Chapter 6

Impact of Trade and Investment Liberalization on Productivity in Organized Manufacturing in India

Ram Upendra Das
Research and Information System for Developing Countries (RIS)

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CHAPTER 6

Impact of Trade and Investment Liberalization On Productivity in Organized Manufacturing in India

RAM UPENDRA DAS[1]

Research and Information System for Developing Countries (RIS)

Over recent years India has witnessed wide-ranging economic reforms in her policies governing international trade and FDI flows. Consequently, both trade and FDI flows have risen dramatically since 1991. Using firm-level panel data this paper finds that significant productivity improvements have taken place in the period since 2000. The paper further explores the important determinants of productivity improvements across a range of different categories. As per the findings of the paper, some of the important determinants of productivity measured by total factor productivity (TFP) include imports of raw materials and capital goods, size of operation, quality of employment captured by wage rates and technology imports measured by royalty payments. It also emerges that R&D in organized manufacturing remains at a nascent stage possibly because of the inadequate emphasis this sphere has been given by the private sector. However, further exploration of this issue is required in order to draw any firm conclusions. Broadly, foreign firms have catered to the Indian domestic market and as a result, India is yet to develop as an export platform. Finally, the import-export linkage is not shown to be significant in the sample of import-dependent firms. However, the paper emphasizes that the issue of productivity gains needs to be kept in a balanced perspective. Towards the end, the paper makes some broad policy suggestions in the realm of regional integration focusing on trade in goods and services, investment cooperation, R&D cooperation and human resource development in order to harness regional sources of demand impulses.

[1] Senior Fellow, RIS, New Delhi. The author would like to place on record his gratitude to Biswajit Dhar for initiating this work. Special thanks are due to Shujiro Urata, Chin Hee Hahn, Dionisius Narjoko for their useful comments and other participants of the ERIA Workshops for the Microdata Project FY2009, including the discussants of this paper. Useful insights received during discussions with B N Goldar are gratefully acknowledged. Thanks are also due to Pragya and Jagdish for their dedicated research assistance. However, usual disclaimers apply.

1. Introduction

The recent economic growth dynamism of India has placed her amongst the set of 'emerging economies' in the global economic arena. This economic growth which has witnessed a trajectory shift coupled with strides made in per capita GDP has made the Indian economy both a source of demand for goods and services as well as their supplier. This has also engendered a spate of initiatives in the realms of telecommunications, IT and physical infrastructure. Consequently, production, trade and investment activities in various sectors have received an impetus through both domestic and international means. Because of this, the importance of international trade in goods and services and inward and outward foreign direct investment (FDI) have assumed greater importance in the Indian context than ever before.

One of the primary reasons for such a dynamic economic growth paradigm is considered to be economic liberalization which has been achieved through a whole host of economic reforms ushered in, in the domains of domestic industrial policy, trade policy, exchange rate policy and FDI policy, among others. In the past, India pursued a policy of import-substitution that helped to strengthen its extensive industrialization process. However, such a policy had two important side-effects, namely the economy becoming high-cost and inefficient which was characterized by low-quality high-priced products due to a lack of foreign competition. Hence, the necessity of economic reforms was realized. These were reflected in domestic de-licensing measures, simplification of administrative procedures, tariff liberalization, removal of quantitative restrictions, decontrol of the exchange rate regime, increased foreign equity participation in an increasing number of sectors with rationalized entry procedures and removal of performance requirements, to name but a few prominent policy steps. Export- and FDI-orientation with import openness substituted the earlier regime of import substitution and protection vis-à-vis global competition.

The economic effects of these reforms were experienced in the realms of increased exports and imports of goods and invisibles, remittances, and FDI inflows and outflows which together have certainly contributed to the economic growth process. More importantly to be noticed is the growth in the per capita income spread over a large

populace enjoying increased purchasing power which is often referred to as the emergence of a new middle class in India. This in turn, has provided a fresh basis for further global integration of the Indian economy whereby other countries became attracted to the Indian market and foreign investors became attracted to the Indian investment arena. India has adopted a cautious approach towards this situation with emphasis on bilateral and regional economic cooperation agreements of varying depths without undermining its basic commitments towards the completion of ongoing WTO negotiations. It also adopted a cautious approach towards capital account convertibility.

While the above have augured well for the economic growth process, it still remains a somewhat debatable issue as to what extent this has resulted in productivity gains in the economy as a whole. More importantly, the evidence with respect to productivity gains has remained a contentious and unresolved issue at the firm level primarily due to a lack of adequate research focus. Furthermore, the firm-level determinants of productivity especially in terms of the role of trade and investment liberalization have remained largely unexplored in the mainstream literature on the subject.

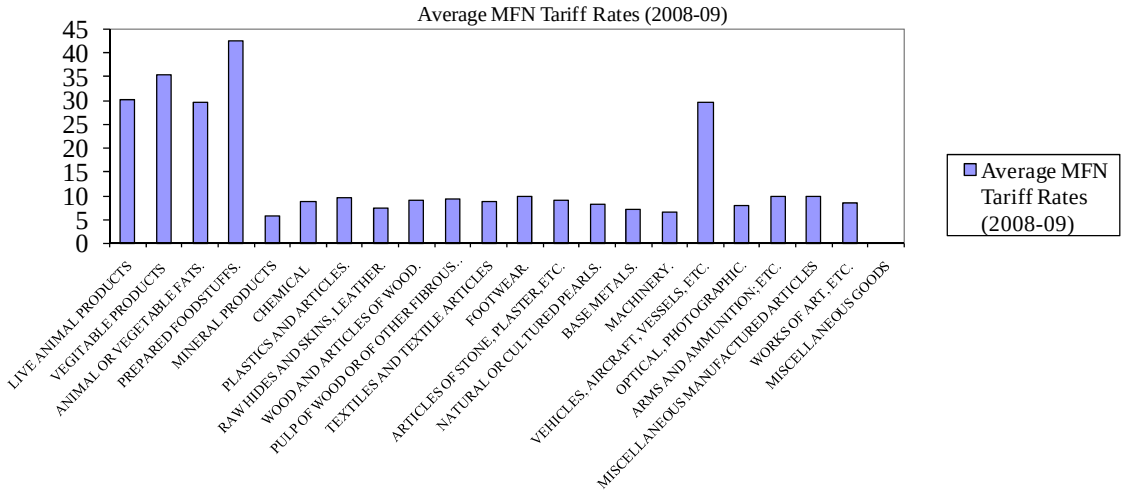
Against this backdrop, Section 2 documents broad macro trends in tariff liberalization, increased trade flows and rising FDI inflows in India, with the latter being indicators of a more liberal policy regime over time. Section 3 presents a brief literature-survey on the subject, including those relating to the Indian context. The analytical framework is presented in Section 4. Section 5 details the methodology and Section 6 presents an analysis of results. In Section 7, the issue of productivity has been placed in a balanced perspective. Finally, Section 8 presents broad conclusions and makes some policy recommendations.

