About the Paper

Poonam Gupta, Rana Hasan, and Utsav Kumar use Annual Survey of Industries data at the 3-digit level and employ a difference-in-differences strategy to shed light on the empirical importance of factors commonly believed to be constraining formal Indian manufacturing. They find that the postreform performance of the manufacturing sector is heterogeneous across industries. In particular, industries that were dependent on infrastructure or external finance and were labor-intensive 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 clearly identify and address the factors inhibiting the growth of labor-intensive industries.

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What Constrains Indian Manufacturing?

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FOREWORD

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ABSTRACT

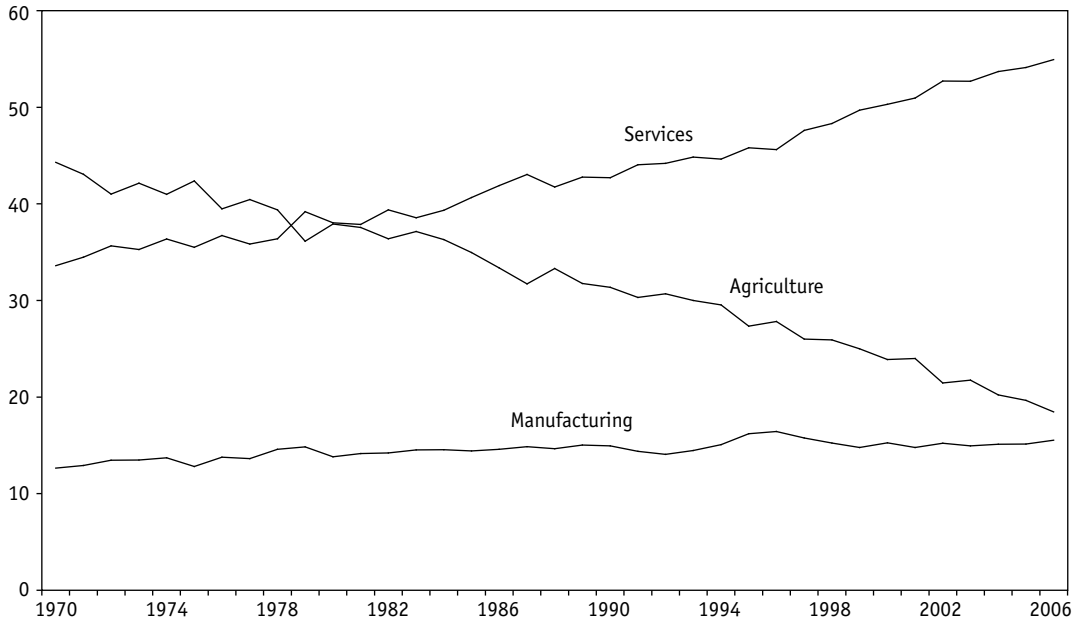
India has undertaken extensive reforms in its manufacturing sector in the last two decades. However, an acceleration of growth in manufacturing, and a concomitant increase in employment, has eluded India. What might be holding the sector back? Using Annual Survey of Industries data at the 3-digit level, and difference in differences estimates, this paper finds that the postreform performance of the manufacturing sector is heterogeneous across industries. In particular, industries that were dependent on infrastructure or external finance and were labor-intensive 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 clearly identify and address the factors inhibiting the growth of labor-intensive industries.

I. INTRODUCTION

Many emerging countries in recent decades have relied on a development strategy focused on promoting the manufacturing sector and the export of manufactured goods. These include many East Asian countries and most recently, the People's Republic of China. India, too, hoped for a dynamic manufacturing sector 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 15 years; however, 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 that 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?

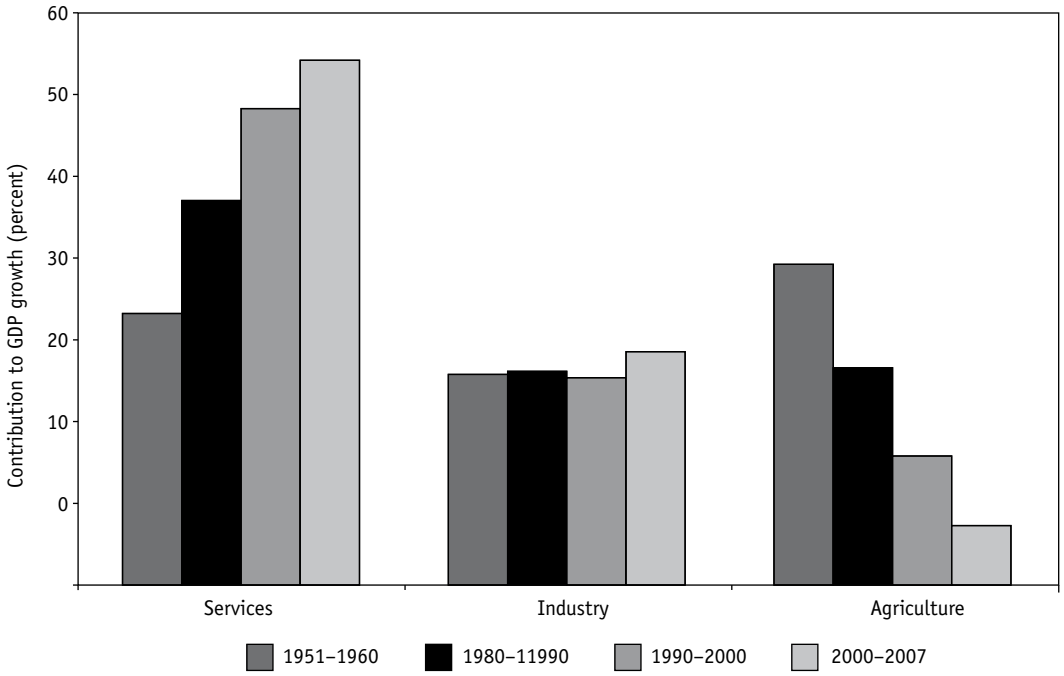
As Figure 1 shows, the manufacturing sector's share in India's gross domestic product (GDP) has been stagnant since the early 1990s despite several wide-ranging reforms in this sector. Similarly, Figure 2 shows that the contribution to GDP growth has primarily been from the services sector, and this contribution has been increasing over time.

