Trade Liberalisation, Import of Capital Goods and Export Performance: Evidence from the Organised Manufacturing Sectors in India

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Abstract

The objective of the study is to examine the impact of import of capital goods on the export performance of organised manufacturing sectors in India. Capital goods, often considered as the source of embodied technology, is a necessary and critical factor input in the production activities of modern manufacturing. We know that the majority of the production of capital goods are produced in the high-income countries whereas in the less income countries, characterised by resource scarcity and structural rigidities, the production of capital goods are often inadequate and inefficient. In this context, the economic integration through trade is expected to offer significant opportunity for domestic manufacturing firms to access and adopt these superior technologies in the production process. The wider choices and technical change from adopting knowledge-intensive inputs will help diffuse technology, improve production capability and increase cost efficiency and competitiveness of the manufacturing production and exports. In this context, the present study makes an attempt to assesses the impact of import of capital goods on the export performance of the manufacturing sector of India in the context of ongoing trade liberalisation process. The empirical analysis is carried out for 15 2-digit manufacturing sectors panel data collected from the PROWESS database (CMIE) during the period from 1997 to 2016. This unique dataset provides information on the export and import of capital goods by manufacturing firms at the 5-digit of NIC-2008. The empirical analysis is carried out using the standard econometric methodology including Fixed Effect(s) and OLS. The descriptive analysis reveals a considerable expansion of manufacturing production and trade, especially by the technology-intensive sectors. The panel regression results reveal that, after controlling for world demand, relative export prices and in-house R&D, the import of capital goods have a positive and statistically significant impact on the aggregate manufacturing sector. The sectoral level analysis based on OLS estimates, however, reveals wide variations in the relationship between capital goods import and exports across sectors. We find that in general, the engineering sectors such as metals, electrical and non-electrical machinery and transport equipment and some traditional labour-intensive sectors such as textiles have witnessed considerable positive gains from large capital goods purchases from abroad. Overall, the empirical results reveal the prevalence of dynamic gains, as predicted by the new trade and endogenous growth models, in the Indian manufacturing sector since liberalisation.

Keywords: India, capital Goods Import, Manufacturing Exports, Trade, Panel Regression

***JEL Classification*:** F14, F62, O14, L6

1 Introduction

Technological progress is arguably the most fundamental determinant of economic growth. Since the accumulation of physical capital is characterised by diminishing returns, the sustained economic growth requires significant amount of productivity growth, representing an outward shift on the production frontier technology. Since the seminal study of Solow (1957), the importance of technical change in generating and sustaining output growth in the economy is well documented. The recent growth theories, while relaxing the simplified notion of technology as an exogenous black box, regard it as an outcome of a deliberate economic activity. In this framework, an economy's growth rate is determined not only by the rate of capital accumulation but also by the rate of investment in knowledge and skill intensive innovations (see Grossman and Helpman (1991), Rivera-Batiz and Romer (1991) among others).

However, it is well known that countries are not equally endowed with the stock of knowledge as the bulk of innovation activities are concentrated in the developed countries. In general, the less income countries are characterised by a plethora of structural rigidities including market imperfections, distortions and lack of incentives to invest in risk bearing innovative activities. In this context, the new trade and the endogenous growth theories argue that international trade can be envisaged as an alternative route to industrialisation through transferring knowledge from rich to the poor countries (Chandra and Kolavalli, 2006; Zanello *et al* 2016). As trade provides an opportunity to increase market scale and access wide range of technology from abroad[1], the removal of trade barriers and restrictive practices under a liberal trade regime is expected to augment productivity and growth in the economy. The remarkable success story of East Asian countries reveals the efficacy of an outward-oriented export-led industrialisation strategy involving seeking out and learning to use technologies that were new to them but in use elsewhere (Kim and Nelson, 2000). The export sector is generally advocated as it will induce greater capacity utilisation, generate large economies of scale, technological progress, employment and labour productivity and relaxes the foreign exchange constraint that helps purchase superior technology inputs from abroad (World Bank, 1993). The recent trade theories argue that the removal of trade barriers will induce substantial reallocation within sectors and the market shares reallocate towards

[1] Tybout (2000) argues that outward oriented development strategy will facilitate long-run growth provided technology diffuses through international transactions.

more advanced productive firms, especially to the exporting plants (see Melitz and Trefler, 2012; Melitz and Redding, 2014).

The dynamic gains from participating in international trade are derived from the positive impact of larger markets on innovation (Melitz and Trefler, 2012) as emphasised in the theories of innovation-based welfare gains from trade among homogeneous firms (see Grossman and Helpman, 1991). Trade integration helps expand the choices of manufacturing firms to acquire technology inputs through knowledge-embodied imports or knowledgeable competitors, and protection that discourages this opportunity will limit growth (Grossman and Helpman, 1991). The increased imports, through trade liberalisation, provide producers with new ideas (which is an externality) and that the restriction of imports reduce the rate at which these producers accumulate and use knowledge capital. Exporters acquire more knowledge by their interaction with foreign buyers than do producers for the home market. Accordingly, trade encourages adaptation of modern technology and process techniques that raise demand for skilled labour and encourage learning by doing, especially in the exporting industries[2].

Theories of trade with imperfect competition argue that policies that constrain imports tend to raise the market power of the domestic producers (Tybout, 2000). Trade liberalisation helps in knowledge spillover among both exporters and other producers in the economy. Trade liberalisation brings technology spillover through adaptation and imitation. A country that imports capital goods or machinery attempt to imitate the same technology and this technological spill over will lead to cost reduction and raises the export competitiveness of domestic firms. Empirical evidence does provide a substantial presence of such production gains[3]. The availability of productive and technologically superior factor inputs has been a major source of productivity gains for several countries, including Indonesia (Amiti and Konings, 2007), Chile (Kasahara and Rodiriguez, 2008), China (Ding *et al.,* 2016) and India (Goldberg *et al*., 2010; Topalova and Khandelwal, 2011).

[2] A study by Obsteld and Rogoff (1996) reveals that more open economies have greater ability to capture new ideas being developed in the rest of the world. Kruger (1998) argues that countries whose economies are relatively more insulated from international trade do seem to fall behind in production technique, quality, and other attributes of production associated with knowledge. Romer (1992) have concluded that countries that are more open have a greater ability to absorb technological progress generated in leading nations. Lee (1995) shows that capital goods imported from the world's technologically most advanced countries may have exceptionally large externalities.

[3] See Helpman (2004) for country level evidences. The theoretical and empirical evidences of a positive causal link between market expanding effects of international integration and innovation is given in Lileeva and Trefler (2010).

In the era of increasing economic integration, understanding the impact of trade openness on industrial performance is crucial, especially for an emerging economy like India. India's case is notably appealing as the policy emphasis in recent decades has shifted away from the relatively heavy protective import-substitution regime to a more liberal and outward-oriented industrialisation strategy since the mid-80s. Since the onset of comprehensive economic liberalisation in 1991, the major policy thrust was to ease barriers to trade and raise the level of openness to improve efficiency and competitiveness of the domestic manufacturing sectors. Unsurprisingly, trade openness, measured by the merchandise trade-GDP ratio, has increased substantially from 12 percent in 1980 to 44 percent in 2008[4]. During 1980–2013, the organised manufacturing sector witnessed a growth rate of 8 per cent per annum with an average share of 16 per cent of GDP[5]. Further, the share of capital goods imports in total merchandise imports, a proxy for embodied technology, has hovered around 16-23 percent, which reflects the growing demand for technology intensive inputs in the manufacturing sector. Since foreign inputs are relatively cheaper and embodied with better technical knowledge and quality, adapting them in the production process will bring dynamic benefits in terms of productive efficiency and output growth. The improved cost efficiency can make firms more competitive and successful in export business.

