highly skilled labor and good information flows are especially critical for sophisticated service exports.

The rest of the paper is organized as follows. Section II outlines some key stylized facts. Section III analyzes formally whether and how the sophistication of exports affects overall economic growth. In turn, Section IV analyzes what factors enhance, or hold back, increases in the sophistication of production. Section V concludes. The Appendix describes the data and their sources.

² "Sophistication" has a multitude of interpretations, but it broadly aims to capture the productivity level associated with a country's production structure. This paper adopts a measure of sophistication based on whether the products exported by any given country are those typically exported by high-income or low-income economies.

II. STYLIZED FACTS

This section outlines some key stylized facts, most of which are insufficiently appreciated. First, we discuss some potential drivers of growth, emphasizing the importance of the service sector. Second, we analyze the changing structure of production, and the extent to which countries have moved over time into more sophisticated sectors characterized by higher value-added goods and services.

The existing literature focuses on manufacturing, but does this sector represent the only plausible route to development? The data presented below suggest that growth in the service sector is an increasingly important component of the overall development process. As a corollary, ignoring services may yield misleading policy conclusions. Hence, later sections will focus on the sophistication of exports of not just goods, but also services.

Over the past decade, services have grown significantly as a share of global GDP, and currently account for 70 percent of total output. Figure 1 illustrates the share of manufacturing and of services in total GDP for countries at different stages of development.

Related to this, output growth is increasingly accounted for by industry and, in particular, services. Figure 2, panel A, illustrates sectoral contributions to overall GDP growth in developing countries for the periods 1995–99 and 2000–08. The contribution of services to growth in developing countries has increased significantly in the post–2000 period (Figure 2, panel B). In most developing countries, services are now the largest contributor to growth, accounting for 55 percent of the total.³

Next, we tackle one key question: are countries moving over time into higher-tech, higher-value-added goods and services? To this end, we analyze the structure of production in some detail, looking at the composition of exports of goods, of manufactures, and of services. We examine the relative importance of various components, as well as the changes over time. In particular, we explore how the export baskets of rich and fast-growing countries differ from those of LICs and SSA, in terms of their current structure as well as their evolution.

In addition, we examine the evolution of resource and manufacturing exports from a slightly different viewpoint, analyzing whether countries are exporting more of the same products, or engaging in completely new economic activities. To this end, exports are classified into four categories: “Classical”, “Marginal”, “Disappearing”, and “Emerging” products. A “classical” product is defined as a product in which a country had a Revealed Comparative Advantage (RCA) in both the 1990–94 and 2005–09 sub-periods.⁴ In other words, the share of the product in

³ Related to this, Triplett and Bosworth (2004) find that services accounted for over 70 percent of the post–1995 surge in labor productivity in the United States.

⁴ Formally, the RCA index for country C and product J is defined as: $RCA = (E_{CJ} / E_{CT}) (E_{WT} / E_{WJ})$, where E denotes exports, T denotes all products, and W denotes the world. The classification is based on COMTRADE trade data at the SITC 5-digit level.

the country's total goods exports exceeded the share of the product in global cross-border exports both at the start and at the end of the sample period. "Marginal" products are instead those in which the country never had an RCA. "Disappearing" products are those in which a country had an RCA at the start, but not at the end, of the sample period. Conversely, "emerging" products are those in which a country only developed an RCA at the end of the sample period. Table 1 summarizes these definitions.

Table 1. Definition of "Classical", "Marginal", "Disappearing", and "Emerging" Products.

	Revealed Comparative Advantage (RCA)	
	1990-94	2005-09
Classical	>1	>1
Disappearing	>1	<1
Marginal	<1	<1
Emerging	<1	>1

A. The Structure and Evolution of Exports: General Points

To set the stage, we note that, over the past 20 years, total exports (relative to GDP) have increased in all major developing-country groups. In SSA, however, the increase was relatively small (Figure 3). Figure 4 illustrates the share of goods and of services in total exports, in 1990 and in 2009, for various regions.⁵

Next, we decompose export of goods into resource and primary products versus manufactures, and examine how this composition has changed over time. Figure 5 illustrates the structure of goods exports in different regions during the periods 1980–85 and 2007–09. Regions vary considerably, in terms of both the composition of their export basket, and changes over time in the relative importance of manufactures. The share of manufactured exports has increased considerably over time in High-Income Countries (HICs) and MICs; by the end of the period, manufactures accounted for almost 90 percent of China's goods exports. On the other hand, resource-based products account for 90 percent of SSA's exports of goods. Put differently, SSA's manufactures, which in the early 1980's accounted for a tiny 7 percent of total goods

⁵ Recorded cross-border service exports in 2007 amounted to \$3.3 trillion, or 20 percent of total world trade. However, the share of services in trade rises to almost 50 percent if transactions are measured in value-added rather than in gross terms (Escaith, 2008). The value of trade in services rises further when adding in the sale of services by foreign affiliates of multinational firms. For instance, data for fifteen OECD countries puts the value of such sales at about \$1.5 trillion in 2007 (WTO, 2009; Francois and Hoekman, 2010).

exports, by 2009 had expanded, but only to 13 percent of the total. In other LICs, the share of manufactures in total exports of goods actually decreased over time, to just over 20 percent. Thus, whereas HICs' exports of goods are dominated by manufactures, the export baskets of LICs and SSA are still dominated by primary and resource-based products.

Next, we further decompose resource and manufactured exports into sub-categories to obtain a finer-grained picture of different regions' export baskets.

B. The Structure and Evolution of Resource Exports

Figure 6 decomposes exports of resources into relatively simple primary products versus relatively higher-value-added resource-based products.⁶ The export baskets of HICs and fast-growing economies differ markedly from those of LICs and SSA. In particular, the share of primary products has remained constant or declined in most regions, with a particularly sharp decrease in fast-growing economies such as India or China. In contrast, SSA resource exports are dominated by primary products, whose share has remained constant over time. In other LICs, the share of primary products has actually increased sharply.

Next, we plot classical, marginal, disappearing and emerging natural resources as a share of total resource exports (Figure 7). For both LICs and SSA, resource exports are dominated by classical products, with very few emerging new products. As of 2009, emerging natural resources, those that the country previously lacked a specialization in, accounted for 11 percent of SSA's total.

Overall, a decomposition of resource exports suggest that in this category LICs' export baskets are still dominated by primary products and traditional export items. On the other hand, fast growing economies, such as India and China, have made a gradual shift towards resource-based and new types of resource exports.

C. The Structure and Evolution of Manufactured Exports

Next, we divide manufactured exports into low-tech, medium-tech, and high-tech (Figure 8).⁷ The share of high-tech manufactures has broadly increased in HICs, in MICs, and in LICs, with a

⁶ Examples of primary products include fresh fruit, rice, cocoa, tea, coffee, wood, coal, crude petroleum, and gas. Resource-based products involve more processing, and can be based on either (i) agriculture or forestry (e.g., prepared meats and fruits, beverages, wood products, vegetable oil), or (ii) other resources (e.g., ore concentrates, petroleum and rubber products, cement, cut gems, glass). Resource-based products tend to be simple and labor-intensive (for instance, most food or leather processing), but some segments use relatively capital-, scale- and skill-intensive technologies (say, petroleum refining or modern processed foods).

⁷ *Low-technology* manufactures tend to have stable, well-diffused technologies, which are primarily embodied in capital equipment. Some of these products lie in the textile/fashion cluster (e.g., textile fabrics, clothing, headgear, footwear, leather manufactures, and travel goods). Other examples include pottery, simple metal parts and structures, furniture, jewelry, toys, and plastic products.

Medium-technology products comprise the bulk of skill- and scale-intensive capital goods and intermediate products. They form the core of industrial activity in mature economies. They tend to have complex technologies, with moderately high levels of R&D, advanced skill needs and lengthy learning periods. Examples include: (i)

particularly large increase in China; however, it has actually declined in SSA. Medium-tech manufactures have grown across the board, but starting from a much smaller base in SSA and LICs.

Figure 9 shows the share of classical, marginal, disappearing, and emerging manufactures in total manufactured exports of goods. Emerging products accounted for 20 percent of SSA's manufactured exports, as opposed to more than half of LICs' manufactured exports.

D. The Structure and Evolution of Service Exports

Service exports by developing countries almost tripled between 1997 and 2007. Perhaps more important, service exports have changed qualitatively. They are no longer exclusively an input into trade in goods; rather, they have increasingly become a final export which is directly consumed.

In particular, the mid-1990's saw two seemingly separate but related developments. First, the revolution in information and communication technology (ICT). Second, rapid growth in the global forces often referred to as the 3Ts (technology, transportability, and tradability), with the advent of the internet age. Both events had a profound impact on the nature, productivity, and tradability of services (Ghani and Kharas, 2010). They resulted in rapid growth of what can be called *modern services*, such as business-processing services, accounting, business consulting, education, remote access services, medical-record transcription, entertainment, production services, design, and marketing. These services, unlike *traditional services*, increasingly require little face-to-face interaction, can be stored and traded digitally, and are not subject to many of the trade barriers that physical exports must overcome. They are becoming similar to manufactures in that they benefit from technological advancement, and their costs depend on economies of scale, agglomeration, networks, and division of labor. Ultimately, modern services are characterized by higher, and faster-growing, productivity levels (see Appendix).⁸

automotive products (passenger vehicles and parts, commercial vehicles, motorcycles and parts); (ii) process industries (synthetic fibers, chemicals and paints, fertilizers, plastics, iron, pipes/tubes); (iii) engineering industries (engines, motors, industrial machinery, pumps, switchgear, ships, watches).

High-technology products have advanced and fast-changing technologies, with high R&D investments and prime emphasis on product design. The most advanced technologies require sophisticated technological infrastructures, high levels of specialized technical skills, and close interactions both among firms, and between firms and universities or research institutions. Examples include: (i) electronics and electrical products (office/data processing/telecommunications equipment, TVs, transistors, turbines, power-generating equipment); (ii) other high tech (pharmaceuticals, aerospace, optical/measuring instruments, cameras); (iii) other transactions (electricity, cinema film, printed matter, "special" transactions, gold, art, coins, pets). See Lall (2000) for details on technology classification, and Appendix for examples.

⁸ Formally, we define modern services as comprising: finance; computer & information; royalties and license fees; and other business services. Traditional services comprise: communications; insurance; transportation; travel; construction; and personal, cultural and recreational services. Throughout, we focus on commercial service exports, and exclude government services.

The world as a whole, as well as most regions and countries, witnessed an increase in the relative share of modern services after the late 1990's (Figure 10 and Figure 11). However, some developing countries, as well as SSA as a whole, actually experienced a *decline* in the relative importance of modern services.

Focusing on the past decade alone, modern services have been growing relatively fast in MICs and in the BRICs (Figure 12). The opposite, however, holds for LICs and, in particular, for SSA. In a similar vein, in most countries service exports account for a rising share of total service-sector value added (Figure 13). Put differently, most countries are taking advantage of the globalization of services. However, the trend is far less marked in SSA.

III. Export Sophistication: A More Formal Measure

One of the contributions of this paper is to develop a more formal, continuous measure of the sophistication of exports of goods, manufactures, and services (based on the measure developed in Hausmann, Hwang and Rodrik, 2007, for goods alone). This measure can be thought of as representing the “quality” of a country’s export basket. Details of how the measure is constructed are given in the Appendix. Intuitively, the measure captures whether any given country’s export basket consists primarily of products typically exported by high-income economies (and viewed as relatively sophisticated) or by low-income economies (and viewed as relatively less sophisticated).

Overall, sophistication of exports of goods, manufactures, and services has risen over time (Figure 14). Levels of export sophistication are in general relatively low in LICs, and in particular in SSA. The evolution of sophistication displays distinct trends in high-growth, rich economies versus slow-growing, poor economies. Goods and manufacturing sophistication steadily increased in Asia, China, and India; SSA as a region lags behind most other regions. A distinct shift occurred through the late 1990s and the 2000s across Asia and other emerging economies, corresponding to the shift in the goods export basket away from resource-based production into more medium and high-tech manufacturing.

A rising trend also characterizes service export sophistication; the rate of change is particularly fast post–2000. India is a particularly interesting case. The composition of the Indian service export basket, and its sophistication, was similar to other countries at its income level in the early 1990s. However, the share of computer information services grew from 0 to 51 percent of the total export basket by 2009. More generally, the composition of service exports moved away from traditional activities to modern activities like business services and computer services. As a result, service export sophistication grew relatively fast in India.

Export sophistication is broadly correlated with income per capita (Figure 15). Nevertheless, some countries stand out as having relatively more sophisticated exports than predicted by their stage of development. While both China and India started at similar sophistication levels, by 2007 China (like the other East Asian tigers) had become relatively sophisticated in

manufacturing, whereas India produced relatively sophisticated services, even controlling for income levels.

Focusing on export sophistication in the latest available year, 2009, Figure 16 shows that goods exports of some advanced economies such as Germany, Sweden, and Japan remain more sophisticated than those of Latin America and China. Some of the West and East African countries, and pockets of Asia, lag behind. Figure 17 performs a similar exercise for manufacturing exports. Ireland, Iceland, Philippines stand out as relatively sophisticated. Figure 18 shows service export sophistication. India stands as a relatively sophisticated service exporter, whereas China only displays average sophistication in services.

Figure 19 illustrates the partial correlation of sophistication measures with some potential determinants. In particular, there is a positive correlation between greater sophistication and (tertiary) years of schooling, information flows, and external liberalization.

Is greater sophistication associated with moving into new products and services of higher technological content? Figure 20 plots the share of high-technology exports in goods, manufactures, and services versus their respective sophistication measures. Overall, the charts confirm that countries exporting more high technology exports tend to also be more sophisticated exporters.

Overall, this section concludes that HICs and fast-growing economies differ systematically from LICs and SSA in terms of their export composition, and of how this has evolved over time. In particular, a large and rising share of high value-added products characterizes the export baskets of HICs and fast growers. In the rest of the paper, we analyze export sophistication and its impact within a more rigorous framework.

IV. ECONOMIC GROWTH AND EXPORT SOPHISTICATION

Do increases in export sophistication matter for overall economic growth? And what factors magnify or, conversely, dampen this impact? To explore these questions, this section applies dynamic panel data estimation techniques, using data for over 100 countries over 1990–2008. In order to abstract from high-frequency business-cycle phenomena, the analysis examines the determinants of the three-year average growth rate of output per capita. The focus is on the sophistication of two different export categories: (a) overall goods exports; and (b) service exports. These sophistication measures are considered separately, owing to strong collinearity among them.

The analysis also controls for various standard determinants of growth, including in particular the following institutional, structural, and policy factors:

- Initial Income per Capita. This captures convergence effects.

