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Exports, Capabilities, and Industrial Policy in India

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ABSTRACT

An extensive literature argues that India's manufacturing sector has underperformed, and that the country has failed to industrialize; in particular, it has failed to take advantage of its labor-abundant comparative advantage. India's manufacturing sector is smaller as a share of GDP than that of East Asian countries, even after controlling for GDP per capita. Hence, its contribution to overall GDP growth is modest. Without greater participation of the secondary sector, the argument goes, the country will not be able to develop and become a modern economy. Standard arguments blame the "license-permit raj," the small-scale industrial policy, and the supposedly stringent laws. All these were part of the industrial policy regime instituted after independence, which favored the heavy-machinery subsector. We show that this policy bias negatively affected the development of India's labor-intensive sector, as the country *should* export with comparative advantage a larger number of these products, given its income per capita. However, India's manufacturing sector is relatively well diversified and sophisticated, given also the country's income per capita. In particular, India's inroads into machinery, metals, chemicals, and other capital- and skilled labor–intensive products has allowed the country to accumulate a large number of capabilities. This positions India well to expand its exports of other sophisticated products.

Keywords: Capabilities; Diversification; India; Industrial Policy; Revealed Comparative Advantage; Sophistication

JEL Classifications: O20, O25, O53

1. INTRODUCTION

Two stylized facts in the development literature are, first, that the share of the manufacturing sector in overall output increases with income per capita before it starts declining, i.e., an inverted U-shape relationship (Felipe and Estrada 2008); and second, that manufacturing is a key driver of growth (Kaldor 1967; Rodrik 2006). Indeed, the importance of industrialization, and in general structural transformation, as the key to develop was highlighted by Kaldor (1967). In the Kaldorian framework, the manufacturing sector is subject to increasing returns to scale and is the engine of growth.[1] From a Kaldorian perspective, the manufacturing sector assumes a central role in the growth process thanks to its ability to generate spillovers, technical progress, economies of scale, induced productivity growth in the sector, and to raise the overall productivity of the economy.

In India—despite the early emphasis on industrialization after independence and deregulation of the manufacturing sector as a key element of the reforms implemented since the mid-1980s—large-scale industrialization, as seen in East Asia, has not happened. Indeed, one of the salient features of India's economic structure is the relatively low share of the manufacturing sector in GDP, about 15%, and it has not changed much over the last 30 years. This is significantly smaller than in the East Asian countries, and much smaller than in China, where the share of the manufacturing in GDP is about 35%. Using a logistic regression and controlling for income per capita and its square, population, and the share of trade in GDP ratio, Felipe and Estrada (2008) estimated that India's manufacturing is about five percentage points smaller than it should be. Several reasons have been discussed in the literature for the underperformance and the relatively small size of the manufacturing sector in India. These include the industrial policy framework adopted in the early days of planning, along with the industrial and import licensing regime, the small-scale sector reservation policy, the rigid labor laws, and the lack of physical and social infrastructure.

[1] Kaldor argued that manufacturing is the engine of growth, in the sense that the faster the rate of growth of manufacturing output, the faster the rate of growth of overall output (GDP). This is because manufacturing has strong linkages with rest of the economy, has potential for capital accumulation, and its potential for technical progress is highest. Felipe et al. (2009) estimate the responsiveness of the rest of the economy's growth rate to growth in the individual sectors of the economy. Their estimates show that, in developing Asia, both industry and services have acted as engines of growth, and that services has had a larger impact than manufacturing. The reason is that many of today's services are also subject to increasing returns to scale.

The relatively high growth achieved by India recently has come largely from the service sector, which has emerged as the main driver of growth, and has contributed an increasing share of the country's overall growth rate: services contributed 50% of overall growth during 1980–1990, 61% during 1990–2000, and 64% during 2000–2007.[2] The information technology (IT) sector has become a leading sector in India during the last decade. The IT sector was outside the ambit of the licensing system and did not suffer from regulation and control of its activities to the extent that the manufacturing sector did.

Kochhar et al. (2006) argue that on the eve of the reforms, India's policy stance with respect to the manufacturing sector was biased in favor of the skilled labor–intensive or large-scale activities, and that the manufacturing sector was more diversified than would be expected given India's income level. Under the development strategy adopted after independence, the public sector was assigned the role to lead India's industrial development, with an emphasis on the heavy machinery sector. Given India's large population, its comparative advantage lies in the labor-intensive activities. These activities, however, were used to employ millions of workers by reserving the manufacture of a large number of products exclusively for the small-sized units, with little regard for optimal size and economies of scale. Kochhar et al. (2006) found that this pattern persists even after twenty years, during which significant reforms were introduced. This, they argue, was the result of a policy regime that has protected small-scale industries, made it hard to lay-off workers in firms above a certain size, restricted imports if something could be produced domestically irrespective of cost, and promoted higher education and scientific learning.

Viewing development as a path-dependent process that involves structural transformation and the accumulation of capabilities, this paper contributes to the debate on the effects of industrial policy in India. To this purpose, we examine the composition of exports at a highly disaggregated level and focus on two different aspects of the export basket, namely, its sophistication and its diversification. The sophistication level of the export basket of a country

[2] Dasgupta and Singh (2005) have argued that the services sector in India, especially the information and communication technology (ICT) sector, have the potential to play the same role, in a Kaldorian sense, as the manufacturing sector. Eichengreen and Gupta (2010) argue that sustained economic growth will require shifting labor from agriculture into both manufacturing and services sector and not just one or the other. On the other hand, Nagaraj (2006) argues that services cannot become an engine of growth as far as India goes because it lacks the potential to create jobs needed to absorb the vast labor pool from rural India. This role, he argues, has traditionally been performed by the industrial sector. Panagariya (2008: 287) argues that "India must walk on two legs," manufacturing and services.

captures its ability to export products produced and exported by the rich countries to the extent that, in general, the exports of rich countries embody higher productivity, wages, and income per capita. Diversification, on the other hand, captures the ability to become competitive in a wider range of products and is measured by the number of products exported with revealed comparative advantage. Hidalgo et al. (2007) argue that development must be understood as a process of accumulating more complex capabilities and of finding paths that create incentives for those capabilities to be accumulated and used. A sustainable growth trajectory must, therefore, involve the introduction of new goods and not merely involve continual learning on the same of set goods.

Using highly disaggregated SITC 4-digit data for 1962–2007 covering almost 800 product categories, we find that India was a positive outlier on both sophistication and diversification, i.e., India's export basket was more sophisticated and diversified than would be expected for a country at its stage of development. Further, we find that the diversification and sophistication of "core" products (metals, machinery, and chemicals) was above what one would expect given India's per capita income. We also find that the share of core products in total manufacturing products exported with revealed comparative is relatively high. In other words, a labor-abundant country like India, whose comparative advantage lies in labor-intensive activities, has diversified in the skill-intensive and capital-intensive sector. There is nothing wrong with this strategy, and in fact we argue that some kind of "targeting" is necessary. Without it, it would have been impossible for a country like India to start manufacturing relatively sophisticated products. We argue that the stock of capabilities that India had accumulated on the eve of the reforms of the 1990s was the legacy of the industrial policies, which emphasized heavy industry–led industrialization. However, we emphasize that not all aspects of industrial policy were beneficial, and that mistakes were made that resulted in inefficiencies and resource misallocation. Finally, we find that the number of labor-intensive products exported with revealed comparative advantage as a share of total manufacturing products exported with revealed comparative advantage is below what would be expected for a country at India's level of development. Here lies India's failure, especially when compared to China.

The rest of the paper is organized as follows. In Section 2 we discuss India's industrial policy landscape. Section 3 examines the evolution over time of the sophistication of India's export basket and its diversification. We discuss the performance of the labor-intensive sectors,

analyze India's progression into sophisticated products, and compare it with China. Section 4 summarizes the arguments.

2. A BRIEF OVERVIEW OF INDIA'S INDUSTRIAL POLICY LANDSCAPE AND MAJOR REFORMS

The key objective of India's new leadership after independence was to be self-sufficient in all sectors of the economy. The early days of policymaking were heavily influenced by the Nehru-Gandhi ideology, which leaned towards a socialist framework by contemporary academic thinking (Rosenstein-Rodan 1943; Scitovsky 1954). The development strategy aimed at achieving self-sufficiency, industrializing, improving living standards, reducing the concentration of economic power, and attaining balanced regional development and an equitable distribution of the gains from economic growth. The planned economy model adopted was largely inspired by the Soviet-style "command and control" system. A key difference was that while the means of the production in the Soviet Union were owned by the state, in the case of India a large share of the economy was privately owned. To plan the private economy, a system of controls and regulatory regimes was adopted. [3]

The key legislation on industrial development included the Industrial Policy Resolution of 1948; the Industries (Development and Regulation) Act, 1951; the First and the Second Five Year Plans; and the Industrial Policy Resolution of 1956.[4] The industrial policy resolutions of 1948 and 1956, and the first and second five-year plans gave a central role to the public sector. The public sector was entrusted to lead the development and expansion of India's heavy machinery sector (i.e., to "make machines that make machines") and overall industrialization. An active role of the public sector in industrial development, it was hoped, would also foster the equitable distribution of income and wealth, balance regional development, prevent the concentration of wealth, create employment opportunities, and generate resources for further development.

[3] Mohan and Aggarwal (1990) note that the origins of the control and the regulatory regime can be traced back to the measures that were put in place at the beginning of the World War II.