FIGURE 1
SECTORAL SHARES IN GDP, INDIA



Sources: Authors' calculations, Central Statistical Organization (India).

Figure 2
Sectoral Contribution to Indian GDP Growth, 1951–2007



Sources: Authors' calculations, 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.[1]

Besides infrastructure, some key areas of policies remain unchanged. In particular, even though there have been extensive product market reforms, it has been widely observed that the labor market reforms to complement these have not been undertaken (see Panagariya 2006 and 2008, Kochhar et al. 2006). Moreover, credit constraints due to weaknesses in the financial sector may be holding back small- and medium-size firms from expanding (see Banerjee and Duflo 2004, Nagaraj 2005, McKinsey 2006).[2] 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.[3]

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

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

[3] Another possibility is that 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). Other factors often believed to be affecting the performance of

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 to test these hypotheses is to exploit interstate heterogeneity in the policy and institutional environment, including labor market regulations, financial sector development, and infrastructure for different states of India; and then to test whether 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 liberalization. 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 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.[4]

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. Similarly, Mitra and Ural (2007) show that industries experiencing larger tariff reductions grew faster in pro-employer states relative to pro-worker states.[5]

In this paper we relate the pattern of growth in India's manufacturing sector to cross industry heterogeneity in the reliance on infrastructure and the financial sector and in the use of labor relative to capital. In particular, we calculate the dependence of industries on infrastructure and the financial sector, and the labor intensity of industries. Using Annual Survey of Industries (ASI) data at the 3-digit level, we employ difference in differences estimates to compare the performance of industries more dependent on infrastructure, on the financial sector, and on labor-intensive industries post-delicensing with that of the control group.

Our results indicate that the aggregate performance of the manufacturing sector masks important interindustry 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

Indian manufacturing are public ownership of enterprises, remaining reservations in small-scale industries, and stringent regulations on land use in India as discussed in Panagariya (2008). In recent years the availability of skilled labor has also emerged as a constraint on the growth of manufacturing and services.

[4] While, in principle, the approach of Besley and Burgess (2004) 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 regulations is widespread, then even an accurate coding of amendments that takes into account the appropriate judicial interpretation loses its meaning.

[5] There are some differences between Mitra and Ural (2007) and Aghion et al. (2006) in terms of the states deemed to have pro-employer or pro-worker labor regulations. See Mitra and Ural (2007) for details.

that in the post-delicensing period, the above-median, infrastructure-intensive industries grew 10% less than the industries below the median of infrastructure dependence. Similarly, industries above-median in the distribution of financial dependence grew 18% less than the industries below the median of financial dependence; and for labor intensity, industries with above-median labor intensity grew 19% less than the below-median industries post-delicensing.

There are two ways to interpret these results. First, one can use the results to identify which industries have not benefited much from reforms. Second, to the extent that the heterogeneity across industries on parameters such as infrastructure dependence is exogenous and determined by factors such as production technology, causal inferences may probably be drawn 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; the same is true for financial sector-dependent industries. For labor-intensive industries, an interpretation in terms of the limited supplies of labor would not be appropriate 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 that make the effective price of hiring labor too high.

In order to ensure that the results are not driven by outliers; that 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.

There are two conclusions that can be drawn from these results. First, product market reforms alone might not be sufficient to spur growth; for gains from these reforms to be maximized they may have to be complemented by reforms in other areas. Second, the potential benefits from product market reforms might not be realized unless these are matched by enabling conditions such as high-quality infrastructure, availability of the right kind of labor, and financial markets that are deep enough. There is no room for complacency, and efforts should be made to remove these constraints if the manufacturing sector is to play the role that it did in the case of East Asian countries.

One point that needs to be noted about our analysis is that it is based on data only on the organized (or registered) manufacturing sector, and not the unorganized sector. This is primarily because of the unavailability of detailed data for the latter. A question that comes up then is whether the lack of quality data on the unregistered manufacturing should preclude any analysis of the registered manufacturing sector. Though there is no denying the fact that the unorganized manufacturing sector is important when it comes to employment, its output, wages, and productivity are very low. In terms of policy objectives, improving the performance of registered manufacturing is a key aspect to making India a powerhouse in manufacturing.

