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THE EFFECTS OF ECONOMIC REFORMS ON MANUFACTURING DUALISM: EVIDENCE FROM INDIA

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Abstract

Dualism is a pervasive feature of the manufacturing sectors of less-developed countries, with large differences in productivity between the informal and the formal sectors. Policy distortions are viewed as an important factor behind the prevalence of manufacturing dualism. We examine whether tariff reforms, industrial de-licensing and the withdrawal of reservation of products for small firms implemented since the mid-1980s have had any effects on efficiency differentials between informal and formal firms in Indian manufacturing. We find strong evidence that economic reforms have exacerbated dualism by increasing the productivity differentials between the more efficient formal firms and the less efficient informal firms, and widening within industry efficiency differentials in both formal and informal firms.

***Key-Words*: reforms, dualism, efficiency, informal, manufacturing, Asia, India.**

JEL Classification: O17, L25, L60

I. INTRODUCTION

Dualism is a pervasive feature of the manufacturing sectors of most developing economies. Typically the manufacturing sector in these economies has a large low-productivity informal sector, where most firms reside, along with a relatively small high-productivity formal sector, comprising fewer firms (Little *et al*. 1987, Bourguignon and Morrisson 1998, Temple 2005). The informal sector comprises around two-thirds of non-agricultural employment and about a quarter of non-agricultural output in Africa and Asia (Charmes 2000, 2006), and in spite of strong economic growth in several African and Asian countries in recent years, the persistence in the size of the informal sector along with large differences in productivity and earnings between the informal and formal sectors has remained a matter of policy concern (ILO 2002, WTO 2009).

Persistence of manufacturing dualism has strong negative implications both for efficiency and equity in the economy. The lack of significant structural change that reallocates workers and firms from the low-productivity informal sector to the high-productivity formal sector constrains the growth of aggregate productivity in the economy.[1] At the same time, sharp

differences in earnings between workers in the informal and formal sectors and the existence of a large pool of workers in the informal sector leads to a high level of income and asset inequality, which may further increase if the process of economic growth is biased towards the growth of the formal sector rather than the informal sector (WTO 2009).

While the determinants of the persistence of manufacturing dualism is not well understood, it is commonly believed that an important factor behind the prevalence of dualism is the policy regime, and that trade and industrial policies that inhibit competition and technological change may exacerbate dualism, especially if they are protective of the formal sector or constrain the growth of the informal sector (Little 1987, Gang 1992, Tybout 2000). Economic reforms that allow for a level playing field between the informal and formal sectors may therefore act as a significant positive force in reducing dualism (World Bank 2005). However, it is not clear if this will indeed be the case if economic reforms provide a more favourable environment for the more well-resourced larger firms in the formal sector to expand and reap economies of scale, to obtain best-practice technology, and to seek market opportunities overseas as compared to less well resourced smaller firms in the informal sector. Therefore, whether economic reforms help reduce manufacturing dualism or exacerbate it is an empirical question.

In this paper, we examine the effects of economic reforms on manufacturing dualism, as evident by differences in total factor productivity levels between informal and formal manufacturing firms.[2] We are specifically interested in the technical efficiency differentials between formal and informal manufacturing firms and the effects of economic reforms on these differentials. We measure efficiency using the stochastic frontier method pioneered by Aigner *et al*. (1977). We look at both absolute and relative technical efficiency. Absolute technical efficiency captures the extent to which firms in the manufacturing sector are producing the maximum possible output, for a given bundle of inputs, in a given industry, and improvements in the absolute technical efficiency of the average firm imply a higher level of output being produced on average, for a given level of inputs in that industry (Kumbhakar and Lovell 2000). Relative technical efficiency, on the other hand, captures the extent to which the efficiency levels of other firms are close to the most efficient firm in a given industry, and improvements in relative technical efficiency imply a more *equal* distribution of efficiency in the industry.

We examine whether economic reforms have led to an increase in absolute and relative technical efficiency of informal firms relative to formal firms. If both the absolute and relative technical efficiency of informal firms have improved relative to formal firms, economic reforms would have reduced manufacturing dualism both by decreasing the distance in efficiency levels between the average firm in the formal sector and the average firm in the informal sector (if these differences in levels exist) and by decreasing the within industry differences in efficiency levels for firms in the informal sector relative to firms in the formal sector. In this case, economic reforms could be said to have positive effects on both the level and distribution of efficiency in the informal sector as compared to the formal sector, and therefore, have strong pro-poor growth effects.

The country we study is India, where there is a long history of manufacturing dualism (Little *et al*. 1987) and where about 80 per cent of manufacturing employment and 17 per cent of manufacturing output is in the informal sector (NCEUS 2007). It is commonly believed that the dualism evident in the manufacturing sector was a legacy of a set of economic policies that provided protection to the larger manufacturing firms from external competition via an import substituting industrialization policy regime and also made it difficult for new firms, whether domestic or foreign, to enter existing industries via a strict licensing policy (Panagariya 2008). At the same time, small firms were protected via a small scale sector reservation policy which did not allow larger firms to produce specific products that were seen as the domain of small firms (Mohan 2002). This led to an industrial structure where both very small and very large firms were present in the same industry, with significant productivity differences between the informal and formal sectors (Kochhar *et al*. 2006, Mazumdar and Sarkar 2008). In 1991, with the advent of major economic reforms, industrial licensing was abolished in the majority of industries, followed by a second wave of de-licensing in the mid 1990s. India has also witnessed rapid trade liberalisation since 1991, where there was a significant reduction in tariffs on most commodities (Sen 2008). The trade reforms were particularly targeted to the manufacturing sector which was among the most protected in the developing world prior to the 1990s (Bhagwati and Srinivasan 1975). The reservation of industries for the small sector was also gradually phased out since the mid 1990s. These reforms were mainly in product markets and varied substantially over time and across industries. Thus, they provide us a unique empirical context to evaluate the effects of economic reforms on efficiency differentials between informal and formal firms. [3] Existing studies do not provide an unambiguous answer on the impact of these reforms on efficiency

of formal and informal manufacturing firms, and whether there has been a widening or narrowing increasing efficiency gap between formal and informal firms following these reforms (Kathuria *et al.* 2010). This is an issue that needs further empirical analysis.

To investigate the effect of economic reforms, we use a very rich data-set which combines large representative surveys of informal firms with the census of manufacturing data on formal firms. The data are pooled cross-sections of firm-level data, available quinquennially, beginning in 1989-90 and ending in 2005-06. We use stochastic frontier analysis to obtain firm level measures of absolute and relative efficiency. If the location of the firm either in the formal or in the informal sector is not random but depends on firm choice, a comparison of efficiency levels between firms in the informal and formal manufacturing sectors without addressing the endogeneity of firm location is not correct. Such a comparison would bias upwards the efficiency levels of formal manufacturing firms if these levels depended on the firm being located in the formal sector. Our stochastic frontier analysis corrects for selection bias, using a methodology proposed by Greene (2010). We find strong evidence that economic reforms have exacerbated the productivity differentials between the average firm in the informal and formal sectors. At the same time, it has increased the gap in efficiency levels between the average firm and the most efficient firm within industries for both the formal and informal manufacturing sector, though the increase in the efficiency gap is more prominent for formal firms as compared to informal firms. Thus, economic reforms have caused an increase in manufacturing dualism in India by increasing efficiency differentials between formal and informal firms, and have had an unequalising effect on efficiency levels for both formal and informal firms within industries.

The rest of the paper is in six sections. In the next section, we provide a brief discussion of the Indian policy regime pertaining to the manufacturing sector. In Section III, we describe our econometric methodology. In Section IV, we discuss the empirical specification. Section V describes the data and the variables used in the empirical analysis. Section VI presents the results of the empirical analysis. Section VII concludes.

II. POLICY REFORMS IN INDIAN MANUFACTURING

The formal sector in India is taken to be definitionally equivalent to the organized sector, which comprises firms which are registered under the Indian Factories Act of 1948. Firms have to register under the Factories Act if they employ ten or more workers and use power, or if they employ twenty or more workers. Registration under the Factories Act implies that the

firm will need to comply with a wide range of government regulations that are exclusively applicable to the formal sector. However, it also implies that the firm will be able to access credit from the formal financial sector, including loans from specialized development financial institutions and commercial banks. Among the most onerous government regulations that firms in the formal manufacturing sector in India face are employment protection legislation which is among the most restrictive in the world (Ahsan, Pages and Roy 2008, Dougherty 2008). In addition, all firms in the formal sector, irrespective of size, are subject to environmental regulations and minimum wage legislation, which informal sector firms are not.

The most important set of policies that the Indian government has followed with respect to the manufacturing sector was a comprehensive industrial licensing system (more commonly known as the License Raj in the literature). For first four decades since independence, the government intervened in almost all aspects of the activities of formal manufacturing firms. Industry in India was subject to rather formidable legal barriers to entry. Investments, both in terms of expansion of capacity of existing firms and creation of new firms, was controlled by the government through its licensing policies that were in turn determined according to plan priorities. Though the purported objective of the licensing regime was balanced growth, it effectively led to a more monopolistic structure and significantly encouraged rent-seeking by corporations entrenched with public powers (Aghion *et al*. 2008). Following an initial attempt in 1975-76, the liberalisation of industrial controls gathered momentum in 1985-86 when some industries and medium sized firms were taken out of the purview of industrial licensing and modernisation of equipment along with expansion of capacity were also allowed in a limited manner. In 1991, the License Raj effectively came to an end, when industrial licensing was abolished irrespective of the level of investment except for sixteen core industries (this list of licensed industries was further reduced in 1996-97). The number of industries reserved for the public sector was significantly reduced. Also, under the new policy guidelines on foreign investment, automatic permission is granted for foreign equity participation up to 51 per cent in a specified list of high technology and high investment priority industries.

In addition to the industrial licensing system, the Indian government followed a trade regime since independence which was aimed at the comprehensive, direct control over foreign exchange utilisation, with an overwhelming reliance on quotas rather than tariffs (Bhagwati

and Srinivasan 1975). The trade regime provided a significant degree of protection to firms in Indian manufacturing. Nearly all imports were subject to discretionary import licensing or were "canalised" by government monopoly trading organisations. Beginning with the export-import policy of 1977-78, there was a slow but sustained relaxation of import controls. The pace of the trade reforms - in particular, the shift from quantitative import controls to a protective system based on tariffs - initiated in the mid-seventies were considerably quickened in the second half of the 1980s. Restrictions on the import of capital goods were further eased to encourage technological modernisation. In 1991, as a part of the comprehensive economic reform programme initiated that year, there was a significant liberalization of the trade regime with respect to capital goods. Import licensing was virtually abolished with respect to the imports of most machinery and equipment and manufactured intermediate goods (Sen 2008). There was also a significant cut in tariff rates, with the peak tariff rate reduced from 300 per cent to 150 per cent and the peak duty on capital goods cut to 80 per cent. Import-weighted custom duty rates fell from an average of 97 per cent in 1990-91 to 29 per cent in 1995-96.

While the industrial licensing and trade policies were mostly targeted to the formal manufacturing, the reservation policy for the small-scale sector which initiated in 1967 mostly applied to the informal sector. Under this policy, selected products were identified for exclusive production by the small-scale sector.[4] The products chosen for reservation by the government were very diverse, and covered industries such as food, chemicals, electronics and textiles. The initial list of products reserved for the small-scale sector was 47 but this increased to 836 by 1989 (Mohan 2002). Entry into the products reserved for the small scale sector was not allowed for large firms and by foreign investors. While the small-sector reservation policy was designed to protect small firms, it also did not allow these firms to grow, to invest in quality upgrading and to benefit from foreign direct investment (Mohan 2002, Mazumdar and Sarkar 2008). Starting in 1997, products were gradually removed from the reservation list and by 2010, only 21 products remained on this list.

Industrial de-licensing, trade reforms and de-reservation are product market reforms and were the most important set of reforms enacted by the Indian government with respect to the manufacturing sector. In contrast, there were less significant reforms in factor markets that manufacturing firms operate in, such as land, labour and credit markets (Joshi 2010). We investigate in this paper whether the product market reforms enacted since the mid-1980s

have led to a widening or narrowing efficiency gap between formal and informal firms, if such a gap existed in the first place. We investigate this issue in the empirical analysis. But first we set out our econometric methodology below.

III. ECONOMETRIC METHODOLOGY

Our methodology involves two steps. In step 1, we estimate efficiency of a firm. In step 2, these efficiency estimates are then used to see the impact of product market reforms on duality.

We use stochastic frontier analysis (SFA) to estimate firm efficiency.[5] We are interested in determining the technical efficiency of the firm – the maximum possible output that a firm can produce, given its inputs. The standard approach to SFA is the one proposed by Aigner *et al*. (1977). Under this approach, a single-equation cross-sectional stochastic production frontier model is estimated, with the assumption that firm i uses the input vector x_i to produce a single output y_i based on the following equation:

$$y_i = x_i\beta + (v_i - u_i)$$

$$where\ u_i = |\sigma_u U_i| = \sigma_u |U_i|, U_i \sim N[0,1] \quad \text{---------- (1)}$$

$$y_i = \sigma_v v_i \sim N(0,1)$$

The model is estimated using the maximum likelihood method. However, the model does not account for selection bias. If being located in the formal sector is not by chance but by choice, a comparison of efficiency levels between firms in the informal and formal manufacturing sectors without addressing the endogeneity of firm location is not correct. It is, therefore, necessary to correct for selection bias in firm location in the informal or formal manufacturing sector in the estimation of technical efficiency.

