DO NOT GET TRAPPED INTO CROSSING:
INDIAN FIRMS AND FOREIGN MARKETS

by

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November 2003

JEL Classification: F1, O1, O3.
Keywords: India, productivity, exports, firm level performance.

This paper has been prepared as part of a World Bank-Centro Studi Luca d’Agliano research project on ‘Trade Technology Diffusion and Performance in Indian Manufacturing’. We are grateful to Philip English, David Dollar and Giuseppe Iarossi for support and making the data set available. Francesco Daveri, Paolo Epifani and participants to a World Bank seminar in January 2003 provided useful comments.
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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 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 38 and 48 percent and it increases thereafter. One likely explanation of this finding is that specialising in exports 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 found to be more capital intensive and to use newer machinery than marginal exporters. In contrast, we find that human capital is not significantly different for different categories of firms.

1. Introduction

This paper examines the relationship between export intensity 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.

Contrary to what has generally been found for most developing countries (Epifani, 2002, Tybout, 2001), there is conflicting evidence on trade induced productivity gains for India. Srinivasan (2001) reports of much restructuring following liberalisation, essentially induced by a reduction of price distortions. This 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. Yet, although there is evidence that these changes trickled down into aggregate gains in efficiency and productivity (IMF, 2000), firm level studies have contradictory results. Parameswarn (2000) finds that technical efficiency

Recent works provide good arguments supporting this ambiguous outcome. The first one rests on firms’ heterogeneity. Melitz (2003) shows that if firms are heterogeneous, increased competition following liberalisation compresses mark ups and pushes the least competitive firms out of the market. As for exporting, this entices higher fixed and operating costs and likely productivity gains in the longer term. Thus, exporters do not always and necessarily recover the higher costs of their exporting activities and could end up being less productive than non exporters. A now wide empirical literature provides robust evidence on the trade off between the cost of exporting and the likely productivity gains arising from foreign activities (Clerides, Lach and Tybout, 1998, Bernard and Jensen, 1999, Aw, Chung and Roberts, 2000). This trade off could generate a non-linear relationship between export intensity and productivity. Melitz (2003) shows that negative net profits from exporting are more likely the smaller the share of output exported. If this is the case, it is important to analyse firms focussing on their export share, rather than on their dichotomous exporting status. Out of our knowledge, Parameswarn, (2000) is the only available study on India relating productivity to the export share at the firm level. Indeed, he finds that the level of technical efficiency is higher the larger the export share, but he does not address non linearities.

A second reason is related to the overall institutional environment in which firms operate. Dollar, Iarossi and Mengistae (2002) show that the investment climate, a synthetic index encompassing infrastructure and regulatory regimes, is far from homogeneous across Indian States. They find that firms are more productive in states with a good investment climate. The overall regulatory and infrastructural environment also affects the relationship between trade liberalisation and performance. Aghion, Burgess, Redding and Zilibotti, 2003 find that firms react more swiftly to changes in incentives following trade liberalisation in 1991 the more liberal is the state’s labour market regime.
This paper deals with the first issue and controls for the second one. It estimates a catching up model of TFP growth, for a sample of manufacturing firms and it carefully explores the relationship between export share and growth. Consistently with the predictions of Melitz (2003), 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 40 percent. It then rises, with further increases in the export share.

Our results are robust to the inclusion of variables measuring the investment climate of the state where the firm is based, although we do not explicitly explore the effect of the investment climate on the growth/export relationship.

This work uses data from a firm-level survey 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 sample is a cross section. The data base contains detailed information on characteristics of successful exporters compared to those of other firms. Particularly interesting is the analysis of the inputs used in production. Competing hypothesis apply. On the one hand, firms faced with international competition have to operate within higher ‘technological windows’ than firms operating in protected markets, (Sutton, 2000). Indeed, Parameswarn (2000) and Hasan (2002) find that more advanced imported technologies and inputs are an important source of efficiency for exporting Indian 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 products intensive in the use of labour at the lower end of the skill range. 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. Still, successful exporters must invest in new technologies and thus face fixed costs of entry and
higher operative costs. These higher costs get not compensated in firms which export a relatively limited share of their output.

We should highlight a few caveats to our results. First, our analysis is a cross section, thus nothing can be inferred on the causal link between the export share and productivity growth. Thus, our results have a mere descriptive value. Moreover, they can be affected by events specific to the year considered. Our data refer to 1998-99, the year after the Asian crisis that has likely affected the export performance of Indian firms. Second, although we control for state specific features (the investment climate) and sector specific features, our results could be partly driven by institutional factors, like labour market regulations, that we are unable to fully control for.

