What Constrains Indian Manufacturing?

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Abstract

India has undertaken extensive reforms in its manufacturing sector in the last two decades. However, an acceleration of growth in manufacturing; and a concomitant increase in employment has eluded India. What might be holding the sector back? Using ASI data at the three digit level and difference in differences estimates this paper finds that the post reforms performance of the manufacturing sector is heterogeneous across industries. In particular, industries dependent on infrastructure, or on external finance, and the labor intensive industries have not been able to reap the maximum benefits of reforms. The results point to the importance of infrastructure development and financial sector development for the manufacturing sector's growth to accelerate further. They also emphasize the need to fully identify and address the factors inhibiting the growth of labor-intensive industries.

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Section I: Introduction

Many emerging countries in recent decades have relied on a development strategy that focused almost exclusively on promoting the manufacturing sector and the exports of manufactured goods. These include many East Asian countries and most recently, China. This is what India hoped to achieve when it introduced substantial product market reforms in its manufacturing sector starting in the mid 1980s. But the sector never took off as it did in other countries. India no doubt has grown impressively in the last fifteen years; but the main contribution to growth has come from the services sector rather than from the manufacturing sector. Moreover, in so far as subsectors within manufacturing have performed well, these have been the relatively capital- or skill-intensive industries, not the labor-intensive ones as would be expected for a labor abundant country like India. What could be the reasons behind the rather lackluster performance of the manufacturing sector in India?

Chart 1a : Sectoral Share in GDP, India

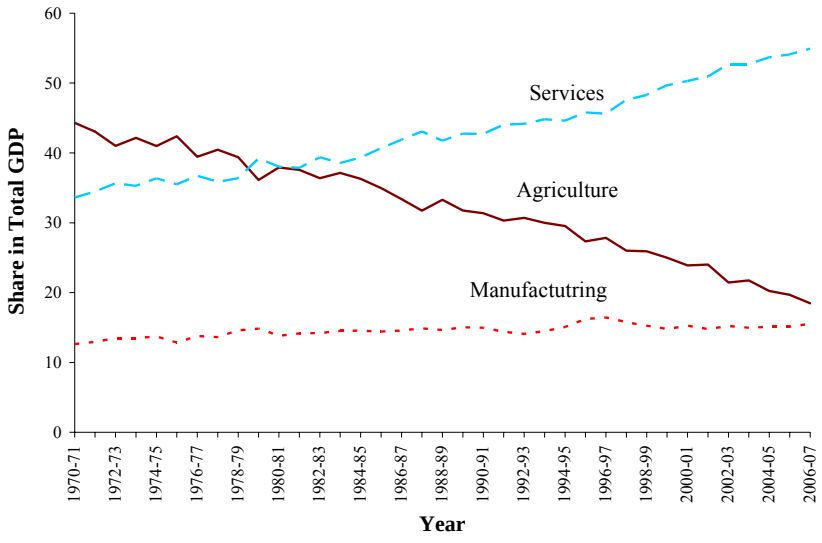
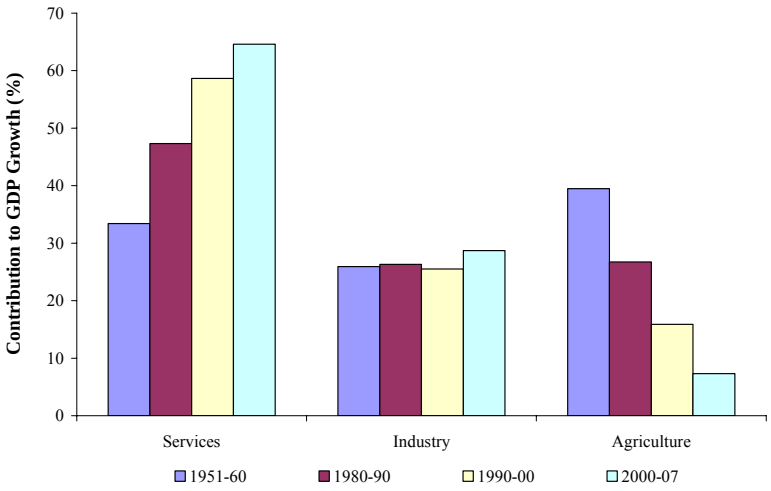


Chart 1b: Sectoral Contribution to Indian GDP Growth, 1951-07



Source: Central Statistical Organization, India

Several hypotheses have been put forward to explain the lack of dynamism in India's manufacturing sector. Infrastructure related bottlenecks are widely believed to be a part of the explanation. In particular, poor quality of power supply, road networks, and ports and airports are believed to create significant disadvantages for Indian manufacturers by pushing up their costs of production, and making them uncompetitive in export markets.[2]

Besides infrastructure, some key areas of policies remain unchanged. In particular, even though there have been extensive product markets reforms, it has been widely observed that the labor market reforms to complement these have not been undertaken (see Panagariya 2006; Kochhar et al 2006). Moreover, credit constraints due to weaknesses in the financial sector may be holding back small and medium sized firms from expanding (see Banerjee and Duflo 2004; Nagaraj 2005; McKinsey 2006).[3] Finally, business regulations might have influenced key decisions of firms and potential investors. As the World Bank's Doing Business surveys of business regulations across the world have found, the procedures and costs for starting and, especially, closing a manufacturing business in India are among the most cumbersome in the world.[4]

[2] As indicated in Gordon and Gupta (2004), the nature of production of services is probably such that it is less affected by infrastructure bottlenecks.

[3] Banerjee and Duflo (2004) use firm level data from the late 1990s and early 2000s and show that medium-sized firms -- even those well above the "small scale" threshold -- were subject to credit constraints and appeared to be operating well below their optimal scale.

[4] Another possibility is that the hysteresis in the pattern of development in Indian manufacturing implies that the relative profitability of capital-and skill-intensive activities remains higher than that of labor-intensive activities despite the reforms of the early 1990s (Kochhar et al 2006).

It would be useful to empirically test the hypotheses related to the idea that various elements of the policy and institutional environment facing the manufacturing sector, either left untouched by the liberalizations of the 1990s or dealt with only partially, have emerged as significant bottlenecks to growth and employment generation.

One obvious way in which one can test for these hypotheses is to exploit the inter-state heterogeneity in the policy and institutional environment, including labor market regulations; financial sector development; and infrastructure for different states of India and then test whether the industrial performance has been better in the states with better policy and institutional framework. This is precisely what has been done in the existing literature to show the importance of labor market flexibilities in explaining the gains from product market liberalizations. Besley and Burgess (2004), for example, exploit state-level amendments to the Industrial Disputes Act (IDA) – arguably the most important set of labor regulations governing Indian industry -- over 1958–1992, and code legislative changes across major states as pro-worker, neutral, or pro-employer. These legislative amendments are then used in the regression analyses of various outcomes in the manufacturing sector, including output, employment, investment and the number of factories. Besley and Burgess find that pro-worker labor regulations have had a negative impact on output, employment, and investment in organized manufacturing.[5]

A related paper by Aghion et al (2006) relates various dimensions of industrial performance to the extent to which an industry was covered by industrial licensing requirements, and state-level measures of the stance of labor regulations. They find that the effects of industrial delicensing were unequal across Indian states. In particular, delicensed industries located in states with pro-employer labor regulations grew faster in terms of both output and employment levels than those with pro-worker regulations.[6]

In this paper we relate the pattern of growth in India's manufacturing sector to cross industry heterogeneity in the use of some of the key inputs and in the reliance on infrastructure and financial sector. In defining these characteristics of industries we have tried to be as comprehensive as possible given the data limitations. In particular we calculate the dependence of industries on infrastructure, on the financial sector, and the labor intensity of industries. Using

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Other factors often believed to be affecting the performance of Indian manufacturing are public ownership of enterprises, remaining small scale industries reservations, and stringent regulations on land use in India. In recent years the availability of skilled labor has also emerged as a constraint on the growth of manufacturing and services.

[5] While, in principle, the approach of Besley and Burgess (2003) has considerable merit, it is not without controversy. Bhattacharjee (2006), in particular, has argued that deciding whether an individual amendment to the IDA is pro-employer or pro-worker in an objective manner is quite difficult. Even if individual amendments can be so coded, the actual workings of the regulations can hinge on judicial interpretations of the amendments. Moreover, if noncompliance with the regulations is widespread, then even an accurate coding of amendments which takes into account the appropriate judicial interpretation loses its meaning.

[6] Similarly, Mitra and Ural (2007) show that industries experiencing larger tariff reductions grew faster in pro-employer states relative to pro-worker states.

the ASI three digit level data we estimate the difference in differences estimates to compare the performance of the industries more dependent on infrastructure, on financial sector and the labor intensive industries post delicensing with that of the control group.

Our results indicate that the aggregate performance of the manufacturing sector masks important inter industry differences. Quite interestingly, we find that the industries with greater need for infrastructure; greater dependence on the financial sector; and greater labor intensity have performed relatively worse in the post delicensing period. Quantitatively the results indicate e.g. that the industries at 75th percentile of infrastructure dependence grew 6 percent less than the industries at the 25th percentile of infrastructure dependence. Similarly industries at 75th percentile of financial dependence grew 13 percent less than the industries at 25th percentile of financial dependence; and for labor intensity, industries at 75th percentile of labor intensity grew 12 percent less than the industries at 25th percentile post delicensing.