[4] There literature on India's development strategy after independence is voluminous. For reasons of space, we discuss only important legislations and their key aspects. More detailed accounts can be found in Bhagwati and Desai (1970), Bhagwati and Srinivasan (1993), Joshi and Little (1994 and 1996), and Panagariya (2008).

Private sector activity was allowed, though the sectors in which it could operate were restricted. The key piece of legislation was the Industries (Development and Regulation) Act of 1951 (IDRA). The key aim of this act was to regulate and control private sector activity in conformity with the government's priorities, as noted in the five-year plans, and to direct scarce resources to industries considered important. A variety of instruments were used. Important among them were the industrial licensing and import licensing. Industrial licensing applied to any industrial undertaking above a certain size in a set of specified industries. No additional capacity expansion in the existing industrial undertakings (or new undertakings) was allowed in these scheduled industries. The license specified the minimum and the maximum quantity that could be produced. The government could dictate the location and the scale of the plant.[5] The industrial licensing regime was tightened over time and its reach widened.[6]

To reduce dependence on foreign exchange and achieve self-reliance, import substitution was encouraged. Trade restrictions in the form of import licensing and tariffs were introduced. Importing anything that could be produced domestically was discouraged regardless of the cost, and exporters were allowed to import inputs under various schemes. Import licensing, together with the industrial licensing, came to be known as the *license-pemit raj*. This system, which led to inefficiencies, created a culture of rent-seeking, erected barriers to entry and exit, provided indiscriminate and indefinite protection, led to misallocation of resources, and limited domestic and foreign competition (Ahluwalia 1991; Bhagwati and Srinivasan 1975; Joshi and Little 1994; Panagariya 2008). Distribution and price controls were used to ensure that priority sectors received inputs at "reasonable" prices and to keep inflation in check. To avoid concentration of economic power in the hands of a few large industrial houses, the Monopoly and Restrictive Trade Practices Act (MRTP), 1969, and the Foreign Exchange Regulation Act (FERA), 1973, were introduced. These laws and regulations imposed severe constraints on the expansion of large business houses and discouraged foreign collaboration and investment.

Labor-intensive small-scale enterprises, cottage industries, and household enterprises were promoted by protecting them against foreign and domestic competition, and providing

[5] Industrial undertaking was defined as any undertaking carrying out an activity pertaining to any of the industries in the First Schedule of the Act in one or more factories. "Factory" in IDRA (1951) was defined as any premises where manufacturing activity was being carried out with by 50 or more workers with power or by 100 or more workers and without power. (Source: http://labour.delhigovt.nic.in/act/details_acts/industrialdevelopment/index.html)

[6] Key policy enactments included the Industrial Licensing Policy of 1970, and two industrial policy notifications dated February 2nd and 19th, 1973.

supportive measures such as preferential access to credit and subsidized credit. A key element of this policy, the Small-Scale Industrial (SSI) Policy, was introduced in 1967, whereby the production of some products was reserved exclusively to the small-scale sector (defined in terms of cumulative amount of investment in plant and machinery). Once a product was classified to be produced by the small-scale sector, no further capacity expansion was permitted for medium- or large-scale units, though they were allowed to produce. All further expansion or capacity creation was reserved only for the small-scale sector and only those firms that had investment limits below the threshold could produce items reserved for the SSI. Mohan (2002) provides a comprehensive discussion and a critical evaluation of the small-scale industry policy in India. He concludes that these policies have been harmful for the growth of the Indian manufacturing sector.

A third aspect that has received considerable attention in the literature is India's supposedly stringent labor laws. Significant job protection was accorded to workers, especially to those employed in large firms. A 1976 amendment to the Industrial Disputes Act of 1947 (IDA) made it necessary for firms employing more than 300 workers to seek the permission of relevant state governments in order to retrench or lay off workers. The reach of this expanded when a further amendment in 1982 lowered the ceiling to firms with more than 100 workers.[7] These labor laws, by preventing restructuring and reallocation of resources, have allowed the Indian firms to remain small (Kochhar et al. 2006; Krueger 2007; Panagariya 2008).[8]

Finally, Bardhan (2006) argues that policy alone is not what has held back the manufacturing sector, but also the lack of physical and social infrastructure.

Most aspects of the license-permit raj were in place until the 1980s, when the first steps were taken to dismantle the licensing regime. Among other steps, these reforms included the

[7] Though the IDA does not prohibit retrenchments, state governments have often been unwilling to grant permission to retrench (Datta-Chaudhari 1996).

[8] Roy (2004) finds that the impact of labor laws is statistically insignificant in a regression explaining the underperformance of the manufacturing sector. Using case studies of labor practices, Deshpande (2004) concludes that the labor market is not as inflexible. In fact, using World Bank's investment climate survey data on Indian states, labor regulations do not show up as a significant concern for enterprises (Gupta, Hasan, and Kumar 2008). This, Kochhar et al. (2006) and Krueger (2007) argue, could be because the incumbent firms have adapted to these laws and it is hard to say what decisions those firms would have made in their absence, i.e., lack of an appropriate counterfactual. Moreover, these laws affect investment decisions of the new entrants, who may choose a more capital-intensive, skilled-labor line of production or technology. To better understand the role played by labor laws, recent studies use differences in rigidity of labor laws across states to show that industrial performance has been weaker in states with pro-worker labor laws (Besley and Burgess 2004) and that gains from delicensing in pro-worker labor laws are lower (Aghion et al. 2006). Gupta, Hasan, and Kumar (2009) show that states with relatively inflexible labor laws experienced slower growth of labor-intensive industries and slower employment growth.

abolition of the licensing regime for select industries and the liberalization of the trade regime (via reductions in the number of products listed under banned/restricted category).[9]

The second, and by all accounts the major, wave of reforms came in 1991. The New Industrial Policy announced in July 1991 extended industrial deregulation, in both its coverage and depth, beyond what had been achieved in the 1980s. These measures included the abolition of industrial licensing for all but 18 industries and the elimination of public sector monopolies, together with the prohibition of private investment in these industries (industries restricted for the public sector were reduced to 8 from 17), as well as the relaxation of foreign direct investment rules. While there was an upper limit on the extent of foreign participation, this varied across industries and has increased over the period. Sweeping trade liberalization measures were introduced. These included the elimination of import licensing and the progressive reduction of tariff and nontariff barriers. The export-import policy (EXIM policy) of 1992–1997 reaffirmed India's commitment to the promotion of free trade. All import licensing lists were eliminated and a "negative" list was established.[10] Except for consumer goods, almost all capital and intermediate goods could be freely imported subject to tariffs. By April 2002, all the remaining quantitative restrictions had been removed. Reforms were undertaken in the banking and the financial sectors as well. Liberalization measures were taken in important services such as telecommunications. Dereservation of the small-scale sector began only in 1997 and the total number of products reserved for the small-scale sector had been reduced from 821 in 1998–1999 to 21 items in October 2008.[11]

3. SOPHISTICATION AND DIVERSIFICATION OF INDIA'S EXPORT BASKET

In this section, we analyze how the sophistication and diversification of India's export basket has evolved since the 1960s. We focus particularly on the labor-intensive categories (the negatively affected by the country's history of industrial policy) and on the machinery groups (the objective of the architects of the country's industrial policy). We use a highly disaggregated data set

[9] For further details, see Panagariya (2008)
[10] The establishment of a "negative" list implied that all items, except those in the negative list, could be imported without any import licenses and were not subject to any quantitative restrictions. The negative list consists of three sections: prohibited list, canalized items, and restricted list.
[11] http://commerce.nic.in/pressrelease/pressrelease_detail.asp?id=2325.

covering almost 800 products. We analyze both the overall export basket as well as the core products. [12] In doing this, we closely follow the product space literature. [13]

The sophistication of a country's export basket (EXPY) is calculated as the weighted average of the level of sophistication of the products (PRODY) that it exports.[14] Diversification is measured by the absolute number of products that a country exports with revealed comparative

[12] Core products include chemicals (SITC Rev2 categories 51-59), machinery (SITC Rev2 categories 71-79, 87, 88, 95), and metal products (SITC Rev2 categories 67, 69). For now, note that the core products tend to be more skilled labor–intensive, as well as use relatively more capital than other manufacturing products; we provide more discussion on product categories later in the paper.

[13] The product space is an application of network theory introduced by Hidalgo et al. (2007). It is a representation of all products exported (at our level of disaggregation, almost 800 products). It shows that some products are close-by to others because they require similar capabilities, while some others are in a sparse area of the product space. In the first case, it easy to jump from one product into another one (and therefore exporting it with revealed comparative advantage), while in the second case it is difficult. The core of the product space (that is, the area with many products close by) is comprised of chemicals, machinery, and metal products (320 products, 41% of the total). The periphery consists of petroleum, raw materials, tropical agriculture, animal products, cereals, labor-intensive goods, and capital-intensive goods (excluding metal products). These categories are based on the Leamer (1984) classification. Following Hidalgo et al. (2007) the capital-intensive category as defined by Leamer (1984) is split into two: capital-intensive goods (excluding metal products) and metal products. Leamer (1984: 73) notes that the labor-intensive category uses unskilled labor; capital-intensive uses capital and unskilled labor; machinery uses skilled labor and moderate amounts of capital; and chemical uses skilled labor and very large amounts of capital. Note that since the capital-intensive category, as defined by Leamer (1984), is divided into two groups in this paper, we assume both capital-intensive (excluding metal products) and metal products use capital and unskilled labor.

