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Make in India: Which Exports Can Drive the Next Wave of Growth?

Rahul Anand, Kalpana Kochhar, and Saurabh Mishra

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Make in India: Which Exports Can Drive the Next Wave of Growth? *

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Abstract

Structural transformation depends not only on how much countries export but also on what
they export and with whom they trade. This paper breaks new ground in analyzing India's
exports by the technological content, quality, sophistication, and complexity of the export
basket. We identify five priority areas for policies: (1) reduction of trade costs, at and
behind the border; (2) further liberalization of FDI including through simplification of
regulations and procedures; (3) improving infrastructure including in urban areas to enhance
manufacturing and services in cities; (4) preparing labor resources (skills) and markets
(flexibility) for the technological progress that will shape jobs in the years ahead; and (5)
creating an enabling environment for innovation and entrepreneurship to draw the economy
into higher productivity activities.

I. INTRODUCTION AND MOTIVATION

India's exports have been increasing since the early-1990s – both as a share of GDP and as a share of world exports. Total exports as a share of GDP have risen to almost 25 percent in 2013 from around 10 percent in 1995 (Figure 1). Likewise, Indian goods exports as a share of world goods exports have risen, with the share almost tripling to 1.7 percent during 1995-2013. A similar trend is visible in India's services export – the share tripling to over 3 percent of world service exports during 2000-2013.

Figure 1. India: Exports of Goods and Services

Sources: World Development Indicators, World Bank and authors' calculations
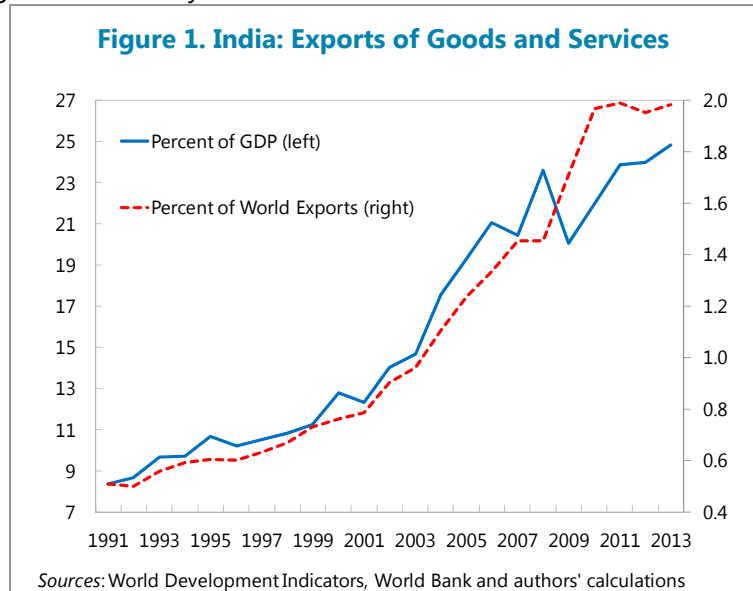
It is generally accepted that trade leads to structural transformation and diversification of economies, but recent literature suggests that the dynamics of structural transformation also depend on what goods and services are traded and with whom. Specifically, structural transformation and future growth and export performance depend on: (i) diversification across destinations, products, and services (ii) composition of the export basket measured by technological content, quality, sophistication, and complexity of exports and (iii) how closely related a country's goods and services exports are to globally-traded products and services.

This paper breaks new ground in documenting the evolution of India exports along these dimensions—which are explained further below—and analyzing its implications for future export performance, structural transformation and growth.

Diversification: Diversification, both geographically and product-wise, is found to expand export revenues and enhance growth. [2,3] Also, countries that are dependent on a narrow export basket often suffer from export instability arising from unstable global demand. Diversification of export products and destinations helps in stabilizing export earnings in the longer run, with benefits analogous to the portfolio effect in finance (Ghosh and Ostry, 1994;

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[2] see Hummels and Klenow (2005); Pham and Martin (2007); and Brenton and Newfarmer (2007) for discussion of the role of intensive or extensive margins for export growth.
[3] Diversification and structural shifts are positively associated with per capita income (Gutierrez de Pineres and Ferrantino, 2000; Herzer and Nowak-Lehmann, 2006; Al-Marhubi, 2000; De Ferranti et al. 2001; and Henn et al, 2013, 2015).

Bleaney and Greenaway, 2001).

Composition of the export basket: Products and services are heterogeneous in their intrinsic value – with exported goods varying considerably in their effect on future growth. First, what matters for growth is not how much you export but what you export (Hausmann, Hwang and Rodrik, 2007, herein referred to as (HHR)). Goods and services exports with high productivity and sophistication contribute more to overall economic growth. (Mishra et al, 2011). Second, economic development is underpinned not just by new products and trading partners, but also by quality improvements to existing products. Producing higher quality varieties of existing products can build on existing comparative advantages and thus raise productivity and hasten favorable structural transformation (see Henn et al, 2013). Third, the enormous income gaps between rich and poor nations are an expression of the vast differences in productive knowledge amassed by different nations. The Economic Complexity Index (ECI), developed by Hausmann et al (2011), approximates the productive knowledge in a country and helps explain differences in the level of income of countries, and more importantly, it predicts future economic growth.

Relatedness of products: A model of structural transformation in the product space shows that changes in the revealed comparative advantage are governed by the pattern of relatedness of products at the global level (Hidalgo et al, 2007). As countries change their export mix, there is a strong tendency to move towards goods that are more closely related to ones already being produced rather than to goods that are less closely related. The pattern of relatedness of products exhibits very strong heterogeneity: there are parts of this 'product space' that are dense while others are sparse. Countries that are specialized in a dense part of the product space have an easier time in developing and expanding their revealed comparative advantage than countries that are specialized in more disconnected products. For example, it will be more difficult for a resource rich economy like Iraq – with more than 99 percent of its exports concentrated in oil –to diversify into hi-tech manufacturing, than a country like Philippines that has already diversified and has comparative advantage in manufacturing several technology products.

In what follows, we document the pattern of comparative advantage and capabilities by technological content of exports and quantify diversity, sophistication, quality and complexity of Indian exports vis-a-vis peer EMs.[4] Further, using network analysis, we study the connectedness of Indian products and services with globally traded goods and services, and characterize the structure of this network to identify sources of emerging comparative advantage in India's exports basket. Finally, we discuss the main policy implications of our findings.

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[4] The emerging market comparators used here are Argentina, Brazil, Chile, China, Colombia, Hungary, Indonesia, Korea, Malaysia, Mexico, Peru, the Philippines, Poland, Romania, Russia, South Africa, Thailand, Turkey and Ukraine. [5] We use developing countries to refer to both emerging markets and low-income countries.

The paper's main findings can be summarized as follows:

Indian exports have progressively diversified in term of products and, in line with other EMs, the share of developing and emerging economies as destinations of Indian exports has increased over time. While services exports, as a share of total exports and in terms of sophistication, are comparable to high income countries, the share of manufacturing exports and their level of overall value content are still low compared to its peers, especially in Asia. India exports many high quality products, but there is still room for India to converge with other EMs in manufacturing quality and complexity.

Given its exports structure, India is well positioned to benefit from the structural changes in technology and emerging forces of globalization. In the medium-term, India has immense potential to diversify by latching onto products and services that are closely related to its current capabilities. India could also benefit by focusing both on domestically-oriented production to satisfy large domestic demand and producing goods for global markets, for example, by in addition to building automobile components, diversifying into designing high-quality export-oriented automotive products. Similarly, in services, India has huge potential to leverage its electronic hardware, storage devices, and computer services exports and diversify into high-quality information solutions. For more complex exports, India should leverage existing information networks, technology, and financial channels. Ongoing transformation would help growth over the medium-term through reallocation of resources to more productive sectors and by productivity gains in specialized sectors. Improving the quality, sophistication and complexity in exporting products and services would help raise overall value of exports and make economic growth more broad based.

Even though exports to emerging and developing economies have increased, the potential to expand them further is substantial. India can also benefit by increasing intra-regional trade integration. Promoting ties in transfer of know-how, and technologies from advanced economies will also help India catch up with global technology and quality frontier. However, to realize these benefits, India will need to continue with trade liberalization policy to reduce at- and behind-the-border costs, which remain high relative to its comparator EMs. In addition, it will also require liberalizing FDI, creating an enabling environment for investments, and higher spending on hard and soft infrastructure to support future exports expansion. Furthermore, encouraging technical innovations by small- and medium-sized firms and integrating the informal sector would not only boost Indian exports, but also help create jobs and make growth more inclusive.

The rest of the paper is organized as follows. Section 2 examines the evolution of Indian exports in terms of its composition, direction, and pattern of diversification. Section 3 documents the transformation of India's exports using measures such as quality, sophistication, and complexity. Section 4 presents the future implications of the evolution of Indian exports. Section 5 summarizes key findings and identifies policy priorities.
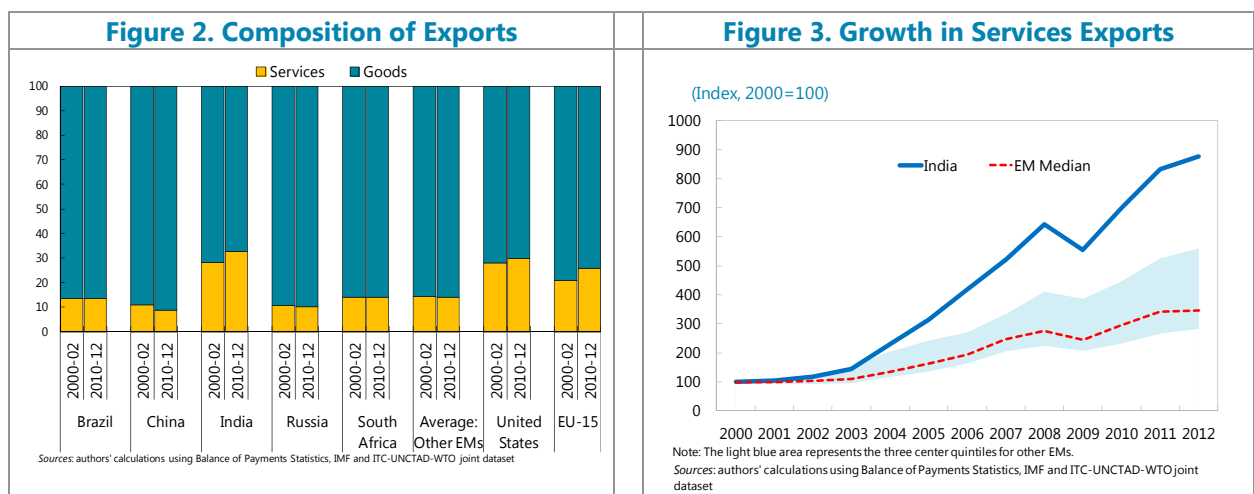
II. THE EVOLUTION OF INDIA'S EXPORT BASKET

The evolution of Indian exports is characterized by a large and growing share of services exports, dominated by modern services; increasing share of manufacturing exports, though still dominated by relatively low-technology content; and a well diversified exports basket, both in terms of destination and product. Increasing the share of manufacturing, particularly medium- and high-tech; expanding trade to new destinations; and further diversifying manufacturing and service exports remain key policy priorities.

A. The Composition of India's Export Basket

The evolution of Indian exports has not followed a "textbook" pattern. The pattern of evolution points to a dichotomy in the Indian economy – a well integrated, technologically advanced services sector, exporting high technology and high-value added services, and a relatively lagging manufacturing sector, exporting relatively low-tech and low-value products.

Typically, as a non-resource rich country develops, its exports basket moves from primary and resource-based exports to low and medium- technology manufacturing, then more high-tech manufacturing; and the share of services exports increases, with modern services becoming progressively more important. While Indian exports have followed this general evolutionary pattern, the share of service exports in total exports has grown to over 32 percent in 2013 from 28 percent in 2000 (Figure 2) and is now larger than many advanced countries and many upper middle-income economies. Also, this stands in contrast to China, where the relative importance of services in total exports has declined to 8 percent from 10 percent during 1990-2013. On the other hand, the share of manufacturing exports in total goods export in India is low and has declined to 67 percent from nearly 80 percent during 1990-2013.

Figure 2. Composition of Exports

Sources: authors' calculations using Balance of Payments Statistics, IMF and ITC-UNCTAD-WTO joint dataset

Figure 3. Growth in Services Exports

(Index, 2000=100)

Note: The light blue area represents the three center quintiles for other EMs.
Sources: authors' calculations using Balance of Payments Statistics, IMF and ITC-UNCTAD-WTO joint dataset

The growth of service exports in India is also atypical. The share of developing countries in the world service exports increased to over 25 percent in 2011 from about 14 percent in

1990. Service exports growth in developing countries has been higher than in advanced economies, albeit from a low base.[5] Services exports accounted for 15 percent of total exports in EMs. However, in India, growth in service exports has been much more rapid (Figure 3), resulting in the share of services exports in total exports to increase rapidly during the last decade. At 35 percent, it is even higher than the average in advanced economies. Commensurate with India's income levels, exports appear to have skipped directly to specialization in skill-intensive industries (within manufacturing) or to services where they appear to have a comparative advantage (at least vis-à-vis other poor countries) (see Kochhar et al 2006)). Several hypotheses have been put forth, such as colonial heritage, English speaking population, policy and infrastructure constraints   making it easier to move to services compared to manufacturing.

The Evolution of Goods Exports

Most of the fast growing economies in the last decade have seen marked increases in the share of manufacturing exports in total exports. For example, in 2013, manufacturing exports accounted for 90 percent of total exports in China, almost double the share during 1980-85. Indian exports have also undergone transformation during the decade of high growth, though to a lesser extent compared to peer-EMs. The share of manufacturing in total merchandise exports has increased to 57 percent in 2013 from 41 percent in 1980. However, the high reliance on resource based and primary products exports continues (Figure 4).[6] Primary products account for almost 40 percent of merchandise exports. Agricultural products such as cotton, rice, tea, bovine meat and spices dominate primary exports. Precious stones and iron ore dominate the resource export basket.

Figure 4. Manufacturing Versus Primary Goods

Figure 5. Technological Intensity of Manufacturing Exports

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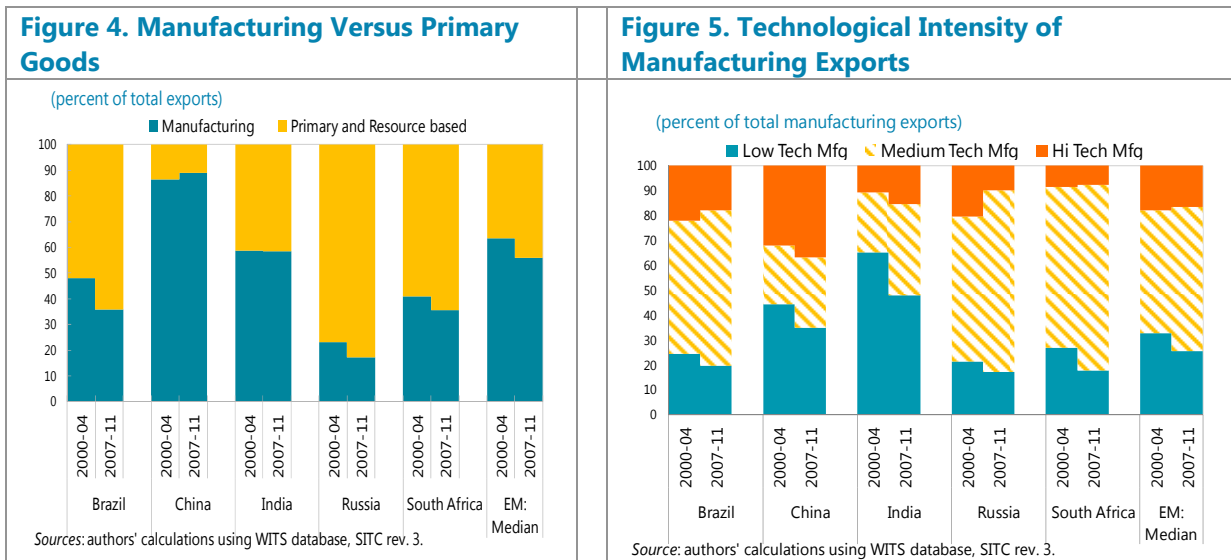
[5] We use developing countries to refer to both emerging markets and low-income countries.
[6] For the definition of primary and resource based products, see Lall et al., 2005 and Lall, 2000.

In terms of technological content,[7] the share of high-tech and medium-tech manufacturing exports in total manufacturing exports has increased globally, with a particularly large increase in China. India is no exception. Within manufacturing exports, there is a clear shift away from traditional exports, such as textiles, gems, and leather products, towards high-tech and medium-tech manufacturing products, such as engineering goods. However, the share of high-tech and medium-tech manufacturing exports in total good exports is substantially lower when compared to China or other EMs (Figure 5). The relative share of high-tech manufacturing exports has been increasing; however, resourced based production and low-tech manufacturing dominate the goods export basket. Manufactured machinery accounts for almost 10 percent of India's merchandise exports, while textile and garments account for more than 15 percent. The main contribution of this work is to comprehensively document Indian exports, which has not been done in the past decade. Also, recently developed methodologies are used to analyze the evolution of exports to study its implications for future growth and trade.

BOX. What Products Did India Export in 2013?

A tree map of India's gross export shows that resource-based products – refined petroleum oil, cotton, jewelry of precious metals, and rice – constitute major exports from India (Figure 6). Appendix Panel I presents a selection of the top exports from India, classified according to their technological intensity. Within low-tech manufacturing exports, jewelry, textile and apparel based exports are a major chunk of Indian exports. Within medium-tech manufacturing, the automotive industry dominates the basket, with machinery, various motor vehicle intermediary inputs for cars, bikes, construction, mining equipment and cosmetics making up the major chunk. In the high technology export basket, veterinary and pharmaceutical products, television, telecommunication transistors, aircraft components, X-ray equipment and electronic R&D in electro-medical, power and automotive industry are key elements of the export basket. Based on Leamer's classification (see Leamer, 1984),) diamonds, iron ore, steel, chemicals, tires and refined petroleum products are the key resource based exports from India. However, capital intensive manufactured goods like plastic and iron ore derivatives and equipment building products are also important (Appendix Panel II). The charts also highlights relatively fast manufacturing export growth in India compared to its peers.

Figure 6. What Did India Exports in 2012?
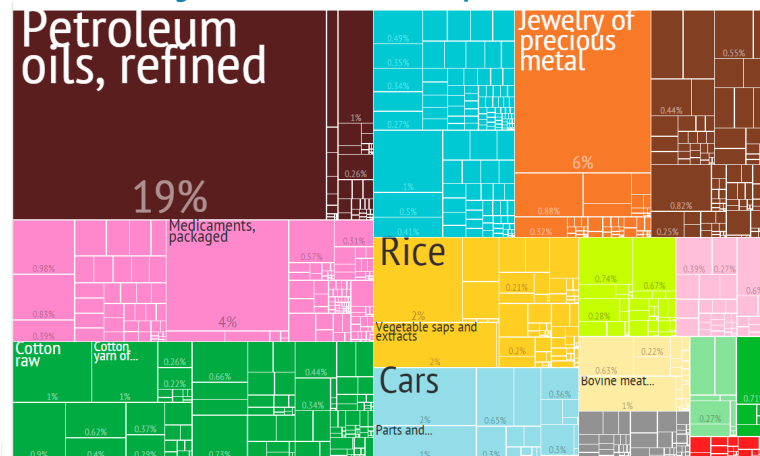
Sources: Atlas of Economic Complexity, Hasumann, Hidalgo et al. 2014.
Note: The chart presents details of products exported (in gross terms) from India at HS4 product classification.

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[7] See appendix for the definition of the technical content of exports.

The Evolution of Service Exports

Rapid growth in services in the last decade has been attributed to information and communication technology (ICT) revolution of mid-1990s and rapid growth in technology, transportability, and tradability (often referred to as the 3Ts) that changed the nature, productivity and tradability of services (Ghani and Kharas, 2010). These advancements have also qualitatively changed services exports – rapid growth of such services that do not require face-to-face interaction, and can be stored and traded digitally. We define these services as *modern services.*[8] Modern services are the fastest growing sector of the global economy, with the share of modern services export in total services export growing in almost every country. In India, modern services exports account for nearly 70 percent of the total commercial services exports (compared to around 35 percent in EMs) and have been growing much faster than the traditional services. In this respect, Indian services exports mix resembles that of Ireland (Appendix Panel III).[9]
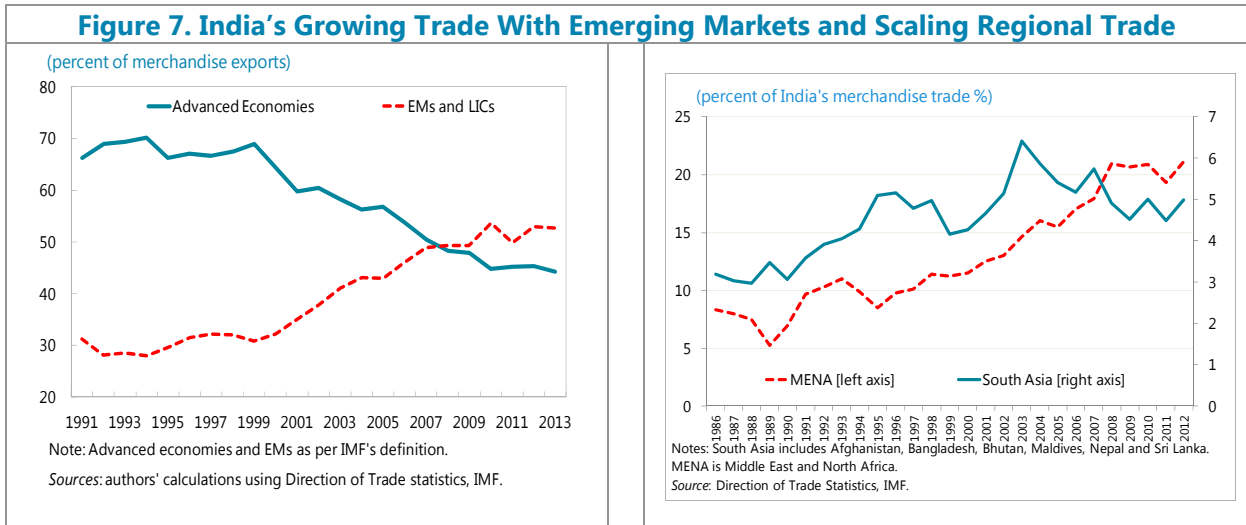
Over time, the importance of sophisticated technology-oriented business exporting services has increased. In particular, computer service exports are a major component of service exports from India, accounting for almost 70 percent of total service exports. Finance, travel, sea transport (freight), and several business services such as legal, accounting, management, public relations, architecture, engineering and technical services account for the remaining chunk of India's service export basket. However, India's service export basket exhibits a peculiar composition in that it involves various skill levels: while the majority of its service exports are computer services, personal travel services and transport are also big. World market share of certain other services are increasing, in particular of research and development, franchising, and service exchange between affiliate enterprises (Appendix Panel IV).