- Human Capital. This is measured using total years of schooling.⁹
- External Liberalization. This composite measure is based on the following factors, with the weight of each factor in parentheses: (i) hidden import barriers (22%); (ii) mean tariff rate (28%); (iii) taxes on international trade / current revenue (27%); and (iv) capital account restrictions (23%). The source is the KOF Globalization Index; see Appendix I for more details.
- Financial Development. This is measured using (private sector credit / GDP).
- Country- and Time-Level Fixed Effects.

The formal regression specification is as follows:

$$y_{i,t} - y_{i,t-1} = \alpha y_{i,t-1} + \beta \ln EXPY_{i,t-1} + \varphi GD_{i,t-1} + \vartheta_i + \varepsilon_{i,t} \quad (1)$$

where $y_{i,t}$ is the natural logarithm of GDP per capita, $y_{i,t-1}$ is the level of GDP per capita at the beginning of each three-year period, $EXPY_{i,t-1}$ is the measure of export sophistication, $GD_{i,t-1}$ are the other growth determinants, ϑ_i are the country-level fixed effects, and $\varepsilon_{i,t}$ is the error term. Throughout, export sophistication is normalized by multiplying by the relevant (goods or services) export ratio.

Overall, the results indicate that export sophistication is an important driver of growth in developing economies (Tables 2 and 3). Initial export sophistication, of both goods and services, is associated with subsequent output growth, even after controlling for financial development, human capital, and external liberalization. Statistically, the impact is significant. The magnitude of the effects is economically relevant. A one standard deviation increase in the sophistication of goods or of services is associated with a, respectively, 0.6 or 0.4 percentage points increase in the average annual growth rate.¹⁰ Put differently, if developing countries were to increase the sophistication of their goods or services to the levels observed in advanced economies, their per capita growth rate would increase by, respectively, 1.1 or 0.5 percentage points. The estimated economic magnitudes remain stable over time, and are larger in the sub-sample of developing countries alone.

An important question is whether increasing sophistication automatically translates into a broader economic take-off. A natural hypothesis is that the link between export sophistication and growth may be stronger in economies with a more appropriate macroeconomic policy, more liberalized markets, and better information flows. Such conditions will facilitate inter- and intra-sectoral resource reallocation, as well as knowledge and technology spillovers. In the absence of these conditions, a sophisticated export sector may remain an isolated enclave, rather than triggering economy-wide growth. To test this hypothesis, we construct measures of:

⁹ To check robustness, the analysis also employed the latest available data on educational attainment from Barro and Lee (2010). Again, the key results did not change.

¹⁰ Based on our preferred specifications, in Table 2, column 4, and Table 3, column 4.

- Overall Macroeconomic Policy. This is proxied by an index of real exchange rate overvaluation, constructed following Johnson, Ostry, and Subramanian (2010). We test for and find asymmetric effects, and therefore adopt an asymmetric variant of the index, where the extent of real exchange rate overvaluation is censored below zero.
- Information Flows. This composite measure is based on the following factors, with the weight of each factor in parentheses: (i) internet users per 1000 people (36%); (ii) televisions per 1000 people (37%); and (iii) trade in newspapers / GDP (28%). The source is the KOF Globalization Index. This measure aims to capture the likelihood of technology and knowledge spillovers.

The evidence suggests that, indeed, sophistication of goods exports has a greater impact on growth when the economy is liberalized and macroeconomic policy is appropriate (Table 4). It should be emphasized that, given the asymmetric specification, overvaluation reduces the positive growth spillovers from a sophisticated export sector, but *undervaluation* yields no corresponding benefits. In a similar vein, sophistication of service exports has a greater impact when the economy is liberalized, and in the presence of good information flows (Table 5).

Having established the importance of export sophistication, and uncovered some of the factors explaining its heterogeneous impact on growth, the paper now turns to the determinants of export sophistication.

V. DETERMINANTS OF EXPORT SOPHISTICATION

This section considers separately the determinants of export sophistication in goods and in services. The choice of potential determinants is difficult, given the lack of literature on this topic. The analysis considers the impact of the following variables:

- Human Capital. This is measured using total years of schooling, and years of schooling in tertiary education, when examining the determinants of, respectively, goods and services sophistication.¹¹
- External Liberalization; Overall Macroeconomic Policy; Information Flows. These are all defined as in the previous section.

Given some evidence of non-stationarity, we estimate the relationships using FMOLS for heterogeneous cointegrated panels. Overall, the results indicate that an educated workforce, external liberalization, and good information flows are all significantly associated with greater sophistication of exports of goods and services, across a broad range of different specifications (Tables 6 and 7). An appropriate macroeconomic policy plays a particularly important role in sustaining sophisticated goods exports. Again, given the asymmetric specification, overvaluation acts to reduce the sophistication of goods exports, but undervaluation yields no corresponding

¹¹ Our prior was that skilled labor might be especially important for producing sophisticated services. Indeed, for sophistication of goods, the impact of tertiary education was not statistically significant. For sophistication of services, all measures of schooling were significant.

benefits. In addition, highly skilled labor and good information flows are especially critical for sophisticated service exports.

The magnitude of the effects is economically relevant. A one standard deviation increase in human capital or in external liberalization is associated with a, respectively, 0.1 or 0.06 standard deviation increase in the sophistication of goods exports.¹² Put differently, if developing economies raised total years of schooling or external liberalization to the level observed in advanced economies, the gap in the sophistication of goods exports between advanced and developing economies would shrink by, respectively, 15 percent and 8 percent.

Likewise, a one standard deviation increase in tertiary human capital or in information flows are associated with a, respectively, 0.34 or 0.5 standard deviation increase in the sophistication of services exports.¹³ Put differently, if developing economies raised tertiary schooling or information flows to the level observed in advanced economies, the gap in the sophistication of service exports between advanced and developing economies would shrink by, respectively, 42 and 53 percent.

VI. CONCLUDING REMARKS

The analysis yields three broad sets of conclusions. First, starting with the stylized facts,

- Over time, rich and fast-growing countries have moved away from resource-based to manufactured exports.
- In contrast, the exports of LICs, and of SSA in particular, remain characterized by a relatively high share of natural resources, and a relatively low share of manufactures. Further, LICs' export baskets are relatively static, that is, over time they have moved into relatively few new products. That said, SSA resource exports are slowly moving up the value chain.
- Services are becoming an increasingly important contributor to output growth and export performance.
- Many countries have witnessed an increase in the relative importance of modern services. Linked to this, they are benefiting from the ongoing globalization of services. However, the LICs and SSA have largely failed to share in these trends.
- Ultimately, the sophistication of exports of both manufactures and services has increased over time. However, this trend has been less pronounced in LICs and in particular in SSA.

Second, increasing sophistication of exports, of both goods and services, can be an important contributor to overall economic growth. Sophisticated sectors are particularly likely to act as an engine of growth for the broader economy, rather than turn into isolated enclaves, if the economy

¹² Based on our preferred specifications, in Table 6, column 5.

¹³ Based on our preferred specifications, in Table 7, column 5.

is liberalized, the exchange rate is not over-valued, and there are good information flows. In more distorted economies, there may be less scope for inter-sectoral and intra-sectoral resource allocation, as well as knowledge and technology spillovers.

Third, an educated workforce, external liberalization, and good information flows are all significantly associated with greater sophistication of exports of goods and services, across a broad range of different specifications. An appropriate macroeconomic policy plays a particularly important role in sustaining sophisticated goods exports. Highly skilled labor and good information flows are especially critical for sophisticated service exports.

Future research should explore the robustness of these findings. In particular, it will be important to consider alternative measures of sophistication, based for instance on whether a good or service are typically consumed (rather than produced) in advanced economies.

One final consideration. Neither China's manufacturing-led growth strategy, nor India's IT-enabled service growth, should be seen as a universal model for growth and development. However, the recent transformation of services provides some important and encouraging lessons, and country-specific ways of adapting to this ongoing phenomenon could provide an alternative path to growth.

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APPENDIX

A. Data Description

The trade data used to construct the export sophistication indices are drawn from the IMF Balance of Payments statistics. Because of incomplete and inconsistent data reporting, our sample covers approximately 100 countries during 1990–2007. GDP per capita data is taken from the World Bank Indicators database.

Appendix Table 1 describes the main categories of export services. Some other key variables used in the regressions are defined as follows:

External Liberalization and Hidden Import Barriers. Source: Gwartney et al. (2010). The index is based on the *Global Competitiveness Report's* survey question: “In your country, tariff and non-tariff barriers significantly reduce the ability of imported goods to compete in the domestic market.” The question’s wording has varied slightly over the years.

Taxes on International Trade (percent of current revenue). Source: World Bank (2010). Taxes on international trade include import duties, export duties, profits of export or import monopolies, exchange profits, and exchange taxes. Current revenue includes all revenue from taxes and nonrepayable receipts (other than grants) from the sale of land, intangible assets, government stocks, or fixed capital assets, or from capital transfers from nongovernmental sources. It also includes fines, fees, recoveries, inheritance taxes, and nonrecurring levies on capital. Data are for central government and in percent of all current revenue.

Appendix Table 1. Data Description: Breakdown of Export Services.

<i>Export Service Category</i>	<i>Explanation</i>
Transportation	Transportation covers all transportation (sea, air, land, internal waterway, space, pipeline, etc) services that are performed by residents of one economy for those of another and that involve the carriage of passengers, goods (freight), rentals of carriers with crew, and related supporting services.
Travel	Travel differs from the other categories in the sense that the consumer (traveler) moves to the location of the provider (a resident of the economy) and what is covered by the travel category are those goods and services acquired during the visit (less than a year). The international carriage of the traveler is covered under transportation. The measure can be interpreted as a proxy for international tourism, business travelling and international student (even if staying longer than one year).
Communication	Communication covers (i) telecommunication and (ii) postal and courier between residents and nonresidents international transactions.
Construction	These are construction services performed by employees outside the country of the location of the enterprise. It also includes the goods the employees bring with them abroad to perform the task. Expenditures for local good though are recorded under Other business services.
Insurance	Insurance services cover insurance provided by a resident to a nonresident and vice versa. It would often be freight insurances but also other direct services.
Financial	Financial services cover financial intermediary and auxiliary services (except those of insurance enterprises and pension funds) between residents and nonresidents. This could be fees related to letters of credit, lines of credit, financial leasing, foreign exchange transaction, transaction in securities, asset management, etc, etc.
Computer Information	Computer data and new-related service transactions between residents and nonresidents. These could be data bases, data processing, hardware consultancy, software implementation, maintenance and repair of computers, new agency services, etc.
Royalties & license fees	These are exchange of payments between residents and nonresidents for the use of intangible and nonfinancial assets or property rights such as patents, copy rights, franchising, manuscripts, films, etc).
Other business	Other businesses include (i) Merchanting (the purchase of goods by a resident from a nonresident and the subsequent resale to another nonresident, during which the good does not leave the compiling country), (ii) Operational leasing without operators covers resident-nonresident leasing, and charter without crew, (iii) Miscellaneous services, including (a) legal, accounting, management consulting, public relation services, (b) advertising and market research services, (c) research and development services, (d) architectural, engineering and other technical services, (d) agricultural, mining and on-site processing services, and (e) other services between residents and nonresidents.
Personal & cultural	These services are divided into (i) audiovisual (services and fees for motion pictures – including to actors and producers, radio and television programs and musical recordings) and (ii) other (services related to museums, libraries, sporting, correspondence courses, etc).

B. Constructing the Measure of Export Sophistication

To formalize the notion of sophistication, a measure of export sophistication (EXPY) is constructed using the framework developed in Hausmann, Hwang and Rodrik (2007). This index aims to capture the productivity level associated with a country's export and is a proxy for the

most productive set of products the country can produce at a given time. The choice of exports as proxy is guided by the idea that they reveal the production frontier as countries can be expected to export those products in which they are most productive, as well as, the availability of data.

EXPY's are computed for three categories of exports: goods, manufactured goods, and services. In order to calculate the EXPY's, each category of goods, manufactured and service exports is ranked according to the income levels of the countries that export it.¹⁴ Products exported by rich countries (controlling for overall economic size) are ranked higher than products exported by poor countries. These product-specific calculations are then aggregated to construct the country-wide indices of export sophistication.

Specifically, let countries be indexed by j and products be indexed by l . Let p be an export category (that is, goods, manufacturing, or services). Total exports of category p from country j equal

$$X_j^p = \sum_l x_{jl}^p$$

Let Y_j denote the per-capita GDP of country j . Then the productivity level associated with product k in category p , $PRODY_k^p$, equals the weighted average of per capita GDPs, where the weights represent the revealed comparative advantage of each country in that product:

$$PRODY_k^p = \sum_j \frac{(x_{jk}^p / X_j^p)}{\sum_j (x_{jk}^p / X_j^p)} Y_j$$

The numerator of the weight, (x_{jk}^p / X_j^p) , is the value-share of the product in the country's category p export basket. The denominator of the weight, $\sum_j (x_{jk}^p / X_j^p)$, aggregates the value-shares across all countries exporting that product in that category.

Next, the $PRODY$'s are used to compute the productivity level associated with country j 's export basket of goods, manufactured goods, or services, $EXPY_j^p$ (export sophistication). Specifically, $EXPY_j^p$ is the average income and productivity level associated with all products in a given category exported by a country. It is computed as the weighted average of all relevant $PRODY$'s, where the weights represent the share of the relevant product in the country's export basket. Thus,

$$EXPY_i^p = \sum_l \left(\frac{x_{il}^p}{X_i^p} \right) PRODY_l^p$$

¹⁴ Our focus is on commercial service exports. Government services are therefore excluded when measuring *Service EXPY*.

EXPYs are constructed for each country and for each year with available data. The *EXPYs* are constructed using *static PRODYs*, that is, the *PRODY* for each good is held constant at the average value during 2005–09. This means that any increase in *EXPY* measures a country's shift from low *PRODY* to high *PRODY* products, that is, the share of high *PRODY* goods, manufactures, and services in the export basket increased. The service exports data aggregation mentioned is sometimes exacerbated by the further aggregation in what the countries report.

Turning to the actual data, in general, higher-value-added goods and services have higher recorded *PRODY* (Appendix Table 2).

The evolution over time of the *PRODYs* for each service category is presented in Appendix Table 3. The columns on the left (transportation, travel, communication and construction) represent traditional services, while the columns on the right (insurance, financial, computer & information, royalties & license fees, other business services, and personal, cultural & recreational services) represent modern services. In general, the *PRODY* of modern services are higher and have been growing more rapidly.

Turning to the goods and services *EXPYs*, not just their mean but also their standard deviation has increased over the years, that is, countries are becoming increasingly diverse in their sophistication (Appendix Table 4). This suggests that the potential *EXPY* has increased, and some countries have started to benefit from this higher potential.