[14] Algebraically, following Hausmann, Huwang, and Rodrik (2007):

$$EXPY_c = \sum_i \left(\frac{xval_{ci}}{\sum_i xval_{ci}} \times PRODY_i \right)$$

EXPY is measured in 2005 PPP$. PRODY provides a measure of the income content of a product and is therefore not an engineering notion. Hausmann, Huwang, and Rodrik (2007) calculate PRODY as a weighted average of the GDP per capita of the countries that export the product in question. This is calculated individually for each product. Algebraically:

$$PRODY_i = \sum_c \left[\frac{xval_{ci} \Big/ \sum_i xval_{ci}}{\sum_c \left(xval_{ci} \Big/ \sum_i xval_{ci} \right)} \right] \times GDPpc_c$$

where $xval_{ci}$ is the value of country *c*'s export of commodity *i* and $GDPpc_c$ is country *c*'s per capita GDP. PRODY is measured in 2005 PPP$.

advantage. Revealed comparative advantage is measured as the ratio of the export share of a given product in the country's export basket to the same share at the world level. [15]

A. Sophistication

To understand changes in the sophistication level of a country's export basket in the course of development, we examine its evolution across countries and over time. We estimate a regression of the log of EXPY on the log of GDP per capita and its square. We also control for period dummies.[16] Figure 1 shows the fitted values (continuous line), the 95% confidence interval (dashed lines), and the actual values for a selected group of countries. The fitted values show the expected level of export sophistication given a country's level of development (proxied by its GDP per capita).

Figure 1 shows that India's export sophistication in the early 1960s, though within the 95% confidence interval, was higher than that of countries such as Thailand, Brazil, or Malaysia. However, post-1970s, the level of sophistication of India's export basket was significantly above what would be expected for a country at a similar stage of development. To give an example,

[15] We use the measure proposed by Balassa (1965), Algebraically:

$$RCA_{ci} = \frac{xval_{ci} \Big/ \sum_i xval_{ci}}{\sum_c xval_{ci} \Big/ \sum_i \sum_c xval_{ci}}$$

Country *c* is said to have revealed comparative advantage in commodity *i* if the above defined index, RCA_{ci}, is greater than 1. The index of revealed comparative advantage can be problematic, especially if used for comparison of different products. For example, a country very well endowed with a specific natural resource can have a RCA in the thousands. However, the highest RCA in automobiles is about 3.6.

[16] Specifically, the relationship estimated is the following:

$$\ln(EXPY_{jt}) = \alpha_0 + \alpha_1 \ln(GDPpc_{jt}) + \delta_t (dummy\ 1986\text{-}2007) + \varepsilon_{jt}$$

where *j* is country and *t* is year from 1962 to 2007, and dummy for 1986–2007 takes value 1 if for the years 1986–2007 and 0 otherwise; 1962–1985 is the omitted category. Country-specific characteristics are controlled using dummy variables. The estimation sample is limited to the countries previously noted. The estimation sample is limited to countries with at least 36 years of data and with a population of at least two million; oil exporters (Algeria, Angola, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Oman, Qatar, Saudi Arabia, United Arab Emirates, and Venezuela) are excluded. Liberia is also excluded from the sample as its GDP falls over time. All the terms included are statistically significant. Cubic and quadratic terms of ln(GDPpc) and their respective interactions with the period dummy variables were statistically insignificant. ln(GDPpc) and its interactions with the period dummy variables are jointly statistically significant. Also, $((\ln(GDPpc))^2$ and its interactions with the period dummy variables are jointly statistically significant.

India's average export sophistication ($12,005) for the period 2001–2007 is not significantly different from that of Brazil ($12,836) or that of Turkey ($12,549). The latter two, however, have much higher per capita incomes. To stress the significance of this point, note that the per capita income of today's rich countries when they had similar levels of export sophistication as India in 2007 was much higher. For example, Korea's EXPY in the year 1985 was comparable to that of India today, but at three times the per capita income (Korea's per capita income in 1985 was $7,500 and India's per capita income in 2007 was $2,600).

Figure 1: Export Sophistication and GDP Per Capita, 1962–2007

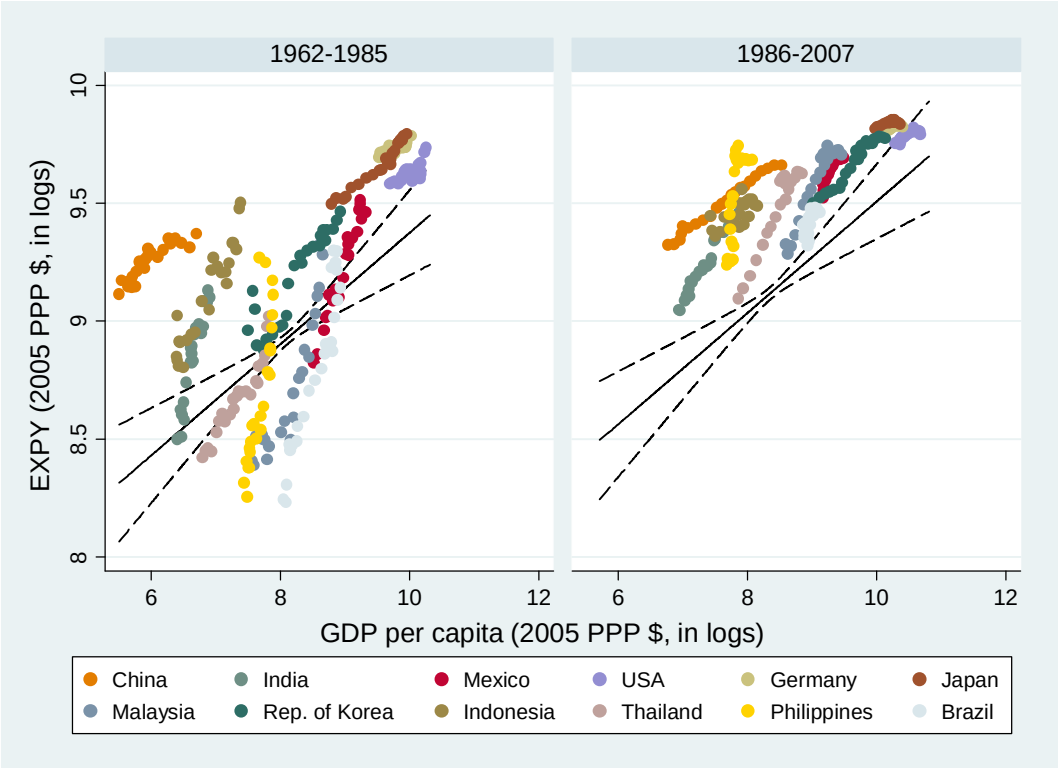
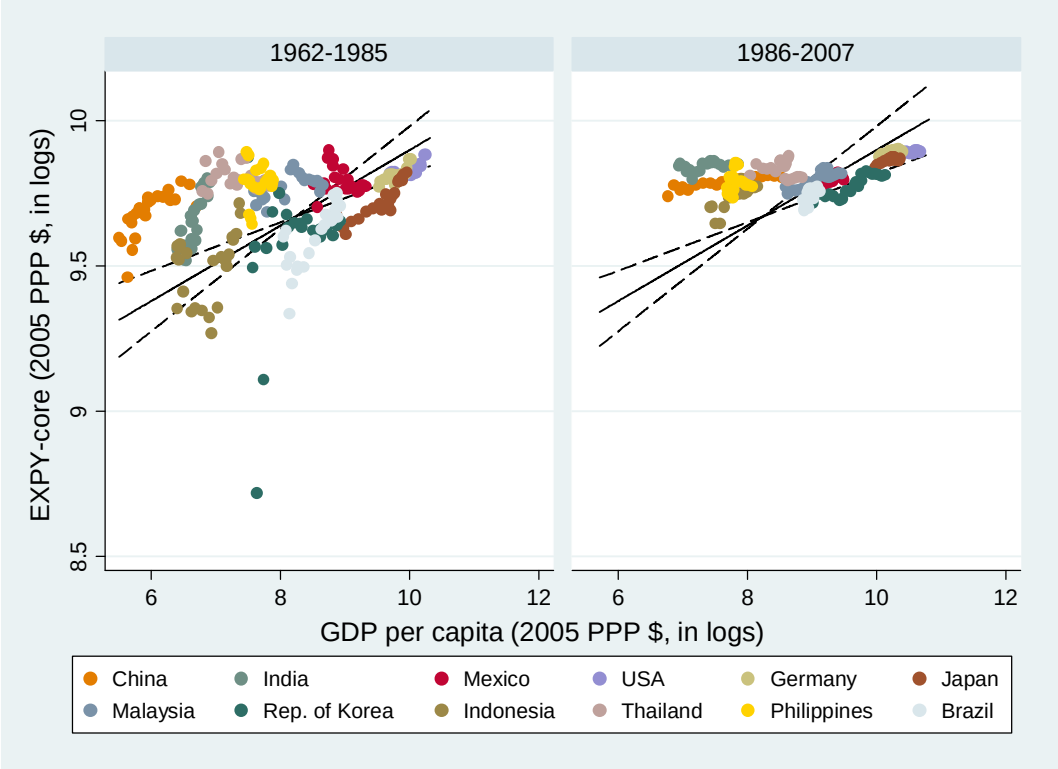


Figure 2: Export Sophistication of the Core and GDP Per Capita, 1962–2007



Source: Authors' estimation

Another way of examining the sophistication of India's export basket is to look at the sophistication of the core commodities only. We call this EXPY-core. This is calculated as overall EXPY, except that the set of commodities over which sophistication is measured is restricted to the core of the product space: machinery, chemicals, and metals. The core commodities are more sophisticated, as measured by PRODY, than those outside the core. The average PRODY of core commodities is $18,687, and that of outside the core is $11,634 (these are averaged from the PRODYs of 779 4-digit SITC products).[17]

To examine the sophistication level of India's core exports given its income per capita, we estimate a regression of log of EXPY-core on the log of GDP per capita. [18] Figure 2 shows

[17] The average sophistication of the various Leamer (1984) categories are: petroleum, $15,446; raw materials, $10,934; forest products, $14,971; tropical agriculture, $8,441; animal products, $12,390; cereals, $8,794; labor-intensive, $13,170; capital-intensive (excluding metal products), $12,459; metal products, $14,964; machinery, $19,205; and chemicals, $19,517.