In this context, the objective of the present study is to examine the impact of import of capital goods on the export performance of organised manufacturing sector in India. Several empirical studies have documented large productivity gains since liberalisation (Goldberg *et al,* 2010; Topalova and Khandelwal, 2011) especially from technology imports, including capital goods (Hasan, 2002 and Rijesh 2015). Since capital goods are the vehicle of embodied foreign technology, adopting them in the domestic production process will increase productive efficiency and competitiveness (Herrerias and Orts, 2011). This will have a positive impact on manufacturing exports. To the best of my knowledge, this important issue has not been explored in the context of India in the current liberalisation regime. The rest of the article is organised as follows. In Section 2 we provide a brief overview of the theoretical and empirical literature. The methodology and data source and construction of

[4] Trade openness is measured by taking the merchandise trade (Export-Import) share in GDP at current prices. The data is collected from World Development Indicators (WDI), World Bank online database. Since the global economic slowdown, the level of trade openness has reasonably declined and registered 32 per cent in 2015.

[5] The growth rate of manufacturing sector is based on data collected from the Annual Survey of Industries (ASI), CSO. The manufacturing share is based on value added share in GDP, collected from WDI, World Bank.

variables are detailed in Section 3. The descriptive statistical analysis is given in Section 4. Section 5 discusses the econometric results. The final Section 6 provides concluding observations.

Literature Review

2.1 Theoretical Underpinnings

The traditional trade theory highlights significant sectoral compositional shifts from export-oriented industrial specialisation, the recent theoretical models predict a positive growth effect from increased openness resulting dynamic productivity benefits in the long run. Moreover, the link between trade and growth is found to be much stronger among imports, especially certain types of imports (Herrerias and Orts, 2013). The theoretical framework of Grossman and Helpman (1991), Rivera-Batiz and Romer (1991), and Quah and Rauch (1990) have shown that international trade not only increases but also sustains the rate of economic growth through wider access to essential and efficient foreign inputs like capital and intermediate goods, with superior application of knowledge and innovation efforts. This improves productive efficiency and productivity which retards the tendency of diminishing returns induced by the accumulation of physical capital in the user industry (Herrerias and Orts, 2013). These superior inputs are embodied with innovative R&D expenditure of the advanced countries, and relatively inexpensive to the domestically available substitute, leading to further capital accumulation (Lee, 1995). Thus, lower-income countries can increase their efficiency in capital accumulation and productive process through importing relatively cheaper but technologically better capital goods from the advanced countries in the world (Lee, 1995). In a simple open economy model in the framework of endogenous growth theories, Rebelo (1991) has shown that the growth rate is higher in a country that uses imported inputs relatively more than the domestically produced inputs for investment.

The cost effective import of technology inputs helps firms to reduce their marginal cost of production compared to those firms which do not engage in international trade. As marginal production cost falls, firms will be able to devote a larger share of expenditure on technology upgrading, new product or process innovations resulting higher product scope (Damijan *et al*, 2014). In addition, the cost reduction can further induce firms to devote quality resources to either enter the export market (export propensity) or encourage new varieties to their export scope (export intensity). Apart from lowering the cost of innovations, the new foreign inputs can induce dynamic learning effects by the availability of machinery and tools with new vintage and superior quality (Bas, 2012). These capital goods are characterised as a bundle of 'knowledge' in the form of blueprints, installation support, quality control software, and services of trained engineers and supervisors, which will increase the short run productive efficiency and stronger domestic absorptive capacity in the long run (see Mody and Yilmaz, 2002).

Since developed countries have a comparative advantage in skilled capital intensive goods, while developing countries specialises in semi-skilled or unskilled labour intensive goods, international trade can be mutually beneficial for both sets of countries. The bulk of world export of capital goods concentrate in a few advanced countries and for the majority of developing countries, the foreign sources of technology have been the major (90 percent or more) determinant of productivity growth (Keller, 2004). Similarly, Eaton and Kortum (1996) argued that more than 50 percent of the growth in some countries is due to innovations originated in countries like the United States, Germany and Japan. Thus, imports plays a similar role to that of R&D activities in the advanced countries, i.e., import aid the less income countries to acquire foreign technology from R&D intensive countries (see Busse and Groizard, 2008; Caselli and Wilson, 2004; Coe *et al.*, 1997; Eaton and Kortum, 2001; Lee, 1995; Mazumdar, 2001). However, since adoption of technology to domestic market is costly and market distortions are prevalent in less income countries, the efficient diffusion of foreign inputs in the production process depends upon several accompanying factors like the technological effort (Lall, 1992) and the absorptive capacity of the recipient firm (Cohen and Levinthal, 1990).

2.2 Empirical Evidences

In the recent period, a number of scholars have looked for evidence for dynamic technology diffusion channel of international trade within the framework of new growth theories and new trade theories. Coe *et al.* (1997) are the first to have shown that productivity capacity in developing countries is significantly related to the R&D activities in the country trade partners, providing evidence of spillover effects between developed and developing countries. A 1 percent increase in the R&D capital stock in the industrial countries on average raises output in the developing countries by 0.06 percent. Edwards (1998) found a positive and significant correlation with international trade and total factor productivity growth among a mix of 93 advanced and less advanced countries. Almeida and Fernandes (2008) using data from 43 developing countries found a strong evidence for trade-induced technology transfer, especially the importing firms, which are 6.4 percent more likely to engage in technological innovations than in autarky. The study uses a broad definition of innovation that included the creation of new production processes but also the adoption and adaptation of existing technologies to local conditions. Using a detailed firm-level data for Argentina manufacturing firms, Bas (2012) demonstrated that the probability of entering the export market is higher for firms producing in industries that are associated with a larger reduction in input tariffs. Using firm-product level dataset for France, Bas and Strauss-Kahn (2014) find a significant impact of higher diversification and increased number of imported inputs varieties on both firm's productivity and export scope. Mazumdar (2001) note that around 85 percent of the import of machinery and transport equipment in less developed countries originate from advanced countries. Using a panel data set of sample developing countries, the econometric estimation reveals a strong evidence for import induced productivity change in these countries. This corroborates the finding of Lee (1995) of a cross-country study of the period 1960-85. In the case of China, Hsu (1989) and Shi (1998), highlight the significant role of the importation of foreign technology in the industrialisation process since the fifties. Recently, Herrerias and Orts (2011) substantiate this by showing that technological progress embodied in foreign capital goods acted as a major factor in the industrialisation process in China.

2.2.1 Case of India

In the past, a number of studies have looked at different aspects of technology on industrialisation in India. Since the private sector's R&D expenditure, a proxy for domestic innovative capability is extremely low compared with other developing and developed countries (Siddharthan 1988), scholars have highlighted the preference of firms to access technology externally (see, for instance, Lall, 2001). However, not many have examined, within an explicit theoretical framework, the impact of technology import (both embodied and disembodied form) on the production process and industrial exports in the era of outward -oriented trade liberalisation regime.

