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by

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Abstract

This paper examines the relationship between the exposure to foreign trade and productivity growth for a sample of Indian manufacturing firms. By testing a catching up model of productivity growth, it sheds some light on the nature of the relationship between the exposure to foreign competition and productivity growth. It finds a non linear relationship between firms' export share and productivity gains. Productivity growth declines with the share of exports on total sales, up to a threshold ranging between 40 and 50 per cent and it increases thereafter. This result appears to be dominated by the behaviour of firms in traditional sectors like textile and clothing. In more technology intensive sectors, like pharmaceuticals, productivity gains also arise for smaller export shares. One likely explanation of this finding is that being successful in the export market for exporters of traditional products also requires investments in technological upgrading. These investments are less likely to be viable for marginal exporters. In fact, firms with a larger than 50 percent share of exports are also found to be more capital intensive and to use newer machinery than non exporters or marginal exporters. In contrast we find that human capital is not significantly different for different categories of firms.

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1. Introduction

This paper examines the relationship between exporting and productivity gains for a sample of manufacturing firms in India. India provides an interesting case to this purpose. Since 1991, this country has moved from being a highly regulated and closed economy into liberalising its trade, with a substantial reduction of import tariffs and the abolition of export controls and subsidies. Exports of manufacturing products have been growing since, mostly in labour intensive sectors like textiles and clothing, but also in some high tech sectors like drugs and pharmaceutical products.

However, contrary to what has generally been found for most developing countries (Epifani, 2002, Tybout, 2001), for India there is conflicting evidence on trade induced productivity gains. Srinivasan, reports of much restructuring following liberalisation, essentially induced by a reduction of price distortions. This more efficient reallocation of resources, coupled with a moderate growth in real product wages induced a growth in output of 9.1 percent a year and of employment of 2.9 percent a year in the Nineties (Srinivasan, 2001). Yet, it is not clear that these changes trickled down into gains in efficiency and productivity. Although there is evidence of aggregate gains in productivity (IMF, 2000), firm level studies have contradictory results. Parameswarn, 2000 finds that technical efficiency declined after liberalisation for a sample of 640 firms analysed between 1989 and 1998. Similarly, Balakrishnan et al., 2000 find a 1 percent fall in the annual rate of productivity growth after liberalisation. In contrast, Krishan and Mitra, 1998, find evidence of an increasing growth rate of productivity between 1991 and 1993 and Chnad and Sen, 2002 find a positive impact on productivity of trad eliberalisation measures adopted in the Eighties.

This paper provides some new light on the nature of the relationship between trade and productivity gains for Indian manufacturing firms. Contrary to these earlier works, it does not compare post-reform to pre-reform performances. Instead, it compares the performance of firms with different degrees of exposure to foreign competition, and particularly it explicitly analyses the role of exporting. Firms are indeed classified according to the export intensity of their sales and to their degree of exposure to foreign competition in the domestic market. By estimating a catching up model of TFP growth, it finds that the export share has a non linear relationship with efficiency: TFP growth declines with export, up to a threshold export share which is on average around 50 percent.

It then rises, with further increases in the export share. This result, although robust to sector specific and size controls, is partly driven by firms' behaviour in the traditional sectors and it is probably related to the extremely segmented nature of domestic vs. foreign markets. Firms that do not specialise in their market of destination get trapped in the middle and under-perform. The paper also finds that the export share has a positive effect on the convergence rate, with elasticities ranging between 0.145 to 0.337, depending on the specification of the model.

Earlier works have dealt extensively with the difficulty of disentangling the causal relationship between export and performance (Clerides, Lach and Tybout, 1998, Bernard and Jensen, 1999, Aw, Chung and Roberts, 2000). Exporting firms become more productive by exporting or, rather, they are able to enter foreign markets because they were already more productive ex-ante. Unfortunately, the data set used in this work is essentially a cross section, thereby limiting the ability of deriving any causal inference. Our results should therefore be considered as purely descriptive.

However, the data set we use, allows us to open the 'black box' of the relationship between export and performance. Even though exporting firms are ex ante more productive, there are various channels through which exporting may reinforce these productivity gains: because they operate in a more competitive environment and they must use their inputs efficiently; because they have access to knowledge and better technology; because their total market is larger and they can exploit their economies of scale.

Although once more we cannot do any inference on the nature of the causal relationship, it is anyway useful to understand what are the characteristics of successful exporters compared to other firms. Specifically it is useful to analyse the technologies that firms use. For the case of India, competing hypothesis apply. On the one hand, firms faced with international competition have to operate in 'technological windows' of a higher level than firms operating in protected markets, (Sutton, 2000). Indeed, in the case of India Parameswarn, 2000 and Hasan, 2002 find that more advanced imported technologies and inputs are an important source of efficiency for exporting firms. This argument is also in line with the Feenstra–Hanson, 1996's result that export oriented firms are generally more human and technical capital intensive than firms catering the domestic market. On the other hand, particularly in large and formerly protected markets with abundant cheap labour, exporters could efficiently specialise in labour intensive products. Indeed, according to Srinivasan, 2001, in Indian

manufacturing, the elasticity of employment to output increased considerably since liberalisation (Srinivasan, 2001).

We find mixed evidence on this issue. By estimating the export premium for the technology/skill intensity of a set of inputs, we find that firms with a large share of exports use newer machines, more capital intensive technologies and more imported inputs, but we find no difference in the relative skill intensity of the workforce. In other words, large exporters are more 'technology' intensive, but not more human capital intensive. This result can provide an explanation of the 'trap in the middle finding': firms, to be successful exporters must invest in new technologies, but they cannot do it if they are just marginal exporters.

This paper is structured as follows. In the next section we describe the data set and derive measures of total factor productivity. In section 3 we derive the catching up model and in section 4 we report its main results. In section five we discuss likely explanations for the pattern observed, specifically the sectoral composition of the sample and the technological features of different types of firms. Section six concludes.

2. Data and Total Factor Productivity

The data set used in this paper is based on firm-level survey information collected by the Development Research Group-Macro Team of the World Bank jointly with the Confederation of Indian Industries (CII) and the Indian Council for Research on International Foreign Relations. The data collected refer to 895 firms operating in the manufacturing sector.[1] For each firm information is plant-based (that is, only one plant belonging to each firm is considered, even if the survey covers multi-plant firms) and it typically covers outputs and inputs, production costs, labour and human resources, trade intensity, investment, technology and R&D expenditures. Nearly all the data on establishments' characteristics and performance refer to the year 1999, although in some instances (e.g. sales, input purchases and labour) firms were asked to provide information also for 1998 and 1997.

[1] These manufacturing firms belong to 5 sectors: Garments, Textiles, Drugs and Pharmaceutical, Electronic Consumer Goods and Electric White Goods

2.1 Characteristics of the Data Set

Firms in our sample can be grouped into three categories depending on their level of exposure to international competition: exporters, non exporters facing foreign competition in the domestic market and non exporters, not facing foreign competition in the domestic market. Exporting firms constitute about 50% of our sample and they are mostly concentrated in Garments, Textiles and Drugs & Pharmaceutical sectors (see Table 1).