II. STYLIZED FACTS AND PRELIMINARY EVIDENCE

A. Indian Policy Framework

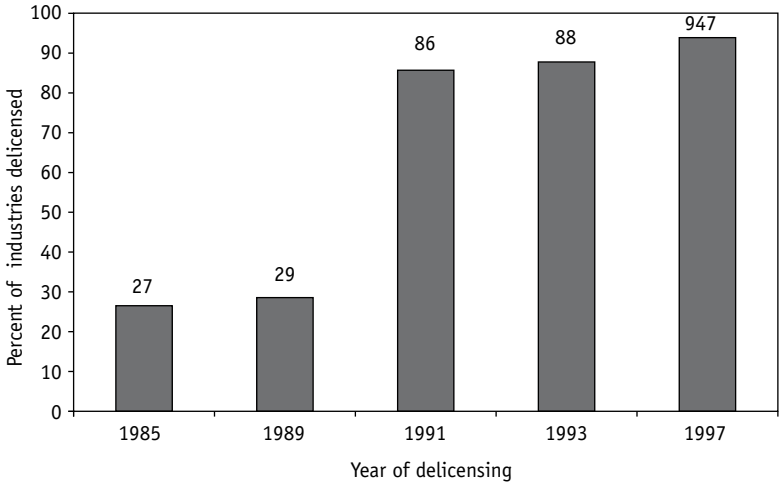
Since the early 1950s up until the early 1980s, the evolution of India's manufacturing sector was guided by industrial and trade policies that protected domestic industry and gave the state a central role in investment decisions. While a strict regime of import and export controls defined trade policy,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

Industries Development and Regulatory Act of 1951, investors 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, 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 and 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% were not uncommon, nontariff 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. (This was largely the case until 2000, and recent reforms have left only 35 items on the list.)

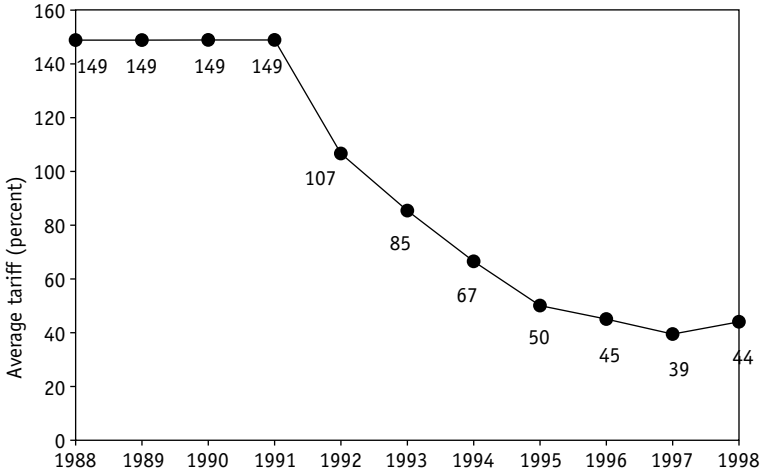
More serious liberalization efforts began in 1985 with delicensing—the exemption from the requirement of obtaining an industrial license—of 25 broad categories of industries, which maps into 13 industries in our 3-digit level data. The next major reform of the licensing regime came in 1991 when industrial licensing was abolished except in the case of a small number of industries (see Figure 2a and Appendix Table A.4 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 nontariff 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 Figure 2b).

FIGURE 3
CUMULATIVE SHARE OF INDUSTRIES DELICENSED



Sources: Based on Aghion et al. (2006) and extended by the authors.

Figure 4
Average Nominal Rate of Protection, 1988–1998



Source: Hasan, Mitra, and Ramaswamy (2007).

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 (2008), 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 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.[6] While the IDA does not prohibit retrenchments, critics of the act argue that it is difficult to carry them out. Datta-Chaudhuri (1996) has argued, 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 the terms and conditions of work. 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

[6] Until 1976, the provisions of the IDA on retrenchments or layoffs were fairly uncontroversial. The IDA allowed firms to lay off 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.

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 and rival unions, making it difficult to arrive at a consensus among workers.

Similarly, hiring contract workers can enable firms to get around many of the regulatory restrictions on adjusting employment levels, productions tasks, and others; 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.

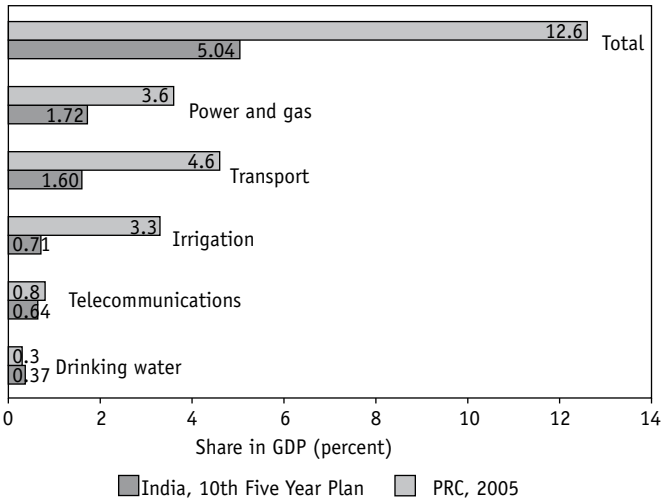
It is important to note that not all analysts agree that India's labor laws have made for a rigid labor market. In particular, a counter argument to the views above is that the rigidity-inducing regulations have been either ignored (see Nagaraj 2002) or circumvented through the increased usage of temporary or contract labor (see Dutta 2003 and Ramaswamy 2003).[7] 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.

Another well-known constraint on growth is India's crumbling infrastructure. According to the Deputy Chairman of the Planning Commission, 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 $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 survey of the Indian economy compares Indian infrastructure with that of other countries and finds India to be badly lagging in most of the areas (OECD 2007).

An interesting comparison in this regard is with the infrastructure in the People's Republic of China (PRC). Total investment anticipated in infrastructure in the Tenth Five-Year Plan (2002–2006) in India was 5% compared to the PRC's 12.6% in 2005 (Figure 3). Not only is the PRC's investment as a share of GDP almost 2.5% times greater than that of India, the PRC's GDP base is larger as well. In almost all sectors, investment as a share of GDP in the PRC is far greater than those in India (Figure 3).

