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Trade Liberalization, Market Efficiency and Productivity Growth: A
Smooth Transition Approach on Indian Firms*

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Abstract

This paper employs the Time Varying Panel Smooth Transition Regression (TV-PSTR) model to investigate the effects of India's dramatic trade liberalization starting from 1991 on market efficiency and productivity growth using Indian manufacturing firm data. We find that the effects of liberalization do follow a smooth transition process instead of previously assumed instantaneous 'big-bang' shift just after reforms. It actually took years for the Indian firms to start to react to the reforms, and the transitional impact of reforms takes approximately 4-8 years to complete, with different timing across industries. There is strong evidence of increase in competition, which pushes down the markup and make it possible to get welfare gains from reduction of dead weight losses. In response to trade reforms, most industries, which suffer most from the shrinking of market size experienced no change or falling total factor productivity (TFP) growth; whereas leather industry, as the industry which benefit most from economy of scales, enjoyed a huge TFP growth in response to reforms. This evidence is consistent with the endogenous growth model prediction, which says TFP growth after liberalization depends on whether trade is encouraging R&D and innovation or discouraging it.

Keywords: Panel Smooth Transition Model, Market Efficiency, Productivity Growth *JEL classification:* C52, D24, F12, F13, L60

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1 Introduction

Trade Liberalization and Its Welfare effects has been a question receiving extensive interests of country policy makers. It has been argued that in imperfectly competitive markets, trade liberalization will bring welfare gains by reducing the dead weight losses created by domestic monopolies and oligopolies by increasing competition and reducing price-marginal cost markups.² Although there has been a revival of interest in the trade-growth nexus, in contrast to the theoretical predictions on the effect of trade on competition and markups, the impact of trade liberalization on productivity gains remains empirical, given the ambiguity in the literature on this issue. Proponents of trade liberalization argue that returns to entrepreneurial effort increase with exposure to foreign competition. Theoretically, Krugman (1986) and Lucas (1988) argue that trade encourages learning by doing and innovation, leading to productivity growth. However, Rodrik (1992a and 1992b) have questioned the importance of these supposed productivity gains, and claims that there are no theoretical reasons to believe that the protection of domestic markets discourages productivity growth. This skepticism stems from the view that trade liberalization might retard productivity growth by shrinking domestic firms' sales, which would in turn reduce the incentive for these firms to invest in technological efforts. Further, in the trade and endogenous growth theories developed by Grossman and Helpman (1990 and 1994) the theoretical prediction on the dynamic effects of trade is quite ambiguous: trade can potentially be growth generating as well as growth decelerating. Trade can enhance growth permanently by facilitating the international exchange of knowledge and technology. Trade can have growth decelerating effects if it, via market size effects, reduces domestic firms' incentives to innovate or diverts resources away from R&D. Since the theory appears to suggest that virtually anything may happen to productivity growth after opening up to trade, the question has largely become an empirical one, and it is important to investigate it using a well grounded methodology.

However, until recently, these hypotheses linking trade to competition and to productivity growth received relatively little empirical attention, especially

²This argument was first made in context of domestic monopolies in the classic paper by Bhagwati (1965), and was subsequently extended to oligopolies by the more recent work of Helpman and Krugman (1989), inter alia. See Helpman and Krugman (1989) for a detailed discussion.

on the firm-level. To examine this question carefully, detailed firm-level data both before and after a trade liberalization is needed, but sufficiently detailed data has only rarely been available. As a consequence, most studies that examined this question at the micro level either employed calibrated industry³ or provided econometric estimates using industry-level aggregate data⁴. One obvious weakness of these studies is that industry level data mask the extensive firm level variations.

Moreover, there are many methodology problems associated with previous studies. Traditionally, the methodology employed for estimating productivity growth is based on the Solow (1957) growth accounting approach, which assumes perfect competition and constant returns to scale (CRS). However, changes in the trade environment under liberalizing reforms appears to alter the nature of competition and returns to scale as Melitz(2003) suggested in his paper. If policy reforms affect the nature of competition, then the productivity changes associated with trade reform estimated by Solow growth accounting model may be mismeasured and biased. Also it will fail to capture the additional welfare gains from reduction of dead weight losses by increasing competition and lower markups.

Harrison (1994) and Krishna & Mitra (1998), being aware of policy reforms affecting the nature of competition and return to scales, respectively, are important exceptions. However, they, as almost all previous studies did, only looked at the several years before and after liberalization, and assume an instantaneous discrete shift in market efficiency parameters and productivity growth, when in fact it is more reasonable to model the transition after liberalization as a sequenced smooth process by a flexible functional form.⁵ First of all, in most countries, the reforms were not done in one day, and there are usually further efforts following the main reform. Also it has been argued, that for many countries liberalization is best seen as a sequenced process with reforms taking time to gain credibility and market reactions. It usually take years before the dynamic effects of trade on productivity growth start to hap-

³Examples of simulated industry studies include the works of Dixit (1988), Rodrik(1988) and Baldwin and Krugman (1988).

⁴Oczkowski and Sharma (2001) examined the relationship between trade liberalization and productivity growth for manufacturing using industry aggregate data.

⁵Greenaway, Leybourne and Sapsford (1997) and McGillivray (1999)suggest that the effects of liberalization on GDP growth rates follow a smooth transition S curve process.

pen, and also take years to finish. Therefore, it is unreasonable to assume the impact of reforms as a discrete 'big bang' effect on the markup, scale parameters and productivity growth, and these assumptions maybe explain why these two papers only find weak evidence on markup and productivity growth changes.