One of the early studies on the role of technology import on manufacturing export is Subrahmanian and Pillai (1976). Their study finds that for the majority of firms in the engineering, pharmaceuticals and dyestuff sectors, the varying degree of foreign collaborations did not culminate in a better export performance. Katrak (1985) found a positive relationship between imported technology and R&D activity of Indian industrial enterprises during 1964-65 to 1969-70. Kumar (1985) by reviewing the existing literature on technology imports in India highlights the excessive cost of such arrangements. Katrak (1997) found that for 82 firms from the electrical and electronics industries in1990, the initial technological capabilities are weakly correlated to technology import. On the other hand, Kumar and Siddharthan (1994) for a panel data set of 406 large Indian companies for the period 1987-1989, found that R&D intensity was positive and statistically significant among medium-technology and low technology-intensive firms. However, most of these studies cover a period of highly restrictive trade and the industrial regime where severe restrictions were placed on the external mode of technology purchases. This has changed considerably since the onset of economic liberalisation since the mid-1980s.

Using a panel data of 787 Indian firms from 1974-75 to 1981-82, Basant and Fikkert (1996) studied the effect of foreign technology purchase, domestic and international spillover on Indian firms. The empirical result reveals high returns to expenditure on technology purchase and R&D and the restriction on technology licensing agreements imposed a substantial cost on the Indian economy. Hasan (2002) estimated the production function using a panel data of 286 public limited Indian manufacturing firms from 1976-87 to determine the extent to which productivity has been influenced by imported and domestic technologies. The econometric results indicate the positive impact of import of capital goods on the productivity of scientific firms such as chemicals, pharmaceuticals, electoral and non-electrical machinery. Kumar and Pradhan (2003) using 4263 firms for the period 1989-2001, analysed the trends and pattern in the production and export structure of knowledge-intensive manufacturing sector. The pooled Tobit regression reveals that the effects of R&D intensity and embodied technology import intensity are positive and significant for the manufacturing sector. However, the sectoral classification revealed that the significant impact is visible only among the technology- intensive firms in the sample. Using 121 sample firms in the basic chemical industry, Bhat and Narayanan (2009) found statistical evidence for the positive role of in-house R&D and imported technology in building technological capability for export competitiveness during 2001-2007.

Parameswaran (2009) examined the sources of technology generation on production function of 2100 firms in Indian manufacturing. The study found evidence of positive role of embodied technology and disembodied technology for the manufacturing sector as a whole, while the latter being relatively more significant among the high technology intensive branch of manufacturing. Goldberg *et al.* (2010) find that firms belong to those industries having the greatest fall in input tariffs witnessed a significant increase in their ability to manufacture new domestic products or higher product scope. Input tariff liberalisation has improved the performance of the firm in terms of output, TFP and R&D activities, which corroborates the predictions of new trade-led growth theories. The study is based on 2927 firms during the period of 1989-97. Using similar theoretical and empirical approach, Topalova and Khandelwal (2011) found that reduction in tariff protection improved firms' productivity during 1987-2001 because of the competitive pressure from lower output tariffs and access to superior foreign inputs from lower input tariffs. Rijesh (2015) examined the impact of technology import on productivity performance of a large number of manufacturing firms during 1995-2010 periods. The econometric estimates revealed that technology import is a significant productivity determinant in manufacturing while the embodied technology, in terms of capital goods imports, is much more pronounced across the medium technology intensive segments such as machinery, chemicals, transport equipments etc.

3 Methodology and Data Sources

3.1 Econometric Methodology

In this study, we follow an econometric methodology to assess the impact of capital goods import on export performance. We hypothesise that a relatively greater access to technology import in the form of embodied capital goods inputs will increase the exports of Indian manufacturing sectors. The econometric modelling is based on relating manufacturing exports (EXP) on capital good import (CGIM) and other control factors (X). The specific control variables are sectoral world demand (WD), domestic R&D (RD) and the ratio of export price to domestic price (RP). Specifically,

$$EXP_{j,t} = f(CGIM, RD, RP, WD) \qquad ---(1)$$

where *j* refers to the manufacturing sector and *t* refers to the year, 1997-2016. As such, the econometric specification includes both demand and supply side factors determining manufacturing exports. The empirical analysis is based on 15 manufacturing sectors identified at the 2-digit level of National Industrial Classification (NIC)-2008. The panel is balanced and the statistical inference is based on standard panel regression estimation techniques. Panel regression provides a robust inference of parameters by blending the inter-sectoral differences with intra-sectoral dynamics and helps to control the problem of omitted variable biases arising from unobserved heterogeneity (Hsiao, 2003). The econometric specification of the empirical model is given in equation (2)

$$lnEXP_{jt} = \alpha_j + \beta_1 lnCGIM_{jt} + \beta_2 lnRD_{jt} + \beta_3 lnRP_{jt} + \beta_4 lnWD_{jt} + \mu_t \quad --(2)$$

where α_j = constant representing the trend growth in manufacturing sector, $lnEXP$ = log of real exports of manufacturing by sector *j* in year *t*, $lnCGIM$ = log of real import of capital goods (embodied technology) by sector *j* in year *t*, $lnRD$ = log of R&D intensity of sector *j* in year *t*, $lnRP$ = log of relative export price of sector *j* in year *t*, $lnWD$ = log of world demand proxied by world export of manufacturing by sector *j* in year *t*. We expect the coefficient of $\beta_1, \beta_2, \beta_3, \beta_4$ to be positive.

We estimate equation (2) using fixed effect(s) (FE) and Random effect(s) (RE) methods. The FE or within transformation model is a pooled OLS to time-demeaned data with the assumption that the unobservable effects have an arbitrary correlation with the explanatory variables in each period. The REs estimator is a feasible Generalised Least Square (GLS) estimator where the unobserved effect is assumed to be uncorrelated with the explanatory variables in each time period. We use the Hausman Specification test (also known as Durbin-Wu-Hausman test) to select the appropriate estimator for inference.

3.2 Data Source and Construction of Variables

The primary source of data for the study is collected from the firm-level database of PROWESS IQ, version 1.7, which is online client software with an interactive querying system maintained by the Centre for Monitoring Indian Economy (CMIE) Pvt. Ltd. The database consists of the financial performance of all listed (stock market) and a large number of unlisted companies of India. The financial performance indicators are based on the audited Annual Financial Reports of companies and information submitted to the Ministry of Company Affairs, company filings with stock exchanges and prices of securities listed on the major stock exchanges. Apart from standard financial indicators such as sales, R&D, exports etc., a unique feature of the database is the reporting of firm's expenses on the purchase of capital good import during the financial year. This enabled us to derive sector specific information on manufacturing exports, R&D and technology import via capital goods inputs. For aggregating firms into major manufacturing sectors at the 2-digit level, we use the NIC-2008 nomenclature.

The original data from PROWESS is available from 1989-90, though, since the update to the latest version, the data range is restricted from 1999 onwards. However, we were able to extract a large number of firms' statistics for the period of 1997-2016. During the entire period, the database report data for 11315 firms, out of which 407 firms did not report any sales data. For the rest of the 10908 firms, we removed 4169 firms that had only five or less than five years data for sales. In the end, the sectoral level analysis is based on the 6550 firms in the sample. In the database, each firm is assigned a unique company code and National Industrial Classification[6] (NIC) code, based on 2008. For the present study, we selected 15 manufacturing sectors[7], which also have a correspondence to the previous NIC-2004 coding structure. This correspondence was felt necessary, as the trade data available at the country level is not available at ISIC rev4, which was the basis of the structure of NIC-2008. The final list is given Table A1 in the Appendix.