Correcting for Selection Bias

The method proposed by Heckman (1976) is the conventional one used in the literature to correct for the selectivity bias. It involves two steps. In the first stage, the probit model is fitted to the data and estimate the sample selection equation. In the second stage, the model is fitted to the selected sample data by adding the inverse Mills ratio obtained from the first step as an independent variable to correct for selectivity bias and test its significance.

As is argued by Greene (2010), this approach is not appropriate for models that are non-linear in nature such as probit and tobit models.[6] As an alternative, Greene (2010) proposed an internally consistent method of incorporating 'sample selection' into a stochastic frontier framework. He proposes the following analytical approach:

$$d^* = \alpha' z + w, d = 1, d^* > 0 \quad \text{---------- (2)}$$

$$y = \beta' x + v - u \quad \text{---------- (3)}$$

$u = |U|, with\ U \sim N[0, \sigma_u^2]$

$(v.w) \sim bivariate\ normal\ with\ [(0,0), (\sigma_u^2, \rho\sigma_v, 1)]$

$(y, x) only\ observed\ when\ d = 1$

where d is a probit selection equation (with adoption depending on a host of price and non-price factors) and y is the stochastic frontier function, specified only for the adopting firms.

The estimation is divided into two parts. For the selected observations, d=1, conditioned on v, the joint density for y and d is the products of the marginals as conditioned on v, where y and d are independent.

$$f(y, d = 1|x, z, v) = f(y|x, v) prob\ (d = 1|z, v)$$

This is the second part. For the first part,

$$y|x, v = (\beta' x + \sigma_v v) - \sigma_u u$$

where u is the truncation at zero of a standard normal variable.

Therefore, the joint conditional density is given by:

$$f(y, d = 1|x, z, v) = \frac{2}{\sigma_u} \Phi\left(\frac{(\beta' x + \sigma_v v) - y}{\sigma_u}\right) \varphi\left(\frac{\alpha' z + \rho v}{\sqrt{1-\rho^2}}\right) \quad \text{---------- (4)}$$

We obtain the unconditional density by integrating v out of equation (4). The integral does not exist in a closed form and hence, Greene (2010) proposes computation by simulation. The final simulated log likelihood is given by:

$$\log L_s = \sum_i \log \frac{1}{R} \sum_{r=1}^{R} \left\{ d_i \left[\frac{2}{\sigma_u} \Phi\left(\frac{\beta' x + \sigma_v v_{ir} - y}{\sigma_u}\right) \varphi\left(\frac{\alpha' z + \rho v_{ir}}{\sqrt{1-\rho^2}}\right) \right] + (1 - d_i) \left[\varphi\left(\frac{-\alpha' z + \rho v_{ir}}{\sqrt{1-\rho^2}}\right) \right] \right\} \quad (5)$$

The model is estimated using NLOGIT version 4.

IV. EMPIRICAL SPECIFICATION

As is clear from the discussion, the implementation of SFA with correction for selection bias involves two stages – in the first stage, estimation of a probit equation which models the selection of firms into the informal and formal sectors, and in the second stage, estimates for the production function and for technical efficiency are obtained, conditioned on the sample selection. Once we obtain the efficiency estimates, in the third stage of the analysis, we carry out regressions where the firm level measure of efficiency is the dependent variable and the key explanatory variables are a composite measure of reforms and the firm's location in the formal or informal sector, along with other controls.

First Stage Analysis

We assume that firms can choose between being in the formal or informal sector subject to a set of variables that capture the benefits and costs of formalization. The decision of the ith firm to be in the formal sector is described by an unobservable selection criterion function, F*, that is postulated to be a function of variables that determine the benefits and costs of formalization. The model is specified as:

$$F^* = \alpha Z_i + w_i \qquad (6)$$

Where Z is a vector of variables explaining the decision to formalize, α is a vector of parameters, and w_i is the white noise error term.

The selection criterion F* is not observed. Instead, a dummy variable F is observed which takes the value of one for formal sector firms, and zero for informal sector firms.

Therefore, F = 1, if $F^* = \alpha Z_i + w_i \geq 0$; and F = 0, otherwise

To obtain the set of explanatory variables which determine the benefits and costs of formalization, we draw from recent theoretical literature on why firms formalize. We also exploit the fact that there are important differences in institutions relating to labour regulation, access to credit and the provision of infrastructure across Indian states and over time. A key factor that has been highlighted by both the theoretical and empirical literature is the degree of regulation faced by the firm if it chooses to be in the formal sector (Fajnzylber *et al*. 2011, Ulyssea 2010, Taymaz 2009, Dabla-Norris *et al.* 2005). While the regulatory framework relating to product market entry and exit are the same across states in India, labour regulations have differed greatly across Indian states. Industrial relations in India fall under the joint jurisdiction of the central and state governments. A particular piece of labour

legislation that has particularly detrimental to the growth of the formal manufacturing sector in India, and has encouraged informality, is the Industrial Disputes Act (IDA) of 1947, which sets out the conciliation, arbitration and adjudication procedures to be followed in the case of an industrial dispute. The IDA applies only to formal sector firms and imposes significant restrictions on employers regarding layoff, retrenchment and closure.[7]

Since labour laws are both within the jurisdiction of state and central governments, the IDA has been extensively amended by state governments during the post-independence period. Besley and Burgess (2004) have coded each state amendment to labour laws as neutral, pro-worker or pro-employer for the period 1947-1997. We extended the Besley-Burgess variable till 2005 and then normalized it between 0 and 1 such that the more pro-employer labour law amendments in a state would result in higher value for that state. We would expect that more pro-employer labour law amendments *(LABOUR LAWS*) as seen by a higher value of our variable would have a positive effect on the firm's decision to formalize.

A second factor highlighted by the theoretical literature is access to formal sector credit (Straub 2005). The higher the likelihood for a firm to obtain formal sector credit, which are usually on more favourable terms than informal sector credit and at lower interest rates, the more likely that the firm will choose to be in the formal sector. This is because registration as a formal sector unit is often a precondition for firms to access credit from specialized formal sources such as commercial banks and development finance institutions. In India, government regulations made it mandatory for commercial banks to lend a large proportion of their funds to small and medium enterprises in the formal manufacturing sector (which are mostly the units that are making the transition from the informal sector) along with farmer-households in the agricultural sector – these regulations were called priority sector lending requirements (Sen and Vaidya 1997). Access to priority sector lending depended a great deal on the level of financial development in a given state, and this differed from state to state and across time (Burgess and Pande 2005). We capture differential access to formal sector credit for small and medium enterprises across Indian states and over time by the share of bank lending going to priority sectors (*PRIORITY SECTOR LENDING*) for 1989-90, 1994-1995, 2000-01 and 2005-06.

Our third variable to explain the decision of a firm to formalize is the provision of a productive public good to formal sector firms which creates a strong incentive to formalize (Dessy and Pallage 2003). We take the public good to be electricity, which has been found to

be a binding constraint for formal manufacturing growth in India (World Bank 2004). Indian states have differed widely in their ability to provide electricity to manufacturing firms, in part due to the very different performance of State Electricity Boards, the main agency responsible for transmission and distribution, across Indian states (Krueger and Chinoy 2002, Panagariya 2008). We measure the electricity constraint on a firm's decision to formalise by the real price of power supply (*COST OF POWER SUPPLY*), which is less subject to endogeneity concerns in comparison to measures of electricity infrastructure such as the degree of electrification (Cali and Sen 2011). A higher price of electricity would reflect better quality of electricity provision (for example, less frequent power outages) and provide an incentive for firms to move from the informal to the formal sector to take advantage of electricity provision in the state, but it could also deter informal firms to move into the formal sector as the cost of production in the formal sector increases. Which of the two impacts dominate is an empirical issue.

Finally, we assume that the larger the firm (in terms of employment) (*FIRM SIZE*), the more likely it will be that the firm is in the formal sector as it will be difficult for the firm not to be noticed by regulators (and state agents such as tax and labour officials) if it remains in the informal sector (Taymaz 2009).

We estimate probit model of the following type:

$$F = f(\textit{LABOUR LAWS, PRIORITY SECTOR LENDING, COST OF POWER SUPPY, FIRM SIZE}) \quad \text{----------(7)}$$

where F is 1 if the firm is in the formal sector, 0 otherwise. We expect that the signs of the *LABOUR LAWS, PRIORITY SECTOR LENDING* and *FIRM SIZE* will be positive. The sign on *COST OF POWER SUPPY* will be indeterminate.

We estimate the probit equation for each industry separately, but for all four years combined. We explain below why we estimate the probit model separately for each industry.

Second Stage Analysis

The production behaviour of formal and informal sector firms is modeled using a simple Cobb Douglas function. Thus, we have:

$$\ln(Y_{iT}) = \beta_0 + \beta_1 \ln(K_{iT}) + \beta_2 \ln(L_{iT}) + (v_{iT} - u_{iT}) \quad \text{----------(8)}$$

Where T=1989-90. 1994-95, 2000-01 and 2005-06 and i is the firm. Y is gross value added, K is capital stock, L is labour, and βs are the parameters to be estimated. The v_{iT}s are random variables independent of the u_{iT}s and purport to capture the random shocks that are beyond the control of firms. The u_{iT}s capture technical inefficiency and are the combined outcome of non-price and organizational factors that constrains a firm from achieving their maximum possible output from the given set of inputs and technology. The u_is are non-negative and assumed to be identically distributed at truncations at zero, $u = |U|$ with $U \sim N [0, \sigma^2_u]$. Thus technical efficiency (TE_i) is measured as the ratio of the observed output of the firm to the potential output derived by the frontier function. We examine both the absolute and the relative technical efficiency of firms in our sample, where the latter is defined as the difference between the actual absolute technical efficiency for the firm in question and the maximum absolute efficiency obtained for a given industry in a given year.

Instead of estimating the same production function for the entire set of firms, irrespective of industry, we estimate equation (8) industry by industry, at the National Industrial Classification (NIC) 2 digit industry level (broadly corresponding to the International Standard Industrial Classification (ISIC) 3 digit level of industrial classification used by the United Nations Industrial Development Organization). There are twenty-two industries in our data-set (we provide the list of industries along with the industry codes in Appendix A). By estimating the production function for firms at the industry level instead of economy-wide production functions, we allow for the parameters for capital and labour in the firm-level production function to differ across industries – a reasonable assumption to make when the industries differ so widely in their production technology and in characteristics relating to export orientation and market structure (e.g., leather versus electrical machinery).

Third Stage Analysis: Testing for Impact of Reforms on Technical Efficiency

Once we have estimated efficiency at the firm level, we regress firm-specific technical efficiency scores on a composite measure of reforms (REFORM), along with a dummy variable that capture whether the firm belongs to formal or informal sector. As discussed in Section II, the major product market reforms that have occurred in the Indian economy since the mid-1980s were the withdrawal of the requirement of a license that firms require if they wish to produce in a given industry (DELICENSE), the de-reservation of products earlier earmarked only for small scale and informal producers (DERESERVE) and trade reforms in

the form of cuts in import tariffs (TARIFF). The Composite measure is a weighted index of these three reforms and is given by: $REFORM_{jt} = {}_{i=1}\Sigma^{3} w_i Reform_{ijt}$

where w_i is the weight for each of the product market reform variables – De-licensing, De-reservation and Tariffs. We assume equal weights for each the three product market reform variables (that is $w_i = 0.33$).

To estimate the effect of economic reforms and firm location in the formal sector on technical efficiency, we use the following specification:

$$TE_{ijt} = \alpha + \beta_1 * FORMAL_{ijt} + \beta_2 * REFORM_{jt} + \delta_j + \gamma_t + \varepsilon_{ijt} \quad \text{----------(9)}$$

Where TE_{ijt} is technical efficiency of firm i in industry j and year t, *FORMAL* is a dummy which takes the value one if the firm is in the formal sector, and zero if the firm is in the informal sector. δ_j are industry fixed effects, γ_t are year effects and ε_{ijt} is the error term. If β_2 is greater than zero (and statistically significant), this would imply that product market reforms have facilitated firms to increase their efficiency. Similarly, if β_1 is greater than zero (and statistically significant), formal firms are more efficient than informal firms, while if β_1 is less than zero, informal firms are more efficient than formal firms. For TE, we use both absolute and relative technical efficiency as our dependent variables.

The impact of the three types of economic reforms – de-licencing, de-reservation and trade reforms - may be different on formal versus informal firms. Consider first the de-licensing reforms of the mid-1980s and early 1990s that largely pertained to the formal manufacturing sector. With the withdrawal of restrictions on firm expansion and new firm entry, formal firms would be expected to increase in size and reap economies of scale. In addition, new firm entry is likely to bring about an increase in average efficiency of formal firms in a given industry, both by exerting competitive pressures on incumbent firms and via the entry of more productive new firms into the industry (Taymaz, 2005).[8] At the same time, informal firms may have benefited indirectly from the license reforms as expanding formal firms entered into sub-contracting arrangements with informal firms for supply of inputs, and invested in the technological capabilities of informal firms to be reliable and high quality suppliers of specialized intermediate and capital goods for the formal sector (Schmitz 1982, Yang and Chen, 2009).