Table 1: Number of Firms Operating in Each Sector, by Export Status

	Garments	**Textiles**	**Drugs & Pharmaceutic.**	**Electric Consumer Goods**	**Electrical White Goods**
Total Sample [a] (676)	207	189	179	49	52
Exporters [b] (383)	139	118	89	14	24
Non Exporters but Subject to Import Competition [c] (116)	24	28	39	14	11

Notes:
a) The firms considered are those for which data on export and sales are available.
b) *Exporters* are those firms with a positive ratio of total exports to total sales.
c) *Import Competition* indicates a firm declaring to have foreign competitors in the domestic market.

Focussing on the characteristics of exporting, firms from Table 2 it is possible to see how their average export share is quite high (more than 60%) and their size (measured by employment) is also significantly bigger than that of the rest of the firms in the sample.

Table 2: Mean of Selected Variables (Standard Deviation)

	Export Share in 1999	Employment In 1999 (no. of employees)	Employment in 1999, by sector (n. of employees)				
			Garment	Textiles	Drugs & Pharmac.	Electric Consumer Goods	Electrical White Goods
Total Sample	0,35 (0,43)	420.72 (2189.34)	101,93 (181,50)	773,25 (3719,09)	404,09 (1072,57)	302,93 (953,69)	370,49 (1754,10)
Exporters [a)]	0,62 (0,39)	723.97 (3285.47)	148,56 (209,46)	1431,47 (5398,13)	649,43 (1613,58)	361,08 (583,88)	845,54 (3033,10)
Non Exporters but subject to Import Competition [b)]	-	185.38 (457.06)	18,43 (14,11)	169,14 (342,14)	330,42 (676,13)	129,06 (292,18)	160,38 (360,35)

Notes: see Table 1.

It is useful to analyse the distribution of the export share for the total sample and by sector, as displayed in Figure 1 and Figure 2. If we look at the total sample first, the distribution appears to be bi-modal, indicating that firms tend to export either most of their production or only a little portion of it, thus suggesting that there is a sort of specialisation towards either foreign or domestic markets.

Figure 1: Kernel Density of the Variable "Export Share in 1999"

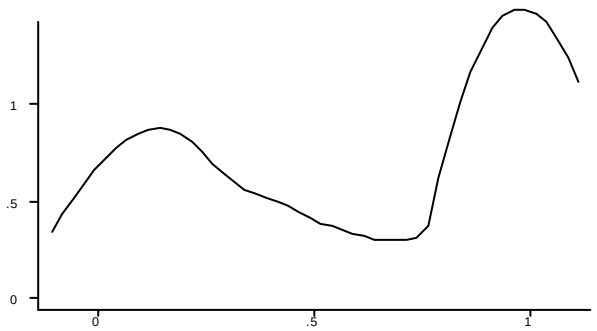
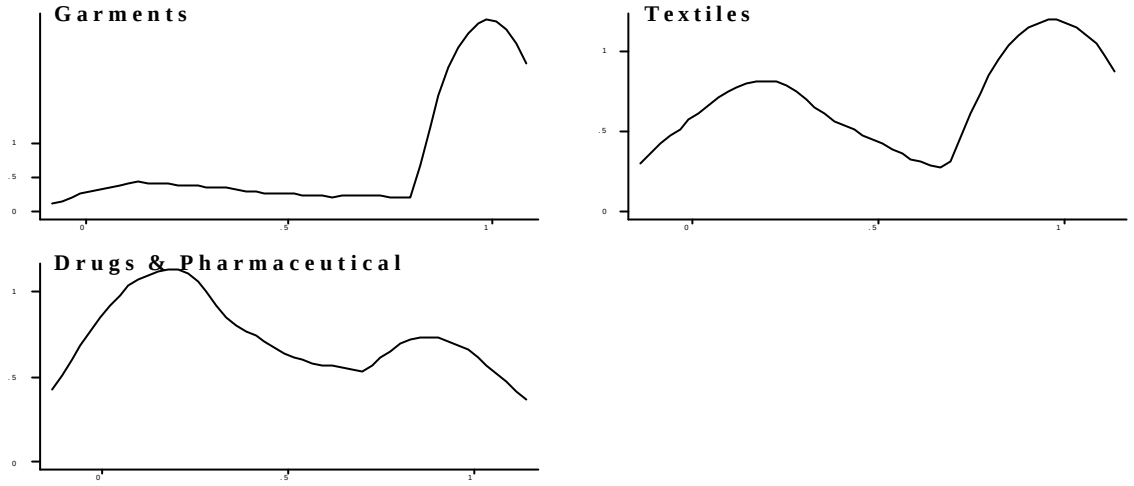


Figure 2. Kernel Density of the Variable "Export Share in 1999", by Sector



Some additional information come from the distribution for the three sectors reported in figure 2. We focus on these sectors, as they are the only one for which we have enough observations to warrant sector specific analysis. The textiles sector mimics the overall sample: firms either export very little or one hundred per cent of their sales. Most of Garment firms, instead are one hundred percent exporters. Finally, Drugs and Pharmaceutical firms when they are exporters, only export a small share of their production. At first sight, export intensity appears to be negatively related to the technological complexity of the industry. These sectoral features and the effects on firm performance will be explored with more details in the analysis of productivity growth that follows.

2.2 Total Factor Productivity

We are interested in the relationship between export activity on a firm's economic performance. There are various measures of performance, the typical one being labour productivity. The limitations of this variable for the purpose at hand are well-known; nevertheless it is frequently employed because of limited data availability. A remarkable feature of our data set is that it includes information on fixed as well as human capital, thus allowing the computation of the most suited measure of a firm's economic performance, its total factor productivity (TFP) (sometimes also referred to as

multifactor productivity). This measure is typically considered as a growth rate and consists of the wedge between the average growth of outputs and the corresponding average growth of inputs. Along with capital deepening and changes in the labour force, TFP is a key source of economic growth (see Scarpetta, Bassanini, Pilat, and Schreyer, 2000).