This paper is structured as follows. In the next section we describe the data set and provide descriptive statistics on the sample and performance measures. In section 3 we derive the catching up model and in section 4 we test it. In section five we discuss likely explanations for the pattern observed, specifically 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.

¹These manufacturing firms belong to 5 sectors: Garments, Textiles, Drugs and Pharmaceutical, Electronic Consumer Goods and Electric White Goods
Table 1 reports the number of firms in our sample distributed by exporting status and sector. Exporting firms constitute about 50% of our sample and they are mostly concentrated in Garments, Textiles and Drugs & Pharmaceutical sectors.

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

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<tbody>
<tr>
<td><strong>Total Sample</strong></td>
<td>207</td>
<td>189</td>
<td>179</td>
<td>49</td>
<td>52</td>
</tr>
<tr>
<td>(676)</td>
<td></td>
<td></td>
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<tr>
<td><strong>Exporters</strong></td>
<td>139</td>
<td>118</td>
<td>89</td>
<td>14</td>
<td>24</td>
</tr>
<tr>
<td>(383)</td>
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</table>

Notes:
- The firms considered are those for which data on export and sales are available.
- Exporters are those firms with a positive ratio of total exports to total sales.

Table 2 reports average size of exporters and non exporters, as measured by the number of employees. Exporters are larger than the average firm in the sample. This pattern is consistent across sectors.

Table 2: Mean of Selected Variables (Standard Deviation)

<table>
<thead>
<tr>
<th></th>
<th>Employment in 1999 (no. of employees)</th>
<th>Employment in 1999, by sector (no. of employees)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Sample</strong></td>
<td>420.72 (2189.34)</td>
<td>101,93 (181,50)</td>
</tr>
<tr>
<td><strong>Exporters</strong></td>
<td>723.97 (3285.47)</td>
<td>148,56 (209,46)</td>
</tr>
</tbody>
</table>

Notes: see Table 1.

2.1 Export Share

As argued in the introduction we are interested in the export intensity. The average export share is 35% for the whole sample and more than 60% for exporters. In Figure 1 we report the distribution of firms according to their export share, as proxied by Kernel density.
estimates. 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.

It is useful to examine how this distribution reflects sectoral patterns. These are reported in Figure 2 for textile, garments and pharmaceutical, those for which we have enough observations to warrant sector specific analysis. Textile mimics the overall sample: firms either export very little or one hundred per cent of their sales. Most of Garment exporters are fully specialised. Finally, few Drugs and Pharmaceutical firms are one hundred percent exporters and many export a small share of their production. These patterns could partly be due to institutional factors. For example production of some garment and textile products has been restricted to small firms till 1997. Since then, larger firms (investments of at least $750,000) are allowed to enter if they export at least 50 or 75 percent of their output (depending on their size). Still, the sample includes many small scale firms, the export share of which is unconstrained by policy and often very large. Sectoral dummies in our estimations will control for sector specific institutional factors. This diversity of patterns supports our strategy of focussing on the export share, rather than on their dichotomous export status (exporter vs. non exporter).
Figure 1: Kernel Density of the Variable “Export Share in 1999”

Figure 2. Kernel Density of the Variable “Export Share in 1999”, by Sector
2.2 Total Factor Productivity

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. Our data set 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).

To compute 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. 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. 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:

\[
V_{ijt} = Y_{ijt} - M_{ijt} = \tilde{F}(L_{ijt}, K_{ijt}, T_{ijt})
\]

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

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

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:

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

where $\alpha = LC / S$, $LC$ 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:

\[
\Delta \ln TFP_{ijt} = \Delta \ln Y_{ijt} - \alpha^w \Delta \ln L^w_{ijt} - \alpha^b \Delta \ln L^b_{ijt} - (1 - \alpha^w - \alpha^b) \Delta \ln K_{ijt}
\]

where \(w\) and \(b\) denote white (skilled) and blue (unskilled) collar worker hours. 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 has the highest rate of growth of total factor productivity. On the other hand, exporting firms have the highest level of TFP in 1998.