[7] For a detailed review of Indian labor regulations and the debate surrounding the issue of rigidity, see Anant et al. (2006).

Figure 5
Infrastructure Investment, The PRC and India



Sources: Authors' calculation, Planning Commission (2007), Lall et al. (2007).

Another area in which there has been rather slow progress on reforms is the financial sector (or the banking sector, more narrowly). Reform efforts in this area have been directed at deregulating 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 (OECD 2007), some major challenges still remain. These include a very high share of public ownership in banks and a low level of bank intermediation partly because of regulations on the allocation of credit that require banks to allocate a substantial percentage of their total advances into government securities and other priority sectors.[8]

B. Performance of Indian Manufacturing

We look at a fairly long time series of data on Indian registered manufacturing from 1973 to 2003.[9] 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.[10] Various panels of Figure 4 show that the growth of value-added, employment, capital formation, and factories has

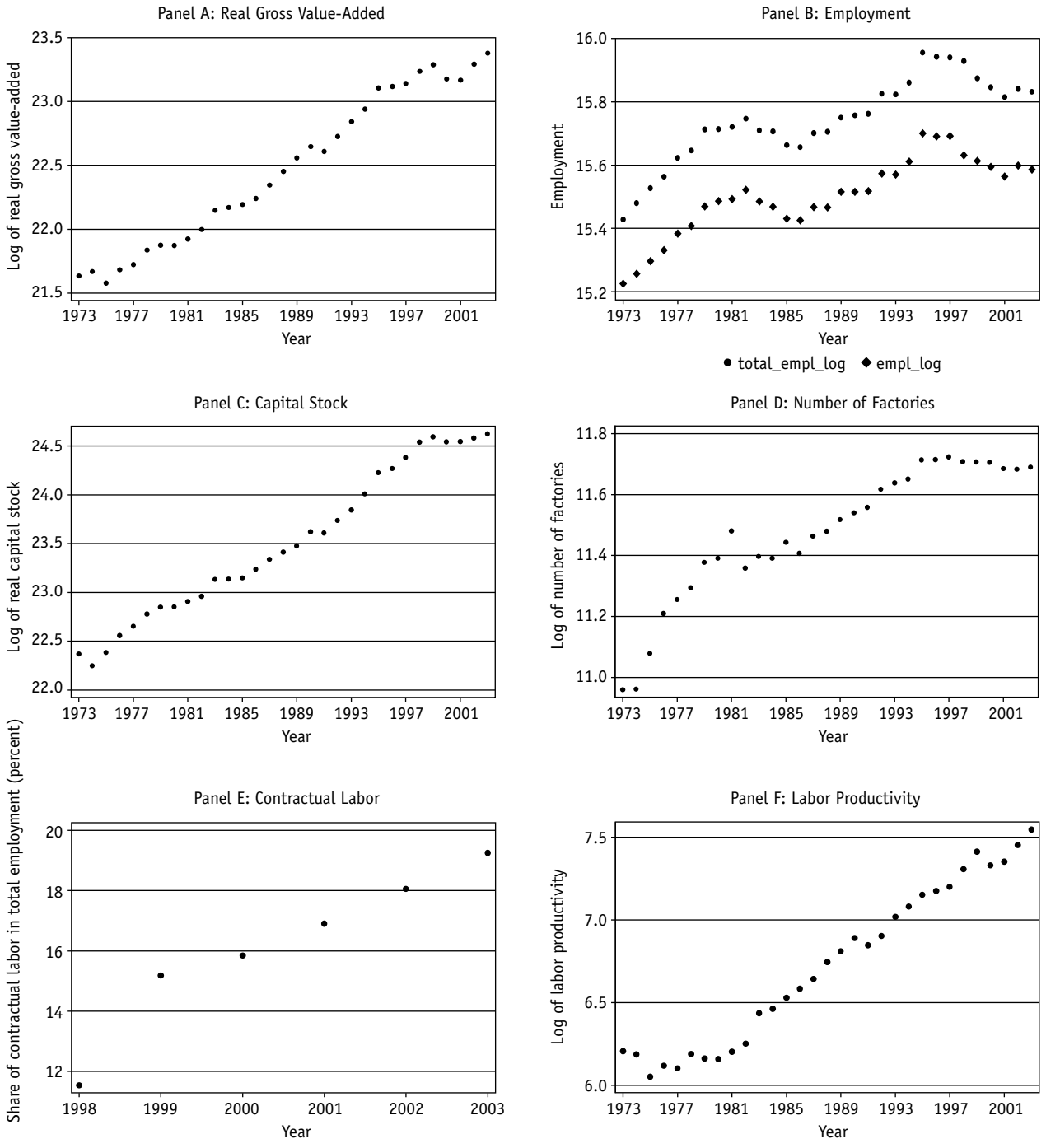
[8] In addition, since the performance of the bank managers is not linked as tightly with the profitability of the banks, and is probably influenced more by the incidence of nonperforming loans, they have little incentive to provide credit to the private sector. Hence they are extremely cautious, and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

[9] Reference period for ASI is the accounting year of the industrial unit ending on any day during the fiscal year. Therefore, in ASI 2003–2004, the data collected from the respective industrial units relates to their accounting year ending on any day between 1 April 2003 and 31 March 2004. In this paper, 2003 refers to fiscal year 2003–2004.