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[8] Formally, we define modern services as comprising: finance; computer and 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.

[9] See Mishra (2015) for details on service trade statistics using IMF Balance of Payments BPM5 and BPM6.

B. Direction of India's Exports

In line with global trends, Indian exports exhibit a shift toward emerging and developing economies at the expense of advanced economies (Figure 7).

Figure 7. India's Growing Trade With Emerging Markets and Scaling Regional Trade

(percent of merchandise exports)

Note: Advanced economies and EMs as per IMF's definition.
Sources: authors' calculations using Direction of Trade statistics, IMF.

Notes: South Asia includes Afghanistan, Bangladesh, Bhutan, Maldives, Nepal and Sri Lanka. MENA is Middle East and North Africa.
Source: Direction of Trade Statistics, IMF.

The share of exports to the EU and the USA fell to around 29 percent in 2013 from over 45 percent in 2000, and East Asia and the Middle East have emerged as the top two destinations (Appendix Panel V). Exports from India to the Middle East have grown rapidly in the last decade, though some of these exports may be re-routed to other countries (in particular to Pakistan). Exports to Latin America are also growing, but the share remains small.[10] Similarly, there is a clear trend of growing South-South trade. The share of exports to emerging and developing countries from India is more than half of India's merchandise exports, growing over 10 percentage points over the last decade. The share of Middle East and North Africa has grown over 5 percentage points over the last decade to over 20 percent of India's total merchandise export. Similarly, Emerging Asia also accounts for a rising share of India's merchandise trade to almost 20 percent (Appendix Panel VI).

C. Diversification of India's Exports

The evolution of Indian export diversification is in line with global patterns of economic transformation. As countries develop they become less specialized and more diversified in terms of output, trade and employment following a "U" shape curve. We use the Herfindahl Index (HI) – both at the aggregate level and at the sector level – to compare the evolution of Indian exports. India has increasingly diversified its merchandise exports over the last three decades (Figure 8). Similarly, services exports have also become more diversified over

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[10] Growing bi-lateral trade relations between Brazil, Mexico and India might foster higher volumes of exports in Latin America in the near future.

time, reflecting the benefits of fragmentation, and integration of different activities becoming tradable through technological changes. Appendix Panel VII provides the trend diversification in Indian export basket both aggregated and within sectors. Among peer-EMs, Indian exports are well diversified. A similar pattern of diversification is witnessed when we look at the Herfindahl Index by technological intensity. There is a clear trend of increased diversification of primary, resource based and hi-technology manufacturing exports. Although, there is some indication of concentration in low- and medium-tech manufacturing, the overall pattern in manufacturing and service exports exhibits growing diversification.

Internationally traded services from India are also growing in diversity, with new firms providing a variety of new services such as architecture, engineering, hardware, software consulting, analysis and financial services. But, relative to goods exports, India's service exports diversification is relatively low compared to peer EMs'. (Appendix Panel VIII).

Figure 8. India's Export Diversification (Measured by Herfindahl Index)
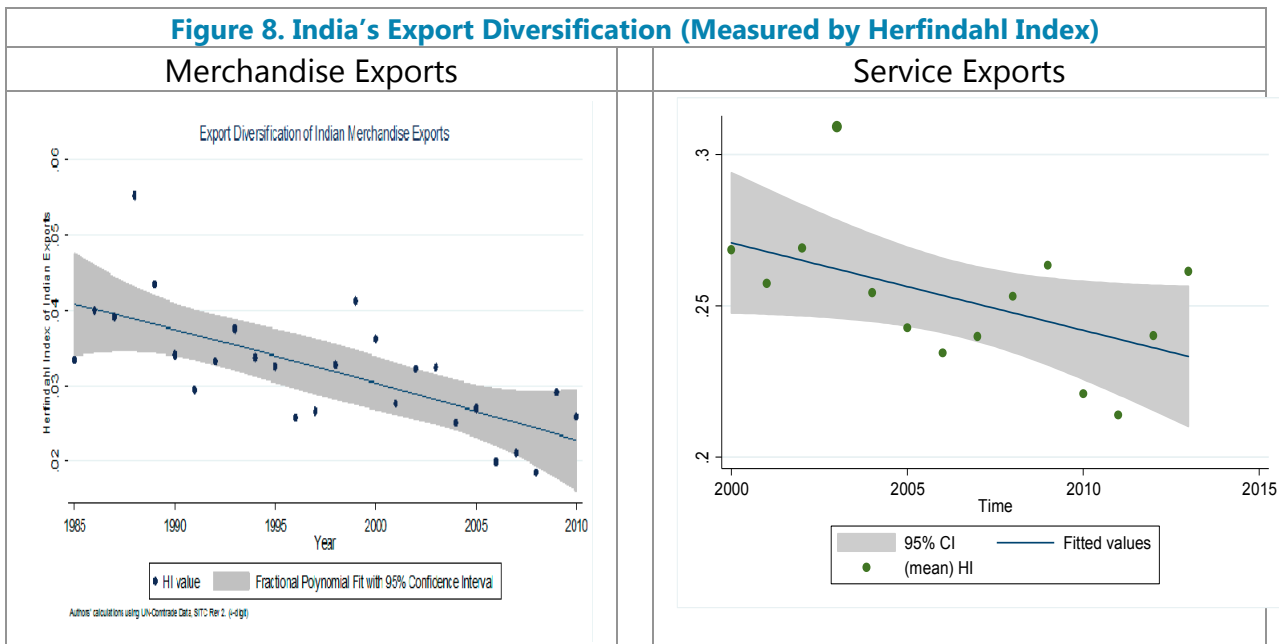
Sources: WITS database, SITC rev. 3, Balance of Payments Statistics, IMF and authors' calculations.
Notes: The service export chart for Herfindahl Index reported above is based BPM6 Trade in Service Classification. The appendix charts provide the disaggregated view of economic diversifiation based on detailed service activities.

### III. THE TRANSFORMATION OF INDIA'S EXPORTS

Indian service exports are highly sophisticated and complex. However, even though the quality, sophistication and complexity of Indian goods exports have increased, it remains below the level of peers. Improving the quality, sophistication, and complexity of goods exports, and further enhancing the complexity of service exports remain key policy priorities.

A. The Quality of Indian Exports

In this section, we examine the evolution of the quality of Indian exports and compare them to its peers. Quality management and quality assurance is critical for firms to be successful in the global market. Moreover, diversification is important to create new opportunities to upgrade (Henn et al, 2013). However, the potential for quality upgrading, that is, the length of a product's quality ladder, varies by product (Khandelwal, 2010; Schott, 2004). Natural resources tend to have lower potential for quality upgrading than agricultural products or manufactures; the latter group typically has the highest quality upgrading potential (Henn et al, 2013; 2015).

Figure 9 compares the quality of selected exports from India with peer-EMs. Indian exports of diamonds, nuclear reactors, tin and alloys are of better quality than peer-EMs; however, on most other goods, India does not fare as well when compared to its peers.

The mean product quality has been steadily increasing over the last few decades. Appendix Panel IX - A plots the export quality of Indian products at the 4-digit level in 1990 and 2010, with most products above the 45-degree line implying that quality has increased over the last two decades. The other panels provide further details on overall and product specific quality trends of India's exports.

Figure 9. Quality of Indian Exports
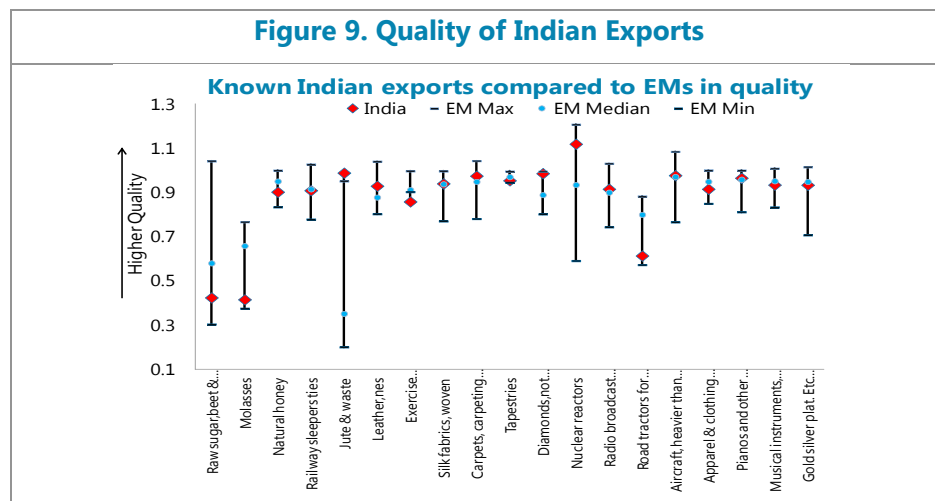
B. The Sophistication of Indian Exports

Similar to the concept of quality, in the recent years, a small but rapidly growing literature has emerged, examining increase in sophistication as a possible determinant of growth. HHR developed an indicator that measures the productivity level associated with a country's export basket. This measure is significantly positively associated with subsequent economic growth. In other words, countries that produce high-productivity goods enjoy faster growth than countries with lower-productivity goods. They conclude that it is not the amount of exports, but the technological content and sophistication of exports that matters for growth

and future export performance. Extending this framework, Anand et al (2012), and Mishra et al (2011) have shown that greater services exports sophistication is also associated with higher growth.

As part of their analysis, HHR define the related concepts of "productivity" or "income potential" of a given product (*PRODY*), ranking products and services based on the income level of the countries that export them – products exported by rich countries are ranked higher. Productivity associated with individual items is then used to construct an index (*EXPY*), which can be thought of as representing the productivity or income level associated with a country's export basket. As a broad rule of thumb,, the measure captures whether any given country's export basket consists primarily of products typically exported by high-income economies (and viewed as relatively more sophisticated) or by low-income economies (and viewed as relatively less sophisticated).[11]

Indian services exports are highly sophisticated. In fact, Indian service exports, dominated by highly sophisticated modern services, are even more sophisticated than the average level of high-income countries (Appendix Panel X). In early 1990s, the composition and sophistication of Indian services export basket was similar to other countries at its income level. However, service export sophistication grew relatively faster in India because the composition of service exports moved away from traditional activities to modern activities like business services and computer services. The share of telecommunications, computer and information services – service with the highest productivity has been steadily increasing, almost composing half of India's commercial service export basket. This has resulted in a rapid increase in sophistication of India's services exports. As a result, for its level of per capital income, India is a clear outlier in terms of the sophistication of its services exports.

In contrast, the level of Indian goods export sophistication remains low. Overall India's goods export sophistication has remained below the average sophistication level of comparator Asian economies, and it is much lower than China's and Brazil's. The sophistication of the manufacturing exports shows similar trends—it has increased over time, but remains below the average sophistication level of the rest of Asia.

C. Complexity of Indian Exports

A new indicator called economic complexity index (ECI), developed by Hausmann et al (2011) and Simoes and Hidalgo (2011), is based on the underlying idea that countries differ in the amount of productive knowledge they hold, and so do products. It is a holistic measure that captures a country's productive knowledge and capabilities. The ECI combines metrics of the *diversity* of countries with the *ubiquity* of products. Countries that possess more knowledge have what it takes to produce a more diverse set of products. In other words, the amount of embedded knowledge that a country has is expressed in its productive

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[11] See Appendix for details.

diversity. Ubiquity is defined as the number of countries that make a product. The ubiquity of a product reveals information about the volume of knowledge that is required for its production. Complex products – those that require large productive knowledge–are less ubiquitous. Therefore, the amount of knowledge that a country has is expressed both in the diversity and ubiquity of the products that it makes.[12] Countries like Japan or Germany, with high ECI's, produce goods that are highly unlikely to be produced by countries' with low ECI. Similarly countries with low ECI's are more likely to produce things that are commonly produced around the globe.

Figure 10. Economic Complexity Index, 2012
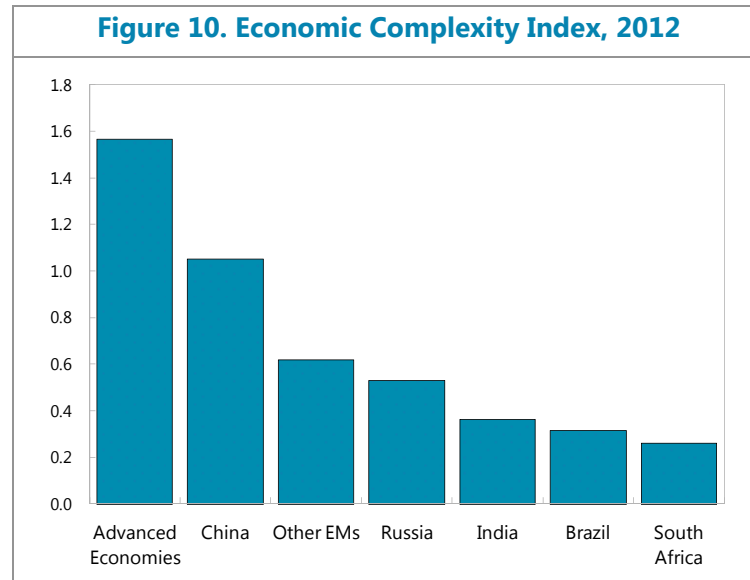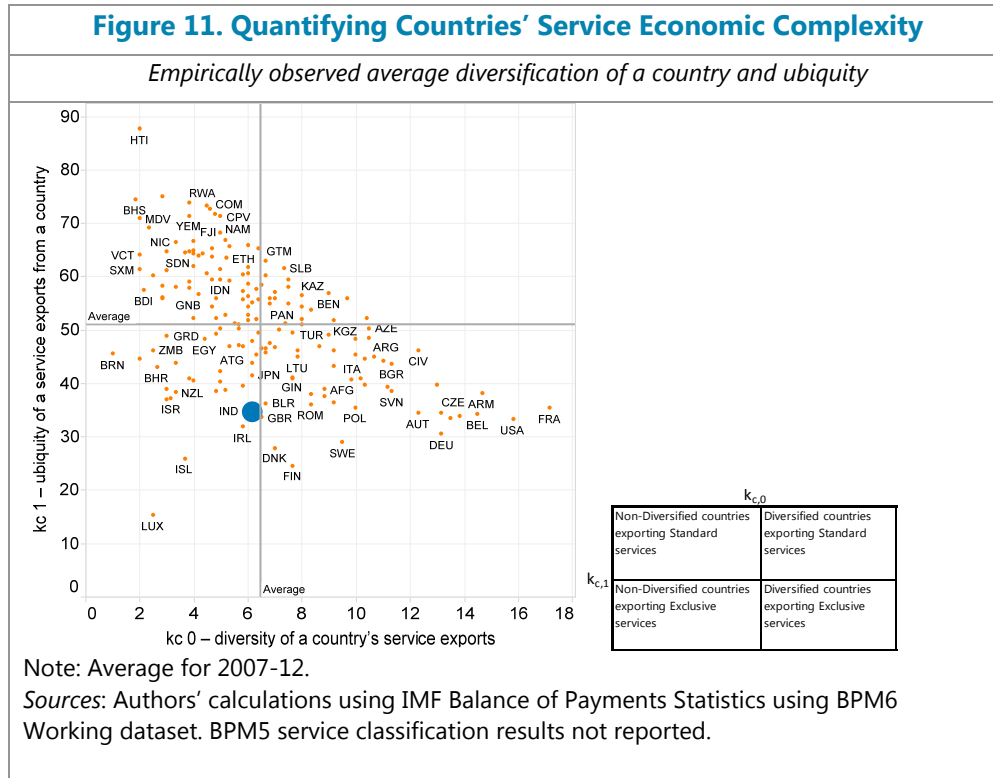
Source: The Atlas of Economic Complexity, 2015.

India has room to converge both in manufacturing productivity and product complexity. On a global scale for the ECI, India ranks 54 out of 144 countries. Though higher than Brazil and South Africa, India ranks below peer-EMs, and especially China in the ECI (Figure 10). India is a non-ubiquitous, and a diversified merchandise exporter.

Similarly, services like goods have intrinsically different values, with specializing in some provides a greater probability to diversify and become more connected to the rest of the economy. Analysis suggests that several freight based transport exports, advertising, marketing, and research services are most connected to the rest of the economy.[13] In particular, several forms of in-land water, rail, sea transport auxiliary service networks are

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[12] See Hausmann et al (2011) for details. A higher index suggests that a country is capable of producing a diverse range of products and products that are less ubiquitous than in other countries.

[13] Freight transportation based service networks, in particular related to rail, road, and sea transport supply chains, are the next most connected services. Other healthcare related, tourism service, as well as business and engineering services are highly linked to overall production in the service economy. Tourism services are found to be the most ubiquitous service export.

becoming important. Specializing in some of these activities may have stronger backward and forward linkages to the rest of the economy. Diversity of service exports against the ubiquity of that country's overall service export basket is shown in Figure 11 (see Mishra 2015 for details), with average diversity and ubiquity dividing the chart into four quadrants (explained in the accompanying table). India falls in the quadrant of relatively non-diversified countries exporting exclusive services. This is a reflection of the fact that high-value computer exports make up the majority of India's service exports. So, even though India's service exports are of high-value, they are much less diversified.

Figure 11. Quantifying Countries' Service Economic Complexity

Empirically observed average diversification of a country and ubiquity

	$k_{c,0}$	
	Non-Diversified countries exporting Standard services	Diversified countries exporting Standard services
$k_{c,1}$	Non-Diversified countries exporting Exclusive services	Diversified countries exporting Exclusive services

Note: Average for 2007-12.
Sources: Authors' calculations using IMF Balance of Payments Statistics using BPM6 Working dataset. BPM5 service classification results not reported.

IV. IMPLICATIONS OF THE EVOLUTION OF INDIAN EXPORTS

Product space analysis and the Revealed Comparative Advantage of Indian exports suggest that India is well placed to diversify into income-enhancing products. Increasing the share of high income marginal and disappearing exports, and diversifying into the core of the product space remain key policy priorities.

Having documented the evolution and composition of Indian exports, we next turn to analyze its implications for future exports performance and growth. We use the product space and network approaches drawing upon the works of Hausmann and Klinger (2006) and Hidalgo et al (2007) and for this purpose.

Central to this framework are the following key ideas: (i) products differ in productivity and future growth consequences; (ii) development is a process that involves not only producing more of the same set of products, but also the introduction of new ones; that is, sustained growth involves the accumulation of more complex sets of capabilities; (iii) the ability of a country to export a new product is dependent on its ability to export similar products; and (iv) commodities requiring similar capabilities are more likely to be exported together.

To study the potential of Indian exports, we proceed as follows: first, we calculate the revealed comparative advantage (RCA) of India's exports. Next, drawing upon product space analysis, we rank products and services according to their income enhancing potential and the likely probability of being exported. This provides an indication about products, whose further development could increase the income of Indian exports. Finally, we also explore products that are easier to diversify into using the concepts of product space. If India's current exports are connected to products with high income enhancing potential and high probability of exporting, then India stands to gain by trying to move to those products.

A. Analysis of Revealed Comparative Advantage of Indian Exports

In this subsection we calculate the revealed comparative advantage (RCA) of India's exports. RCA, a concept first developed by Balassa (1965), is a measure of the relative export performance by a country for a specific export product.[14] A country is said to have a revealed comparative advantage in a particular export when the share of that product in a country's total exports is larger than the share of that product in the global trade (yielding an RCA greater than one). Using RCAs, India's major export products are classified into four main categories: "Classic", "Marginal", "Disappearing", and "Emerging" products. A "classic" product is defined as a product in which India had RCAs in both the 1990-94 and 2007-11 sub-periods.[15] In other words, the share of that product in India's total goods exports

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[14] See Appendix for details.

[15] Please note that for measures of trends in comparative advantage of services, we use the time period of 2000-02 and 2008-11.

exceeded the share of that 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 India 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. "Emerging" products are those in which a country only developed an RCA at the end of the sample period.