2. Broad Trends: Tariffs, Trade and FDI

In this section, we document some broad macro trends in the Indian economy in terms of tariff liberalization and the associated trade flows, primarily the import flows. Since the FDI regime has also undergone considerable liberalization in India, the broad FDI inflows are additionally highlighted.

As mentioned above, India has undergone massive tariff liberalization, especially since 1991. The current tariff levels are relatively low in most sectors, except in the agriculture and automobile sectors (Chart 1).

Chart 1.



To further elaborate the point made above, an attempt has been made to identify the sectors, as per the standard industry classifications, that have displayed different degrees of tariff liberalization over the period 1990-2008, and are classified in three categories (Table 1) of high, medium and low tariff liberalization.

Table 1. Level and Extent of Sectoral Tariff Liberalization in India (1990-2008)

NIC98	Description
	High Liberalisation
142	Mining and quarrying n.e.c.
369	Manufacturing n.e.c.
173	Knitted and crocheted fabrics and articles
182	Dressing, dyeing of fur and articles of fur
131	Mining of Iron Ores
323	Sound or video recording, associated goods
132	Non-ferrous metal ores mining, except uranium, tho
243	Man-made fibers
313	Electricity distribution and control apparatus
319	Other electrical equipment n.e.c.

(Table 1. Continued)

271	Basic Iron & Steel
292	Special purpose machinery
241	Basic chemicals
353	Aircraft and spacecraft
	Medium Liberalisation
181	Wearing apparel, except fur apparel
333	Watches and clocks
315	Electric lamps and lighting equipment
332	Optical instruments, photographic equipment
272	Basic precious and non-ferrous metals
192	Footwear
314	Accumulators, primary cells, primary batteries
361	Furniture
251	Rubber products
331	Medical appliances except optical instruments
293	Domestic appliances, n.e.c.
141	Quarrying of stone, sand and clay
261	Glass and glass products
291	General purpose machinery
252	Plastic products
172	Other textiles
242	Other chemical products
342	Coach work for motor vehicles, trailers, semi-trail
101	Mining and agglomeration of hard coal
231	Coke oven products
311	Electric motors, generators and transformers
289	Other fabricated metal products
269	Non-metallic mineral products n.e.c.
222	Printing and printing services
191	Tanning of leather, leather products
201	Saw milling and planning of wood
202	Wood, cork, straw and plaiting materials
312	Electricity distribution and control apparatus
281	Structural metal products, steam generators, etc
359	Transport equipment n.e.c.
210	Paper and paper product
343	Parts, accessories for motor vehicles and their en
351	Building and repair of ships & boats
171	Spinning, weaving and finishing of textiles.
103	Extraction of agglomeration of peat
221	Publishing

(Table 1. Continued)

352	Railway, tramway locomotives and rolling stock
Low Liberalisation	
341	Motor Vehicles
50	Fishing, operation of fish hatcheries
155	Beverages
154	Other food products
153	Grain products, prepared animal feeds, etc.
152	Dairy Product

The exact basis for this categorization is presented in Table 2 which presents a dynamic overview of import-weighted tariff liberalization in different industrial sectors. Between 1990 and 2008, most of the sectors experienced a gradual decline in tariff levels, indicating that liberalization has been wide-ranging over time.

Table 2. India's Industry-wise Import Weighted Tariff (1990-2008)

NIC98	Description	1990	1992	1997	1999	2001	2004	2005	2007	2008
152	Dairy Product	55.3	60	24.2	16.7	35.3	34.4	32.9	34.6	29
153	Grain products, prepared animal feeds, etc.	58.1	37.2	23.5	32	35	30	32.2	32.9	28.8
154	Other food products	92.8	67.1	27.7	41.3	46.3	80.5	83.4	55.8	40.1
155	Beverages	329.5	326.8	96.9	142	154	56.4	62.1	103.4	133.7
171	Spinning, weaving and finishing of textiles.	54.8	35.9	32	33.3	29.1	27.2	17.5	15.2	13.3
172	Other textiles	90.7	58.6	40	40	28.4	26.2	15	12.5	10.4
173	Knitted and crocheted fabrics and articles	100	65	40	40	30.1	29.5	15	12.5	4.6
181	Wearing apparel, except fur apparel	100	65	40	40	34.7	30	15	12.5	9.3

(Table 2. Continued)

182	Dressing, dyeing of fur and articles of fur	100	35.6	20.2	26.1	13.2	15.4	13.2	12.5	4.6
191	Tanning of leather, leather products	60.4	60.1	0.8	25.5	25.5	25.4	15	12.5	10
192	Footwear	100	65	40	40	35	30	15	12.5	10
201	Saw milling and planing of wood	60	60	28.7	17.2	25.6	25.2	14.7	12.5	10
202	Wood, cork, straw and plaiting materials	58.7	60	30	37.6	35	30	15	12.5	10
210	Paper and paper product	34.6	45.9	12.4	20.5	19	17.2	12.7	10.9	7.4
221	Publishing	33.6	21.9	32.2	35.4	31.5	16.5	5.2	12.4	8.9
222	Printing and printing services	59.6	20.6	22	26.1	26.6	25.8	15	12.5	9.2
231	Coke oven products	40	1.3	10	15	15	15	15	12.5	5
241	Basic chemicals	75.9	60.7	25.1	28.3	29.9	25.6	14.2	11.8	6.4
242	Other chemical products	76.9	57.6	30.1	33.4	32.3	28.6	14.9	12.3	9
243	Man-made fibers	100	61.5	29.6	35.1	20	20	15	12.5	6.3
251	Rubber products	93.7	62	39.7	40	34.7	29.8	14.8	12.4	9.8
252	Plastic products	87.8	65	29.8	34.8	34.8	29.9	15	12.5	10
261	Glass and glass products	87.7	63.8	39.9	39.9	34.3	29.8	15	12.5	9.8
269	Non-metallic mineral products n.e.c.	58.3	58.8	35.1	33.3	32	28.4	15	12.5	8.5
271	Basic Iron & Steel	79.8	62.6	29.4	34.3	34.5	37.7	19.3	18	6.2