Also, countries with more sophisticated exports of either goods or services generally enjoy a higher GDP per capita (Appendix Figure 1). In order to better display region specific performance in export sophistication we discuss Appendix Figure 2-4 in the main text.

C. Outlier Regressions

Appendix Table 5 presents outlier regressions. The dependent variable is the sophistication of exports of goods and of services. We control for: log income per capita; log income per capita squared; and size, as proxied by log population. Lastly, we add regional dummies of interest.

We note that China and India are both positive, and typically statistically significant, outliers. In particular, India is a large positive, significant outlier in the sophistication of services. SSA's sophistication was roughly as expected, given its stage of development and size.

Table 2. Panel Regressions. Dependent Variable: Growth in Income Per Capita (3-Year Average). Independent Variable: Sophistication of Goods Exports

	(1)	(2)	(3)	(4)	(5) Post 1998	(6) Developing countries
Log initial GDP per capita	-3.969*** (0.92)	-7.866*** (1.13)	-8.211*** (1.15)	-7.216*** (1.32)	-7.974*** (1.58)	-5.448*** (1.24)
Log initial Goods EXPY	0.65* (0.36)	0.654* (0.37)	0.663* (0.38)	0.694* (0.38)	0.843* (0.44)	0.626* (0.39)
Years of Schooling		3.798*** (0.78)	2.611*** (0.87)	2.533*** (0.88)	3.835*** (1.08)	2.799*** (1.01)
External Liberalization			1.147*** (0.30)	1.181*** (0.30)	2.071*** (0.39)	0.933** (0.37)
Financial Development				-0.508 (0.36)	-0.894** (0.40)	-0.32 (0.42)
Constant	17.85** (7.920)	34.57*** (8.982)	29.90*** (9.128)	24.19** (10.01)	15.99 (11.69)	25.05** (12.30)
Observations	630	527	486	483	398	308
R-squared	0.039	0.114	0.150	0.155	0.249	0.151
Number of countries	153	123	111	111	110	78

Notes: Regressions include country-level fixed effects. *, **, and *** denote significance at the, respectively, 10 percent, 5 percent, and 1 percent level. All coefficients are presented in semi-standardized form (that is, the original coefficients are multiplied by the overall standard deviation of the independent variable). Robust standard errors are in parentheses.

Table 3. Panel Regressions. Dependent Variable: Growth in Income Per Capita (3-Year Average). Independent Variable: Sophistication of Service Exports

	(1)	(2)	(3)	(4)	(5) Post 1998	(6) Developing countries
Log initial GDP per capita	-5.63*** (0.98)	-7.664*** (1.16)	-7.752*** (1.18)	-7.497*** (1.34)	-7.249*** (1.61)	-5.759*** (1.25)
Log initial Service EXPY	0.721*** (0.14)	0.46*** (0.17)	0.447** (0.18)	0.455** (0.18)	0.322* (0.19)	0.537** (0.22)
Years of Schooling		2.904*** (0.87)	1.889* (0.96)	1.885* (0.97)	3.075** (1.19)	2.345** (1.13)
External Liberalization			1.014** (0.30)	1.034*** (0.30)	2.045*** (0.40)	0.766** (0.38)
Financial Development				-0.116 (0.34)	-0.371 (0.38)	0.182 (0.39)
Constant	16.38*** (6.188)	30.92*** (7.350)	25.53*** (7.618)	23.75*** (8.401)	14.62 (9.920)	21.62* (11.29)
Observations	664	553	507	504	412	329
R-squared	0.069	0.099	0.127	0.128	0.197	0.132
Number of Countries	152	123	111	111	110	80

Notes: Regressions include country-level fixed effects. *, **, and *** denote significance at the, respectively, 10 percent, 5 percent, and 1 percent level. All coefficients are presented in semi-standardized form (that is, the original coefficients are multiplied by the overall standard deviation of the independent variable). Robust standard errors are in parentheses.

Table 4. Panel Regressions. Dependent Variable: Growth in Income Per Capita (3-Year Average). Independent Variable: Sophistication of Goods Exports.

	(1)	(2)	(3)	(4)	(5)
Log initial GDP per capita	-3.969*** (0.91)	-4.747*** (1.16)	-5.469*** (1.11)	-4.977*** (1.03)	-6.015*** (1.07)
Log initial Goods EXPY	1.656* (0.35)	1.857* (0.38)	4.247*** (0.39)	1.824 (0.45)	0.728 (0.46)
Overvaluation		0.256 (0.41)	-0.09 (0.40)		
Overvaluation * Goods EXPY			-3.585*** (0.55)		
External Liberalization				0.912*** (0.32)	0.239 (0.38)
External Liberalization * Goods EXPY					1.633*** (0.46)
Constant	17.85** (7.920)	17.47* (9.220)	42.90*** (9.640)	20.95** (9.866)	34.41*** (10.68)
Observations	630	559	559	530	530
R-squared	0.039	0.042	0.130	0.060	0.082
Number of Countries	153	137	137	123	123

Notes: Regressions include country-level fixed effects. *, **, and *** denote significance at the, respectively, 10 percent, 5 percent, and 1 percent level. All coefficients are presented in semi-standardized form (that is, the original coefficients are multiplied by the overall standard deviation of the independent variable). Robust standard errors are in parentheses.

Table 5. Panel Regressions. Dependent Variable: Growth in Income Per Capita (3-Year Average). Independent Variable: Sophistication of Service Exports.

	(1)	(2)	(3)	(4)
Log initial GDP per capita	-5.63*** (0.98)	-7.363*** (1.03)	-9.465*** (1.06)	-6.996*** (1.18)
Log initial Service EXPY	0.721*** (0.14)	0.353** (0.16)	0.026 (0.16)	0.524*** (0.18)
Information Flows		1.418*** (0.31)	0.02 (0.38)	
Information Flows * Service EXPY			2.232*** (0.21)	
External Liberalization				0.425 (0.37)
External Liberalization * Service EXPY				0.994*** (0.42)
Constant	16.38*** (6.188)	38.32*** (7.740)	63.72*** (8.620)	26.71*** (7.750)
Observations	664	664	664	553
R-squared	0.069	0.106	0.164	0.088
Number of Countries	152	152	152	122

Notes: Regressions include country-level fixed effects. *, **, and *** denote significance at the, respectively, 10 percent, 5 percent, and 1 percent level. All coefficients are presented in semi-standardized form (that is, the original coefficients are multiplied by the overall standard deviation of the independent variable). Robust standard errors are in parentheses.

Table 6. Cointegrating Panel Regressions. Dependent Variable: Sophistication of Goods Exports. Independent Variables: Institutional / Structural / Policy Factors.

	(1)	(2)	(3)	(4)	(5)
Log GDP per capita	0.97*** (32.64)	0.47*** (17.47)	0.60*** (14.45)	0.73*** (15.36)	0.87*** (9.13)
Years of Schooling		0.34*** (5.23)	0.34*** (5.83)	0.17*** (4.82)	0.10*** (5.64)
External Liberalization			0.29 (1.54)	0.03 (0.96)	0.06** (2.02)
Overvaluation				-0.02 (1.31)	-0.09*** (4.02)
Information Flows					0.17** (2.02)
Observations	684	684	684	684	684
Number of Countries	38	38	38	38	38

Notes: Regressions estimated using FMOLS for co-integrated heterogeneous panels. Both country- and time-effects are included. *, **, and *** denote significance at the, respectively, 10 percent, 5 percent, and 1 percent level. All coefficients are presented in standardized form (that is, the original coefficients are multiplied by the overall standard deviation of the independent variable, and divided by the overall standard deviation of the dependent variable). Robust t-statistics are in parentheses.

Table 7. Cointegrating Panel Regressions. Dependent Variable: Sophistication of Service Exports. Independent Variables: Institutional / Structural / Policy Factors.

	(1)	(2)	(3)	(4)	(5)
Log GDP per capita	1.52*** (72.40)	0.86*** (29.13)	0.65*** (22.41)	0.76*** (20.96)	0.49*** (14.46)
Years of Tertiary Schooling		0.40*** (14.33)	0.40*** (15.15)	0.32*** (17.11)	0.34*** (19.68)
External Liberalization			0.02*** (4.62)	0.02*** (4.45)	0.02*** (4.93)
Overvaluation				0.01*** (3.10)	0.00*** (2.61)
Information Flows					0.50*** (8.04)
Observations	684	684	684	684	684
Number of Countries	38	38	38	38	38

Notes: Regressions estimated using FMOLS for co-integrated heterogeneous panels. Both country- and time-effects are included. *, **, and *** denote significance at the, respectively, 10 percent, 5 percent, and 1 percent level. All coefficients are presented in standardized form (that is, the original coefficients are multiplied by the overall standard deviation of the independent variable, and divided by the overall standard deviation of the dependent variable). Robust t-statistics are in parentheses.

Appendix Table 2. PRODY for Various Categories of Goods and Services

	GOODS					SERVICES				
	Primary Products	Resource Based	Low Tech	Medium Tech	High Tech	Transport	Construction	Royalty and License Fees	Computer and Information	Financial
Average PRODY	10,425	14,827	13,635	19,070	21,814	11,563	9,405	14,480	18,585	24,158

Source: Authors' calculations.

Appendix Table 3. Sophistication of Service Exports, by Category, at Global Level

	Transportation	Travel	Communication	Construction	Insurance	Financial	Computer & Information	Royalties & License Fees	Other business services	Personal, cultural and recreational services
2000	10,516	8,082	6,553	10,422	10,856	24,409	19,852	14,973	10,763	14,282
2001	11,213	8,408	6,552	9,695	10,496	25,160	18,058	15,318	11,132	14,613
2002	11,559	8,696	6,467	9,185	13,842	24,862	17,906	14,828	11,812	13,442
2003	11,870	8,769	6,926	8,232	15,187	22,486	17,961	14,670	12,725	13,615
2004	12,656	9,086	7,932	9,494	14,894	23,871	19,150	12,611	13,175	14,491
Mean	11,563	8,608	6,886	9,405	13,055	24,158	18,585	14,480	11,921	14,089
Standard Deviation	792	381	611	799	2,232	1,053	874	1,072	1,024	529

Source: Authors' calculations.

Appendix Table 4. Summary Statistics, Goods and Services EXPY (2007)

GOODS EXPY			SERVICE EXPY		
Year	Mean	Standard Deviation	Year	Mean	Standard Deviation
1980	9,706	4,592	1990	9,235	1,799
1990	10,768	4,783	1995	9,492	1,903
2000	12,182	4,586	2000	9,921	1,822
2007	12,509	4,645	2005	9,865	2,000
2009	12,714	4,848	2007	10,004	2,012

Source: Authors' calculations.

Appendix Table 5. Export Sophistication: Outlier Regressions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Goods Export Sophistication			Manufacturing Export Sophistication			Service Export Sophistication		
	1991	2000	2006	1991	2000	2006	1991	2000	2006
log GDP per capita)	0.592 (0.671)	0.424 (0.454)	0.705** (0.336)	-0.730 (0.518)	-0.286 (0.316)	-0.193 (0.325)	0.257 (0.247)	-0.182 (0.244)	-0.168 (0.235)
(log GDP per capita) ²	-0.0148 (0.0381)	-0.00917 (0.0255)	-0.0232 (0.0184)	0.0527* (0.0289)	0.0282 (0.0177)	0.0224 (0.0179)	-0.0109 (0.0141)	0.0155 (0.0139)	0.0159 (0.0132)
Geographical Size	0.0678*** (0.0135)	0.0408*** (0.0126)	0.0521*** (0.00913)	0.00493 (0.0129)	0.0145 (0.0119)	0.00450 (0.0111)	0.0179** (0.00724)	0.000860 (0.00995)	0.00146 (0.00806)
India	0.236** (0.0931)	0.108 (0.0655)	0.154** (0.0619)	0.0479 (0.113)	0.0597 (0.0752)	0.186** (0.0759)	0.0911** (0.0390)	0.400*** (0.0671)	0.457*** (0.0516)
China	-0.00385 (0.160)	-0.0320 (0.156)	-0.157 (0.121)	0.167 (0.171)	0.105 (0.152)	0.252* (0.146)	-0.0445 (0.0813)	0.0645 (0.129)	0.152 (0.103)
SSA	-0.0618 (0.0958)	-0.116* (0.0676)	-0.00775 (0.0715)	0.0108 (0.116)	-0.0352 (0.0787)	-0.00707 (0.0821)	-0.0660 (0.0413)	0.00821 (0.0605)	0.0461 (0.0501)
Constant	4.646 (2.958)	6.031*** (2.061)	4.507*** (1.532)	11.58*** (2.343)	9.540*** (1.433)	9.271*** (1.484)	7.308*** (1.091)	9.508*** (1.097)	9.553*** (1.067)
Observations	103	125	122	103	125	122	114	124	118
R-squared	0.710	0.698	0.752	0.363	0.552	0.576	0.372	0.311	0.509

Notes: These regressions indicate where different regions and countries lie in terms of export sophistication, compared to the global norm, after controlling for the stage of development, size, and other independent variables. *, **, and *** denote significance at the, respectively, 10 percent, 5 percent, and 1 percent level. Robust standard errors are in parentheses.