Classic Products

Classic products – export products in which India has demonstrated consistent and long-run RCA – account for over 60 percent of India's export basket. Classic products include some of key traditional Indian exports, such as gems and jewelry, tea, garments, and leather etc. The average income level associated with classic product is 11,734, which is relatively low. However, out of the 129 classic products, 38 product lines are income enhancing (PRODY greater than EXPY).

Disappearing Products

Disappearing products – export products in which India no longer has RCA – account for almost 4 percent of India's export basket. The average income level associated with disappearing products is approximately 12,225, marginally higher than the average income level associated the classic exports.

Emerging Products

Emerging products – export products in which India has gained RCA in recent times – account for almost 10 percent of India's exports value. Though the number of emerging products is relatively small, these products are of high productivity (average income level of 12,673. Out of the 37 emerging products, 40 percent of them are income enhancing.
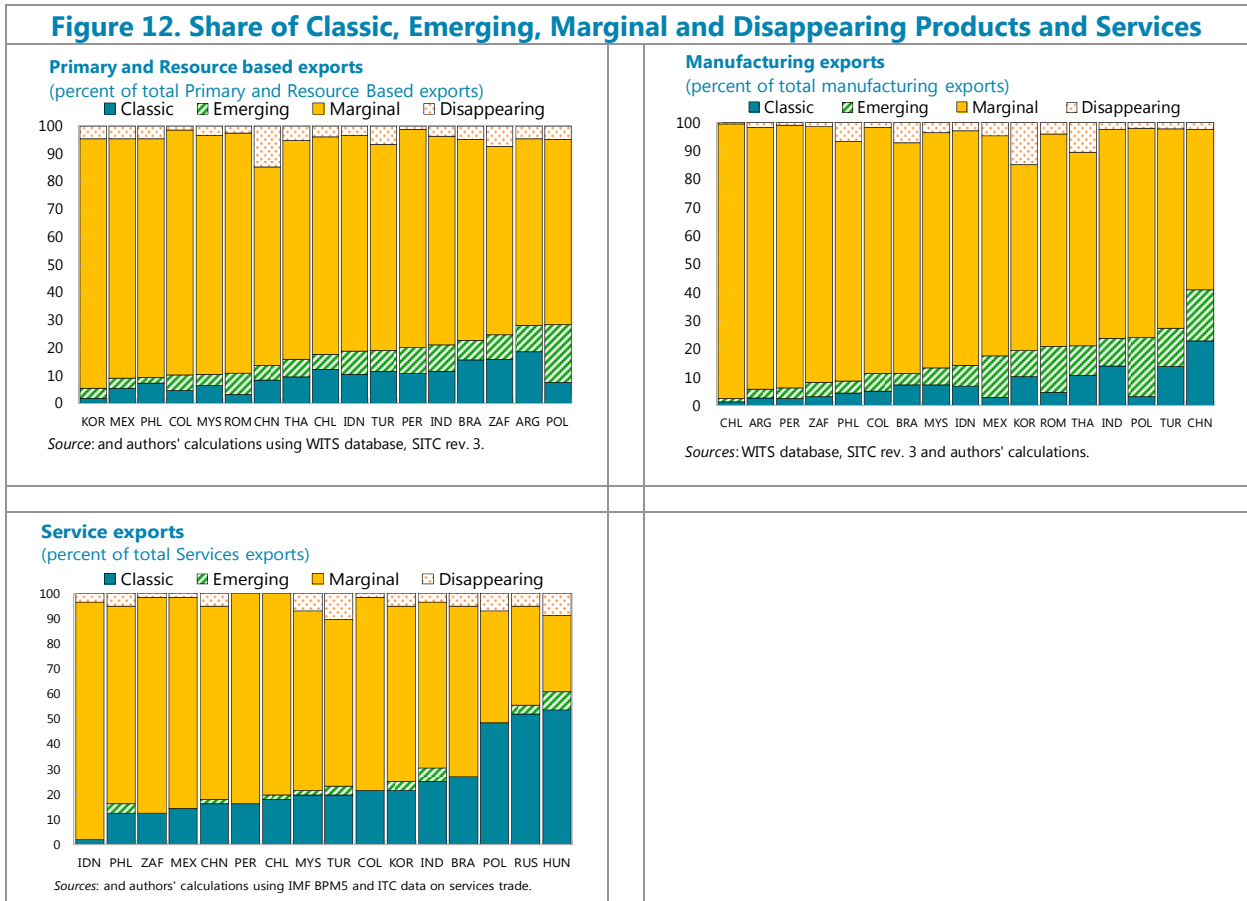
Marginal Products

Marginal Products – export products in which India never had comparative advantage – make up slightly over 25 percent of export basket. The average income level associated with India's marginal export basket is almost 19,000, indicating a tremendous potential boost in income from increasing the exports of these products. Out of the 573 products that are marginal to India's exports, over 60 percent of them are income enhancing and belong mostly to medium- and high-tech manufacturing category.

Finally, we plot the summary export charts for resources, manufacturing and service exports for India comparing it to its peers (Figure 12). India's comparative advantage in exports is less than 20 percent of potential resource and manufactured products. In other words, India has potential 80 percent of products and activities that can be developed and exported to new destinations. Similarly, India only exports 70 percent of potential services that are

tradable, implying significant scope for diversifying Indian services exports. Appendix Panel XI provides details on India's evolving comparative advantage in exporting services.

Figure 12. Share of Classic, Emerging, Marginal and Disappearing Products and Services

Primary and Resource based exports
(percent of total Primary and Resource Based exports)

Source: and authors' calculations using WITS database, SITC rev. 3.

Manufacturing exports
(percent of total manufacturing exports)

Sources: WITS database, SITC rev. 3 and authors' calculations.

Service exports
(percent of total Services exports)

Sources: and authors' calculations using IMF BPM5 and ITC data on services trade.

B. Product Space Analysis of India Exports

In standard trade theory, diversifying to new export products of higher productivity (structural transformation) is a passive consequence of changing comparative advantage based on factor accumulation. However, there is a growing literature suggesting that the process is much more complex.[16] This is based on the idea that every product requires highly specific inputs, which are relatively easily redeployed to produce a similar product. To analyze development and structural transformation from this perspective, Hidalgo et al. (2007) have developed a new analytical tool called the *product space*.

Product space is a term used to describe the network of relatedness between products. Relatedness is associated with the similarity in the inputs required by a certain activity, including skills, institutional and infrastructure requirements, and technological similarity, and is quantified by a measure called *proximity*. The concept of proximit*y* formalizes the intuitive idea that the ability of a country to produce a product depends on its ability to produce similar products. The underlying ideas is that the production (and export) of different products requires different and very specific capabilities, such as human or physical capital, knowledge of markets, legal systems, institutions, etc. For example, the capabilities required to successfully export pineapples are very different from those required to export iPads. What differentiates these capabilities is that some of them can be easily redeployed into the production and export of many other products; that is, there are some goods that are "closer" to other goods. Likewise, there are many other products that are "far away" from other products. One example is the case of natural resources such as oil, which requires very specific capabilities that cannot be easily redeployed. This notion of *proximity* between two products is measured by observing trade outcomes rather than by looking at physical similarities between products on the assumption that similar products are more likely to be exported in tandem.[17]

The collection of all proximities is a network connecting pairs of products that are significantly likely to be co-exported by many countries, and is referred to as the *product space*. The proximity matrix can be considered a complex network, where each product represents a node in the network while the edges between them and their intensities are denoted by the proximities between the products.

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[16] HHR (2007) argue that while fundamentals play an important role, they do not uniquely pin down what a country will produce and export. Furthermore, they show that not all good are alike in terms of their consequences for economic performance. Specializing in some products will bring higher growth than specializing in others. Hausmann and Klinger (2006) and Hidalgo et al. (2007) show that it is much easier to produce a good that is "similar" to an already produced good.

[17] We take the conditional probability of exporting a product or a service given that you export a different product or service. See appendix for details.

To use product space analysis to analyze future prospects of exports and growth performance, two notional variables "path" and "density" are used. While path is a measure of the potential for future diversification, density is a measure of the ability of a country to take advantage of that potential. Formally, path is defined as the sum of all proximities between any given product and all other products. A high value of path is indicative of products that are at the core of the product space and whose proximities with the rest of the nodes have larger values. A product with a longer *path* offers a better platform for further diversification than products at the periphery (with shorter *paths*).

The probability to develop comparative advantage for a product in the future depends on the ease with which capabilities existing in the country can be adjusted to the needs of launching the new product. Hence it is important how close the new product is to the existing export structure. This measure is called *density*. Density varies from 0 to 1, with higher values indicating that the country has achieved comparative advantage in many nearby products, and therefore should be more likely to export that good in the future. Hausmann and Klinger (2006) show that this measure of density is indeed highly significant in predicting how a country's productive structure will shift over time: countries are much more likely to move to products that have a higher density, meaning they are closer to their current production.

A country's position in the product space signals its capacity for structural transformation. The process of structural transformation can be helped or hindered by the nature of the products in which the country specializes.[18] A country that produces goods in the dense core of the product space will find structural transformation a much easier process because the set of acquired capabilities can be easily redeployed into the production of other products. However, for a country that specializes in peripheral products, the shift to the production of other products will be more challenging. On average, core products are the most sophisticated and well-connected to the rest of the product space, that is, these products provide more opportunities to redeploy the capabilities that they embody, which facilitates the export of a large number of other products. Consequently, countries that export a significant share of core commodities face much more favorable prospects from those faced by countries with a low presence in the core.

The product space for India is such that products with high average income per-capita associated with them, as measured by PRODYs, are located in the core of the product space, while products on the periphery are generally associated with low average income per-capita. So, there is a rich region of the product space, composed of machinery, metal

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[18] Hausmann & Klinger (2006) show that this measure of density is indeed a highly significant in predicting how a country's productive structure will shift over time: countries are much more likely to move to products that have a higher density, or are *closer* to their current production.

products, chemical and capital intensive goods, and a poor, peripheral region, made of some agricultural and labor intensive goods. To one side lies an electronics cluster; to another side there is an apparel cluster. Disconnected from it and closer to the central cluster is the textile cluster. The rest of the product space is quite barren.

We use the product space network to study the evolution of India's productive structure, by observing the location of products in which India has revealed comparative advantage (RCA > 1, defined earlier) in two different time periods. Figure 13 presents India's product space network map of merchandise exports in 1995 and 2012.

Two clear trends are visible: the number of products in which India has comparative advantage has increased, and in line with the experience of other countries, the core has become more populated (blue nodes). Moreover, as discussed above, the network exhibits heterogeneity and a core-periphery structure: the core of the network consists of metal products, machinery, and chemicals, whereas the periphery is formed by fishing, tropical, and cereal agriculture. Over time exports of apparels and textiles have lead to comparative advantages in related products such as fabrics, leather, fashion, garment technology exports (green nodes). Similarly other sources of comparative advantage can be traced in Indian manufacturing through diversifying into automotive components to design, domestic sourcing, assembly, and distribution of finished automotive vehicles (blue nodes) and chemical products (brown nodes). Compared to India's product space, Panel XII depicts the product space of Germany, a country known for its design and engineering intensive manufacturing exports.

Figure 13. Product Space

1995
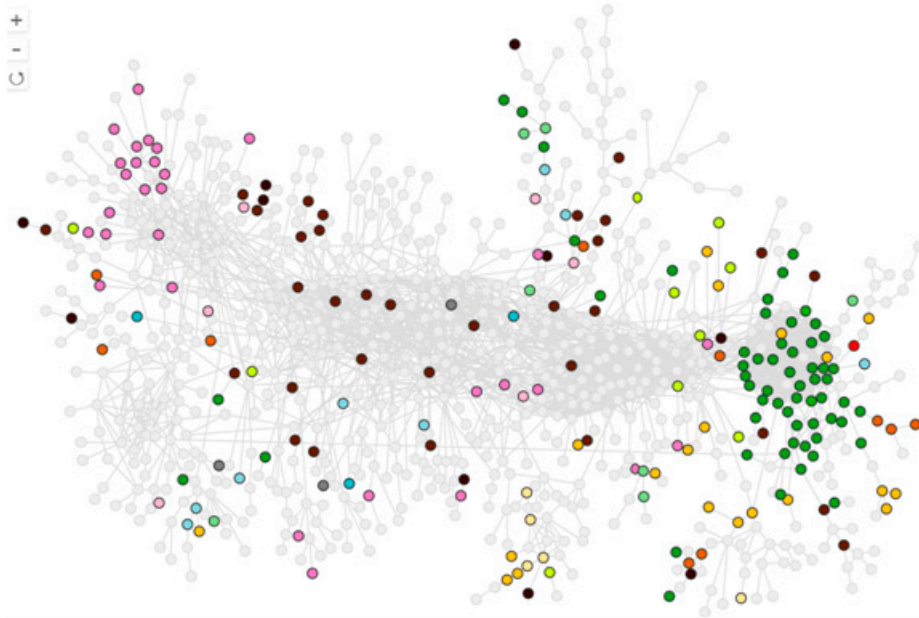
2012
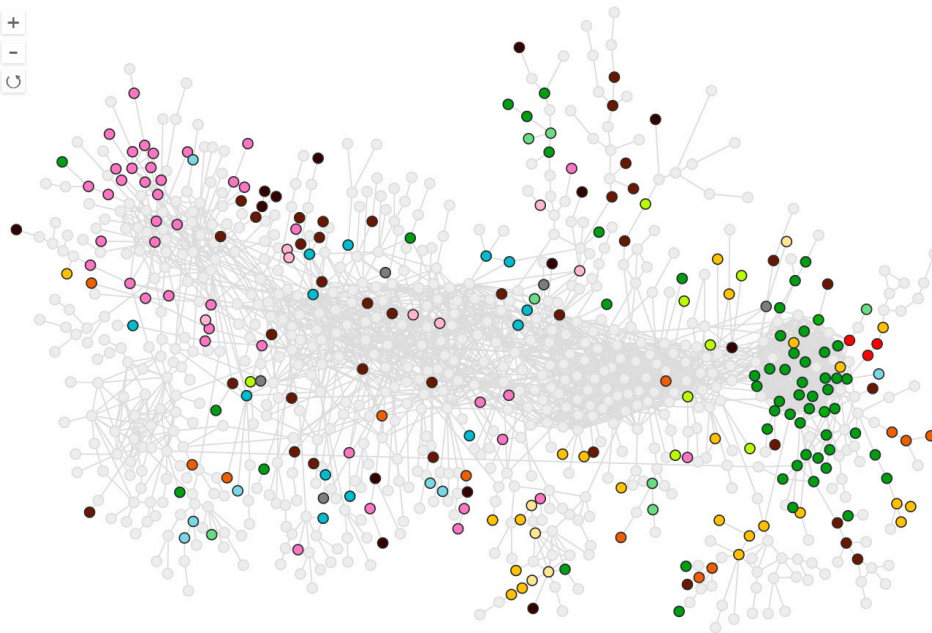
Source: Atlas of Economic Complexity, Hausmann, Hidalgo et al. 2014.
Notes: The product space filters by RCA Threshold>=1. The product space is based on HS4 Product Class.

C. The Income Enhancing Potential of Indian Exports

Having classified Indian exports into various categories, using the concept of RCA, and product space analysis of Indian exports, we examine the income enhancing potential of Indian exports. We use the concept of income associated with a product to rank the income enhancing potential of Indian exports. Products with higher income (PRODY) than that of goods in the export basket (EXPY) are more sophisticated than the country's export basket as a whole, and producing them will increase the income or EXPY of the export basket. Defined as ln (PRODY)/(EXPY), a higher number represents higher income enhancing potential. We present the top income enhancing exports by their RCA categories – disappearing, emerging, and classic products. Products are color coded to represent the technological intensity. (Appendix Panel XIII).

Indian exports categorized into four categories (based on RCA) with the path, densities, and PRODYs associated with them are summarized in Table 1. The same information for services is summarized in Table 2. The products are ranked in the descending order of their share in the overall export basket.

Table 1. Details of Good Exports

| Product	Share in Merhcandise Exports (%) 2007-11	PRODY (2007-11)	Path	Density	Export Value	Tech Class	Community
Special transactions, commodity not classified accordir	19.7	20,001	105	0.29	56,500,000		Not classified
Diamonds (non-industrial), not mounted or set	9.7	8,902	83	0.38	22,400,000	RB2	Precious Stones
Precious jewellery, goldsmiths' or silversmiths' wares	4.7	14,249	118	0.35	19,400,000	LT2	Mining
Medicaments (including veterinary medicaments)	2.6	24,751	158	0.28	9,038,613	HT2	Other Chemicals
Iron ore and concentrates, not agglomerated	2.5	9,726	62	0.45	2,407,949	RB2	Mining
Passenger motor vehicles (excluding buses)	1.4	22,631	164	0.24	4,237,831	MT1	Machinery
Rice, semi-milled or wholly milled	1.4	5,409	89	0.44	5,996,717	PP	Cotton, rice, soy beans and others
Under-garments, knitted or crocheted; of cotton, not el	1.3	7,574	129	0.38	2,578,301	LT1	Garments
Tugs, special purpose vessels and floating structures	1.2	11,194	102	0.35	3,299,603	MT3	Ships
Organic chemicals, nes	1.1	18,675	111	0.29	2,617,244	RB2	Chemicals and health related produc
Copper and copper alloys, refined or not, unwrought	1.1	6,510	98	0.37	2,247,423	PP	Mining
Raw cotton, excluding linters, not carded or combed	1.0	1,945	80	0.43	3,647,066	PP	Cotton, rice, soy beans and others
Cotton yarn	1.0	4,442	117	0.41	3,216,340	LT1	Textile & Fabrics
Oilcake and other residues (except dregs)	1.0	6,555	106	0.34	2,460,145	PP	Cereals and vegetable oils
Linens and furnishing articles of textile, not knitted or	0.9	7,039	131	0.38	2,766,998	LT1	Garments
Other parts and accessories, for vehicles of headings 7	0.9	21,300	179	0.24	3,515,147	MT1	Machinery
Other tubes and pipes, of iron or steel	0.9	13,482	157	0.32	1,774,201	MT2	Metal products
Television, radio-broadcasting; transmitters, etc	0.8	20,772	97	0.32	2,868,286	HT1	Electronics
Other sheet and plates, of iron or steel, worked	0.7	17,654	147	0.33	1,741,408	LT2	Metal products
Cyclic hydrocarbons	0.7	23,161	119	0.33	2,427,080	RB2	Chemicals and health related produc
Bovine meat, fresh, chilled or frozen	0.7	11,576	135	0.30	2,995,860	PP	Meat and eggs
Ferro-alloys	0.7	8,490	99	0.36	1,908,147	MT2	Metal products
Footwear	0.7	11,149	146	0.35	1,686,395	LT1	Garments
Womens, girls, infants outerwear, textile, not knitted or	0.7	8,724	140	0.38	1,287,118	LT1	Garments
Crustaceans and molluscs, fresh, chilled, frozen, salted,	0.7	7,490	95	0.38	2,332,392	PP	Fish & Seafood
Outerwear knitted or crocheted, not elastic nor rubber	0.6	9,004	130	0.41	1,489,818	LT1	Garments
Parts, nes of the aircraft of heading 792	0.6	23,537	129	0.29	1,708,347	HT2	Aircraft
Fabrics, woven, of continuous synthetic textile material	0.6	21,991	134	0.38	1,052,389	MT2	Textile & Fabrics
Synthetic organic dyestuffs, etc, natural indigo and colc	0.5	18,202	133	0.31	1,375,244	RB2	Chemicals and health related produc
Ships, boats and other vessels	0.5	15,777	95	0.29	596,999	MT3	Ships
Switches, relays, fuses, etc; switchboards and control p	0.5	18,861	155	0.25	1,385,254	MT3	Machinery
Womens, girls, infants outerwear, textile, not knitted or	0.4	8,997	155	0.36	1,214,768	LT1	Garments
Iron or steel coils for re-rolling	0.4	16,425	141	0.30	1,136,171	MT2	Metal products
Under garments of textile fabrics, not knitted or croche	0.4	8,230	133	0.39	977,943	LT1	Garments
Building and monumental stone, worked, and articles t	0.4	13,140	127	0.38	909,165	RB2	Not classified
Cotton fabrics, woven, bleached, dyed, etc, or otherwis	0.4	10,129	128	0.39	1,295,205	LT1	Textile & Fabrics
Travel goods, handbags etc, of leather, plastics, textile,	0.4	12,632	105	0.38	1,002,362	LT1	Garments
Alkyds and other polyesters	0.4	22,693	156	0.32	839,625	MT2	Not classified
Polypropylene	0.4	16,541	163	0.31	1,063,897	MT2	Petrochemicals
Yarn 85% of synthetic fibres, not for retail; monofil, str	0.4	10,573	148	0.33	1,291,308	LT1	Textile & Fabrics
Nuts edible, fresh or dried	0.3	2,184	106	0.41	860,854	PP	Cotton, rice, soy beans and others
Womens, girls, infants outerwear, textile, not knitted or	0.3	11,411	137	0.38	1,118,570	LT1	Garments
Maize, unmilled	0.3	8,213	116	0.33	1,132,559	PP	Cereals and vegetable oils
Articles of apparel, clothing accessories of leather	0.3	8,383	144	0.36	887,499	LT1	Garments
Clothing accessories, of textile fabrics, not knitted or cr	0.3	7,522	135	0.38	854,140	LT1	Garments
Antibiotics, not put up as medicaments	0.3	28,573	136	0.30	887,708	HT2	Other Chemicals
Castings of iron or steel, in rough state	0.3	17,093	177	0.28	1,129,138	LT2	Processed minerals
Motorcycles, auto-cycles; side-cars of all kind, etc	0.3	16,461	116	0.33	1,318,130	MT1	Machinery
Refined sugar etc	0.3	8,795	139	0.34	990,933	RB1	Misc Agriculture
Building and monumental (dimension) stone, roughly	0.3	9,878	122	0.39	835,853	PP	Processed minerals
Copper and copper alloys, worked	0.3	16,822	156	0.28	173,630	PP	Metal products
Piston engines parts, nes, falling in headings: 7132, 71.	0.3	17,748	164	0.24	707,092	MT3	Machinery
Tea	0.3	2,072	96	0.43	685,456	PP	Cotton, rice, soy beans and others
Cocks, valves and similar appliances, for pipes boiler sl	0.3	24,065	172	0.24	1,007,590	MT3	Machinery
Mineral tars and products	0.3	16,213	152	0.32	827,381	RB2	Agrochemicals
Aluminium ores and concentrates (including alumina)	0.3	3,338	73	0.38	400,947	RB2	Mining
Chemical products and preparations, nes	0.3	22,276	132	0.25	682,496	MT2	Chemicals and health related produc
Heterocyclic compound; nucleic acids	0.3	31,038	100	0.23	998,550	RB2	Chemicals and health related produc
Aluminium and aluminium alloys, unwrought	0.3	15,364	113	0.28	685,664	PP	Processed minerals
Men's and boys' outerwear, textile fabrics not knitted c	0.3	7,189	141	0.38	663,430	LT1	Garments
Bars, rods (not wire rod), from iron or steel; hollow mir	0.3	14,941	151	0.29	686,567	LT2	Construction materials and equipme
Base metal domestic articles, nes, and parts thereof, ne	0.3	11,767	149	0.36	603,899	LT2	Home and office products
Insecticides, for sale by retail or as preparations	0.3	14,846	150	0.30	802,656	MT2	Agrochemicals
Machinery for specialized industries and parts thereof,	0.3	27,224	128	0.22	681,887	MT3	Machinery
Other artificial plastic materials, nes	0.3	16,388	140	0.36	6,203,904	MT2	Ships
Structures and parts of, of iron, steel; plates, rods, and	0.3	17,767	177	0.27	810,428	LT2	Construction materials and equipme
Machinery, plant, laboratory equipment for heating an	0.3	22,545	150	0.21	426,256	MT3	Machinery
Other made-up articles of textile materials, nes	0.2	8,303	140	0.38	520,250	LT1	Garments
Zinc and zinc alloys, unwrought	0.2	9,471	112	0.32	483,806	PP	Mining
Other electric power machinery, parts, nes	0.2	18,675	146	0.24	569,072	HT1	Electronics
Castor oil	0.2	5,072	41	0.40	716,936	RB1	Cereals and vegetable oils
Miscellaneous articles of plastic	0.2	18,981	178	0.27	813,781	LT2	Other Chemicals
Motor vehicles for the transport of goods or materials	0.2	19,327	165	0.25	1,315,544	MT1	Machinery