<table>
<thead>
<tr>
<th>Table 3: Total Factor Productivity, Statistics by Openness Status</th>
</tr>
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<tbody>
<tr>
<td><strong>Observations</strong></td>
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<tr>
<td><strong>Total sample</strong></td>
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<tr>
<td></td>
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<tr>
<td><strong>Exporters</strong></td>
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<td></td>
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<tr>
<td><strong>Not Exporters</strong></td>
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</tbody>
</table>

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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.
The comparison between exporters and non exporters is not clear cut when we consider both TFP growth and TFP levels. On average exporters are more productive, but their productivity grows at a slower pace. Thus, we may likely presume the existence of some sort of convergence process we need to control for, if we want to isolate the relationship between productivity growth and exporting. We do so in the following section by developing a catching up model.

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 the firm level (Scarpetta, Hemmings, Tressel, and Woo, 2002; Scarpetta and Tressel, 2002, Griffith, Redding, and Van Reenen, 2000, Griffith Redding and Simpson, 2002, Cameron, Proudman and Redding, 2003), we consider a multifactor productivity equation derived from a production function in which technological progress is a function of industry/firm specific factors, as well as a catch-up term that measures the distance from the technological frontier. This framework allows us to test for the direct relationship between export intensity and productivity growth, as well as for the indirect one, i.e. how the catching up process changes with export intensity.

Specifically, the conventional endogenous growth model, where 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 industry and firm characteristics, as well as on the technological and organisational transfer from a leader ($L$). The leader is the frontier firm in the industry, the one with the highest TFP, which we assume outside our sample, in another country than India.

Then, starting from a general autoregressive distributed lags (ADL 1,1) representation to model the relationship between the TFP of plant $i$ in industry $j$ and the TFP of the leader firm $L$ in industry $j$:

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5 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) \( \ln TFP_{ijt} = \phi_1 \ln TFP_{ijt-1} + \phi_2 \ln TFP_{Ljt} + \phi_3 TFP_{Ljt-1} + \omega_{ijt} \)

where \( \omega_{ijt} \) is a stochastic error. Subsequently, imposing the assumption of long run homogeneity (\( \phi_2 + \phi_3 = 1 - \phi_1 \)) and substituting \( \alpha_{ijt}=\phi_2 \) and \( \beta_{ijt}=1-\phi_1 \), it is possible to model multi-factor productivity of the Indian firm in a given industry \( j \) by an Error Correction Model:

(6) \( \Delta \ln TFP_{ijt} = \alpha_{ijt} \ln \left( \frac{TFP_{ijt}}{TFP_{Ljt}} \right) - \beta_{ijt} \ln \left( \frac{TFP_{ijt-1}}{TFP_{Ljt-1}} \right) + \omega_{ijt} \)

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

This representation implies that TFP growth in the frontier firm leads to faster TFP growth in followers by widening the production possibility set. In addition, it is assumed that, in each industry, the firm's distance from the technological leader measures the scope for technological transfer.

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 (6) both directly and through the rate of technology transfer from the frontier firms. Supposing linearity this amounts to write the following:

(7) \( \beta_{ijt} = \beta_1 + \beta_2 Z_{ijt} \)

(8) \( \omega_{ijt} = \gamma_1 + \gamma_2 Z_{ijt} + f_i + g_j + d_t + \varepsilon_{ijt} \)
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, \( \epsilon_{ijt} \) 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 (6) adapted to the present case, taking into account (7) and (8), amounts to the following:

\[
\Delta \ln TFP_{i,1999} = \alpha (\ln TFP_{L,1999} - \ln TFP_{L,1998}) - (\beta_1 + \beta_2 Z_{ijt}) (\ln TFP_{i,1998} - \ln TFP_{L,1998}) + \gamma_1 + \gamma_2 Z_{ijt} + f_i + g_j + d_t + \epsilon_{ijt}
\]

Clearly, as there is no time dimension in the data, TFP levels for the leader firm are single numbers and they are absorbed into the intercept term. Therefore we can rewrite (9) as:

\[
\Delta \ln TFP_{i,1999} = \theta_1 - \theta_1 \ln TFP_{L,1999} - \theta_2 \ln TFP_{L,1998} Z_{i,1999} + \theta_3 Z_{i,1999} + f_i + g_j + \epsilon_{ijt}
\]

From equation (10) it is clear that the coefficient of the TFP gap term, \( \theta_1 \), 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 (10) was estimated using standard OLS with heteroskedasticity robust standard errors. All estimations are carried out controlling for sector and size category. The results are presented in Table 4.