Figure 1. Share of Manufacturing and Services in GDP versus Stage of Development, 2008

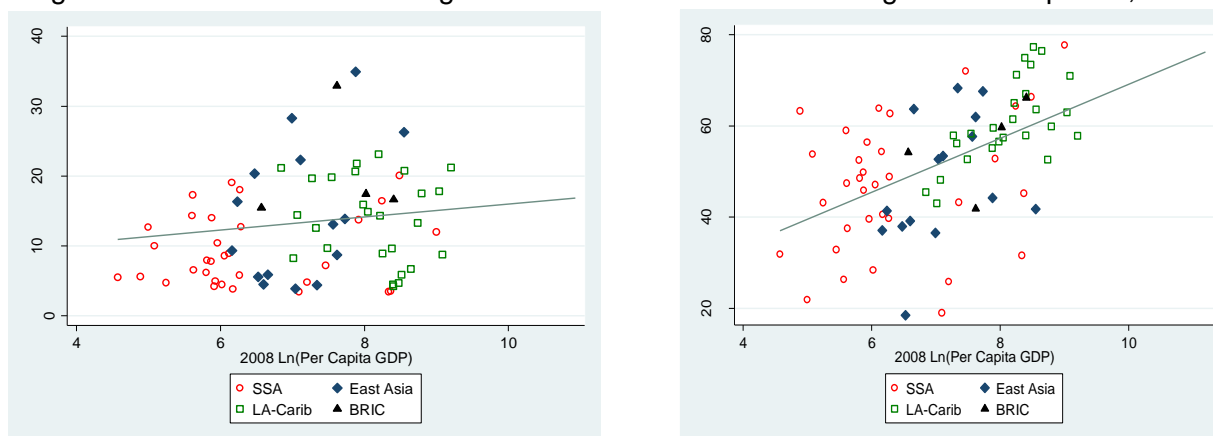
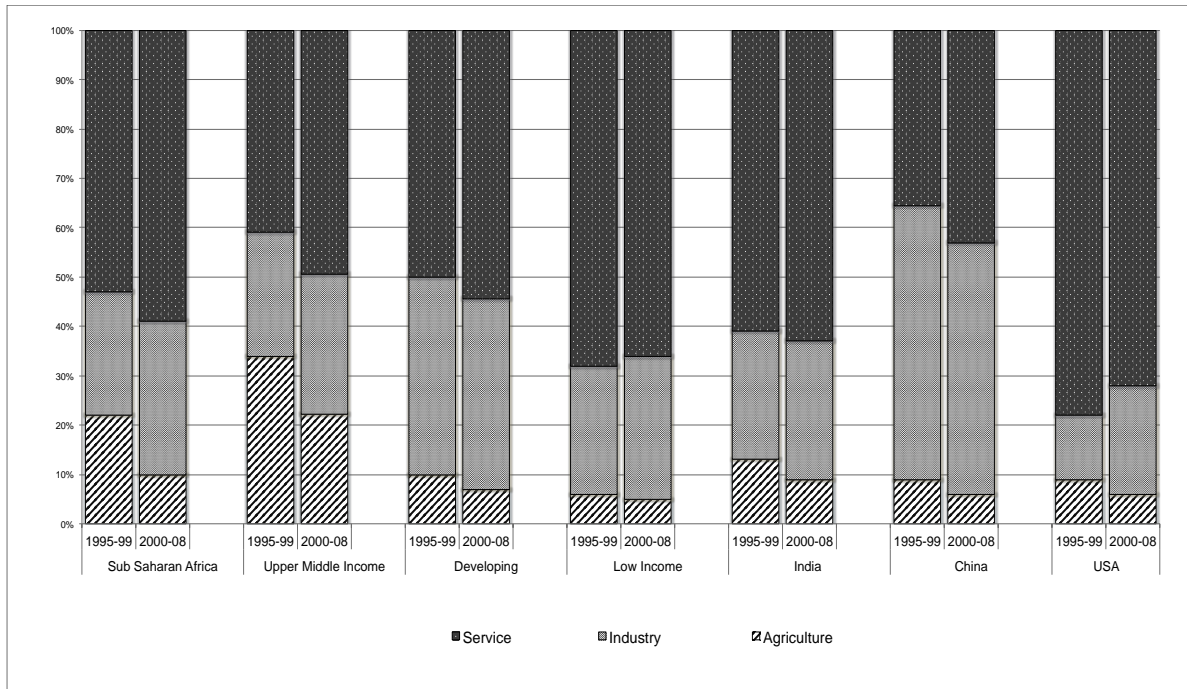
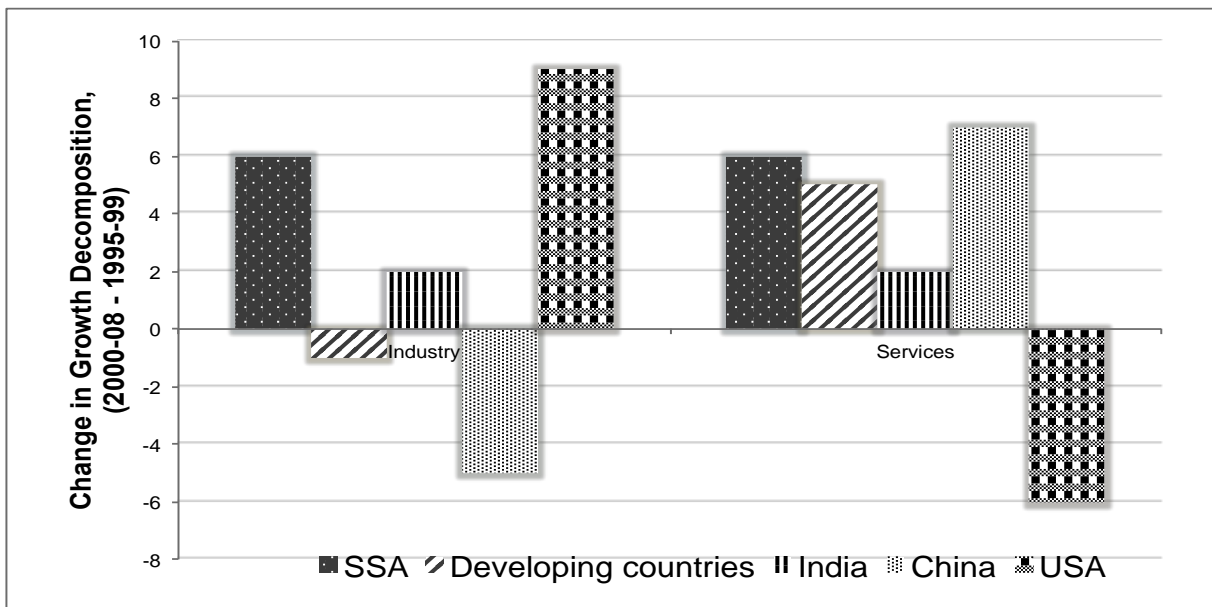


Figure 2. Panel A. Both Industry and Services Increasingly Contribute to Growth
(Growth Accounting by Sectors, 1995–09 and 2000–08)

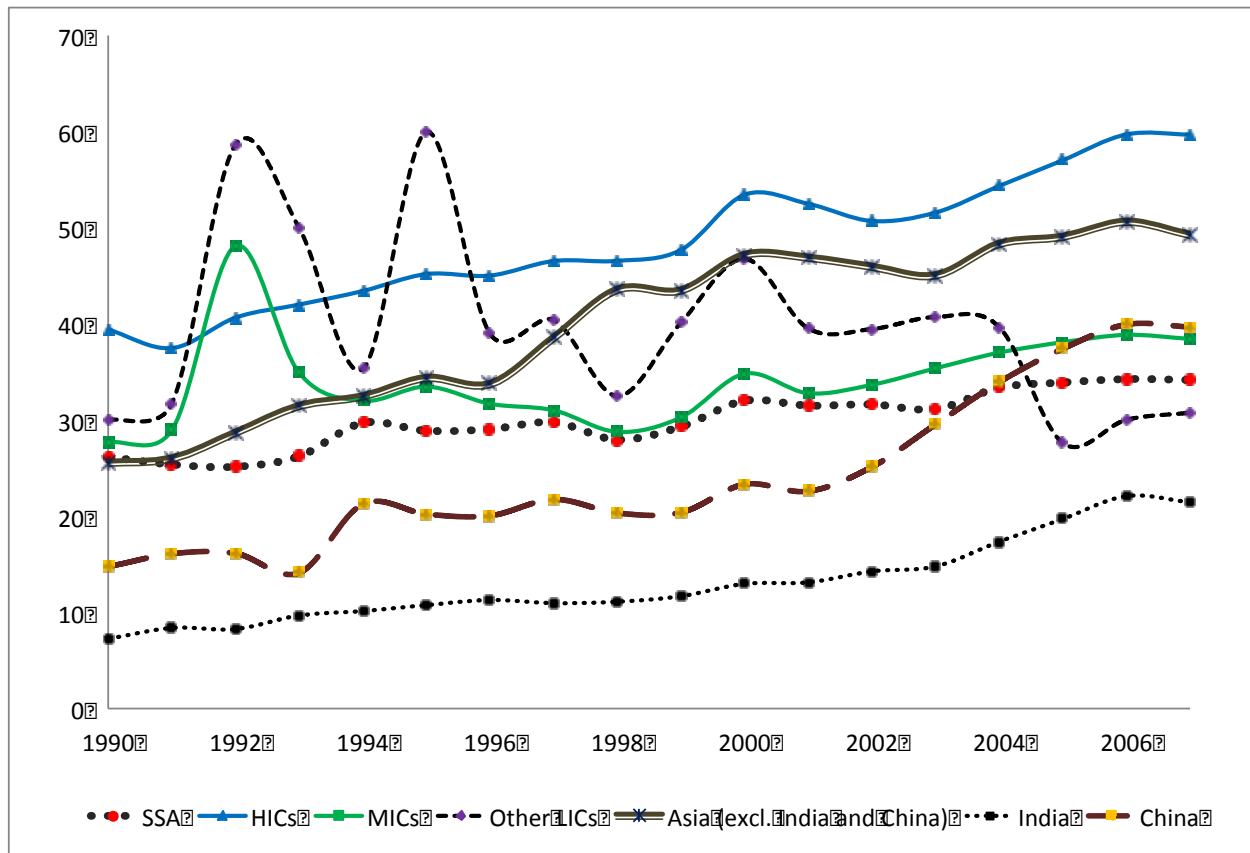


Panel B. Change in Growth Decomposition (2000–08 versus 1995–99)



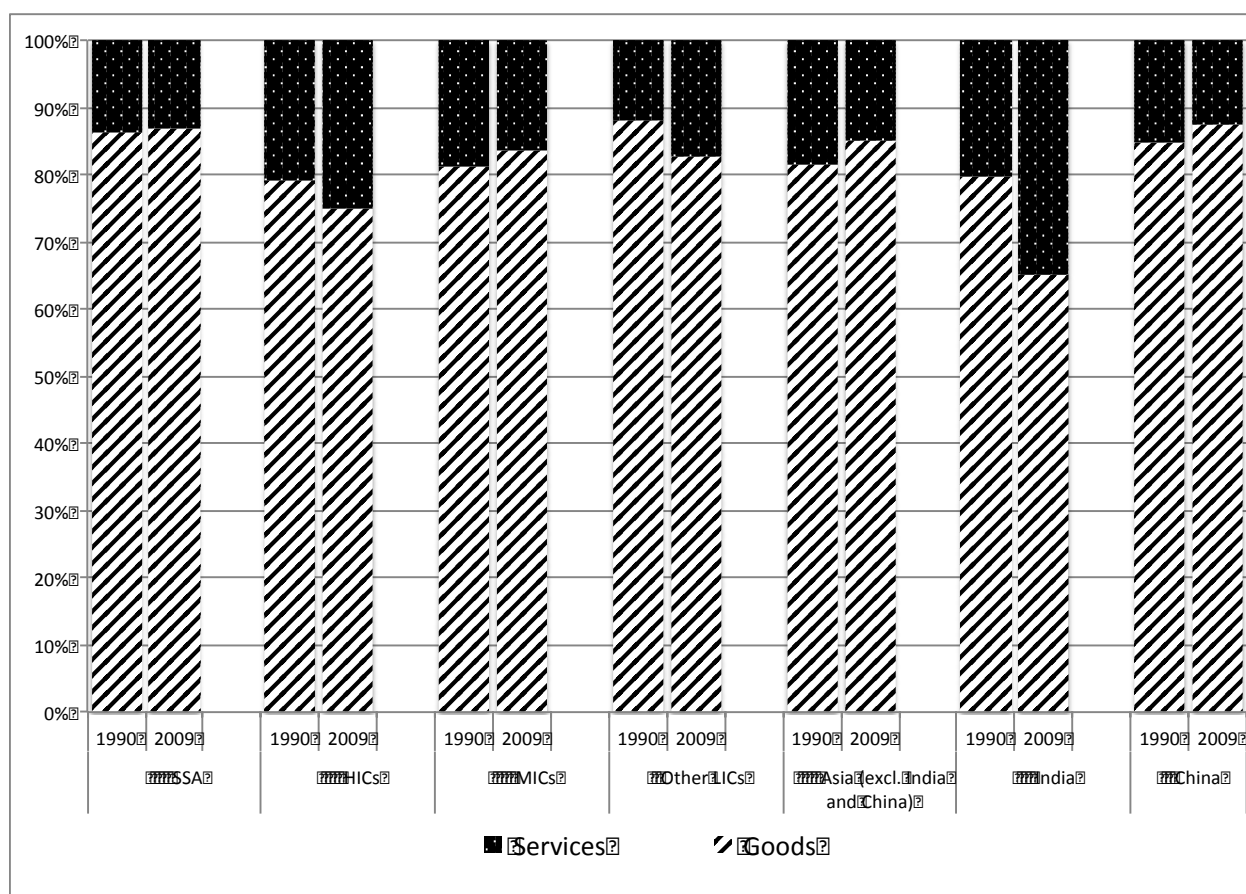
Source: World Development Indicators, 2011.

Figure 3. Export Share in GDP.



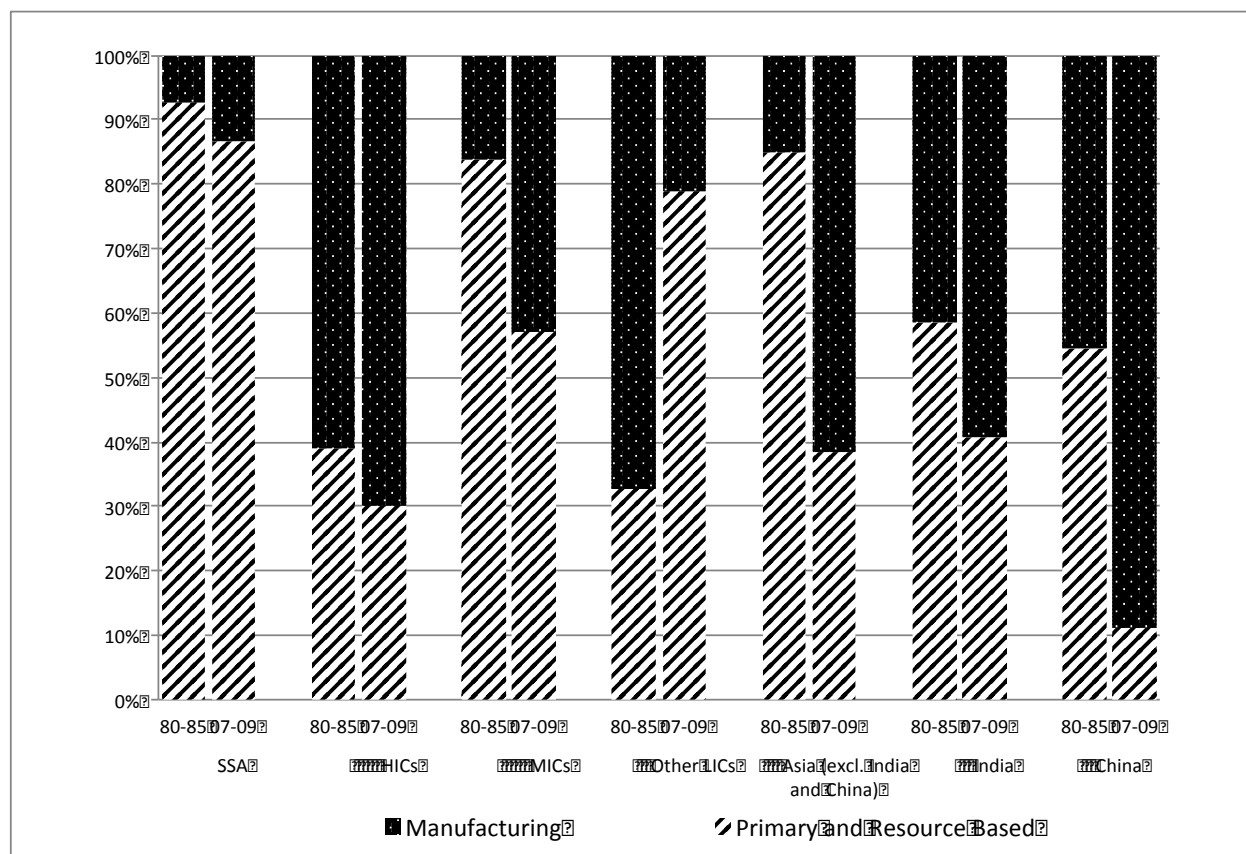
Source: World Development Indicators, World Bank. 2011.