Table 2. Summary of Top Service Exports From India

sector	Export value (in millions) current US$ 2007-13	Share in Export Basket (%) 2007-13	Share of World Service exports (%) 2007-13	income level associated with export (PRODY)	path	density	Ubiquity
Computer	54,000	45.00	33.88	18,476	0.17	0.19	8.45
Travel, Personal, Other,	14,000	11.67	3.41	6,115	0.22	0.19	6.69
Other Business Technical, trade-related, and other business	12,000	10.00	2.18	12,524	0.17	0.25	6.09
Other Business Professional and management consulting	9,900	8.25	4.39	14,501	0.23	0.19	9.14
Transport, Other	7,700	6.42	3.75	9,915	0.23	0.21	7.43
Transport, Freight	6,500	5.42	1.67	13,054	0.23	0.19	7.94
Financial Explicitly charged and other financial	4,900	4.08	1.82	29,746	0.12	0.22	7.22
Transport, Sea Transport, Other	3,600	3.00	4.43	9,657	0.20	0.22	7.48
Transport, Other mode of Transport, Other	2,900	2.42	4.40	10,586	0.22	0.20	8.94
Insurance and pension Direct insurance	1,600	1.33	7.31	13,464	0.19	0.22	7.62
Transport, Air Transport, Other	1,200	1.00	1.99	10,797	0.22	0.20	7.66
Other Business Research and development	1,000	0.83	1.43	25,040	0.20	0.20	11.43
Personal, cultural, and recreational Other personal, cultural, and recreational	780	0.65	5.00	10,134	0.19	0.21	8.19
Construction, Construction abroad	770	0.64	2.09	13,723	0.25	0.22	9.60
Travel, Business, Other	710	0.59	0.91	4,355	0.24	0.19	8.02
Government goods and services n.i.e.	450	0.38	0.63	4,016	0.20	0.23	6.12
Information	410	0.34	4.96	18,793	0.19	0.19	10.76
Transport, Passenger	360	0.30	0.21	8,972	0.22	0.22	7.18
Personal, cultural, and recreational Audiovisual and related	300	0.25	1.99	12,952	0.22	0.23	10.07
Charges for the use of intellectual property n.i.e.	240	0.20	0.10	27,982	0.13	0.20	8.42
Financial Financial intermediation services indirectly measured (FISIM)	220	0.18	0.84	47,837	0.15	0.16	10.10
Travel, Personal,Education related	190	0.16	0.34	21,595	0.15	0.19	10.05
Insurance and pension Reinsurance	190	0.16	0.69	8,998	0.16	0.17	8.82
Transport, Other mode of Transport, Freight	130	0.11	0.12	8,426	0.28	0.18	9.46
Travel, Personal, Health related	120	0.10	1.50	9,053	0.23	0.17	9.87
Maintenance and repair services n.i.e.	69	0.06	0.13	22,823	0.19	0.21	8.85
Manufacturing services on physical inputs owned by others, Goods for processing in reporting economy	37	0.03	0.03	5,770	0.21	0.14	8.77
Insurance and pension Pension and standardized guaranteed	32	0.03	0.55	33,906	0.10	0.21	8.22
Transport, Other mode of Transport, Passenger	4	-	0.08	4,100	0.27	0.17	9.73

Note: The above table is based on working BPM6 data for India's service credit accounts. See appendix tables for details.

We show graphically how this product space looks from the point of view of India exports. Each of these products has a level of income enhancing potential and is plotted against their distance. The x-axis is the inverse of log (density), meaning that a *smaller* value represents a product that is *closer* to the current productive structure, and the y-axis is income enhancing potential. The horizontal line drawn is where the *PRODY* of the good equals the *EXPY* of the country or region. Products below that line are less sophisticated than the country's export basket as a whole.

First we plot only those products in which India has emerging comparative advantage (Figure 14). In this case, we color code each product according to its technology intensity. This chart represents success stories, where Indian firms have been able to innovate and discover comparative advantage in sectors that are highly productive but otherwise difficult to diversify into (top right corner of the chart). This is particularly promising given that it would help India move to higher productivity products which are closer to these newly acquired products. This also unlocks possibilities for other firms and entrepreneurs to more easily latch onto the know-how and absorb the capabilities from these emerging niches. There are several emerging products that have high connectivity to other high value and complex products that Indian entrepreneurs and firms can diversify into.

Figure 14. Product Space Analysis
(Restricted to Products India Has Emerging Comparative Advantage)
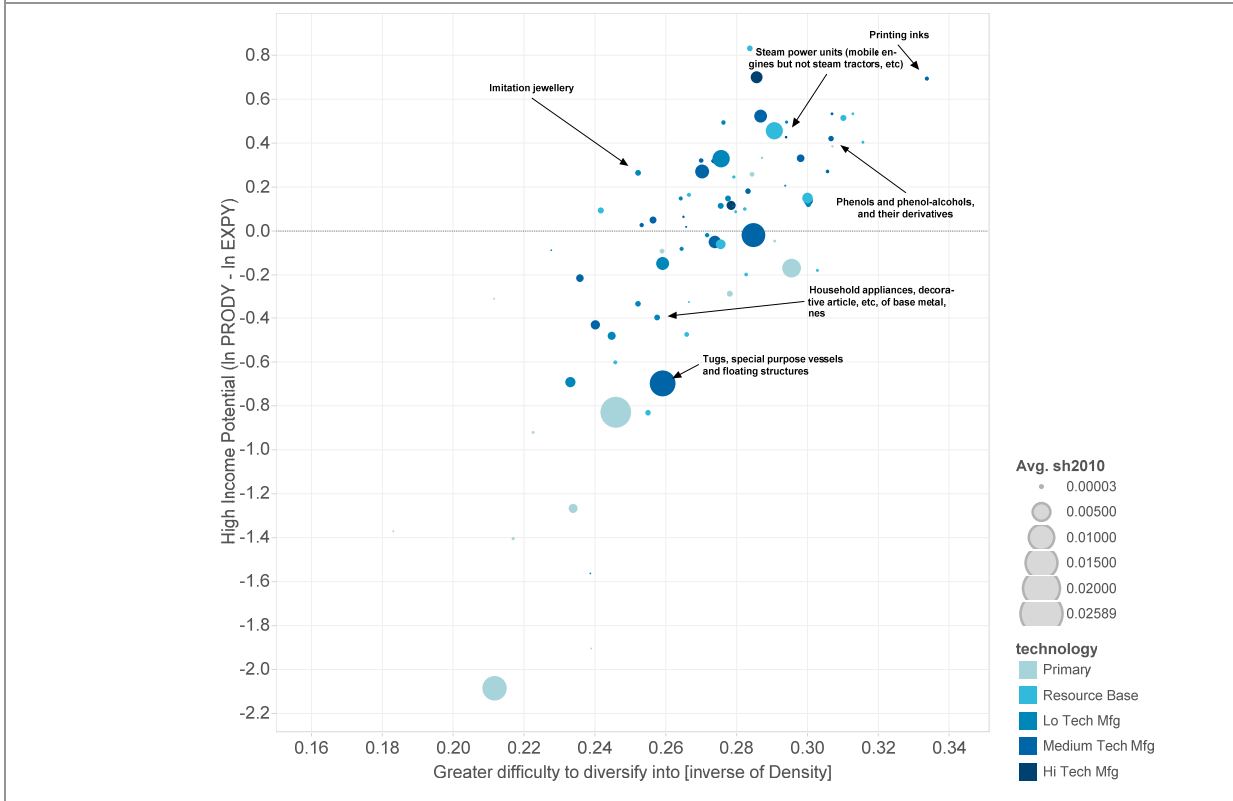
Next we plot the same chart with all products (Appendix Panel XIV). From the point of view of adding valuable new exports to the current basket, the ideal location on this plane is the upper-left quadrant: goods that are close and also highly sophisticated. This figure suggests a tradeoff between ease of diversification and export sophistication. The products that are closest to the current export basket (and therefore further to the left) are easiest to move toward, yet these nearest products are not often of high income potential. The more sophisticated products with higher income potential are further away from the current structure of production. Panel B shows the same for services exports. It shows that over time capabilities to move into income enhancing services has become easier, but the ability to develop comparative advantage in exporting services is rather more difficult.

V. THE WAY FORWARD

Based on our analysis, we see that India is well positioned to benefit from these structural changes in the export basket: it has good potential to expanding exports to new areas, increasing the share of manufacturing, increasing sophistication of goods and services, and diversifying into income enhancing exports.

A. What Needs to be Done?

Our analysis of Indian exports suggests:

- ***India could benefit by increasing the value and quality of manufacturing exports, especially of high-tech and medium-tech goods.*** Although manufacturing exports have increased, there is still room for India to catch up with comparator EMs, which could also address employment needs in the medium term. However, there is likely to be much less scope for India to make major gains in low-skill or low-tech products because it is likely to face an incumbency disadvantage relative to China and other low-cost producers in Asia. Building on emerging products with high income potential (accounting for 40 percent of total emerging products in India), and developing a strategy to re-discover relative comparative advantage in disappearing products could bolster Indian exports earning and income. Similarly, diversifying into a large number of income enhancing marginal products such as aircraft, machinery, motor vehicles – passenger and transport, auto parts, rail construction, and heterocyclic compounds could enhance the income potential of Indian exports. Furthermore, increasing sophistication and diversification of manufacturing exports would result in productivity and reallocation gains similar to the one witnessed in the services sector.

- ***Even though Indian service exports are sophisticated, India can benefit from overall diversification and uniqueness of service activities***. The distinctiveness of India's service exports is well established, but there is still scope to diversify on the extensive margin of tradable services. Several services underpin the modern manufacturing supply chain. India should build upon its comparative advantage in high value services to discover niches in other critical service that will feed into successful operation of manufacturing supply chain networks, leading the tradability of services towards faster productivity convergence. India's emerging comparative advantage in Research and Development Services is comparable to that of Australia, and other advanced economies like Germany, France, or the United States. This is evident through various fields in bio-informatics, aerospace, pharmaceuticals, management, chemical or mechanical engineering. Design based systems for services across industrial engineering or information technology are fundamental to the next production frontier. High exports sophistication, particularly of services, is likely to support growth (Anand et al., 2012). India's comparative advantage in R&D services with an ecosystem of risk-based capital to entrepreneurs would play an important role for future developments. In particular, the role of banking and financial sector to incentivize inventions and facilitate young firms to scale across world markets would be critical.

- ***Diversifying into products and services that are of higher quality, high income potential and central in the world network will be essential to amass new sources of comparative advantage.*** The quality of Indian exports has been

increasing over time, but remains well below global frontier. Indian exports have several emerging products with high income enhancing potential and should be easy to diversify into (being closely connected to existing exported products). The study shows that the capabilities exists in several niche sectors that can leveraged for driving higher volume and value of exported activities.

- ***Going forward, India could also benefit from realizing exports with new regions.*** Indian exports are more diversified, both geographically and product-wise, than those of comparator countries—in particular, they are less dependent on advanced economies than most of emerging Asia. Still, the potential to diversify destinations further is substantial. Increasing trade complementarily of Indian exports with East Asia (17 percent in 1990 to 32 percent in 2008) suggests that the potential for greater trade with East Asia is high (World Bank, 2010).[19] Similarly, the potential to expand trade with South Asian countries is large. The Research and Information System for Developing Countries (RIS) has estimated that the potential of intra-South Asia trade is about $ 40 billion, four times the existing formal trade (RIS, 2008). Using a gravity model, Prabir De (2010) has shown that the potential for expansion of India's trade is highest with countries such as China and ASEAN-6, and that India's exports have remained largely unrealized with other parts of the world (Central Asia, Eastern Europe, Latin America, and Africa).

In the medium term, the structural transformation in production and exports should benefit India through reallocation of resources and catch up in productivity. The productivity gap between agriculture and other sectors in India is high. As agriculture still accounts for 52 percent of employment and relative productivity levels are so low, there is significant opportunity to raise living standards through agricultural productivity improvements. Quality upgrading opportunities in agriculture may be larger than previously believed, and they may underpin inclusiveness of growth (Henn et al, 2013). In addition, by freeing up resources, this would also allow for reallocating resources from relatively low to high productivity sectors. Because the employment share of agriculture is very large Moreover, India lags comparator EM's in TFP levels and is far behind the frontier in productivity levels if all sectors. As noted by Dabla-Norris and Kochhar (2013), the good news is that there is significant scope for catch up growth in India in all major sectors of the economy.

B. How to Achieve it: Medium-Term Policy Priorities

India stands well-positioned to benefit from its current exports and production structure. However, to realize the benefits, in addition to ensuring macroeconomic and financial stability, India will need to continue liberalizing trade and forging greater trade integration.

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19 See World Bank, 2010, for the definition and construction of Trade Complementarily Index. Higher index values indicate more favorable prospects for a successful trade agreement between countries.

Also, greater investment in infrastructure, skills especially to move up the quality and sophisticated ladder, and labor and land reforms are needed to bolster competitiveness. Some of these measures are already underway under the "Make in India" program, which includes major new initiatives designed to facilitate investment, foster innovation, protect intellectual property, and build best-in-class manufacturing infrastructure.

1. **Reducing Trade Barriers and Fostering Integration:**

- ***Trade reforms will be necessary to expand trade and to realize trade with new regions.*** The key reform areas include: 1) reducing trade restrictiveness; and 2) improving trade facilitation. A recent study by the World Bank shows that India's Overall Trade Restrictiveness Index, which is the restrictiveness of tariffs which is higher for any given tariff if demand is elastic. Compared to other G20 economies restrictiveness in goods and service imports are high. Reducing trade restrictiveness further will help export performance (Joshi et al., 2006). Improving trade facilitation – broadly defined as the set of policies aiming at reducing export and import costs – will be important for realizing higher trade potential (Portugal-Perez et al., 2010). Hoekman et al., 2011, have found that a 10 percent reduction in the cost associated with importing (exporting) would increase imports (exports) by about 5 percent. Also, India scores much below China, Brazil, South Africa and other comparator Asian economies on the Overall Logistic Performance Index of the World Bank.[20] Modi and Subramanian, 2015, argue that exemptions in the countervailing duties levied on imports are undermining Indian manufacturing and the "Make in India" initiative. India scores particularly low on efficiency of customs clearance, quality of trade, and transport-related infrastructure. According to Broadman, 2007, a 10 percent improvement in export custom procedures would enhance merchandise export performance by 15 percent and manufacturing export performance by 17 percent. Furthermore, India seems to be extremely restrictive in different modes of supply for services (see Mattoo et al, 2013).

- ***Fostering regional trade integration will reduce trading costs, help in integrating with the rest of the world, and improve competitiveness.*** Regional trade integration would reduce real trade costs and behind-the-border barriers in the region (Pomfret and Sourdin 2009), essential for integration with the rest of the world. Integrated South Asian markets would improve the scale economies of domestic firms, both in manufacturing and services, which in turn would allow them

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[20] The logistics Performance Index overall score reflects perceptions of a country's logistics based on efficiency of customs clearance process, quality of trade- and transport-related infrastructure, ease of arranging competitively priced shipments, quality of logistics services, ability to track and trace consignments, and frequency with which shipments reach the consignee within the scheduled time. The index ranges from 1 to 5, with a higher score representing better performance.

to attract higher investments. It would increase competition, promote efficiency, and would facilitate skills and knowledge spillovers (Kumar and Singh, 2009). Regional integration may also help attain internationally acceptable productivity and quality levels (Draper et al., 2013).[21]

- ***Expansion of trade and trade integration can accelerate the process of productivity convergence.*** For India, firm level evidence suggests that trade liberalization has encouraged greater competition and generated efficiency gains, and is also associated with increases in the growth rate of productivity (Krishna and Mitra 1998; Topalova and Khandelwal 2011). Dissemination of knowledge and technologies would help build domestic regional trade hubs and bolster exports performance.

- ***Trade liberalization will help harness the demographic dividend.*** India is going through a demographic transition (a period of increasing working age population), which could add about 2 percentage points per annum to India's per capita GDP growth over the next two decades (Aiyar et al., 2011). That said, the demographic dividend will only be fully realized if India is able to create gainful employment opportunities that harness the growing working age population. This will require enabling reforms, and the experience of East Asia in the 1960s suggests that trade reforms could play an important role (Bloom and others 2003). In particular, China capitalized on the demographic dividend through trade liberalization in the 1960s (Gernaut and others 2006). Meanwhile, the absence of liberalization in Latin America in the early-1980s cost the region an average 0.9 percent growth per annum (IDB, 2000). Bloom and others (2004) find that openness could double the size of a country's demographic dividend. For countries relatively more open to trade, the shift in age structure toward a greater working age ratio is more likely to be translated into higher saving (Behram and others 1999). This is partly because of the increase in productivity brought about by trade liberalization. If high productivity coincides with a low dependency ratio, the opportunity arises to dramatically raise savings rates. Further, the decline in unemployment along a country's average age profile is much steeper for countries more open to trade. This suggests that trade policy might help to release some pressure from labor markets at a time when large shares of the population are entering working-age.

- ***Efforts to become a central hub in Global Value Chains (GVCs):*** Rich and fast growing economies have been exporting varieties of complex products and services

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[21] In the Mexican case, regional integration due to NAFTA played an important role in the upgrading of the country's garment industry from simple tasks to more complex ones (Bair and Gereffi, 2001).

in intricate supply chains in the world market. There is some evidence that successful integration and upgrading in GVCs can underpin development success, with data showing that countries that participate more in GVCs are richer, and that those that integrate more rapidly grow faster (World Trade Report, 2014). Also, technology and knowledge transfers have been shown to be higher across countries linked through GVCs (Piermartini and Rubinova ,2014). Countries with more favorable domestic business environment have been found to be more integrated into GVC, while infrastructure and customs barriers are found to be major obstacles to GVC integration (World Trade Report, 2014). Similarly, tariffs on intermediate goods have a significant negative effect on GVC participation (IMF, 2015a). Trade facilitation measures could reduce the cost of trading times and improve the predictability of trade. Firms combine the comparative advantages of geographic locations with their own resources and competencies to maximize their competitive advantage (Mudambi, 2008). A common pattern is the "smile" of value creation in which companies break up the location of high value–added and low value–added activities. To reap the benefits of these trends in GVC's, even developing economies where manufacturing still looms large must develop state-of-the-art services. Such services are needed for manufacturing firms to connect to global value chains and develop competitiveness in more skill-intensive activities along the value chain. Some countries may be able to use their comparative advantage in labor costs to become exporters of some intermediate or final service products (see Loungani and Mishra, 2014). Policies can foster cooperation between firms in clusters, and between firms and universities to enable and prepare communities across India to export.