[18] Specifically, the relationship estimated is the following:

$$\ln(EXPY-core_{jt}) = \alpha_0 + \alpha_1 \ln(GDPpc_{jt}) + \varepsilon_{jt}$$

the fitted values (continuous line), 95% confidence interval (dashed lines), and the actual values. The figure shows that India's core exports have, for the most part, been either as sophisticated or more sophisticated when compared with the core exports of comparator countries such as Brazil, China, Indonesia, Malaysia, Mexico, and Thailand. India lies outside the 95% confidence interval, i.e. India's core exports are more sophisticated than what would be expected given its level of development. Also from figure 2, we see that, in general, core exports of the high-income countries are more sophisticated. The average sophistication level of India's core exports ($18,955) during 2001–2007 is similar to that of France ($19,300), Japan ($19,288), Spain ($19,258), Hong Kong ($18,750), Australia ($18,665), and Korea ($18,308). The latter, however, have much higher income levels than India.

B. Diversification

A key insight from Hidalgo et al. (2007) is that the more diversified a country is, the greater its capabilities, which allows it to acquire revealed comparative advantage in other products. Table 1 shows the number of products India exported with revealed comparative advantage according to the Leamer (1984) classification over the period 1962–2007. We see that in 1962, out of a total of 71 products that India exported with revealed comparative advantage, only four (i.e., less than 6% of the total) were in the core. Animal products, cereals, and capital-intensive products (excluding metals) added up to 44 products. By 1980, the number of products that India exported with revealed comparative advantage had more than doubled to 157.[19] Of the 157 products, 38 were core commodities, roughly a quarter of the total. This indicates that, on the eve of the reforms, India had built in a significant stock of capabilities in the core commodities.

Over the next 27 years, India acquired revealed comparative advantage in an additional 97 products (in net terms). In 2007, out of 254 products exported with revealed comparative advantage, 84 were in the core (representing one-third of the total). Of the 97 additional products in which India had gained a revealed comparative advantage between 1980 and 2007, 46 were in

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where, *j* is country and *t* is year from 1962 to 2007. The estimation sample used is the same as noted previously. Higher powers of ln(GDPpc) and their interactions with the dummy variables were found to be statistically insignificant and hence not included. Also, period dummy variables were found to be insignificant. Country-specific characteristics are controlled using dummy variables.

[19] These numbers are the net gain, since India also lost revealed comparative advantage in some products during the periods considered. The net gain is the difference between the number of (new) products in which India acquired revealed comparative advantage and the number of (old) products in which India lost revealed comparative advantage.

the core (6 in metal products, 16 in machinery, and 24 in chemicals). The other category that registered a significant increase in the number of products exported with revealed comparative advantage was the capital-intensive products (excluding metals). The number of products exported with revealed comparative advantage in this category increased by 14 (again in net terms), an increase largely due to the textiles sector, which saw an increase of 12 products.

We stress six points regarding diversification. The first concerns the product composition. Between 1962 and 1980, there was a net gain in the number of products exported with revealed comparative advantage in the labor-intensive categories, capital-intensive products, metal products, machinery, and chemicals, with labor-intensive accounting for a quarter of the increase. Between 1980 and 2007, it was the core sectors that accounted for half of the net gain in the number of products exported with revealed comparative advantage. As noted above, there was net gain in capital-intensive and raw materials as well. The labor-intensive sector did not see any major net gains in the post-reform period.

Table 1: India's Export Diversification According to Leamer Classification

	1962	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**
Petroleum	1	1	1	0	0	1	1	1	2	1	1	1
Raw materials	8	7	9	10	8	10	14	15	14	22	25	25
Forest products	0	2	2	2	2	2	1	2	2	2	2	2
Tropical agriculture	7	8	12	10	12	10	11	11	14	13	18	17
Animal products	13	11	13	11	15	14	8	9	13	13	14	14
Cereals	13	14	12	13	19	20	23	25	19	24	27	28
Labor-intensive	7	7	12	32	30	28	29	34	37	39	37	36
Capital-intensive (exc. Metals)	18	21	20	28	33	29	37	44	41	45	44	47
Core Commodities												
Metal products	1	3	11	12	15	10	13	21	21	21	19	21
Machinery	1	2	4	9	12	17	14	12	14	22	23	28
Chemicals	2	3	6	9	11	11	27	28	37	30	34	35
Total	**71**	**79**	**102**	**136**	**157**	**152**	**178**	**202**	**214**	**232**	**244**	**254**

Second, we examine how diversification changes with income per capita. We estimate a regression of the log of diversification on the log of GDP per capita, its square, and it cube. Period dummies are also included. [20] Fitted values and the 95% confidence intervals obtained

[20] Specifically, the relationship estimated is the following:

from the regression, along with the actual values, are shown in figure 3. We find that India is diversified in a greater number of products than comparator countries such as Indonesia, Korea, Malaysia, Mexico, and Thailand. Further, given its stage of development, the number of products in which India has revealed comparative advantage is significantly higher than what would be expected (shown by the fitted values).

Third, during the period 2001–2007, China and India exported 257 and 246 products with revealed comparative advantage, respectively.[21] Except for Indonesia (which exported 213 products with revealed comparative advantage) and Thailand (197 products), no other lower-middle income had a revealed comparative advantage in so many products. Other countries that were as diversified were either upper-middle income or high-income countries. Korea had revealed comparative advantage in 154 products during the period 2001–2007. Brazil and Russia, both upper-middle income countries, exported 190 and 105 products with revealed comparative advantage, respectively.

$$\ln(Diversification_{jt}) = \alpha_0 + \alpha_1 \ln(GDPpc_{jt}) + \alpha_2(\ln(GDPpc))^2 + \alpha_3(\ln(GDPpc))^3 + \delta_t(dummy\ 1986\text{-}2007) + \varepsilon_{jt}$$

where, *j* is country and *t* is year from 1962 to 2007, and a dummy for 1986–2007 takes the value of 1 if for the years 1986–2007 and 0 otherwise; 1962–1985 is the omitted category. Country-specific characteristics are controlled using dummy variables. Estimation sample is limited to the countries previously noted. All the terms included are statistically significant.

[21] The measure of diversification shown is the average number of products that a country exported with revealed comparative advantage during 2001–2007. It does not mean that a country had revealed comparative advantage in the same 257 products in each year during 2001–2007.