[10] The only comprehensive database available on Indian manufacturing is the ASI data, which include 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% of the total manufacturing employment.

been stable throughout the last three decades and has not necessarily accelerated in the postreform period. If anything, there is probably a stagnation starting sometime in the mid-1980s to the late 1990s.

Figure 6
Performance of Indian Manufacturing



Panel B of Figure 4 shows the employment of blue collar workers and total employment. The trends seem to be broadly similar for both the variables. The data on contractual labor 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 over time. Finally, the 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, as seen in Table 1 below. The table estimates 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 logs, and regress them on a linear trend and a dummy that takes the value 1 for post-1992 period, and zero otherwise. Thus the coefficient measures the percentage change in the dependent variable post-1992 after accounting for its trend growth rate.

The results indicate a marginal pickup 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.[11]

Table 1
Pre-Reform and Post-Reform Performance of Indian Manufacturing

	VALUE-ADDED	CAPITAL STOCK	NUMBER OF FACTORIES	TOTAL EMPLOYMENT
Trend	5.997***	7.318***	2.703***	1.292***
	[21.82]	[27.16]	[7.75]	[5.26]
Trend*Post1992	0.447**	0.838***	-0.375*	-0.013
	[2.18]	[4.55]	[2.04]	[0.08]
Observations	31	31	31	31
R-squared	0.98	0.99	0.87	0.77

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

Thus the data show that the aggregate value-added has increased at about 6% a year in the sample period, and there has been a modest annual growth acceleration of about half a percentage point between 1993 and 2003. 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 1.3% a year, with no change in the rate of growth post-delicensing. New factories have come up at the rate of 2.7% a year; with the rate decelerating post-1992. Investment rate, however, has been commensurate with the growth of value-added. Investment accelerated by about 8.5% post-1992. Poor performance of employment is a very important question in itself and we cannot do full justice to this issue here, hence propose to take it up in another paper.

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

[11] The ASI data is available until 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 including the PRC, 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 Asian countries. For example, manufacturing value-added in Republic of Korea grew at an average annual real growth rate of approximately 17% between 1960–1980; the PRC's manufacturing sector witnessed an average growth rate of 12% per year between 1990–2005.

III. EVIDENCE FROM ENTERPRISE SURVEYS

What lies behind this relatively lackluster performance? Before turning to the main econometric analysis of this paper, it is useful to examine the views of managers based on two recent surveys of manufacturing firms: the Investment Climate Survey conducted by the World Bank and a survey of about 250 firms from some of the most labor intensive sectors, conducted by ICRIER.[12]

The World Bank's investment climate survey (ICS) data consists of the responses of managers to a wide range of questions including those pertaining to their perception on how various regulatory and other factors influence their firms. A key question asks about the extent to which 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.[13] The scale 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.

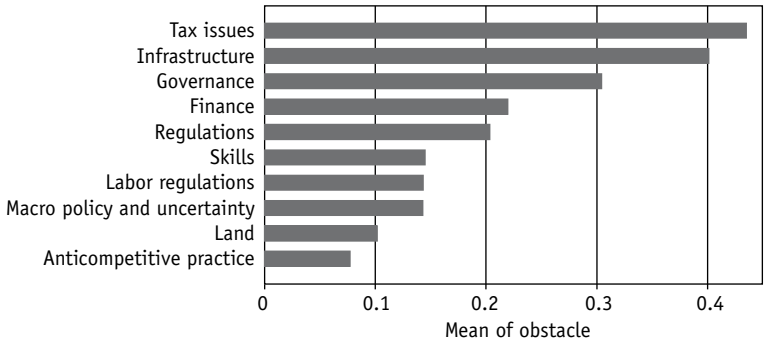
Figure 5 depicts the fraction of firms describing a given factor as a major or very severe obstacle in the 2005 ICS survey (similar patterns are observed in the 2002 ICS survey). Tax-related issues, incorporating difficulties with either the tax administration system or complaints about tax rates, are considered to be a major or severe constraint by more than 40% of respondents. Of course, it is not easy to interpret this finding given what is probably a natural penchant among firms to want to pay as little as possible in taxes. Ignoring tax-related issues then, the situation with infrastructure can be seen to be a critical obstacle for operations and growth from the perspective of the firms.[14] Almost 40% of respondents cite it as a major or severe obstacle. In addition to infrastructure, one fifth or more of the respondents cite governance issues (which include concerns with corruption) and the cost and access to finance as the major obstacles. Surprisingly, an almost equal percent of respondents cite skills and labor regulations as major obstacles (around 15%).

[12] The survey, "How to Enhance Employment Generation and Exports of Labour Intensive Firms", was conducted by a team led by Deb Kusum Das. We thank him for sharing the data with us.

[13] 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.

[14] 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.

Figure 7
Obstacles for Operations and Growth
(all firms, 2005)



Note: Fraction reporting issue as "major" or "very severe" obstacle.
Source: Authors' estimates based on World Bank-CII survey data.

A useful follow-up question entailed asking firms what constituted the *single* most important obstacle for their operation and growth. By far the biggest problem relates to infrastructure and within this, electricity was cited as the key issue. Indeed, 31% of firms listed electricity as the source of their single most important obstacle to operations and growth.