2. Liberalize Foreign Direct Investment Regime:

Greater focus on FDI to boost exports and enhance productivity. Liberalizing FDI regime and processes would enhance export competitiveness by lowering production costs and boost exports performance. There has been significant progress in liberalizing FDI regime in the recent years; however, FDI inflows have not picked up substantially. There is ample scope to simplify procedures, improve business environment, and expedite regulatory and other clearances at all levels to translate greater liberalization into higher inflows. Higher FDI would also increase exports through capacity increasing effects and through spillover effects such as increasing competition in the domestic market (Iacovone et al., 2011) and transfer of knowledge. Higher FDI tends to increase the quality of exports in developing countries (Harding and Javorcik, 2012). Furthermore, FDI spurs domestic investment by lowering the costs of adopting new technologies (Borenszstein et al., 1998).[22] A study of Indian IT firms

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[22] Following the entry of Walmex (the Mexican affiliate of Walmart), local retailers started to adopt advanced technologies, such as cold chain.

has found that the probability of exporting and the volume of exports are higher for firms receiving FDI. In addition, there is a spillover effect of FDI to non-recipient firms as their probability of exporting also increase (Kemme et al., 2009).

3. Improve Infrastructure Planning:

Investments to improve export-related infrastructure and to boost industrial production are vital for realizing exports potential. Structural reforms are needed to remove supply bottlenecks to strengthen exports.[23] Constraints, particularly in energy and mining, have prevented Indian exports to benefit from the recent rupee depreciation (see IMF, 2015b). Investments in improving inland roads/railway lines to ports, enhancing warehousing and cold storage facilities, improving port/airport capacity to handle export consignments are needed.[24] Investments will also be required to boost industrial production to support export expansion, which in turn will require enhancing the business environment, developing infrastructure, and deepening financial markets (Tokuoka, 2012). Similarly, reducing economic policy uncertainty will boost investment (Anand et al, 2014). Perez et al., 2010, have shown that investment in physical infrastructure and regulatory reforms to improve the business environment lead to higher exports performance. Mohan and Kapur (2015) also emphasize the importance of land reforms, especially in urban areas. They note that there has been a "traditional prejudice" through urban land ceilings and other regulations, against the location of industries in cities, where skilled labor is more likely to be available. The size of mega cities like Delhi (over 20 million), Mumbai (over 20 million), Kolkata (over 15 million) and Bangalore (over 10 million) are unprecedented. There are over 54 other cities in India with over a million people. The trend is expected to continue over the next two decades at least. Recent studies have shown that informational networks in cities attract a large proportion of high ability workers making them attractive place to live and productivity centers (see Venables, 2014). Central and sub-national policy making must utilize the best international resources to solve supply chain congestion and bottlenecks to plan for long term efficiency.

4. Develop Skills and Liberalize Labor Markets:

Building human capital and liberalizing labor market to increase value, quality, and income potential of Indian exports. Much has been written about the need for quickly upgrading skills in India, as well as the problems caused by labor market restrictions. First on skills, Chandra (2015) notes that manufacturing in India faces twin problems—those who are available for employment in manufacturing do not have the necessary skills and those who do have skills are typically less willing to work in manufacturing. He notes therefore that there is a need to prepare the low-skilled workers to become "industrial persons" by providing training in manufacturing and behavioral skills. And that the already skilled

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[23] See IMF staff report 2013 and 2014 for the details of structural reforms.
[24] See Mohan and Kapur (2015)

workers need to be attracted into manufacturing by focusing on innovation to push India toward the technology frontier. He stresses the need for policy initiatives that integrate skilling efforts and manufacturing policy, as well as those that integrate Indian firms into global and regional production networks. The creation of a new ministry exclusively for skill development and entrepreneurship – with a mandate to skill 500 million people by 2020 and to create an ecosystem to encourage entrepreneurship – is encouraging. Similarly, recently announced social safety net for workers in the informal sector is a welcome step.

Turning next to labor market reforms, firm level evidence from many countries indicates that industries with more stringent employment protection tend to exhibit lower productivity growth. Also country experiences suggest that such protection can slow down job creation in global value chains, causing countries to miss out on agglomeration effects and knowledge spillovers. Also, evidence suggests—not surprisingly—that countries with more flexible labor markets experience greater structural change as resources are able to flow more freely across sectors and firms, Labor law reforms would be necessary to realize efficiency and productivity gains in manufacturing (Dabla-Norris et al., 2013; Krishna and Mitra, 1998). IMF, 2014 has shown that easing product and labor market restrictions will boost India's competitiveness and bolster exports performance.

5. Environment for Innovation and Entrepreneurship:

New technology and cultural inventions from India would shape the wave of economic growth. Most Fortune 500 companies have strong presence in high end technology and R&D services across a variety of operations including finance, computers, pharmaceutical or defense. Policy can help improve legal framework and enforcement ability for starting new businesses for exports. It is important to address local political uncertainties associated with investment across locations in India. The transformative role of entrepreneurs to use technology for innovations in agriculture and sources of green and renewable energy would be key. If harnessed properly, India's strength lies in its massive market size and human potential. Breakthrough home grown exportable innovations in finance, marketing and technology would help bring inclusive growth. The opportunities for entrepreneurs to bring business solutions for transition from low productivity to tradable niche activities are immense. For example, California with a population barely 3 percent of India has the GDP which is very similar to India's. It is driven by a pocket of few concentrated yet uniquely specialized hubs of exports within California. Similar clusters with unique new inventions could be a source of growth engine in India too, and would require an enabling environment for openness and creative inventions in India. This could help move faster towards convergence.

APPENDIX ON METHODS

The appendix defines the set of export-related indicators used in the paper, and explains their construction.

Diversification

More specifically, the standard indicators may be defined as follows, with the indices *c* (or *c′*), *i* (or *i′* or *i″*), and *t* referring to countries, goods (or services), and years, respectively. Export Diversification in service exports (*HI)* is a time- and country-specific measure of export concentration by country, and time period:

$$HI_{c,t} = \sum_i \left(\frac{E_{c,i,t}}{\sum_{i'} E_{c,i',t}} \right)^2$$

Technology Intensity of Exports

Indicators of the technological content of exports are also frequently included in analyses of structural transformation as it is indicative of the sophistication of a country in a given product category. Technologically sophisticated products tend to be associated with a high *PRODY*. We follow Lall's classification (2000) and classify products into primary, resource-based, low-, medium- or high-tech.[25]

- *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) 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).

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[25] For details see Lall (2000) and Lall, Weiss, and Zhang (2006).

- *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).

Quality

We use the IMF's export quality database, where export quality is estimated using unit values (average traded price for each product category). Schott (2004) and Hummels and Klenow (2005) showed that these unit values increase with GDP per capita.[26] Quality is calculated as the unit value adjusted for differences in production costs and for the selection bias stemming from relative distance. At a first step, for a given product, the trade price (or equivalent unit value) is determined by three factors: unobserved quality, per capita income of exporter and selection bias i.e. composition of exports to more distant destinations is typically more tilted towards high-priced goods. Next, a quality augmented gravity equation is specified. By substitution observables for the unobservable quality parameter in the gravity equation yields 851 sets of coefficients for each product. The results are used to calculate a comprehensive set of quality estimates and then aggregated into a multi-level database.[27]

Relative Comparative Advantage (RCA)

The Revealed Comparative Advantage (RCA), a concept introduced by Balassa (1965), is a measure constructed to inform whether a country's share of a product's world market, is larger or smaller than the product's share of the entire world market. Mathematically, the RCA of a nation is measured by the relative weight of a percentage of total export of a product (or service) in a nation over the percentage of world export in that product (or

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[26] This sparked an interest in estimating export quality, for which unit values are at best a noisy proxy, being driven also by a series of other factors, including production cost differences. The strategies recently developed for quality estimation (including Khandelwal, 2010, Hallak and Schott, 2011, and Feenstra and Romalis, 2012) typically model demand, and in some cases also supply, using explicit microeconomic foundations. However, these methodologies do not allow calculation of a set of quality estimates with large country and time coverage, owing to their significant data requirements.

[27] For details on construction of Export Quality, please see "Export Quality in Developing Countries" by Christian Henn, Chris Papageorgiou, and Nikola Spatafora, IMF WP/13/108.

service). K is an industrial index while j is a country index, X is export, using this notation, RCA can be written as:

$$RCA_{kj} = \frac{X_k^j / \sum_k X_k^j}{\sum_j X_k^j / \sum_k \sum_j X_k^j}$$

On the basis of the evolution of their *RCA*s, exported products may be classified as classic, emerging, disappearing, or marginal. The classic may be understood as the traditional exports of a country, i.e., services in which the country has always had a comparative advantage. The emerging champions are services in which the country did not have a comparative advantage in the past but developed it in recent years. The time periods 'past' and 'present' can be specified by the analyst. The disappearing products are those in which the country had a comparative advantage in the past but does not have it anymore, and the marginal services are those in which the country never has had a comparative advantage.

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

	2000-2006	*2007-2012*
Classic	RCA>1	RCA>1
Marginal	RCA<1	RCA<1
Disappearing	RCA>1	RCA<1
Emerging	RCA<1	RCA>1

Sophistication

We follow HHR (2007) to compute sophistication of products. The potential income level of a service i in t, $PRODY_{i,t}$ is defined on the basis of GDP per capita (*GDPPC*) of all exporting countries, with the weight of each country defined by how important i is in its exports (measure by the share of i in the total export value of country c): [28]

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[28] The *PRODY* concept was developed by Hausmann, Hwang and Rodrik (2007). According to Schott (2008), *PRODY* may overestimate the income potential of complex manufactured products such as hi tech electronics if they are exported both by relatively poor countries like China and rich Western countries. However, Schott (2008) has also noted that for simpler products exported by most developing countries, especially low income ones, the *PRODY* is a reasonable representation of the income potential of the products exported.

$$PRODY_{i,t} = \sum_{c} \left[\frac{\left(\dfrac{E_{c,i,t}}{\sum_{i'} E_{c,i',t}} \right)}{\sum_{c'} \left(\dfrac{E_{c',i,t}}{\sum_{i'} E_{c',i',t}} \right)} \cdot GDPPC_{c,t} \right]$$

Some evidence suggests that developing countries that start to produce and export a product over time may be able to raise the prices that they receive as quality improves over time, reducing the price gap vis-à-vis developed country producers (HHR, 2007 , pp. 13-14). Along the same reasoning and as described below we will construct a *Service EXPY* to proxy the service production frontier of a country. The potential income level of the export basket of a country, *EXPY*, defined using *PRODY* with each service *i* weighted by its share in the exports the country:

$$EXPY_{c,t} = \sum_{i} \frac{E_{c,i,t}}{\sum_{i'} E_{c,i',t}} \cdot PRODY_{i,t}$$

Econometric cross-country time-series analysis indicates that *EXPY* is a strong and robust predictor of subsequent economic growth (HHR< 2007); Mishra et al 2011, 2012; Anand et al 2013).

The notion behind the measure is to factor internal knowledge and external knowledge transfer to human capital and R&D sources of knowledge creation. These directly contribute to the rise of export sophistication to catch up and imitate products of advanced economies. (see Xang He, 2010).

Indicators used in Product Space Analysis

The **proximity (φ)** between two products, *i* and *i'*, in time *t*, a key building-block of all network indicators in the PS analysis, indicates the extent to which the simultaneous having an *RCA* in two services is related:

$$\varphi_{i,i',t} = \min \left\{ P\left(x_{i,t} \middle| x_{i',t} \right), P\left(x_{i',t} \middle| x_{i,t} \right) \right\}$$

where *P* (the conditional probability) is computed using all countries *c* in year *t*, and where

$$x_{c,i,t} = \begin{cases} 1 \text{ if } RCA_{c,i,t} > 1 \\ 0 \quad \text{otherwise} \end{cases}$$

The **Path** is a measure of the relative position of each product *c* in the product space in time *t*. It is defined as the sum of all proximities between product *i* and all other products. Longer

I are indicative of products that are at the core of the product space and whose proximities with the rest of the nodes have larger values. A product with a longer *path* offers a better platform for further diversification than products at the periphery (with shorter *paths*). Mathematically, the *path* of a product *i* in *t* may be defined as:

$$PATH_{i,t} = \sum_{i'} \varphi_{i,i',t}$$

However, it is important to note that the *PATH* indicator does not consider the characteristics of the products *i'* to which *i* is close, such as the income level of countries that tend to have an *RCA* > 1 in products *i'*.

The **density** of a product *i* in [which a country does *not* have an *RCA* to the country's current export basket], scaled to vary from 0 to 1, can be seen as a measure of the probability (or capability) of developing an *RCA* > 1 in product *i* in the future. For each product, it is the ratio between (a) the sum of all proximities between that particular product and all products in which the country has an *RCA* > 1; and (b) the sum of all proximities of the product (irrespective of whether or not the country has an *RCA* in the other product):

$$density_{c,i,t|RCA_{c,i,t}<1} = \frac{\sum_{i'|i\neq i'} \varphi_{i,i',t} \cdot x_{c,i',t}}{\sum_{i'|i\neq i'} \varphi_{i,i',t}} = \frac{\sum_{i'|i\neq i' \text{ and } RCA_{c,i',t}>1} \varphi_{i,i',t}}{\sum_{i'|i\neq i'} \varphi_{i,i',t}}$$

Bi-Partite Network Structure – Complexity

Extending on the product space, and network based analysis of exports, Hausmann et al (2013) have developed an index of economic complexity. Building upon some of the measures described earlier, in this approach we begin with a matrix that is 1 if country produces a service, and otherwise, we can measure diversity and ubiquity simply by summing over the rows or columns of that matrix. Formally:

Diversity

$$k_c = \sum_{i=1}^{N_i} M_{ic}$$

Ubiquity

$$k_i = \sum_{i=1}^{N_c} M_{ic}$$

Complexity

To generate a more accurate measure of the number of capabilities available in a country, or required by a product, we need to correct the information that diversity and ubiquity carry by using each one to correct the other. For countries, this requires us to calculate the

average ubiquity of the products that it exports, the average diversity of the countries that make those products and so forth. For products, this requires us to calculate the average diversity of the countries that make them and the average ubiquity of the other products that these countries make. This can be expressed by the recursion:

$$k_{c,n} = \frac{1}{k_{c,0}} \sum_{i=1}^{N_i} M_{ic} k_{i,n-1}$$

$$k_{i,n} = \frac{1}{k_{i,0}} \sum_{c=1}^{N_c} M_{ic} k_{c,n-1}$$

n= iterations (run them till rankings don't change)

$$k_{c,N} = \sum_{c'} \tilde{M}_{cc'} k_{c',N-2}$$

where

$$\tilde{M}_{cc'} = \sum_{p} \frac{M_{cp} M_{c'p}}{k_{c,0} k_{p,0}}$$

We note the above is satisfied when $K_{c,n}= K_{c, n-2}$. This is the eigenvector of $\widehat{M_{cc}}$ which is associated with the largest eigenvalue. Since this eigenvector is a vector of ones, it is not informative. We look, instead, for the eigenvector associated with the second largest eigenvalue. This is the eigenvector that captures the largest amount of variance in the system and is our measure of economic complexity. Hence, we define the Economic Complexity Index (ECI) as:

$$ECI = \frac{\vec{K} - <\vec{K}>}{stdev(\vec{K})}$$

where $< K >$ represents an average, stdev stands for the standard deviation and analogously, we define a Product Complexity Index (PCI). Because of the symmetry of the problem, this can be done simply by exchanging the index of countries (c) with that for products (p) in the definitions above. Hence, we de-fine PCI as:

$$PCI = \frac{\vec{Q} - <\vec{Q}>}{stdev(\vec{Q})}$$

Table 4. Variable Definitions

Variable Name	Interpretation
$k_{c,0}$	Observed level of diversification of a country
$k_{s,0}$	Observed number of countries exporting product p.
$k_{c,1}$	A generalized measure of ubiquity of country c's exports
$k_{s,1}$	A generalized measure of diversity of product p's exporters
RCA	Revealed comparative advantage
$M_{c,s}$	In a matrix of countries and product, $M_{(c,p)}=1$ if country c is a significant exporter of product p
HI_c	Herfindahl index, a measure of export concentration of country c
$PRODY_s$	Average income per capita associated with product p
$EXPY_c$	Average PRODY of its exports
$density_{c,s}$	A country's likelihood to export product p in the future
$PATH_s$	A product's association to other products.

Panel I. Composition of India's Manufactured Exports
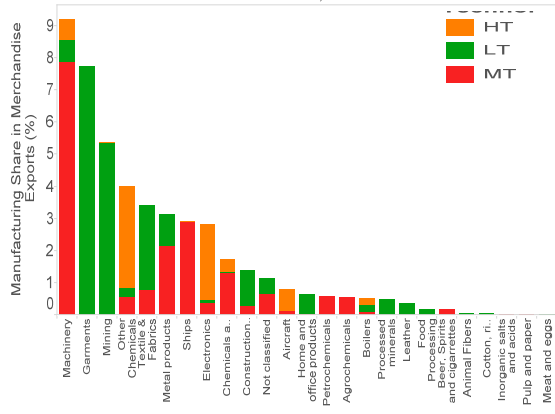
Top Five Hi-tech Manufactured Exports
(percent of merchandise exports, average 2010-12)
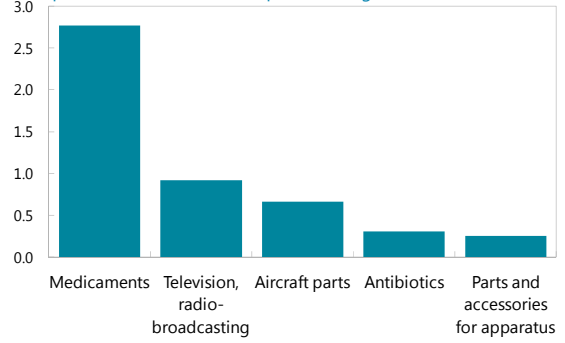
Source: authors' calculations WITS database, SITC rev. 3.

Top five medium tech products
(percent of merchandise exports, average 2010-12)
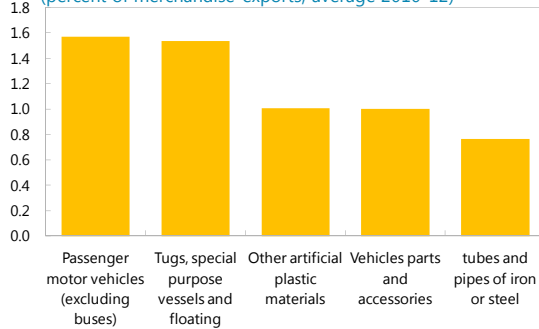
Source: authors' calculations using WITS database, SITC rev. 3.

Top five Low-tech manufactured exports
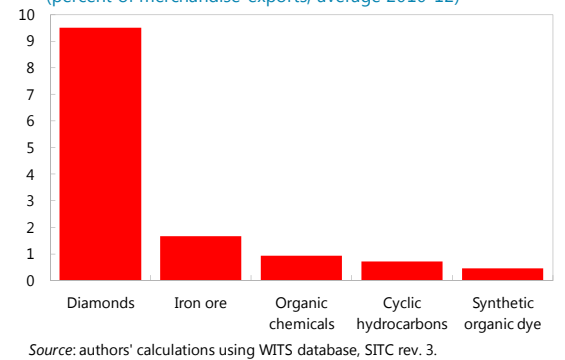(percent of merchandise exports, average 2010-12)
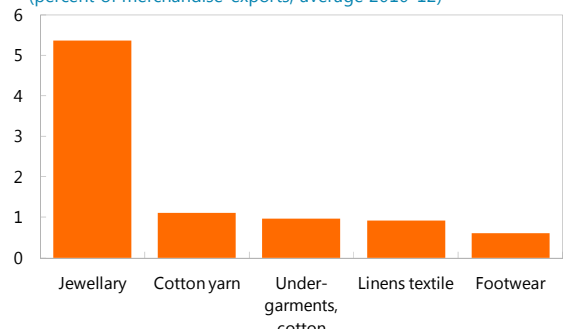
Source: authors' calculations WITS database, SITC rev. 3.

Top five primary products in export basket
(percent of merchandise exports, average 2010-12)
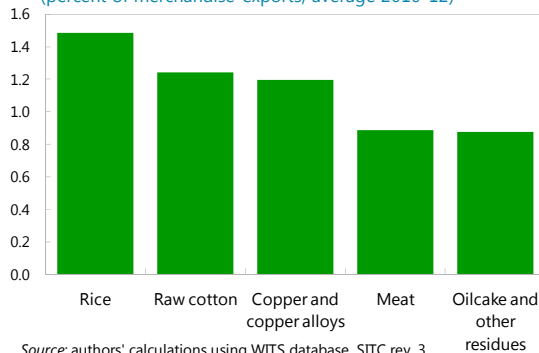
Source: authors' calculations using WITS database, SITC rev. 3.

Top five resource based exports
(percent of merchandise exports, average 2010-12)

Source: authors' calculations using WITS database, SITC rev. 3.