(Table 2. Continued)

272	Basic precious and non-ferrous metals	84.6	61.1	36.7	38.9	34	29	15	12.5	8.4
281	Structural metal products, steam generators, etc	48.4	54.1	28.4	32.4	32	26.8	15	12.5	9.1
289	Other fabricated metal products	77.7	58.5	28.8	30.9	34.7	29.3	15	12.5	10
291	General purpose machinery	66.7	47.7	20.8	25.6	27.9	26.4	15	12.5	7.5
292	Special purpose machinery	76.8	45.9	20.3	25.7	25.8	25.4	15	10.8	6
293	Domestic appliances, n.e.c.	87.3	45.3	36.1	36.3	32.6	28.8	15	12.5	9.5
311	Electric motors, generators and transformers	55.9	34.7	20.3	25	25.1	25	15	12.5	7
312	Electricity distribution and control apparatus	35	49.9	30	34.5	34.4	29.6	15	12.5	6
313	Electricity distribution and control apparatus	100	65	40	38.9	23.4	28.8	14.2	12.1	6.7
314	Accumulators, primary cells, primary batteries	100	65	39.6	39.9	35	30	15	12.5	10
315	Electric lamps and lighting equipment	100	64.8	40	40	35	30	15	12.5	9.8
319	Other electrical equipment n.e.c.	93.2	54.9	27.1	31.4	30.7	27.8	14.8	12.3	6.6

(Table 2. Continued)

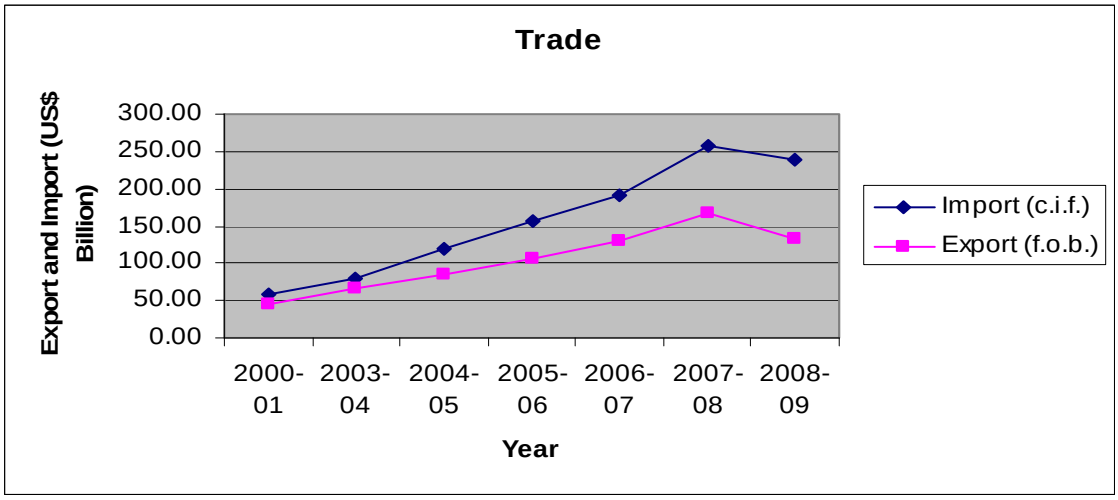
323	Sound or video recording, associated goods	100	65	26.1	31.4	29.3	27.5	15	5.9	5.2
331	Medical appliances except optical instruments	56.6	56.8	20.7	25.3	23.4	22.9	12.6	10.4	6.1
332	Optical instruments, photographic equipment	76.2	57	35.2	36.1	31.8	27.3	14.3	11.8	7.5
333	Watches and clocks	100	65	29.8	30.1	30.2	28.8	15	12.5	9.6
341	Motor Vehicles	114.7	63.3	38.7	38.1	51	60.9	49.3	39.8	37
342	Coach work for motor vehicles, trailers, semi-trailers	82.8	58.3	40	40	35	30	15	12.5	10
343	Parts, accessories for motor vehicles and their en	44.2	65	35.3	38.4	35	30	15	12.5	9.6
351	Building and repair of ships & boats	37.7	40	3.9	40	28.2	28.2	15	12.5	8.7
352	Railway, tramway locomotives and rolling stock	34.9	40	25.1	27.5	28.6	26.1	15	12.5	10
353	Aircraft and spacecraft	36.3	42.6	1.9	11.4	8.4	5.1	3.6	3.8	3.2
359	Transport equipment n.e.c.	94.3	64.4	40	40	36.3	32	16.4	16.1	17.8
361	Furniture	100	65	40	40	35	30	15	12.5	10
369	Manufacturing n.e.c.	135.3	36	37.9	38.9	34.7	29.9	15	12.5	2.8

Source: RIS based on World Bank, TRAINS-WITS and Government of India, Annual Survey of Industries, various issues.

Note: Indian industry classification NIC-98 is similar to that of ISIC-Rev. 3.

Tariff liberalization, almost across the board in the industrial sector, has been associated with increased import flows, with a greater rise in imports than exports (Chart 2). Given a certain level of import intensity of exports and taking into account the fact that the availability of competitively-priced raw material, intermediate and capital goods imports in the international market would have made final products more competitive might have, to an extent, resulted in an increase in exports as well. This chart tracks trends in merchandise trade. It suggests a steady trend between 2000 and 2008 except for a marginal decline in 2009 possibly due to the global economic meltdown.

Chart 2.