The primary source of India's foreign trade statistics is the Directorate General of Commercial Intelligence and Statistics (DGCI&S), which compiles and publishes the export & import data on merchandise trade. Since 1988, DGCI&S has adopted the Harmonized Commodity Description and Coding System (Harmonized System, or HS) for commodity classification and provides trade statistics according to HS nomenclature. We use the International Standard Industrial Classification (ISIC), available from United Nations Commodity Trade Statistics Database or COMTRADE online databases of the United Nations Statistical Division (UNSD). ISIC rev3 is compiled from the HS classification based on UN correspondence scheme[8]. We accessed UN COMTRADE database through World Integrated Trade Solution (WITS)[9]. In particular, we collected India's export and import of manufacturing by sectors and use-based classification by country and year. In addition, using WITS we were able to collect 2-digit wise export data for all reporting countries, which represent our world demand variable.

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[6] The NIC is based on International Standard Industrial Classification (ISIC) nomenclature of the UN. The NIC-2004 and NIC-2008 follows ISIC rev3.1 and ISIC rev4, respectively.

[7] The following industries were excluded from the analysis: Printing and reproduction of recorded media (18), Manufacture of furniture (31) and other manufacturing (32).

[8]UN has prepared the product concordance by mapping various nomenclatures. This is available to the public and can be accessed from the following hyperlink: http://wits.worldbank.org/product_concordance.html.

[9] WITS is a data consultation and extraction software with simulation capabilities. It is developed by the World Bank in collaboration and consultation with United Nations Conference on Trade and Development (UNCTAD), International Trade Center (ITC), United Nations Statistical Division (UNSD) and World Trade Organization (WTO).

For constructing the variables for the econometric estimation, we proceed as follows. The manufacturing exports at the sectoral level are deflated using unit value index (UVI) of representative groups. The construction of UVI follows Paasche's formula, which uses import quantities in the current period as weights. We use the UVI reported by the Reserve Bank of India (RBI) in their Handbook of Statistics on Indian Economy. For deriving the relative export price series, the formula given in equation (3) is used

$$RP_{jt} = \frac{UVI_{jt}}{WPI_{jt}} \qquad --- (3)$$

where UVI is unit value index of sector j in year t and WPI is the corresponding Wholesale Price Indices. The WPI is collected from the Office of the Economic Advisor, Ministry of Commerce & Industry, Government of India. We use the financial year average series of 1993-94 and 2004-05 and spliced the series to construct the price indices with 2004-05 base[10]. The capital goods import were deflated by UVI of machinery and machine tools. The real R&D expenditure is derived by deflating it with GDP deflator.

4 Descriptive Statistics

In this section, we provide a descriptive statistical account of India's foreign trade and industrial characteristics during the study period. In subsection 4.1, the pattern of India's foreign trade is analysed using the custom official statistics, representing the overall performance of merchandise trade since liberalisation. In subsection 4.2, the discussion follows the data collected from firm-level database, which is aggregated at the 2-digit level, for our econometric analysis.

4.1 Pattern of Merchandise Trade by India since Liberalisation

The early 1990s witnessed a gradual but systematic change in India's trade policy regime. Until then, the trade and industrial development strategy were largely based on heavy import-substitution and commanding heights of the public sector in economic decision-making. The economic liberalisation policy initiatives of 1991 marked the beginning of an era of outward-oriented trade open regime with much greater emphasis on economic decision based on market-orientation. These policy changes were part of the economic reform measures implemented in the aftermath of a severe balance of payment and fiscal

[10] In a few cases, the aggregate product group is derived by computing average of the disaggregate product price series.

crisis[11]. The liberalisation of trade consists of a large reduction in trade protective instruments such as tariff and non-tariff barriers confining to the manufacturing sector.

Import licensing was abolished relatively early for capital goods and intermediates, which became freely importable in 1993, simultaneously with the switch to a flexible exchange rate regime (Ahluwalia, 2002). The protective regime gradually shifted from tariff to quantitative restrictions and there was some expansion in the OGL list (i.e. the list of products which require no import license). The import liberalisation was introduced so that firms can modernise their product structure by importing embodied and disembodied technology from abroad[12]. The liberal imports of capital goods and technology were viewed as a means to enable exporters to undertake technological up gradation in order to compete effectively in the international market. The policy dismantled almost all entry barriers, and gradually brought down tariffs and non-tariff barriers making the economy more outward oriented[13]. Tariffs were progressively brought down and all quantitative restrictions removed[14]. All export subsidies were abolished and exporters were allowed tradable entitlement called Exim-Scrips for importing even restricted items needed to keep up the export performance.

Table 1
Trend in Merchandise Trade of India: By Use-Base Classification (1991-2016)

Use-Based Classification	1991-2000		2001-2010		2011-2016		1991-2016	
	Export	Import	Export	Import	Export	Import	Export	Import
Raw materials	4.4	14.8	19.5	19.9	1.7	1.0	9.6	13.6
	(12.1)	(34.4)	(10.2)	(38.7)	(9.4)	(39.1)	(10.8)	(37.2)
Intermediate goods	11.1	9.9	16.8	25.6	2.6	-0.5	11.3	13.6
	(41.7)	(30.7)	(37.2)	(31.2)	(31.6)	(32.4)	(37.6)	(31.3)
Capital goods	9.2	8.6	26.0	24.2	6.9	4.5	15.1	13.7
	(6.2)	(18.2)	(10.0)	(20.2)	(12.8)	(18.4)	(9.2)	(19.0)
Consumer goods	9.4	6.3	18.9	20.2	6.0	6.8	12.3	11.7
	(39.9)	(16.7)	(42.6)	(9.9)	(46.3)	(10.1)	(42.4)	(12.6)
Total Merchandise goods	9.3	9.9	18.5	22.1	4.3	1.3	11.7	12.6
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Note: Figures adjacent to parenthesis are growth rates which are derived from the trade values reported in current US$. The figures in parenthesis are the average annual share during the respective periods.
Source: Authors calculations based on data collected from UN Comtrade, accessed through WITS

[11] Literature on India's economic reforms, their rationale, impact and implication on different economic and social issues are well documented. See Joshi and Little, (1996), Nagaraj (2003) and Kotwal *et al* (2011) for a detailed overview.
[12] Some of the other promotional measures include the permission to freely import technology, purchase foreign components, and expand capacity for larger entrepreneurs. Details of these policy changes can be seen in Aksoy (1992) and Panagariya (2008).
[13] The peak tariff fell from over 200 percent in 1990 to 65 percent in 1994 and the average nominal tariff more than halved during 1990-94 (Kaplinsky, 1997).
[14] Quantitative restrictions on imports of manufactured consumer goods and agricultural products were finally removed on April 1, 2001.