Figure 4. Share of Goods and Service Exports in Total Exports, 1990 and 2009



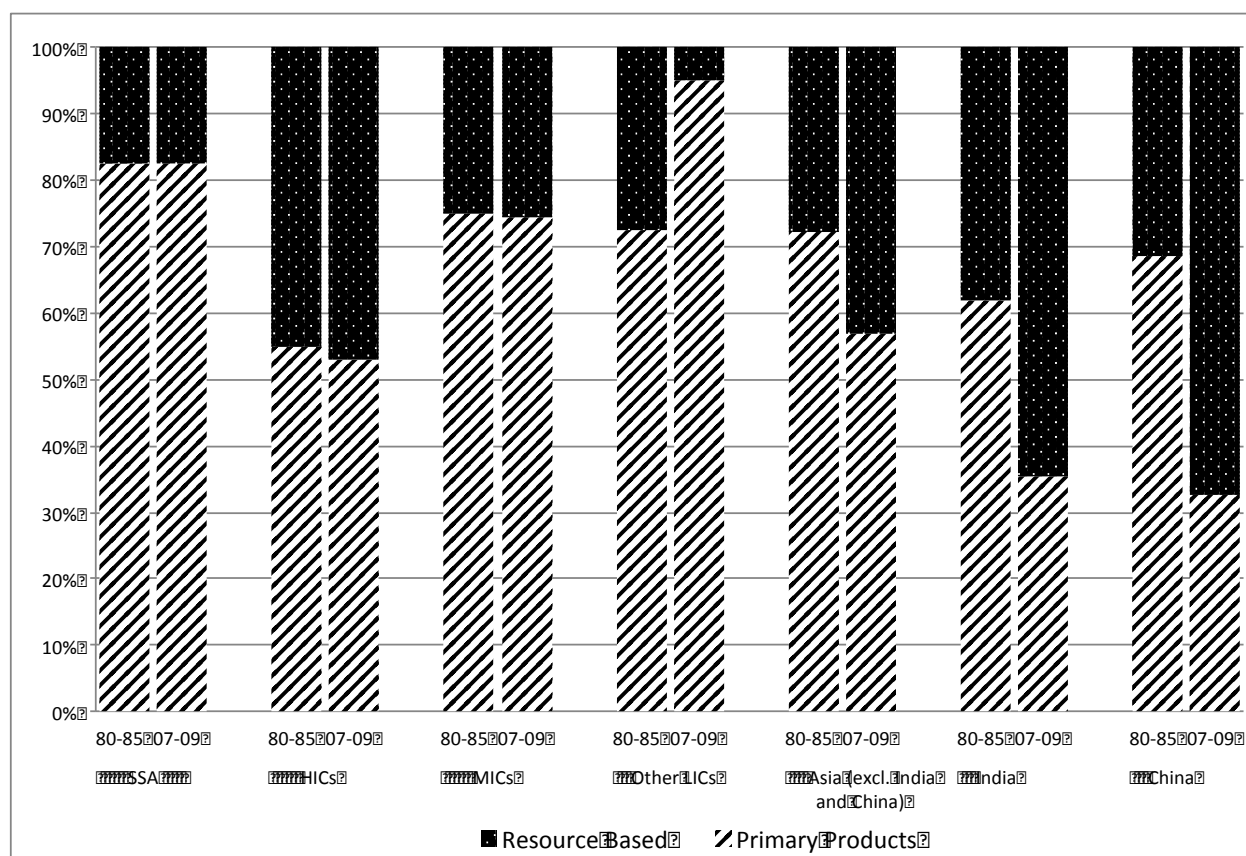
Source: IMF Balance of Payments, 2011.

Figure 5. Share of Resources and of Manufactures in Total Exports of Goods



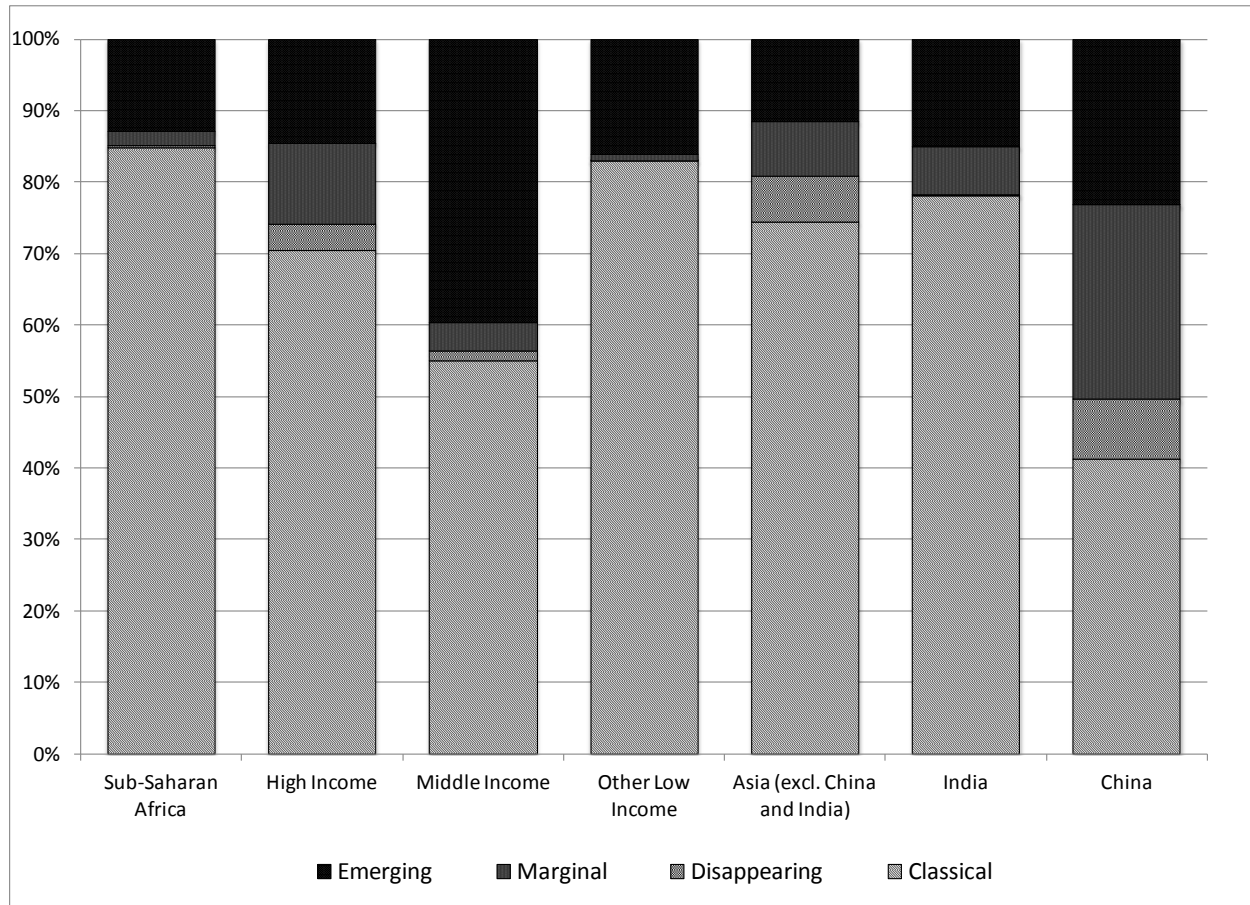
Source: Authors' calculations using COMTRADE data.

Figure 6. Resource Exports: Primary versus Resource-Based Products, 1980–85 and 2007–09



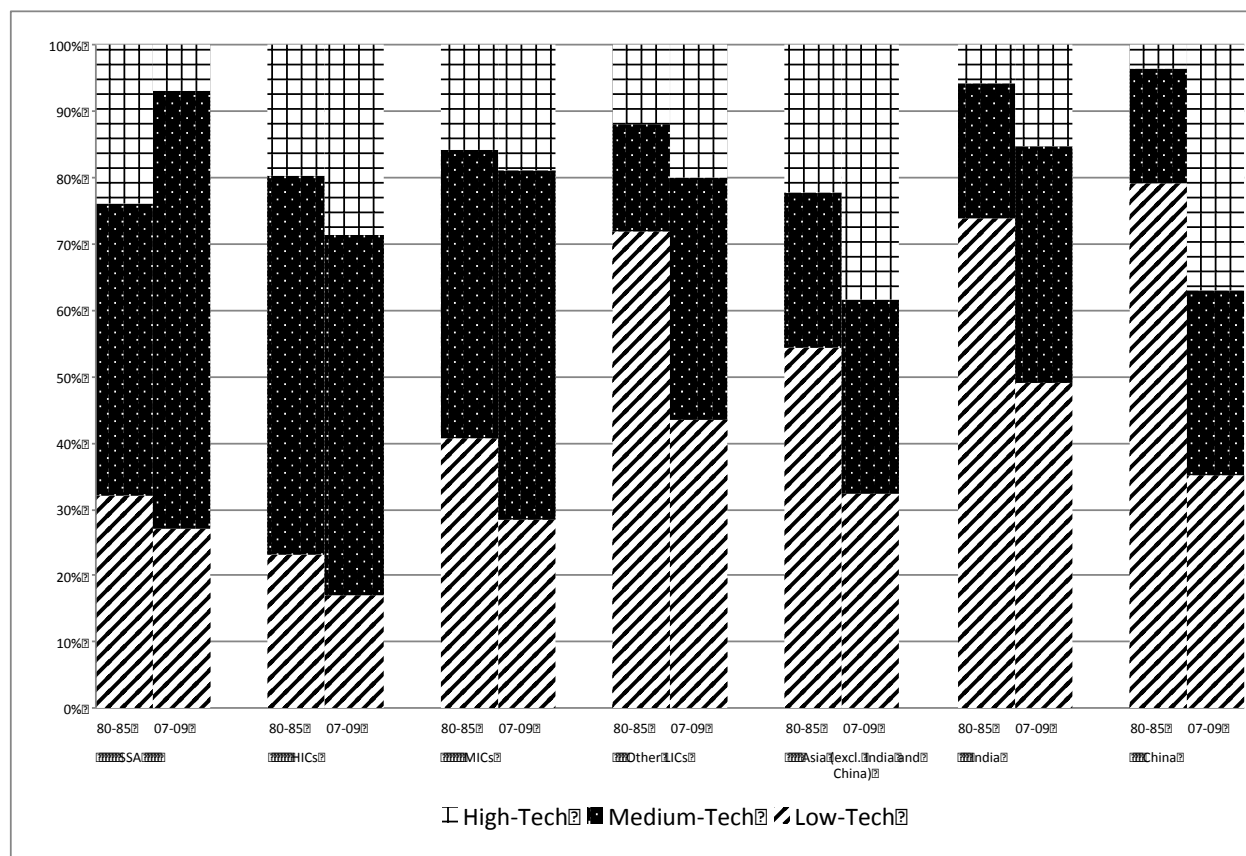
Source: Authors' calculations using COMTRADE data.

Figure 7. Share of Classical, Marginal, Disappearing, and Emerging Natural Resources in Total Resource Exports, Between 1990–94 and 2005–09.



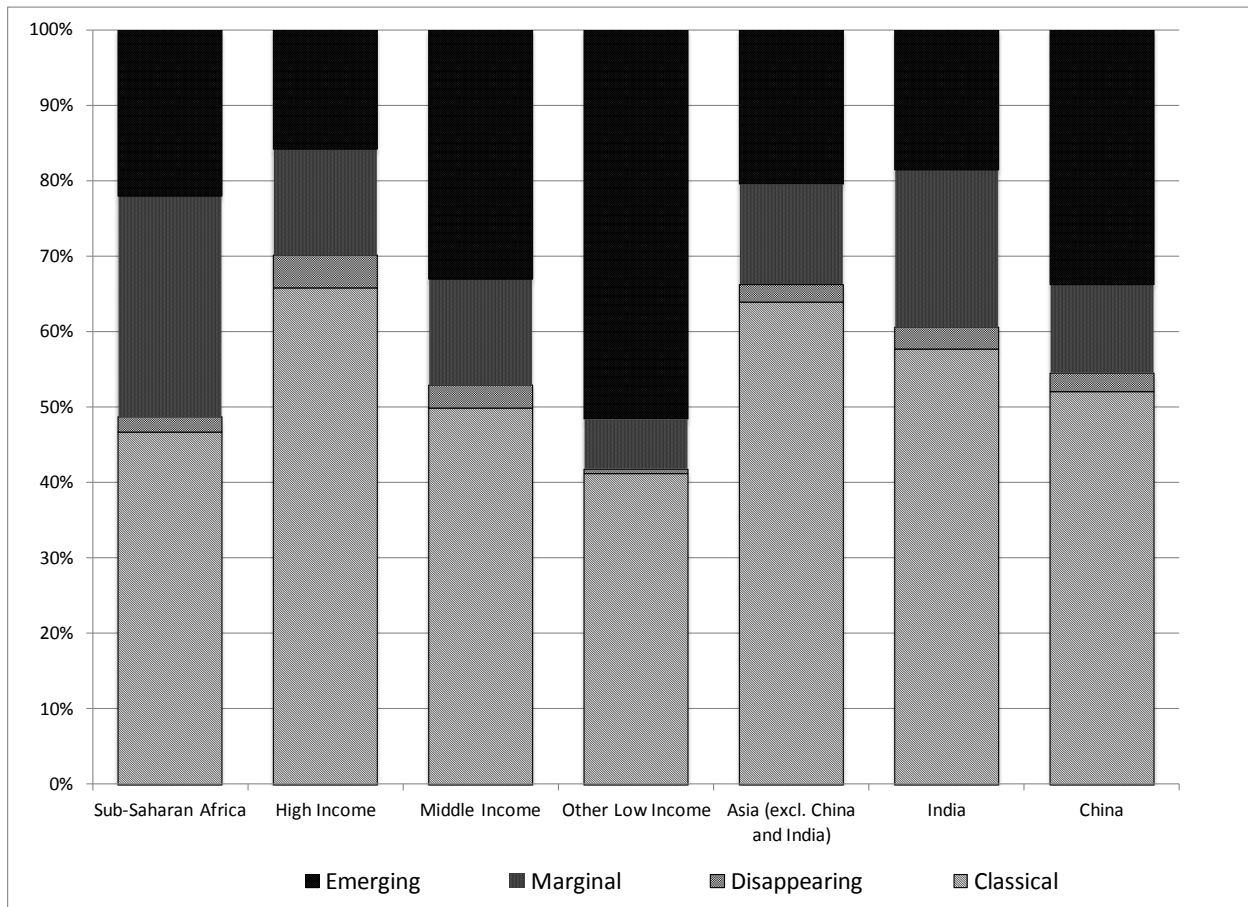
Source: Authors' calculations using COMTRADE data.