Similarly, trade reforms in the form of reduced tariffs would have a pro-competitive effect on those firms that are in direct competition with imports, these firms being mostly in the formal

sector (Tybout 2000). Since informal firms primarily cater to the local market, and do not compete directly with imports, the efficiency enhancing effects of trade reforms would be less for these firms. On the other hand, informal firms would be better able to adjust their use of labour and capital in response to trade reforms as compared to formal firms who face various policy induced impediments to the adjustment of factors of production. Thus, it is not clear that trade and license reforms would necessarily increase efficiency levels in formal firms more than in informal firms.

With respect to the de-reservation of products for the small scale sector, it would be expected that these reforms would benefit informal firms in particular as these firms would not face disincentives to expand the scale of production that existed under the reservation policy (since the size limits that applied under this policy penalized the expansion of firms). Efficiency levels of informal firms may also increase via the greater competition that these firms will face from formal firms entering into product markets that were reserved for small firms. At the same time, the ability of formal firms to move into new product markets may provide efficiency gains to these firms as they obtain both economies of scale and scope in production.

To examine the differential impact of reforms on informal and formal firms, we introduce an interaction term (FORMALxREFORM), where we interact our reform variable (REFORM) with the variable that captures whether a firm is formal or not (FORMAL). Thus, the revised model estimated is as follows:

$$TE_{ijt} = \alpha + \beta_1 * FORMAL_{ijt} + \beta_2 * REFORM_{jt} + \beta_3 * FORMALxREFORM_{ijt} + \delta_j + \gamma_t + \varepsilon_{ijt} \quad \text{----------(10)}$$

The coefficient β_3 measures the differential impact of reforms on formal and informal firms. A positive and statistically significant β_3 (along with a positive and statistically significant β_2) implies that reforms have led to greater increase in the efficiency of formal firms as compared to informal firms. A negative and statistically significant β_3 would imply just the reverse.

We estimate the above equations using Ordinary Least Squares. There is a possibility that the FORMAL variable is endogenous if firms with higher technical efficiency may tend to move to the formal sector. We do not need to use instrumental variable methods as our first stage analysis controls for this possibility and therefore, of simultaneity bias.[9]

V. DATA AND VARIABLES

We use unit level data for the formal and informal manufacturing sectors for four years, 1989-90, 1994-95, 2000-01 and 2005-06.[10] The choice of years is governed by the fact that the data on informal sector firms are only available for these years. Data on the formal manufacturing sector is drawn from the Annual Survey of Industries (ASI), undertaken by the Central Statistical Organization (CSO), which is the annual census-cum-sample survey of all the formal manufacturing units for all the industries across all the states. For the informal sector, we use the National Sample Survey Organization (NSSO) firm-level surveys on the informal manufacturing sector (that is, those firms which are not registered under the Indian Factories Act of 1948) which are undertaken quinquennially using a stratified sampling procedure.[11] The average number of firms in the formal sector that we use in our empirical analysis is 25,000 and for the informal sector, 28,000.

The variables for the stochastic frontier model are real value added and real capital stock at 1993-94 prices and number of persons employed. We omitted observations for which real value added, real capital and the labour variables are less than or equal to zero. Real value added is obtained by deflating nominal value added using the wholesale price index (WPI) for manufactured products at the four digit industry level. Labour is measured as total number of persons engaged in the production activity, which include production workers as well as employees. Real capital stock is constructed by deflating gross fixed assets by WPI for machinery and machine tools. To ensure that the empirical analysis is not sensitive to the inclusion of outliers, we have dropped all firms where real capital stock, employment or real output are more than two standard deviations from the industry means of these variables.

Labour regulation data till 1997 comes from Besley and Burgess (2004), and we have updated it using similar coding procedures till 2005. Data on the share of credit going to the priority sector are drawn from Burgess and Pande (2005) till 1995, and we have updated it for the years 2000-01 and 2005-06 from an annual publication titled *Statistical Tables Relating to Banks in India* published by the Reserve Bank of India (RBI). The data on the cost of power supply comes from the Indian Planning Commission (2002).

We obtain simple and weighted tariffs ratios from the trade and industrial output data of the *World Bank Trade Data-base* (World Bank 2006). The *World Bank Trade Data-base* provides simple and import weighted average tariffs data for 28 manufacturing sectors at the ISIC 3 digit level of classification till 2001. We match the data to the NIC 3 digit

classification of the Annual Survey of Industries. Thus, our tariff variables vary across industries and over time (but not across states).[12]

As discussed, the de-licensing of industries started in 1980s with nearly half of the 4-digit industries de-licensed by 1985. The industrial licensing was effectively abolished in 1991 with only few industries requiring licensing requirement. As of 2006-07, only 4 per cent of the industries were under licensing requirements. We construct the de-licensing variable as the total number of four-digit industries de-licensed in a year to that of total number of four-digit industries in the sector. Similar to Aghion et al. (2008), we consider an industry to be de-licensed if all or part of a four-digit industry (3-digit in their case) is de-licensed in a year.

The reservation of items for exclusive manufacture in small scale sector, as statutorily provided for in the Industries (Development and Regulation) Act, 1951, was one of the key policy measures to promote the sector. The only exception to this reservation was allowed if a non-small scale sector unit undertakes 50 per cent export obligations of the reserved product. We construct the de-reservation variable as the cumulative number of products de-reserved in respective two-digit industries to that of total reserved products in the industry. The list of number of products de-reserved is obtained from different notifications of the Government of India. Like tarffis, our de-licensing and de-reservation variables also vary across industries and over time, but not across states.

Figure 1 and Table 1 present the trend in de-licensing, de-reservation and tariffs since 1985 onwards for the entire manufacturing sector while Table 2 gives industry-wise reforms accomplished till 2005-06. Most of the de-licensing reforms were over by 1995, whereas de-reservation reforms started only after 1995. There was not much progress in tariff reforms after the early 2000s. [13]Two important points are to be noted – a); a) as Table 2 makes clear, the pace of the three product market reforms differed greatly across industries e.g., tobacco is yet to be de-licensed but fully de-reserved while paper is fully de-licensed but only 39 per cent of the industry is de-reserved and b) by 2005-06, the terminal year of our study period, almost all industries have been fully de-licensed (except for food products, tobacco, chemicals and transport equipment), only nine out of 22 industries have been fully de-reserved and there is very little difference in tariff rates across industries with the average tariff being at 29 per cent (ranging between 24 per cent to 37 per cent). .

INSERT TABLE 1

INSERT FIGURE 1

INSERT TABLE 2

Once we have data for different product market reforms, we construct a composite index (REFORM) with equal weights for all the reforms. Since direction of reforms is different for different reforms - trade reform moves from high to low, whereas other two reforms move from low value to high with progressive reforms - we reconstruct our tariff reform variable as 100 - Current Tariff. This modification reconciles the direction of tariff reforms with other two reforms. A high value of REFORM thus indicates significant reforms and vice versa. There is a significant heterogeneity in the reforms for different industries as indicated in Figure 2. Industries like tobacco, minerals and transport equipment are much behind the reforms compared to textiles, apparels, leather, office machinery, publishing and basic metals.

INSERT FIGURE 2

Table 3 presents the descriptive statistics for the main variables that we use in our estimation – both the first stage probit model and the second stage stochastic frontier estimation and testing for duality in manufacturing. On average, priority sectors such as small-scale industries, services and agriculture together received about 31 per cent of the total bank lending for the period 1989-90 to 2005-06. The labour regulation variable suggests that, on average, labour laws in India have been pro-worker. It is clearly evident from the Table that average value added per employee is considerably higher for firms in the formal sector as compared to their counterparts in the informal sector. Evidence also points to significant differences in the level of input use between firms in the formal and informal sector. The capital-labour ratio computed for both the sectors suggest the highly capital intensive nature of production process employed in the formal sector vis-à-vis the informal sector.

INSERT TABLE 3 HERE

VI. RESULTS

We first present the results for the first stage estimation followed by the results for the second stage and third stage estimation respectively.

First stage estimation

We present the results of the first stage probit equation estimation in Table 4. The chi-square test statistic in the probit selection equation is significant at the 1 per cent level in all the industries except three industries, namely medical, precision and optical instruments, office machinery and basic metal industries. As expected, the likelihood of the firm being in the formal sector is positively correlated with firm size (*FIRM SIZE*). We also find that weaker labour regulation (*LABOUR LAWS*) significantly and positively influences the firm's decision to be in the formal sector. By and large, wherever the variable is significant in the industry by industry results, there seems to be a positive relationship between the availability of power (*COST OF POWER SUPPLY*) supply and the firm's decision to be in the formal sector. This suggest that the greater the quality of the electricity supplied in a given state, the more likely is it that firms in that state will be formalized. In most industries, greater availability of priority sector lending (*PRIORITY SECTOR LENDING*) from commercial banks seems to have a greater likelihood of firms to be in the formal sector.

INSERT TABLE 4 HERE

Second stage estimation

Table 5 and Figure 3 give the summary statistics for variables used in estimating stochastic production frontier for formal and informal firms separately. As expected, in each industry the informal firms on an average use less labour and capital and produces less, though the variation is smaller for the group. These differences in input usage is also clearly evident from Figure 3 which displays kernel density plots showing cumulative differences in the logged values of value added, capital stock and labour between formal and informal sector.

INSERT TABLE 5 HERE

INSERT FIGURE 3 HERE

The maximum likelihood estimates of the parameters of the model obtained from estimating the stochastic production frontier model separately for 22 industries are presented for 1989-90, 1994-95, 2000-01 and 2005-06 in Tables 6 and 7 respectively. [14] The models estimated by the maximum likelihood method are highly significant as shown by the large likelihood values. The coefficient of the selectivity variable ($\rho_{w,v}$) is significantly different from zero at the 5 per cent level in most of the industries especially for 2000-01 and 2005-06, which confirms that serious selection bias exists, thereby supporting the use of a sample-selection framework in the stochastic frontier model. The results of the stochastic production frontier

models show that as expected in a labour surplus economy, labour is a more important input than capital in the production function – the coefficient of labour is higher than that of capital for most industries and for most years. [15] We also examine whether there was a change in the estimated parameters of the industry production functions over time – we do not find evidence of any significant change as the t-ratio for differences in coefficients is found to be insignificant for most industries and most years.

In Figure 4, we present kernel density plots of changes in absolute technical efficiency for formal and informal firms for selected industries. We observe that absolute efficiency levels of firms in the formal and informal sector show a clear improvement over time.

INSERT TABLE 6 HERE

INSERT TABLE 7 HERE

INSERT FIGURE 4 HERE

Third Stage Estimation: Impact of Reforms on Dualism

We now examine how the reforms have impacted on dualism in Indian manufacturing. This is done in two steps – first, we directly assess the impact of reforms on absolute and relative efficiency of Indian manufacturing firms in an estimate of equation (9).[16] In the next step, we see whether reforms have reduced or exacerbated manufacturing dualism. This is tested by including an interaction term between the variable REFORM and the dummy for Formal firms in an estimate of equation (10). To take into account that efficiency may be impacted by macroeconomic shocks and cyclical factors and that firm efficiency may be correlated with unobserved industry characteristics, we include year and industry fixed effects in all our regressions. In Cols. (1) and (5) of Table 8, we present our results on the effects of reforms and firm location in the formal sector on absolute and relative technical efficiency, and in Cols. (1) and (5) of Table 9, we present the results for both absolute and relative technical efficiency, with the interaction term included.

Our estimates of equation (9) as reported in Table 8 show that formal firms are, on average, more efficient than informal firms and that the efficiency level of the representative firm in the formal sector is closer to the maximum efficiency level in a given industry than is the case for the representative firm in the informal sector – the coefficients on the Formal sector dummy is statistically significant at the 1 per cent level for absolute and relative technical efficiency in Cols. (1) and (5). Reforms have induced all firms, both formal and informal, to

be more efficient as given by the positive and statistically significant coefficient of the REFORM variable when the dependent variable is absolute technical efficiency. Interestingly reforms have led to decline in relative technical efficiency, as indicated by the negative and statistically significant coefficient of REFORM variable. This suggests that that economic reforms have led to a wider dispersion in firm efficiency, as the efficiency level of the representative firm in a given industry is further away from that of the most efficient firm in that industry. Based on the coefficient value of the variable FORMAL, the results indicate that the absolute efficiency level of formal firms is higher by 1.22 per cent as compared to that of informal firms, whereas the difference between the efficiency level of the representative informal firm and the maximum efficiency level in a particular industry is 2.5 per cent less as compared to a similar efficiency gap for formal firms.