There are two ways in which one can interpret our results. First, without drawing any causal interpretations one can simply use these results to see which industries have not benefited as much from reforms and then try to devise policies specifically aimed at benefitting these industries. Second, to the extent that the heterogeneity across industries on parameters such as infrastructure dependence is exogenous and determined by factors such as technological, we can probably draw causal inferences as well. Thus, for example, we can claim that if industries dependent on infrastructure have not benefited as much from reforms it is because of the unavailability of adequate infrastructure; and similarly for financial sector dependent industries. For labor intensive industries, an interpretation in terms of the limited supplies of labor would perhaps not be the most appropriate one in the Indian context. A more natural interpretation would be to relate the relatively weak performance of labor intensive industries to the quality of labor, skill mismatch and regulations on employment which make the effective price of hiring labor too high.

In order to ensure that the results are not driven by outliers; and the standard errors are corrected for heteroskedasticity and autocorrelation; and that the estimates are not biased due to omitted variables, we conduct extensive robustness tests, and find our results to be robust to these sensitivity analyses.

The rest of the paper is organized as follows. In the next section we summarize the Indian policy framework and lay out the stylized facts related to the performance of the Indian manufacturing sector. In Section 3 we specify the main econometric exercise and present and discuss our results. In Section 4 we summarize the complementary evidence from two different firm level survey data; and the last Section concludes.

Section II: Stylized Facts and Preliminary Evidence

IIA: Indian Policy Framework

Since the early 1950s up until the early 1980s the evolution of India's manufacturing sector was guided by the industrial and trade policies that protected domestic industry and gave the state a central role in investment decisions. While a strict regime of import and export controls defined

trade policy, industrial policy worked through an elaborate system of industrial licensing. Under the Industries (Development and Regulatory) Act of 1951 every investor over a very small size needed to obtain a license before establishing an industrial plant, adding a new product line to an existing plant, substantially expanding output, or changing a plant's location.

While the state-led import substitution policy framework had helped create a diversified manufacturing sector by the mid-to-late 1960s, industrial stagnation since the mid-1960s – increasingly blamed on the policy framework – led to some tentative steps aimed at liberalizing these regimes in the late 1970s and early 1980s (see Ahluwalia 1987, 1991). Relaxations of the industrial licensing system were introduced and import licensing requirements were eased. However, by most accounts these reforms were marginal. Tariff rates as high as 400 percent were not uncommon, non-tariff barriers remained widespread, and the industrial licensing regime continued to impose binding constraints to entry and growth for most firms. The so-called small-scale sector reservations (introduced in 1969), which limited the entry and operations of firms above a certain size threshold in a number of labor-intensive industries – continued in full force.

More serious liberalization efforts began in 1985 with delicensing—the exemption from the requirement of obtaining an industrial license—of 25 broad categories of industries, which maps into 13 industries in our three digit level data. The next major reform of the licensing regime came in 1991 when industrial licensing was abolished except in the case of a small number of industries (see Chart 2a and Table A4 for the time path of delicensing). This was also the year in which a decisive break was made with the trade policies of the past. The liberalization of 1991 included the removal of most licensing and other non-tariff barriers on the imports of intermediate and capital goods, the simplification of the trade regime, devaluations of the Indian rupee and the introduction of an explicit dual exchange market in 1992 (see Chart 2b).

Chart 2a: Cumulative Share of Industries Delicensed

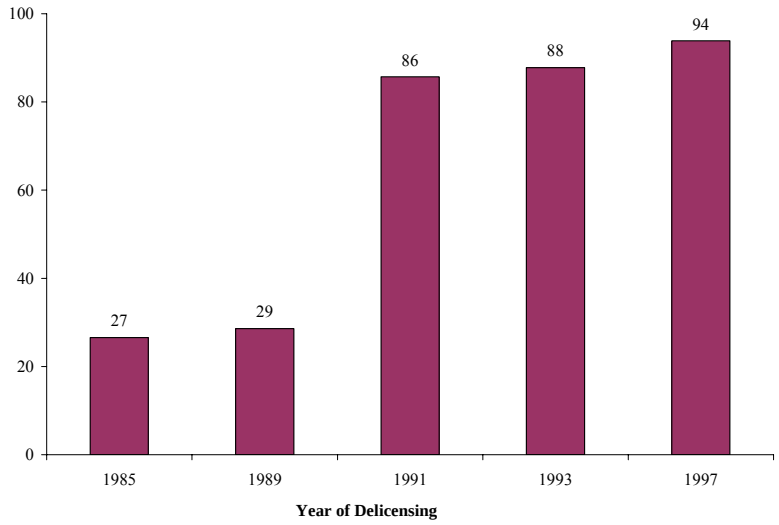
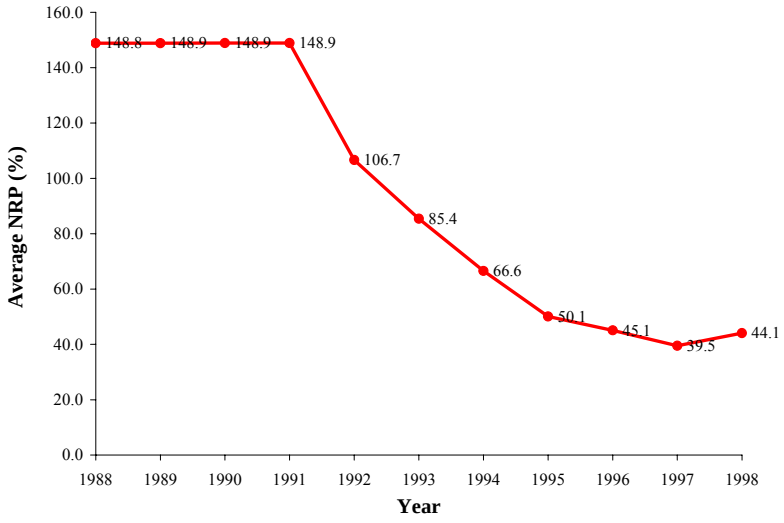


Chart 2b: Average Nominal Rate of Protection, 1988 to 1998



Despite these impressive reform measures there are certain areas in which there has been little progress. One area in which there has been no major policy change is in the labor regulations that apply to India's industry sector. According to Panagariya (2006), it is rigidities introduced by these (unchanged) regulations that are holding back the manufacturing sector in general and its labor-intensive subsectors in particular. Since the issue of India's labor regulations is one of the most contentious ones in the context of debates on economic reforms, some details are in order.

While India's labor regulations have been criticized on many accounts including, for example, the sheer size and scope of regulations, their complexity, and inconsistencies across individual pieces of regulation, a few specific pieces of legislation are the controversial ones. First, as per

Chapter VB of the Industrial Disputes Act (IDA) it is necessary for firms employing more than 100 workers to obtain the permission of state governments in order to retrench or lay off workers.[7] While the IDA does not prohibit retrenchments, critics of the act argue that it is difficult to carry them out. Datta-Chaudhuri (1996) argues, for example, that states have often been unwilling to grant permission to retrench.

Second, additional rigidities in using effectively a firm's existing workers are believed to stem from Section 9A of the IDA and the Industrial Employment (Standing Orders) Act —which pertain to procedures that must be followed by employers before changing workers' hours of work, nature of work, etc. While the two pieces of legislation seek to make labor contracts complete, fair, and legally binding they can constrain firms from making quick adjustments to changing conditions. In particular, worker consent is required in order to modify job descriptions or move workers from one plant to another in response to changing market conditions.

In and of itself, this does not seem to be an unreasonable objective. The problem, according to some analysts, is that the workings of India's Trade Union Act (TUA) make it difficult to obtain worker consent. While the TUA allows any seven workers in an enterprise to form and register a trade union, it has no provisions for union recognition (for example, via a secret ballot). The result, according to Anant (2000), has been multiple unions (within the same establishment) with rivalries common across unions so that a requirement of worker consent for enacting changes "can become one of consensus amongst all unions and groups, a virtual impossibility" (page 251). Somewhat similarly, hiring contract workers could enable firms to get around many of these restrictions. However, it is argued that Section 10 of the Contract Labour Act, which empowers the Government to prohibit the employment of contract labor in any industry, operation, or process, limits this course of action.

It is important to note, however, that not all analysts agree that India's labor laws have made for a rigid labor market. In particular, a counter-argument to the views above is that the rigidity inducing regulations have been either ignored (see Nagaraj (2002)) or circumvented through the increased usage of temporary or contract labor (see, in particular, Datta (2003) and Ramaswamy (2003)). Ultimately, whether India's labor laws have created significant rigidities in labor markets or not is an empirical issue, as is the broader question of whether and to what extent various policies have been the main constraints on the growth of Indian manufacturing.