We report different specifications of the model. The first one is our baseline and it only includes the export share variable. This enters both directly and interacted with the catching
up factor, lagged TFP. To control for non linearity we also include the square of the export share. Specifications (B) and (C) include other firm specific variables that might affect TFP growth: age of machinery, export experience and the share of foreign ownership. We have argued earlier that the overall institutional framework varies widely across states. To control for this factor, specifications (D), (E) and (F) replicate the first three ones including a variable, which is a synthetic index of the investment climate of the state where the firm is located. This variable is derived from Confederation of Indian Industry and World Bank, 2002 and Dollar, Iarossi and Mengistae, 2002. All variables are described in the appendix.

First, note that the coefficient of lagged TFP is always negative, besides for regression (A). We cannot however conclude that there is catching up, as we also need to take into account the coefficients of the interacted terms. The computation of the convergence rate is reported in table 5, which will be discussed below. Let us first focus on the export share. The results indicate a significant direct effect on productivity and, if the interaction of the export share with the technology gap is considered, an indirect effect. 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 term enters negatively in the regression, whereas the square term enters positively. The opposite occurs when export shares are interacted with total factor productivity. Note that these results are robust to the inclusion of various controls. They are also robust when we control for the investment climate, which in itself is rarely significant. We also controlled for the degree of exposure to foreign competition of non exporters, as import competition can also be an important factor behind productivity gains. Also in this case (not reported) the results on the export share are robust.
<table>
<thead>
<tr>
<th></th>
<th>(A)</th>
<th>(B)</th>
<th>(C)</th>
<th>(D)</th>
<th>(E)</th>
<th>(F)</th>
</tr>
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<tbody>
<tr>
<td>LnTFP 1998</td>
<td>0.189*</td>
<td>-0.253**</td>
<td>-0.210**</td>
<td>-0.144</td>
<td>-0.453**</td>
<td>-0.592***</td>
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<tr>
<td></td>
<td>(1.91)</td>
<td>(2.15)</td>
<td>(1.98)</td>
<td>(0.64)</td>
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<td>(3.07)</td>
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<td>(2.98)</td>
<td>(2.40)</td>
<td>(2.09)</td>
<td>(2.29)</td>
</tr>
<tr>
<td>Export Share square 1999</td>
<td>2.800**</td>
<td>3.110***</td>
<td>2.007***</td>
<td>2.563**</td>
<td>3.020**</td>
<td>1.665**</td>
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<td></td>
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<tr>
<td>LnTFP 1998 * Investment Climate Index</td>
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<td>0.061</td>
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<td>(1.77)</td>
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<td></td>
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<td>(1.54)</td>
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<tr>
<td>LnTFP 1998 * Foreign Ownership 1999</td>
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<td>(2.04)</td>
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<td></td>
<td></td>
<td>(2.53)</td>
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<td>(2.01)</td>
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<tr>
<td>Age of Machinery 1999</td>
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<td></td>
<td>-0,022**</td>
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<td>(1,98)</td>
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<td>(2.03)</td>
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<td>LnTFP 1998 * Age of Machinery 1999</td>
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<td>0,030***</td>
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<td>0,031***</td>
<td></td>
<td>(4.99)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5.29)</td>
<td></td>
<td></td>
<td></td>
<td>(4.99)</td>
</tr>
<tr>
<td>Export Experience 1999</td>
<td></td>
<td>0,088</td>
<td></td>
<td>0,125</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.33)</td>
<td></td>
<td>(0.46)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export Experience Square 1999</td>
<td></td>
<td>-0,045</td>
<td></td>
<td>-0,057</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.59)</td>
<td></td>
<td>(0.71)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LnTFP 1998 * Export Experience 1999</td>
<td></td>
<td>0,187</td>
<td></td>
<td>0,172</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.30)</td>
<td></td>
<td>(1.13)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LnTFP 1998 * Export Experience Square</td>
<td></td>
<td>-0,008</td>
<td></td>
<td>-0,004</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.21)</td>
<td></td>
<td>(0.10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0,145</td>
<td>0,316</td>
<td>0,246</td>
<td>0,238</td>
<td>0,307</td>
<td>0,506**</td>
</tr>
<tr>
<td></td>
<td>(0.47)</td>
<td>(1.31)</td>
<td>(1.22)</td>
<td>(0.66)</td>
<td>(0.97)</td>
<td>(1.95)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>356</td>
<td>314</td>
<td>332</td>
<td>356</td>
<td>314</td>
<td>332</td>
</tr>
<tr>
<td>R-square</td>
<td>0,68</td>
<td>0,79</td>
<td>0,81</td>
<td>0,68</td>
<td>0,79</td>
<td>0,81</td>
</tr>
<tr>
<td>Specification test⁷ [p-value]</td>
<td>11,88</td>
<td>64,87</td>
<td>1045,81</td>
<td>10,41</td>
<td>61,93</td>
<td>1472,16</td>
</tr>
<tr>
<td></td>
<td>[0,000]</td>
<td>[0,000]</td>
<td>[0,000]</td>
<td>[0,000]</td>
<td>[0,000]</td>
<td>[0,000]</td>
</tr>
<tr>
<td>“Export share square” F-test ⁶ [p-value]</td>
<td>8,76</td>
<td>2,97</td>
<td>8,14</td>
<td>6,43</td>
<td>4,98</td>
<td>5,68</td>
</tr>
<tr>
<td></td>
<td>[0,000]</td>
<td>[0,052]</td>
<td>[0,000]</td>
<td>[0,012]</td>
<td>[0,026]</td>
<td>[0,018]</td>
</tr>
</tbody>
</table>