To see how reforms have impacted on manufacturing dualism, we introduce the interaction of the composite measure of reforms (REFORM) with that of whether the firm is in the formal sector or not (FORMAL) in an estimate of equation (10). The results are reported separately for absolute and relative technical efficiency in Col (1) and Col (5) of Table 9 respectively. We find that the interaction term is positive and significant for absolute technical efficiency and negative and significant for relative technical efficiency, while the coefficient on the reform variable remains positive and significant in the case of absolute technical efficiency and negative and significant in the case of relative technical efficiency.[17] Thus, economic reforms have brought about a widening of efficiency differentials between formal and informal firms where formal firms were more efficient than informal firms to begin with, exacerbating dualism in the Indian manufacturing sector. At the same time, the efficiency gap between the representative firm and the most efficient firm in a given industry widened more in the formal sector as compared to the informal sector following reforms. The latter finding could be due to significant barriers to exit for formal firms as compared to informal firms in India, possibly leading to a lack of exit for the less productive firms in the formal sector after reforms relative to the informal sector.[18]

We estimate the extent of differential impact of REFORM variable on the efficiency of formal and informal sector firms. Calculations indicate that for the average values of REFORM variable, the efficiency difference between formal and informal firms is 0.04 for absolute efficiency and 5.35 for relative technical efficiency. At the mean value of absolute technical efficiency (0.44), this suggests that reforms have increased the efficiency of formal

firms by 9 per cent vis-à-vis informal firms. Similarly, relative to a mean relative technical efficiency of 24.5 per cent, the efficiency gap between the representative formal firm and the most efficient firm in a particular industry has increased by 21.9 per cent as compared to the efficiency gap between the representative informal firm and the most efficient firm in the same industry. The REFORM vs efficiency relationship in the formal and informal sectors is also captured in Figure 5 where we plot our REFORM variable against absolute and relative technical efficiency.[19] The figure shows that the relationship is stronger in the formal sector as compared to the informal sector, and that the relationship between absolute technical efficiency and the reform variable is positive, while the relationship between relative technical efficiency and the reform variable is negative.

INSERT FIGURE 5 HERE

As we have noted in Section V, the extent of de-licensing, de-reservation and trade reforms differed widely across industries and over time. Figure 2 indicated that trade reform has had a significant overlapping timeline with de-licensing and de-reservation reforms. To test the impact of three sets of reforms, we enter each reform variable sequentially rather than including all of them at the same time in equation (9). Col (2) to Col (4) and Col (6) to Col (8) in Table 8 presents the results for each of the reform variables on absolute and relative technical efficiency respectively. All the three types of reforms - increased de-licensing, de-reservation and tariff reduction – have had a discernible positive impact on absolute technical efficiency, as indicated by the positive and statistically significant coefficients on the DELICENSE andDERESERVE variables and the negative and statistically significant coefficient on the TARIFF variable.[20] Interestingly the impact of reforms is not identical in the case of relative technical efficiency. De-licensing reform widens the gap between the most efficient firm and average firm in the industry, while trade reform has reduced it. However, de-reservation has no impact on relative technical efficiency. The results indicate that additional de-licensing, de-reservation and tariff reforms to the tune of 10 per cent from their mean values would have resulted in an 7 per cent, 1.8 per cent and 1.3 per cent increase in absolute efficiency of Indian manufacturing firms respectively. The gap between most efficient firm and the average firm increased by 6 per cent in case of de-licensing, but the gap decreased by half a percent in the case of trade reforms. [21]

To see how individual reforms have influenced manufacturing dualism, the interaction of the three reform variables with that of whether the firm is a formal firm or not (FORMAL) has

been introduced sequentially. Cols (2) to (4) and Cols (6) to (8) of Table 9 report the results. When absolute technical efficiency is the dependent variable, we find that the interaction terms between de-licensing and FORMAL and between de-reservation and FORMAL are positive and significant, while the interaction term between tariff cuts and FORMAL is negative and significant. This suggests that all three product market reforms have led to an increase in absolute efficiency of formal firms relative to informal firms. [22]. On the other hand, when relative technical efficiency is the dependent variable, we find that the interaction term between de-licensing and FORMAL is negative and significant while the interaction between de-reservation and FORMAL and tariff cuts and FORMAL are both positive and significant. This suggests that de-licensing and tariff reforms have led to a decrease in relative efficiency of formal firms relative to informal firms, increasing the efficiency gap between the average formal firm and the most efficient firm in the formal sector, relative to a similar efficiency gap for the informal sector, within industries. In contrast, de-reservation has led to a widening of the efficiency gap between the average firm and the most efficient firm for the informal sector relative to the formal sector. The different effect of de-reservation on relative technical efficiency as compared to de-licensing and tariff cuts could be explained by the ability of some firms in the informal sector to take advantage of the withdrawal of barriers to expansion following de-reservation.

INSERT TABLE 9 HERE

VII. CONCLUSIONS

Do economic reforms reduce or exacerbate manufacturing dualism? We investigate this question using firm level data for the informal and formal manufacturing for the Indian economy combined from four repeated cross-sections over the period 1989-2005. We use stochastic frontier analysis applied to twenty-two industries to calculate absolute and relative efficiency at the firm-level for the Indian economy for both formal and informal firms. We use a recent econometric methodology proposed by Greene (2010) to correct for selection bias in the firm's decision to be in the informal or formal sectors in the estimates of efficiency. We then estimate the effects of key reforms enacted in India since the mid 1980s – tariff reforms, industrial de-licensing and the scaling back of small sector reservation policy – on relative and absolute efficiency differentials between informal and formal firms.

Our regression results suggest that economic reforms have had an unambiguous positive effect on absolute levels of technical efficiency in the entire manufacturing sector (both

informal and formal sectors combined). While average efficiency levels in both the informal and the formal manufacturing sectors have increased, economic reforms have increased the efficiency differentials between the more efficient formal firms and the less efficient informal firms in Indian manufacturing. At the same time, economic reforms have led a decline in relative efficiency levels across the entire manufacturing sector, suggesting that the reforms have brought about a greater efficiency gap between the average firm and the most efficient firm in a given industry. However, the widening of the efficiency gap has been more significant for formal firms as compared to informal firms, suggesting that the within industry effects of economic reforms on efficiency have been more unequalising for the formal manufacturing sector as compared to the informal manufacturing sector. Overall, our results suggest that dualism has increased in Indian manufacturing since the reforms, both by increasing the efficiency differential between formal and informal firms, and by increasing the efficiency gap between the average firm and the most efficient firm within industries. We also find that all three types of product market reforms undertaken in India - de-licensing, de-reservation and tariff reforms - have contributed to the exacerbation of manufacturing dualism by increasing the efficiency differentials between formal and informal firms.

Our results have important implications for the effects of economic reforms on pro-poor growth in emerging economies. While we find that economic reforms can have strong positive effects on overall efficiency in the manufacturing sector, the increase in dualism following reforms may make it more difficult for informal firms to graduate to the formal sector by increasing the efficiency levels of formal firms relative to informal firms (so that the productivity level need to make the transition to the formal sector is further out of reach). Moreover, the widening gap between the productivity of formal and informal firms in manufacturing also makes it difficult for informal firms to compete in external and domestic markets that are increasingly integrated. Given the large presence of unskilled and semi-skilled workers who comprise the majority of the workforce in the informal manufacturing, such a process of dualistic development may act as a significant obstacle for the poverty reducing and employment creating impact of economic growth.

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Table 1: Trend in Reform variables

	1989-90	1994-95	2000-01	2005-06
De-licensing (per cent of 4-digit industries de-licensed)	53.02 (36.85)	84.41 (26.28)	93.47 (21.64)	93.82 (21.42)
De-reservation (per cent of products de-reserved)	9.09 (29.42)	9.09 (29.42)	15.30 (30.4)	70.83 (32.13)
Trade reforms (Tariffs in per cent)	76.67 (15.0)	56.09 (10.1)	31.80 (4.55)	29.02 (3.93)

Note: Figures in parenthesis are the standard deviations.

Table 2: Industry-wise status of Reforms, 2005-06

Industry	De-licensed (in per cent)	De-reserved (in per cent)	Tariff (in per cent)
Food Products	93.8	62.5	37.79
Tobacco	0.0	100	30.00
Textiles	100.0	100	27.06
Wearing Apparel	100.0	100	29.93
Leather Products	100.0	100	28.23
Wood and Wood Products	100.0	43.75	29.22
Paper and Paper Products	100.0	38.71	27.05
Publishing	100.0	100	23.57
Coke and Petroleum	100.0	100	29.71
Chemicals	84.6	78.19	28.57
Rubber & plastic products	100.0	36.90	29.56
Non-Metallic Mineral Products	100.0	10	29.25
Basic metal	100.0	100	33.50
Metal products	100.0	64.66	28.66
Machinery	100.0	78.79	25.10
Office machinery	100.0	100	25.10
Electrical machinery	100.0	54.05	24.57
Radio & Television	100.0	83.33	24.74
Medical, precision inst.	100.0	80	24.74
Motor vehicles	100.0	100	36.02
Transport equipment	85.7	5.88	36.02
Furniture	100.0	21.43	30.00
Average	**96.1**	**62.27**	**29.02**

Table 3: Descriptive statistics at the aggregate level: 1989-2006

	Mean	Standard deviation
Selection Variables		
Labour regulation index (pro-worker: +1; pro-employer: -1)	0.576	0.235
Cost of power supply, state level, (Rs./Kwhr)	5.323	0.5422
Share of priority sector lending, state-level (per cent)	31.457	9.883
Firm size (log (ln) employment)	2.652	1.557
Stochastic Frontier Variables		
Ln formal manufacturing value added per employee	10.719	1.126
Ln informal manufacturing value added per employee	8.920	1.199
Ln formal manufacturing capital labour ratio	10.454	1.727
Ln informal manufacturing capital labour ratio	9.821	1.341
Ln formal manufacturing employment (No.)	3.893	1.211
Ln informal manufacturing employment (No.)	1.404	0.529
Reform Variables		
REFORM (weighted Reform measure)	52.58	19.50
De-licensing (per cent of four-digit industries de-licensed)	81.6	31.2
De-reservation (per cent of products de-reserved)	26.07	48.39
Trade liberalization (Tariff in per cent)	48.39	21.66

Notes: The data are for the 15 major sates for the period 1989-2006. Since Bihar, MP and UP were bifurcated in 2000 to form the new states, Uttarakhand, Chhattisgarh and Jharkhand, we have merged these three states with their parent states so as to have consistent data for the study period.

Table 4: Parameter estimates of the Probit selection equation, industry level, all years

Industries	Constant	Size	Labour regulation	Power	Priority-sector lending	Log likelihood	MaFadden R-square	N	Chi-squared
Food	-7.54* (0.21)	2.45* (0.03)	0.89* (0.07)	0.33* (0.03)	-0.01* (0.002)	-5072.35	0.81	38978	154.53
Tobacco	-9.32* (0.48)	1.31* (0.04)	-1.43* (0.14)	0.92* (0.07)	0.07* (0.01)	-1064.94	0.65	4449	28.70
Textiles	-10.22* (0.26)	2.84* (0.04)	0.38* (0.07)	0.43* (0.04)	0.01* (0.001)	-3955.03	0.83	35138	203.86
Apparel	-23.90* (2.96)	11.60* (1.21)	0.14 (0.48)	-0.41 (0.26)	0.001 (0.01)	-98.57	0.98	12320	
Leather	-7.79* (0.68)	2.90* (0.12)	1.26* (0.18)	0.07 (0.11)	0.01* (0.005)	-490.19	0.82	4035	16.90
Wood	-6.10* (0.32)	2.48* (0.06)	0.18* (0.11)	0.10* (0.05)	0.01* (0.003)	-1930.47	0.66	9400	149.49
Paper	-5.92* (0.60)	2.42* (0.09)	0.65* (0.19)	0.09 (0.09)	0.0003 (0.004)	-661.49	0.67	3692	10.53
Publishing	-7.76* (0.47)	2.88* (0.08)	0.27* (0.14)	0.17* (0.07)	0.01* (0.004)	-973.04	0.80	7122	30.49
Petroleum	-4.94* (0.89)	1.52* (0.11)	1.79* (0.36)	0.23 (0.14)	0.01 (0.01)	-208.23	0.57	1259	17.50
Chemicals	-5.44* (0.33)	1.93* (0.05)	-0.74* (0.11)	0.24* (0.05)	0.01* (0.002)	-2044.35	0.62	11649	12.55
Rubber	-7.83* (0.41)	2.31* (0.06)	0.59* (0.13)	0.40* (0.06)	0.01* (0.003)	-1459.21	0.67	6848	24.91
Minerals	-4.12* (0.21)	1.51* (0.02)	0.77* (0.07)	-0.02 (0.03)	0.01* (0.002)	-5131.86	0.54	16634	44.73
Basic metal	-5.73* (0.47)	2.30* (0.07)	0.83* (0.15)	0.21* (0.07)	-0.01* (0.003)	-970.82	0.69	7594	3.46
Metal products	-8.32* (0.30)	2.83* (0.05)	0.32* (0.09)	0.33* (0.04)	0.01* (0.002)	-2585.47	0.78	17146	153.99
Machinery	-7.40* (0.30)	2.42* (0.05)	1.05* (0.10)	0.36* (0.05)	-0.004* (0.002)	-2386.36	0.73	13571	88.99
Office machinery	-2.55* (2.18)	2.08* (0.38)	-0.46 (0.76)	-0.57 (0.38)	0.04* (0.02)	-34.98	0.69	294	1.38
Electrical machinery	-5.91* (0.50)	2.39* (0.08)	0.52* (0.17)	0.005 (0.08)	0.02* (0.004)	-874.18	0.73	5281	24.94
Radio & Television	-7.00* (1.23)	2.40* (0.19)	1.50* (0.43)	0.05 (0.19)	0.03* (0.009)	-134.77	0.74	1353	3.75
Medical, precision & optical instrmnts	-5.71* (0.99)	2.40* (0.16)	1.60* (0.35)	0.05 (0.150	-0.009 (0.007)	-196.34	0.74	1427	0.62
Motor vehicles	-4.14* (0.72)	2.14* (0.10)	0.03 (0.230	-0.09 (0.11)	0.001 (0.005)	-527.59	0.67	3162	8.71
Transport equipment	-4.58* (0.56)	2.02* (0.08)	1.24* (0.23)	0.11 (0.09)	-0.02* (0.004)	-647.97	0.65	3241	34.60
Furniture	-5.90* (0.33)	2.28* (0.05)	0.77* (0.12)	-0.04 (0.05)	0.01* (0.003)	-1850.72	0.71	14843	96.01

Notes: a) N is the total number of firms; b) * indicates level of significance at 5 per cent; c) Figures in parenthesis are standard errors.