[7] Until 1976, the provisions of the IDA on retrenchments or layoffs were fairly uncontroversial. The IDA allowed firms to layoff or retrench workers as per economic circumstances as long as certain requirements such as the provision of sufficient notice, severance payments, and the order of retrenchment among workers (last in first out) were met. An amendment in 1976 (the introduction of Chapter VB), however, made it compulsory for employers with more than 300 workers to seek the prior approval of the appropriate government before workers could be dismissed. A further amendment in 1982 widened the scope of this regulation by making it applicable to employers with 100 workers or more.

Another well known constraint on growth is India's crumbling infrastructure. According to the Deputy Chairman of the Planning Commission, Mr. Montek Singh Ahluwalia, India needs to increase its investment in infrastructure from 5 % of GDP to 8% of GDP by the end of the Eleventh Five-Year Plan, yielding an investment of USD 400 billion in its infrastructure to sustain the current growth rates. One does not need any scientific evidence to show that infrastructure in India needs to be improved, as the erratic and costly electricity supply, congested roads, ports and airports are for all to witness. A recent OECD survey of Indian economy report compares Indian infrastructure with that of other countries and finds India to be badly lagging in most of the areas.

Another area in which there has been rather slow progress on reforms is the financial (or more narrowly banking sector) sector. Reform efforts in this area have been directed at deregulating the interest rates; some dilution of public ownership of banks; and limited opening up of the sector to private domestic and foreign banks. However as pointed out often, and most recently in the OECD Economic Survey on India (2007), some major challenges still remain. These include a very high share of public ownership in banks; low level of bank intermediation partly because of regulations on the allocation of credit which require banks to allocate a substantial percentage of their total advances into government securities and other priority sectors.[8]

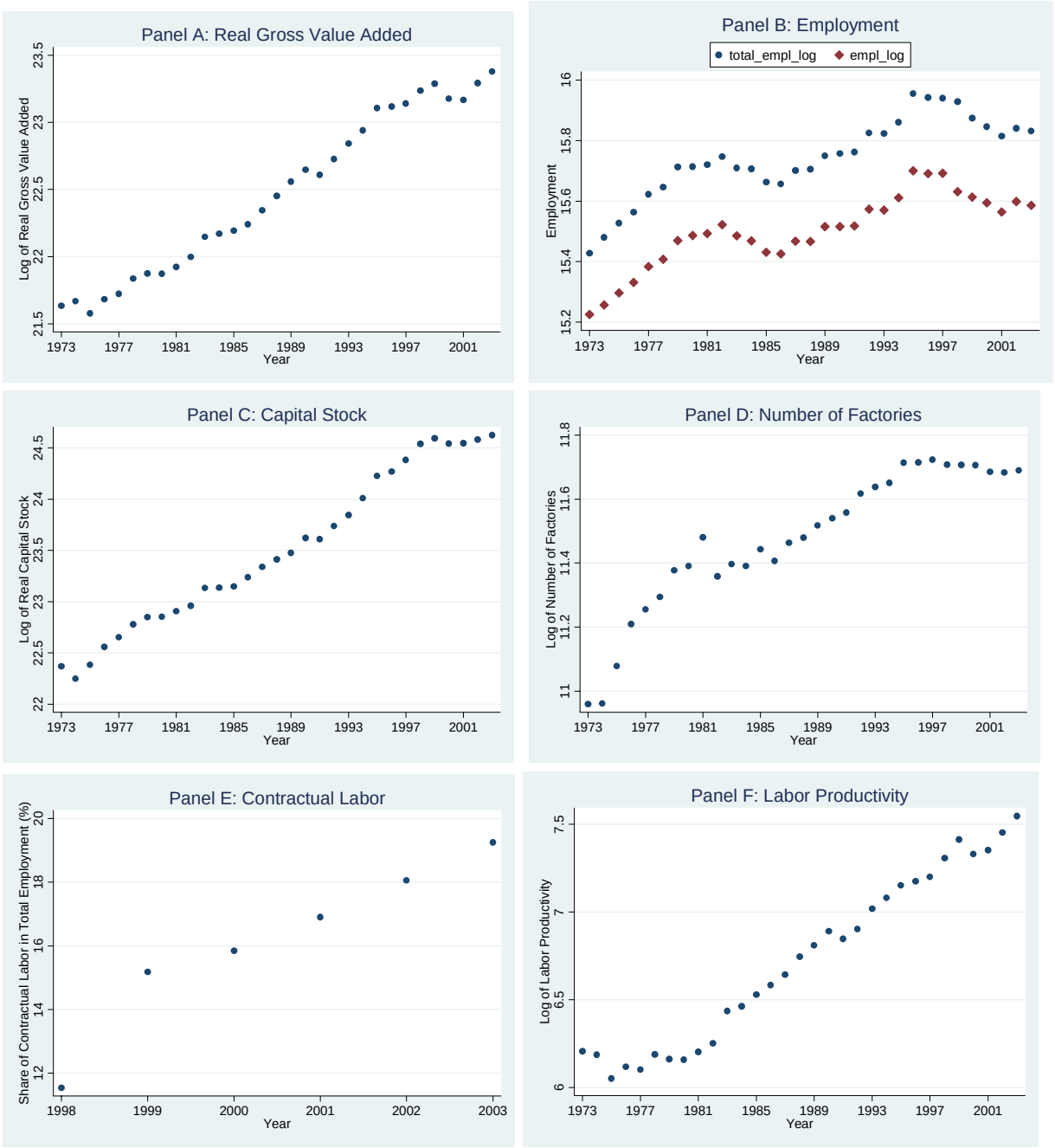
II B: Performance of Indian Manufacturing

We look at a fairly long time series of data on Indian registered manufacturing from 1973-2003. Below we summarize some of the empirical regularities that we observe in the data on the various indicators of industrial performance and on employment related variables.[9] Various panels of Chart 3 show that the growth of value added, employment, capital formation and factories has been stable throughout the last three decades and has not necessarily accelerated in the post reform period. If anything there is probably a stagnation starting sometime in the mid to late 1990s.

[8] In addition since the performance of the bank managers is not linked as tightly with the profitability of the banks, and is probably influenced more by the incidence of non-performing loans, they have little incentives to provide credit to the private sector. Hence they play extremely cautious and rather than lending to the private sector would rather invest in safe government securities (see Banerjee and Duflo, 2004).

[9] The only comprehensive database available on Indian manufacturing is the ASI data which includes data on registered manufacturing, i.e. factories with more than 20 workers if not using power and factories employing more than 10 workers if using power. One caveat of using this data is that we are only looking at a fraction of total manufacturing. Registered manufacturing comprises 70 percent of the total output being produced in the manufacturing sector but only 20 percent of the total manufacturing employment.

Chart 3: Performance of Indian Manufacturing



Panel B of the chart shows separately the employment of blue collared workers and total employment. The trends seem to be broadly similar for both the variables. There is only limited data on contractual labor, which is available only since 1998, but the trends show an increase in the share of contractual labor in total employment. The pace of growth of capital stock seems to be faster than that of employment. These different trends in employment and investment are

probably reflected in the growth of labor productivity overtime. Number of factories does not seem to have kept pace with the growth of value added.

The trends in these charts are also picked up in the table below. In Table 1 we estimate the trend growth rates for the aggregate values of various performance indicators pertaining to the manufacturing sector. The regression equations include the dependent variables in log, and regress it on a linear trend and a dummy which take the value 1 for post 1992 period, and zero otherwise. Thus its coefficient measures the percentage change in the dependent variable post 1992 after accounting for its trend growth rate.

The results indicate a marginal pick up in the growth rate of value added post 1992; and in the rate of investment, but no significant improvement in the number of factories operating or in employment.[10]

Table 1: Pre and Post Reforms Performance of Indian Manufacturing

	(1)	(2)	(3)	(4)
	Real Value Added	Capital Stock	Number of Factories	Total Employment
trend	.0586***	.0628***	.0247***	.0113***
	[21.30]	[22.45]	[6.96]	[4.37]
Dummy for	0.15***	0.19***	-0.05	0.03
Post 1992	[3.03]	[3.72]	[1.09]	[0.89]
Observations	31	31	31	31
R-squared	0.98	0.99	0.87	0.77

Note: 3 digit ASI data from 1973-2003 has been used in the analysis. All variables are measured in log. Robust t statistics are given in brackets. * indicates significance at 10%; ** significance at 5%; *** significance at 1%.

Thus the data show that the aggregate value added has increased at about 6 percent a year in the sample period, with the value added growing by an additional 15 percent between 1993 and 2003 (i.e. a little more than 1 percent a year). This modest pickup in value added is not accompanied by an additional growth in employment or in the number of factories. Employment has grown at the rate of 1.1 percent a year. New factories have come up at the rate of 2.5 percent a year; with the rate remaining unchanged post 1992. Investment rate however has been commensurate with the growth of value added.

Is this growth pick up impressive and does it imply that the reforms have paid off? When we compare this performance with the pace of growth in the manufacturing sector of many East Asian countries including China, we realize that not only in terms of employment, but also in terms of value added, the performance of Indian manufacturing has not been close to that of East

[10] The ASI data is available till FY 2003-2004; hence we do not include data for 2004-2006 in the analysis when there has been growth acceleration in the industrial sector.