Table 2
Single Most Important Obstacle for Operation and Growth of the Firm

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

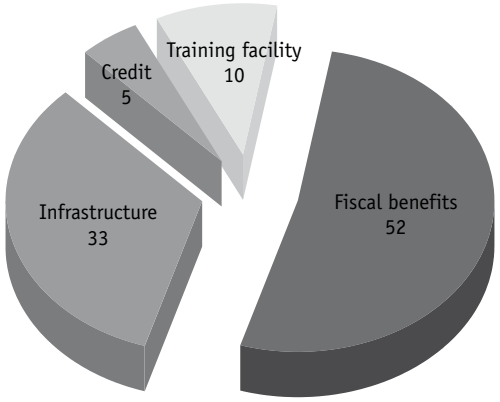
Another source of the views of manufacturing firm managers comes from the ICRIER survey of 250 enterprises engaged in manufacturing activities in five different sectors (apparel, bicycles, gems and jewelry, leather, and sports goods). It is useful to examine the results of this survey because it covers firms from some of the most labor-intensive manufacturing activities. Thus to the extent that labor regulations create serious constraints and growth prospects of firms, the sample firms should be among those most affected.[15]

Broadly speaking, the respondents find electricity and infrastructure in general; financing; and skilled labor availability to be the most serious constraints on growth. Just like in the ICS

[15] 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.

survey, they also point to specific regulations especially those related to taxes (and fiscal benefits, in general) among things that can be improved.[16] The chart below summarizes the responses of the firms.[17]

Figure 8
Areas of Improvement (percent)



Source: Authors' calculation using data from (ICRIER 2007).

In response to the questions on hurdles to increasing employment, a majority of the respondents reported shortage of labor (of mostly skilled and semi-skilled labor) as the key hurdle to hiring more labor.[18] Further, most of the firms (approximately 90%) responded in the 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.

Taken together, there are some striking similarities in the results of these two very different surveys. First, infrastructure-related issues are very high on the list of constraints faced by firms. Indeed, ignoring tax-related issues, concerns with electricity seem to be paramount. Second, finance-related issues also seem be a problem, especially for the smaller firms. Third, surprisingly, labor regulations do not show up as a significant concern for firms. Indeed, both surveys suggest that concerns with skills-related issues are more important than those having to do with labor regulations.

[16] 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 answered that they would like taxes to be lowered or subsidies received from the government.

[17] The survey also tried to find whether the technological changes are such that they are inhibiting employment growth. About two thirds of the respondents acknowledged technological changes (either a lot or modest) taking place globally in their industry. Of those answering affirmatively to worldwide changes in technology in their respective industries, 70% of the respondents adopted new technology during the 5 years prior to the year of the survey; however, 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), on the other hand, growth resulting from adopting new technology might be expansionary and could lead to hiring of more labor (growth effect).

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

While the concerns with electricity are not surprising for anyone with some 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 nonincumbent 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 to capture through the 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.

In what follows, we turn to an approach that has the potential for getting around the "selection" problem inherent in surveys of incumbent firms. In particular, we use industry-level data from India's organized manufacturing sector to examine the relative performance of industries with various characteristics.

IV. ECONOMETRIC ANALYSIS

We are interested in testing the variants of the following hypotheses: did industries that are more labor-intensive; or industries that rely more on infrastructure; or industries that rely more on the financial sector for their financing needs, grow less than the control group of industries in the post-delicensing period? The econometric methodology is derived from Rajan and Zingales (1998), who analyze the effect of financial development on growth by comparing the growth of industries depending more on the financial sector that are in countries with greater financial depth, with the growth of these industries in countries with shallower financial markets. Thus if the financial sector indeed matters for growth, then one would see higher growth in industries that rely on the financial sector in countries with a deeper financial sector, and vice versa. This technique gets to the causality issue much more cleverly than the alternative econometric ways to measure this relationship. The methodology has subsequently been used in several different contexts (see, e.g., Dell'Ariccia et al. 2005, Rajan and Subramanian 2005).

We use this technique to look at the constraints that Indian industry might have experienced post-delicensing. Hence we analyze the performance of the industries that rely more heavily on infrastructure, industries that depend on the financial sector, and the labor-intensive industries post-delicensing. An evidence of lackluster growth in these industries is attributed then to the unavailability of inputs or factors that the respective industries rely more heavily on. Thus if the infrastructure-dependent industries have not performed well post-delicensing, then it is likely to be due to the fact that the infrastructure availability has not been adequate for these industries to tap the maximum benefit from the reforms.

A. Construction of Variables

1. Reform Variables

As discussed in Section II, industrial and trade policy has seen wide-ranging reforms over the period under study. While limited reforms were started from the mid-1980s onward, major policy changes were undertaken following the crisis in 1991. Some of the reforms introduced were more generic and aimed at macroeconomic management; others were more specific to the industries. The reforms spanned several areas, including delicensing of industries, trade reforms, and exchange rate reforms. In subsequent years these were complemented by the liberalization of foreign investment—both foreign direct investment (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, which is one of the most comprehensive programs that covered almost all the industries. 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 control for it in the robustness exercises.[19] In robustness tests we also 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 that were more generic in nature, besides the delicensing. Results remain broadly unchanged and are presented selectively here.

2. 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 and infrastructure intensity. To the extent that these two characteristics define input usage, the technological requirement assumption is perhaps as valid as for defining external financing dependence. We briefly describe the various industrial characteristics below, and further details are provided in the appendices.

3. Labor Intensity

Labor intensity is the ratio of total employment to capital stock. Since there are no comprehensive databases of employment at the firm level, we use the ASI industry-level data to calculate this ratio.

4. Dependence on External Finance

We calculate the external financial dependence of firms in two different ways using two different databases: the first one uses firm-level data from the Prowess database published by the Center for Monitoring Indian Economy and employs the same definition as used by Rajan and Zingales (1998).