Figure 8. Share of Low-, Medium-, and High-Tech Manufactured Exports in Total Manufactured Exports



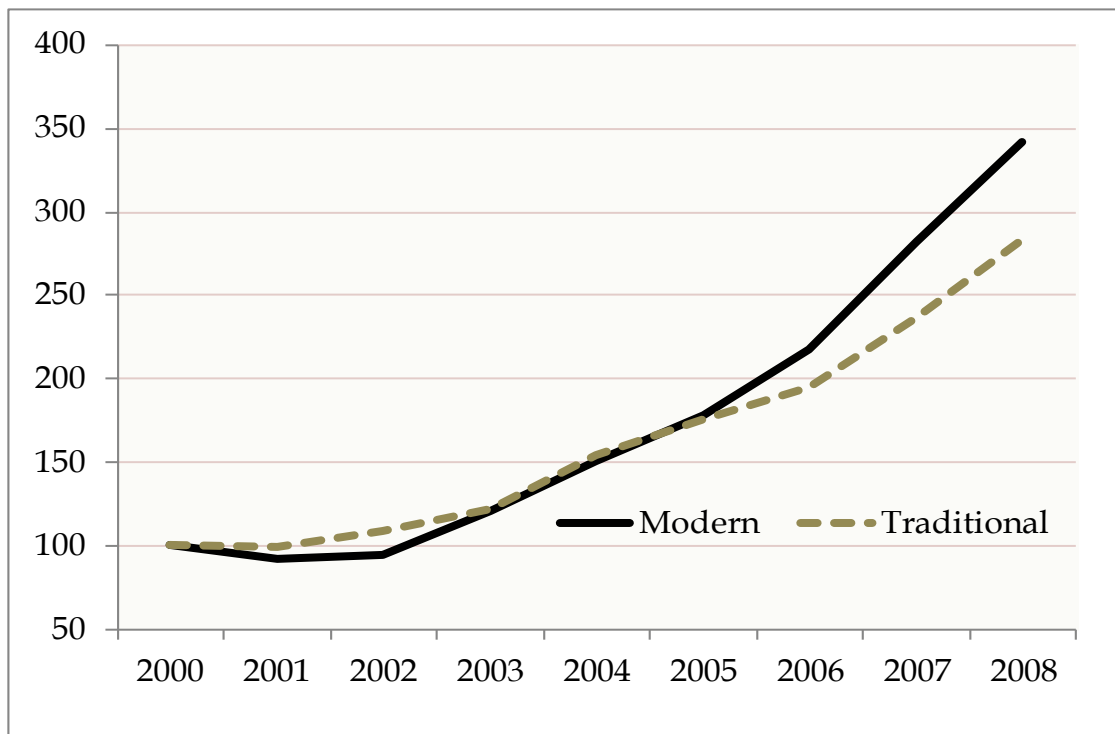
Source: Authors' calculations.

Figure 9. Share of Classical, Marginal, Disappearing, and Emerging Manufactures in Total Manufactured Exports, Between 1990–94 and 2005–09.



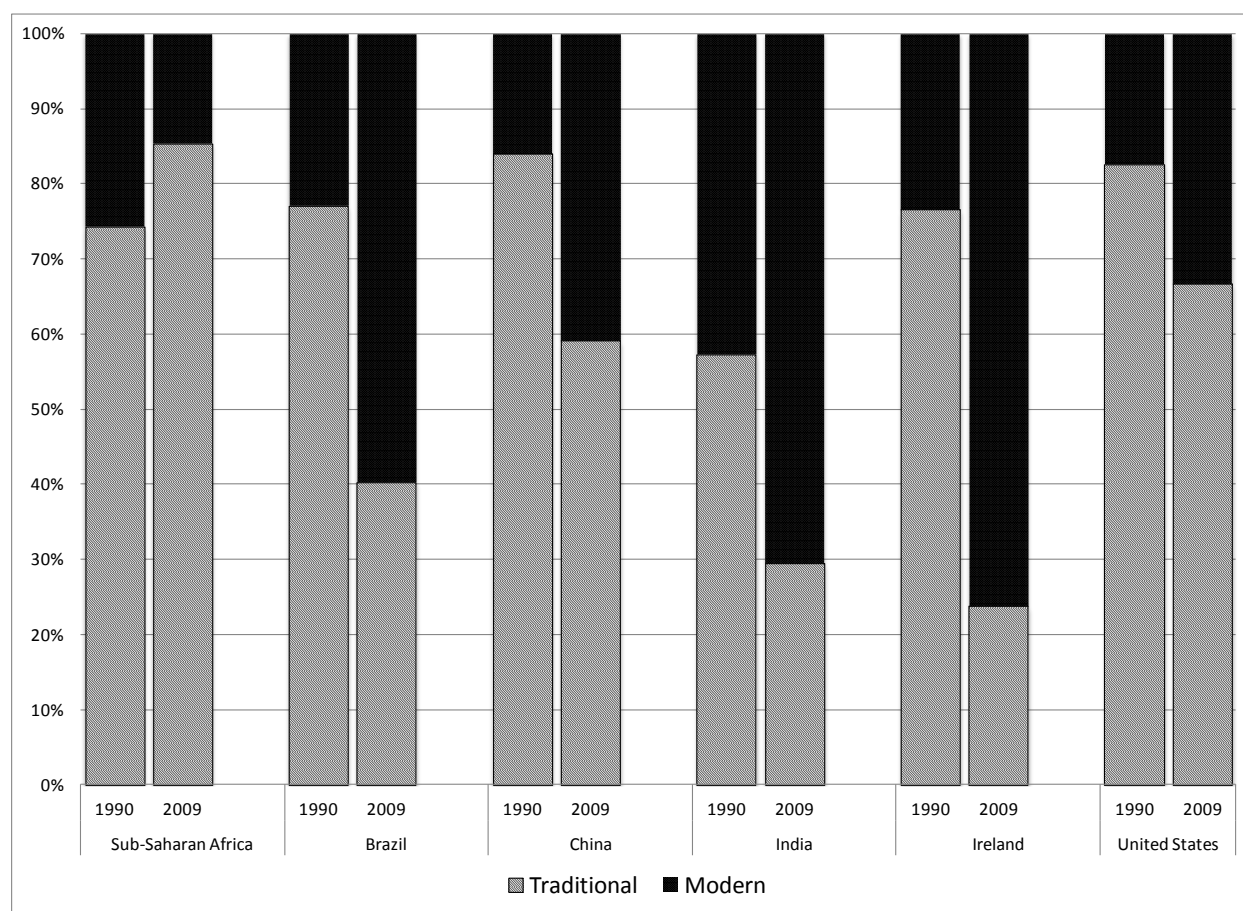
Source: Authors' calculations using COMTRADE data.

Figure 10. Growth in Modern and in Traditional Service Exports, World, 2000–09



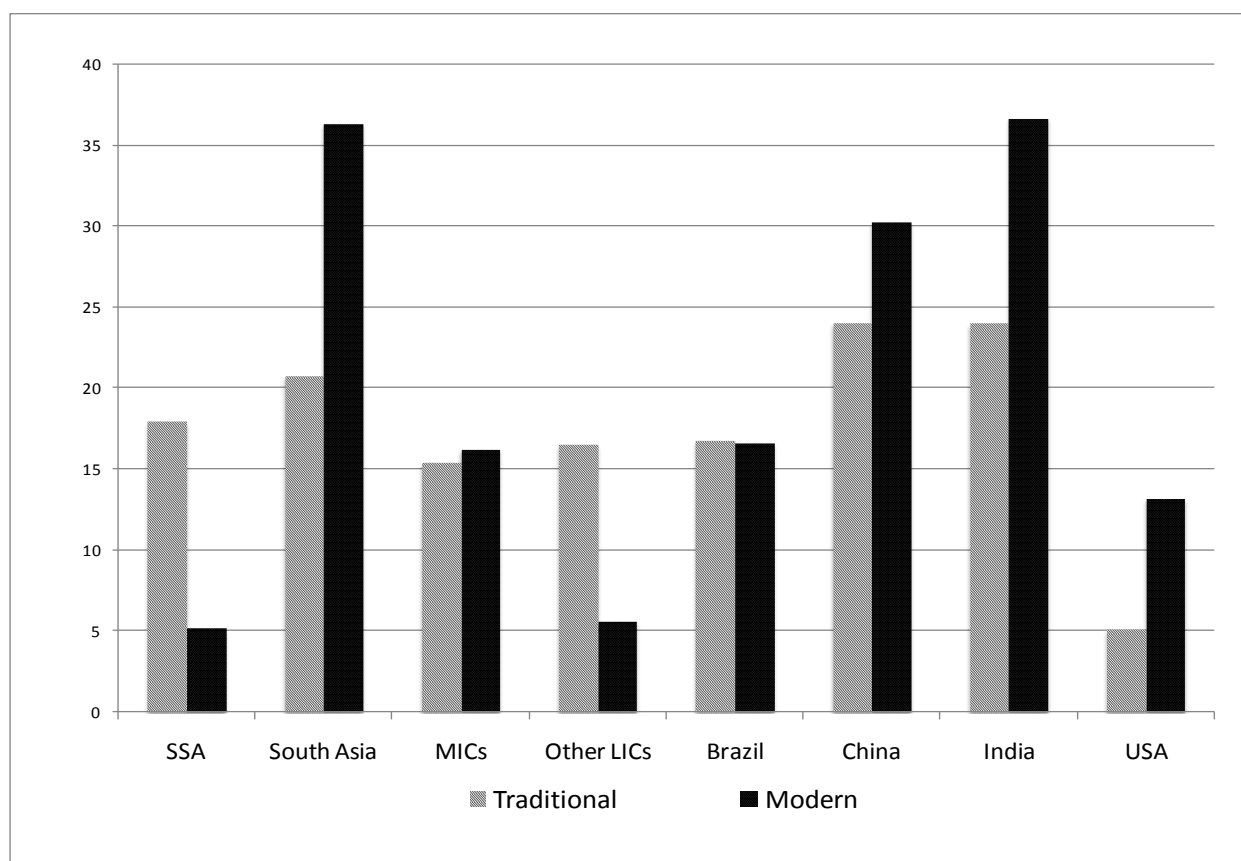
Source: Authors' calculations using Balance of Payments, IMF.

Figure 11. Share of Modern and of Traditional Services in Total Service Exports: 1990 & 2009



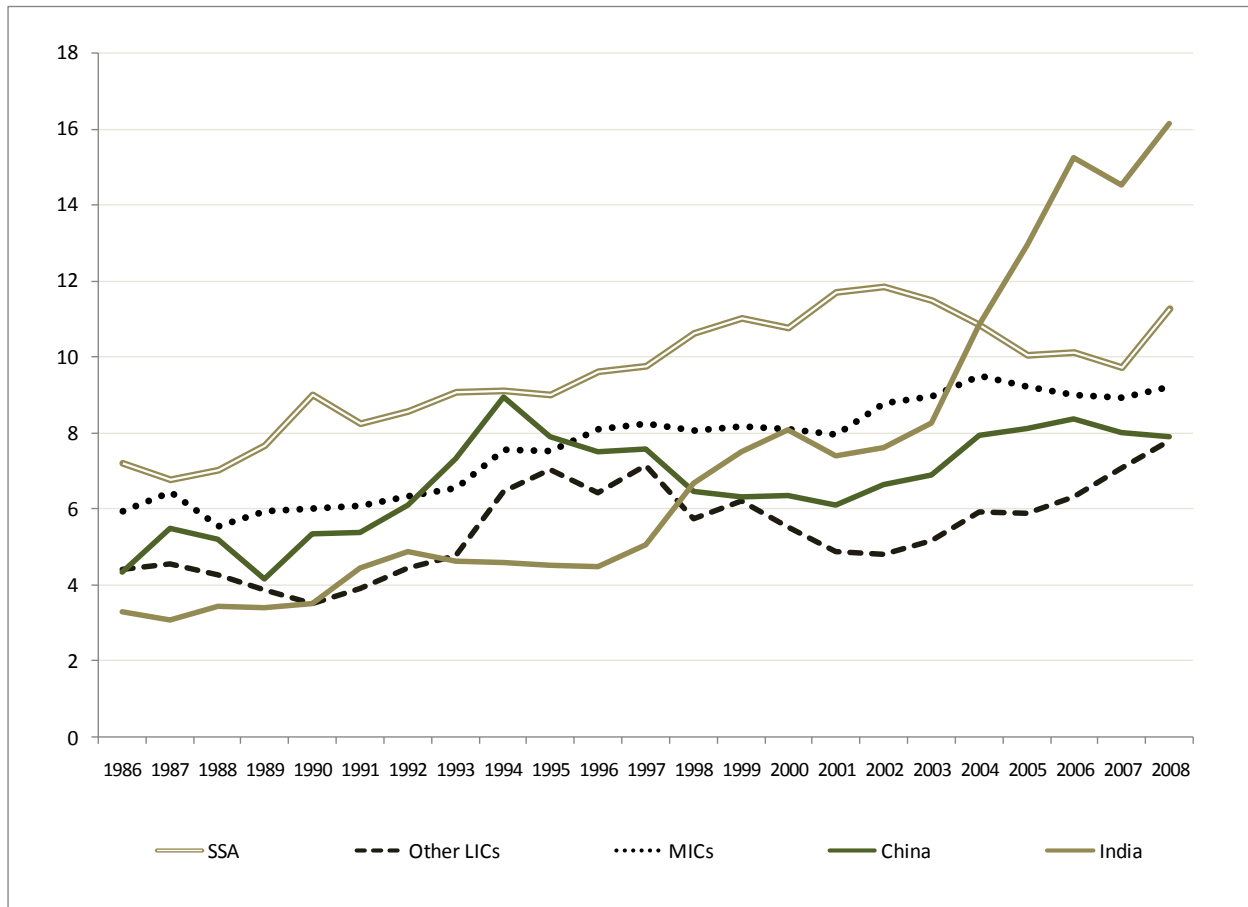
Source: Authors' calculations using IMF Balance of Payments.