To calculate a firm's TFP it is necessary to have suitable measures of output and factor inputs as well as measures of partial output elasticities of inputs. However, the latter are not directly observable and a standard choice in the literature is to assume them to be equal to income shares, given that the labour share can be easily computed from national as well as company accounts. This corresponds to making a few assumptions, most importantly that the product and input markets are perfectly competitive. Furthermore, it is often assumed that elasticities are constant across the whole period of observation (implicitly making the assumption of unit elasticity of substitution between factors) and equal to the observed average.[2] An alternative for the measurement of partial output elasticity is to estimate them econometrically from production functions, the most popular choice being the Cobb-Douglas. This avoids assuming a relationship between partial output elasticities and income shares. However direct estimation raises a number of econometric issues that put into question the robustness of the results.[3] It turns out that in the case of the Cobb-Douglas the output elasticities of inputs coincide with the factor shares. Moreover, under the assumption of constant returns to scale, only one input share needs be computed. Starting with a standard production function for firm *i* in sector *j* at time *t* we have:

$$(1) \qquad VA_{ijt} = Y_{ijt} - M_{ijt} = \tilde{F}(L_{ijt}, K_{ijt}, T_{ijt})$$

where *VA* is value added, *Y* is output (sales), *L* is labour services, *K* is capital services, and *M* is intermediate inputs. Variable *T* denotes the state of technology. Because our data do not include

[2] Alternatively, it can be recognised that elasticities can vary significantly over time for reasons different from measurement errors. In this case use is made, as a discrete time approximation, of the simple average of factor shares for each couple of subsequent years. This is not an issue oin the present context given that only a single couple of adjacent years is available.

[3] For a comprehensive treatment of productivity measurement and of the issues and problems involved see Schreyer and Pilat (2001).

enough observations on intermediate inputs and no information on value added, we assume that materials usage is proportional to output so that $M_{ijt} = l Y_{ijt}$. Substituting into (1) yields a production function for gross output:

$$(2) \qquad Y_{ijt} = \frac{1}{1-l}\tilde{F}(L_{ijt}, K_{ijt}, T_{ijt}) = \frac{1}{1-l}A_{ijt}F(L_{ijt}, K_{ijt})$$

where *A* denotes the state of technology under the assumption of Hicks-neutral technical progress. Taking *F*(.) to be Cobb-Douglas, under constant returns to scale we get that the rate of growth of Total Factor Productivity is given by:

$$(3) \qquad \Delta \ln TFP_{ijt} = \Delta \ln A_{ijt} = \Delta \ln Y_{ijt} - a\Delta \ln L_{ijt} - (1-a)\Delta \ln K_{ijt}$$

where $a = LC/S$, LC being the firm's labour costs.

Measurement issues related to inputs and outputs are also important. Concerning the labour input, what counts for productivity analysis is not the number of workers but the number of effectively worked hours. Moreover, both labour and capital inputs tend to increase their quality over time and the use of quality adjusted indices makes the interpretation of resulting TFP estimates more straightforward. In the case of labour, the labour composition in terms of skills or educational attainment is relevant. In the case of capital, quantities and prices should be adjusted for changes in quality, for example through hedonic price methods in cases where both quality and volumes are changing rapidly. Measures of both levels and growth rates of TFP can also be sensitive to aggregation methods. This may be the case particularly when quantities and user costs of some disaggregated inputs evolve along different patterns from those of the corresponding aggregate input, for example, when quality improvements in some particular capital inputs (such as ICT) are faster than those in others.

Like the vast majority of firm-level data, we cannot adjust the capital stock for quality changes. However, a nice feature of our data set is that we can disaggregate the labour input by skill and

distinguish white and blue collar workers. For these two categories we have both employment levels and separate compensation data. In addition, we have information on hours worked by each labour category. We can therefore improve upon the definition of TFP growth in (3) and write:

$$(4) \qquad \Delta \ln TFP_{ijt} = \Delta \ln Y_{ijt} - a^{w} \Delta \ln L^{w}_{ijt} - a^{b} \Delta \ln L^{b}_{ijt} - (1 - a^{w} - a^{b}) \Delta \ln K_{ijt}$$

where *w* and *b* denote white (skilled) and blue (unskilled) collar worker hours.[4] Finally, it ought to be clear from the cross-section nature of our data set that t = 1999, i.e. it is a single point in time. We will compute the rate of change of a firm's TFP between 1998 and 1999 both for the entire sample and for individual sectors.

The inspection of productivity statistics presented in Table 3 shows how the subset of non-exporting firms and in particular of those subject to foreign competition in the domestic market have the highest rate of growth of total factor productivity. On the other hand, exporting firms have the highest *level* of TFP in 1998.

Table 3: Total Factor Productivity, Statistics by Openness Status

		Observations	Mean	Standard Deviation
Total sample	ΔTFP	421	0.056661	0.415063
	TFP98	421	0.990608	1.422745
Exporters	ΔTFP	193	0.055575	0.40977
	TFP98	193	1.088823	1.509764
Not Exporters	ΔTFP	139	0.070614	0.380042
	TFP98	139	0.692092	1.305866
Of which:				
Subject to Import	ΔTFP	63	0.093282	0.337161
Competition	TFP98	63	0.938589	1.306932
Protected	ΔTFP	74	0.053767	0.417302
	TFP98	74	0.449578	1.273139

[4] Capital is the net book value of machinery, equipment, land buildings and leasehold improvement. A more detailed description of all the variables used in the paper can be found in the Appendix.

A further investigation of sectoral productivity of firms in Table 4 shows that Drugs and Pharmaceutical is the sector with firms having on average the highest rate of growth of TFP, while Garments has the highest initial average level in 1998. In addition the higher rates of productivity growth are found in small and medium size firms, but the highest initial level characterises large ones.

Table 4: Total Factor Productivity, Statistics by Sector and by Firm Size

	Variable	Observations	Mean	Standard Deviation
By Sector				
Drugs & Pharmaceutical	ΔTFP	126	0.096678	0.336384
	TFP98	126	1.115735	1.294719
Electrical White Goods	ΔTFP	47	0.069123	0.38869
	TFP98	47	1.072912	1.479357
Electric Consumer Goods	ΔTFP	23	-0.01105	0.422945
	TFP98	23	0.47194	1.440634
Garments	ΔTFP	96	0.041308	0.522997
	TFP98	96	1.219757	1.514702
Textiles	ΔTFP	129	0.036531	0.404591
	TFP98	129	0.760349	1.414153
By Firm Size				
Less than 50 Workers	ΔTFP	199	0.064084	0.409191
	TFP98	199	0.961082	1.462313
Between 50 and 200 Workers	ΔTFP	114	0.068785	0.44681
	TFP98	114	0.935543	1.4056
More than 200 Workers	ΔTFP	108	0.030185	0.393182
	TFP98	108	1.103135	1.372724

All the features emerging from the descriptive analysis of the data seem to suggest the existence of some sort of convergence process regarding the productivity among the firms in our sample. In fact

the highest rates of growth tend to be associated to those groups that have lower initial level and vice versa those groups of firms with higher productivity in 1998 have smaller rates of growth. The following section will explore this with inference analysis.

3. Exporting and the Catching Up Model

What drives the growth rate of total factor productivity of Indian firms? Following recent developments in empirical growth analysis at both the aggregate and firm level (Scarpetta, Hemmings, Tressel, and Woo, 2002; Scarpetta and Tressel, 2002), we consider a multifactor productivity equation derived from a production function in which technological progress is a function of country/industry/firm specific factors, as well as a catch-up term that measures the distance from the technological frontier in each industry. This framework allows testing for the direct effect of exporting activity and status on estimated productivity, as well as for the indirect influences of these factors *via* the process of technology transfer.