Asian countries. For example, manufacturing value added in South Korea grew at an average annual growth rate of approximately 17 percent between 1960-1980; China's manufacturing sector witnessed an average growth rate of 12 percent per year between 1990-2005. On the other hand, India's manufacturing has grown at an average annual rate of 7 percent over the period 1980-2005.

Next, we explore the possibility whether the overall performance of the manufacturing sector masks inter-industry heterogeneity. Are there certain industries which have not benefited as much from the reforms? This is what we turn to next.

In Table 2 below we find that the performance varies across different sectors. In particular, we identify industries which depend more on infrastructure, industries which depend more on the financial sector for their financing needs and the labor intensive industries, see Appendix B1. We divide the industries into those belonging to above or median values for each industry characteristic and estimate separate regressions for industries below and above median values. We use log of value added as the dependent variable and control for industry and year fixed effects and a dummy for delicensing which varies across industries and years in the regressions.

Table 2: Growth of Gross Value Added Post Delicensing Across Industries

	Infrastructure dependent		Dependent on External Finance		Labor Intensive	
	Above Median	Below Median	Above Median	Below Median	Above Median	Below Median
Delicensing	-0.15***	0.33***	0.08	0.18***	-0.01	0.24***
	[3.12]	[4.46]	[1.31]	[2.64]	[0.22]	[3.19]
Observations	682	679	682	679	682	679
Number of Industries	22	22	22	22	22	22
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.77	0.66	0.71	0.70	0.69	0.72

Note: We have used 3 digit ASI data from 1973-2003 in the analysis. The industry characteristics have been defined as explained in Section III and Appendix 2. The dependent variable used is real value added in log. Robust t statistics are given in brackets. * indicates significance at 10%; ** significance at 5%; *** significance at 1%.

Results in Table 2 show that the industries which depend more on infrastructure on average experienced 15 percent lower growth in value added post delicensing, as compared to 33 percent higher output growth in value added of industries which are less reliant on infrastructure. Similarly the industries more dependent on the financial sector or the labor intensive industries have fared much worse than the industries that do not rely as much on the financial sector and are less labor intensive industries. We explore these patterns further in the next section.

Section III: Econometric Analysis

III A: Econometric Framework

We use the following econometric specification to analyze the impact of delicensing on various performance indicators:

$$Y_{it} = \Sigma\alpha_i d_i + \Sigma\beta_t d_t + \gamma \text{ (delicensing dummy}_{it}) + \delta \text{ (characteristic of industry i * delicensing dummy}_{it}) + \varepsilon_{it} \quad (1)$$

Where Y_{it} is the outcome variable measured in log, which varies over industry and time. As before we consider gross value added at constant prices, employment, capital stock, and number of factories as the outcome variables.

In equation 1, di's are industry specific dummies and α_i's are their respective coefficients; d_t's are year specific dummies and β_t's are their respective coefficients. The fixed effects account for the industry specific omitted variables; and the year fixed effects control for year specific shocks that are common to all industries. Since we are using industry fixed effects and year fixed effects in the regression equation the only additional variables we can include are the ones that vary with both industry and year. The next term in equation 1 is the delicensing dummy which varies over time and industry. The dummy takes a value one from the year when the delicensing requirement for a particular industry was removed and remains one for the rest of the sample period.[11]

We are interested in testing the variants of the following hypotheses: did industries that are more labor intensive industries (or industries that rely more on infrastructure or industries that rely more on the financial sector for their financing needs) grew less than the control group of industries in post delicensing period? The econometric methodology is derived from Rajan and Zingales (1998), who used it to analyze the effect of financial development on growth by comparing the growth of industries which depend more on financial sector in countries with greater financial depth with the growth of these industries in countries with shallower financial markets. The methodology has subsequently been used in several different contexts.[12]

Testing for these hypotheses requires us to set up the regression equation for difference in differences estimates and obtain the following coefficients:

[11] The delicensing dummy is based on the information provided in Aghion et al (2007) which we updated ourselves until 2003. As of 2003 all but three industries had been delicensed, see Appendix Table A4.

[12] See e.g. Dell'Ariccia et al(2005); Rajan and Subramanian (2005);

	Outcome Variable in Pre Reform period	Outcome variable in Post Reform period
For More Labor Intensive (treatment group)	$\Theta_{L,Pre}$	$\Theta_{L,Post}$
For Less Labor Intensive (control group)	$\Theta_{C,Pre}$	$\Theta_{C,Post}$

And test the hypothesis that: $(\Theta_{L,Post}- \Theta_{L,Pre})-(\Theta_{C,Post}- \Theta_{C,Pre})$ is significantly different from zero. The coefficient δ in equation 1 gives us precisely this estimate. We use the interaction of each of the industry characteristics defined here with delicensing separately and together in the regression equations.

How do we interpret a negative and significant coefficient for the interaction term of a particular industry characteristic, let's say infrastructure dependent industries? The coefficient indicates that the industries which use the infrastructure more intensively have grown less post delicensing as compared to the industries which use infrastructure less intensively. Can it be interpreted as a causal relationship between the lack of infrastructure and performance? As mentioned in the introduction, to the extent that an industry characteristic is exogenous of performance, e.g. it is some sort of a technical requirement; or if we can control for potential omitted variables, then we can probably claim causality in this result.

For exogeneity in our industry characteristics we use the data from the earliest possible period for which we have the data (in our case early 1990s). We control for omitted variables varying only over industries and over years by including the respective fixed effects. To rule out other potential omitted variables we conduct extensive robustness tests as described later.

III B: Construction of Variables

Reform Variables: As we discussed in the previous section Indian industries have been subjected to several different kinds of reforms. While limited reforms were started in mid 1980s onwards, major policy changes were undertaken following the crisis in 1991. While some of the reforms were more generic, others were more specific to the industries. The reforms spanned several areas including delicensing of industries; trade reforms and exchange rates reforms. In subsequent years these were complemented by the liberalization of foreign investment—both FDI and portfolio; dereservation of industrial sectors under small scale; financial sector liberalization; and privatization of public sector units.

In our econometric exercise we look at the effect of delicensing on Indian manufacturing industries. The reasons being that it is one of the most comprehensive programs which covered almost all the industries, and the information on it is readily available. The fact that these reforms were undertaken at different points in time, allows us to include time fixed effects to account for unobservable but common macroeconomic shocks in the regressions. We do not have complete

data for trade reforms, but we do control for it in the robustness exercises.[13] In robustness tests we estimate a specification in which we include the interaction of industry characteristics with a post 1992 dummy in the benchmark specification to account for the reforms which were more generic in nature, besides the delicensing. We only have limited data on financial sector reforms but in robustness exercises we include these as well. Results remain broadly unchanged and are presented selectively here.

Industrial Characteristics: Next we define three industrial characteristics of various industries: labor intensity; dependence of industries on external finance; and infrastructure dependence. Rajan and Zingales (1998) assume that there are probably technological reasons why some industries depend more on external finance than others. We extend this reasoning to labor intensity (also done previously in Kochhar et al (2006)) and to infrastructure intensity. To the extent that these two characteristics define input usage, the technological requirement assumption is perhaps as valid as for defining the external financing development. We briefly describe the various industrial characteristics below, further details are provided in the various tables in the Appendices.

Labor Intensity: We define labor intensity as the ratio of total employment and capital stock. Since there are no comprehensive databases of employment at firm level; hence we use the ASI industry level data to calculate this ratio.

Dependence on External Finance: We calculate the external financial dependence of firms in two different ways and using two different data bases: the first one uses the firm level data from the Prowess database published by the CMIE, and employs the same definition as used by Rajan and Zingales (1998). The second measure is calculated using the ASI data as the ratio of outstanding loans to invested capital. The index of external finance dependence does not correlate well across two databases and across different definitions. Neither of these correlates too well with the index calculated by Rajan and Zingales (1998) which was calculated for industrial data at 2 digit level for US industries. To the extent that our firm level data (from Prowess) is only for listed firms whose access to financial markets is likely to be different from that of small and medium enterprises, and it might affect the cross industry ranking, we use the financial dependence indicator calculated using the ASI data.

Infrastructure Dependence of Industries: We calculate it as the ratio of expenses on distribution (i.e., storage and transportation) and power and fuel to gross value added using the firm level data. To the extent that we have data on expenses on fuel consumption in both CMIE and ASI, we calculate an indicator just as the ratio of fuel expenditure to gross value added. These are highly correlated across the two databases; and with the indicator which includes distribution expenses as well. Appendix B1 indicates which industries quality as below or above median for each of these characteristic.

In order to get around the concern that these characteristics would reflect the equilibrium conditions between the demand and supply of the respective inputs, we use the data from an

[13] See Mitra and Ural (2007); Kumar and Mishra (2007) and Topalova (2005) for the analyses of the effects of trade liberalization.

earlier year rather than contemporaneous data. Furthermore to smooth out the noise in the data we use five year averages of the relevant variables to calculate the industry indicators. Since the Prowess data are available only from early 1990s we use the data from 1991-95 to calculate our various industry characteristics. We also confirmed where possible that the relative industry rankings across various characteristics do not change overtime. This robustness check gives credence to the belief that there are perhaps external technological reasons for why an industry uses more external finance; or uses more labor than capital; or depends more on infrastructure; and to the fact that using data from early 1990s is legitimate.