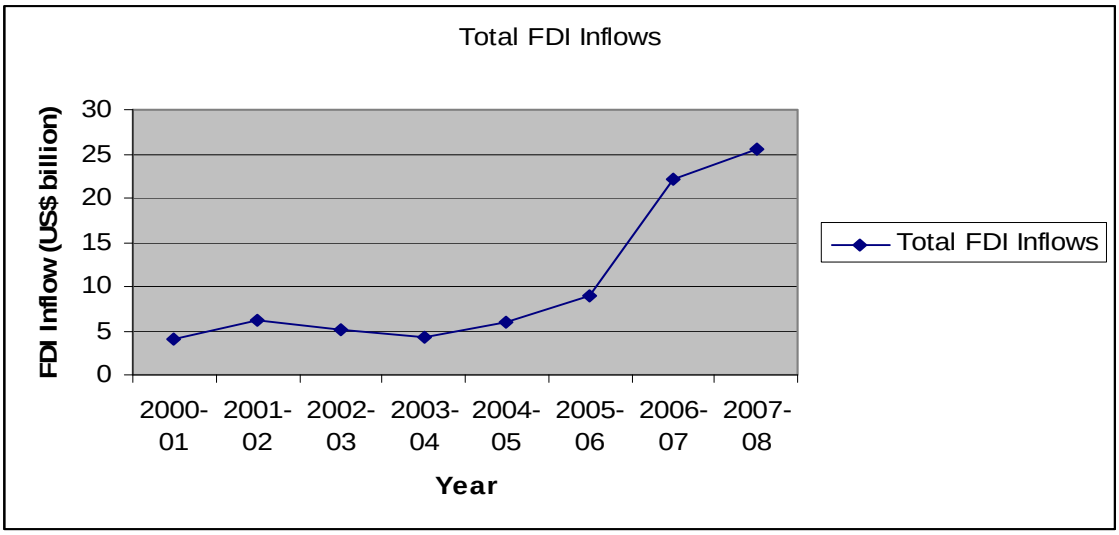


Source: Economic Survey 2008-2009.

As evident from Chart 3, FDI inflows have also increased in recent times, of which liberalization of the FDI policy regime has been one of the major determinants. The rise in FDI has been especially steep since 2005.

Given the above broad macro trends relating to trade and FDI policy liberalization and their possible impact on increased trade and FDI flows, it is important to examine their implications for productivity gains, if any, especially at the micro level – a dimension often omitted from the macro analysis, sometimes due to data limitations. In so doing, we first present a brief survey of literature relating to these linkages.

Chart 3.



3. Literature Survey

One of the broad definitions of productivity includes efficient use of resources, technological progress, and efficient management. Productivity is a crucial factor required for sustainable economic growth. Even without an increase in the use of inputs such as labor, capital, or intermediate inputs, production and thus the economy will grow if there are increases in productivity (Urata, 1994).

One of the channels through which trade is linked to productivity improvements is when a market finds a conglomeration of both efficient and inefficient firms, but only the efficient ones, empowered by total factor productivity, venture into export markets. However, Melitz (2003) argues that the reallocation of productive factors may generate aggregate productive gains and this may not ensure improvement in production efficiency at the individual firm level. Kawai (1994) explores the relationship between trade liberalization and productivity. He concludes that first of all, not only capital accumulation but also productivity changes are important factors in explaining the diversity of growth patterns among developing countries. Second, differences in trade policy are an important factor in explaining the disparities in growth rates of developing countries. Third, trade policy can work positively or negatively on productivity through several routes.

To examine how trade liberalization affects firm and industry-level productivity, as well as social welfare, Long *et al.* (2007) develop an oligopolistic model of international trade with heterogeneous firms and endogenous R&D. Four effects of trade liberalization on productivity are categorized: (i) a direct effect through changes in R&D investment; (ii) a scale effect due to changes in firm size; (iii) a selection effect due to inefficient firms leaving the market; and (iv)a market-share reallocation effect as efficient firms expand and inefficient firms reduce their output. Among the robust results that hold for any market structure is that trade liberalization (i) increases (decreases) aggregate R&D for low (high) trade costs; (ii) increases expected firm size if trade costs are high; and (iii) raises expected social welfare if trade costs are low.

Does trade liberalization increase aggregate productivity through reallocation toward more productive firms or through productivity increases at individual firms is a question asked by Gibson (2006). Using a trade model with heterogeneous firms, it argues that aggregate productivity gains come from firm-level productivity increases. The paper considers how trade liberalization affects technology adoption by individual firms. If technological improvements are not costly - for example, if they occur through dynamic spillover effects - then trade liberalization has the potential to generate large increases in productivity.

In a sector-specific study, Ruan and Gopinath (2008) test the hypothesis that an industry's average productivity increases with liberalized trade in the context of the processed food industry. They find that countries with faster productivity growth than the global average benefit from trade liberalization by acquiring a larger share of global markets and resources.

Pavcnik (2000) empirically investigates the effects of trade liberalization on plant productivity in the case of Chile and finds evidence of within-plant-productivity improvements that can be attributed to a liberalized trade policy, especially for the plants in the import-competing sector. In many cases, aggregate productivity improvements stem from the reshuffling of resources and output from less to more efficient producers. Das (2002) explores the relationship between trade liberalization and industrial productivity in developing countries, drawing upon a large number of studies in Latin America, Africa and Asia, finding a somewhat ambiguous nature of the trade liberalization-productivity linkage. Ferreira and Rossi (2003) show that trade

liberalization in Brazil has yielded positive effects for productivity growth. It has been shown in empirical studies that tariff liberalization alone has yielded a 6% hike in total-factor productivity.

Amiti and Konings (2005) estimate the effects of trade liberalization on plant productivity. They distinguish between productivity gains arising from lower tariffs on final goods relative to those on intermediate inputs. Lower output tariffs can produce productivity gains by inducing tougher import competition whereas cheaper imported inputs can raise productivity via learning, variety or quality effects. Using the Indonesian manufacturing census data from 1991 to 2001, which includes plant-level information on imported inputs, their results show that the largest gains arise from reducing input tariffs.

Thus, theory and much empirical evidence suggest that increased openness should lead to increases in productivity. These increases occur on both the export and import side and are driven by technology transfer and increases in competition, resulting in the exit of inefficient firms and sectors, the growth of firm-level productivity, and an increasing share of more productive firms in the market. However, the evidence in the case of Morocco by Augier *et al.* (2009) indicates that productivity growth over 1990-2002 for key manufacturing sectors has been minimal despite liberalization. They conclude that while the mechanisms driving trade and productivity linkages and 'creative destruction' are well documented, results reinforce the need to understand more fully the circumstances under which they may or may not arise.

Turning towards the Indian experience of productivity gains, the results are rather mixed and somewhat incomplete as far as firm-level insights are concerned.