Specifically, the conventional endogenous growth model in which TFP is generally expressed as a function of knowledge and a residual set of influences (Aghion and Howitt, 1992) is extended by assuming that, within each industry, the level of firm efficiency depends on country and industry characteristics as well as technological and organisational transfer from the technology-leader country (L). This implies that TFP growth in the frontier country leads to faster MFP growth in follower countries like India by widening the production possibility set. It is assumes that, in each industry, a country's distance from the technological leader measures the scope for technological transfer. The leader country is defined as the country with the highest level of TFP. Hence, multi-factor productivity of the Indian firm in a given industry j can be modelled as follows:[5]

[5] Griffith, Redding, and Van Reenen (2000) have, amongst others, used a similar approach. A number of other studies have looked at productivity convergence using industry/country data (see e.g. Dollar and Wolff, 1994; Bernard and Jones, 1996a, 1996b; Harrigan, 1997).

(5) $$\Delta \ln TFP_{ijt} = a_{ijt} \ln\left(\frac{TFP_{Ljt}}{TFP_{Ljt-1}}\right) - b_{ijt} \ln\left(\frac{TFP_{ijt-1}}{TFP_{Ljt-1}}\right) + w_{ijt}$$

where a_{ijt} captures the instantaneous effect of changes in growth of the leader country, b_{ijt} indicates the pace of technological transfer, $\ln\left(TFP_{ijt-1} / TFP_{Ljt-1}\right)$ is the technology gap between country *i* and the technology leader and w_{ijt} includes all other influences on TFP growth.

From the discussion in the previous sections, we assume that certain indicators of firm characteristics, in particular those related to the export activity, affect the rate of growth of TFP of the Indian firm (5) both directly and through the rate of technology transfer in non-frontier countries. Supposing linearity this amounts to write the following:

(6) $$b_{ijt} = b_1 + b_2 Z_{ijt}$$

(7) $$w_{ijt} = g_1 + g_2 Z_{ijt} + f_i + g_j + d_t + e_{ijt}$$

where Z_{ijt} is a vector of firm and sectoral indicators, which include the firm's export share, f_i, g_j, and d_t are unobserved firm, industry, and time effects. Finally, e_{ijt} is a serially uncorrelated error term.

In the present case only a cross section of individual firm data for 1999 is available. Thus, there is no time dimension in our model. Writing (5) adapted to the present case, taking into account (6) and (7), amounts to the following:

(8) $$\begin{aligned}\Delta \ln TFP_{i,1999} = {} & a(\ln TFP_{L,1999} - \ln TFP_{L,1998}) - (b_1 + b_2 Z_{i,1999})(\ln TFP_{i,1998} \\ & - \ln TFP_{L,1998}) + g_1 + g_2 Z_{ijt} + f_i + g_j + d_t + e_{ijt}\end{aligned}$$

Clearly, TFP levels for the leader country are single numbers: they are therefore absorbed into the intercept term. Therefore:

(9) $$\Delta \ln TFP_{i,1999} = q_0 - q_1 \ln TFP_{i,1998} - q_2 \ln TFP_{i,1998} Z_{i,1999} + q_3 Z_{i,1999} + f_i + g_j + e_{ijt}$$

From equation (9) it is clear that the coefficient of the TFP gap term, q, measures the speed of (conditional) convergence to the long-run steady state level of TFP. Moreover, in the presence of technological convergence, the technological distance between each country/industry and the leader converges to a constant value. This implies that the vector of covariates as well as the firm and industry fixed effects translate only into differences in TFP levels, and not into permanent differences in growth rates of TFP.

4. Empirical Results of the Catching up model

The catch-up model (9) was estimated using standard OLS with heteroskedasticity robust standard errors.[6] The results are presented in Table 5 for total manufacturing and in Table 7 for individual sectors. If we concentrate on the results for total manufacturing, we see that the fit of the regressions is quite good.

The technology-gap term, i.e. the coefficient in front of lnTFP, is negative as expected and is significant at conventional levels in all specifications, suggesting that, within each industry, Indian firms that are further behind the frontier experience higher rates of productivity growth.

However, the coefficient does not express the overall rate of convergence of TFP as the catch-up term is interacted with a number of variables. These summarise the export activities of the firm – export share, foreign ownership, export experience, and import competition – and its technological and human capital characteristics – plant age, age of machinery, white labour share, average wage.[7] All these variables enter the regressions both directly and interacted with lagged TFP. Generally speaking the regressors enter significantly (the main exception being the export experience variables in the first column and partly in the third column of Table 5) and display the expected sign.

[6] A few other papers have considered the impact of trade liberalisation or of import of technology on the productivity and efficiency of Indian firms: see Chand and Sen (2002), Hasan (2002), Parameswarn (2002).

[7] These variable are more precisely defined in Appendix 1.

Table 5: Convergence Model - Total Manufacturing

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	(1)	(2)	(3)	(4)
LnTFP $_{1998}$	-0,253**	-0,909***	-0,909***	-0,210**
	(2,15)	(3,75)	(4,89)	(1,98)
Export Share $_{1999}$	-2,836**	-2,070***	-2,483**	-1,764***
	(2,24)	(2,92)	(2,32)	(2,98)
Export Share square $_{1999}$	3,110**	2,314***	2,877***	2,007***
	(2,38)	(2,94)	(2,61)	(2,83)
LnTFP $_{1998}$*Export Share $_{1999}$	1,267*	2,401***	1,592***	1,907***
	(1,87)	(5,73)	(2,87)	(5,29)
LnTFP $_{1998}$*Export Share Square $_{1999}$	-1,604**	-2,458***	-1,794***	-1,925***
	(2,09)	(5,16)	(3,01)	(4,00)
Foreign Ownership $_{1999}$				0,425
				(1,54)
LnTFP $_{1998}$*Foreign Ownership $_{1999}$				-0,296**
				(2,53)
Plant Age $_{1999}$		-0,183*	-0,037	
		(1,68)	(0,31)	
LnTFP $_{1998}$*Plant Age $_{1999}$		0,273***	0,211***	
		(4,68)	(3,69)	
Age of Machinery $_{1999}$				-0,023**
				(2,03)
LnTFP $_{1998}$*Age of Machinery $_{1999}$				0,030***
				(5,29)
Export Experience $_{1999}$	0,088		-0,080	
	(0,33)		(0,36)	
Export Experience Square $_{1999}$	-0,045		0,013	
	(0,59)		(0,19)	
LnTFP $_{1998}$*Export Experience $_{1999}$	0,187		0,336***	
	(1,30)		(3,08)	
LnTFP $_{1998}$*Export Experience Square	-0,008		-0,083**	
	(0,21)		(2,36)	
No. Observations	314	353	312	332
R-square	0,79	0,78	0,82	0,81

Notes:

a) Dependent variable: growth rate of TFP between 1998 and 1999. For the precise definition of the regressors see Appendix 1.

b) Absolute value of t-statistics in parentheses. Standard errors are White-corrected in presence of heteroskedasticity.

c) Single, double, and triple asterisks denote statistical significant at 0,1, 0,05, and 0,01 confidence levels respectively.

d) All estimation runs have been done controlling for sector and firm size. Size is defined by means of three dummies taking on the value of 1 if the total number of employees is, respectively, less than 50, greater than 50 and smaller than 200, and larger than 200.