The questions that come to mind about these industry features are: are these capturing some other features of the industries; and how are the three features correlated with each other. In Tables B2 in the Appendix we report correlations among these characteristics and some of the other features of the industries that we could calculate. As we can see from the table the various industry characteristics are not correlated significantly with each other. The exceptions include that the labor intensive industries are negatively correlated with imports and financial dependence; and infrastructure dependence is negatively correlated with import and FDI intensity. Labor intensive industries are also somewhat more export intensive.

IIIC: Empirical Results from the ASI Data

In Table 3 we present our results for the benchmark case as give by Equation 1. Coefficients of the industry Fixed Effects and year Fixed Effects have been suppressed from the table. In the results in column 1 the coefficient for delicensing shows a 12 percent increase in value added per industry post delicensing. Given that the average delicensing period is about 15 years, it amounts to a less than 1 percent increase in value added per year in post delicensing period. However as we had seen in Table 2 certain industries did not fare as well during post delicensing period. Thus when we control for the different effects on these industries separately, the post delicensing impact on growth of the control group improves substantially.

In Columns 2-4 we include these characteristics with the interaction of delicensing one at a time. As expected the performance of the control group goes up considerably. From Column 2-4, we see that the industries more dependent on infrastructure, labor and external finance respectively have witnessed slower growth as opposed to their respective control group. In Column 5 we include them together and we find that industries ranking higher on each of our three industry characteristics have faired poorly in the post delicensing period. Finally, the last column is the same as Column 5 except that in this column instead of including the index of industry characteristics, we divide them into above and below median groups and includes the interaction of the dummy variables which takes the value one when an industry is above the median of the respective characteristic, with delicensing. Once again we find that the results hold and industries above the median in each of the three characteristics have not done as well as the control group in the post delicensing period.

Table 3: Value Added Post Delicensing

	1	2	3	4	5	6
delicensing	0.12**	0.18***	0.26***	0.53***	0.93***	0.36***
	[2.50]	[3.10]	[3.31]	[4.65]	[7.35]	[5.61]
Infrastructure Dep* delicensing		-0.17** [2.42]			-0.18*** [2.59]	
Labor Intensity* delicensing			-0.30** [2.02]		-0.51*** [3.55]	
External Finance Dep* delicensing				-0.93*** [4.01]	-1.22*** [5.49]	
Infrastructure Dummy* delicensing						-0.10* [1.88]
Labor Intensity Dummy* delicensing						-0.19*** [4.07]
External Finance Dummy* delicensing						-0.18*** [3.40]
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1361	1361	1361	1361	1361	1361
Number of Industries	44	44	44	44	44	44
R-squared	0.70	0.70	0.70	0.70	0.71	0.71

Dependent variable is log real value added. Robust t statistics in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%

Quantitatively the results, from Column 5 of Table 3, indicate that in the post delicensing period the industries at 75th percentile of infrastructure dependence grew 6 percent less than the industries at the 25th percentile of infrastructure dependence. Similarly industries at 75th percentile of financial dependence grew 13 percent less than the industries at 25th percentile of financial dependence; and for labor intensity, industries at 75th percentile of labor intensity grew 12 percent less than the industries at 25th percentile post delicensing.

In Table 4 results are presented for dependent variable, number of factories (in log). The overall performance of Indian manufacturing seems to be much less impressive for the number of factories. There is no acceleration in the rate of expansion of factories. These results are on account of the fact that the performance has been particularly worse for the labor intensive industries and industries dependent on financial sector. Once we control for these as in the previous set of regressions, the performance of the control group is seen to be much better. The point remains that industries more dependent on external finance and labor intensive industries have fared much worse post delicensing in terms of new factories opening.

Table 4: Number of Factories

	(1)	(2)	(3)	(4)	(5)
delicensing	0.04	0.03	0.11**	0.15**	0.31***
	[1.09]	[0.86]	[2.20]	[2.41]	[3.42]
Infrastructure*		0.02			0.01
delicensing		[0.39]			[0.23]
Labor Intensity*			-0.16**		-0.22***
delicensing			[2.15]		[2.86]
External Finance*				-0.27**	-0.39***
delicensing				[2.24]	[3.05]
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1361	1361	1361	1361	1361
Number of Industries	44	44	44	44	44
R-squared	0.58	0.58	0.58	0.58	0.58

Dependent variable is log number of factories. Robust t statistics in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%

Next we look at employment. The issues related to employment are manifold and much more complex, and all of these probably cannot be addressed in this paper. These include: why has growth not been employment intensive; is technology displacing labor; how has the employment of unskilled vs. skilled workers evolved overtime; how is the skill premium changing overtime etc. For brevity we look only at total employment here, which includes manual workers as well as supervisors; and regular as well as contract employees. The econometric specification is also somewhat different for employment (and capital).

We set up the regression equation as follows:

$$E_{it} = \Sigma\alpha_i d_i + \Sigma\beta_t d_t + \theta Y_{it} + \pi Y_{it} \text{ x delicensing dummy}_{it}$$

$$\lambda (Y_{it} \text{ x } * \text{characteristic of industry } i * \text{ delicensing dummy}_{it}) + \varepsilon_{it} \quad (2)$$

In equation 2, E_{it} refers to log of employment, di's are industry specific dummies and d_t's are year specific dummies as before. We also include log of gross value added in the equation, the coefficient θ can be interpreted as the employment elasticity of output. So θ shows the percentage change in employment for a 1 percent increase in output. The next term is the interaction of delicensing dummy with $Y_{it.}$ Its coefficient π gives the employment elasticity of output post delicensing. Finally, we include the interaction of Y_{it}, delicensing and industry characteristics. The coefficient λ measures the employment elasticity of output for the industry characteristic used in the interaction post delicensing. Thus if we are including labor intensity in the interaction term in equation 2 then it measures the change in elasticity of employment post delicensing in labor intensive industries. If it is positive it implies that the employment elasticity in labor intensive industries has increased post delicensing and so on.

Results on employment are presented in Table 5. The results indicate that the employment elasticity of output is about 50 percent on average, though there are differences across industries.

The elasticity is higher for labor intensive industries than for infrastructure dependent industries or for financially dependent industries. Results also indicate that there has been no change in the elasticity of employment post delicensing, this is true on average for all industries, including for the industry characteristics that we control for explicitly in our regressions.

These results have two implications: first, if growth were to accelerate in Indian manufacturing it would probably generate employment at the same rate as before; and second, in order to generate more employment in Indian manufacturing it is imperative that the labor intensive sectors grow faster. As we mentioned earlier, aggregate employment masks several nuances related to different kinds of employment, but we do not have space to discuss them all here.

Table 5: Employment Post Delicensing

	(1)	(2)	(3)	(4)	(5)
Log Gross value added (GVA)	0.52***	0.57***	0.47***	0.62***	0.552***
	[20.76]	[19.49]	[17.30]	[9.14]	[7.03]
Delicensing* GVA	-0.000	-0.001	0.001	0.001	0.004
	[0.27]	[0.35]	[0.48]	[0.28]	[0.86]
Infrastructure		-0.199***			-0.160***
* GVA		[3.98]			[3.19]
Infrastructure*		0.003			0.001
Delicensing*GVA		[0.90]			[0.28]
Labor Intensity			0.092***		0.081***
* GVA			[3.36]		[2.70]
Labor Intensity*delicensing * GVA			-0.000		-0.002
			[0.13]		[0.66]
Financial dep*GVA				-0.257*	-0.107
				[1.92]	[0.74]
Financial dep*delicesning*GVA				-0.001	-0.004
				[0.10]	[0.43]
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1361	1361	1361	1361	1361
Number of Industries	44	44	44	44	44
R-squared	0.69	0.70	0.70	0.70	0.70

Dependent variable is log Employment. Robust t statistics in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%. GVA refers to log value added in the above table.

For analyzing the patterns in investment we use a specification similar to the one used for employment. Thus we look at the investment elasticity of value added and compare it with the elasticity post delicensing. We also compare the investment elasticity of value added across

industries and see whether there are any patterns in the investment elasticity of output across industries post delicensing. Here we find that the elasticity of investment is higher than that for employment. Across industries, infrastructure and financially dependent industries have a higher elasticity of investment than the labor intensive industries. The elasticity has also increased somewhat post delicensing; quite interestingly this is on account of the increased elasticity of investment in the labor intensive industries. Thus over time and especially post delicensing, the labor intensive industries seem to be substituting away from labor and adopting relatively more capital intensive technology! In addition, we find that industries which are more dependent on external finance see a decline in the elasticity of investment in the post delicensing period.