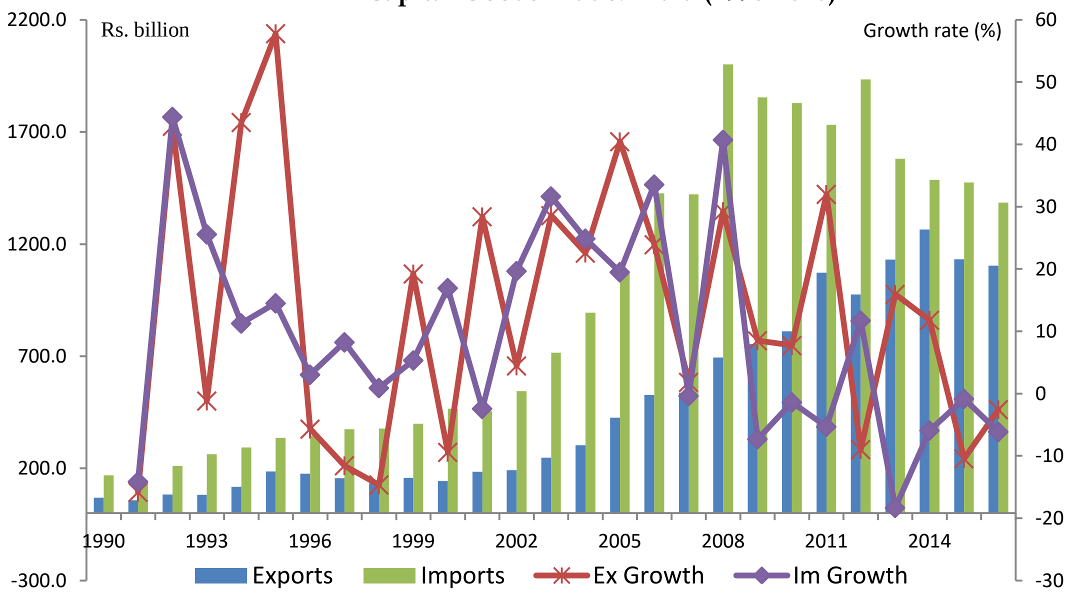
Since the onset of liberalisation, the merchandise trade sector has responded relatively well. For instance, the level of trade openness, measured by merchandise trade-GDP ratio, has reached 44 percent by 2008. Post global economic crisis, it has decelerated to 32 percent in 2015, which is, however, relatively higher than the level achieved during the pre-reform period. The pattern of merchandise trade since liberalisation is given in Table 1. The total merchandise trade is distributed across four use-based categories, namely, raw materials, intermediate goods, capital goods and consumer goods. The trade data is collected from 1991 to 2016 and is based on HS standard product group classification, accessed from WITS online portal of UN Comtrade. For assessing the trend, we divided the entire period into following four sub-periods: Period I (1991-2000), Period II (2001-2010), Period III (2011-2016) and Period IV (1991-2016). Table 1 reports both average annual growth rates and the relative (average) share of these commodities during these periods.

For the entire period (i.e., period IV), both merchandise exports and imports grew at the rate of 12 percent and 13 percent per annum, respectively. The sub-period break up of growth rates reveals that the period II (i.e., 2001-2010) has been the most remarkable phase for India's merchandise trade, both at the aggregate level and different use-based classification level. For instance, compared all other periods, trade witnessed a marked improvement and all sectors recorded double-digit rates during this phase. In this period, the largest growing sectors were the export of capital goods (26 percent) and import of intermediate goods (31 percent). However, during period III, all use-based sectors declined sharply, even the rates of growth were far lesser than what was achieved during the period I (see Table 1). For the entire period, trade in foreign inputs has been highly significant. The compositional pattern, measured by the relative share of tradable goods, reveals a strong persistence of raw materials, intermediate and capital goods in import basket throughout the different sub--periods. Although the export basket is largely confined to consumer goods (42 percent), followed by intermediate goods (38 percent) and capital goods (9 percent); the import basket is dominated by raw materials (37 percent), intermediate goods (31 percent) and capital goods (19 percent) during period IV. This clearly indicates India's heavy reliance on productive inputs from abroad since economic liberalisation.

A comprehensive account of the evolution of capital goods trade is given in Figure 1. The bar diagram represents the level of export and import of capital goods while the line plots indicate the nature of growth rates during 1990-2016. During the entire period, the level of import of capital goods has been systematically higher than the export of capital goods.

Moreover, the trade gap has consistently widened over time, which, apparently, much more pronounced during the decade of the 2000s. In 1990, India imported ₹169 billion worth of capital goods and exported only ₹69 billion of capital goods, a trade balance of -100.0. Thereafter, the trade balance has widened and reached a peak of -1306 (export at ₹695 billion and imports at ₹2001 billion) in 2008. Since the onset of global recessions, the trend has reversed to some extent as the export growth outstrip imports and reached -281 in 2016 with ₹1104 billion exports and ₹1384 billion imports, respectively. For the entire period, both exports and imports grew at the rate of 13 percent and 10 percent per annum, respectively. The annual growth rates have witnessed a cyclical trend with significant upward trend during the 1990s and 2000s. However, as noted before, since post-2008, the rate of growth has decelerated for both exports and imports.

Figure 1
Capital Goods Trade: India (1990-2016)



Note: The trade values are in Rs. billion at 2004-05 prices, which is constructed by deflating with the unit value of capital goods export/import series.
Source: Authors calculations based on UN Comtrade data, accessed from WITS

Finally, Table 2 provides an overview of the direction of India's capital goods trade by regions and countries for selected years. We can see that the export of capital goods are largely directed towards medium to high income countries including Asian region. Among the OECD countries, the export to the US has been significant and consistent over the years. For instance, out of the total capital good exports, around 8 percent went to the US in 1991. This has reached around18 percent in 2001 but has declined thereafter and reached around 13 percent in 2016. On the other hand, we can observe some noticeable shifts in the pattern of source countries in India's import basket. In the early 90s, the demand for capital goods was largely met from advanced countries (50 percent) such as EU-25 (45 percent), Japan (20 percent), Germany (19 percent) and the United States (19 percent). Since then the share of developing countries, in particular, the Asian region has increased substantially. The most striking development has been the growing importance of Chinese market, especially since 2001. For example, at the beginning of 1990s, China had virtually no presence in Indian market (See Table 2). However, by 2001, the share has increased marginally and reached 5 percent. Since then, it has emerged as the dominant supplier for India as the share shot up to 42 percent in 2016. Consequently, the largest source of machinery and tools in India is by China in recent period.

Table 2
Trade direction: Capital goods (Share in %)

Region/Countries	Exports				Imports			
	1991	2001	2011	2016	1991	2001	2011	2016
EU-25	13.3	22.4	18.4	17.6	44.9	34.2	25.5	18.2
Asia	26.1	30.8	34.8	35.2	25.4	31.1	50.7	59.9
Developing Countries#	12.4	19.4	19.2	24.1	1.2	14.3	39.6	48.5
High-income Countries#	21.1	33.4	43.6	34.2	49.9	47.1	30.5	28.9
Low & Middle income members#	31.8	35.4	31.7	41.1	1.2	14.5	39.8	48.7
Less Developed Countries#	8.2	8.6	4.6	9.7	0.0	0.1	0.1	0.1
China	0.0	0.6	2.3	3.2	0.0	5.0	31.9	41.1
France	0.6	1.7	1.6	2.4	6.2	3.3	2.3	1.5
Germany	3.2	5.8	4.0	3.8	18.6	11.7	10.4	7.8
Japan	0.4	2.0	0.9	1.4	19.9	9.4	7.6	6.5
Korea, Rep.	0.2	0.7	0.5	1.0	1.2	5.9	6.4	6.0
Malaysia	4.1	7.7	1.2	3.0	0.3	4.1	2.6	1.9
Russian Federation	0.0	1.0	1.1	1.1	0.0	0.4	0.2	0.2
Singapore	3.5	3.3	12.0	4.3	4.7	8.3	3.7	3.7
Thailand	1.1	0.9	1.6	1.7	0.4	2.8	2.1	2.6
United Kingdom	4.2	4.6	2.9	3.8	6.6	4.7	2.0	1.5
United States	7.8	17.5	12.8	12.9	18.5	16.8	7.9	8.0
World	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note: The figures are corresponding share of each region/countries in total export/import of capital goods from/to the world;. # denotes WTO classification of economies.
Source: Authors calculations based on UN Comtrade data, accessed from WITS

4.2 Exports and Technology Characteristics at the Sectoral Level: 2-digit NIC

In this subsection, we focus on the statistical account of trade and technology aspects of organised manufacturing sector at the 2-digit level. The descriptive statistics is based on data collected from PROWESS, which is employed for the econometric analysis discussed in Section 5. The focus of discussion is to provide an overview of the nature of exports, the incidence of technology import and domestic technological capability in terms of R&D expenditure by 2-digit sectors. Since the data is available from 1997-2016, for brevity, the entire period is structured into the following: 1997-2007, 2008-2016 and 1997-2016. The first period gives an idea about the performance of Indian manufacturing before the external demand shock and the second period represents the post-crisis scenario. For discussion, we use industrial sales, exports, capital goods import and R&D expenditure by sectors. The descriptive details are given in Table 3.