This paper investigates the effects of India's dramatic trade liberalization starting from 1991 on manufacturing price-marginal cost markups, returns to scales (RTS) and productivity growth. This paper intends to correct the previously mentioned biases in productivity measurement and remove the wrong assumption imposed by previous studies, by relaxing the perfect competition and CRS assumptions. More importantly, this paper will apply the Time Varying Panel Smooth Transition Approach to model the effects of reforms as having undergone a smooth non-linear transition through time, which doesn't put any prior estimation restrictions on the process of transition. India is a suitable case study because of its long history of protecting its domestic manufacturing sector. However, the extensive changes in the trade regime of India (significant reductions of tariffs on a wide range of imports, rationalization of the tariff schedule and expansion of quota limits) coming unexpectedly as they did, after several decades of restrictive external policies, provided an excellent controlled experiment in which the effects of restrictive trade policies could be measured. The data set used in this paper contains detailed firm level data on a large sample of firms in a variety of industries, thereby facilitating analysis at a higher level of disaggregation than previous studies.

Our main findings are that the effects of liberalization on market structure and productivity do follow a smooth transition process. Instead of previously assumed instantaneous 'big-bang' shift just after reforms, it actually took years for the Indian firms start to react to the reforms, and the transitional impact of reforms takes approximately 4-8 years to complete. There is strong evidence of increase in competition, which pushes down the markup and make it possible to get welfare gains from reduction of dead weight losses by increasing competition and lower markups. Except for Leather and Chemical industries, RTS in most industries shrink after the transition. The effects of reforms on TFP are mixed, as predicted by the endogenous growth theory, depending on whether trade is encouraging R&D and innovation or discouraging it. In response to trade reforms, most industries, which suffer

most from the shrinking of market size experienced no change or decreasing total factor productivity (TFP) growth; whereas leather industry, as the industry which benefit most from economy of scales, enjoyed a huge TFP growth in response to reforms.

The remainder of this paper is organized as follows. Section 2 briefly discusses the trade reforms in India. Section 3 outlines the Time Varying Panel Smooth Transition Regression Model (TV-PSTR) and estimation methodology, discusses some econometric issues and describes the data. Section 4 presents and discusses the estimation results. Section 5 concludes.

2 Trade liberalization and reforms in India

Before 1991, India had one of the worlds most complex trade regimes characterized by severe quantitative restrictions on imports and exports and extraordinarily high tariffs on imports. Trade policy was characterized by high tariffs and pervasive import restrictions. Imports of manufactured consumer goods were completely banned. For capital goods, raw materials and intermediates, certain lists of goods were freely importable, but for most items where domestic substitutes were being produced, imports were only possible with import licenses. The criteria for issue of licenses were nontransparent, delays were endemic and corruption unavoidable. Industrial policy prior to the reforms was characterized by multiple controls over private investment that limited the areas in which private investors were allowed to operate and often also determined the scale of operations, the location of new investment and even the technology to be used. The industrial structure that evolved under this regime was highly inefficient and needed to be supported by a highly protective trade policy, often providing tailor-made protection to each sector of industry⁶.

In July 1991, forced by a severe balance of payments crisis, newly elected Indian government approached the IMF, and launched a series of economic reforms required by the strong conditionality attached with its loan. Many of

⁶For a classic and highly readable account of Indias economic policies in this earlier period, see Bhagwati and Desai (1970). The costs imposed by these policies had been extensively studied (for example, Bhagwati and Desai, 1965; Bhagwati and Srinivasan, 1971; Ahluwalia, 1985)

these economic reforms since 1991 directly or indirectly led to a substantial liberalization of the corporate sector, and have brought many changes to the environment in which Indian companies previously operated. A great deal has been achieved in terms of greater liberalization and openness after ten years of gradualist reforms.

The principal aim of these reforms was to strengthen market discipline and promote greater competition by putting an end to the “license raj,” namely through the abolition of the Industries Development and Regulation Act (1951) and amendments to the Companies Act and several other major laws, which had imposed a heavy legal and regulatory burden on the corporate sector⁷. The list of industries reserved solely for the public sector—which used to cover 18 industries, including iron and steel, heavy plant and machinery, telecommunications and telecom equipment, minerals, oil, mining, air transport services and electricity generation and distribution—has been drastically reduced to three industries: defense aircrafts and warships, atomic energy generation and railway transport. Industrial licensing by the central government has been almost abolished, except for a few hazardous and environmentally sensitive industries. The requirement that investments by large industrial houses needed a separate clearance under the Monopolies and Restrictive Trade Practices Act to discourage the concentration of economic power was abolished, and the act itself was replaced by a more modern competition law in the Ninth Plan period when steps had been taken to dereverse a number of small-scale industries, particularly those industries with the greatest export potential. This new competition law focuses more on anti-competitive practices, by giving greater consideration to abuse of market dominance rather than through firm size per se.

In addition, the government announced its primary trade reforms which included the removal of most import licensing and other non-tariff barriers on all imports of intermediate and capital goods and significant reductions in tariffs on imports⁸; foreign investment opportunities were increased; and

⁷The 1951 Industries Development and Regulation (IDR) Act put in place a system of mandatory licenses, which acted to limit a firm’s ability to expand capacity, change product mix, introduce new processes, and import machinery and equipment without obtaining various licenses from the central government.

⁸Prior to the reform, a policy of import substitution was implemented with high tariffs and a requirement of multiple import licenses, shielding domestic firms from foreign

shareholders' rights were improved. Indian companies were allowed to enter into joint ventures with multinational enterprises more freely, import new technologies and capital goods, expand productive capacity, and introduce new products without obtaining industrial licenses⁹. The reforms are gradual and take steps. Import licensing was abolished relatively early for capital goods and intermediates, which became freely importable in 1993, simultaneously with the switch to a flexible exchange rate regime. Removing quantitative restrictions on imports of capital goods and intermediates was relatively easy, because the number of domestic producers was small and Indian industry welcomed the move as making it more competitive. It was much more difficult in the case of final consumer goods because the number of domestic producers affected was very large. Quantitative restrictions on imports of manufactured consumer goods and agricultural products were finally removed on April 1, 2001, almost exactly ten years after the reforms began, and that in part because of a ruling by a World Trade Organization dispute panel on a complaint brought by the United States.