Figure 3: Diversification and GDP Per Capita, 1962–2007

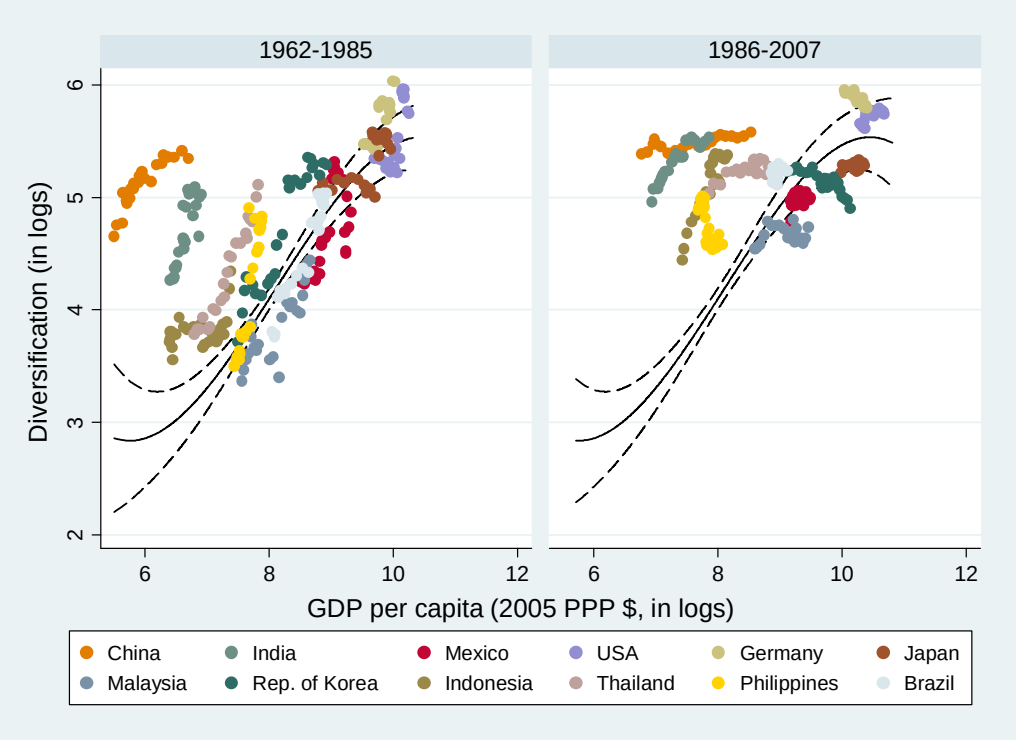
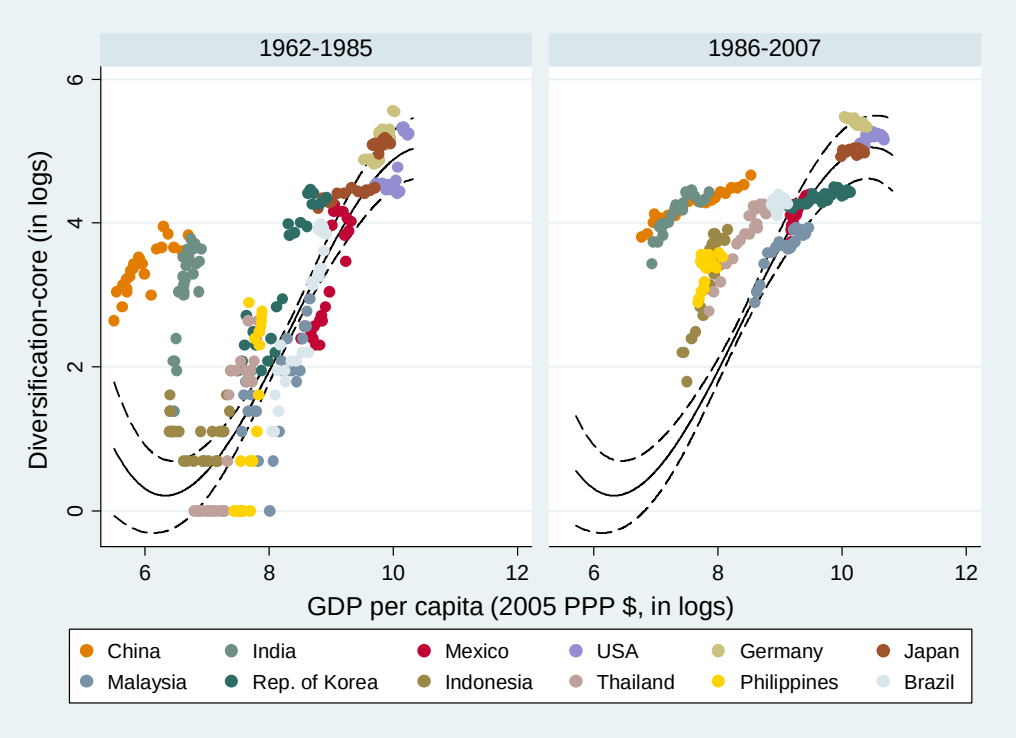


Figure 4: Diversification in the Core and GDP Per Capita, 1962–2007



Fourth, in figure 4 we compare how diversification in the core evolves with per capita income. Like with overall diversification, we estimate a regression of the log of diversification in the core on the log of GDP per capita, its square, and its cube. Also included are the period dummies.[22] Figure 4 shows that not only did India export a larger number of core products with revealed comparative advantage than other comparator countries, but also was exporting a significantly higher number of products than would be expected for a country at its stage of development (as shown by the fitted values). During 2001–2007, on average, India exported 81 core products with revealed comparative advantage, while China exported 89. Among the lower-middle income countries that exported a large number of core commodities with revealed comparative advantage were Ukraine (73), Thailand (68), and Indonesia (45). Other countries that exported so many core products with revealed comparative advantage are either high-income countries or upper-middle income countries. For the high-income countries (those in the OECD) it is not uncommon to export over 100 core commodities with revealed comparative advantage. Indeed, the average number of core products exported with revealed comparative advantage in the core for the high-income OECD countries is 105.

Fifth, it is important to make a comparison with China. Table 2 shows China's export diversification over 1962–2007. Over this period, China increased the number of products exported with revealed comparative advantage from 105 to 265, and in the core increased from 14 to 106. The highest number of commodities that China exports with revealed comparative advantage is in the labor-intensive category. In China, the majority (39 out of 60 in 2007) of the machinery products exported with revealed comparative advantage are office and data processing, telecommunications, electrical, and photographic equipment. On the other hand, in India, the largest share (16 out of 28 in 2007) of machinery products exported with revealed comparative advantage are the power generating, machinery specialized for particular industries, metalworking, and general industrial machinery. Another interesting feature of China's

[22] Specifically, the relationship estimated is the following:

$$\ln(Diversification-core_{jt}) = \alpha_0 + \alpha_1 \ln(GDPpc_{jt}) + \alpha_2(\ln(GDPpc))^2 + \alpha_3(\ln(GDPpc))^3 + \delta_t(dummy\ 1986\text{-}2007) + \varepsilon_{jt}$$

where, *j* is country and *t* is year from 1962 to 2007, and a dummy for 1986–2007 takes the value of 1 if for the years 1986–2007 and 0 otherwise; 1962–1985 is the omitted category. Country-specific characteristics are controlled using dummy variables. The estimation sample is limited to the countries previously noted. All the terms included are statistically significant.

progression is that it lost revealed comparative advantage in categories such as tropical agriculture, animal products, and cereals, and gained revealed comparative advantage in labor-intensive, capital-intensive, and core commodities. The speed at which China acquired revealed comparative advantage in the machinery category is notable, from 3 in 1980, to 22 in 1990, to 60 in 2007.[23]

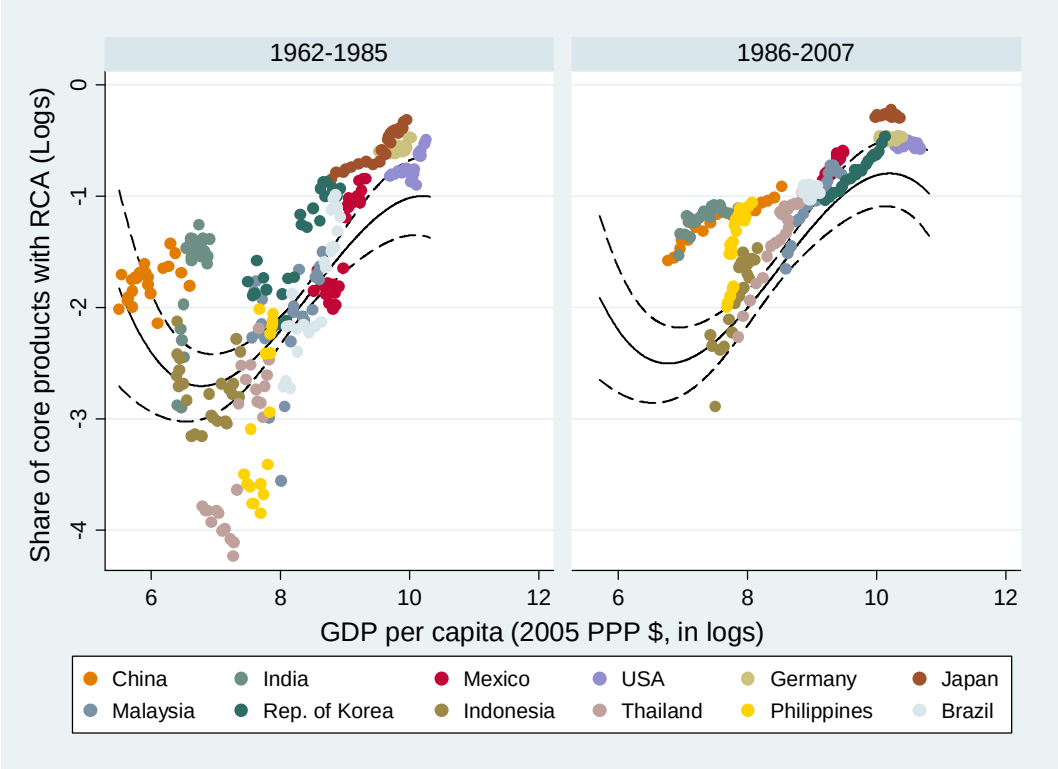
Table 2: China's Export Diversification According to Leamer Classification

	1962	**1965**	**1970**	**1975**	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2006**	**2007**
Petroleum	0	1	1	1	5	3	2	1	2	1	2	1
Raw materials	9	8	7	10	13	11	15	14	16	11	11	11
Forest products	3	6	5	4	5	3	4	7	6	7	7	7
Tropical agriculture	15	23	25	23	20	17	15	15	15	10	10	8
Animal products	18	24	22	28	27	22	21	19	15	9	9	8
Cereals	13	20	24	21	21	31	27	14	16	9	8	8
Labor-intensive	18	22	32	36	49	44	60	59	63	69	69	68
Capital-intensive (exc. Metals)	15	14	16	21	21	32	37	35	36	47	47	48
Core Commodities												
Metal products	6	7	10	9	14	10	17	16	18	20	21	26
Machinery	1	4	7	8	3	15	22	36	41	54	55	60
Chemicals	7	11	11	14	22	21	21	22	16	15	17	20
Total	**105**	**140**	**160**	**175**	**200**	**209**	**241**	**238**	**244**	**252**	**256**	**265**

Finally, we also analyze how the absolute number of overall products and core products exported with revealed comparative advantage change with the level of income. As discussed earlier, core products embody, in general, more complex capabilities than other products. Therefore, it could be the case that two countries export a similar number of products with revealed comparative advantage, but one of them has revealed comparative advantage in a larger number of core products. Capabilities in these two countries are of a very different nature. In figure 5, we examine how the share of the core commodities exported with revealed comparative advantage (we call this share_core) changes with the level of income per capita. We estimate a regression of share_core on the log of GDP per capita and its square. Also included are the period dummies.[24] Figure 5 shows that the share_core in India was above what could be expected for a country at a similar level of income.