**Panel II. Composition of Goods Exports**

India's Export Basket, 2012
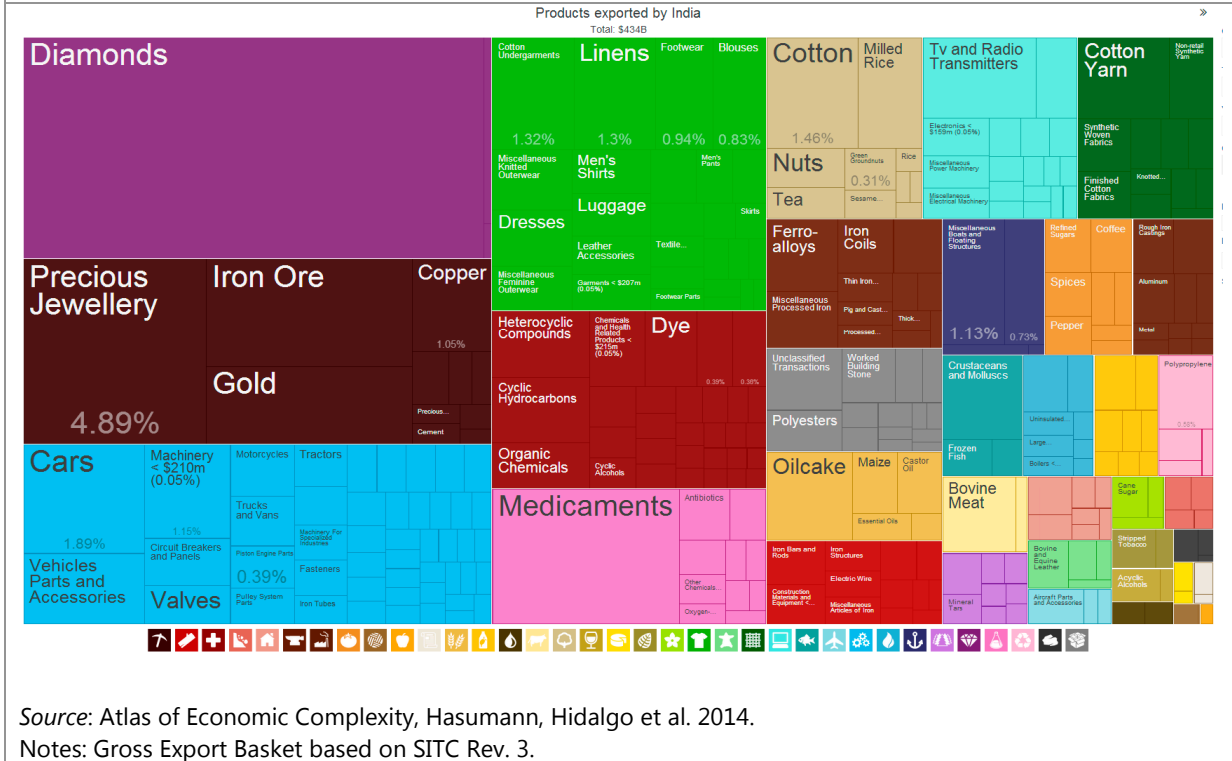
Source: Atlas of Economic Complexity, Hasumann, Hidalgo et al. 2014.
Notes: Gross Export Basket based on SITC Rev. 3.

Growth in Merchandise exports
(2000=100)
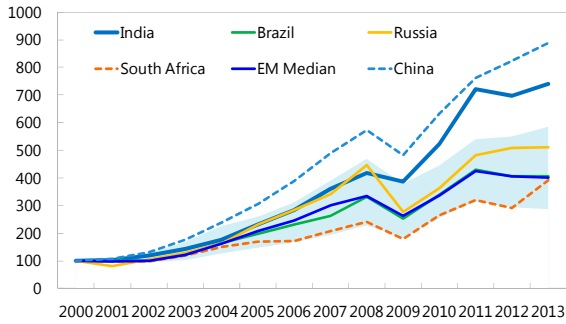
Source: authors' calculations using WITS Trade data, Rev. 3.
Note: The light blue area represents three centre quintiles for other EMs
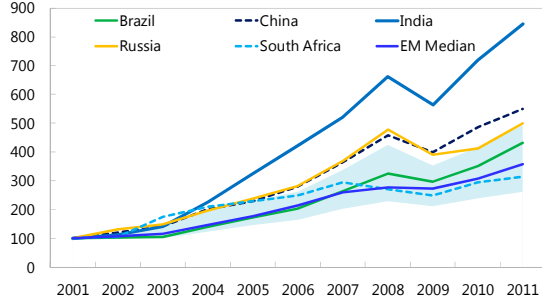
Share on Indian exports in World Goods Exports
(percent of World Goods Exports)
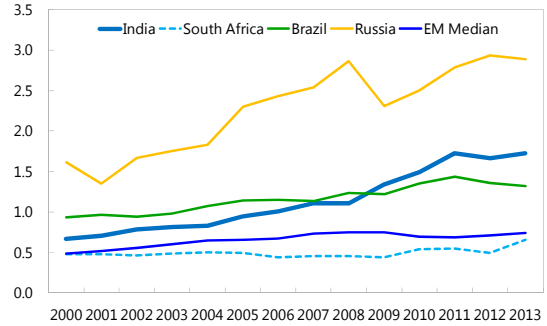
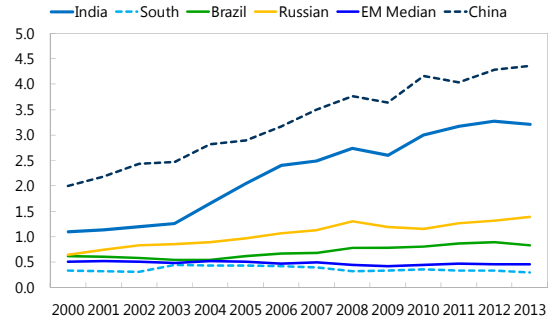Source: authors' calculations using WITS Trade data, Rev. 3.

Panel III. Services Exports

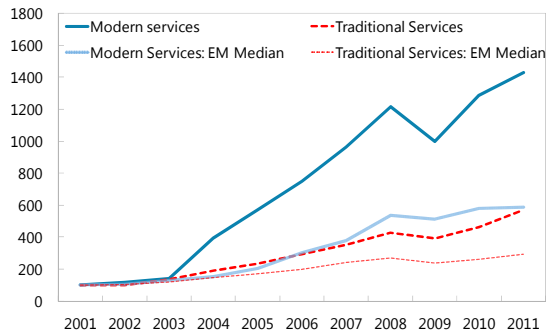### Growth in Services exports
(2000=100)

Sources: authors' calculations using Balance of Payments Statistics, IMF and ITC.
Note: The light blue area represents three centre quintiles for other EMs

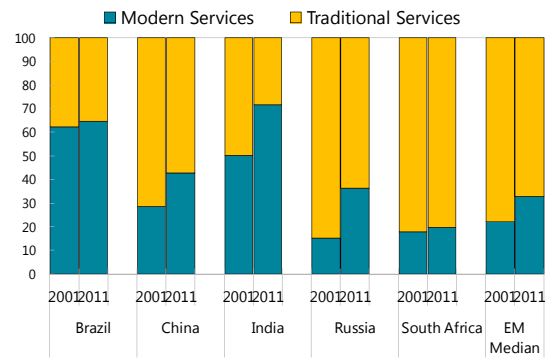### Growing share of India in World Services Exports
(percent of World Services Exports)

Sources: authors' calculations using Balance of Payments Statistics, IMF and ITC.

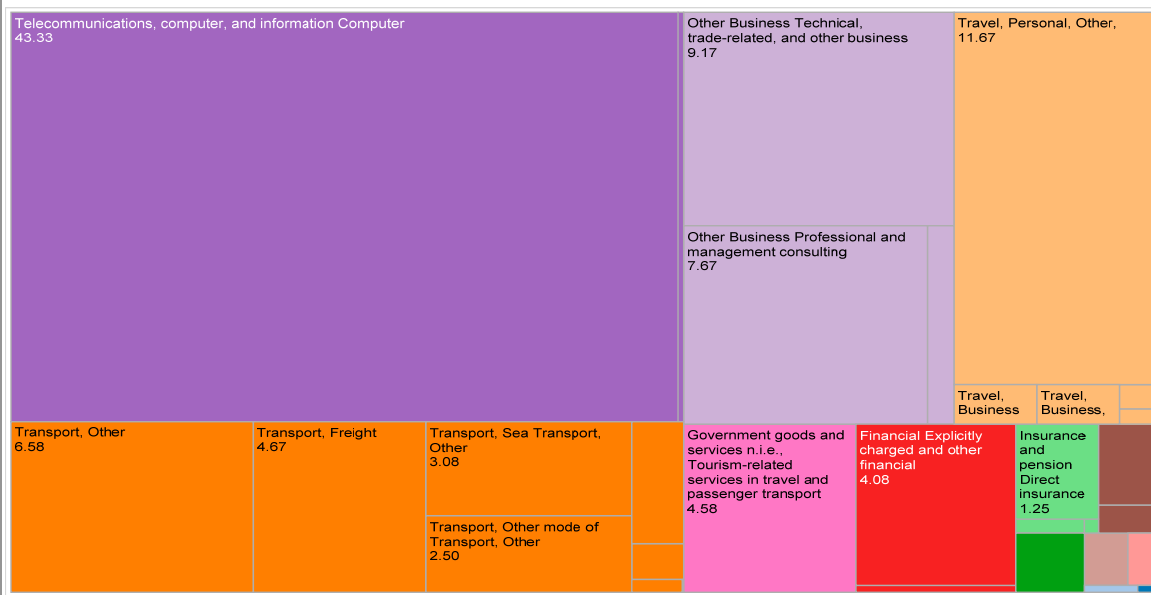### Modern IT and IT enabled services are growing faster than other EM's
(2001=100)

Sources: Balance of Payments Statistics, IMF and authors' calculations
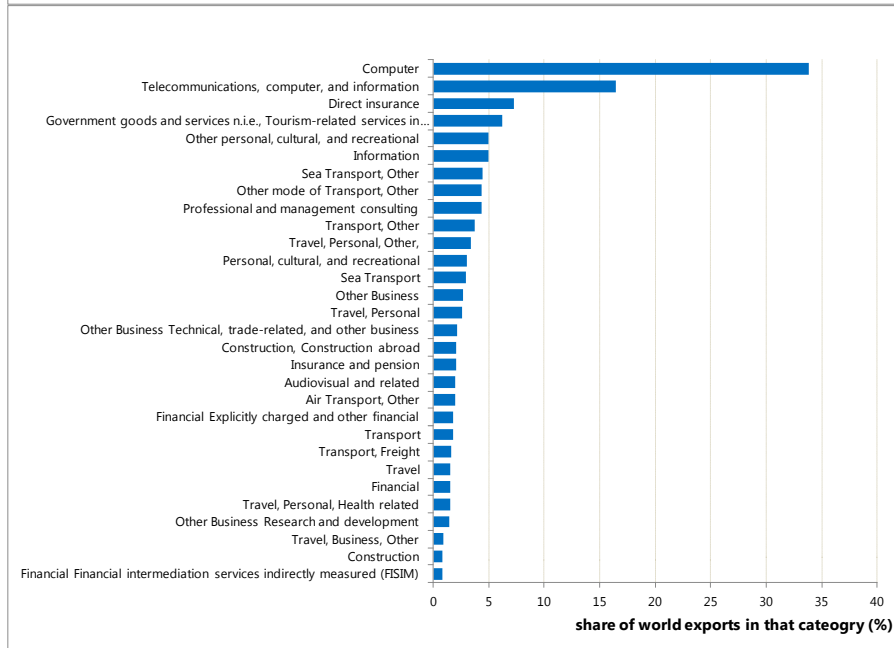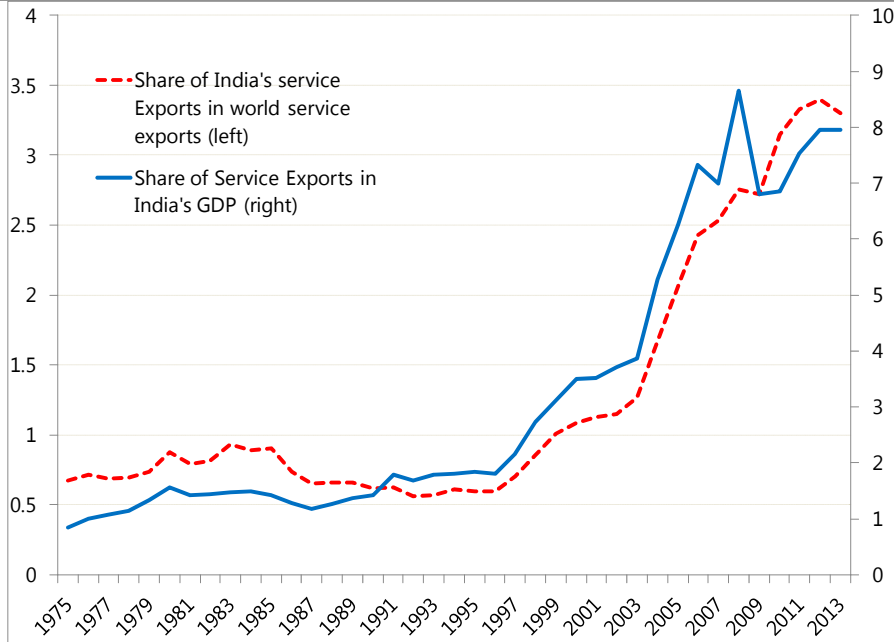
Modern versus Traditional Services

Source: authors' calculations using Balance of Payments Statistics BPM 5, IMF.

Panel IV. Composition of Services Exports
A. Service Export Basket, 2008-13

Telecommunications, computer, and information Computer
43.33

Other Business Technical, trade-related, and other business
9.17

Travel, Personal, Other,
11.67

Other Business Professional and management consulting
7.67

Travel, Business

Travel, Business,

Transport, Other
6.58

Transport, Freight
4.67

Transport, Sea Transport, Other
3.08

Transport, Other mode of Transport, Other
2.50

Government goods and services n.i.e., Tourism-related services in travel and passenger transport
4.58

Financial Explicitly charged and other financial
4.08

Insurance and pension Direct insurance
1.25

Source: Authors' calculations using BPM6 Working dataset of service credit accounts, IMF, 2014.

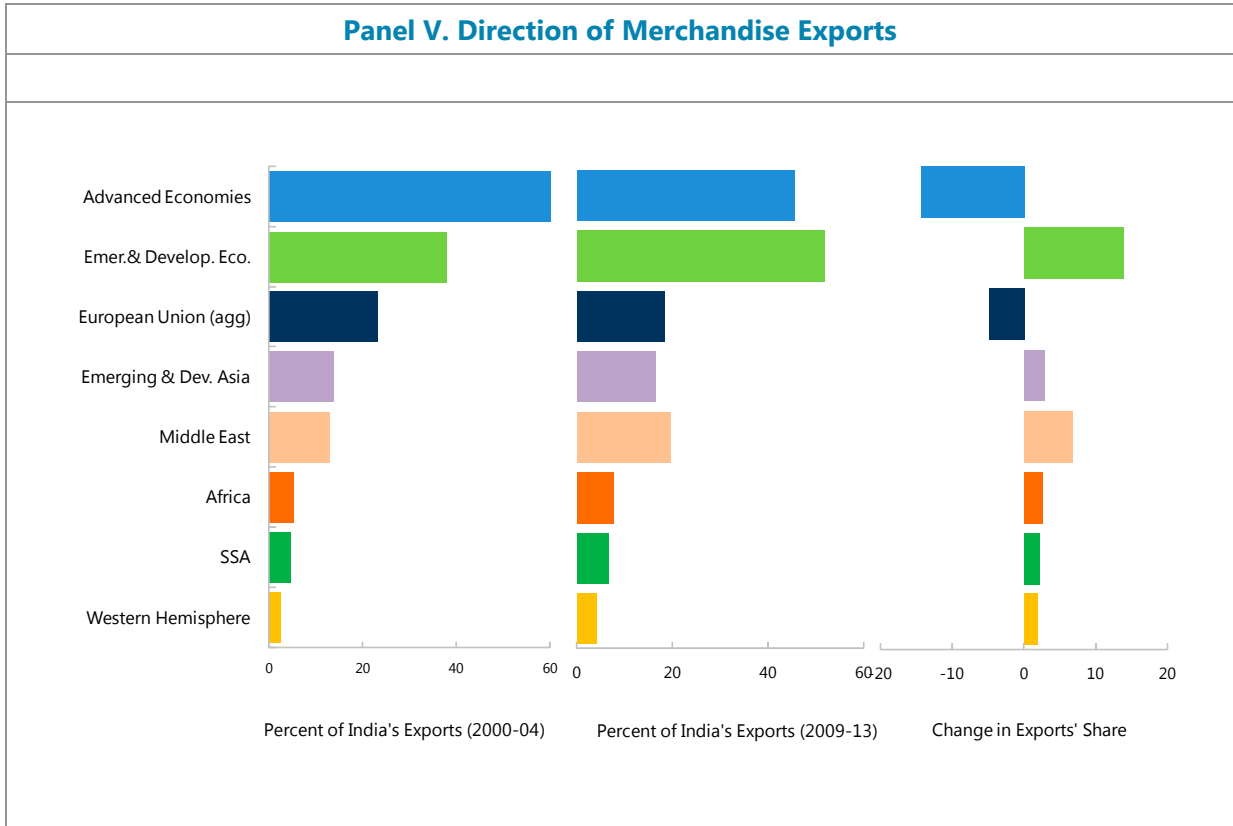## B. Growing Importance of India's Service Exports in the World

Legend:
- Share of India's service Exports in world service exports (left)
- Share of Service Exports in India's GDP (right)

Bar chart categories (top to bottom):
- Computer
- Telecommunications, computer, and information
- Direct insurance
- Government goods and services n.i.e., Tourism-related services in…
- Other personal, cultural, and recreational
- Information
- Sea Transport, Other
- Other mode of Transport, Other
- Professional and management consulting
- Transport, Other
- Travel, Personal, Other,
- Personal, cultural, and recreational
- Sea Transport
- Other Business
- Travel, Personal
- Other Business Technical, trade-related, and other business
- Construction, Construction abroad
- Insurance and pension
- Audiovisual and related
- Air Transport, Other
- Financial Explicitly charged and other financial
- Transport
- Transport, Freight
- Travel
- Financial
- Travel, Personal, Health related
- Other Business Research and development
- Travel, Business, Other
- Construction
- Financial Financial intermediation services indirectly measured (FISIM)

share of world exports in that cateogry (%)

Source: Authors' calculations using BPM6 Working Data, IMF, 2015.

C. Average Annual Growth of India's Service Exports

| sector	2000-07	2008-13
Services Total	22.3	9.1
Manufacturing services on physical inputs owned by others		-3.9
Manufacturing services on physical inputs owned by others, Goods for processing in reporting economy		-3.9
Maintenance and repair services n.i.e.		95.8
Transport	21.4	8.4
Transport, Passenger	18.5	39.1
Transport, Freight	20.3	26.0
Transport, Other	16.6	-2.9
Transport, Sea Transport	21.5	6.7
Transport, Sea Transport, Other	31.2	4.0
Transport, Air Transport, Other	32.3	-3.5
Transport, Other mode of Transport	24.5	-17.8
Transport, Other mode of Transport, Passenger		-33.2
Transport, Other mode of Transport, Freight		40.7
Transport, Other mode of Transport, Other	24.5	23.7
Travel	15.9	9.0
Travel, Business		66.7
Travel, Business, Other		66.7
Travel, Personal	20.4	7.2
Travel, Personal, Health related		25.7
Travel, Personal,Education related		31.5
Travel, Personal, Other,	20.2	6.5
Construction	5.8	8.0
Construction, Construction abroad		19.1
Insurance and pension	23.1	5.9
Insurance and pension Direct insurance	20.3	9.7
Insurance and pension Reinsurance	57.5	6.2
Insurance and pension Pension and standardized guaranteed	63.5	84.2
Financial	35.8	10.6
Financial Explicitly charged and other financial	35.8	9.4
Financial Financial intermediation services indirectly measured (FISIM)		70.9
Charges for the use of intellectual property n.i.e.	24.6	16.7
Telecommunications, computer, and information	29.1	10.1
Telecommunications, computer, and information Computer	29.7	10.3
Telecommunications, computer, and information Information	22.5	-15.9
Other Business	10.3	5.5
Other Business Research and development	76.9	-2.5
Other Business Professional and management consulting	41.5	14.6
Other Business Technical, trade-related, and other business	4.7	-1.0
Personal, cultural, and recreational	80.3	14.7
Personal, cultural, and recreational Audiovisual and related		25.9
Personal, cultural, and recreational Other personal, cultural, and recreational	80.3	6.0
Government goods and services n.i.e.	-5.8	6.2
Government goods and services n.i.e., Tourism-related services in travel and passenger transport		-7.5

Source: Authors' calculations using BPM6 Working Data, IMF. 2015.