Table 6: Investment Post Delicensing

	(1)	(2)	(3)	(4)	(5)
Gross value added (log)	0.85***	0.81***	0.88***	0.71***	0.73***
	[36.17]	[25.27]	[26.53]	[10.28]	[8.19]
Delicensing* GVA	0.008***	0.007***	0.004	0.02***	0.01
	[4.29]	[2.69]	[1.51]	[3.47]	[1.58]
Infrastructure* GVA		0.16**			0.12*
		[2.23]			[1.69]
Infrastructure* Delicensing*GVA		0.001			0.004
		[0.21]			[0.73]
Labor Intensity* GVA			-0.058*		-0.038
			[1.76]		[1.05]
Labor Intensity*delicensing * GVA			0.007*		0.007
			[1.74]		[1.57]
Financial dep*GVA				0.36**	0.28
				[2.34]	[1.64]
Financial dep*delicesning*GVA				-0.02**	-0.02*
				[2.22]	[1.76]
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	1361	1361	1361	1361	1361
Number of Industries	44	44	44	44	44
R-squared	0.90	0.90	0.90	0.90	0.90

Dependent variable is log real capital stock. Robust t statistics in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%

IIID: Robustness of Results

We do extensive tests for the robustness of our results. These include checking the robustness to different time periods; to omitted variables—i.e. the omitted variables related to policies and to industry characteristics; and to potential outliers. We also account for the possibility that the outcomes might be correlated by the industries or by the year of delicensing. While we do obtain small variations in coefficients and in the standard errors across these different specifications, overall the results are quite robust to various sensitivity tests. One result which does seem a bit sensitive to some of the corrections for autocorrelation is the result on infrastructure dependence. In some of the corrections for autocorrelations the coefficients of the interaction between infrastructure and delicensing become less significant, but even here its effect holds at about the 20 percent level of significance. Details on each robustness test follow.

Though in the methodology used here the omitted variables that vary only by industries or only by year have been accounted for through the respective fixed effects, the estimates remain susceptible to the omission of variables that vary over industry-year dimensions of the data. In particular, there might have been the following two types of omissions: first, the interaction of delicensing with industry characteristics other than the ones included; and second, the interaction of policy variables other than delicensing and their interactions with the industry characteristics included.

We explicitly control for only one of the major policy changes pertaining to Indian industries-delicensing. What about the other policy changes. In order to address these concerns we carry out two robustness tests. First, to control for the reforms which were more generic rather than specific to industries, we include in our regressions interaction of industrial characteristics with a post 1992 dummy. Second, we construct a trade policy measure which is industry specific and interact it with industrial characteristics. Results that infrastructure dependent, external finance dependent, and labor intensive industries have not benefited as much from reforms are fairly robust across these various specifications.

While we are unable to conduct these tests for some of the other reforms, the results are unlikely to change. The reason is that the reforms are highly correlated over time and across sectors. Thus even if we get a somewhat different coefficient when we include interaction of industry characteristics with different reforms instead of delicensing, the basic message we want to bring home is that without sufficient infrastructure development; financial depth; and progress on factors inhibiting labor intensive industries, Indian industry is unlikely to realize its potential. For this argument it is really immaterial what kind of reforms we are talking about. Second, if we include the interactions of industry characteristics with different reforms measures, e.g. delicensing and trade reforms, in the same specification, then the coefficients for a particular policy measure will become weaker and probably even lose their statistical significance. Such a specification will be of little use since again the interest is in a composite reform measure rather than specific reform measures. Thus, even if the coefficients might be biased in the benchmark specification, to the extent that we do not really care about attributing it to delicensing per se, we are fine.

For omitted industry characteristics we also control for characteristics such as export intensity or FDI intensity interacted with delicensing and find the results to be robust.

We report results for some of the robustness tests conducted in Table 7. The reported results are for the dependent variable log real value added. In order to address the concerns related to autocorrelation we reduce the sample length to the period from 1980 onwards, as in Column 1 in Table 7. We can restrict the period further but then we would start losing our control period. In the results reported in column 2 of the table we calculate the standard errors corrected for Newey West adjustment.

Table 7: Robustness Tests

	(1)	(2)	(3)	(4)	(5)
	1980s and beyond	newey2	w/o tobacco, petroleum	Trade reform	Trade and delicensing
delicensing	0.71***	.9***	1.1***		0.62***
	[4.69]	[5.12]	[8.41]		[3.18]
Trade openness				1.04***	0.72***
				[6.33]	[3.46]
Infrastructure x delicensing	-0.22**	-0.18*	-0.18***		0.03
	[2.57]	[1.83]	[2.62]		[0.29]
Labor Intensity x delicensing	-0.45***	-0.51**	-0.60***		-0.30*
	[2.97]	[2.32]	[4.08]		[1.94]
External Finance x delicensing	-0.94***	-1.2***	-1.37***		-1.09***
	[3.52]	[3.80]	[6.21]		[2.88]
Infrastructure x Trade openness				-0.41***	-0.45***
				[5.26]	[5.01]
Labor Intensity x Trade openness				-0.05	0.03
				[0.97]	[0.55]
Financial dependence x Trade openness				-0.52**	0.13
				[2.01]	[0.36]
Industry FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	1056	1361	1299	1056	1056
Number of Industries	44		42	44	44
R-squared	0.67		0.71	0.68	0.69

Dependent Variable is log real value added. Robust t statistics in brackets, * significant at 10%; ** significant at 5%; *** significant at 1%

We also drop two industries, tobacco and petroleum (these industries typically show extreme measures on various accounts such as labor productivity and size) in column 3 and the results are unchanged. Finally in the last two columns of Table 7 we include the trade reform variable. Here as expected we find that the trade reforms have had a growth enhancing effect on Indian

industries, and again the effect has varied across industries along the same dimension as we seen in the earlier tables.

Section IV: Additional Evidence

Do the results that we find in the aggregate data make sense on the ground? Are the firms actually finding infrastructure and financial constraints and issues related to labor to be binding their growth and expansion? In order to reconcile our results with the observations on the ground we analyze two databases. First, we analyze the Investment Climate Survey conducted by the World Bank; and second, we look at the responses of a smaller survey of about 250 firms from some of the most labor intensive sectors, which was conducted by ICRIER (*Field Survey on "How to Enhance Employment Generation and Exports of Labour Intensive Firms"*).[14]

IVA: Results from the Investment Climate Surveys of the World Bank

We use the firm level survey data collected by the World Bank for its investment climate assessment studies (carried out in India jointly with the Confederation of Indian Industry CII in 2002 and 2005). The investment climate survey (ICS) data consists of the responses of managers to a wide range of questions including questions pertaining to managers' perceptions about how various regulatory and other factors influence their firms.

A useful starting point is a question on which of the various factors are considered "a problem for the operation and growth" of the surveyed firm's business. For each factor listed, respondents can reply in terms of a five-point scale: 0= no obstacle; 1= minor obstacle; 2= moderate obstacle; 3= major obstacle; 4= very severe obstacle.[15] It enables one to compare firms' responses about various factors, ranging from regulatory and governance issues to infrastructure related concerns, in terms of how they influence firms' operations or growth prospects. Chart 4 depicts the fraction of firms describing a given factor as a major or very severe obstacle in the 2005 survey (similar patterns are observed in the 2002 round).

First, the situation with infrastructure is viewed as one of the most important obstacles for operations and growth.[16] Almost 40% of respondents cite it as a major or severe obstacle. In addition to infrastructure, one fifth or more respondents cite governance issues (which include

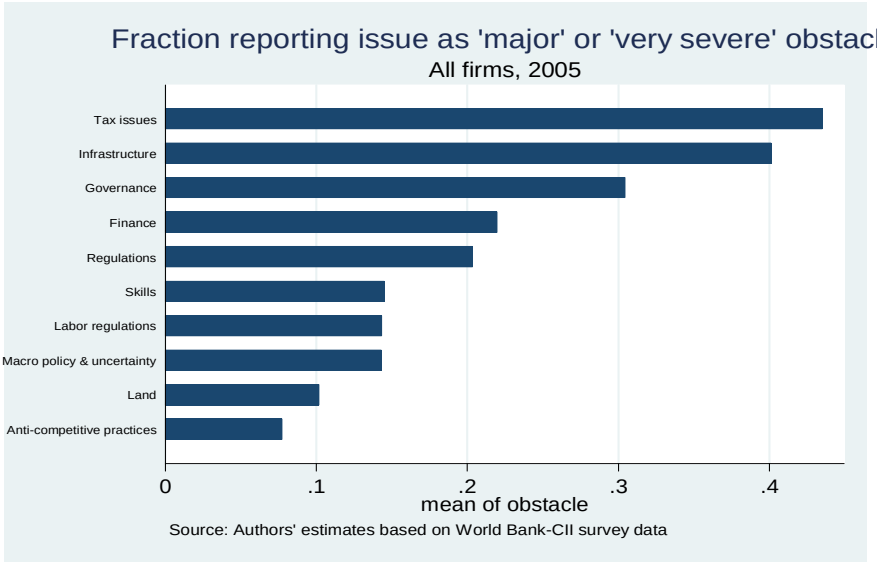
[14] This survey was conducted by a team led by Dr. Deb Kusum Das. We thank him for sharing the data with us.