The most interesting finding of the table concerns the role of export share. First of all, the results indicate a significant direct effect on productivity but also, if the interaction of the export share with the technology gap is also considered, a strong indirect effect. This suggests a distinct effect on productivity the further the firm is from the technology frontier. As a second aspect, it turns out that the export share affects TFP growth and convergence in a non-linear way. Indeed, when not interacted with the technology gap, the linear terms enter negatively the regression, whereas the square terms enter positively. The opposite occurs when export shares are interacted with total factor productivity. As Table 6 shows, with the exception of the regression in the fourth column of the previous table, the rates of technological convergence display the expected sign. In addition, it emerges that an increase in the export share has a positive impact on the catch-up rate. The last two columns of the table show that the impact of the export share on the rate of change of total factor productivity of Indian firms is non-linear. In particular, the rate of growth of TFP decreases as the export share increases from very small values, but after a critical threshold it starts picking up and gets stronger as the export share tends to 100%. In other words, the relationship between export share and TFP growth exhibits a U-shape with a turning point around a 50% share value[8]. In the following two sections we will try to provide a rationale for this result

Table 6: Analysis of Convergence and the Role of the Export Share

Equation Number (Table 5)	Covergence Rate	Impact of Export Share on Convergence Rate	Critical Level of Export Share	Curvature of the Export Share Impact
(1)	-0,006	0,145	0,520	3,044
(2)	-0,370	0,681	1,285	-0,239
(3)	-0,572	0,337	0,412	2,202
(4)	0,221	0,560	-	-

Notes:

a) The convergence rate is computed by taking the derivative of the dependent variable (TFP growth) in expression (9) with respect to the log of lagged TFP.

b) The impact of the export share on the rate of convergence is computed as the derivative of that rate with respect to the export share (i.e. the cross derivative of TFP growth relative to lagged TFP level and to the export share).

c) This critical level is obtained by setting equal to zero the expression for the rate of convergence and solving for the export share.

d) The curvature is the second derivative of TFP growth with respect to the export share.

[8] Indeed, we carried out a sequence of tests that the mean export share be equal to certain values over the whole range 0-100% and we were unable to reject the hypothesis that it lies in the 40%-50% range.

e) All computed values are averaged across firms.

We have also estimated the effect on productivity of being exposed to foreign competition in the domestic market, but this variable is never significant. Note also that plant age has a negative effect on productivity, i.e younger plants grow faster, and that export experience has no direct effects on productivity.

5. What is behind the U shaped relationship between efficiency and exports?

The obvious intuitive explanation for the U shape result is that the domestic and the export market are very different, and that only firms specialising in either one or the other can achieve good levels of efficiency. Consider also, that the Indian domestic market is large and therefore competitive, particularly for traditional products like textile and clothing. However, this hypothesis is not testable. Rather, there are other sets of factors that may be observed and can have an effect on productivity: the sectoral composition of the sample and the technologies and types of labour used by the exporting firms.

5.1. Sectors

The results for the whole sample could be driven by sector specific patterns, notwithstanding all estimations control for sector specific fixed effects. Remember from Figure 2 that the distribution of export shares differ substantially by sector, with simple sectors like garments exporting most of their output and more complex sectors exporting a small share. Could it be that Indian Pharmaceutical firms do not yet fully master the technologies required for exports? In table 7 we report sector specific estimations, for the 3 sectors for which a sufficient number of observations is available. The fit of the regressions is good for textiles, whereas the R-square is much lower in the case of Garments and Drugs & Pharmaceutical, although it should be borne in mind that we are estimating a single cross section.[9]

[9] These are the sectors for which there were enough data for meaningful regression analysis (see the sample size of the various industries in Table 1).

Table 7: Convergence Model – Individual Sectors

	Garments	Garments	Textiles	Drugs & Pharma
	(1)	(2)	(1)	(1)
LnTFP $_{1998}$	-0.237	-0.193	-0,465***	0.025
	(1,50)	(1,13)	(3,66)	(0,26)
Export Share $_{1999}$	-1,957***	-1,974***	-1,878**	1,279*
	(2,88)	(2,73)	(2,19)	(1,88)
Export Share Square $_{1999}$	1,875***	1,899***	1,443*	-1,780**
	(2,92)	(2,76)	(1,75)	(2,22)
LnTFP $_{1998}$*Export Share $_{1999}$	1,908***	1,933***	2,174***	-0,702**
	(3,27)	(3,17)	(3,21)	(2,03)
LnTFP $_{1998}$*Export Share Square $_{1999}$	-1,709***	-1,764***	-1,569	0,945**
	(3,13)	(1,92)	(2,45)	(2,36)
Import Competition $_{1999}$	-0,431***	-0,421***		
	(2,82)	(2,72)		
LnTFP $_{1998}$*Import Competition $_{1999}$	0,163**	0,149*		
	(2,21)	(1,88)		
Age of Machinery $_{1999}$			0,001	
			(0,08)	
LnTFP $_{1998}$*Age of Machinery $_{1999}$			0,014*	
			(1,84)	
Foreign Ownership $_{1999}$		0,233*		-0,036
		(1,81)		(0,20)
LnTFP $_{1998}$*Foreign Ownership $_{1999}$		Dropped		0,070
				(0,92)
White Share $_{1999}$				0,088
				(0,89)
LnTFP $_{1998}$*White Share $_{1999}$				-0,044
				(0,95)
Average Wage $_{1999}$				
LnTFP $_{1998}$*Average Wage $_{1999}$				
Number of Observations	79	78	95	70
R-square	0.25	0.24	0,95	0.20

Notes: see Table 5.

The statistical significance remains strong as far as the export share variable is concerned, though the lagged TFP levels display only weak significance and the other indicators enter the regressions insignificantly in general. The low R-square limits the usefulness of carrying out an exercise on export

share similar to the one performed above. Yet it is interesting that the sign on the export variables is reverted for Drugs and chemicals: productivity initially increases with the export share and then starts declining after a threshold. Exporters with a small share in the drug sector are indeed efficient. Thus, results for the whole sample are not due to a composition effect, with inefficient marginal exporters clustered in the relatively high tech Pharmaceutical sector and efficient large exporters in the easy labour intensive sectors. Rather, the average trend appears to be essentially driven by firms' behaviour in the two labour intensive sectors.