Panel V. Direction of Merchandise Exports

Percent of India's Exports (2000-04)

Percent of India's Exports (2009-13)
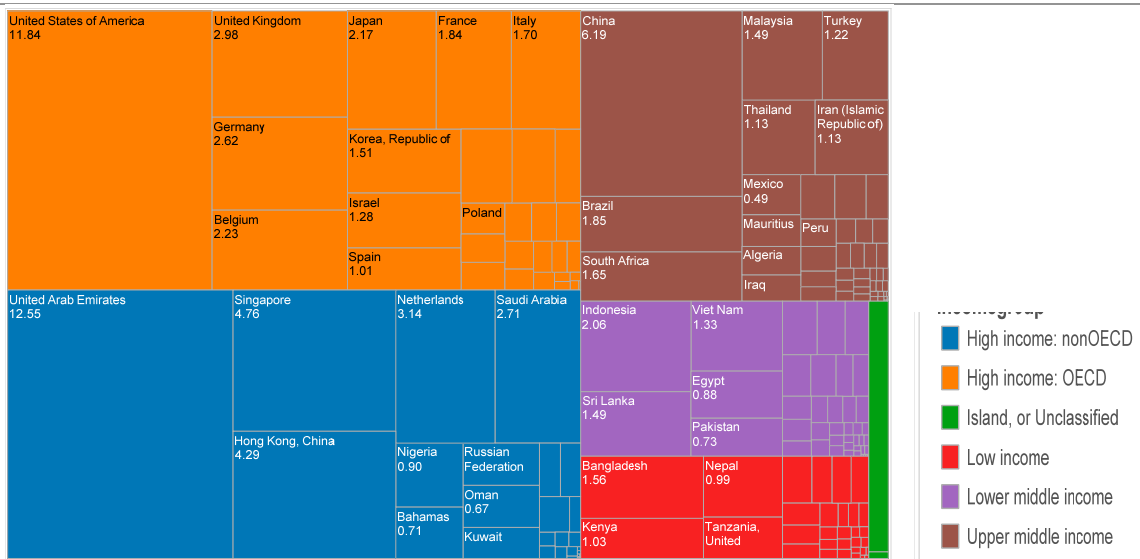
Change in Exports' Share

Sources: Direction of Trade statistics, IMF and authors' calculations.
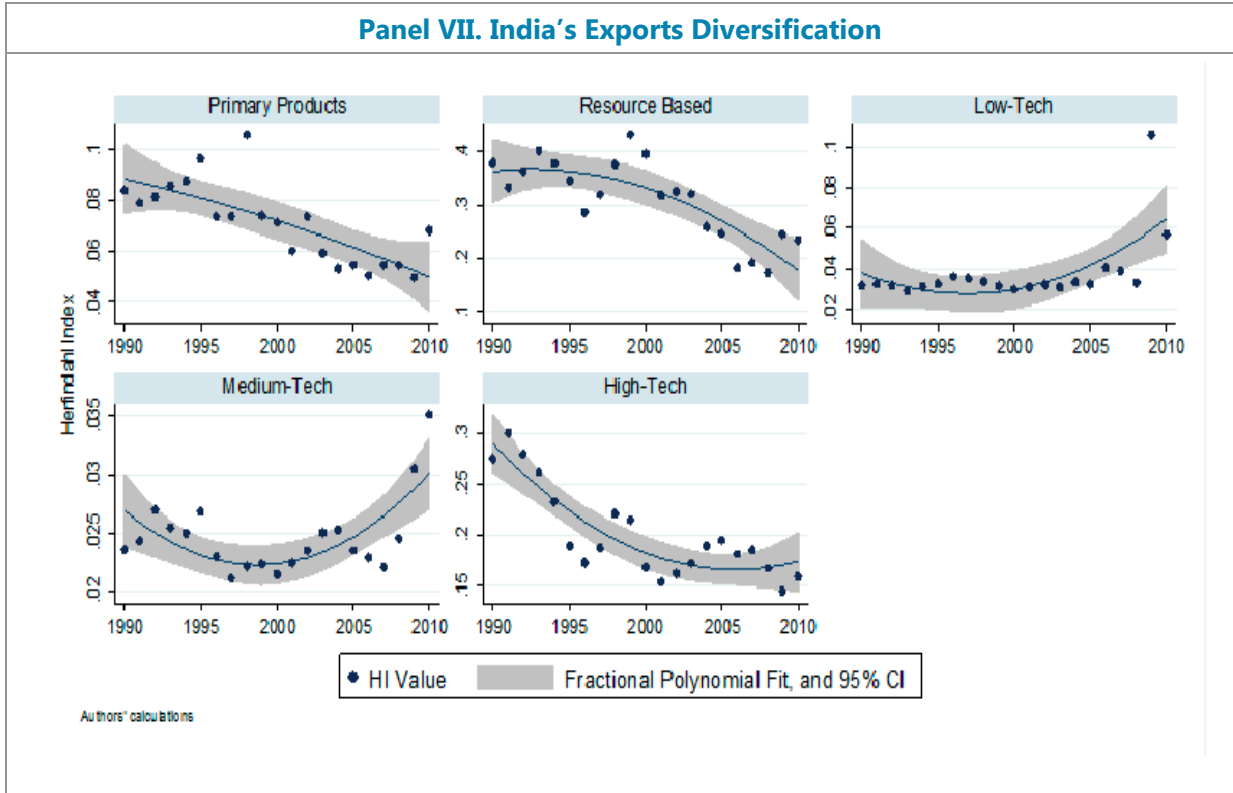
48

Panel VI. Exports Destinations

Export Destination (share of total bi-lateral merchandise export)2000-03
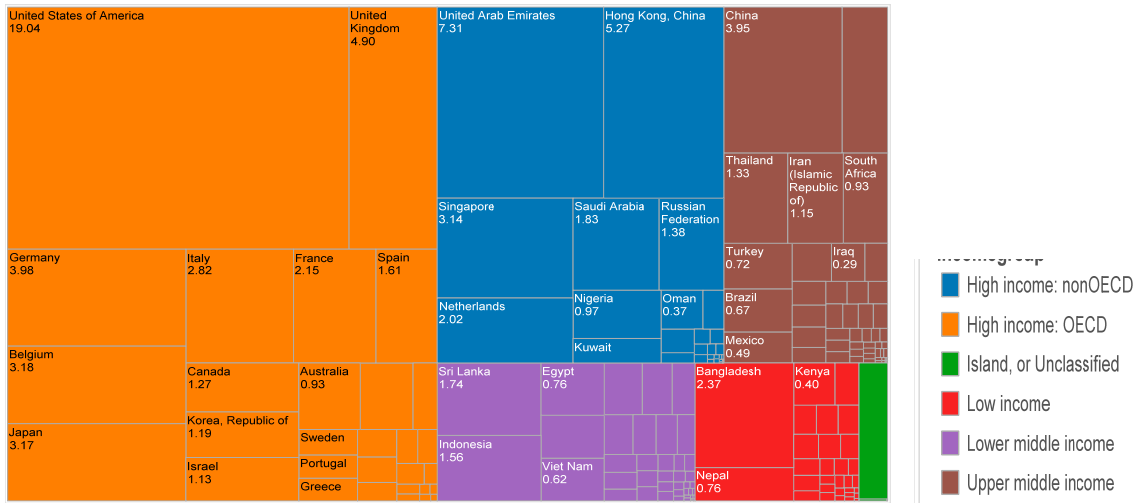
Export Destination (share of total bi-lateral merchandise export)2010-2013

Source: Authors' calculations using Balance of Payments BPM5 statistics, IMF and authors' calculations.

## Panel VII. India's Exports Diversification

Sources: Authors' calculations using WITS database, SITC rev. 3.

Panel VIII. Exports Diversification
India: Marchandise Exports Diversification (average, 2007-11)

India: Exports Diversification
(average, 2007-11)
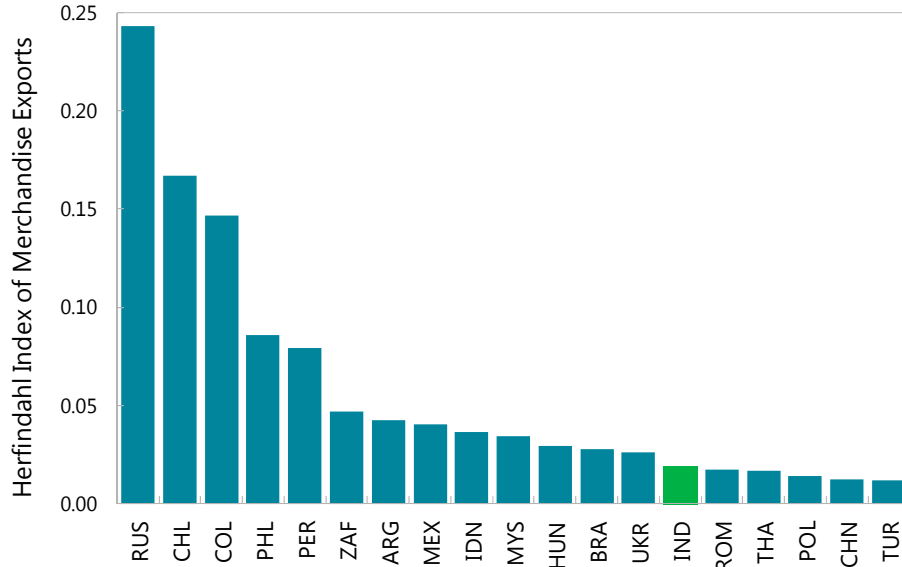
Source: authors' calculations using WITS database, SITC rev. 3.

India: Service Exports Diversification (average, 2007-11)
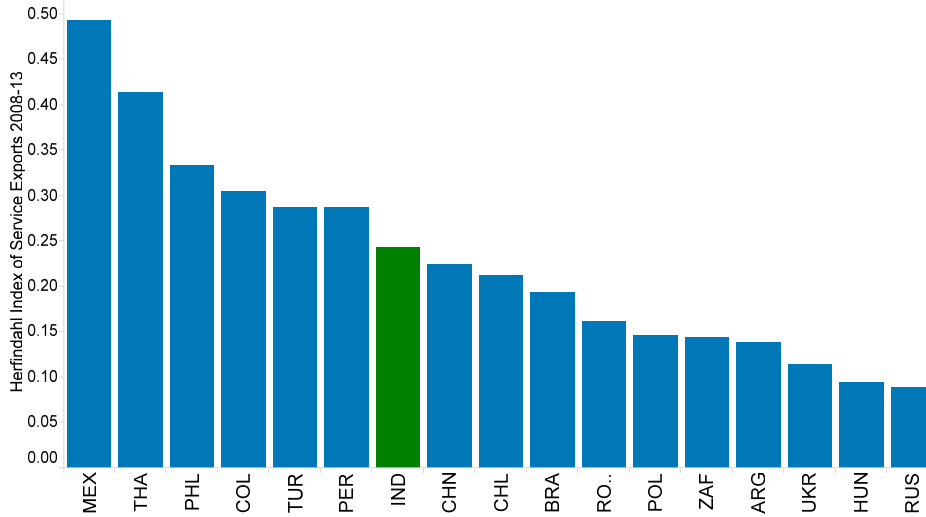
Source: Authors' calculations using Balance of Payments BPM5 statistics, IMF and authors' calculations
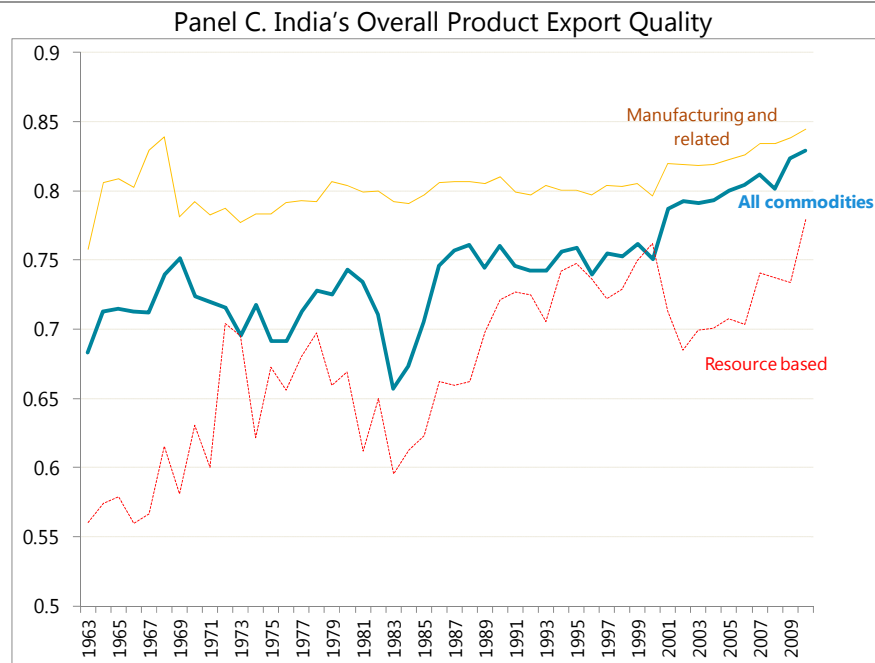
Panel IX. Export Quality

Panel A. Export Quality in 1990 and 2010
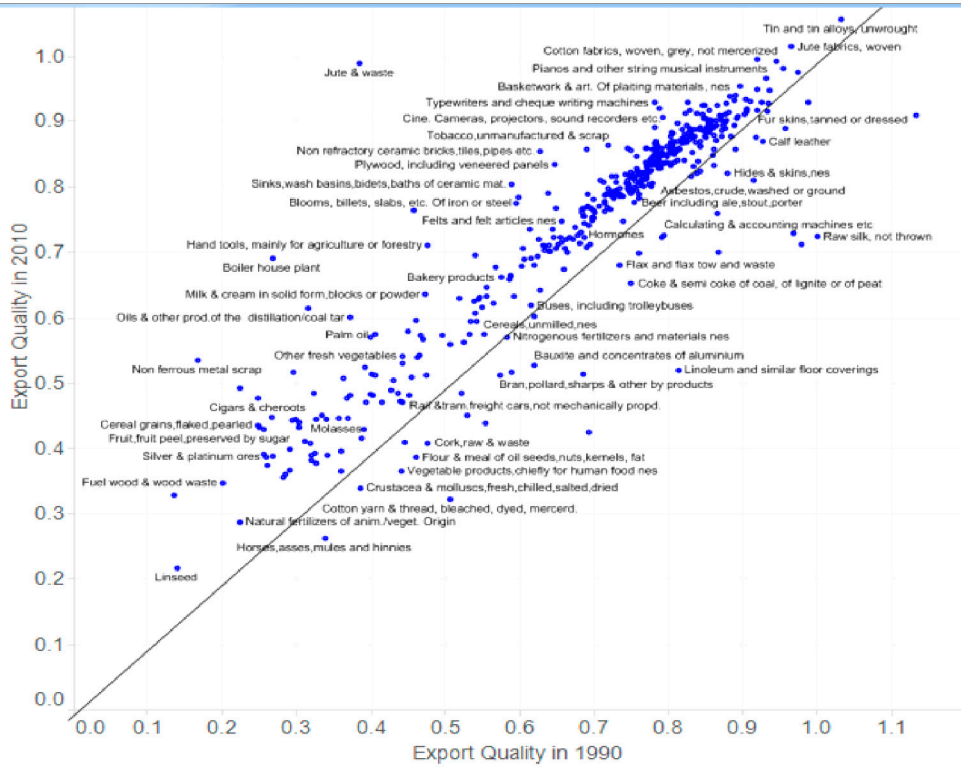
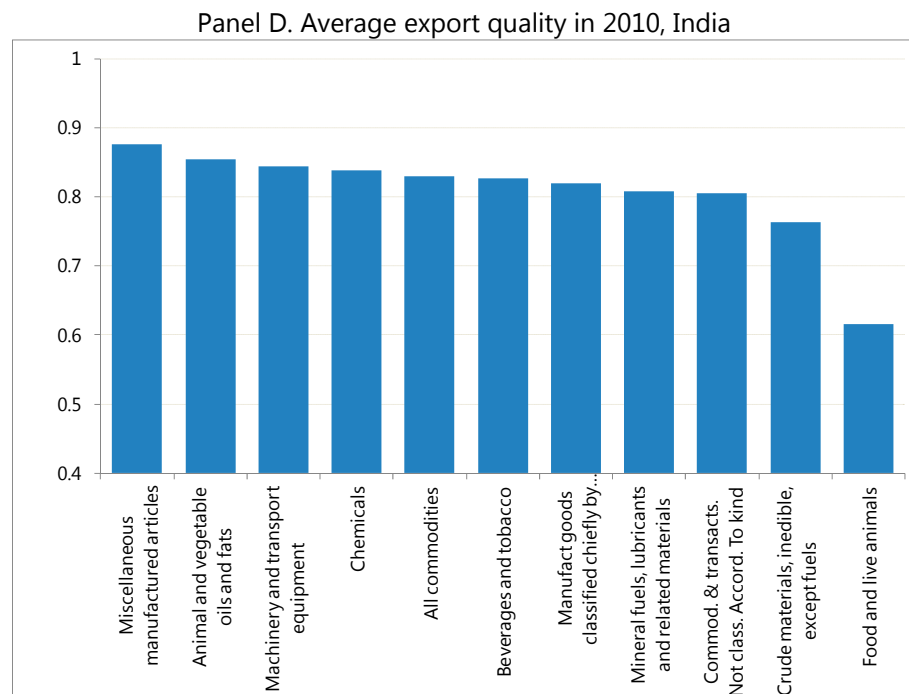*Source*: Authors' calculations WITS database, SITC Rev. 4, IMF trade database.

Panel B. Export Quality comparison across specific products

## Panel C. India's Overall Product Export Quality
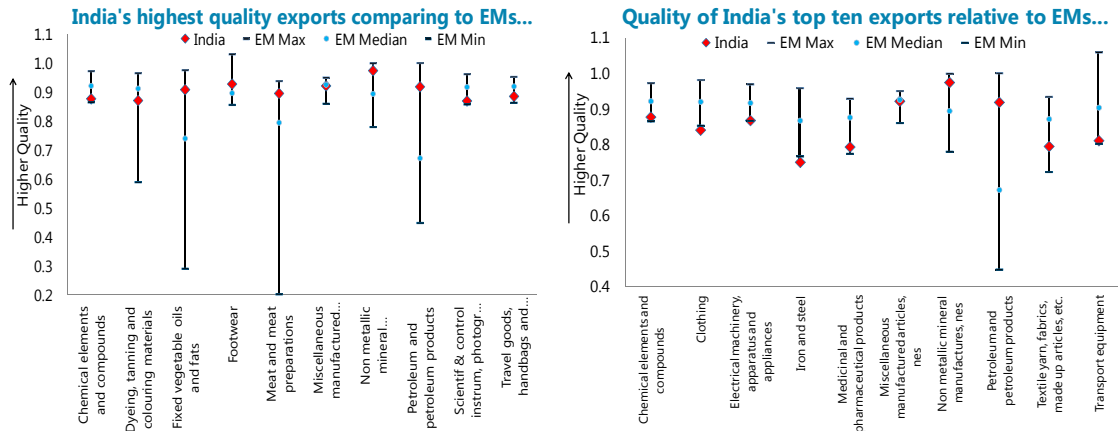
Source: IMF export quality database at 1 digit.

Notes: Resource based exports are the following: Food and live animals, Beverages and tobacco, Crude materials, inedible, except fuels, Mineral fuels, lubricants and related materials, Animal and vegetable oils and fats, Commod. & transacts. Not class. Accord. To kind. Manufacturing and related exports are the following: Chemicals, Manufact goods classified chiefly by material, Machinery and transport equipment, Miscellaneous manufactured articles.
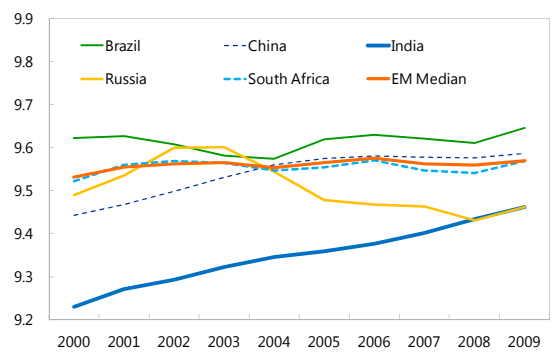
Panel D. Average export quality in 2010, India

Panel X. Sophistication of Indian Exports

Goods Export Sophistication
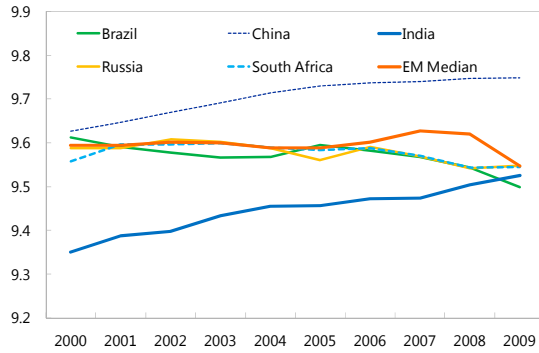
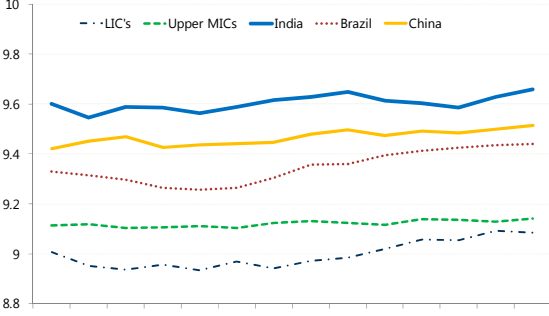Sources: WITS database, SITC rev. 3 and authors' calculations.
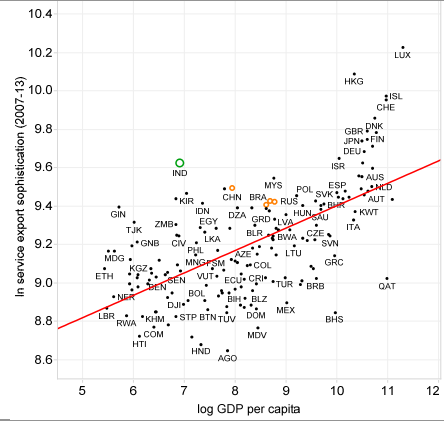
Manufacturing Exports Sophistication

Sources: WITS database, SITC rev. 3 and authors' calculations.