[19] See Mitra and Ural (2007), Kumar and Mishra (2008), and Topalova (2005) for analyses on effects of trade liberalization.

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, possibly affecting the cross industry ranking, we use the financial dependence indicator calculated using ASI data.

5. Infrastructure Dependence of Industries

This is the ratio of expenses on distribution (i.e., storage and transportation) and power and fuel to gross value-added using 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 that includes distribution expenses as well. Appendix B1 indicates which industries are below or above the median for each of these characteristics.

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 earlier year (in general we use averages over the early 1990s, but where data are available we confirmed that the industry characteristics are correlated highly with the ones calculated using data for earlier periods) rather than contemporaneous data. Furthermore, to smooth out the noise in the data, we use 5-year averages of the relevant variables to calculate the industry indicators. We also confirmed, where possible, that the relative industry rankings across various characteristics do not change over time. 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 the 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? Appendix Table B2 reports correlations among these characteristics and some of the other features of the industries that we could calculate. As we can see from this appendix table, the various industry characteristics are not correlated significantly with each other. The exceptions include labor-intensive industries being negatively correlated with imports and financial dependence; and infrastructure dependence being negatively correlated with import and FDI intensity. Labor-intensive industries are also somewhat more export-intensive.

B. Empirical Results from the ASI Data

We begin by exploring the possibility that the overall performance of the manufacturing sector masks significant interindustry heterogeneity. Are there certain industries that have not benefited as much from the reforms?

In Table 3 below we find that performance varies across different sectors. In particular, we identify industries that depend more on infrastructure, industries that depend more on the financial sector for their financing needs, and labor-intensive industries (see Appendix B1). We divide the industries into those belonging to above or at 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 that varies across industries and years in the regressions.

TABLE 3
GROWTH OF GROSS VALUE-ADDED POST-DELICENSING ACROSS INDUSTRIES

	DEPENDENT ON INFRASTRUCTURE		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 fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.77	0.66	0.71	0.70	0.69	0.72

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

Results in Table 3 show that the industries that are more infrastructure-intensive, on average, experience 15% lower growth in value-added post-delicensing (i.e., in the delicensed period relative to the earlier period), as compared to 33% higher output growth in value-added of industries that are less reliant on infrastructure. Similarly the industries more dependent on the financial sector, i.e., 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. Thus, there seems to be significant heterogeneity in the performance of Indian manufacturing across industry groups.

C. 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. As before, we consider gross value-added at constant prices, employment, capital stock, and number of factories as the outcome variables.

In equation 1, $d_i s$ is industry-specific dummy and $\alpha_i s$ is the respective coefficient; $I_t s$ is year-specific dummy, and β_t is the respective coefficient. 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 1 from the year when the delicensing requirement for a particular industry was removed, and remains 1 for the rest of the sample period.[20]

We are interested in testing the variants of the following hypotheses: did industries that are more labor-intensive (or industries that rely more on infrastructure or the financial sector for their financing needs) grow less than the control group of industries in the post-delicensing period? Testing for these hypotheses requires us to set up the regression equation for difference in differences estimates. Continuing with the specific hypothesis involving labor-intensive industries, consider the following possible cases for any given outcome variable:

	OUTCOME VARIABLE IN PRE-REFORM PERIOD	OUTCOME VARIABLE IN POSTREFORM PERIOD
More labor-intensive (treatment group)	$\Theta_{L,Pre}$	$\Theta_{L,Post}$
Less labor-intensive (control group)	$\Theta_{C,Pre}$	$\Theta_{C,Post}$

Essentially, we would like to 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 allows us to do this. In the regression equations, we use the interaction of each of the industry characteristics with delicensing separately and together.

How do we interpret a negative and significant coefficient for the interaction term of a particular industry characteristic, say, infrastructure-dependent industries? The coefficient indicates that the industries that use infrastructure more intensively have grown less post-delicensing, compared to the industries that use infrastructure less intensively. Can this 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, the 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 to be described later.

In Table 4 we present our results for the benchmark case as given by equation (1). Coefficients on both the industry and year-fixed effects have been suppressed from the table. In the results in column 1, the coefficient for delicensing shows a 12% increase in value-added per industry post-delicensing. Given that the average delicensing period is about 15 years, it amounts to a less than a 1% increase in value-added per year in the post-delicensing period. However as shown in Table 3, certain industries did not fare as well during the 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.

[20] The delicensing dummy is based on the information provided in Aghion et al. (2006), updated until 2003. As of 2003, all but three industries had been delicensed; see Appendix Table A4.

In Table 4 columns 2–4 we include, one at a time, these characteristics with the interaction of delicensing. As expected, the performance of the control group goes up considerably. 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 median and below median groups. We also include the interaction of the dummy variables, which takes the value 1 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 4
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**			-0.18***	
		[2.42]			[2.59]	
Labor intensity*delicensing			-0.30**		-0.51***	
			[2.02]		[3.55]	
External finance dep*delicensing				-0.93***	-1.22***	
				[4.01]	[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 fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	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

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

The results from Table 4 column 6 indicate that in the post-delicensing period the above-median infrastructure-intensive industries grew 10% less than the industries below the median of infrastructure dependence. Similarly industries above median in the distribution of financial

dependence grew 18% less than the industries below the median of financial dependence; for labor intensity, industries with above-median labor intensity grew 19% less than the below-median industries post-delicensing.