Progress in reducing tariff protection, the second element in the trade strategy, has been even slower and not always steady. Table 1 shows the reduction in average tariffs¹⁰ in several industrial sectors before and after the primary trade liberalization. We can see after huge tariff reductions in the primary trade reforms, there are further liberalizing efforts afterwards for each industry. Although India's tariff levels are significantly lower than in 1991, they remain among the highest in the developing world, because most other developing countries have also reduced tariffs in this period.

competition.

⁹See Chopra et. al. (1995) for a complete description of the macroeconomic and structural reforms in the aftermath of the 1991 crisis.

¹⁰Average industry level tariff data are from the World Bank.

3 The Time Varying Panel Smooth Transition Regression (TV-PSTR) Model and estimation issues

3.1 The TV-PSTR Model

Smooth Transition Regression Model (STR), initiated by Bacon and Watts (1971), may be seen as a generalized switching regression models in such a way that the transition from one extreme regime to the other is not discrete but smooth as a function of the continuous transition variable. The TV-PSTR model, as a young member of the STR family, is a newly developed type of STR model by Gonzalez et al (2005), which extends its application on panel data and use time t as the transition variable.

Consider the nonlinear regression model

$$y_{it} = x'_{it}\varphi + (x'_{it}\theta)S(\gamma, c; z_t) + u_{it}, \quad t = 1, \dots, T \quad (1)$$

where $x_t = (1, x_{1t}, \dots, x_{qt})'$ with $m = 1 + q$ is the vector of explanatory variables. $\varphi = (\varphi_0, \varphi_1, \dots, \varphi_m)'$, and $\theta = (\theta_0, \theta_1, \dots, \theta_m)'$ are parameter vectors, and $\{u_t\}$ is a sequence of iid errors. S is the transition function, bounded continuous transition function between zero and unity. Granger and Terasverta(1993, Chap. 7) define S of the form

$$S(r, c; z_t) = (1 + \exp\{-\gamma(z_t - c)\})^{-1}, \quad \gamma > 0 \quad (2)$$

The transition function (2) is monotonically increasing function of z_t . The slope parameter γ indicates how rapid the transition is, and the location parameter c determines in which year the transition midpoint occurs. Letting $\gamma \rightarrow \infty$, where there is a single structural break (the most popular alternative to parameter constancy in econometric work); the small the γ , the smoother (slower) the transition process. This STR may often be a more realistic assumption than that of a single structural break. Also with Discrete change in parameters as a special case within this more general framework, the model doesn't lose its generality. With the transition variable $z_t=t$, the TV-PSTR model is testing the constancy of regression parameters against continuous structural change.

By writing (1) as $y_t = x_t'(\varphi + \theta S) + u_t$, it is seen that the model is locally linear in x_t and that the combined parameter vector $\varphi + \theta S$. If S is bounded between 0 and 1, the combined parameters fluctuate between φ and $\varphi + \theta$.

In developing the analytical framework we follow the methodology initially advocated by Hall (1988) and extended by Harrison (1994) and Krishna & Mitra (1998). Consider a homogenous production function of degree θ , for an industry:

$$Y = A \cdot f \cdot G(L, M, K) \quad (3)$$

where output Y is produced by firm with inputs, labor L , material M and capital K . A is the technology shock, $G()$ is a general functional form, f is a firm specific parameter which allows for firm specific differences in technology. Taking the logs and differentiating both sides of (3) w.r.t time gives:

$$\begin{aligned} \frac{1}{Y} \cdot \frac{dY}{dt} &= \frac{\partial G}{\partial L} \cdot \frac{L}{G} \left(\frac{1}{L} \cdot \frac{dL}{dt} \right) + \frac{\partial G}{\partial M} \cdot \frac{M}{G} \left(\frac{1}{M} \cdot \frac{dM}{dt} \right) \\ &\quad + \frac{\partial G}{\partial K} \cdot \frac{K}{G} \left(\frac{1}{K} \cdot \frac{dK}{dt} \right) + \frac{1}{A} \cdot \frac{dA}{dt} \end{aligned} \quad (4)$$

Assuming that firms have market power in the goods market but are competitive in the factor market, the resulting first-order optimality conditions imply:

$$\frac{\partial G}{\partial L} \cdot \frac{L}{G} = \left(\frac{P}{MC} \right) \frac{wL}{PY} = \mu\alpha \quad (5)$$

$$\frac{\partial G}{\partial M} \cdot \frac{M}{G} = \left(\frac{P}{MC} \right) \frac{rM}{PY} = \mu\delta \quad (6)$$

$$\frac{\partial G}{\partial K} \cdot \frac{K}{G} = \left(\frac{P}{MC} \right) \frac{rK}{PY} = \mu\beta \quad (7)$$

where P , w , r are the prices of output, labor, material and capital respectively; MC is marginal cost; $\mu = P/MC$ is the price-marginal cost markup; and α , δ and β are labor, material and capital revenue shares. Combining equations (4) and (5)–(7) and expressing the result in discrete time, we get:

$$\Delta y = \mu(\alpha\Delta l + \delta\Delta m + \beta\Delta k) + \Delta a \quad (8)$$

where lower case letters are log terms. To incorporate the returns-to-scale parameter (θ) into the framework we apply Euler's theorem to equation (3) and get:

$$\theta = \frac{\partial G}{\partial L} \cdot \frac{L}{G} + \frac{\partial G}{\partial M} \cdot \frac{M}{G} + \frac{\partial G}{\partial K} \cdot \frac{K}{G} = \mu(\alpha + \delta + \beta) \quad (9)$$

Combining (8) and (9) we can write:

$$\Delta y^* = \mu \Delta x^* + (\theta - 1) \Delta k + \Delta a \quad (10)$$

where $y^* = \ln(Y/K)$, $\Delta x^* = \alpha \Delta l^* + \delta \Delta m^*$ with $l^* = \ln(L/K)$ and $m^* = \ln(M/K)$. Equation (10) is the basic estimating equation which permits both non-competitive pricing behavior through a mark-up μ and non-constant returns to scale through a scale parameter θ .