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.

e) Specification F test under the null that all the coefficients are jointly equal to zero.

f) F-test under the null that coeff on “Export Share square 1999” and on “LnTFP 1998 * Export Share Square 1999” are jointly equal to zero.
Little can be gauged on the role of export shares by just looking at these estimations, as we need to jointly take into account the direct and the interacted effects of both the linear and the square measures of the export share. We are interested in understanding the nature of the non-linear relationship between the export share and productivity growth. In Table 5 we explore these relationships. In the first column we compute the convergence rate and we indeed find that there is catching up. The last two columns of the table explore the non-linear relationship between the export share and the rate of change of total factor productivity. The relationship between the export share and TFP growth is convex. It exhibits a U-shape with a turning point between 37 and 47 percent, depending on the estimations.

Table 5: Analysis of Convergence and the Role of the Export Share

<table>
<thead>
<tr>
<th>Equation Number (Table 5)</th>
<th>Convergence Rate</th>
<th>Critical Level of Export Share</th>
<th>Curvature of the Export Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>-0.283</td>
<td>0.428***</td>
<td>3.419</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(7.62)</td>
<td></td>
</tr>
<tr>
<td>(B)</td>
<td>-0.557</td>
<td>0.474***</td>
<td>4.817</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(9.85)</td>
<td></td>
</tr>
<tr>
<td>(C)</td>
<td>-0.566</td>
<td>0.399***</td>
<td>2.329</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(9.85)</td>
<td></td>
</tr>
<tr>
<td>(D)</td>
<td>-0.260</td>
<td>0.424***</td>
<td>3.094</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(6.64)</td>
<td></td>
</tr>
<tr>
<td>(E)</td>
<td>-0.537</td>
<td>0.478***</td>
<td>4.705</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(10.00)</td>
<td></td>
</tr>
<tr>
<td>(F)</td>
<td>-0.544</td>
<td>0.372***</td>
<td>1.796</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.20)</td>
<td></td>
</tr>
</tbody>
</table>

Notes:

a) The convergence rate is computed by taking the derivative of the dependent variable (TFP growth) in expression (10) with respect to the log of lagged TFP.

b) This critical level is obtained by setting equal to zero the derivative of the dependent variable (TFP growth) in expression (10) with respect to export share and solving for the export share. In parentheses the t-value for the test on the non-linear combination of the parameters with H₀: Rb=0 and triple asterisks denote statistical significant at 0.01 confidence level.

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

d) All computed values are averaged across firms.

e) Single, double, and triple asterisks denote statistical significant at 0.1, 0.05, and 0.01 confidence levels respectively.

The understanding of the factors behind the U shaped relationship is not straightforward and we will discuss this in the coming section.
5. What is behind the U shaped relationship between efficiency and exports?

The obvious intuitive explanation for the U 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. As argued earlier, theoretical findings on heterogeneity are consistent with our result that marginal exporters (firms exporting a small share of output) are less productive than either national firms or firms exporting a large share of their output. One way of indirectly gauging whether exporting entices some entry costs, is to look if factors of production used by exporters differ from those used by non exporters. In particular, we can control if exporters use more advanced technologies which could entice higher running and fixed costs in the short term and which cannot be offset by marginal exporters. As argued in the introduction earlier studies provide mixed predictions on whether exporting comes along with technological upgrading.