Different studies have found a positive relationship between trade liberalization and total-factor productivity during the 1980s and 1990s. These include studies by Goldar (1986), Ahluwalia (1991), and Chand and Sen (2002) for the 1980s. Fujita (1994) concludes in the case of India that the liberalization policies improved the productivity of the manufacturing industries and extends the analysis further by concluding that the improvement in productivity led to the expansion of the export of manufactured products. In addition, he showed that the improvement in productivity involved mainly labor-intensive industries. Golder *et al.* (2004) show that domestically-owned firms

tended to catch up with foreign-owned firms in terms of technical efficiency after the reforms were put in place.

Using a panel of firm-level data, Topalova (2004) examines the effects of India's trade reforms in the early 1990s on firm productivity in the manufacturing sector, focusing on the interaction between policy shock and firm characteristics. The paper tries to establish a causal link between variations in inter-industry and inter-temporal tariffs and consistently estimated firm productivity. It finds that reductions in trade protectionism lead to both higher levels and growth of firm productivity. In contrast, there are studies that have found that trade liberalization in India has not resulted in productivity gains (Srivastava, 2001, Balakrishnan *et al.,* 2000, Driffield and Kambhampati, 2003 and Das, 2003).

There have been relatively a few studies focusing on linking TFP and other forms of productivity gains with FDI inflows. Among the group of advanced OECD members, FDI is found to be strongly associated with higher growth (in terms of output and productivity) in various sectors. However, among the group of developing economies, low-skilled and resource - intensive industries are the ones in which a positive link between FDI and growth is observed (Castejón and Woerz, 2005). However, Hale and Long (2007) surveyed the existing literature on the productivity spillovers of FDI presence in China and suggested that many of the empirical estimates of productivity spillover from FDI to domestic firms in China contain an upwards bias. Bijsterbosch and Kolasa (2009) conclude that foreign capital, in the form of FDI inflows, plays an important role in accounting for productivity growth in the Central and Eastern European regions. Veeramani and Goldar (2004) find a direct link between investment climate and TFP, i.e. Indian states perceived as having a better investment climate are the ones showing higher TFP levels, with only one state out of the 25 states sampled not fitting this trend.

The above-mentioned literature survey reveals that there is tremendous scope to further explore the issues of trade and investment liberalization in India and fill some of the important gaps in the existing literature, especially in the context of their implications for productivity improvements or a lack thereof t at the firm-level. Further, evidence is sparse in terms of the Indian experience at the firm-level relating to the determinants of TFP gains. This paper attempts at doing some value addition to the

existing knowledge on the subject inasmuch as, at the policy level, it tries to combine trade and investment liberalization. The period of analysis covered in the paper is also different as it covers a much more recent period of trade and investment liberalization i.e., 2000-2008. It also explores the issue of determinants of TFP gains at firm level in the context of a liberalized trade and FDI regime. At the conceptual level while the paper first attempts to extend the analytical framework to include both trade and investment liberalization and their implications for productivity, it further examines the evidence of productivity improvements from a fresh perspective. Some of the variables that have been included in the analysis as well as the estimations are also new. The estimation is also carried out in terms of several analytical categories as explained in the subsequent section.

4. Analytical Framework

Trade and FDI openness have the potential to infuse foreign competition into the domestic economy, especially in a country such as India which followed a protectionist policy in general and an import substitution policy in particular. The competitive pressures thus exerted have forced domestic producers to become more efficient and productive, manifested in increased availability of lower-priced and higher-quality products. These in turn help the economy to become more export-oriented as well. As mentioned earlier, inefficient firms are forced to exit, whereas newer firms enter the production arena in a liberalized trade and FDI policy environment.

Trade liberalization enables firms to use high-quality parts, components, and machinery at lower prices resulting in improved productivity. Liberalization of FDI contributes positively to the recipient countries, as multinational enterprises (MNEs) bring in not only technologies and management know-how, but also financial resources to be used for fixed investment. All of these resources, which are in short supply in the recipient countries, contribute to improvements in productivity which leads to an increase in production and exports, as it tends to enhance competitiveness. In the

second round, increased production enables firms to reap benefits from economies of scale. On the other hand, with increased foreign exchange earnings from increased exports, firms' capability to import high-quality components and equipment also rises, resulting in turn in higher productivity (Urata, 1994).

In addition, firm-level productivity is jointly determined by the trade, FDI and technology regimes, among other factors. The size of the firm could be another important determinant of firm-productivity. Larger firms usually have more options than smaller ones with regard to choices of technology, products and markets. Larger firms may also be better positioned to enter into joint ventures with MNEs (Siddharthan, 2003). Ownership by a foreign firm is yet another factor that could help firms to push productivity frontier favorably due to their well-known inherent advantages. Firms also import technology against royalty and lump sum payments to improve productivity and this could be another determinant of productivity. Import of capital goods is yet another dimension that is crucial for a firm's productivity. With import liberalization, including those of capital goods in the Indian case, this factor assumes greater importance for raising firms' productivity. One of the important constraints on growth and hence productivity is the demand constraint. Firms that are export-oriented are able to overcome this constraint.

Given the above, we have taken four scenarios for analysis of firm-productivity (captured by TFP) comprising trade and investment liberalization at the aggregate level including all firms; comparing foreign and domestic-owned firms; export-oriented and domestic-market-oriented firms; import-dependent and domestic-market-dependent firms, in order to bring out similarities and differences among various analytical categories. This was considered crucial since a comparison of this kind would also have important policy implications.

4.1. Firm-level Panel Data Estimation

4.1.1. Trade and Investment Liberalization: Aggregate

The firm-level panel data estimation for the determinants of TFP was carried out by capturing trade and FDI liberalization simultaneously with the help of the following specification:

$$TFP = \alpha + \beta_1 IMP + \beta_2 L + \beta_3 R\&D + \beta_4 Size + \beta_5 XI + \beta_6 Cap + \beta_7 R + \beta_8 Exp + \beta_9 COR + \beta_{10} MNE + \beta_{11} I\text{-}CG + \beta_{12} I\text{-}FG + \mu$$

where *TFP* is total factor productivity, *IMP* is import penetration ratio, *L* is labor, *R&D* is research and development, *Size* is the size of the firm, *XI* is export incentives, *Cap* is capacity building, *R* is royalty and technical fee payments made abroad, *Exp* is exports, *COR* is capital-output ratio, *MNE* is foreign ownership, *I-CG* is imports of capital goods and *I-FG* is imports of final goods.