The TV-PSTR model for equation (10) can be written as:

$$\Delta y_{it}^* = \mu \Delta x_{it}^* + \mu_x S_t \Delta x_{it}^* + (\theta - 1) \Delta k_{it} + \theta_k S_t \Delta k_{it} + \eta S_t + u_{it} \quad (11)$$

where u_{it} is disturbance term, and $S_t = 1/\{1 + \exp[-\gamma(t - c)]\}$ is the smooth transition function (monotonically increasing in t and lies between 0 and 1). The subscripts i and t are for firm and time (year); η measures the change in productivity growth over the transition process; γ is the velocity or speed of transition; and c is the location of transition, which measures the number of years before the transition midpoint, and be a number between 0 and total number of years T in the sample. μ_x and θ_k are the total change of markup and RTS over the transition.

3.2 Estimation methodology and Data

Equation (11) is our final estimation equation. Since it is highly non-linear, to get the consistent estimates of the TV-PSTR model for equation (11), we will apply non-linear squares (NLS) to determine the values of the parameters that minimize the concentrated sum of squared errors, conditional on γ and c ¹¹. A practical issue that deserves special attention in the estimation of the PSTR model is the selection of starting values of the parameters in the

¹¹Parameters are obtained by ordinary least squares at each iteration in the non-linear optimization. In case the errors are normally distributed, this estimation procedure is

transition function. In this paper, we apply simulated annealing¹² instead of the often used means of grid search to get the starting value of (γ, c) . The (γ, c) space is then sampled more densely than in the case of a grid search, which improves the quality of the starting values.

The data used in the estimation are Indian PROWESS firm level data obtained from the Centre for Monitoring the Indian Economy (CMIE). The dataset contains annual financial report data from 1988-2006 of firms which are either listed on various stock exchanges in the country. In addition, if an entity is not listed, it qualifies for inclusion in the database if the average sum of sales and total assets is at least Rs.200 million ($\approx US\$4.6$ million) as per the latest audited financial results¹³. The database covers all industries in the manufacturing sector. To the extent that a particular industry is dominated by the unorganised/small-scale firms, it is under-represented in the database. In this paper, due to the limited number of firms with available data for several industries, we will present results for 9 two-digit level manufacturing industries as listed in Table 3. These 9 industries almost cover the manufacturing sector, and is a much more broader coverage than previous study on similar topic. (For example, for unknown reason, Krishna & Mitra (1998) only report results for 4 industries.)

Deflated real output, labor, raw materials and energy, capital stock, and their shares in real output, are used in the estimation of our panel of firms. Real outputs were obtained by deflating nominal outputs by sectoral price level deflators. Real labor was obtained by deflating the wage bill by the public sector employee wage rates¹⁴. Material inputs were deflated by the

equivalent to maximum likelihood, (where the likelihood function is first concentrated with respect to the fixed effects μ .) An appendix Gonzalez et al (2005) paper considers the properties of the ML estimator in full detail, including a formal proof of its consistency and asymptotic normality.

¹²For practical implementation, see Goffe, Ferrier, and Rogers (1994) and Brooks and Morgan (1995)

¹³Thus, the unorganised/small-scale firms who form about 30 per cent of the manufacturing sector as a whole in India are not covered in this database.

¹⁴The sectoral price deflators and the public sector employee wage rates were obtained from the ‘Economic Survey’ which is published annually by the Indian Ministry of Finance. The public sector employee wage rate is a particularly good indicator of the overall manufacturing wage rate, itself not available for recent years due to reporting lags, since the ratio of the public sector wage rate to the overall manufacturing wage rate was almost

producer price index (PPI) each year¹⁵. Real capital stock was computed by deflating net fixed assets by sector level investment deflators¹⁶. The sample period for analysis considered here is from 1988 to 2006, hence the total number of years T in the sample equals to 19.

4 Empirical Results

4.1 Estimation results based on the restricted assumption of instantaneous ‘big bang’ shift

To model the impact of trade liberalization on the production relationship previous studies have incorporated intercept and slope liberalization dummy variables into equation (10)¹⁷. A weakness of this approach is that it assumes the impact of reforms are best represented as a discrete big bang effect on the markup and scale parameters. Recent evidence, however, suggests that the effects of reforms maybe better modeled as having undergone a smooth non-linear transition through time with reforms taking time to gain credibility and market reactions. Especially for India, the reforms are gradual and take steps, it is reasonable to expect a sequenced transition process. Moreover, the TV-PSTR model, as a more realistic assumption than that of a single structural break, includes the discrete change in parameters as a special case within this more general framework, so the model doesn’t lose its generality.

Before we see the estimation results from our superior TV-PSTR model, it is interesting to have a look at what the estimation results look like if we use the restricted assumption of instantaneous ‘big bang’ shift, and whether they make sense. These results can also be used as a comparison basis with those of the TV-PSTR model. Table 2 show the estimation results based on the restricted assumption of instantaneous ‘big bang’ shift. The liberalization time dummy is a 0/1 dummy, with value of 0 before 1991 liberalization reform and 1 after. With very low R^2 statistics, the overall fitting of the model is not good. More importantly, the estimates of μ and μ_x doesn’t

constant in the last 20 years.