B

Services Exports Sophistication

*Sources*: authors' calculations using BPM6 Working data, IMF. 2015.

**Panel XI. Revealed Comparative Advantage for Service Exports, India**

Sector	Year (group)		Avg. Rca
	2000-05	2008-13	0.0036 — 1.0000
Charges for the use of intellectual property n.i.e.			
Construction, Construction abroad			
Financial Explicitly charged and other financial			
Financial Financial intermediation services indirectly measured (FISIM)			
Government goods and services n.i.e.			
Insurance and pension Direct insurance			
Insurance and pension Pension and standardized guaranteed			
Insurance and pension Reinsurance			
Maintenance and repair services n.i.e.			
Manufacturing services on physical inputs owned by others, Goods fo..			
Manufacturing services on physical inputs owned by others, Goods fo..			
Other Business Professional and management consulting			
Other Business Research and development			
Other Business Technical, trade-related, and other business			
Personal, cultural, and recreational Audiovisual and related			
Personal, cultural, and recreational Other personal, cultural, and recre..			
Telecommunications, computer, and information Computer			
Telecommunications, computer, and information Information			
Transport, Air Transport, Other			
Transport, Freight			
Transport, Other			
Transport, Other mode of Transport, Freight			
Transport, Other mode of Transport, Other			
Transport, Other mode of Transport, Passenger			
Transport, Passenger			
Transport, Sea Transport, Other			
Travel, Business, Acquisition of goods and services by border, seaso..			
Travel, Business, Other			
Travel, Personal, Health related			
Travel, Personal, Other,			
Travel, Personal, Education related			

Source: Authors' calculations using BPM6 service credit accounts.

Panel XII. Germany, Product Space

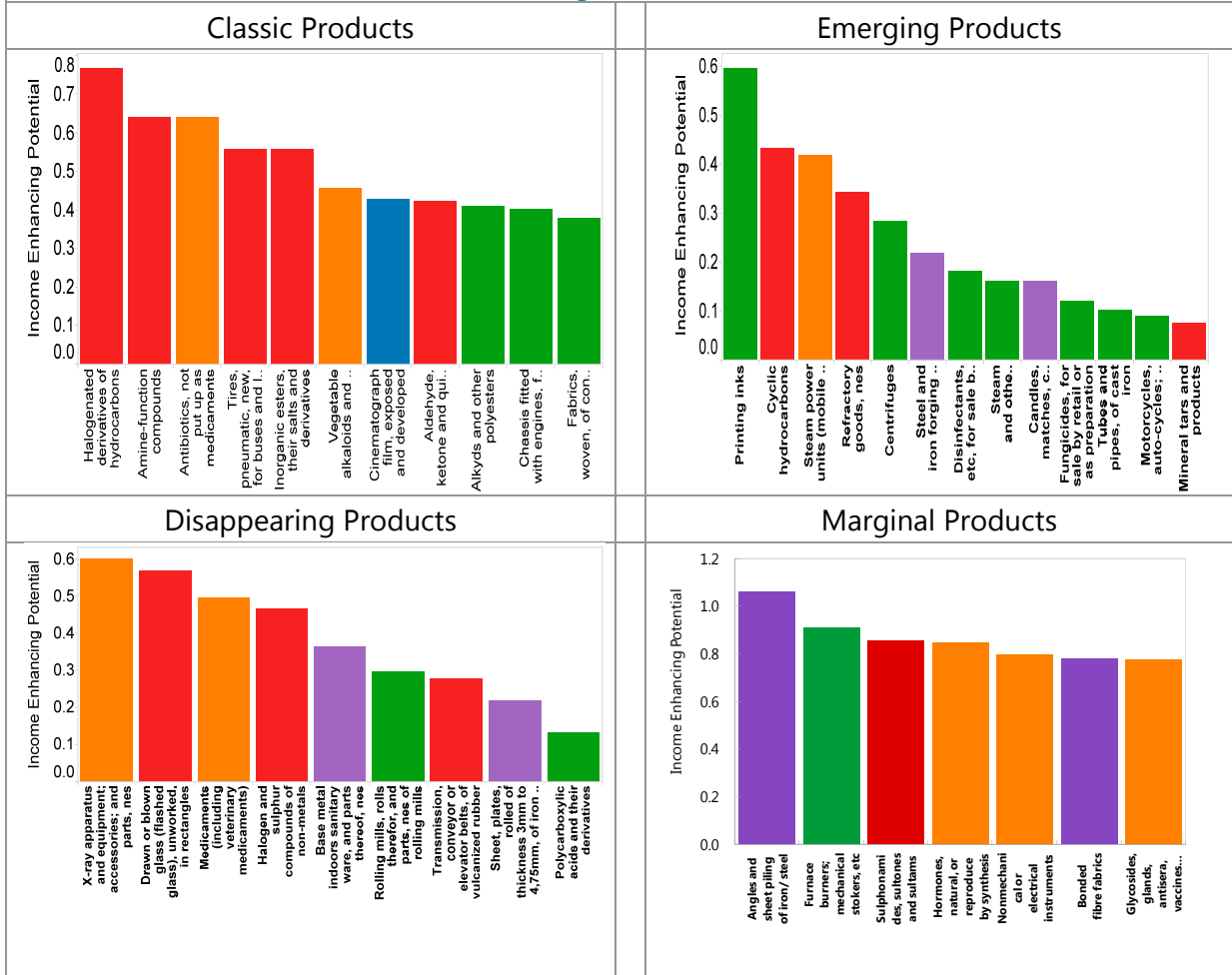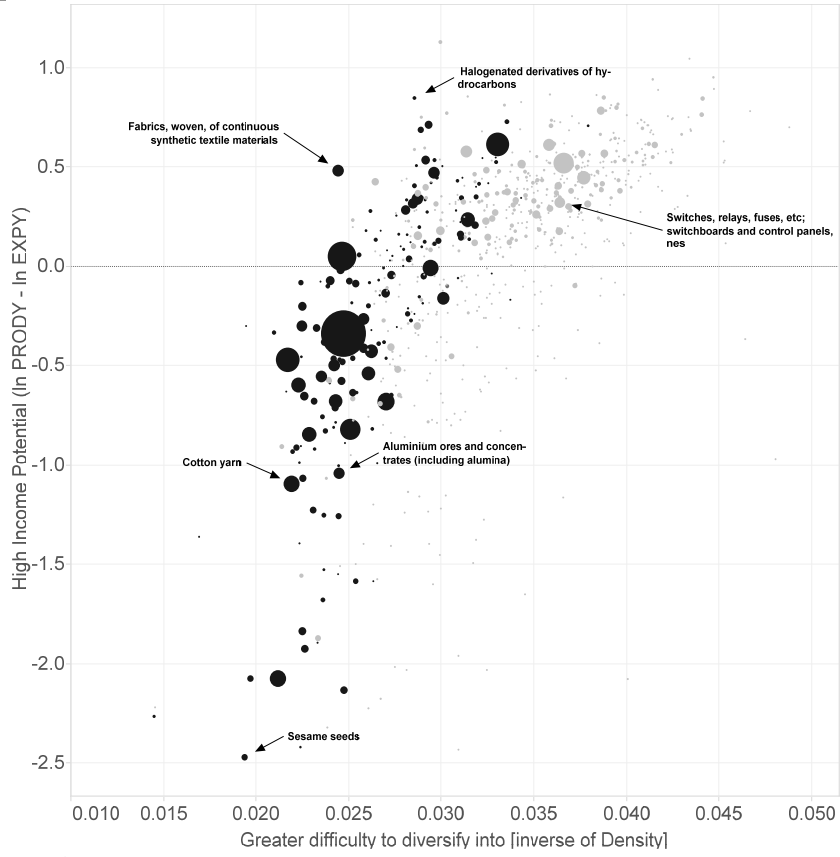**1995**
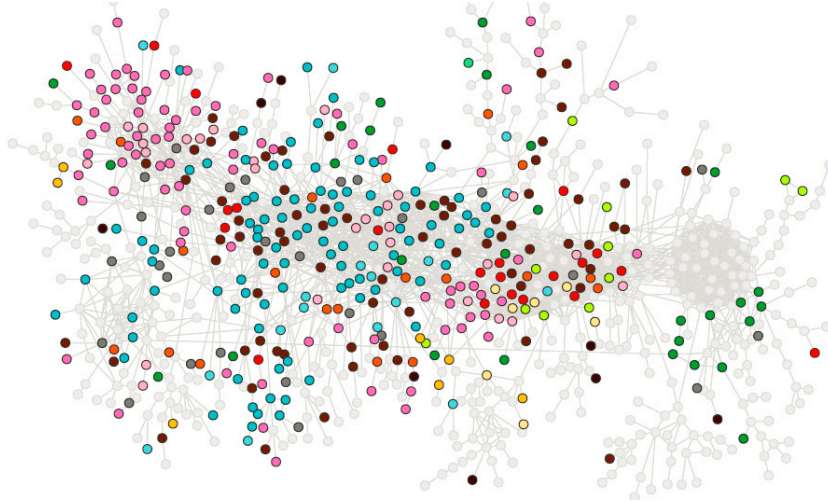
2012
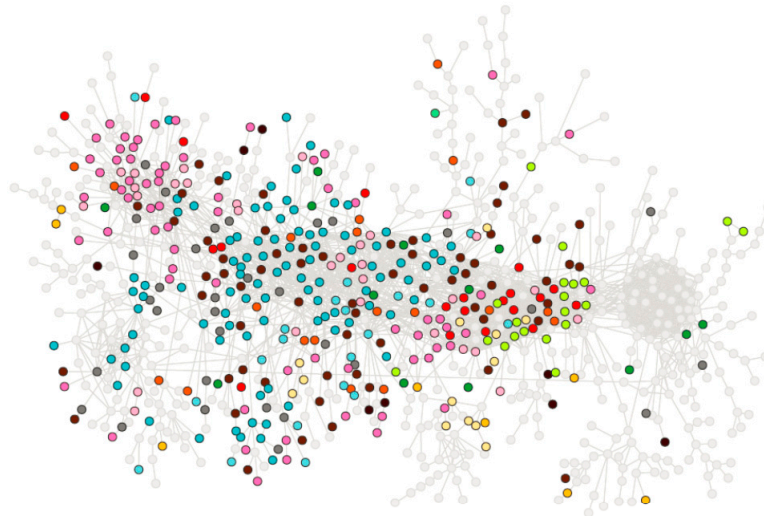
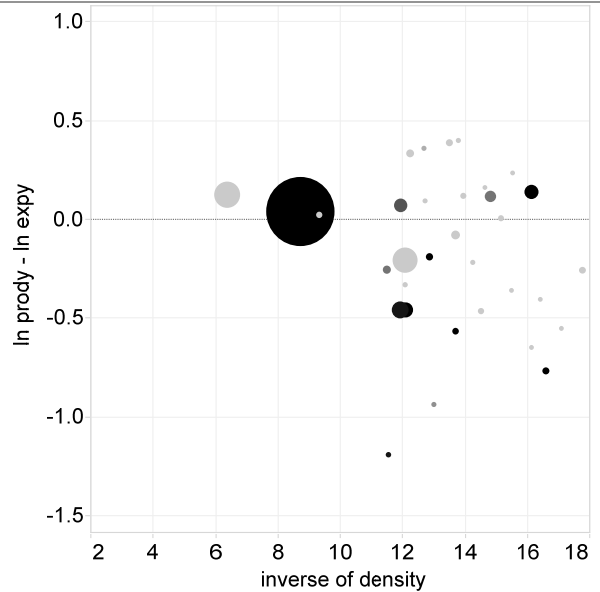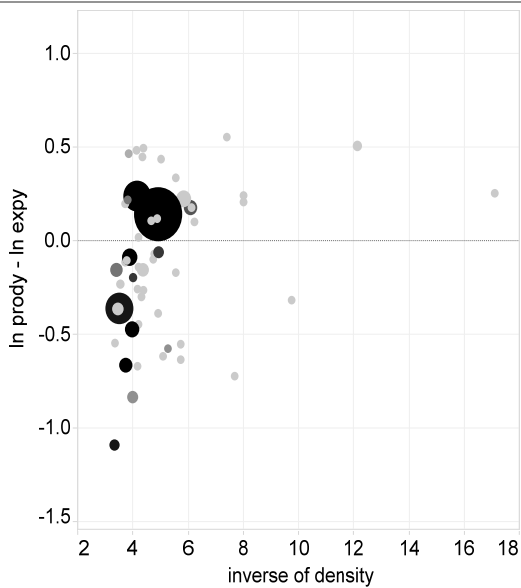**Panel XIII. Top Income Enhancing Products From India by Comparative Advantage, averages 2008-12**

Panel XIV. Product Space

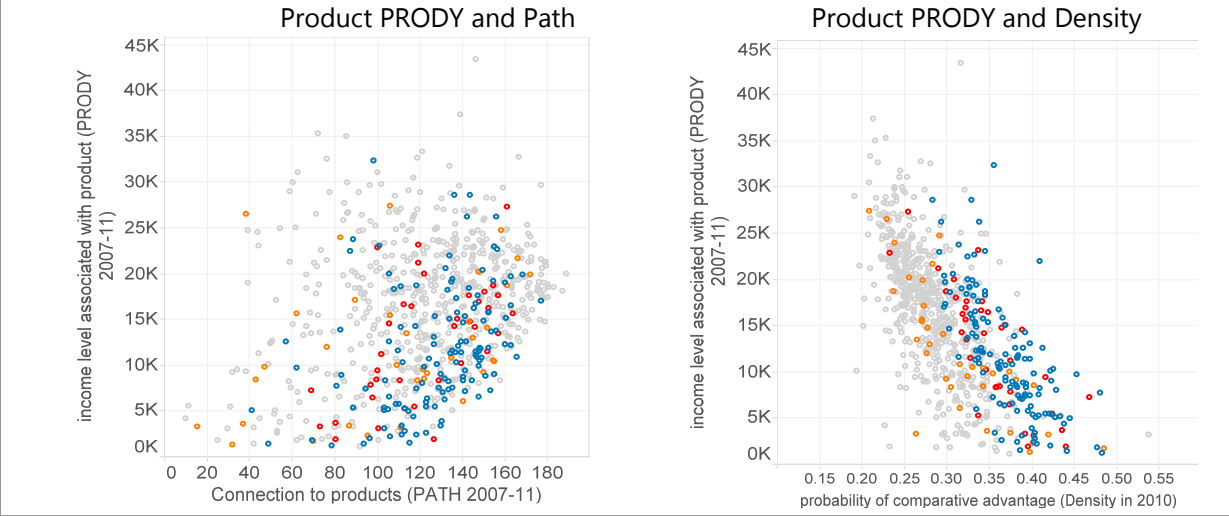*Product Space Analysis for Merchandise Export Basket (India)*

Note: The color filters RCA Threshold>=1. The size indicates the share in India's export basket.
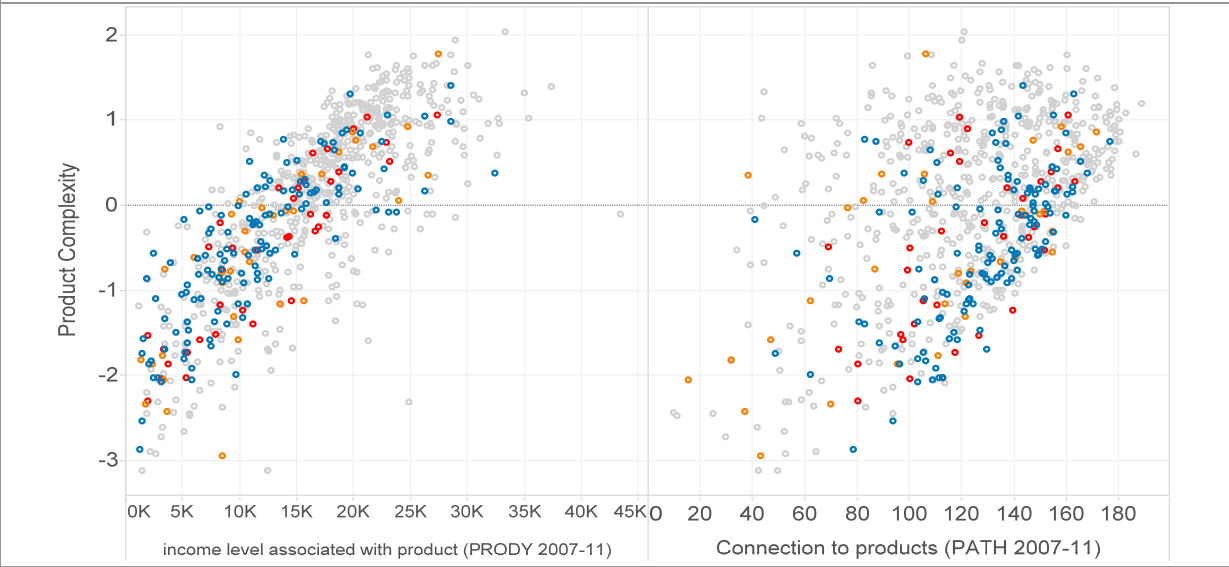
Services, 2000-02 and 2008-11

Sources: Authors' calculations using service credit data from BPM5.

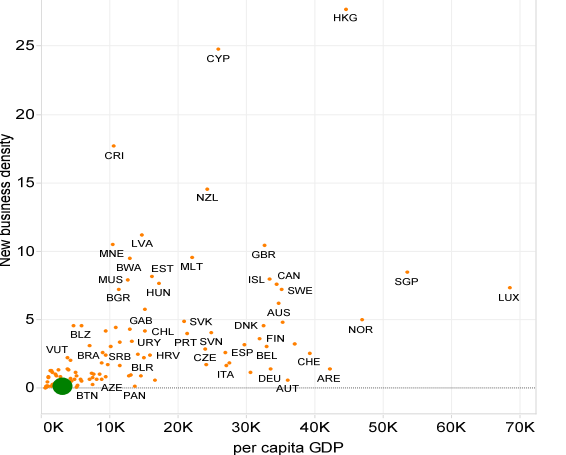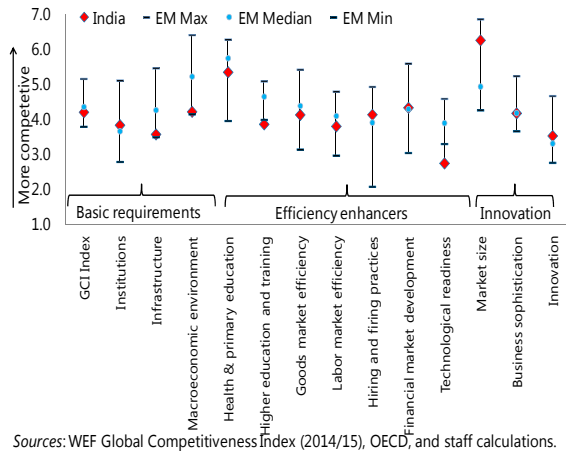Product Level Comparative Advantage of India's Goods Exports

Product PRODY and Path
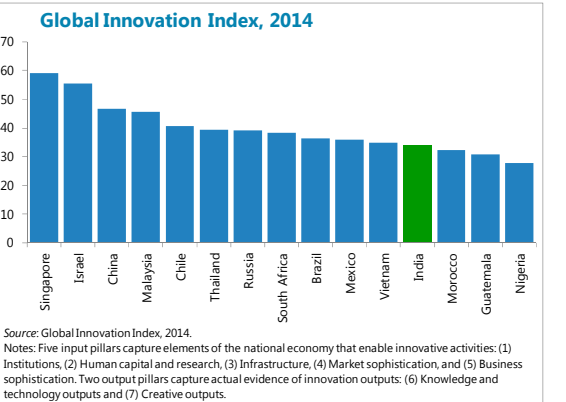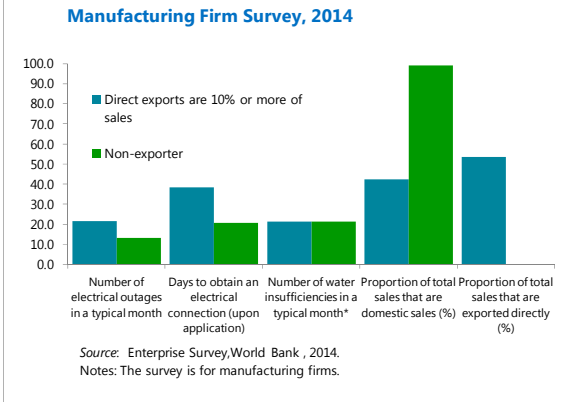
Product PRODY and Density

Product Complexity Index and Comparative Advantage, India, 2012

Panel XV. Policy Prospects

Overall Trade Restriction Index
(2009)

Sources: Kee, Hiau Looi, e. al., Economic General (2009), World Bank.

Overall Service Trade Restrictiveness Index
(2008-12)

Source: World Bank Database on Service Trade Restriictiveness, 2012.
Notes: Completely open (0);Virtually open but with minor restrictions (25);Major restrictions (50); Virtually closed with limited opportunities to enter and operate (75); Completely closed (100).

Manufacturing Firm Survey, 2014

Source: Enterprise Survey,World Bank , 2014.
Notes: The survey is for manufacturing firms.

Global Innovation Index, 2014

Source: Global Innovation Index, 2014.
Notes: Five input pillars capture elements of the national economy that enable innovative activities: (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication. Two output pillars capture actual evidence of innovation outputs: (6) Knowledge and technology outputs and (7) Creative outputs.

Sources: WEF Global Competitiveness Index (2014/15), OECD, and staff calculations.

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