4.1.2. Foreign-owned vs. Domestic Firms

The above will also be tested in terms of foreign and domestic ownership of firms, in an attempt to observe their behavioral differences. The hypothesis is that foreign-owned firms are more productive due their inherently stronger capacities on various fronts such as technological-edge, managerial expertise, skills, etc. This categorization also helps to isolate the effects of FDI policy liberalization. For our purposes, a firm having equity greater than 51 percent has been categorized as a foreign firm.

4.1.3. Export-oriented vs. Domestic-market-oriented Firms

The scenarios will be tested separately for export-oriented and domestic market – oriented firms with the hypothesis that export-oriented firms may be more productive due to the pressures of global competition. For the domestic-oriented firms, X-Sales Ratio will be taken as zero.

4.1.4. Import-dependent vs. Import-independent Firms

The effects of import tariff liberalization would best be captured by conducting analysis separately for import-dependent firms as compared with import-independent firms. The import dependent firms will be those with an import penetration ratio greater than 0.65.

5. Empirical Strategy

In an improvement over earlier studies on TFP, consistent estimates of the parameters of the industry-level production functions in constructing firm-level productivity measures, using the methodology of Levinsohn and Petrin (2003) were obtained in a similar way to Topalova (2004). The details are presented in the Technical Appendix to this paper.

5.1. Measurement of Variables:

While the dependent variable was used as the estimated TFP, the independent variables included: Size is measured as the number of employees of a company; L is labor measured as wage-rate, thus capturing quality of employment; IMP is the import penetration ratio measured as Import of raw material/(Output + Total Imports) I-CG is imports of capital goods as a ratio of sales; I-FG is imports of final goods as a ratio of sales; XI is export incentives; R&D – R&D ratio of sales, R is royalty and technical fee payments made abroad as a ratio of sales; Cap – Exp on capacity building (training) and welfare expenses as a ratio of sales; COR - Capital-output ratio, EXP is the exports to sales ratio and MNE is defined as the percentage share of the foreign collaborator's equity of the total equity. In a wholly owned subsidiary it will be 100 per cent. The variables were deflated by the wholesale price index.

5.2. Estimation of Equations

We have used both the GLS and the Newey-West estimation procedures. From the basic model of panel data estimation, where the intercept changes for individuals but is constant over time, the slope is constant for individuals and over time:

$$Y_{it} = \beta_{1i} + \sum_{k=2}^{K} \beta_k X_{kit} + e_{it}$$

To estimate the model we can make assumptions about the intercept: $\beta_{1i} = \beta_1 + \alpha_i$. This means that there is a constant portion in the intercept for all individuals (beta) and a portion that changes for each group (alpha). In a fixed effects model, α_i is a fixed

parameter→ X_{kit} and α_i are correlated. In a random effects model, α_i is a random variable→ X_{kit} and α_i are uncorrelated.

We use fixed and random-effects models when N is large and T is small. A fixed-effects model is better if we have data on all members of the population. If the population is too large and we have a sample, then a random-effects model is better and it saves us degrees of freedom because some of the parameters are random variables. This is precisely the case with our estimation since the sample is very large. We also estimate GLS specifications that account for various patterns of correlation between the residuals due to the need for varying weights across firms and over time. We also take into account the problem of non-stationary in a panel with the help of the Hadri test.

In the context of linear regression, well-known large sample tests, such as the Wald and LM tests, usually require estimating the asymptotic covariance matrix of the normalized OLS estimator. This estimation may be cumbersome when data have complex dynamic properties. Newey and West (1987) and Gallant (1987) suggested nonparametric kernel estimators that are consistent even when there are serial correlations and conditional heteroscedasticity of unknown forms.

Where firm_identifier is the variable which denotes each firm and time_identifier is the variable that identifies the time dimension, such as year. This specification allows for observations on the same firm in different years to be correlated (i.e. a firm effect). If we want to allow for observations on different firms but in the same year to be correlated we need to reverse the firm and time identifiers. We can specify any lag length up to t-1, where t is the number of years per firm. It was found that the Newey-West estimations were more robust than the GLS estimates as they tackled the problems of multicollinearity and heteroscedasticity.

5.3. Data

Data used for estimation is taken from the Prowess data base which covers approximately 11, 230 firms in the organized sector, including both public and private firms (covering around 70 percent of the economic activity in the organized industrial sector of India). A good summary of the dataset is provided by Topalova (2004). The

time period taken was 2000-2008 and the focus was limited to firms engaged in the manufacturing sector.

6. Results

The Newey-West results based on panel data estimation (as opposed to random effects chosen on the basis of Hausman test under GLS[2]) are summarized in Table 3 for the aggregate as well as different categories.

For the *aggregate*, in the first scenario wherein *trade and investment liberalization* have been taken together with the former captured by the imports and the latter in terms of foreign equity participation, it is found that royalties, import penetration ratio, and employment denoted by wage rate, are significantly positive, whereas R&D and size are significantly negative. While the significantly positive variables can be expected to determine TFP, according to the literature, a negative sign for R&D is puzzling. One explanation for this could be the fact that in India R&D was mostly undertaken by the public sector and private sector R&D is only now catching up. On the other hand, our results are in agreement with Amiti and Konings (2005) whereby imported inputs can raise productivity via learning, variety or quality effects. Size being negative has important implications too, indicating that there is ample scope for economic activity levels to be stepped up in India through scale expansion.

In the second scenario of *export-oriented firms*, import penetration ratio, royalties, and employment denoted by wage rate are positive and significant. Additionally, imports of capital goods are also significantly positive. This is important to note as it shows the positive productivity gains appear to be accruing due to import liberalization of both raw materials and capital goods, the latter possibly embodying technology and hence the effect. R&D remains significantly negative even in this scenario.

[2] The Hausman test tests the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator. If they are (insignificant P-value, Prob>chi2 larger than .05) then it is safe to use random effects. If a significant P-value is obtained, however, it is advisable to use fixed effects.

The third scenario of *import-dependent firms* has size, employment denoted by wage rate, and import of capital goods as significant. This is interesting as these suggest that import-dependent firms generally do reap productivity gains with greater numbers of workers employed at higher wage rates. This might possibly be due to the technological improvements in their operations assisted by capital goods import regulations which have been extensively liberalized in India. This is evident from the fact that capital goods imports turn out to be positive and significant. An important insight one gets is the significant and negative export to sales ratio, indicating that import-dependent firms have been oriented towards the Indian domestic market and a possible import-export link is yet to be established. In other words, it may be argued that import liberalization especially of capital goods has largely helped consumers in the domestic market.