¹⁵PPI was obtained from the RBI.

¹⁶The sector level investment deflators were obtained from the World Bank.

¹⁷See Harrison (1994) Krishna and Mitra (1998) and other previous studies.

make sense at all. The initial markups are values not much higher than zero for all industries, and after the liberalization the markups further drop to zero. We know the average performance level of the industries cannot be operating for nothing. Now let us see whether the TV-PSTR approach can improve the results or not.

4.2 Estimation Results on the TV-PSTR Model

The estimation results on the TV-PSTR Model from equation (11) is presented in Table 3. Relaxation of assumption of transition time and speed (instantaneous ‘big bang’ shift), significantly improves our regression estimates. LM_F test values for all industries are significant at the 5 per cent level, implying the overall good fitting of the model. Moreover, all estimates survive the diagnostic checks, which means no remaining heterogeneity in the error term and the results of which are available upon request. The estimates of markup before liberalization are all values exceeding unity, which make sense and reflect the imperfect competitive market reality in India before the liberalization reforms.

Based on the mark-up, scale, and transition parameter estimates from Table 3 the time-series smooth transition behavior of the mark-up and scale parameters is plotted in Figures 1 and 2. As shown in Figure 1 mark-ups vary substantially from sector to sector and in general appear to be linked with the level of protection. μ_x for all industries are negative and significant, which provide strong evidences of increase in competition, which pushes down the markup and make it possible for India to get welfare gains from reduction of dead weight losses by increasing competition and lower markups.

Except for paper industry, γ for all industries are very small numbers, which implies the effects of liberalization on market structure and productivity do follow a smooth transition process, instead of previously assumed instantaneous ‘big-bang’ shift just after reforms. Moreover Figures 1 and 2 also show that for most industries transition takes approximately 4-8 years to move completely from a pre-reform to a post-reform era. It took years for the Indian firms start to react to the reforms, and the starting point for a transition in metal industry was as late as around 2000. The timing of the transition differs between sectors. The transition mid-point for five out of the

nine industries happen around 2000, which coincide the major policy change of removal of quantitative restrictions on imports of manufactured consumer goods and agricultural products. The delayed transition and slow reactions from the firms can be caused by several reasons: the rigid labor market; the established business relationships between an oligopolistic real sector and a few large public financial sector institutions (Mohan 2004), which provided financing for large firms and made them feel less pro-competitive pressure; delays of actions by state governments¹⁸ and also firm restructuring should take time.

The policy changes under the liberalizing reforms were expected to generate faster industrial growth and greater penetration of world markets in industrial products, but performance in this respect has been disappointing. As shown in Figure 2, except for Leather industry, returns to scale in most industries shrink significantly after the transition. These shrinking of market scales are not surprising at all if we notice the modestly improved export performance in most industries. India's share in world exports, which had declined steadily since 1960, increased slightly from around 0.5 percent in 1990-1991 to 0.6 percent in 1999-2000, but much of the increase in world market share is due to agricultural exports. India's manufactured exports had a 0.5 percent share in world markets for those items in 1990, and this rose to only 0.55 percent by 1999. Unlike the case in China and South-East Asia, foreign direct investment in India did not play an important role in export penetration and was instead oriented mainly toward the domestic market, where these investments inflows added great competitive pressure to domestic firms and at the same time further squeeze on their market shares. Leather industry, on the other hand, enjoyed a lot from the liberalization and expand its scales significantly by exporting, and now India is among the top 10 exporters of leather and leather products in the world.

One reason why export performance has been modest is the slow progress

¹⁸Industrial liberalization by the central government needs to be accompanied by supporting action by state governments. Private investors require many permissions from state governments to start operations, like connections to electricity and water supply and environmental clearances. They must also interact with the state bureaucracy in the course of day-to-day operations because of laws governing pollution, sanitation, workers welfare and safety and such. Complaints of delays, corruption and harassment arising from these interactions are common.

in lowering import duties that make India a high-cost producer and therefore less attractive as a base for export production. Exporters have long been able to import inputs needed for exports at zero duty, but the complex procedure for obtaining the necessary duty-free import licenses typically involves high transactions cost and delays. High levels of protection compared with other countries also explains why foreign direct investment in India has been much more oriented to the protected domestic market, rather than using India as a base for exports. However, high tariffs are only part of the explanation for poor export performance. The reservation of many potentially exportable items for production in the small-scale sector (which has only recently been relaxed) was also a relevant factor. The poor quality of India's infrastructure compared with infrastructure in East and South-East Asia is yet another.

The effects of reforms on TFP are mixed (shown in Table 3): for most industries TFP either has no change or slightly fell after the transition; while leather industry enjoy a TFP growth rate of 24 per cent over the transition. Industries with significantly decreasing TFP growth rate, are industries which suffer the most from shrinking market size; whereas leather industry, as the industry which benefit most from economy of scales, enjoyed a huge TFP growth in response to reforms. This evidence is consistent with the endogenous growth model prediction, which says TFP growth after liberalization depends on whether trade is encouraging R&D and innovation or discouraging it. Trade liberalization can stimulate TFP growth, but only when it spurs firms' incentives to innovate, if the market size shrinks, trade can reduce the incentives faced by domestic producers to innovate, which therefore slow down their TFP growth rate.

Besides, inflexibility of the labor market is a major factor reducing India's competitiveness in exports and also reducing industrial productivity generally (Planning Commission, 2001). Any firm wishing to close down a plant or to retrench labor in any unit employing more than 100 workers can only do so with the permission of the state government, and this permission is rarely granted. These provisions discourage employment and are especially onerous for labor-intensive sectors. The increased competition in the goods market has made labor more willing to take reasonable positions, because lack of flexibility only leads to firms losing market share.