[15] We are aware that the phrasing of this question may not be ideal since it lumps together operations and growth. It is quite possible, for example, that some aspect of industrial regulations may not be a problem for the operations of a firm, unless the firm tried to expand its operations.

[16] Infrastructure includes electricity, telecommunications, and transportation. Disaggregating this variable shows that the concern with infrastructure is overwhelmingly driven by concerns with electricity. Telecommunications are hardly considered a problem.

concerns with corruption) and the cost and access to finance as the major obstacles.[17] Surprisingly, an almost equal percent of respondents cite skills and labor regulations as major obstacles (around 15%).

Chart 4: Obstacles for Operations and Growth



In the 2005 survey, a useful follow-up question to the obstacles question was to simply ask firms the single most important obstacle for firms' operation and growth. By far the biggest problem relates to infrastructure and within this, electricity was cited as a big problem. Indeed, 31 percent of firms listed electricity as the source of their single most important obstacle to operations and growth.

Table 8: Single Most Important Obstacle for Operation and Growth of the Firm

Factor	Number of	Percent of responses
Infrastructure	821	36
Tax issues	510	22
Governance	231	10
Finance	130	6
Skills	91	4
Labor regulations	82	4

[17] The response on tax issues seem to be driven more by the desires of firms to pay lower taxes or to avail subsidies than any problems with tax administration as such.

These findings are qualitatively consistent with the findings in the previous sections; the results however cannot be compared quantitatively with the regression results in the previous section. Also it seemed to us that when asked about the constraints facing them, several firms accorded a high weightage to reducing the taxes that they paid. This results on taxes is however hard to interpret as though it could be a reflection of the complexities of the overall tax system, but probably reflects more the individual desires of the firm owners to pay lower taxes.

While the concerns with electricity are not surprising for anyone with even a little familiarity with the Indian industrial scene, the low ranking of labor regulations as obstacles for operations and growth is surprising. One interpretation of these results could be that labor regulations may not matter much to firms in practice. This could happen, for example, if noncompliance with labor regulations is not costly. Alternatively, firms may be able to "get around" restrictions on layoffs by hiring contract workers. A second interpretation of these results, however, is that labor regulations may not matter that much to *incumbent* firms. But it may matter to a non-incumbent investor contemplating entry into the manufacturing sector.

More generally, an investor's choice on which specific sectors (for example, services versus manufacturing) and subsectors (for example, a more labor intensive manufacturing industry versus a less labor-intensive one) to enter, as well as the production technologies, scale, and desired levels of employment to adopt, can be expected to be influenced by the regulatory framework. In this way, there may be an "ex-ante" effect of the law that would be very difficult, if not impossible, to capture through surveys of incumbent manufactures. In other words, deterred by specific elements of labor regulations such as Chapter VB of the IDA, potential investors, especially those contemplating large investments, choose to avoid investing in manufacturing altogether, or if they do invest in manufacturing, they avoid subsectors, product lines, or scales of production for which the regulations have most bite.

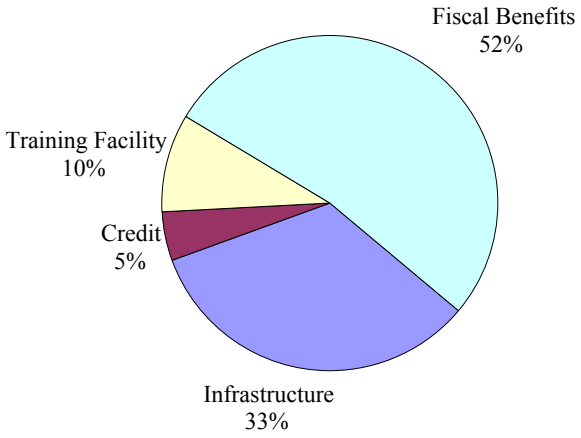
IVB: Results from the ICRIER Survey

This section briefly summarizes some key findings from the ICRIER field survey. The survey covered 250 respondents over five different sectors (apparel, bicycles, gems and jewelry, leather, and sports goods) and is useful to look at because it covers firms from some of the most labor intensive manufacturing activities. Not all the firms covered responded to all the questions in the survey. For the purposes of the present study, we focus on the responses relating to the questions on the hurdles to the growth of the firms.

Broadly speaking, the respondents find electricity and infrastructure in general; financing; and skilled labor availability to be a constraint on growth. Just like in the ICS survey they also point to specific regulations especially those related to taxes (and fiscal benefits, in general) among things that can be improved.[18] The chart below summarizes the responses of the firms.

[18] A look at the specific responses makes it clear that the concern with fiscal issues is very narrowly defined and is more in the nature of a personal issue to the firms, to the extent that taxes directly affect their bottom lines. In response to the question what would you like to see changed to help you, majority of them answered that they would like the taxes to be lowered or subsidies from the government.

Chart 5: Areas for Improvement



Source: Authors' calculation using the ICRIER survey

In response to the questions on hurdles to increasing employment, majority of the respondents reported shortage of labor (of mostly skilled and semi-skilled labor) as the key hurdle to hiring more labor.[19] Further, most of the firms (approximately 90 percent) responded in negative to being affected by any labor disputes or to having labor unions in their organization and/or any impact of the unions on their activities. This brings us back to the findings in the ICS survey on labor regulations; and in view of these survey findings and the debate surrounding the labor market regulations, we prefer to interpret our findings on labor intensive industries as reflecting labor market regulations as well as other constraints that the labor intensive industries might be facing in particular. Unfortunately in our analysis we cannot shed any further light on what these factors might be.

The survey also tried to find whether the technological changes are such that they are inhibiting employment growth. About two-third of the respondents acknowledged technological changes (either a lot or modest) taking place globally in their industry. Of those answering in affirmative to world-wide changes in technology in their respective industries, 70 percent of the respondents adopted new technology during the five years prior to the year of the survey; but the majority of them still find a gap between the technologies they used and those used globally. In general, however, there is no clear evidence on the impact of adoption of new technologies on labor. One potential explanation for the lack of a clear pattern could be that while adoption of new technology, on one hand, might be labor saving (substitution effect) and, on the other hand,

[19] Interestingly approximately 10 percent of the firms rue the lack of training facilities. This is consistent with shortage of labor or, more precisely, the "right" kind of labor with the "right" kind of skills.

growth result from adopting new technology might be expansionary and lead to hiring of more labor (growth effect).

Section VI: Concluding Remarks

In this paper, we have analyzed the performance of India's manufacturing sector using data from the ASI. In line with some recent studies, we find that industrial performance has improved with industrial delicensing. However, our analysis also indicates that there is considerable heterogeneity in the response of industries to policy reforms. In particular, three types of industries have not done too well. These are the industries more dependent on infrastructure; industries with greater dependence on external finance; as well as those with high labor intensity.

From a policy perspective, the important question then is what features of India's policy and institutional landscape explain this pattern? The ongoing policy debates in India suggest several leading candidates. In the case of infrastructure dependent industries, the inadequacy of public provision of infrastructure is probably the main culprit. Similarly, the failure to improve the Indian financial sector's ability to identify and finance creditworthy firms and investors may well lie behind the relatively weak performance of industries especially dependent on external finance.

Finally, a candidate for the weak performance of labor-intensive industries is likely to be labor regulation. In particular, certain elements of the IDA may have raised significantly the effective cost of hiring workers, thereby hitting the relative profitability of labor-intensive industries disproportionately. Since this is more likely to be the case for larger firms (due to the nature of the regulations), labor regulations may have led to relatively weaker performance of labor-intensive industries in two ways. First, by discouraging entry by large firms; and second, by reducing incentives among small firms to expand.

A complementary analysis of two firm level surveys of managers in the manufacturing sector lends further support to these arguments, especially in the case of infrastructure and finance. Taken together, the results of the World Bank's investment climate survey and ICRIER survey of labor-intensive manufactures support the notion that weak provision of infrastructure and finance has constrained the growth of the manufacturing sector.

One way to make headway on this issue -- i.e., establishing whether certain elements of the policy or institutional framework are causal drivers of the pattern of industrial performance we find -- is to extend our analysis to the state level. To the extent that India's states present sufficient variability in the provision of infrastructure and finance and in the stance of labor regulations (as they actually apply to firms and not just on paper), and that we are able to capture this variability, carrying out our analysis at the state level should shed very useful light. We take up this issue in forthcoming work.

In the meantime, our econometric analysis has served to highlight from where relatively weaker performance in India's manufacturing sector is coming. Unlike previous work that has highlighted mainly the role of labor regulations in influencing industrial performance, our econometric results interpreted in conjunction with perceptions of managers suggest that steps to improve infrastructure and the financial system should go a long way in improving

manufacturing performance. Additionally, and arguing on a conservative basis, our results also point to the urgency of identifying the constraints on labor-intensive manufacturing in India and relaxing these.