Table 5: Summary statistics for second stage estimation – average over 1989-90 to 2005-06

Industry	Informal Sector			Formal Sector		
	Y	K	L	Y	K	L
Food	9.96 (6.93-13.04)	10.99 (7.36-14.50)	1.24 (0.69-2.48)	14.52 (10.68-18.54)	14.32 (9.39-19.30)	4.01 (1.39-6.73)
Tobacco	9.63 (6.99-12.26)	10.18 (7.07-13.12)	1.39 (0-3.18)	13.85 (9.37-18.44)	11.77 (3.58-18.92)	4.21 (0.69-7.95)
Textiles	10.37 (7.44-13.20)	10.93 (7.40-14.32)	1.57 (0.69-2.71)	15.10 (11.12-19.15)	15.12 (9.96-20.21)	4.34 (1.61-7.36)
Apparel	9.84 (6.72-13.11)	11.14 (8.80-13.53)	1.14 (0.69-2.20)	15.38 (12.19-18.40)	14.90 (10.67-18.89)	4.69 (2.08-7.21)
Leather	10.51 (7.43-13.57)	11.02 (7.81-14.15)	1.40 (0.69-2.56)	14.74 (11.32-18.08)	14.64 (10.49-18.69)	4.01 (1.39-6.73)
Wood	10.19 (7.26-12.96)	10.90 (6.96-14.59)	1.27 (0.69-2.30)	12.98 (10.13-16.04)	12.63 (8.27-16.87)	2.88 (1.10-5.07)
Paper	11.07 (7.89-14.17)	12.12 (8.82-15.14)	1.63 (0.69-2.83)	14.55 (11.00-18.35)	14.60 (10.19-19.36)	3.63 (1.39-6.34)
Publishing	10.28 (7.10-13.29)	11.92 (8.43-15.05)	1.34 (0.69-2.40)	14.23 (10.63-17.93)	14.01 (9.01-18.93)	3.62 (1.39-6.14)
Petroleum	10.43 (7.21-13.51)	11.71 (8.12-15.04)	1.63 (0.69-2.71)	14.72 (10.41-19.71)	14.99 (9.97-20.38)	3.73 (1.10-6.66)
Chemicals	11.04 (7.51-14.54)	12.06 (8.43-15.50)	1.82 (0.69-3.14)	15.15 (11.00-19.57)	14.91 (9.58-20.44)	4.14 (1.61-6.98)
Rubber	11.25 (7.82-14.54)	12.47 (8.76-15.82)	1.64 (0.69-2.77)	14.64 (11.26-18.27)	14.64 (10.64-18.92)	3.55 (1.39-6.13)
Minerals	10.59 (7.45-13.73)	11.42 (7.60-15.08)	1.83 (0.69-3.56)	13.75 (10.20-17.87)	13.36 (8.84-18.57)	3.65 (1.39-6.25)
Basic metal	10.76 (7.31-14.27)	11.86 (8.23-15.43)	1.55 (0.69-2.77)	14.97 (11.10-19.18)	14.98 (10.15-20.13)	3.97 (1.39-6.86)
Metal products	10.54 (7.44-13.55)	11.52 (8.13-14.66)	1.35 (0.69-2.40)	14.23 (10.87-17.89)	13.83 (9.67-18.19)	3.50 (1.39-6.11)
Machinery	10.79 (7.56-13.93)	11.91 (8.23-15.29)	1.41 (0.69-2.56)	14.54 (10.98-18.44)	14.20 (9.94-18.74)	3.60 (1.10-6.38)
Office machinery	12.43 (9.73-14.57)	12.96 (10.97-15.88)	1.85 (0.69-3.00)	16.11 (11.84-20.35)	15.66 (11.20-19.47)	4.27 (1.79-6.69)
Electrical machinery	10.77 (7.17-14.52)	11.98 (8.32-15.20)	1.46 (0.69-2.77)	15.02 (11.24-19.20)	14.51 (9.99-19.34)	3.75 (1.39-6.59)
Radio & Television	11.70 (7.74-15.42)	12.33 (8.79-15.32)	1.70 (0.69-3.00)	15.70 (11.60-20.08)	15.37 (10.49-20.32)	4.19 (1.61-7.02)
Medical, precision inst.	11.17 (7.85-14.48)	11.87 (8.61-14.90)	1.49 (0.69-2.77)	15.08 (11.40-18.76)	14.63 (10.11-19.11)	3.79 (1.39-6.44)
Motor vehicles	11.38 (8.33-14.29)	12.53 (9.81-15.10)	1.72 (0.69-2.89)	15.33 (11.27-19.59)	15.30 (10.49-20.34)	4.18 (1.39-7.26)
Transport equipment	11.05 (7.94-14.10)	12.18 (1.38-8.28)	1.58 (0.69-2.71)	14.82 (10.95-19.08)	14.37 (9.72-19.40)	3.84 (1.10-7.13)
Furniture	10.24 (7.18-13.30)	10.96 (7.68-14.03)	1.28 (0.69-2.56)	14.07 (10.32-18.14)	13.38 (8.17-18.59)	3.39 (1.10-6.10)

Note: Figures in the parentheses show the ranges for the respective variables; Y, K and L represent log of real gross value added, real fixed capital stock and number of workers respectively.

Table 6: Estimated production parameters, industry level, 1989-90 and 1994-95

Industry	1989-90						1994-95					
	Constant	Ln K	Ln L	Log L	Rho	N	Constant	Ln K	Ln L	Log L	Rho	N
Food	7.57* (0.15)	0.35* (0.01)	0.61* (0.02)	-4356.28	-0.08 (0.09)	7743	6.73* (0.12)	0.38* (0.01)	0.67* (0.01)	-9955.52	0.04 (0.04)	11759
Tobacco	8.59* (0.65)	0.19* (0.02)	0.72* (0.06)	-771.78	-0.10 (0.19)	863	8.26* (0.33)	0.24* (0.01)	0.76* (0.04)	-1340.60	0.02 (0.11)	1903
Textiles	6.96* (0.17)	0.32* (0.01)	0.82* (0.02)	-2932.03	0.20* (0.08)	6149	7.26* (0.10)	0.34* (0.01)	0.66* (0.02)	-6103.41	0.13* (0.05)	13401
Apparel	8.03* (0.79)	0.35* (0.03)	0.50* (0.06)	-375.97	0.10 (0.65)	589	8.06* (0.33)	0.37* (0.02)	0.44* (0.03)	-1366.52	-0.35 (0.60)	1383
Leather	7.91* (0.59)	0.30* (0.05)	0.67* (0.07)	-492.13	-0.45 (0.29)	642	7.56* (0.49)	0.27* (0.02)	0.77* (0.04)	-977.52	0.01 (0.21)	1310
Wood	7.96* (0.60)	0.23* (0.03)	0.73* (0.08)	-740.03	0.26* (0.15)	1858	8.07* (0.22)	0.24* (0.02)	0.75* (0.05)	-1394.81	0.12 (0.12)	2664
Paper	8.08* (0.31)	0.33* (0.02)	0.63* (0.06)	-612.75	-0.12 (0.48)	605	7.11* (0.21)	0.35* (0.02)	0.77* (0.04)	-1147.83	0.20 (0.25)	1097
Publishing	7.20* (0.21)	0.30* (0.02)	0.85* (0.04)	-961.20	0.09 (0.16)	1487	7.42* (0.20)	0.28* (0.01)	0.92* (0.03)	-1278.57	0.03 (0.14)	2040
Petroleum	4.47* (0.82)	0.46* (0.04)	0.85* (0.07)	-286.72	0.28 (0.53)	249	4.55* (0.75)	0.55* (0.03)	0.60* (0.05)	-524.74	-0.82* (0.13)	405
Chemicals	5.75* (0.21)	0.51* (0.01)	0.61* (0.03)	-2716.27	-0.22 (0.20)	2129	6.08* (0.14)	0.45* (0.01)	0.67* (0.02)	-4612.17	0.12 (0.13)	3830
Rubber	7.86* (0.31)	0.33* (0.02)	0.71* (0.05)	-1116.25	0.37* (0.20)	1110	6.90* (0.19)	0.35* (0.01)	0.84* (0.05)	-1947.59	0.48* (0.15)	2152
Minerals	6.43* (0.17)	0.30* (0.01)	0.85* (0.03)	-2471.65	0.61* (0.09)	2563	6.46* (0.13)	0.34* (0.01)	0.82* (0.02)	-4351.07	0.31* (0.10)	4830
Basic metal	6.51* (0.39)	0.46* (0.03)	0.47* (0.06)	-1831.99	0.44 (0.42)	1430	6.65* (0.27)	0.34* (0.01)	0.77* (0.02)	-2753.51	0.14 (0.14)	2454
Metal products	7.59* (0.19)	0.24* (0.01)	0.95* (0.03)	-1805.86	0.43* (0.13)	2987	6.97* (0.24)	0.30* (0.01)	0.85* (0.02)	-2952.08	0.13 (0.09)	4989
Machinery	7.18* (0.16)	0.30* (0.01)	0.94* (0.03)	-2183.91	0.48* (0.13)	2773	7.51* (0.13)	0.30* (0.01)	0.85* (0.02)	-3507.10	0.15* (0.08)	4405
Office machinery	6.97* (1.07)	0.31* (0.08)	1.10* (0.12)	-77.46	1.00 (10.25)	72	5.87* (1.35)	0.51* (0.09)	0.64* (0.13)	-151.07	-0.68 (1.11)	105
Electrical machinery	6.55* (0.52)	0.35* (0.02)	0.85* (0.04)	-933.50	-0.17 (0.26)	904	7.16* (0.34)	0.31* (0.02)	0.88* (0.03)	-1565.09	0.02 (0.20)	1557
Radio & Television	7.03* (0.76)	0.33* (0.06)	0.77* (0.10)	-276.47	0.60 (0.62)	230	7.43* (0.38)	0.34* (0.03)	0.81* (0.07)	-691.09	-0.32 (0.40)	541
Medical, precision inst.	8.67* (0.58)	0.26* (0.05)	0.81* (0.10)	-259.45	0.00 (0.42)	249	7.80* (0.43)	0.30* (0.03)	0.84* (0.06)	-420.35	0.96* (0.24)	397
Motor vehicles	6.18* (0.69)	0.35* (0.03)	0.85* (0.05)	-358.00	-0.18 (0.54)	351	6.76* (0.39)	0.32* (0.02)	0.87* (0.03)	-764.52	0.27 (0.18)	800
Transport equipment	8.01* (0.76)	0.22* (0.03)	0.89* (0.05)	-547.11	0.22 (0.30)	545	7.53* (0.23)	0.29* (0.02)	0.85* (0.03)	-1135.97	0.32* (0.14)	1194
Furniture	7.29* (0.35)	0.28* (0.03)	0.87* (0.07)	-681.00	0.07 (0.19)	2808	6.98* (0.47)	0.29* (0.02)	0.91* (0.05)	-1283.84	0.12 (0.10)	3763

Notes: a) Ln K and ln L are natural logarithms of capital stock and labour respectively; b) Log L is the value of the log likelihood function, Rho is selection parameter; and N is the total number of firms; d) * indicates level of significance at 5 per cent; e) Figures in parenthesis are standard errors.