Further, we divide the firms into two groups: existing firms before 1991

reforms and new-entry firms after that. Their average TFP growth performance both before and after the transition (transition mid-point) are shown in Table 4. Consistent with the theory prediction, new-entry firms do tend to have relatively high overall productivity growth estimates than existing firms which were under protection. On average, there is only slight improvement in the overall average manufacturing TFP growth estimates over the transition process.

It can be argued that the liberalization and initial relaxation of controls has created a more competitive environment and given restructuring pressure to domestic firms, but this could have led to industrial growth only if industrial investment had been oriented to tapping export markets, as was the case in East Asia. As it happened, India's industrial and trade reforms were not strong enough, nor adequately supported by infrastructure and labor market reforms, to generate such a thrust.¹⁹

5 Conclusion

In this paper, we employ the TV-PSTR model to investigate the effects of India's dramatic trade liberalization starting from 1991 on manufacturing price-marginal cost markups, returns to scales (RTS) and productivity growth using Indian firm level data. We find that the effects of liberalization on market structure and productivity do follow a smooth transition process instead of previously assumed instantaneous 'big-bang' shift just after reforms. Trade reform impacts do not occur immediately after the primary reforms, and not occur over the same time period for all industries, also the length of the transition process also varies across industries. It actually took years for the Indian firms start to react to the reforms, and the transitional impact of reforms takes approximately 4-8 years to complete. There is strong evidence of increase in competition, which pushes down the markup and make

¹⁹The one area that has shown robust growth through the 1990s with a strong export orientation is software development and various new types of services enabled by information technology, like medical transcription, backup accounting and customer related services. India's success in this area is one of the most visible achievements of trade policy reforms, which allow access to imports and technology at exceptionally low rates of duty, and also of the fact that exports in this area depend primarily on telecommunications infrastructure, which has improved considerably in the post-reform period.

it possible to get welfare gains from reduction of dead weight losses by increasing competition and lower markups. Except for Leather and Chemical industries, RTS in most industries shrink after the transition. The effects of reforms on TFP are mixed, as predicted by the endogenous growth theory, depending on whether trade is encouraging R&D and innovation or discouraging it. In response to trade reforms, most industries, which suffered most from the shrinking of market size and tended to have the highest absolute protection levels, experienced no change or falling total factor productivity (TFP) growth; whereas leather industry, as the industry which benefit most from economy of scales, enjoyed a huge TFP growth in response to reforms. The policy implications we can get from the findings is that to stimulate TFP growth, the industrial and trade policy reforms need to be supplemented by labor market reforms and more investment in infrastructure²⁰ to facilitate exports and exploit returns to scale, and innovation spurring policy environment to stimulate productivity growth and counteract the possible disincentive to innovate caused by shrinking market size.

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²⁰Infrastructure deficiencies may take time and resources to remove, but deficiencies in supporting central government's industrial liberalization policies by state governance should be handled more quickly with sufficient political will.

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Table 1: Reduction in Average Tariff Rate in Indian Manufacturing Sector

Industry	1990	1992	1997	1999	2001
Food	85.3	47.5	27.7	30.6	40.6
Beverage	190.7	181.9	130.9	121.8	114.6
Textiles	93.9	62.1	38.0	38.3	29.7
Textile Products	99.8	65.0	39.9	39.9	35.0
Leather	82.1	55.3	19.4	29.8	27.7
Leather Products	100.0	65.0	40.0	40.0	35.0
Paper	90.5	58.5	23.1	31.7	30.4
Chemicals	77.1	63.4	29.1	34.1	33.4
Chemical Products	82.8	58.9	31.5	35.3	34.2
Rubber	95.0	63.4	39.4	40.0	33.4
Plastic Products	100.7	64.9	31.7	35.2	34.6
Metal	84.6	64.8	28.5	33.9	33.7
Metal Products	75.0	59.9	29.7	32.4	33.8
Machinery	82.0	57.7	31.1	31.5	27.8
Transport Equipment	62.8	52.7	31.1	35.6	38.9

Table 2: Estimation results based on the restricted assumption of instantaneous ‘big bang’ shift

Industry Estimate	Food and Beverage	Textiles and Products	Leather and Products	Paper and Products	Chemical and Products	Rubber and Plastics	Metal and Products	Machinery and Equipment	Transport Equipment
μ	0.058* (0.015)	0.184* (0.029)	0.074 (0.273)	0.179* (0.083)	0.022* (0.007)	0.159* (0.051)	0.091* (0.033)	0.050* (0.009)	0.232* (0.036)
$\Delta\mu \cdot Tdum$	-0.058* (0.015)	-0.183* (0.029)	0.032 (0.247)	-0.145* (0.083)	-0.022* (0.007)	-0.143* (0.051)	-0.091* (0.033)	-0.050* (0.009)	-0.211* (0.036)
$\theta - 1$	-0.858* (0.158)	-0.374* (0.189)	-0.542 (0.886)	-0.603 (0.441)	-0.893* (0.162)	-0.455* (0.170)	-0.647* (0.252)	-0.407* (0.099)	-0.396* (0.229)
$\Delta\theta \cdot Tdum$	0.206 (0.161)	-0.208 (0.190)	0.002 (0.894)	0.064 (0.444)	0.257 (0.163)	-0.158 (0.172)	-0.066 (0.254)	-0.237* (0.100)	-0.197 (0.230)
$Tdum$	-0.099* (0.051)	-0.091* (0.048)	-0.154 (0.442)	-0.150 (0.100)	-0.084* (0.043)	-0.086 (0.067)	-0.125* (0.069)	-0.054 (0.035)	-0.000 (0.043)
$cons$	0.110* (0.050)	0.101* (0.047)	0.059 (0.441)	0.139 (0.098)	0.126* (0.042)	0.111* (0.066)	0.174* (0.068)	0.080* (0.034)	0.058 (0.042)
R^2	0.112	0.128	0.282	0.290	0.053	0.082	0.018	0.086	0.224
N_firm	475	462	22	101	430	247	226	637	137