Figure 12. Traditional and Modern Service Exports: Recent Growth Trends, 2000–07



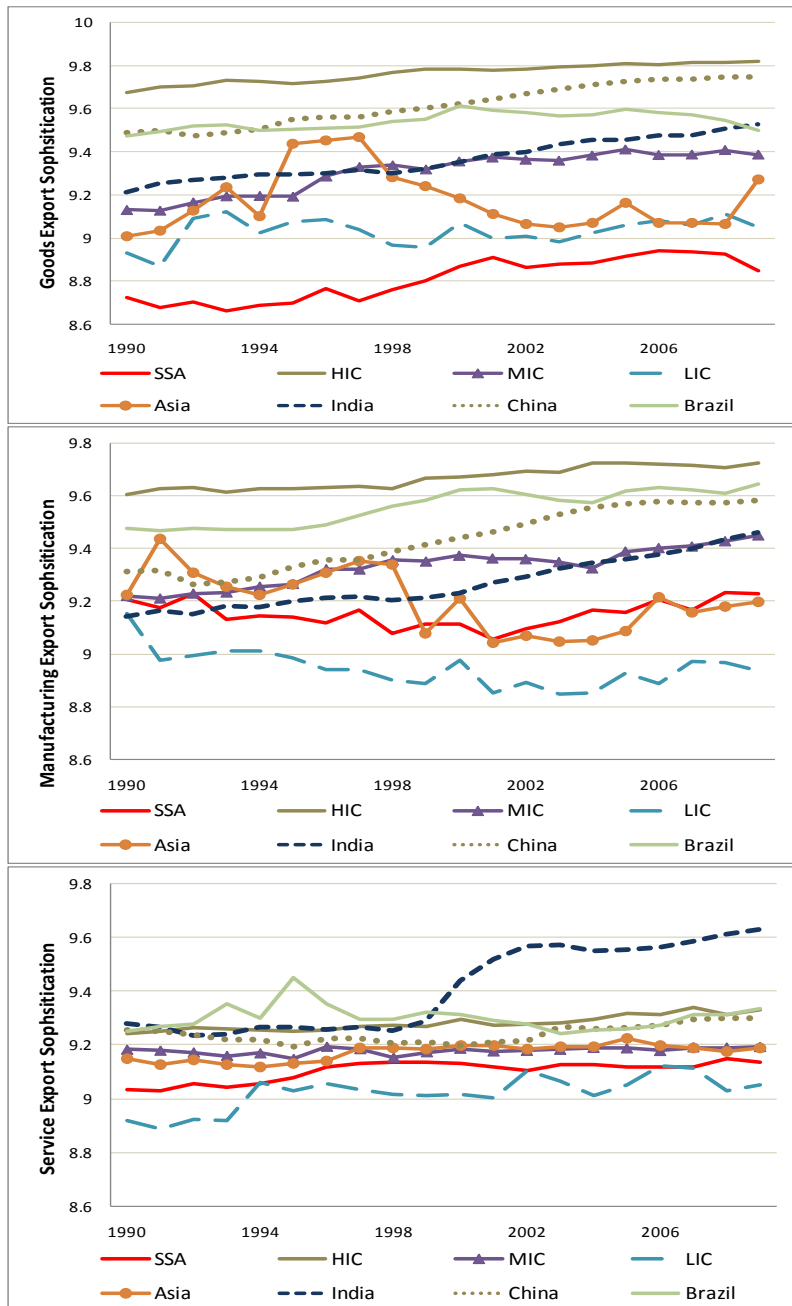
Source: Authors' calculations using IMF Balance of Payments.

Figure 13. Services Are Becoming Increasingly Tradable
(Service Exports / Service Value Added (percent))



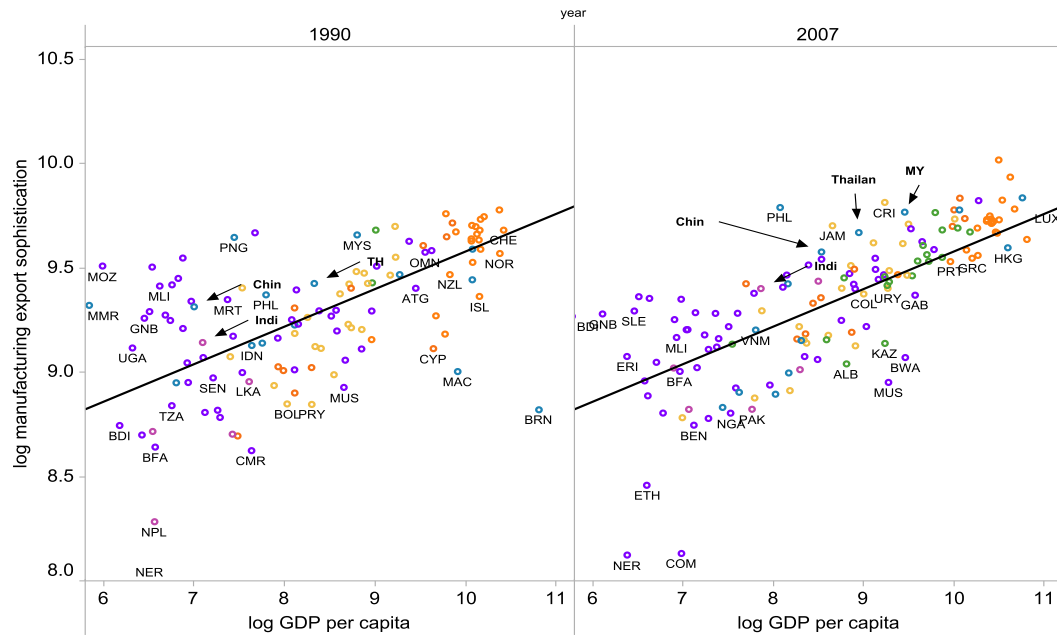
Source: Authors' calculations using IMF Balance of Payments and World Bank World Development Indicators.

Figure 14. Export Sophistication over Time, for Goods, Manufactures, and Services, 1990-2009



Source: Authors' calculations.

Figure 15. Panel A. Sophistication of Manufactured Exports versus GDP per capita, 1990 and 2007



Panel B. Sophistication of Service Exports versus GDP per capita, 1990 and 2007

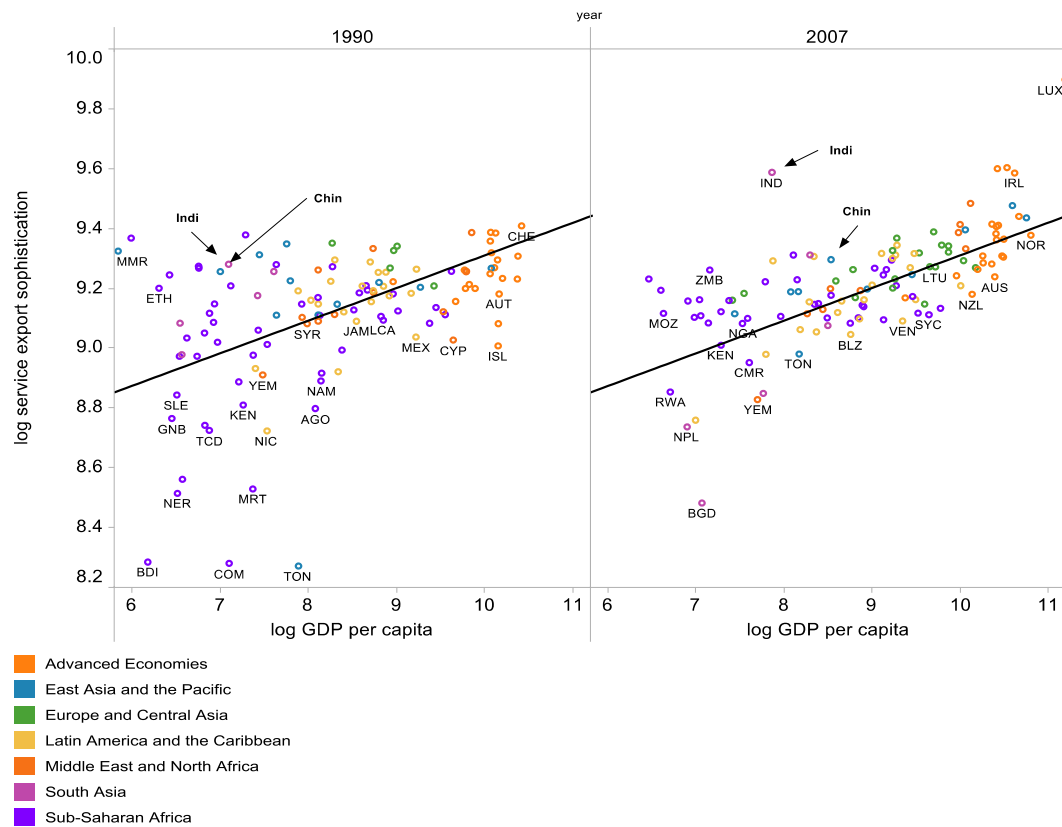
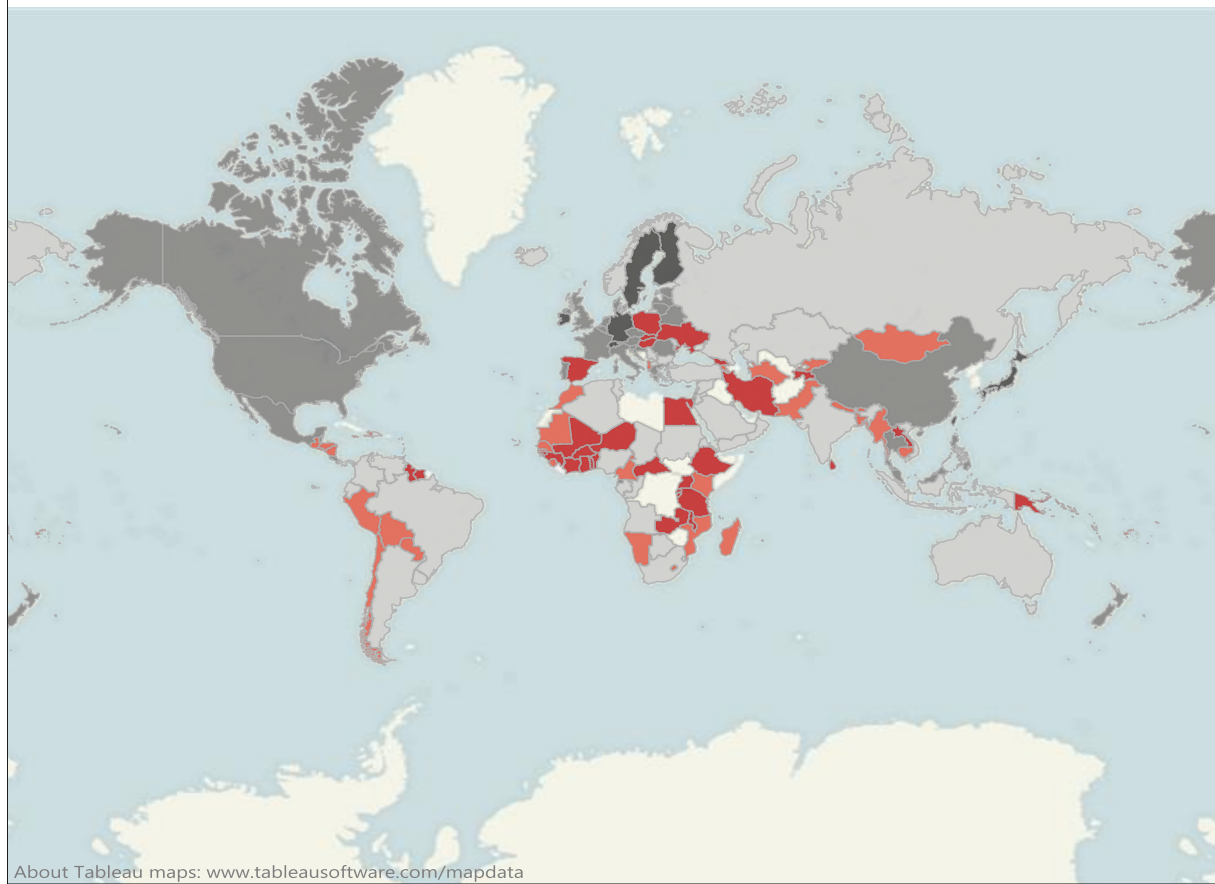


Figure 16. World Map of Sophistication of Goods Exports

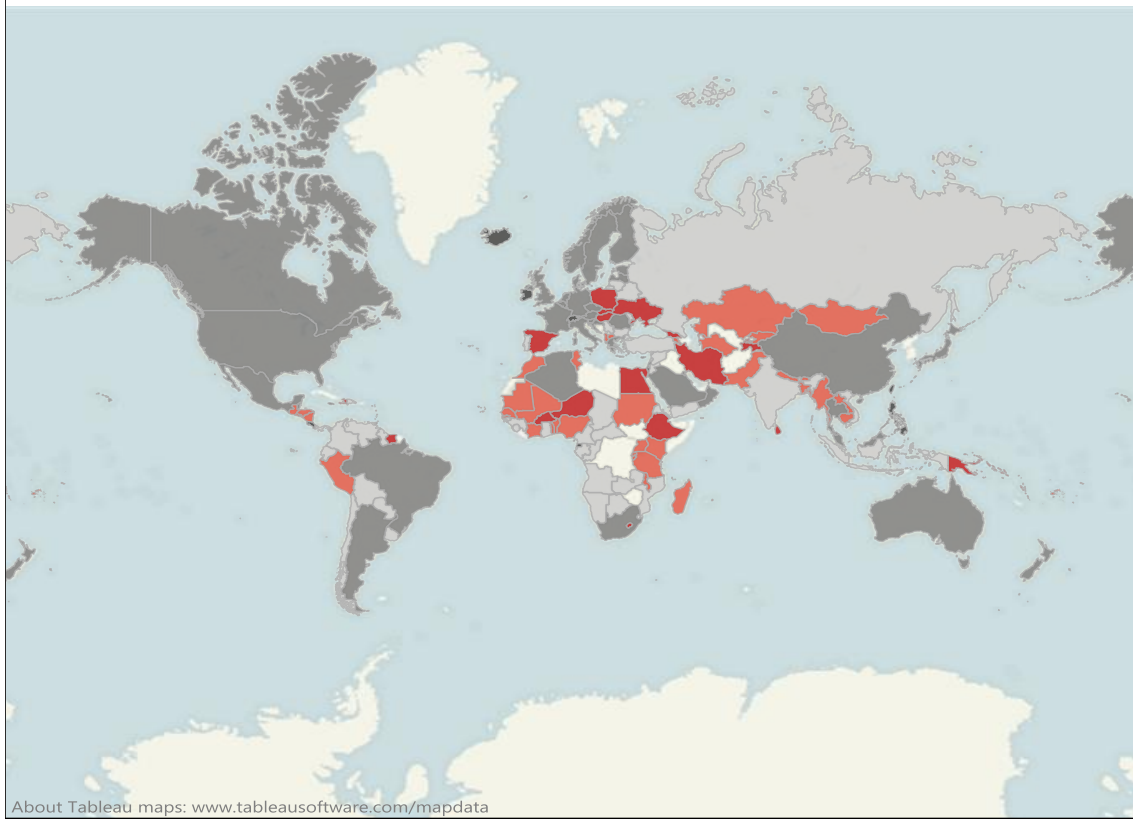


Map based on Longitude (generated) and Latitude (generated). Color shows average of goods export sophistication*. Details are shown for countryname. The data is filtered on year, which keeps 2009

Avg. goods export soph..