4.2.1 *Manufacturing Output and Exports*

The largest manufacturing sector, in terms of sectoral output (i.e., cumulative sales share), is coke and petroleum (33 percent), followed by chemicals (14 percent), basic metals (12 percent) and machinery (10 percent). Since the onset of global financial economic slowdown, the output share of traditional low technology-intensive sectors such as tobacco, textiles, paper as well as knowledge intensive sectors like chemicals and electrical machinery has declined. In terms of average annual growth rates, we find similar deceleration during this period across all sectors except leather. The largest growing sectors for the entire period are transport equipment (11 percent) and machinery sector (9 percent).

In terms of manufacturing exports, the largest contributor is coke and petroleum (28 percent), which, remarkably, been able to gain 41 percent share during 2008-16. Similarly, the chemical and pharmaceuticals (18 percent), basic metals (16 percent) and textiles (11 percent) remained as the largest exporting sector during this period. Moreover, some of the technology intensive engineering sectors were able to maintain double-digit growth rates during the same period. As before, all sectors witnessed a drastic reduction in exports post-2008, which is expected as exports are highly susceptible to external demand shocks.

4.2.2 *Technological Characteristics*

For assessing the technological facet of manufacturing, we selected two indicators, namely, sectoral import of capital goods (i.e., embodied technology from external sources) and domestic R&D expenditure (i.e., internal technological capability/effort). As well known, the domestic R&D expenditure, in this case, should not be taken as a representation of pure technological innovative effort for a technology follower country like India. Scholars have argued that most of the R&D effort in India is channelled towards adapting or modifying the external technology (see Katrak, 1985; Siddharthan 1988; and Kumar and Aggarwal, 2005). With this caveat in mind, let us examine the trend in technological aspects in Indian manufacturing in the recent period.

Table 3

Trend in Output, Exports and Technology in Organised Manufacturing in India: 2-Digit Level Classification

2-digit (NIC)	1997-2007				2008-2016				1997-2016			
	O	**EX**	**CGIM**	**R&D**	**O**	**EX**	**CGIM**	**R&D**	**O**	**EX**	**CGIM**	**R&D**
Food products and beverages (10+11)	13.5 (6.0)	19.5 (5.7)	39.9 (1.4)	2.6 (0.1)	5.1 (6.4)	-0.1 (4.4)	3.2 (1.8)	17.2 (0.1)	9.5 (6.2)	10.2 (5.1)	22.5 (1.6)	9.5 (0.1)
Tobacco (12)	6.0 (1.6)	11.7 (1.2)	29.7 (1.4)	39.6 (0.1)	1.4 (1.2)	-0.2 (0.6)	-1.2 (1.3)	8.1 (0.2)	3.9 (1.4)	6.1 (0.9)	15.0 (1.3)	24.7 (0.2)
Textiles and wearing apparel (13+14)	8.4 (5.0)	9.7 (15.2)	22.6 (10.9)	2.0 (0.0)	4.8 (3.8)	1.5 (6.3)	-14.5 (6.5)	17.2 (0.1)	6.7 (4.5)	5.8 (11.2)	5.0 (9.0)	9.2 (0.0)
Leather (15)	6.3 (0.2)	17.0 (1.0)	27.2 (0.3)	1.3 (0.1)	7.6 (0.2)	-3.5 (0.4)	-5.5 (0.2)	9.0 (0.1)	6.9 (0.2)	7.3 (0.7)	11.7 (0.2)	4.9 (0.1)
Wood (16)	8.3 (0.1)	11.8 (0.1)	111.2 (0.1)	18.4 (0.1)	4.7 (0.1)	0.7 (0.0)	79.5 (0.1)	-10.8 (0.0)	6.6 (0.1)	6.5 (0.1)	96.2 (0.1)	4.6 (0.0)
Paper (17)	7.3 (1.1)	16.4 (0.5)	39.2 (1.5)	6.2 (0.1)	2.0 (0.8)	3.3 (0.3)	57.0 (1.7)	1.3 (0.1)	4.8 (1.0)	10.2 (0.4)	47.6 (1.6)	3.9 (0.1)
Coke and petroleum (19)	11.6 (31.4)	26.4 (16.7)	88.8 (18.2)	20.0 (0.0)	3.7 (34.5)	5.0 (41.2)	25.1 (16.5)	10.9 (0.0)	7.8 (32.8)	16.3 (27.7)	58.6 (17.4)	15.7 (0.0)
Chemicals and Pharmaceuticals (20+21)	7.1 (16.0)	15.9 (20.5)	3.2 (12.1)	22.2 (0.6)	6.5 (12.2)	7.8 (15.9)	-4.1 (10.0)	9.8 (1.4)	6.8 (14.3)	12.1 (18.4)	-0.2 (11.1)	16.3 (1.0)
Rubber and Plastics (22)	8.5 (2.7)	8.1 (3.7)	5.3 (3.9)	5.9 (0.2)	8.4 (2.4)	1.5 (2.4)	6.2 (5.1)	15.9 (0.2)	8.4 (2.6)	5.0 (3.1)	5.7 (4.4)	10.6 (0.2)
Non-metallic Minerals (23)	9.6 (3.5)	7.7 (2.5)	20.6 (4.2)	9.7 (0.1)	6.9 (3.8)	-5.4 (1.0)	-14.6 (4.5)	12.2 (0.1)	8.3 (3.6)	1.5 (1.8)	3.9 (4.3)	10.9 (0.1)
Basic Metals (24)	9.6 (12.4)	16.9 (17.2)	11.2 (15.8)	6.5 (0.1)	2.8 (13.4)	-0.9 (13.4)	4.9 (27.1)	7.2 (0.1)	6.4 (12.8)	8.5 (15.5)	8.2 (20.9)	6.9 (0.1)
Fabricated Metals (25)	15.3 (0.9)	13.8 (1.1)	51.1 (0.6)	4.5 (0.1)	1.0 (1.1)	12.6 (1.0)	-2.4 (0.8)	20.0 (0.1)	8.5 (1.0)	13.2 (1.1)	25.7 (0.7)	11.8 (0.1)
Non-Electrical Machinery (26+28)	12.1 (6.8)	25.2 (5.6)	13.3 (3.5)	7.3 (0.5)	3.7 (6.3)	-1.3 (3.8)	-13.5 (2.5)	11.7 (0.9)	8.1 (6.6)	12.6 (4.8)	0.6 (3.0)	9.4 (0.7)
Electrical Machinery (27)	12.3 (3.2)	21.2 (2.5)	5.8 (8.9)	15.9 (0.2)	4.2 (2.8)	2.4 (1.6)	-1.6 (4.6)	15.4 (0.3)	8.5 (3.1)	12.3 (2.1)	2.3 (7.0)	15.7 (0.3)
Transport Equipments (29+30)	13.5 (9.0)	11.7 (6.4)	13.7 (17.3)	18.6 (0.7)	8.5 (10.9)	6.0 (7.6)	-7.1 (17.3)	11.8 (1.0)	11.1 (9.9)	9.0 (6.9)	3.8 (17.3)	15.4 (0.8)

Note: O=output (cumulative sales), EX=Exports, CGIM= Capital goods import, R&D=Research & Development expenditure. All figures, adjacent to the parenthesis, are growth rates calculated from deflated real values at 2004-05=100 price series. Figures in parenthesis are average shares in total. R&D share reflects R&D intensity.