Table 7: Estimated production parameters, industry level, 2000-01 and 2005-06

Industry	2000-01						2005-06					
	Constant	**Ln K**	**Ln L**	**Log L**	**Rho**	**N**	**Constant**	**Ln K**	**Ln L**	**Log L**	**Rho**	**N**
Food	6.11*	0.44*	0.66*	-9055.74	0.11*	10325	6.66*	0.43*	0.56*	-6533.19	-0.08	9151
	(0.11)	(0.01)	(0.02)		(0.06)		(0.11)	(0.01)	(0.010		(0.06)	
Tobacco	7.58*	0.24*	0.81*	-659.94	-0.11	940	7.23*	0.27*	0.87*	-1067.91	-0.09	743
	(0.68)	(0.02)	(0.05)		(0.16)		(0.50)	(0.01)	(0.04)		(0.12)	
Textiles	7.55*	0.38*	0.56*	-3889.29	-0.15*	10130	7.76*	0.38*	0.62*	-4861.61	-0.25*	5458
	(0.13)	(0.01)	(0.02)		(0.06)		(0.10)	(0.01)	(0.01)		(0.05)	
Apparel	8.30*	0.33*	0.61*	-893.34	0.48*	6352	8.85*	0.28*	0.61*	-1098.24	-0.39*	3996
	(0.29)	(0.02)	(0.03)		(0.20)		(0.22)	(0.01)	(0.02)		(0.22)	
Leather	8.39*	0.26*	0.78*	-529.66	-0.16	1212	7.27*	0.38*	0.52*	-710.77	-0.01	871
	(0.40)	(0.03)	(0.05)		(0.20)		(0.59)	(0.02)	(0.03)		(0.12)	
Wood	7.23*	0.28*	0.90*	-847.22	0.21	3107	7.75*	0.29*	0.79*	-1083.45	-0.08	1771
	(0.35)	(0.02)	(0.09)		(0.15)		(0.30)	(0.01)	(0.09)		(0.14)	
Paper	7.67*	0.34*	0.64*	-681.14	-0.41*	964	7.89*	0.36*	0.62*	-1013.39	-0.21*	1026
	(0.29)	(0.02)	(0.04)		(0.12)		(0.21)	(0.02)	(0.04)		(0.10)	
Publishing	6.40*	0.35*	0.80*	-757.13	-0.10	2200	6.98*	0.34*	0.74*	-963.62	-0.11	1395
	(0.54)	(0.02)	(0.05)		(0.13)		(0.40)	(0.01)	(0.04)		(0.10)	
Petroleum	4.76*	0.49*	0.69*	-318.56	-0.46*	249	3.96*	0.47*	1.00*	-425.10	0.52*	316
	(0.96)	(0.03)	(0.06)		(0.22)		(0.76)	(0.03)	(0.05)		(0.18)	
Chemicals	6.51*	0.42*	0.67*	-2957.92	0.24*	2665	7.61*	0.39*	0.58*	-3769.07	-0.13	3025
	(0.19)	(0.01)	(0.03)		(0.12)		(0.16)	(0.01)	(0.02)		(0.09)	
Rubber	7.14*	0.40*	0.60*	-1127.65	-0.40*	1741	8.08*	0.35*	0.65*	-1776.14	-0.11	1845
	(0.29)	(0.02)	(0.04)		(0.11)		(0.19)	(0.010	(0.03)		(0.10)	
Minerals	6.24*	0.40*	0.70*	-2822.38	-0.10	4265	7.07*	0.37*	0.70*	-4946.57	-0.30*	4976
	(0.19)	(0.01)	(0.03)		(0.10)		(0.16)	(0.01)	(0.03)		(0.06)	
Basic metal	7.54*	0.35*	0.68*	-1503.30	-0.47*	1620	8.19*	0.35*	0.64*	-2387.69	-0.62*	2090
	(0.20)	(0.02)	(0.03)		(0.13)		(0.17)	(0.01)	(0.03)		(0.07)	
Metal products	7.99*	0.31*	0.73*	-1691.65	-0.26*	5326	8.30*	0.34*	0.56*	-2533.25	-0.40*	3844
	(0.18)	(0.01)	(0.03)		(0.08)		(0.15)	(0.01)	(0.02)		(0.05)	
Machinery	7.66*	0.31*	0.82*	-2273.62	0.03*	3349	7.74*	0.34*	0.74*	-2853.54	-0.20*	3044
	(0.17)	(0.01)	(0.02)		(0.09)		(0.14)	(0.01)	(0.02)		(0.06)	
Office machinery	5.71*	0.57*	0.55*	-60.18	0.99*	60	11.08*	0.16*	0.93*	-61.70	-0.99	57
	(1.68)	(0.14)	(0.17)		(0.53)		(1.43)	(0.14)	(0.23)		(0.002)	
Electrical machinery	7.92*	0.34*	0.76*	-1073.98	-0.22	1274	8.32*	0.33*	0.74*	-1318.18	-0.12	1546
	(0.26)	(0.02)	(0.04)		(0.14)		(0.25)	(0.02)	(0.04)		(0.13)	
Radio & Television	7.49*	0.38*	0.74*	-292.97	-0.72*	304	10.71*	0.21*	0.71*	-333.99	-0.45*	278
	(0.53)	(0.04)	(0.06)		(0.32)		(0.64)	(0.05)	(0.09)		(0.18)	
Medical, precision inst.	8.53*	0.32*	0.69*	-386.39	-0.53*	410	9.74*	0.28*	0.63*	-428.31	-0.61*	371
	(0.46)	(0.04)	(0.06)		(0.20)		(0.52)	(0.04)	(0.08)		(0.19)	
Motor vehicles	7.00*	0.37*	0.76*	-744.36	-0.18	979	7.96*	0.34*	0.70*	-1096.71	-0.28*	1032
	(0.24)	(0.02)	(0.04)		(0.18)		(0.27)	(0.02)	(0.04)		(0.16)	
Transport equipment	7.44*	0.34*	0.71*	-596.37	-0.09	729	7.98*	0.36*	0.62*	-724.00	-0.32*	773
	(0.38)	(0.03)	(0.05)		(0.17)		(0.22)	(0.02)	(0.03)		(0.12)	
Furniture	8.33*	0.28*	0.88*	-830.08	-0.29*	5044	9.61*	0.22*	0.77*	-1131.41	-0.40*	3228
	(0.35)	(0.02)	(0.06)		(0.14)		(0.25)	(0.02)	(0.04)		(0.09)	

Notes: a) Ln K and ln L are natural logarithms of capital stock and labour respectively; b) Log L is the value of the log likelihood function, Rho is selection parameter; and N is the total number of firms; d) * indicates level of significance at 5 per cent; e) Figures in parenthesis are standard errors.

Table 8: Impact of Reforms on technical efficiency in Indian manufacturing

Variables	Absolute Technical Efficiency				Relative Technical Efficiency			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Formal	0.018*	0.043*	0.025*	0.041*	6.032*	5.376*	5.420*	5.341*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.108)	(0.106)	(0.105)	(0.110)
REFORM	0.012*				-0.306*			
	(0.000)				(0.007)			
DELICENSE		0.005*				-0.222*		
		(0.000)				(0.003)		
DERESERVE			0.004*				-0.001	
			(0.000)				(0.004)	
TARIFF				-0.001*				-0.040*
				(0.000)				(0.008)
Constant	0.091*	0.135*	0.325*	0.378*	44.669*	46.899*	38.437*	41.660*
	(0.003)	(0.003)	(0.003)	(0.009)	(0.254)	(0.244)	(0.189)	(0.660)
Ind. Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	173108	173108	173108	173108	173108	173108	173108	173108
R-Squared	0.170	0.164	0.133	0.110	0.220	0.237	0.210	0.210

Note: * indicates significance at minimum 5per cent level; Figures in parenthesis are standard errors.

Table 9: Impact of Reforms on dualism in Indian manufacturing

VARIABLES	Absolute Technical Efficiency				Relative Technical Efficiency			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Formal	-0.223*	-0.220*	-0.00277	0.205*	17.977*	39.41*	3.972*	-2.318*
	(0.004)	(0.00469)	(0.00199)	(0.00455)	(0.310)	(0.297)	(0.111)	(0.285)
REFORM	0.009*				-0.166*			
	(0.000)				(0.007)			
Formal*REFORM	0.005*				-0.240*			
	(0.000)				(0.006)			
DELICENSE		0.00415*				-0.0724*		
		(4.84e-05)				(0.00247)		
Formal*DELICENSE		0.00317*				-0.409*		
		(5.37e-05)				(0.00328)		
DERESERVE			0.00208*				-0.102*	
			(9.49e-05)				(0.00618)	
Formal*DERESERVE			0.00205*				0.109*	
			(6.73e-05)				(0.00439)	
TARIFF				0.000885*				-0.105*
				(0.000110)				(0.00683)
Formal*TARIFF				-0.00338*				0.158*
				(8.64e-05)				(0.00569)
Constant	0.247*	0.269*	0.357*	0.333*	36.937*	29.55*	40.18*	43.79*
	(0.004)	(0.00362)	(0.00304)	(0.00901)	(0.240)	(0.194)	(0.194)	(0.620)
Ind. Dmy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yr dmy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	173108	173108	173108	173108	173108	173108	173108	173108
R-squared	0.19	0.179	0.139	0.119	0.23	0.314	0.215	0.215

Note: * indicates significance at minimum 5 per cent level; Figures in parenthesis are standard errors.

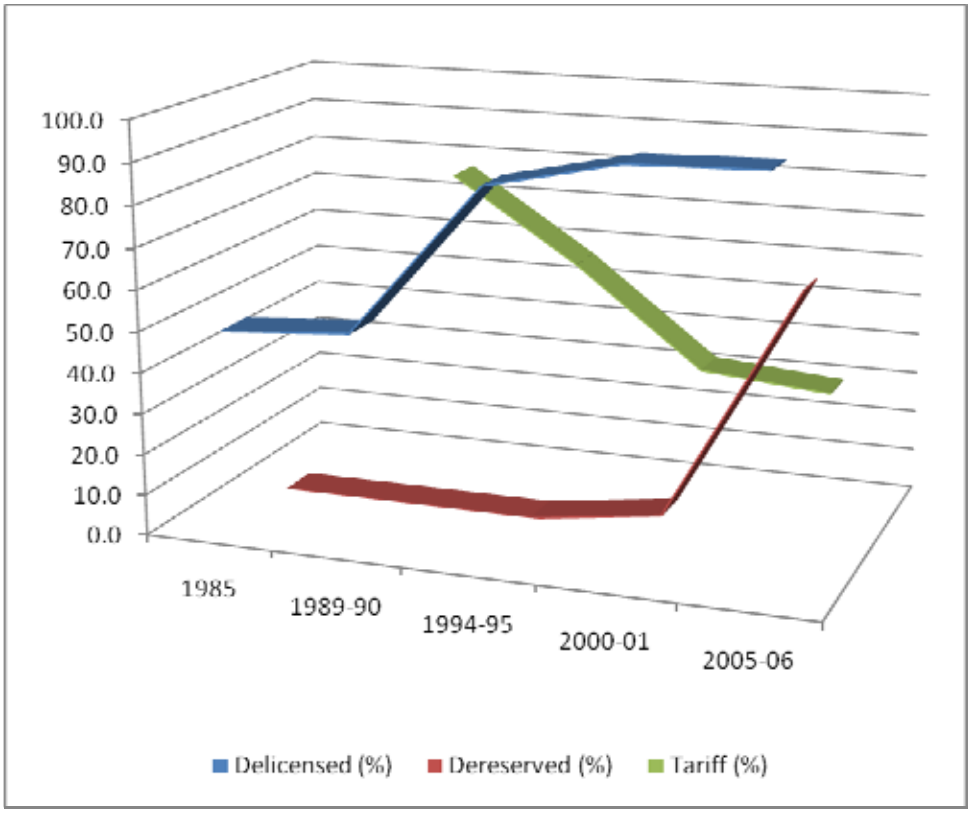


Figure 1: Trend of different Reform variables

Notes: De-licensing indicates percentage of 4 digit industries de-licensed, de-reserved indicates percentage of industries became open to large and medium firms and tariffs represents percentage of import duties levied on an industry.