5.2 *Exports, technology and human capital*

The different performance of exporting firms can be explained by their use of different factors of production than non exporting ones. This is partly captured by our TFP measures, particularly human capital, but some specific features elapse from our estimations. To make things simple, in what follows we test whether there is an export premium for a set of variables measuring human capital, i.e. the composition and the average skill of the labour force; technology, i.e. the average age of the machines used; the exposure to foreign inputs, i.e. the share of inputs imported. The general export premium estimated can be represented as follows:

$$(10) \qquad S_{ijt} = g_1 + g_2 Z_{ijt} + f_i + g_j + d_t + e_{ijt}$$

where S_{ijt} is our input variable for firm i, in sector j at time t, Z is a dummy representing the status of the firm, concerning its exposure to foreign competition and f, g and d are firm, sector and time dummies respectively.

Table 8: Export Premium on Technology and Skill Variables

	Average age of machinery	%Raw mat. produced abroad (in 1999)	%Raw mat. produced abroad (in 1998)	Capital Intensity In 1999 (lnK_L)	Wh_Blue Ratio	Share of workers in R&D	Average years of education of workers
exporters vs non exporters	-1.837***	8.379***	8.065***	-0.128**	0,059	-0.001	-0.167
	(3.36)	(4.94)	(4.94)	(2,27)	(1,61)	(0.05)	(0.46)
							\
Among not exporters: subject to import competition vs protected	-0.452	0.948	0.702	0.090	0,082**	-0.082***	0.192
	(0.61)	(0.63)	(0.45)	(0.94)	(2,00)	(2.81)	(0.36)
Expsh greater than 50% vs. expsh smaller than 50%	-1.990***	6.197***	5.048**	-0.012	0,034	-0.039*	-0.277
	(3.61)	(2.75)	(2.35)	(0.22)	(0,86)	(1.80)	(0.71)
Among exporters: expsh greater than 50% vs. expsh smaller than 50%	-1.627**	3.271	2.229	0.135***	0,015	-0.076*	-0.060
	(2.42)	(1.07)	(0.74)	(2,61)	(0,30)	(1.72)	(0.10)

Note: All rhe regression for the export premium have been done with constant, sector and size dummies as controls
Absolute value of t-statistics in parentheses.
Standard errors are White-corrected in presence of heteroskedasticity

We imagine 4 dichotomous groups of firms: i) exporters vs. non exporters; ii) exporters with and export share of more than 50 percent and the rest of the firms; iii) among non exporters, firms exposed to foreign competition and those which are not; iv) among exporters, those with an export share larger than 50 percent and those with a smaller export share. Compare exporters and non exporters first. The two variables significantly and widely differing between these two groups of firms are the age of machinery and the share of imported inputs: exporting firms use younger machines and a larger share of imported inputs. Also, we find that exporting firms are more labour intensive (the capital labour ratio is lower) and that there is no difference for what concerns any measure of human capital. If we just focus on exporting firms and split them between those exporting more or less than 50 percent of their share, we find still a significant difference: those that export more than 50 percent use younger machines. Note also that the capital labour ratio is significantly larger for firms with a large export share. Thus, whereas exporters are more labour intensive than non exporters, among them firms exporting a large share of output are more capital intensive. These firms also import a larger share of inputs, though the difference in this latter variable between the two groups is not significant. Also in this case there are no significant differences for what concerns human capital.

As for non exporting firms, there we find some significant differences in the share of white collars, but no differences in the technology variables.

Summing up, the fastest growing firms in the sample, those with a larger export share than 50 percent, are also those renewing faster their capital and, among exporters, using more capital intensive technologies and more imported inputs. Surprisingly, this intensity in the use of more advanced technologies, does not reflect in the quality of the labour force, in that human capital does not appear to differ from non or marginal exporters.

7. Conclusions

This paper examines the relationship between the exposure to foreign trade and productivity growth for a sample of Indian manufacturing firms. The available evidence on trade induced productivity gains is at best mixed for India. Different studies find that technical efficiency and growth decline in the Nineties, following a wide process of trade liberalisation. By testing a catching up model of productivity growth, this paper sheds some lights on the nature of the relationship between the exposure to foreign competition and productivity

growth. It finds a non linear relationship between firms' export share and productivity gains. Productivity growth declines with the share of exports on total sales, up to a threshold ranging between 40 and 50 per cent and it increases thereafter. This result appears to be dominated by the behaviour of firms in traditional sectors like textile and clothing. In more technology intensive sectors, like pharmaceuticals, productivity gains also arise for smaller export shares.

One likely explanation of this finding is that being successful in the export market for exporters of traditional products also requires investments in technological upgrading. These investments could be not viable for marginal exporters. In fact, firms with a larger than 50 percent share of exports are also found to be more capital intensive and to use newer machinery than non exporters or marginal exporters. In contrast we find that human capital is not significantly different for different categories of firms. Given the likely complementarity between technology and human capital this result is not easily explained.

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Appendices

Appendix A.1: Variable Definition

Export Share	Value of exports of the three main products relative to value of total sales in the year 1999.
Foreign Ownership	*D*ummy variable taking on the value 1 if more than 10% of the firm's equity capital is owned by foreigners.
Plant Age	Difference between 1999 and the year of foundation of the firm.
Age of Machinery	Average of the age of plant machinery and equipment of the firm.
Export Experience	Difference between 1999 and the first year that the firm has started exporting at least one of the main products.
White Share (blue share)	Share of white (blue) collar workers on the total number of employees in 1999.
Average Wage	Average compensation per employee.
Capital Intensity	Net book value of machinery, equipment, land buildings and leasehold improvement per employee.

Appendix A.2: Additional Descriptive Statistics

Table A.2.1: Statistics on skill intensity and technology used by export status (export share)