[23] For an in-depth analysis of China, see Felipe et al. (2010).
[24] Specifically, the relationship estimated is the following:

Figure 5: Share_core and GDP Per Capita, 1962–2007



C. India's Comparative Advantage in Labor-Intensive Products

It is important to examine how revealed comparative advantage of the labor-intensive sector (as defined in the Leamer [1984] classification) changes with income per capita. To this purpose, we estimate a regression of the log of the share of labor-intensive products exported with revealed comparative advantage in the total manufacturing products exported with revealed comparative advantage, on the log of income per capita, its square, and period dummies.[25] Figure 6 shows the estimated values and the 95% confidence interval. During both subperiods, the share of labor-

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$$share\_core_{jt} = \alpha_0 + \alpha_1 \ln(GDPpc_{jt}) + \alpha_2 (\ln(GDPpc))^2 + \alpha_3 (\ln(GDPpc))^3 + \delta_t (dummy\ 1986\text{-}2007) + \varepsilon_{jt}$$

where, *j* is country and *t* is year from 1962 to 2007, and a dummy for 1986–2007 takes the value of 1 if for the years 1986–2007 and 0 otherwise; 1962–1985 is the omitted category. Country-specific characteristics are controlled using dummy variables. The estimation sample is limited to the countries previously noted. All the terms included are statistically significant.

[25] The manufacturing sector is defined to include labor-intensive, capital-intensive, machinery, and chemicals as defined in Leamer (1984); see appendix table 1. It is common in the literature to use SITC (Rev. 2) codes 5 to 8 (except 68) as manufacturing products. In using the above definition of the manufacturing sector, we leave out two sectors, namely 63 and 64.

intensive products in total manufacturing products was below the fitted line. In the case of China, on the other hand, the share lies within the 95% confidence interval.

We showed in figure 5 the share of the number of core products in total products exported with revealed comparative advantage. In figure 7, we show how the share of the number of core products in manufacturing products exported with revealed comparative advantage changes with income per capita. We find that for the first period, the share was within the 95% confidence interval, but for the second period it was above the fitted line and outside the confidence interval. In other words, the share of the number of core products in total number of products exported with revealed comparative advantage is more than what would be expected for a country at India's level of development.

Figure 6: RCA in Labor-Intensive Products and GDP Per Capita, 1962–2007

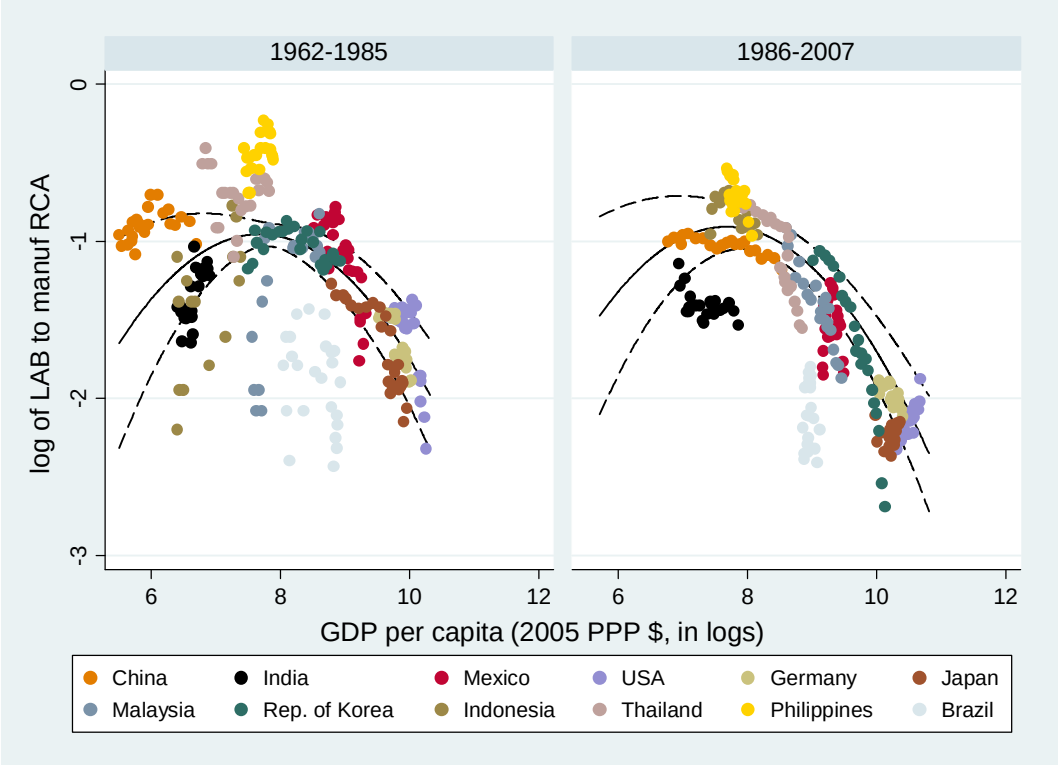
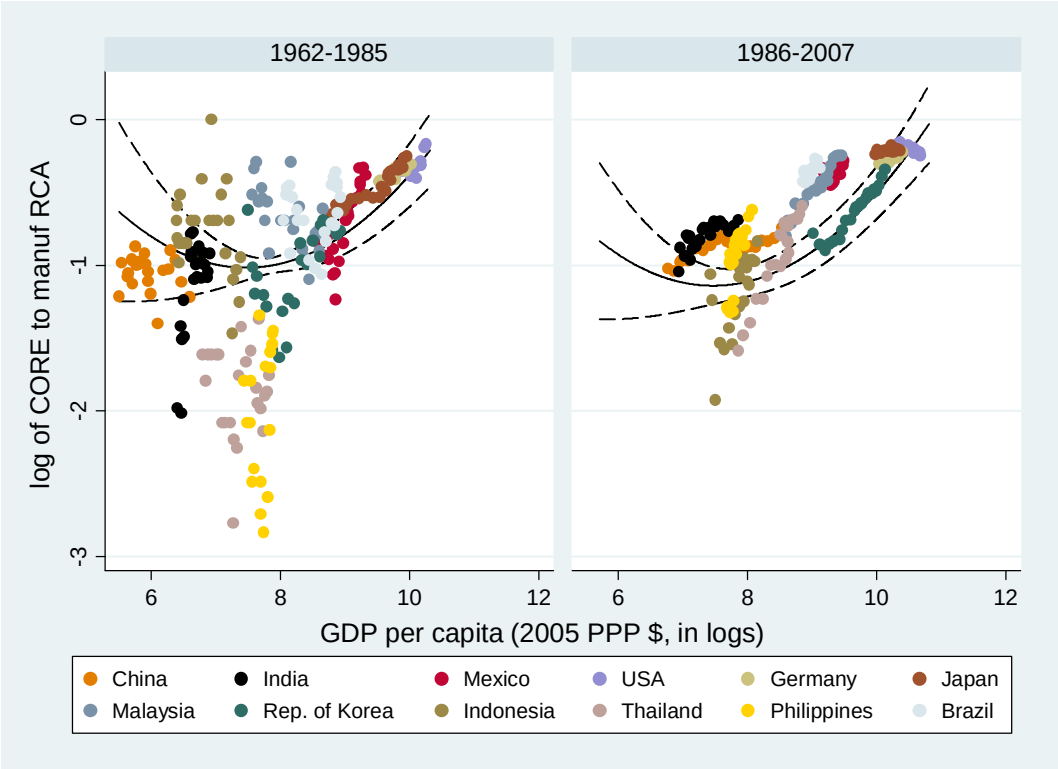


Figure 7: RCA in Core Products (As a Share of Manufacturing Sector) and GDP Per Capita, 1962–2007



Next we examine how the ratio of the number of labor-intensive products to the number of capital-intensive products exported with RCA changes with per capita income. Here capital-intensive products are defined to include the capital-intensive, machinery, and chemicals sector as defined by Leamer (1984), who argues that these three sectors use more capital (see appendix table 1 and table 2). Figure 8 shows the estimated relationship. We find that India was below the fitted line, though within the confidence interval for the most part. For the period 1986–2007, India was below the fitted line, i.e., the ratio of the number of labor-intensive products to the number of capital-intensive products exported with comparative advantage was less than what would be expected. This could be happening due to an unusually smaller number of labor-intensive products exported with revealed comparative advantage or an unusually high number of capital-intensive products that are exported with comparative advantage. From figures 6 and 7, we see that it is both. This ratio in China, on the other hand, though below the fitted line for the period 1986–2007 is higher than in India.

In figure 9, we look at the ratio of the number of unskilled labor–intensive products to the number of skilled labor–intensive products exported with revealed comparative advantage. According to the Leamer classification (see appendix table 1 and table 2), labor-intensive and capital-intensive (including metals which are in the core of the product space as defined by Hidalgo et al. [2007]) products use relatively more unskilled labor, and chemicals and machinery use relatively more skilled labor. Thus, the only difference between figures 8 and 9 is how capital-intensive sectors are categorized: in figure 8 it was in the sectors that use more capital and in figure 9 it is in the sectors that use more unskilled labor. We find that India is below the fitted line in both the periods, in the latter period it is outside the confidence interval.