The fourth scenario of *foreign ownership* has size, employment denoted by wage rate, export incentives, and import penetration ratio as positive and significant. These indicators suggest that foreign firms in India contribute to employment with higher wage rates; which, it should be noted, are responsive to the availability of export incentives and derive benefits from liberalized imports of raw materials as denoted by the import penetration ratio. On the other hand, foreign firms' productivity is negatively related to R&D, capital goods imports and exports. The significant and negative export to sales ratio perhaps indicates that until now, multinationals in India have largely catered to the Indian domestic market and have yet to turn India into a major export platform.

The sum and substance of the results at the aggregate level is that variables capturing import and FDI liberalization effects have contributed to TFP gains. The merit of the scenarios is that it is possible to isolate the effects of trade and investment liberalization on productivity gains in terms of export-orientation, import-dependence and foreign ownership.

Table 3. Determinants of TFP: Summary of Results

Scenario	Trade and Investment Liberalisation: Aggregate	X -Oriented	Import -dependent	Foreign-ownership
	-Size,	-R&D,	Size,	Size,
	-R&D,	R, L,	I-CG,	-R&D,
	R, L,	IMP	L,	-I-CG,
	IMP	I-CG	-X-Sales	XI, L,
				-X-Sales,
				IMP

Note: Only variables that have come out as significant either at 99% or 95% have been mentioned along with their signs.

7. Productivity in Perspective

Having explored the determinants of labor productivity in the contexts of trade and investment liberalization with the help of a detailed micro-data set at the firm level, our aim is to put labor productivity gains into perspective. This can be done on two levels: First, assessing the employment effects of labor productivity and secondly, by studying productivity gains in conjunction with work-hours.

7.1. Impact of Productivity on Employment

The linkage between trade liberalization and employment can be examined through the effects on labor productivity; however the complexity of such a relationship is not always properly understood. It has been argued and confirmed empirically by Das (2007) that trade liberalization to technology linkages may yield higher labor productivity gains. However, translating this into increased demand for labor is dependent upon the possibilities of scale expansion. This is because in the absence of scale expansion, labor productivity gains could result in a lower demand for labor per unit of output production, precisely because labor has become more productive. This provides another perspective of labor productivity gains in an era of trade liberalization.

7.2. Implications of Increased Work-hours on Productivity

Another factor which has gone unnoticed in the literature concerns intensification of labor through increase in work-shifts. It has been found in different sectors where labor productivity has increased at a very high rate that the length of shifts has reportedly increased too (Ghosh, 2009).

Both these dimensions should be kept in mind while envisaging any policy conclusions for productivity gains with the help of trade and investment liberalization policies.

8. Conclusions and Policy Recommendations

India has witnessed wide-ranging economic reforms in her policies governing international trade and FDI flows. Consequently, both trade and FDI flows have risen dramatically since 1991. In the era of reforms, productivity improvements have taken place and the findings of this paper support several other studies on the subject (e.g. Topalova, 2004). The paper further explores the important determinants of productivity improvements across different categories. As per the findings of the paper, some of the important determinants of productivity measured by TFP include imports of raw materials and capital goods, size of operation, quality of employment captured by wage rates and technology imports measured by royalty payments. It also emerges that R&D in organized manufacturing is still at a nascent stage possibly because of the inadequate emphasis this sphere has been given by the private sector. However, further exploration of this issue is required in order to draw any firm conclusions. Broadly, foreign firms have catered to the domestic market and as a result, India is yet to develop as an export platform. Finally, the import-export linkage is not shown to be significant in the sample of import-dependent firms.

While the issue of productivity gains needs to be kept in a balanced perspective, some of the broad conclusions of the paper are that the aggregate-level variables capturing import and FDI liberalization effects have contributed to TFP gains.

Taken together, these conclusions have important policy implications for tariff liberalization, especially for imports of raw materials and capital goods, FDI liberalization and technology imports along with the case for a sound wage rate regime, primarily determined by market forces. Size being negative at the aggregate level has important implication too, indicating that the there is ample scope for the level of economic activity to be stepped up in India by scale expansion with increased employment of skilled human resources. However, in the context of a global slowdown this may mean focusing on domestic sources of scale expansion alongside tapping **regional sources of demand impulses**. Given these findings, **India's** integration with other Asian countries, especially in the framework of the ASEAN+6 could mean enhanced and more structured cooperation agreements in the fields of, but not limited to:

1. Comprehensive Economic Partnership Regional Agreement that includes an FTA in trade in goods; Agreement on Trade in Services; and an Investment Cooperation Agreement (given India's growing purchasing power and market, comparative advantage in services trade and being an attractive investment destination)
2. Comprehensive Regional Agreement on R& D Cooperation (covering Microelectronics, IT, Space Technology, Agricultural technology, pharmaceuticals and advanced materials, some of which are developed in India)
3. Regional Agreement for Human resources Development (for skilling and re-skilling human resources at varying levels of skill-formation – given India's expertise in various dimensions)

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Annex Table 1.

Variable name	Aggregate	X - Oriented	Import - dependent	Foreign-owned
Size	.00165*	0.00003	.000476**	.000172*
	-0.00037	-0.00002	-0.00023	-0.000054
R&D	-.000319**	-.022312*	0.01334	-.2022*
	-0.00015	-0.00813	0.0071	-0.0506
XI	0.01016	-0.00502	0.3331	.02912**
	0.01406	-0.0116	0.40798	0.01328
R	.08593*	.04736*	-0.00499	-0.00817
	0.0203	0.01023	-0.02056	-0.0396
L	8.332*	65.997*	616.99*	66.97*
	2.2707	16.514	179.52	15.631
COR	0.00001	-0.04309	-0.00365	-.6915**
	0.00002	-0.0398	-0.00328	-0.322
Cap Building	0.0004	-0.0008	-152.64**	-147.09*
	0.0003	-0.001	-62.24	-30.755
X-Sales	0.0002	-1.2475*	4.603**	-2.078*
	0.0004	-0.3289	2.2796	-0.685
MNE	0.00204	0.00414	3.0364	
	0.00583	0.0058	3.5638	
IMP	.6974**	.6904*	7.058 (4.5298)	1.1718*
	0.3166	0.1938		0.448
N	3138	2322	616	778
F Stat	22.15*	18.70*	894.18*	27.50*

Newey West Stnd Error in parenthesis.
*Significant at 99%.
** Significant at 95%.