	Not Exportes and not subject to foreign competition			Exporters with exp share between 0 and 50%			Exporters with exp share larger than 50%		
Skill Intensity	Obs	Mean	Std.	Obs	Mean	Std.	Obs	Mean	Std.
White Share	98	0.23	0.22	130	0.18	0.15	169	0.18	0.17
Blue Share	100	0.66	0.25	128	0.73	0.23	171	0.70	0.27
Share of workers in R&D	34	0.06	0.07	61	0.11	0.18	58	0.07	0.07
Average number of years of education of white collar workers	64	16.60	2.89	83	16.26	3.18	117	16.26	2.70
Average number of years of education of blue collar workers	42	11.03	2.49	41	11.19	2.83	69	10.70	2.27
Average number of years of education of workers	35	12.01	2.24	35	12.47	2.95	62	11.95	2.38
Capital Intensity	106	2.54	0.87	136	2.03	0.47	176	2.18	0.65
Average wage of blue collar workers	118	28.23	11.09	161	29.31	14.68	222	26.34	14.49
Average wage of whire collar workers	118	98.23	47.89	161	98.02	50.02	222	90.79	57.04
Inputs and Technology	**Obs**	**Mean**	**Std.**	**Obs**	**Mean**	**Std.**	**Obs**	**Mean**	**Std.**
% Machinery <5 years old	113	30.48	37.15	153	32.03	32.90	212	37.59	37.83
% Machinery 5-10 years old	113	37.91	35.35	153	38.04	32.01	212	41.97	36.76
% Machinery 10-20 years old	113	25.36	32.36	153	20.23	27.71	212	15.92	26.85
% Machinery >20 years old	113	6.23	19.64	153	9.67	21.96	212	4.50	15.87
Value imported raw materials in 1999 (000 Rs) – first product	95	2257.04	13581.19	81	22546.7	122146.4	134	315700.9	3535080
Value imported raw materials in 1999 (000 Rs) – second product	69	522.82	129,52	55	5855.5	16545.42	70	2848.73	9865.70
Value imported raw materials in 1999 (000 Rs) – third product	20	949,8	4247.63	33	11148.65	30177.8	41	3342.62	11750.96
% Raw materials Produced domestically by other divis. of comp. in	112	3.40	16.94	139	11.23	29.11	205	9.49	26.59

1999									
% Raw materials Produced domestically by other companies in 1999	112	92.05	22.84	139	74.63	35.53	205	78.63	36.15
% Raw materials Produced abroad (imported) in 1999	112	4.54	16.94	139	14.13.	24.48	205	11.86	27.25
% Raw materials Produced domestically by other divis. of comp. in 1998	111	3.42	17.01	138	10..91	29.03	202	9.01	25.64
% Raw materials Produced domestically by other companies in 1998	111	92.15	22.54	138	74.14	35.80	202	79.88	35.17
Raw materials Produced abroad (imported) in 1998	111	4.42	15.62	138	14.93	25.60	202	11.09	26.21
Royalty or license fee to domestic companies in 1999	20	3307.81	12610.82	38	5948.70	30344.85	43	416.65	1705.71
Royalty or license fee to foreign owned companies in 1999	12	855.16	2962.38	25	1406.32	3731..35	38	340.55	1795.29
Royalty or license fee to domestic companies in 1998	19	1867.23	6123.15	38	4967.51	22483.46	43	286.96	1034.51
Royalty or license fee to foreign owned companies in 1998	13	887.46	2233.62	26	1988.69	4592.12	37	312.05	1662.73

TableA.2.2 Statistics on skill intensity and technology used by export status (% of exports), and by sector

		Not Exportes and not subject to foreign competition			**Exporters with exp share between 0 and 50%**			**Exporters with exp share larger than 50%**	
	Skill Intensity	Obs	Mean	Std.	Obs	Mean	Std.	Obs	Mean	Std.
Garments	**White Share**	21	0.29	0.35	25	0.17	0.11	86	0.20	0.20
	Blue Share	21	0.75	0.23	25	0.79	0.15	86	0.69	0.28
	Share of workers in R&D	9	0.03	0.02	11	0.12	0.22	31	0.09	0.09
	Average number of years of education of white collar workers	14	16.43	1.68	17	15.93	4.09	56	16.23	2.32
	Average number of years of education of blue collar workers	8	11.06	3.12	9	11.18	3.49	30	10.71	1.96
	Average number of years of education of workers	8	12.14	2.93	8	12.05	3.47	26	11.93	1.92
	Capital Intensity	20	2.77	0.92	20	2.17	0.43	82	2.10	0.73
	Average wage of blue collar workers	23	31.15	15.70	28	28.06	10.05	111	25.21	12.64

	Average wage of whire collar workers	23	97.67	51.64	28	91.60	38.28	111	81.13	37.16
		Obs	Mean	Std.	Obs	Mean	Std.	Obs	Mean	Std.
	White Share	18	0.26	0.18	41	0.17	0.14	48	0.18	0.13
	Blue Share	18	0.64	0.25	40	0.73	0.22	50	0.69	0.27
	Share of workers in R&D	5	0.05	0.03	18	0.16	0.23	19	0.06	0.05
	Average number of years of education of white collar workers	11	17.33	4.71	22	16.41	4.10	38	16.07	2.50
	Average number of years of education of blue collar workers	6	12.00	2.89	9	12.02	2.77	21	9.88	2.22
	Average number of years of education of workers	5	14.08	2.52	7	13.93	2.52	20	11.22	2.49
Textile	**Capital Intensity**	21	2.37	0.65	45	1.94	0.47	59	2.25	0.60
	Average wage of blue collar workers	23	26.94	2.72	50	31.32	16.71	67	27.83	16.40
	Average wage of whire collar workers	23	87.14	10.41	50	102.25	47.06	67	96.26	57.38
		Obs	Mean	Std.	Obs	Mean	Std.	Obs	Mean	Std.
	White Share	32	0.24	0.21	42	0.17	0.14	28	0.15	0.12
	Blue Share	32	0.63	0.30	42	0.74	0.23	28	0.80	0.22
	Share of workers in R&D	10	0.11	0.11	22	0.09	0.16	6	0.05	0.07
	Average number of years of education of white collar workers	17	16.63	2.89	33	16.50	2.51	18	17.65	3.04
	Average number of years of education of blue collar workers	15	10.03	1.75	14	10.73	3.17	16	11.75	2.69
	Average number of years of education of workers	11	11.11	1.83	13	11.93	3.37	14	12.96	2.92
Drugs & Pharma	**Capital Intensity**	36	2.31	0.80	45	2.06	0.53	25	2.24	0.52
	Average wage of blue collar workers	38	28.09	14.84	55	28.95	14.80	34	24.69	14.51
	Average wage of whire collar workers	38	104.35	54.52	55	95.44	51.47	34	106.29	89.82
	Inputs and Technology									
		Obs	Mean	Std.	Obs	Mean	Std.	Obs	Mean	Std.
	% Machinery <5 years old	23	42.83	45.92	25	32.60	37.20	109	41.95	39.60
	% Machinery 5-10 years old	23	30.65	36.10	25	44.40	35.83	109	42.39	38.32
	% Machinery 10-20 years old	23	17.39	29.54	25	22.60	32.34	109	11.90	24.54
Garmen	**% Machinery >20 years old**	23	9.13	28.07	25	0.40	2.00	109	3.76	15.17