Source: Author's calculation based on firm wise data collected from ProwessIQ ver1.7 database, CMIE.

Table 3 shows clearly the low incidence of R&D in Indian manufacturing across sectors. All sectors, except chemicals and pharmaceuticals, have devoted less than 1 percent to R&D activities. The chemical sector has not only spent a large proportion of resources to R&D but continue to improve considerably during 2008-2016 period. For instance, from period I to II, the share has increased from 0.6 percent to 1.4 percent. In terms of annual growth rates, the largest growth in R&D is noticed for tobacco (25 percent), coke & petroleum (16 percent), Chemicals (16 percent), non-electrical machinery (15 percent) and metallic minerals (11 percent). The analysis reconfirms clearly the relatively low incidence of internal technological effort by the Indian manufacturing sector.

In contrast, a large number of industrial sectors devote considerable resources on acquiring technology inputs from abroad. The incidence of a large share of capital goods import across different manufacturing segments reflects this phenomenon. For the entire period, the capital good import were largely confined to basic metals (21 percent), coke & petroleum (17 percent), transport equipments (17 percent) and chemical sector (11 percent). Out of the 15 selected sectors, the share of capital goods import has increased in 8 manufacturing segments. However, as observed across manufacturing, the growth rates seemed to have declined post 2008. For the entire period, the food and beverages, tobacco, leather, wood, paper, coke and petroleum and fabricated metals reported a double-digit growth rates.

5 Econometric Results

In this section, we provide the empirical results of the econometric model outlined in Section 3. We use panel econometric modelling to estimate the impact of capital goods import on export performance using a 15-panel group of manufacturing sector observed during 20 years (i.e., 300 observations). In addition, we perform simple OLS regression for each individual sector to identify the inter-sectoral dynamics.

The summary statistics of real exports (REX), real capital goods import (CGIM), world demand (WD), real R&D expenditure (RD) and relative export prices (RP) for the panel manufacturing sector is given in Table A2 in the appendix. We report the average mean and standard deviation by overall, within and between sample groups. For all variables, the between mean variations are larger than within variations, except RP. The largest overall variance is observed in R&D and the minimum is reported by RP.

The panel regression results are given in Table 4. All variables are measured in the natural log and, therefore, the coefficients have elasticity interpretations. We report the Fixed Effect (FE) estimator results for the aggregate manufacturing sector based on the Hausman specification tests[15]. The FE method allow us to 'net out' the time-invariant unobserved characteristics (heterogeneity) influencing the econometric model. Among the control variables, we find a positive and statistically significant impact of world demand and R&D expenditure on exports. The individual regression results based on OLS do confirm the strong and unambiguous positive impact of world demand conditions in shaping manufacturing exports. For instance, out of the 15 regression results, the coefficient of WD is positive for 14 manufacturing sectors, and positive and statistically significant in nine sectors. In the case of food & beverages and wood products, the coefficient is found to be larger than unity and significant. The internal R&D expenditure is found to be positively related to exports of 7 industrial sectors. However, out of seven sectors, only in two sectors (i.e., paper and chemical sectors) the coefficient positive and statistically significant. The relative price effect is found to a have negative impact on manufacturing exports. This suggests that relatively the domestic market continues to provide much favourable incentives for Indian manufacturers than foreign market price conditions.

5.1 Impact of Capital good import on Manufacturing Exports

The panel econometric results reveal that, on average, the import of capital goods has a positive and statistically significant impact on manufacturing exports. The results reveal that a 10 percent increase in capital good import increases aggregate manufacturing exports by 1.14 percent, holding WD, RD and RP fixed. Examining the individual coefficients, we find that the relationship is positive among 12 industrial sectors. Among them, the coefficient is positive and statistically and economically significant for seven sectors. These sectors are the following: the textiles and wearing apparel (0.14), leather (0.31), wood (0.13), fabricated metals (0.24), non-electrical machinery (0.23), electrical machinery (0.31) and transport equipment and products (0.25). For selected sample, the elasticity coefficient ranges from -0.11 to 0.31. The engineering sectors such as the metals and machinery & equipment manufacture seem to have relatively larger elasticity compared to the less technology-intensive sectors such as wood and textiles.

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[15] The alternative test results based on the Random effect model, which is computed using the weighted average of within and between models, produce quantitatively similar results.

Table 4
Regression Estimation of Manufacturing Exports of India: 2-digit Industry sector Sample (1997-2016)
Dependent Variable: Log of Real Exports (REX) at 2004-05 prices

	CGIM	WD	RD	RP	Year	Constant	F stat	R^2	Observations
Organised Manufacturing Sector	0.114**	0 .886***	0.221*	-0.264		-1.640	214.08	0.77	300
	(0.034)	(0.074)	(0.118)	(0.198)		(1.051)	(0.000)		
Food products & beverages	-0.105	1.081**	-0.137	-1.679***	0.072**	-138.6**	49.67	0.95	20
	(0.115)	(0.384)	(0.197)	(0.498)	(0.026)	(48.17)	(0.000)		
Tobacco Products	0.003	0.278	0.119	-1.045***	0.0232	-35.66	14.95	0.84	20
	(0.090)	(0.318)	(0.089)	(0.329)	(0.015)	(29.57)	(0.000)		
Textiles & wearing apparel	0.136***	0.308***	0.113	-0.001	0.044***	-82.88***	97.58	0.97	20
	(0.045)	(0.086)	(0.099)	(0.396)	(0.010)	(18.69)	(0.000)		
Leather Products	0.307**	0.059	-0.012	-1.018***	0.057***	-102.0***	26.40	0.90	20
	(0.119)	(0.193)	(0.245)	(0.283)	(0.016)	(29.24)	(0.000)		
Wood Products	0.126*	1.321**	0.053	-0.817	0.044	-94.22	12.81	0.82	20
	(0.067)	(0.561)	(0.111)	(1.346)	(0.034)	(64.21)	(0.000)		
Paper Products	0.011	0.256	1.038***	-1.046*	0.0613**	-117.2**	21.89	0.89	20
	(0.067)	(0.346)	(0.277)	(0.592)	(0.027)	(50.09)	(0.000)		
Coke & petroleum	-0.042	0.606***	-0.100	-1.375***	0.160***	-308.8***	72.41	0.96	20
	(0.099)	(0.114)	(0.323)	(0.273)	(0.045)	(87.40)	(0.000)		
Chemical Products	0.010	0.192*	0.339***	-1.080***	0.062***	-112.7***	576.93	0.99	20
	(0.035)	(0.099)	(0.096)	(0.152)	(0.013)	(24.43)	(0.000)		
Rubber & Plastics	0.080	0.625***	0.118	-1.088***	0.056**	-106.5**	143.92	0.98	20
	(0.052)	(0.139)	(0.166)	(0.273)	(0.024)	(44.85)	(0.000)		
Non-metallic Minerals	-0.001	0.644***	-0.044	-2.044***	0.040**	-67.24**	18.51	0.87	20
	(0.071)	(0.213)	(0.090)	(0.484)	(0.015)	(26.74)	(0.000)		
Basic Metals	0.080	0.590***	-0.142	-0.0809	0.052*	-99.24*	58.00	0.95	20
	(0.076)	(0.164)	(0.345)	(0.498)	(0.026)	(48.52)	(0.000)		
Fabricated Metals	0.240***	-0.271	0.0841	-0.683***	0.104***	-194.2***	118.34	0.98	20
	(0.061)	(0.195)	(0.097)	(0.172)	(0.016)	(29.60)	(0.000)		
Non-Electrical Machinery	0.226*	0.810***	-0.122	-1.824***	0.088***	-170.3***	57.44	0.95	20
	(0.127)	(0.233)	(0.112)	(0.486)	(0.015)	(27.63)	(0.000)		
Electrical Machinery	0.312***	0.300	-0.069	-0.790***	0.109***	-211.2***	42.22	0.94	20
	(0.094)	(0.195)	(0.233)	(0.245)	(0.021)	(39.40)	(0.000)		
Transport Equipments	0.252***	0.348	-0.043	-1.291***	0.169***	-328.8***	192.37	0.99	20
	(0.050)	(0.198)	(0.109)	(0.135)	(0.019)	(36.38)	(0.000)		