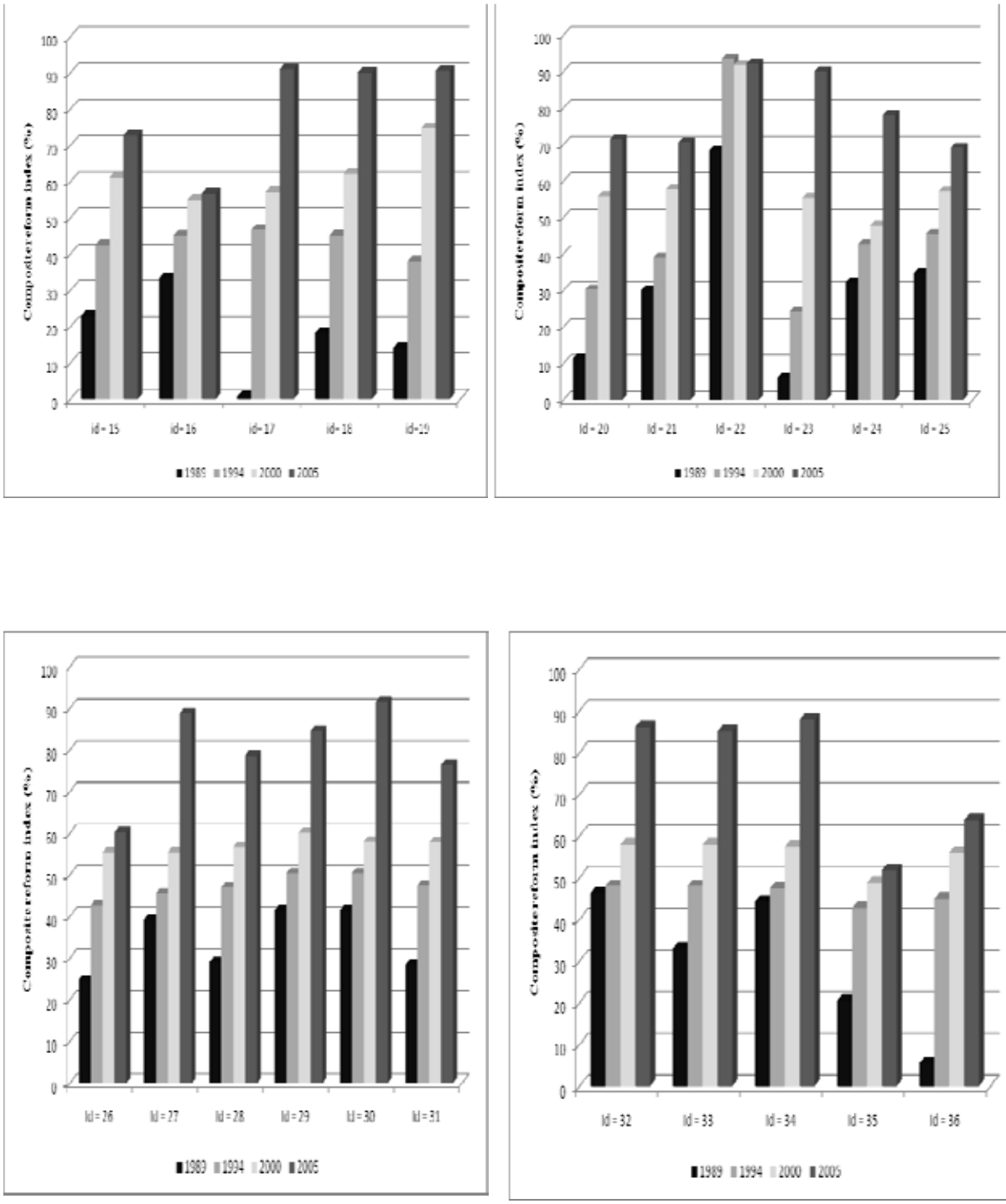


Figure 2: Industry-wise trend of composite Reform variable (REFORM)

Note: The list of industries with their corresponding industry codes is presented in Appendix A.

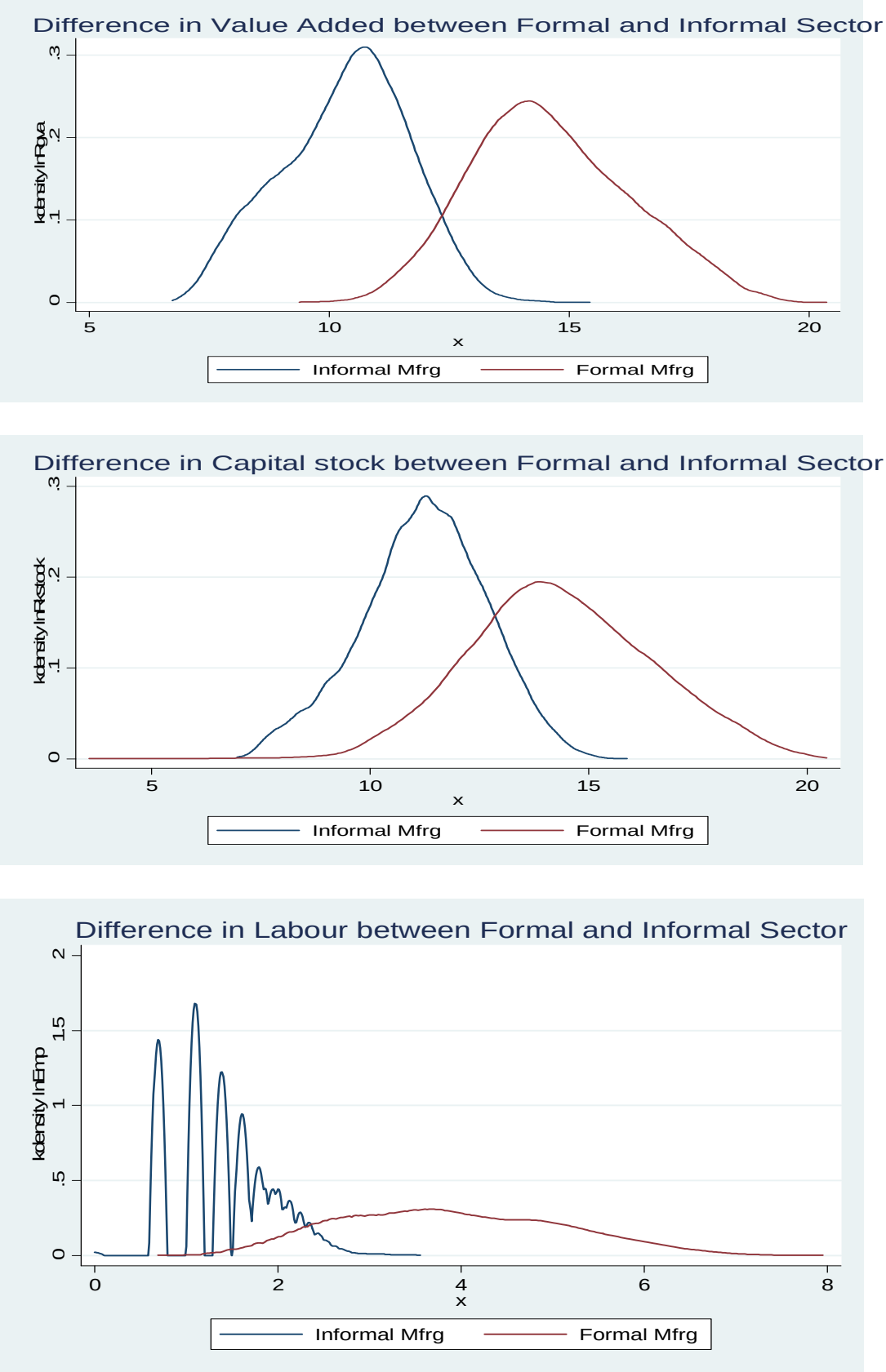


Figure 3: Differences in value added, capital and labour employed between firms in the informal and formal sectors (averages over the period, 1989-90 to 2005-06)

Note: Mfrg=Manufacturing

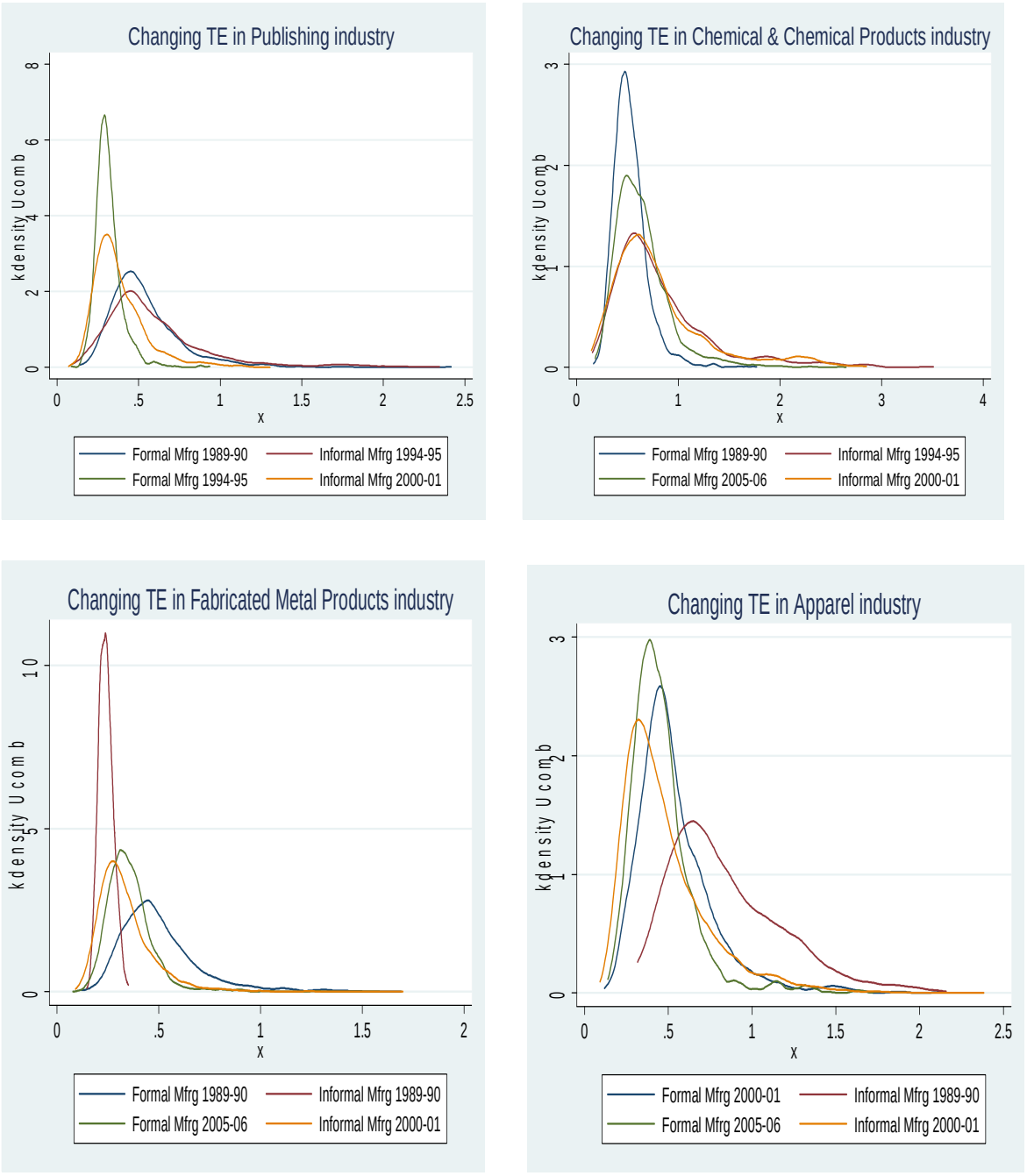
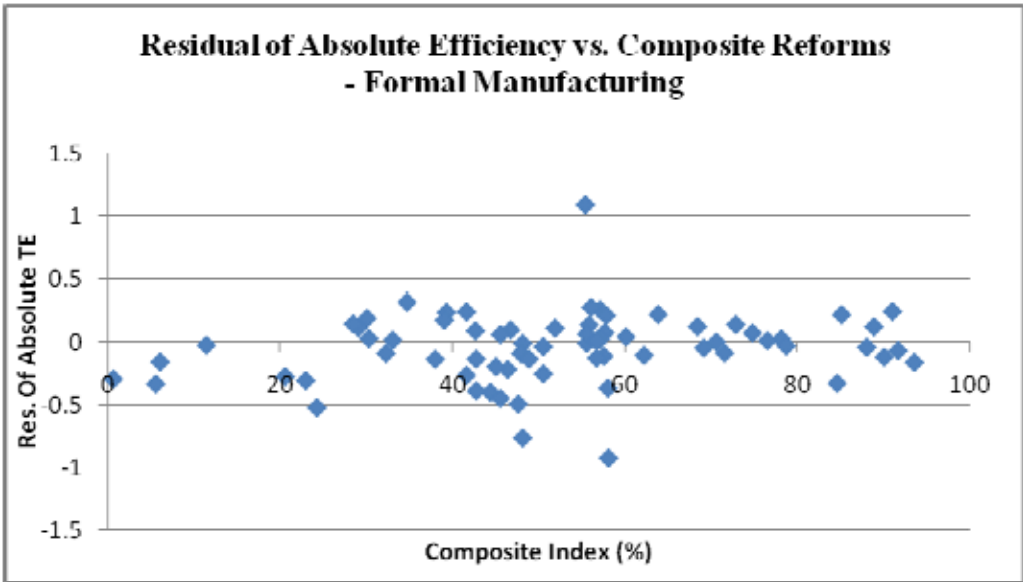
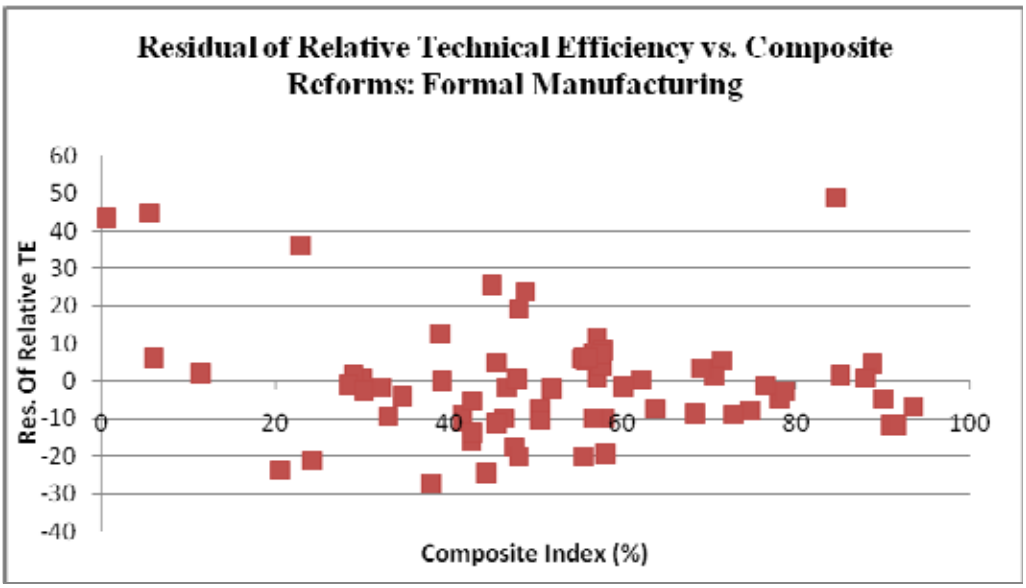


Figure 4: Kernel density plots showing change in bsolute Technical Efficiency (TE) for selected industries for formal and informal firms

Note: Mfrg=Manufacturing.