^aStandard error in parenthesis

Table 3: Estimation Results on the TV-PSTR Model

Industry Estimate	Food and Beverage	Textiles and Products	Leather and Products	Paper and Products	Chemical and Products	Rubber and Plastics	Metal and Products	Machinery and Equipment	Transport Equipment
μ	1.112* (0.058)	1.340* (0.046)	2.053* (0.161)	1.878* (0.667)	1.336* (0.066)	1.200* (0.062)	1.510* (0.106)	1.261* (0.050)	1.199* (0.115)
μ_x	-0.499* (0.101)	-0.456* (0.101)	-0.915* (0.257)	-0.677* (0.074)	-0.149* (0.107)	-0.489* (0.104)	-0.841* (0.185)	-0.487* (0.091)	-0.367* (0.377)
$\theta - 1$	-0.210* (0.057)	-0.007 (0.047)	-0.075 (0.152)	0.835* (0.071)	-0.333* (0.065)	-0.190 (0.123)	0.044 (0.092)	-0.021 (0.045)	-0.128 (0.080)
θ_k	-0.017 (0.181)	-0.128 (0.101)	1.252* (0.399)	-0.886* (0.079)	0.233 (0.138)	-0.201 (0.150)	-0.272* (0.150)	-0.314* (0.083)	-0.319* (0.132)
η	0.001 (0.681)	-0.008* (0.002)	0.241* (0.047)	-0.020* (0.010)	-0.149 (0.006)	-0.008 (0.009)	0.116* (0.005)	-0.026* (0.004)	-0.039* (0.006)
γ	2.605	2.615	1.419	112.487	1.945	4.968	1.844	2.594	9.144
c	13.091	13.039	11.412	7.566	8.936	13.924	15.960	13.039	12.565
LM_F	33.656	22.089	19.647	11.506	18.276	10.388	17.420	32.233	3.673
N	475	462	22	101	430	247	226	637	137

^aHeteroscedasticity-consistent standard error in parenthesis

Table 4: Total Factor Productivity Growth Estimates of Existing and New-Entry firms

*

	Pre-transition Productivity Performance	Post-transition Productivity Performance
Existing firms before 1991 reform	-0.004	0.003
New-Entry firms after 1991 reform	0.021	0.024

*Here TFP growth is calculated using the relevant Tornquist index number formula with markup μ and θ incorporated in the definition:

$$TFP = [\ln Y_t - \ln Y_{t-1}] - \mu[\alpha(\ln L_t - \ln L_{t-1}) + \delta(\ln M_t - \ln M_{t-1}) + (\theta/\mu - \alpha - \delta)(\ln K_t - \ln K_{t-1})].$$

where $\alpha = (1/2)(\alpha_t + \alpha_{t-1})$ and $\delta = (1/2)(\delta_t + \delta_{t-1})$. To identify the periods of pre- and post-transition we rely on the transition location mid-point estimate from table 3. Even though the changes in parameters follow a smooth transition, the mid-point of this transition provides a useful reference point for the timing of major reforms.