Figure 8: Ratio of Labor-Intensive Products to RCA in Capital-Intensive Manufacturing Products and GDP Per Capita, 1962–2007

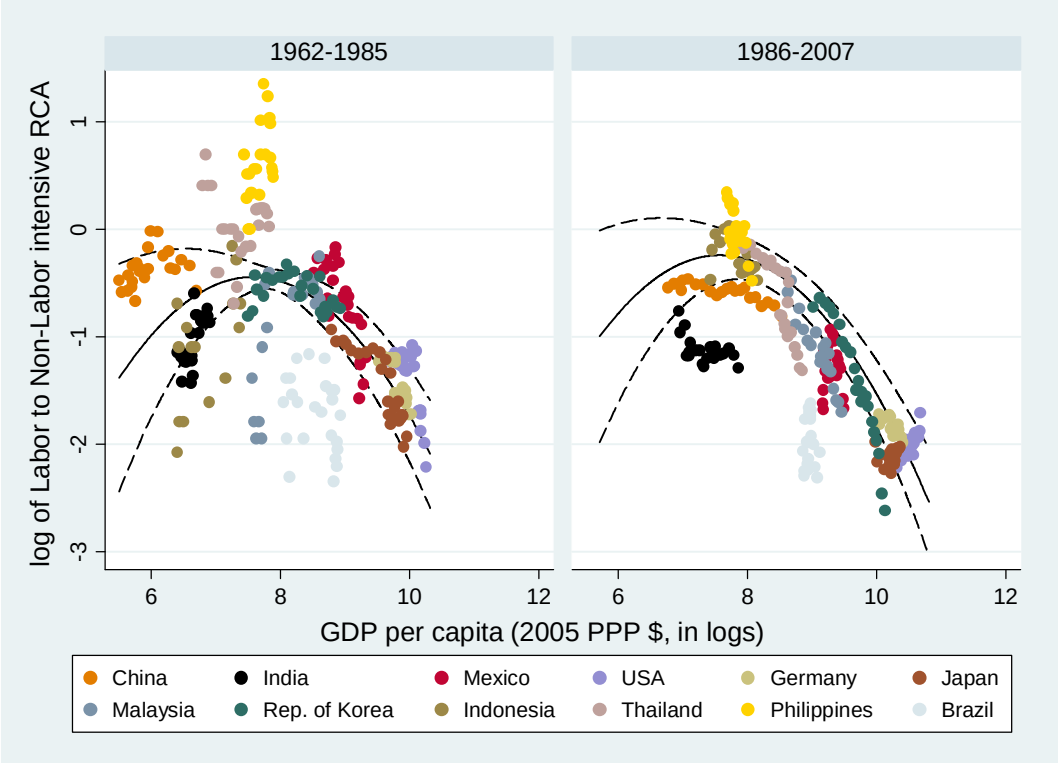
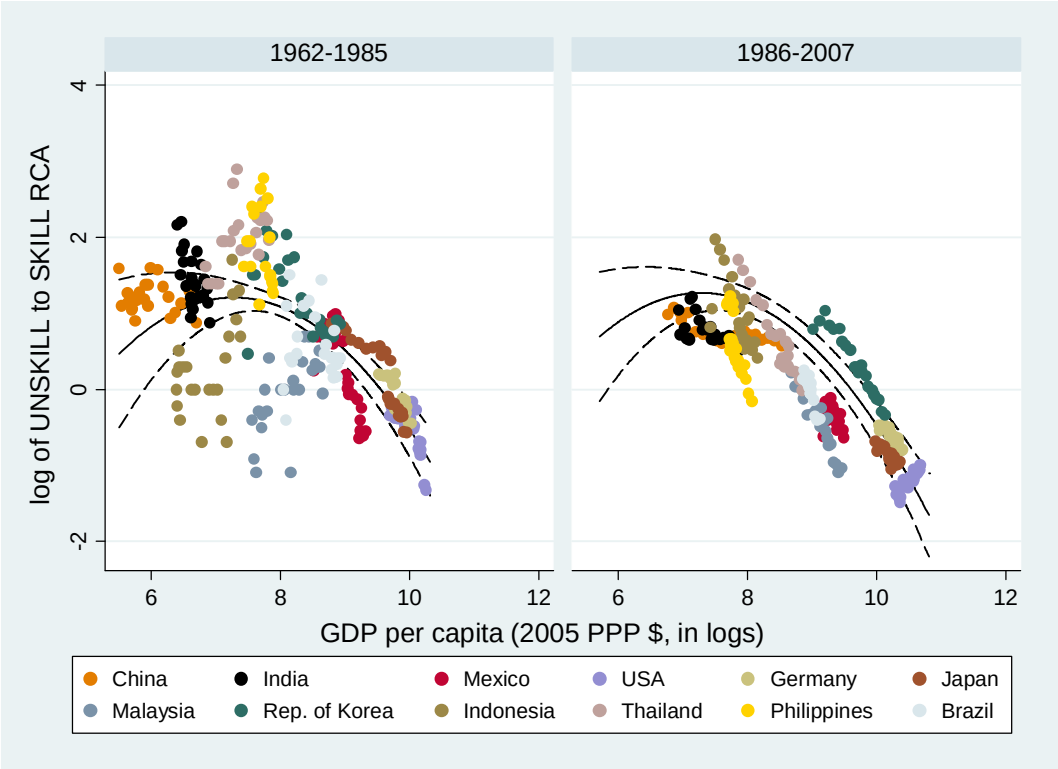
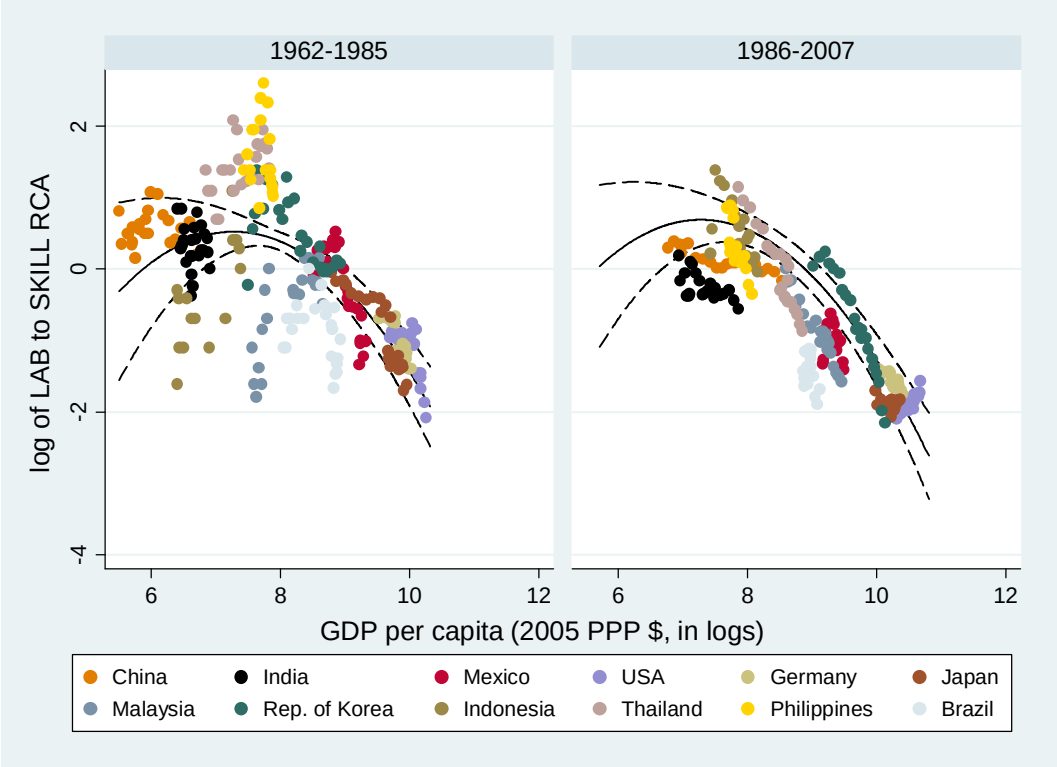


Figure 9: Ratio of RCA in Unskilled Labor–Intensive Manufacturing Products to RCA in Skilled Labor–Intensive Manufacturing Products and GDP Per Capita, 1962–2007



Finally, figure 10 shows the two opposite ends of factor intensity, i.e., labor-intensive products on one hand, and machinery and chemicals on the other. Labor-intensive products use relatively more of unskilled labor and little of capital, whereas machinery and chemicals use relatively more skilled labor and capital. We find that the ratio of the number of labor-intensive products to the number of machinery and chemical products exported with revealed comparative advantage in India is below the fitted line in the first period, though inside the confidence interval. For the second period, India is below the fitted line and outside the confidence interval, showing that the ratio is significantly different from the expected value. The ratio in India is below that of China and similar to countries that have a higher per capita income.