	Value imported raw materials in 1999 (000 Rs) – first product	20	0.00	0.00	15	3986.67	15165.84	65	4246.80	16368.92
	Value imported raw materials in 1999 (000 Rs) – second product	15	0.00	0.00	9	3.33	10.00	35	375.71	1469.66
	Value imported raw materials in 1999 (000 Rs) – third product	2	0.00	0.00	2	53.50	75.66	24	303.27	1390.27
	% Raw materials Produced domestically by other divis. of comp. in 1999	23	4.35	20.85	21	0.00	0.00	103	8.01	25.94
	% Raw materials Produced domestically by other companies in 1999	23	95.65	20.85	21	97.14	6.44	103	83.85	32.60
	% Raw materials Produced abroad (imported) in 1999	23	0.00	0.00	21	2.86	6.44	103	8.14	22.27
	% Raw materials Produced domestically by other divis. of comp. in 1998	23	4.35	20.85	21	0.00	0.00	100	7.25	24.61
	% Raw materials Produced domestically by other companies in 1998	23	95.65	20.85	21	97.14	6.44	100	85.39	31.12
	Raw materials Produced abroad (imported) in 1998	23	0.00	0.00	21	2.86	6.44	100	7.36	21.07
	Royalty or license fee to domestic companies in 1999	2	5.00	7.07	4	3.00	6.00	18	0.59	1.65
	Royalty or license fee to foreign owned companies in 1999	1	0.00	.	3	0.00	0.00	19	105.37	458.81
	Royalty or license fee to domestic companies in 1998	2	5.00	7.07	4	3.00	6.00	18	1.70	3.88
	Royalty or license fee to foreign owned companies in 1998	1	0.00	.	3	0.00	0.00	18	83.44	353.53
		Obs	Mean	Std.	Obs	Mean	Std.	Obs	Mean	Std.
	% Machinery <5 years old	21	17.14	28.92	47	23.28	27.63	60	30.88	38.34
	% Machinery 5-10 years old	21	36.67	31.40	47	31.38	31.53	60	37.12	35.20
	% Machinery 10-20 years old	21	34.76	34.66	47	24.68	28.18	60	25.08	32.58
	% Machinery >20 years old	21	11.43	25.89	47	20.66	31.45	60	6.92	18.67
Textile	**Value imported raw materials in 1999 (000 Rs) – first product**	19	45.21	197.07	24	49033.29	222944.90	41	1009913.0	6390424.00
	Value imported raw materials in 1999 (000 Rs) – second product	10	637.20	2015.00	14	1561.71	2854.17	20	3403.10	7749.38
	Value imported raw materials in 1999 (000 Rs) – third product	1	0.00	.	8	14683.62	40713.22	6	2671.03	6053.87

	% Raw materials Produced domestically by other divis. of comp. in 1999	22	4.55	21.32	42	10.00	28.46	60	9.27	25.53
	% Raw materials Produced domestically by other companies in 1999	22	95.36	21.30	42	81.69	33.98	60	75.07	39.73
	% Raw materials Produced abroad (imported) in 1999	22	0.09	0.43	42	8.31	20.31	60	15.67	33.50
	% Raw materials Produced domestically by other divis. of comp. in 1998	22	4.55	21.32	42	10.24	29.01	61	8.64	23.97
	% Raw materials Produced domestically by other companies in 1998	22	95.23	21.30	42	82.17	33.42	61	77.26	38.11
	Raw materials Produced abroad (imported) in 1998	22	0.23	1.07	42	7.59	18.89	61	14.10	31.62
	Royalty or license fee to domestic companies in 1999	2	0.00	0.00	10	18714.30	59081.46	9	337.38	998.55
	Royalty or license fee to foreign owned companies in 1999	2	0.00	0.00	7	0.00	0.00	8	1367.38	3867.52
	Royalty or license fee to domestic companies in 1998	2	0.00	0.00	10	13760.00	43352.51	9	334.72	999.49
	Royalty or license fee to foreign owned companies in 1998	2	0.00	0.00	7	0.00	0.00	8	1255.50	3551.09
		Obs	Mean	Std.	Obs	Mean	Std.	Obs	Mean	Std.
	% Machinery <5 years old	37	24.14	30.88	54	39.29	34.98	33	42.09	31.73
	% Machinery 5-10 years old	37	38.76	34.32	54	37.08	27.00	33	39.88	30.41
	% Machinery 10-20 years old	37	30.76	32.75	54	17.52	23.97	33	16.52	21.81
	% Machinery >20 years old	37	6.35	16.94	54	6.11	15.38	33	1.52	6.06
	Value imported raw materials in 1999 (000 Rs) – !st product	30	2175.25	9797.70	23	16915.17	21631.61	23	26950.06	58677.30
	Value imported raw materials in 1999 (000 Rs) – 2nd product	25	1188.12	4999.78	20	6548.38	13107.97	13	8841.50	20014.70
	Value imported raw materials in 1999 (000 Rs) – 3rd product	10	1899.60	6007.06	16	12189.85	31087.40	10	11304.31	22187.15
Drugs & Pharma	**% Raw materials Produced domestically by other divis. of comp. in 1999**	34	0.91	4.38	51	13.46	30.27	32	15.17	31.18
	% Raw materials Produced domestically by other companies in 1999	34	87.50	26.14	51	65.24	38.25	32	65.91	38.73
	% Raw materials Produced abroad (imported) in 1999	34	11.59	25.69	51	21.31	29.16	32	18.92	30.76
	% Raw materials Produced domestically by other divis. of comp. in 1998	33	0.91	4.41	52	11.94	29.25	32	15.31	31.32

% Raw materials Produced domestically by other companies in 1998	33	87.52	25.47	52	63.97	38.39	32	66.09	38.87
Raw materials Produced abroad (imported) in 1998	33	11.58	25.17	52	24.09	31.29	32	18.59	30.69
Royalty or license fee to domestic companies in 1999	11	6005.85	16863.21	15	1450.59	5165.25	15	991.28	2750.61
Royalty or license fee to foreign owned companies in 1999	5	0.00	0.00	9	1968.89	5541.54	10	0.00	0.00
Royalty or license fee to domestic companies in 1998	10	3542.65	8270.52	15	2146.51	6466.63	15	619.77	1552.14
Royalty or license fee to foreign owned companies in 1998	6	739.17	1810.58	10	1813.75	4968.25	10	0.00	0.00

Table A.2.3. Descriptive Statistics on variables by destination of exports

	North America and Western Europe			Russia and East Europe			Asia			Other		
Variable	**Obs**	**Mean**	**Std. Dev**	**Obs**	**Mean**	**Std. Dev**	**Obs**	**Mean**	**Std. Dev**	**Obs**	**Mean**	**Std. Dev**
TFP_Growth	121	0.05	0.43	20	-0.01	0.40	89	0.08	0.35	73	0.04	0.33
TFP99	121	1.17	1.42	20	1.45	1.73	89	0.98	1.50	73	1.00	1.45
TFP98	121	1.12	1.46	20	1.46	1.85	89	0.90	1.58	73	0.96	1.48
% of Imported Raw Material	216	14.03	27.96	33	15.85	28.41	130	13.84	27.53	124	14.89	28.31
Age of Machinery	229	7.86	5.23	37	9.61	6.40	142	8.39	5.97	130	8.08	4.92