Technical Appendix

Total Factor Productivity Estimation

The objective is to estimate Total Factor Productivity at firm level for manufacturing firms. Much of this literature has been devoted to the estimation of firm productivity levels, obtained as residuals from an estimated production function based on the deflated sales proxy. Different researchers have calculated the productivity index using different production functions, for example, Cobb Douglas, Translog Production Function etc. In a further example, Solow (1957) used Tornquist's Index to measure productivity. Much of the literature is also devoted to using labor productivity (LP) as a measure of productivity. But a drawback of LP is that it does not fully consider firms' productivity and is not an accurate measure of productivity when many firms in the dataset are capital intensive.

Usually, a functional form for the production function is preferred, in the vast majority of cases Cobb-Douglas. An alternative to the Cobb-Douglas function would be a more flexible translog function, which is, in theory, more attractive because it is less restrictive. In practice, however, the restriction of the functional form as in Cobb-Douglas does not tend to make a significant numerical difference. On the other hand, the advantage of employing the Cobb Douglas function is that it is relatively easy to assess whether the estimated coefficients and the resulting returns to scale are broadly in line with common sense.

In a Cobb Douglas production function where labor, capital and material are taken to be inputs.

$$Yt = b_0 + b_l l_t + b_k k_t + b_m m_t + w_t + u_t$$

Where y_t the logarithm of firm's output, l_t and m_t are the logarithm of the freely variable inputs labor and the intermediate input, and k_t is the logarithm of state variable capital. The error has two components, the transmitted productivity component given by w_t and u_t an error term that is uncorrelated with input choices.

The following problem which can be described as one of simultaneity is usually encountered: at least a part of the TFP will be observed by the firm at a point in time early enough so as to allow it to change the factor input decision. If that is the case,

then the firm's profit maximization implies that the realization of the error term of the production function is expected to influence the choice of factor inputs. This means that the regressors and the error term are correlated, which makes OLS estimates biased. Awareness of this phenomenon is far from new: it was first pointed out by Marschak and Andrews (1944).

Fixed-effect estimation techniques

A relatively simple solution to this problem can be found if one has sufficient reason to believe that the part of TFP that influences firms' behavior, w_t is a plant-specific attribute, and invariant over time. In that case, including plant dummies in the regression, i.e. a fixed-effect panel regression, will solve the problem caused by w_t and deliver consistent estimates of the parameters. There are two drawbacks to this method: First, a substantial part of the information in the data is left unused. A fixed-effect estimator uses only the across-time variation, which tends to be much lower than the cross-sectional one. This means that the coefficients will be weakly identified. Second, the assumption that w_t is fixed over time may not always be correct, thus invalidating the entire procedure.

The Olley and Pakes approach

As an alternative to fixed-effect regressions, a consistent semi-parametric estimator was developed by Olley and Pakes (1996). This estimator solves the simultaneity problem by using the firm's investment decision to proxy unobserved productivity shocks.

A key issue in estimation of production function is the correlation between unobservable productivity shocks and input levels. Profit-maximizing firms respond to positive productivity shocks by expanding output, which requires additional inputs. In such cases, OLS estimates lead to a productivity bias. Olley and Pakes use investment as a proxy for these unobservable shocks.

The Levinsohn and Petrin approach

The method suggested by Olley and Pakes (1996) is able to generate consistent estimates for the production function estimates, provided a number of conditions are

met. One of these conditions is that there must be a strictly monotonous relationship between the proxy (investment) and output. This means that any observation with zero investment must be dropped from the data in order for the correction to be valid. Depending on the data, this may imply a considerable drop in the number of observations because it will often be the case that not all firms will make a strictly positive annual investment. Levinsohn and Petrin (2003) offer an estimation technique that is very close in spirit to the Olley and Pakes approach. Instead of investment, however, they suggest the use of intermediate inputs rather than investment as a proxy. Typically, many datasets will contain significantly less zero-observations in materials than in firm-level investment. Levinsohn Petrin Procedure uses intermediate input as a proxy for these unobservable shocks.

Data

Data has been taken from the Prowess database by CMIE. It is an unbalanced database from the year 2000-2008 comprising 948 firms. Data has been drawn on the following variables: Sales, Inventory, and Number of employees, Capital employed, Raw material used and Power and Fuel used. Real values of all of these variables have been obtained by deflating the nominal figures by the wholesale price index (Base 1993-94=100). Gross Output is calculated adding Sales and Inventory data. Number of employees is taken as a measure of labor input. Capital employed is taken as a measure of capital input. Raw material is taken as a measure of raw material input. Power and Fuels is taken as a proxy for Energy input.

Methodology

Because complete data for all the firms for all variables were not available many companies must be dropped from the data. The total observations number 3138. After calculating the gross values of all the variables, they are deflated using the WPI index and then converted to logarithmic terms.

We have used the Levinsohn Petrin Procedure in our model in preference to other methods available for various reasons. The most commonly used methods in firm level panel data as mentioned above have drawbacks. The Levinsohn Petrin procedure overcomes these problems. It takes into account the time variation as well as cross-

sectional variation. It also deals with the problem encountered in the Olley and Pakes methodology in which firms for whom investment is zero, overtime TFP cannot be calculated. Rather, it takes intermediate input as the proxy variable. The Estimation in the Levinsohn Petrin Procedure takes place in two stages using OLS. First,

$$Yt = b_l l_t + f(k_t, m_t) + u_t \qquad \text{_____(1)}$$

is estimated where

$$f(k_t, m_t) = b_0 + b_k k_t + b_m m_t + w_t \qquad \text{_____(2)}$$

This completes the first stage of estimation from which an estimate of b_l and an estimate of f_t (up to the intercept) are estimated.

The second stage identifies the coefficient of b_k. Here function f_t is estimated using OLS. Now w_t is estimated by

$$w_t = f_t - b_k k_t \qquad \text{_____(3)}$$

Using these values, TFP is estimated from regression

$$w_t = a_0 + a_1 w_{t-1} + a_3 w^2_{t-1} + a_3 w^3_{t-1} + e_t \qquad \text{_____(4)}$$

Generally, energy is taken as the proxy variable and in our model we have also used the variable “power and fuel” as the proxy variable.