Figure 10: Ratio of RCA in Unskilled Labor–Intensive Manufacturing Products to RCA in Skilled Labor–Intensive and Capital-Intensive Manufacturing Products and GDP Per Capita, 1962–2007



Our findings are consistent with those of Kochhar et al. (2006) who, using cross-country data for manufacturing output for 1981, found that India's manufacturing sector was biased towards large-scale (capital-intensive) or skilled labor–intensive sectors.[26] They also found that the Indian manufacturing sector was more diversified than would be expected given India's level of development. This pattern has persisted even after twenty years of significant reforms. Panagariya (2004) argues that reforms have been unable to provide an impetus to the labor-

[26] To be precise, Kochhar et al. (2006) find a bias towards large-scale sectors. They note that the measure of scale used in their paper could also be a proxy for capital intensity. The definition of skilled labor–intensive and large sectors used in Kochhar et al. (2006) is different from the one used here. Kochhar et al. (2006) measure labor intensity by the share of wages in value-added for the industry in a country (averaged across a broad group of developing countries). Relative size is the ratio of value-added per establishment within the industry over the value-added per establishment within the country, averaged across countries for each industry. Skill is measured by the ratio of remuneration of highly skilled and skilled labor over the total value-added of the industry. Categorization of manufacturing sectors according to factor-intensity as used in this paper is shown in appendix table 2.

intensive manufacturing industries in India and exports of labor-intensive industries have not grown rapidly. This is where India lags behind China.

The Nehru-Mahalanobis blueprint for India's development recognized very early on the critical importance of the heavy machinery sector. The data show clearly that the capital- or skilled labor–intensive industries have seen fast export growth. Mistakes were made in the implementation of this vision, but it did help India get a foothold into the "core" of the product space. As shown in table 1, of the 157 commodities exported with revealed comparative advantage in 1980, 38 (a quarter of the total) were in the core of the product space. This means that by 1980 India had accumulated capabilities to produce and export a significant number of sophisticated products. Between 1980 and 2007, the period during which the industrial licensing regime was dismantled and import barriers were brought down (tariff rates are still among the highest in the world), the number of commodities with revealed comparative advantage increased to 254, a net gain of 97 commodities. Of these 97, 46 are in the core of the product space. In our view, this would not have happened in the absence of the "making machines that makes machines" philosophy, as shown by the fact that other countries at a similar level of development have a much smaller presence in the core of the product space. By making heavy machinery a focal point of the industrial development strategy, India was able to establish a presence in core commodities and build up capabilities in producing and exporting sophisticated products. Our argument is not that all the policies implemented pre-1980s were successful, or that the right tools were used to promote the heavy machinery sector. By focusing on heavy machinery, Indian policymakers defied comparative advantage, which lay with the labor-intensive industries, but this provided a foundation and a base that the private sector has capitalized on later in a more supportive environment.

The stock of capabilities and technologies that were built as a part of heavy machinery–led industrialization provided India with a foothold in the core of the product space and the building blocks to exploit other nearby products once the license-permit raj was gone. On the other hand, the labor-intensive sectors continued to be bound by labor laws and small-scale industrial policy (until the late 1990s when the first set of dereservation was introduced). The two together tilted the composition of the manufacturing sector towards the skill-intensive, capital-intensive sector and away from the unskilled labor–intensive sector.

Similarly, the finding that India was more diversified (as measured by the number of products exported with revealed comparative advantage) may have been the result of a bias towards producing anything that could be produced domestically in an import-substitution-based industrialization strategy. Though this may not have been the best use of the scarce resources at the time, it did help accumulate capabilities in a wide array of products. In other words, India gained revealed comparative advantage in a variety of products, which in turn led to the accumulation of a diverse set of capabilities, making it easier to acquire revealed comparative advantage in other products.

Another related factor that assisted in establishing an industrial sector biased towards the skill-intensive activities was the creation of a scientific and a technical infrastructure, as well as the set up of institutes of higher education, especially in engineering and management. India spent more on tertiary education as a percent of GDP per capita than any other country at its stage of development, and far more than what it spent on primary education. Of course, this may not have been the best allocation, but it did not harm India's long-term growth prospects. Institutions of higher education, research, and development, which were established in the post-independence period, provided the much needed know-how and highly skilled low-cost labor for industrial development, especially the heavy machinery, metals, and the chemical sectors. The ready availability of scientific and technical base, low-cost skilled labor, and experienced professionals provided the much-needed human resources to support the setting up as well as the growth of the information technology and communications industry.[27]

4. CONCLUSIONS

In this paper, we have examined the sophistication and diversification of India's export basket since the 1960s. The industrial development strategy adopted after independence favored the heavy machinery and capital-intensive sectors at the expense of the labor-intensive activities. These were promoted by reserving some products exclusively to be produced by small units. The data show that: (i) on both accounts, overall sophistication and diversification of the export

[27] The information technology (IT) sector has become a leading sector in India during the last decade. The rise of the IT sector is sometimes attributed to "benign neglect," in the sense that it was outside the ambit of the licensing system and did not suffer from regulation and control of its activities in the same way as the manufacturing sector. Balakrishnan (2006) and Singh (2010) note that the IT sector was a beneficiary of a "newer" industrial policy framework that promoted and encouraged new activities, rather than regulated and controlled them.

package, India is a positive outlier after controlling for income per capita; (ii) India has succeeded in acquiring revealed comparative advantage in a significant number of sophisticated products, and now exports a large number of chemical, machinery, and metal products with revealed comparative advantage; and (iii) the number of labor-intensive products exported with revealed comparative advantage has increased during the last five decades, but probably not as much as it should have. Overall, India is exporting fewer labor-intensive products and a higher number of skilled labor–intensive products (and also the ones using relatively more capital) as a share of the total number of manufacturing products exported with revealed comparative advantage than is typical for a country at India's level of per capita income.

Post-reforms, the skilled labor–intensive sectors and the sectors using relatively more capital benefited from the capabilities accumulated that were built as a part of heavy machinery-led industrialization. In choosing this path, India seemed to be defying its comparative advantage, which lay with the labor-intensive sectors. Taking a path-dependent view of development, this strategy allowed India to accumulate capabilities in key areas. No doubt mistakes were made in targeting certain sectors. However, it would have been impossible for a country like India to acquire comparative advantage in sophisticated activities by simply following its comparative advantage. The labor-intensive sector, on the other hand, continued to be bound by rigid labor laws and small-scale industrial policy (until recently), which prevented firms from operating at the optimal size and from achieving economies of scale required in a world of wafer-thin profit margins. The significant number of reforms introduced since the 1980s have not led to the expansion of the labor-intensive sectors. Here lies India's failure and the difference with China.

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Appendix Table 1: Leamer's Classification and SITC Rev. 2 (2-digit)

Leamer's Classification	SITC	Leamer's Classification	SITC
1. Petroleum		**7. Labor-intensive**	
Petroleum and petroleum products	33	Non-metallic mineral	66
		Furniture	82
2. Raw materials		Travel goods, handbags	83
Crude fertilizer and crude minerals	27	Articles of apparel	84
Metalliferous ores	28	Footwear	85
Coal	32	Miscellaneous manufacture	89
Gas	34	Postal packages, not classified	91
Electric current	35	Special transactions, not classified	93
Non-ferrous metals	68	Coin (other than gold coin)	96
Gold, non-monetary	97		
		8. Capital-intensive	
3. Forest products		Leather	61
Cork and wood	24	Rubber	62
Pulp and waste paper	25	Textile yarn, fabrics	65
Cork and wood	63	Sanitary fixtures and fittings, nes	81
Paper	64	*Iron and steel*	*67*
		Manufactures of metals, nes	*69*
4. Tropical Agriculture			
Vegetables and fruit	05	**9. Machinery**	
Sugar	06	*Power generating*	*71*
Coffee	07	*Specialized for particular industries*	*72*
Beverages	11	*Metalworking*	*73*
Crude rubber	23	*General industrial*	*74*
		Office and data processing	*75*
5. Animal products		*Telecommunications*	*76*
Live animals	00	*Electrical*	*77*
Meat	01	*Road vehicles*	*78*
Dairy products	02	*Other transport equipment*	*79*
Fish	03	*Professional and scientific instruments*	*87*
Hides, skins	21	*Photographic equipment*	*88*
Crude animal and vegetable materials	29	*Armoured vehicles, firearms, and ammunition*	*95*
Animal and vegetable oils and fats	43		
Animals, live (nes)	94		
		10. Chemicals	
6. Cereals		*Organic*	*51*
Cereals	04	*Inorganic*	*52*
Feeds	08	*Dyeing and tanning*	*53*
Miscellaneous edible products	09	*Medicinal and pharmaceutical*	*54*
Tobacco	12	*Oils and perfume*	*55*
Oil seeds	22	*Fertilizers*	*56*
Textile fibers	26	*Explosives*	*57*
Animal oils and fats	41	*Artificial resins and plastic*	*58*
Fixed vegetable oils and fats	42	*Chemical materials, nes*	*59*

Source: Leamer (1984) and Hidalgo et al. (2007).

Note: Italicized subsectors are in the core of the product space.

Appendix Table 2: Categorization of Manufacturing Sector Products by Factor Intensity

Labor*	Skilled Labor*
Sectors using relatively more labor and relatively less of capital	*Sectors using relatively more unskilled labor and relatively less of skilled labor*
Labor-intensive	Labor-intensive
	Capital-intensive (excluding metal products)
	Metal products[#]
Sectors using relatively more capital and relatively less of labor	*Sectors using relatively more skilled-labor and relatively less of unskilled-labor*
Capital-intensive (excluding metal products)	Machinery
Metal products[#]	Chemicals
Machinery	
Chemicals	

Note: *Manufacturing sectors are based on the Leamer (1984) terminology shown in appendix table 1.
[#]SITC codes 67 and 69, originally categorized under capital-intensive sectors but separated for the purposes of this paper.