Note: (1) The Fixed Effect estimation results are given for manufacturing sector. For the rest of the 15 sectors, the coefficient estimates are based on OLS (2) The panel estimation results are based on Hausman Specification test, with the coefficient of 14.8 (0.005). It is asymptotically χ^2 distributed with p-values in brackets. (3) The Huber-White robust standard errors are given in parentheses under estimated coefficients. (4) * significant at 0.01 level for a two-tailed test, ** at 0.05 level for a two-tailed test, *** significant at 0.1 level for a two-tailed test (i.e., *** p<0.01, ** p<0.05, * p<0.1). (5) REX: real manufacturing exports, CGIM= Real import of capital goods, WD= World demand, RD= R&D expenditure at 2004-05 prices, RP=Relative export prices.

The empirical results provide considerable evidence of a positive impact of technology import, in terms of embodied technology, facilitating better export prospects of Indian manufacturing segment in the recent period. The findings are in line with the theoretical predictions that technology inputs act as vital carriers of technology and knowledge and accessing them through imports has been a major determinant of improving domestic production capability and exports. Our econometric results further complement the empirical findings of a positive impact of import of technology on the productivity of manufacturing sectors by studies such as Basant and Fikkert (1996), Hasan (2002), Parameswaran (2009) and Rijesh (2015). However, since the results vary considerably across sectors, it also reminds us the importance of technological effort and adaptive capability in utilising the external technology effectively. Moreover, in certain cases, the external technology might be competing directly with the domestically available substitutes, resulting lower productive benefits from imports. A further complication arises from the cumulative nature of capital good inputs which should be ideally addressed through capital stock construction adjusted for depreciation. Since these adjustments are not made in the present empirical exercise, the results should not be taken as exhaustive. Further empirical scrutiny, especially for manufacturing enterprises at the firm level will provide much more interesting facets and intricacies of the relationship between the import of capital goods and export performance since liberalisation.

6 Concluding Observations

The purpose of the present study is to examine empirically the impact of capital goods import on manufacturing export of India since liberalisation. The production of capital goods, which is an embodied form of technology, is highly concentrated in advanced countries and often relatively scarce in less income countries. As capital goods such as machinery, tools and equipment are the vital element in the production process, accessing them through imports is often argued as an alternative route for industrialisation and development in recent economic theories. In this context, the economic integration and openness are expected to allow less income economies such as India to access the superior and quality technology inputs from advanced countries. The recent advancement in international trade theories predicts several important insights regarding the static and dynamic welfare gains from participating in international trade and product specialisation. This is especially relevant for an emerging economy like India which has embarked an outward-oriented development strategy through a series of economic reforms including a comprehensive trade liberalisation program in 1991. As a result, the relative openness has widened considerably with a drastic increase in import of productive inputs in the recent period. In this context, the present study hypothesis that relatively greater import of capital goods inputs, by increasing domestic productivity and efficiency, will have a positive impact on export of manufacturing by India. To study this important empirical issue, we use econometric estimation methodology for a sample of 15 major manufacturing sectors during the period of 1997-2016. The descriptive statistics reveals that the trade orientation in Indian manufacturing has widened over the years and the capital good import has been a major item of import in the recent period. Moreover, the source of countries has shifted away from OECD to the Asian region, especially towards China in recent decades. In general, the incidence of capital good import has been considerable across sectors such as textiles and engineering sectors like metals, electrical and non-electrical machinery and transport equipment. However, the dependence on internal R&D has been rather low. During the study period, the manufacturing export has expanded considerably, especially by the technology-intensive sectors.

The empirical finding reveals that the technology inputs have a positive and statistically significant impact on manufacturing exports. The coefficient is found to be less than unity and economically significant among a large number of 2-digit sectors. In particular, the export of engineering sectors tends to benefit much from the import of capital inputs. Further, the textiles and wearing apparel, one of India's largest traditional and labour intensive segments, is found to have benefited positively by these inputs. These findings do provide considerable evidence for the theoretical underpinnings of new growth and trade theories highlighting the dynamic role of technology in the domestic manufacturing. In addition, the findings are in line with the predictions and arguments of various Schumpeter and Neo-Schumpeterian understanding of the crucial role of technology and knowledge in improving manufacturing capability and competence. As such, the study offers valuable insights into the relationship between capital goods import and manufacturing exports. Further research, especially carried out at the firm level, will provide much richer insights.

Appendix

Table A1
Distribution of Firms across Sample Manufacturing Sector (1997-2016)

Sl no	2-digit NIC04	Description	Number of Firms
1	10+11	Manufacture of food products and beverages	560+130
2	12	Manufacture of tobacco products	18
3	13+14	Manufacture of textiles and wearing apparel	789+146
4	15	Manufacture of leather and related products	60
5	16	Manufacture of wood and products of wood and cork,	43
6	17	Manufacture of paper and paper products	246
7	19	Manufacture of coke and refined petroleum products	71
8	20+21	Manufacture of chemicals, pharmaceuticals, medicinal and botanical products	829+451
9	22	Manufacture of rubber and plastics products	447
10	23	Manufacture of other non-metallic mineral products	251
11	24	Manufacture of basic metals	831
12	25	Manufacture of fabricated metal products, except machinery and equipment	232
13	26+28	Manufacture of machinery, equipment, computer, electronic and optical products	414+251
14	27	Manufacture of electrical equipment	337
15	29+30	Manufacture of motor vehicles, trailers and other transport equipment	52+392
		Grand Total	**6550**

Source: Authors compilation from PROWESS IQ, CMIE

Table A2
Summary Statistics

Variable		Mean	Std. Dev.	Min	Max	Observations
REX	overall	10.599	1.732	5.666	14.221	N = 300
	between		1.680	6.679	12.801	n = 15
	within		0.598	8.573	12.019	T = 20
CGIM	overall	8.123	1.744	1.723	11.660	N = 300
	between		1.663	4.356	10.102	n = 15
	within		0.672	5.490	10.688	T = 20
WD	overall	12.596	1.270	9.538	14.732	N = 300
	between		1.212	9.863	14.251	n = 15
	within		0.486	10.377	13.777	T = 20
RD	overall	6.218	2.217	-0.223	10.909	N = 300
	between		2.196	1.400	9.671	n = 15
	within		0.633	3.838	7.958	T = 20
RP	overall	4.6252	0.257	3.576	5.241	N = 300
	between		0.124	4.305	4.818	n = 15
	within		0.227	3.607	5.105	T = 20

REX: real manufacturing exports, CGIM= Real import of capital goods, WD= World demand, RD= R&D expenditure at 2004-05 prices, RP=Relative export prices

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