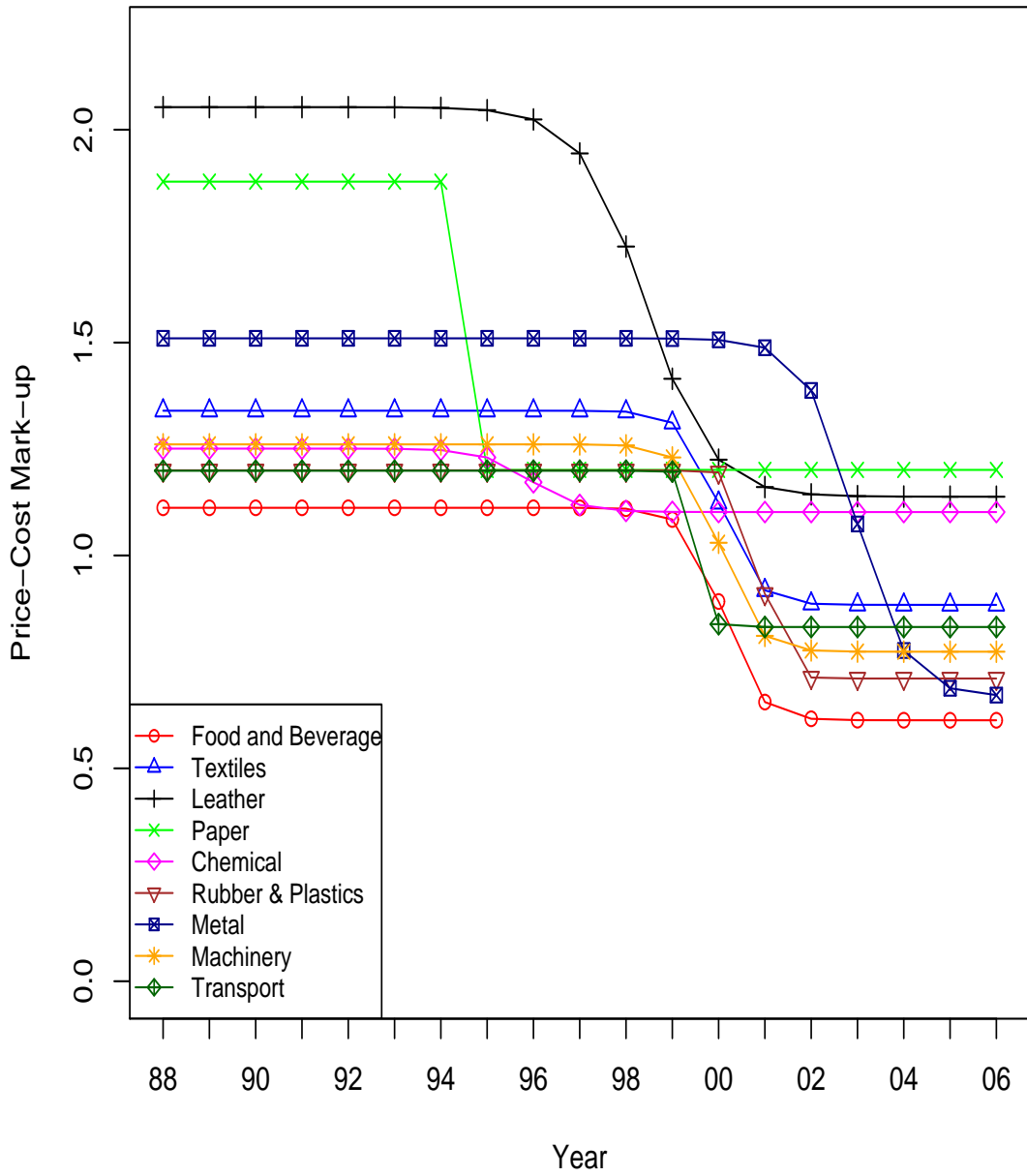


Figure 1: Estimated Price-Cost Mark-Ups

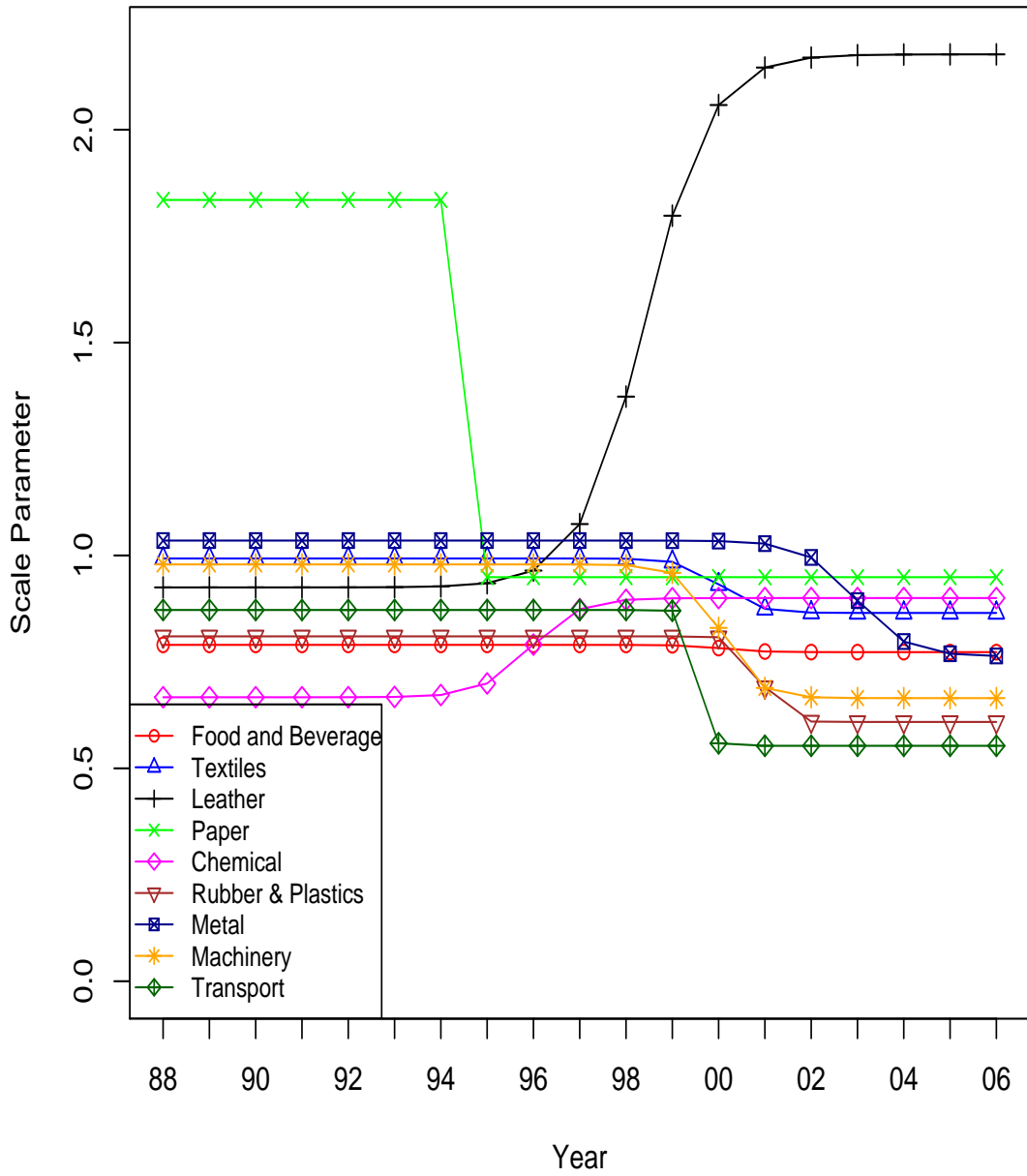


Figure 2: Estimated Scale Parameters