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:

\[
S_{ij} = \gamma_i + \gamma_j Z_{ij} + f_i + g_j + \varepsilon_{ij}
\]

where \(S_{ij}\) is our input variable for firm i, in sector j, \(Z\) is a dummy representing the status of the firm, concerning its exposure to foreign competition and \(f\) and \(g\) are firm and sector dummies respectively.
### Table 6: Export Premium on Technology and Skill Variables

<table>
<thead>
<tr>
<th></th>
<th>Average age of machinery</th>
<th>%Raw mat. produced abroad (in 1999)</th>
<th>Capital Intensity (lnK_L)</th>
<th>Wh_Blue Ratio</th>
<th>Share of workers in R&amp;D</th>
<th>Average years of education of workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exporters vs non exporters</td>
<td>-1.837***</td>
<td>8.379***</td>
<td>-0.128**</td>
<td>0.059</td>
<td>-0.001</td>
<td>-0.167</td>
</tr>
<tr>
<td></td>
<td>(3.36)</td>
<td>(4.94)</td>
<td>(2.27)</td>
<td>(1.61)</td>
<td>(0.05)</td>
<td>(0.46)</td>
</tr>
<tr>
<td>Among exporters:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>expsh greater than 50% vs. expsh smaller than 50%</td>
<td>-1.627**</td>
<td>3.271</td>
<td>0.135***</td>
<td>0.015</td>
<td>-0.076*</td>
<td>-0.060</td>
</tr>
<tr>
<td></td>
<td>(2.42)</td>
<td>(1.07)</td>
<td>(2.61)</td>
<td>(0.30)</td>
<td>(1.72)</td>
<td>(0.10)</td>
</tr>
</tbody>
</table>

Notes:

a) All the regression for the export premium have been done with constant, sector and size dummies as controls.

b) Absolute value of t-statistics in parentheses.

c) Standard errors are White-corrected in presence of heteroskedasticity.

d) Single, double, and triple asterisks denote statistical significant at 0.1, 0.05, and 0.01 confidence levels respectively.

We split the sample into 2 dichotomous groups of firms: i) exporters vs. non exporters; ii) 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 which differ significantly between these two groups of firms are the age of machinery and the share of imported inputs: exporting firms use younger machines and are more reliant on imported inputs. Also, we find that exporting firms are more labour intensive (the capital labour ratio is lower) and that there are no differences in what concerns any measure of human capital.

Are these characteristics similar within exporters, or are large exporters different from marginal ones? We now just focus on exporting firms and split them between those exporting more and those less than 50 percent of their output. We find a significant gap in the age of machinery: large exporters use younger machines. The coefficient is very similar to the one of the comparison between exporters and non exporters, implying that younger machines are mostly concentrated among large exporters. 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. Large exporters also import a larger share of inputs, though the difference in this latter variable between the two groups is no
longer significant and the coefficient is smaller than for exporters vs. non exporters. Also in this case there are no significant differences for what concerns human capital.

Thus, firms with an export share larger than 50 percent, those placed in the upward sloping leg of the U are also those renewing faster their capital and, among exporters, using more capital intensive technologies and still more imported inputs. This implies that marginal exporters, firms with an export share of less than 50 percent were to export more than 50 percent of their output, they would face the fixed costs of moving to more recent and capital intensive technologies. In other words, there are barriers into becoming a specialised exporter.

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.

6. 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 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 38 and 48 per cent and it increases thereafter.

One likely explanation of this finding is that to specialise in exports requires investments in technological upgrading. In fact, firms with a larger than 50 percent share of exports are found to be more capital intensive and to use newer machinery than marginal exporters. Technological upgrading could not be viable for marginal exporters, particularly given that these firms are the least productive in the sample. Note that these results are robust also when we control for broader institutional factors and for whether firms are exposed to import competition in the home market.
References


International Monetary Fund, 2002, ‘India, Recent Economic Developments’, IMF Staff Country Report N.00/155


Appendix 1: Variables Definition

Export Share
Value of exports of the three main products relative to value of total sales in the year 1999.

Foreign Ownership
Dummy 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.

Investment Climate Index: is an index that ranks Indian states from 1 to 4 with respect to the local Investment Climate. This Index has been derived from the analysis done jointly by the Confederation of Indian Industries and World Bank (2002). In particular the analysis is based on the answer given in the questionnaire by firm’s manager with respect to their perception of the Investment Climate in all the states involved in the survey. This subjective ranking has then been compared with quantitative measures such as labour productivity, regulatory burden (e.g. government inspections), delays at custom houses, costs and reliability of power supply and interests costs, finding that in most cases there is the expected correlation and that managers’ judgments can be considered reliable. (Best IC: Maharashtra and Gujarat, Good IC: Andhra Pradesh Karnataka and Tamil Nadu Medium IC: Delhi and Punjab Poor IC: Kerala, Uttar Pradesh and West Bengal).