Residual of Absolute Efficiency vs. Composite Reforms - Formal Manufacturing
Res. Of Absolute TE
1.5
1
0.5
0
-0.5
-1
-1.5
0
20
40
60
80
100
Composite Index (%)


Residual of Relative Technical Efficiency vs. Composite Reforms: Formal Manufacturing
Res. Of Relative TE
60
50
40
30
20
10
0
-10
-20
-30
-40
0
20
40
60
80
100
Composite Index (%)

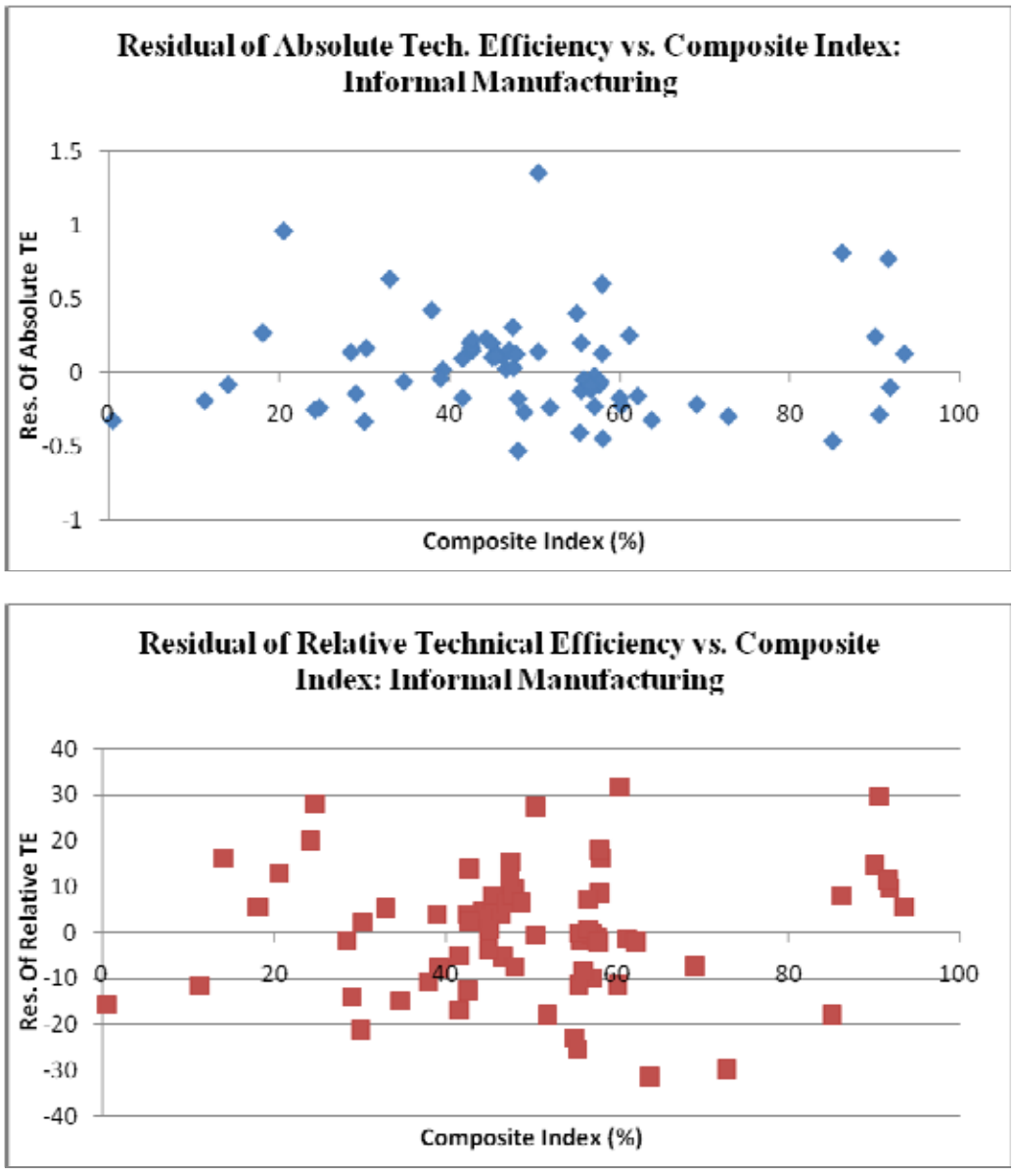


Figure 5: Composite Reform ndex (per cent) versus Technical Efficiency – Absolute and Relative.

APPENDIX A: LIST OF INDUSTRIES

National Industrial Classification (NIC) – 1998 (At Two Digit Level)

NIC 2-digit classification	ISIC Code	Description
15	311, 313	Manufacture of food products and beverages
16	314	Manufacture of tobacco products
17	321	Manufacture of textiles
18	322	Manufacture of wearing apparel; dressing and dyeing of fur
19	323, 324	Tanning and dressing of leather; manufacture of luggage, handbags, saddler, harness and footwear
20	331	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	341	Manufacture of paper and paper products
22	342	Publishing, printing and reproduction of recorded media
23	353, 354	Manufacture of coke, refined petroleum products and nuclear fuel
24	351, 352	Manufacture of chemicals and chemical products
25	355, 356	Manufacture of rubber and plastics products
26	361, 362, 369	Manufacture of other non-metallic mineral products
27	371, 372	Manufacture of basic metals
28	381	Manufacture of fabricated metal products, except machinery and equipment
29	382	Manufacture of machinery and equipment not elsewhere classified
30	382	Manufacture of office, accounting and computing machinery
31	383	Manufacture of electrical machinery and apparatus not elsewhere classified
32	385	Manufacture of radio, television and communication equipment and apparatus
33	385	Manufacture of medical, precision and optical instruments, watches and clocks
34	384	Manufacture of motor vehicles, trailers and semi-trailers
35	384	Manufacture of other transport equipment
36	332	Manufacture of furniture; manufacturing not elsewhere classified

NOTES

[1] Temple (2005) finds that different rates of structural change across countries that lead to the reallocation of labour from the low productivity 'backward' sector to the high productivity 'modern' sector is an important reason why there are international differences in aggregate productivity growth.

[2] An early literature on dualism (e.g. Schmitz 1982) has taken the latter to mean significant differences in labour productivity between informal and formal firms. However, given that formal firms tend to be more capital intensive, it would be natural to expect that labour productivity in formal firms are higher than that in informal firms. Therefore, partial productivity measures are inherently problematic and it is preferable to use total factor productivity measures in the analysis of dualism (Tybout, 2000).

[3] A major policy concern in India has been the low employment intensity of manufacturing growth following reforms (Kotwal *et al.* 2011; NCEUS 2007). If reforms were to increase the efficiency levels of informal sector firms relative to formal sector firms (and thereby reduce dualism) it would lead to a higher growth rate in the more employment intensive segment of the manufacturing sector and consequently lead to an increase in the employment intensity of manufacturing growth. Thus the reduction of manufacturing dualism can be important contributory factor in making economic growth more job creating in the Indian economy.

[4] A firm was classified as being in the small-scale sector if its investment in fixed assets in plant and machinery did not exceed a certain limit, and the limit was frequently changed over time.

[5] For an early application of SFA to the estimation of firm efficiency in developing countries, see Taymaz and Saatci (1997). See also Suyanto *et al*. (2009) for an application of SFA to measuring productivity spillover effects from foreign direct investment (FDI) in the Indonesian manufacturing sector.

[6] See Greene (2006, 2010) for details.

[7] Under Chapter VB of the IDA, labour courts and Tribunals can set aside any discharge or dismissal referred to them as not justified. In units employing more than 100 workers, retrenchment requires seeking authorization from the state government and this authorization is rarely granted.

[8] Chari (2011) estimates that the license reform led to an aggregate productivity improvement of 22 per cent in the formal manufacturing sector, three-fourths of which can be attributed to the relaxation of entry constraints and the remaining one-fourth to gains in scale efficiency.

[9] With respect to the possible endogeneity of the REFORM variable – that is, if the government is reforming more efficient industries first – there is a large literature that suggests that the choice of industries for de-licensing, de-reservation and trade reforms were largely exogenously determined by Indian policy-makers (see Chari 2011).

[10] Data are in the form of repeated cross-sections, and not in panel form. This is because the Indian statistical agencies do not reveal the identity of the firm/plant in the unit level data, and for the informal sector, the same firms may not be surveyed in each round.

[11] We limit our analysis of informal firms to only those which hire outside labour, as there are serious limitations on the quality of data for family firms. One such limitation emanates from the very reason of these firms in business. Family firms (i.e. those which do not hire outside labour) are often in business simply because running a small enterprise allows them to bring in additional income with little additional effort and they are unlikely to expand or invest in their businesses (Banerjee and Duflo, 2008). As our interest is in those firms that are likely to modify their behavior in response to policy changes, we confine our analysis to those informal firms that employ at least one hired worker.

[12] We have noted from the discussion in Section II that trade reforms also included major roll-backs and eventual withdrawal of import quotas. In our empirical analysis, we do not include import quotas in our measure

of trade reforms as we do not have industry data on quotas. Moreover, most of the quotas were dismantled in 1991, while tariff reforms occurred all through the 1990s and early 2000s.

[13] It is important to note that all these reforms were nationwide in nature, when an industry de-licensed or a product de-reserved or tariffs reduced, it affected all the firms irrespective of their geographical location.

[14] We have assumed that the one-sided error term follow truncated-normal distribution. But the results were not significantly different for half-normal distribution.

[15] When we estimated the stochastic frontier model without selection bias we found that the coefficient of labour was unnaturally high.

[16] Absolute efficiency is defined as the ratio of the observed output (y_i) of the firm to the potential output ($\hat{y}$) derived by the frontier function ($TE_{i,t}=y_{,ti}/\hat{y}_t$), where $TE_{i,t}$ is technical efficiency for industry i and year t. Relative technical efficiency (RTEi,t) is defined as the difference between the maximum absolute efficiency obtained in a given industry for a given year, and the actual absolute technical efficiency relative to the maximum absolute efficiency in that industry and year (RTEi,t = (TEmax,t – TEi,t)*100/TEmax,t).

[17] It should be noted that the coefficient on the formal sector dummy variable is negative and significant in Col. (1) in Table 9 (and in Cols. (2) and (4)) which is different from the results obtained on this variable in Table 8. However, the effect of firm location in the formal sector on absolute technical efficiency is given by the expression: $\beta_1 + \beta_3$**REFORM*. Therefore, even if β1 is negative, $\beta_1 + \beta_3$**REFORM* can be positive if the β_3**REFORM* is positive when we evaluate the expression at the mean value of REFORM. In our case, the expression is positive in Cols. (1), (2) and (4), confirming the results obtained in Table (8) which shows that formal firms are more efficient, on average, than informal firms.

[18] Goldberg *et al*. (2010) find little evidence of product rationalization and creative destruction that accompanies economic reforms in the case of the Indian manufacturing sector. This is in contrast to the other developing countries where much of the increases in productivity accompanying economic reforms is due to a re-allocation of productivity within industries from the exit of less productive firms and the entry of more productive firms (Alvarez and Vergara 2010).

[19] The estimates of absolute and relative technical efficiency used in Figure 5 are obtained by regressing actual firm level absolute and relative technical efficiency against industry and year dummies, and using the residuals of these regressions in the Figure rather than the actual efficiency levels themselves. This was done to control for differences in efficiency across firms that originate from industry specific characteristics and cyclical factors.

[20] We also used weighted tariff instead of simple tariff as a measure of trade reforms. Our results did not change, indicating the robustness of the results to different measures of tariffs.

[21] Our finding of an increase in within industry inequality in efficiency across firms following de-licensing is similar to the finding of Aghion *et al*. (2005) that within industry standard deviation of labour productivity and total factor productivity increased in industries that were de-licensed in India in the mid 1980s and early 1990s. Their finding is based on data on formal manufacturing alone, while our results show that within industry inequality in efficiency increased for both the formal and the informal manufacturing sector.

[22] The finding that de-reservation has also had a positive effect on efficiency of formal firms relative to informal firms similar to the effect of de-licensing and tariff reforms suggest that the pro-competitive effects of de-reservation on informal firms has been outweighed by the efficiency gains related to scale and scope of formal firms entering into products that were de-reserved.