Appendix A: Data Sources and Construction of Variables

We have primarily used ASI data at the three digit level. After the concordance from NIC87 and NIC70 into NIC 98 classification, we have data on 49 industries. Data are available from 1973-2003. Data in general seems good and comparable pre and post 1998, when there was a change in the sampling framework. The following industries were excluded from the analysis. The first three (dressing & dyeing of fur, saw milling, and publishing) were excluded because of lack of data on infrastructure dependence from CMIE. The others that were dropped included processing of nuclear fuels and reproduction of recorded media. As noted by Aghion et al (2006), processing of nuclear fuels is likely to be affected by non-economic factors and hence we drop them from our sample. Finally, reproduction of recorded media was introduced as a new category in 1998. There is no data for this industry for the period 1973-1998 and is therefore excluded from the sample. As the table below shows, we exclude less than 1% of the registered manufacturing sector, whether we look in terms of employment or gross value added.

Table A1: Industries not included in the sample

Industry	Percentage Share in value added in 2004	Percentage Share in employment in 2004
Dressing and Dyeing of fur, articles	0.001	0.01
Saw Milling	0.02	0.1
Publishing	0.8	0.6
Reproduction of recorded media	0.02	0.03
Processing of Nuclear Fuels	NA	NA

Analysis from here onwards, when it refers to total manufacturing output, employment etc., refers to the registered manufacturing excluding the above 5 industries. The real values have been calculated by using respective WPI deflators (unless otherwise noted, e.g. for the capital formation or capital stock variables).

Table A2: Construction of variables

Variable	Data Source	Description/construction
Value added	ASI	It is increment to the value of goods and services that is contributed by the factory and is obtained by deducting the value of total input.
Workers (blue collared)	ASI	Blue collared workers are defined to include all persons employed directly or through any agency whether for wages or not, and engaged in any manufacturing process or in cleaning any part of the machinery or premises used for manufacturing process or in any other kind of work incidental to or connected with the manufacturing process or subject of the manufacturing process.
Total employment	ASI	Total employment is defined to include all blue collared workers as defined above and persons receiving wages and holding clerical or supervisory or managerial positions or engaged in administrative office, store keeping section and welfare section, sales department as also those engaged in purchase of raw materials etc. or production of fixed assets for the factory and watch and ward staff.
Capital Stock	ASI	Sum of fixed capital and physical working capital. Fixed capital represents the depreciated value of fixed assets owned by the factory and covers all types of assets, new or used or own constructed, deployed for production, transportation, living or recreational facilities, hospitals, schools, etc. for factory personnel. Physical working capital includes all physical inventories owned, held or controlled by the factory as on the closing day of the accounting year such as the materials, fuels and lubricants, stores etc..
Capital Formation	ASI	It represents the excess of fixed capital at the end of accounting year over that at the beginning of the year.
Number of factories	ASI	Factory for the purposes of ASI is defined as the one which is registered under sections 2m (i) and 2m (ii) of the Factories Act, 1948. Broadly, according to these sections. Premises whereon 10 or more workers with the aid of power or 20 or more workers without the aid of power is referred to as a factory.

Labor productivity	ASI	Ratio of Value Added to Total Employment
Labor intensity	ASI	Labor intensity: (employment/real invested capital)*1000. Where deflator used is the WPI for the NIC classification 319 (other electrical equipment, to proxy for the capital goods)[20].
Infrastructure Dependence	CMIE	Ratio of distribution and power & fuel expenses to gross value added. It is the average of the ratio over the period 1994-1998.
Dependence on External Finance	ASI	Ratio of outstanding loans to invested capital, averaged over 1991 to 1995.
Export Intensity	CMIE	Ratio of total foreign exchange earnings to GVA.
Trade Reforms	Hasan, Mitra, and Ramaswamy (2007)	Nominal Rate of Protection
Financial sector liberalization	Abaid and Mody	

[20] Results do not depend on the deflator used or whether we use only fixed capital, rather than invested capital which included working capital as well to define labor intensity. It is not surprising since the correlation of the WPI series is of the order of .94 with the WPI for electrical goods; and the correlation of fixed capital with invested capital is of the same order of magnitude.

Table A3 : Summary Statistics of the ASI data

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Log (Number of Factories)	1361	6.86	1.42	1.39	21.74
Log (Total Employment)	1361	11.11	1.31	6.996	14.31
Log (Blue Collared Workers)	1361	10.81	1.36	6.38	14.18
Log (White Collared Workers)	1361	9.68	1.23	5.84	12.92
Log (Real Gross Value Added)	1361	17.88	1.42	13.94	21.74
Log(Real Invested Capital)	1361	18.76	1.51	14.36	22.65
Log(Productivity)	1361	6.77	0.75	4.62	9.95
Size-Log(Labor per Factory)	1361	4.25	0.70	2.85	6.94
Size-Log(Gross Value Added per Factory)	1361	11.02	1.09	8.30	14.71
Infrastructure Dependence	44	0.30	0.25	0.04	1.17
Financial Dependence	44	0.52	0.48	0.04	3.27
Labor Intensity	44	0.42	0.14	0.09	0.83

Table A4: Delicensing

Year of Delicensing	Industry Code	description
1985	151,191,210,252,261,281,300,311,319,321,322,331,341 Total number of industries delicensed: 13	meat, fish, fruit, vegetables etc.; leather; paper; plastic products; glass; metal products; office/computing machinery; electric motors; other electric equipment; electronic components; television; radio transmitters; medical appliances and motor vehicle.
1989	251 Total number of industries delicensed: 14	rubber products
1991	152,153,154,155,171,172 173,181,182,192,202,221,222,233,241,269,271,272,289,313,314,332,333,351,352,359,361,369 Total number of industries delicensed: 42	dairy products; grain mill products; other food products; beverages; spinning, weaving; other textiles; knitted fabrics; weaving apparel; articles of fur; footwear; wood products; publishing; printing; processing of nuclear fuels; basic chemicals; non-metallic; iron and steel; basic precious/non-ferrous metals; fabricated metal products; insulated wire and cable; accumulators, cells/batteries; optical and photographic equipment; watches; ships and boats; railway locomotives; transport equipment nec; furniture; and manufacturing nec.
1993	293 Total number of industries delicensed: 43	domestic appliances
1997	201,223,232 Total number of industries delicensed: 45	saw milling; recorded media; and refined petroleum products.

We used the data provided in Aghion et al (2006), mapped into our 3 digit classification, and updated up to the year 2003.

Appendix B1: Industry Characteristics

NIC98 3digit	Industry Description	Infrastructure Dependence	Financial sector dependence	Labor Intensive
151	Meat, Fish, Fruit,Vegetables etc.	1	0	0
152	Dairy Products	1	1	1
153	Grain Mill Products	1	0	1
154	Other Food Products	1	0	1
155	Beverages	1	1	0
160	Tobacco Products	0	0	1
171	Spinning, Weaving and Finishing of Textiles	1	1	1
172	Other Textiles	1	0	1
173	Knitted and Crocheted Fabrics	1	0	1
181	Wearing Apparel	0	0	1
191	Leather Products except footwear	1	0	1
192	Footwear	1	1	1
202	Wood Products	1	1	1
210	Paper and Paper Products	1	1	0
222	Printing	0	0	1
231	Coke oven Products	0	0	0
232	Refined Petroleum Products	1	0	0
241	Basic Chemicals	1	1	0
251	Rubber Products	1	1	0
252	Plastic Products	1	1	0
261	Glass and Glass Products	1	1	1
269	Non-metallic Mineral products	1	1	0
271	Basic Iron and Steel	1	1	0
272	Basic Precious & Non-ferrous Metals	1	0	0
281	Metal Products	0	0	1
289	Fabricated Metal Products	1	1	1
293	Domestic Appliances, Electric Lamps & Equipment	0	0	1
300	Office, accounting and Computing Machinery	0	0	0
311	Electric Motors, Generators & Transformers	0	1	0
313	Insulated Wire and Cable	0	1	0
314	Accumulators, Cells & Batteries	0	0	0
319	Other Electric Equipment	0	0	1
321	Electronic Components	0	1	0
322	Television, Radio Transmitters etc	0	1	0
331	Medical appliances and Instruments	0	0	1
332	Optical Instruments & Photographic Equipment	0	1	0
333	Watches & Clocks	0	1	0
341	Motor Vehicles, Trailers, Parts and Accessories	0	1	0
351	Ships and Boats	0	1	0
352	Railway Locomotives	1	0	1
353	Aircraft & Spacecraft	0	0	0
359	Transport Equipment nec	0	0	1
361	Furniture	0	1	1
369	Manufacturing not elsewhere Classified	0	0	1

Table B2 : Spearman Rank Correlation Between Different Industry Characteristics

	Infrastructure dependence	External Finance dependence	Exports Intensity	Import intensity	Labor Intensity
External Finance dependence	0.19	1			
Exports Intensity	0.16	-0.08	1		
Import intensity	-0.31**	0.02	0.18	1	
Labor Intensity	0.05	-0.29*	0.25	-0.48***	1
FDI Intensity	-0.43**	-0.08	0.06	-0.16	0.17

Note: Authors' calculation. * indicates significant at 10%; ** indicates significant at 5%; *** indicates significant at 1%

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