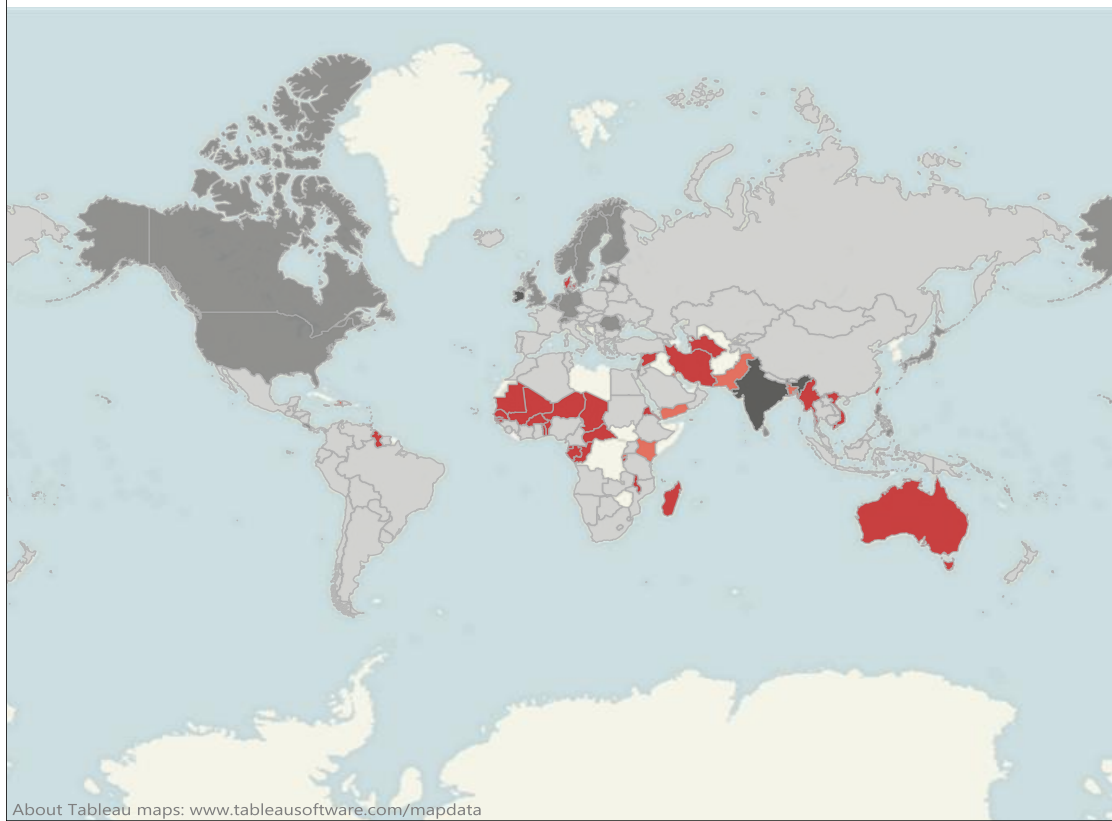


Figure 17. World Map of Sophistication of Manufacturing Exports



Map based on Longitude (generated) and Latitude (generated). Color shows average of manufacturing export sophistication. Details are shown for countryname. The data is filtered on year, which keeps 2009

Figure 18. World Map of Sophistication of Service Exports



Map based on Longitude (generated) and Latitude (generated). Color shows average of service export sophistication. Details are shown for countryname. The data is filtered on year, which keeps 2009

Avg. service export sop..

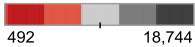
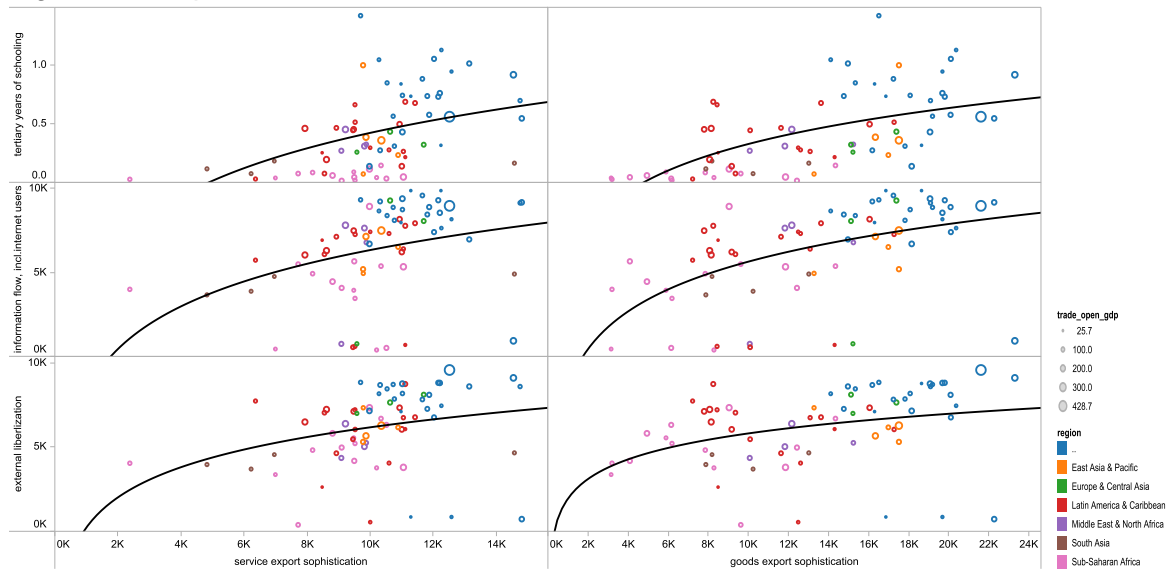


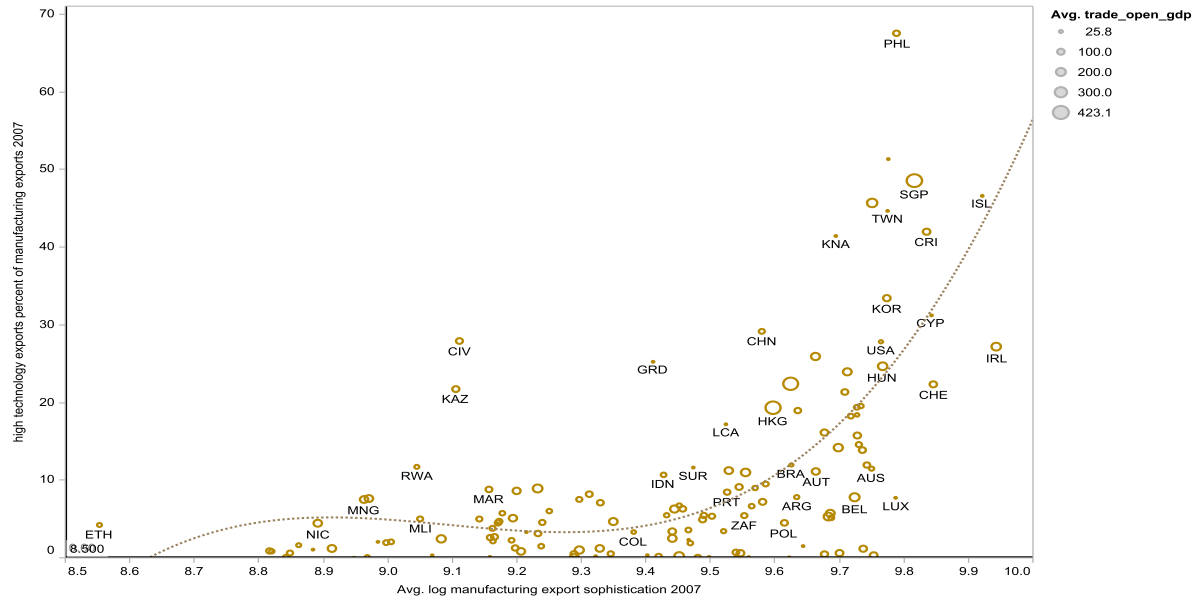
Figure 19. Sophistication versus Potential Determinants



Notes: colors represent different regions; size of bubbles denotes trade ratios.

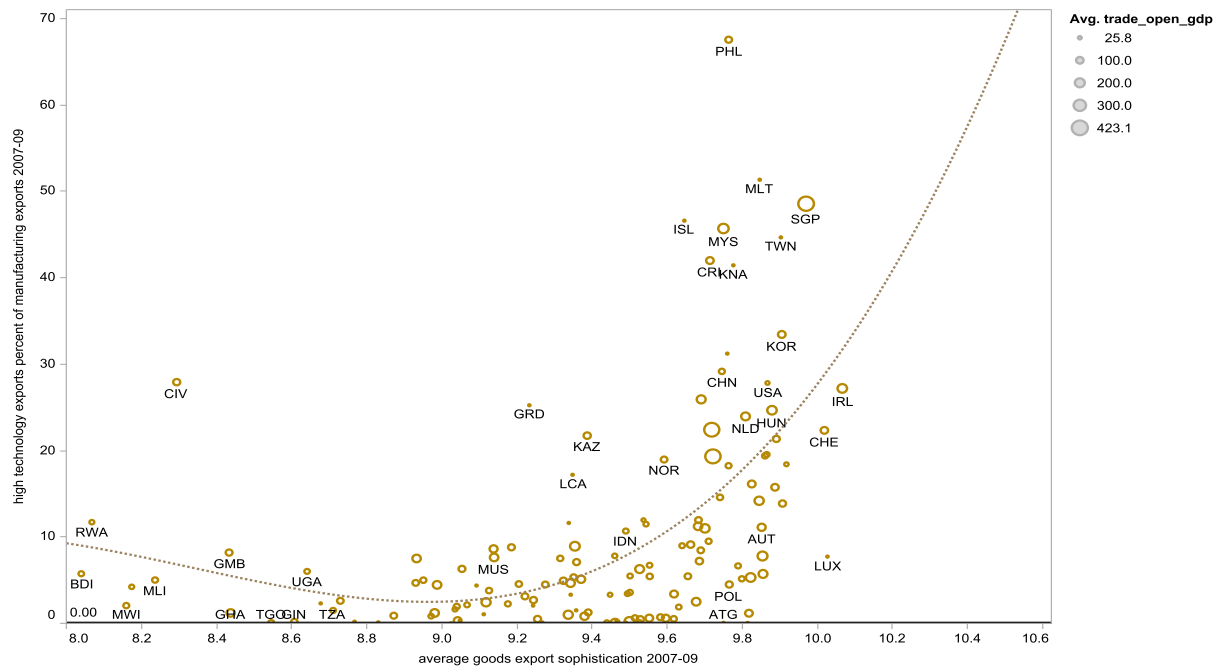
Figure 20. High-Technology Exports and Export Sophistication

Panel A. Manufacturing Exports Sophistication, 2007–09



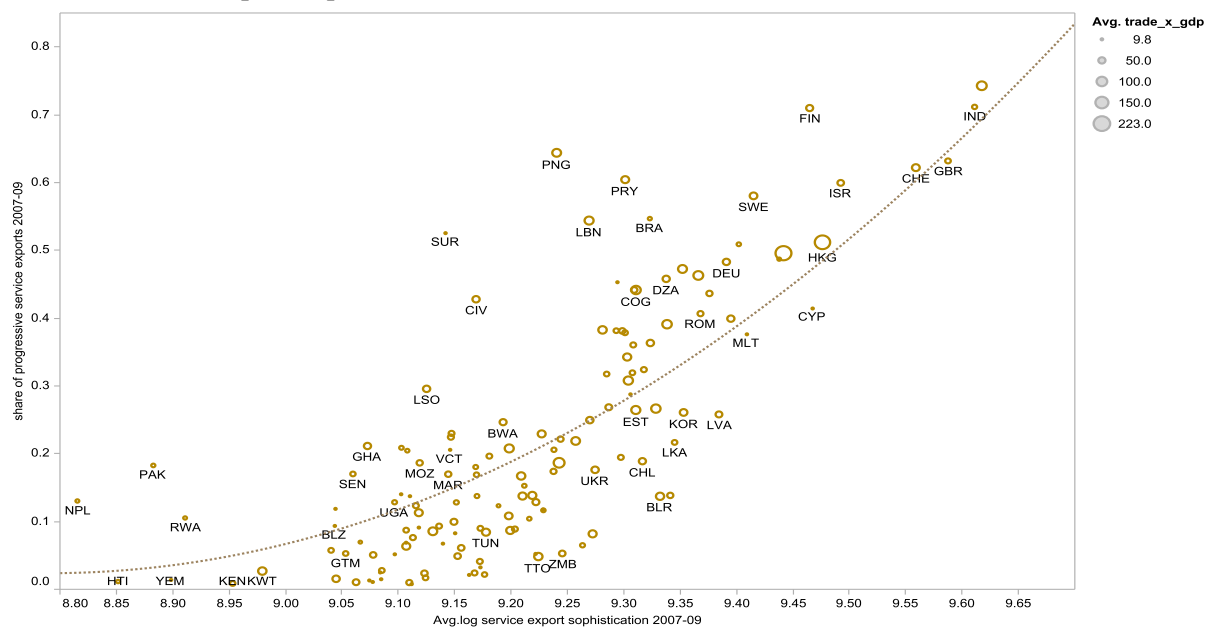
Note: size of bubbles denotes trade ratios.

Panel B. Goods Export Sophistication, 2007–09



Note: size of bubbles denotes trade ratios.

Panel C. Service Export Sophistication, 2007–09



Note: size of bubbles denotes trade ratios.