In Table 5 results are presented for the dependent variable, number of factories (in log). The overall performance of Indian manufacturing seems to be even less impressive when we look at the number of factories. Overall there is no acceleration in the rate of expansion of factories post-delicensing. These results are on account of the fact that the performance has been particularly worse for the labor-intensive industries and industries dependent on the financial sector. Once we control for these as in the previous set of regressions, the performance of the control group (industries less dependent on infrastructure or financial sector or labor) 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 5
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 dep* delicensing		0.02			0.01
		[0.39]			[0.23]
Labor intensity*delicensing			-0.16**		-0.22***
			[2.15]		[2.86]
External finance dep*delicensing				-0.27**	-0.39***
				[2.24]	[3.05]
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	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

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

Next we look at employment and capital stock. The issues related to employment are manifold and much more complex, and all of these probably cannot be addressed in this paper. Some of the issues that merit attention include: why has growth not been employment-intensive; is technology displacing labor; how has the employment of unskilled versus skilled workers evolved over time; how is the skill premium changing over time etc. For brevity we look only at total employment here, which includes manual workers, supervisors, and regular as well as contract employees.

We look at two econometric specifications here. The first is the estimates from equation 1, results of which are reported in Table 6a and 7a, respectively, for employment and capital stock. From column 1 of Table 6a, employment has increased by a mere 7% over the entire delicensing period. With the average delicensing period about 15 years, this translates into a less than 0.5% increase in employment per year post-product market reforms.

As expected, once we introduce heterogeneity based on industry characteristics, the performance of the control group improves rather substantially (columns 2–5). The maximum increase is in the case of the industries less dependent on external finance. Notably, infrastructure-dependent and external finance-dependent industries, as well as labor-intensive industries, are the weakest performers in so far as employment generation in the post-delicensing period is concerned.

In addition, we estimate the following regression equation:

$$E_{it} = \Sigma\alpha_i d_i + \Sigma\beta_t d_t + \theta Y_{it} + \pi Y_{it} \text{ x delicensing dummy}_{it}$$
$$\lambda \text{ (}Y_{it} \text{ x *characteristic of industry } i \text{ * delicensing dummy}_{it}) + \varepsilon_{it} \quad (2)$$

In equation 2, E_{it} refers to log of employment (or log of invested capital in real terms), d_i is industry-specific dummy, and d_t is year-specific dummies. We also include log of gross value-added in the equation; the coefficient θ can be interpreted as the employment elasticity of output. It measures the percentage change in employment for a 1% 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 with post-delicensing. Thus if we are including labor intensity in the interaction term in equation (2), then it measures the change in the 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 from specification 2 are in Table 6b. The results indicate that the employment elasticity of output is about 50% on average, though there are differences across industries. The elasticity is higher for labor-intensive industries than for infrastructure-dependent 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; 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 6A
Employment Post-Delicensing—Results from Equation 1

	(1)	(2)	(3)	(4)	(5)
Delicensing	0.07**	0.15***	0.11*	0.36***	0.59***
	[2.47]	[4.37]	[1.92]	[3.95]	[7.03]
Infrastructure dep* delicensing		-0.25***			-0.25***
		[5.69]			[6.12]
Labor intensity*delicensing			-0.075		-0.22**
			[0.64]		[2.05]
External finance dep*delicensing				-0.67***	-0.78***
				[3.48]	[4.62]
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1361	1361	1361	1361	1361
Number of industries	44	44	44	44	44
R-squared	0.35	0.36	0.35	0.36	0.37

* significant at 10%; ** significant at 5%; *** significant at 1%.
Note: Dependent variable is log Employment. Robust t statistics in brackets.

Table 6B
Employment Post-Delicensing—Results from Equation 2

	(1)	(2)	(3)	(4)	(5)
Log GVA	0.52***	0.57***	0.47***	0.62***	0.55***
	[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*GVA		-0.20***			-0.16***
		[3.98]			[3.19]
Infrastructure*delicensing*GVA		0.003			0.001
		[0.90]			[0.28]
Labor intensity*GVA			0.09***		0.08***
			[3.36]		[2.70]
Labor intensity*delicensing*GVA			-0.000		-0.002
			[0.13]		[0.66]
Financial dep*GVA				-0.26*	-0.107
				[1.92]	[0.74]
Financial dep*delicensing*GVA				-0.001	-0.004
				[0.10]	[0.43]
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	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

* significant at 10%; ** significant at 5%; *** significant at 1%.
GVA = log value-added.
Note: Dependent variable is log Employment. Robust t statistics in brackets.

For analyzing the patterns in investment we use both the specifications used for employment (Tables 7a and 7b). Thus we look at the capital elasticity (i.e., how investment changes) of value-added and compare it with the behavior of investment post-delicensing. We also compare investment behavior across industries and see whether there are any patterns in the investment changes across industries post-delicensing. Here we find that capital elasticity (Table 7b) is higher than that for employment elasticity. Across industries, infrastructure and financially dependent industries see higher investment than the labor-intensive industries as value-added increases. Investment has also increased somewhat post-delicensing; quite interestingly this is on account of a higher 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 that are more dependent on external finance see a decline in investment in the post-delicensing period.

Table 7a
Investment Post-Delicensing—Results from Equation 1

	(1)	(2)	(3)	(4)	(5)
Delicensing	0.26***	0.24***	0.36***	0.66***	0.94***
	[4.97]	[3.94]	[4.62]	[5.33]	[7.33]
Infrastructure dep* delicensing		0.06			0.06
		[0.77]			[0.70]
Labor intensity*delicensing			-0.224		-0.41***
			[1.55]		[2.96]
External finance dep*delicensing				-0.94***	-1.18***
				[3.59]	[4.91]
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1361	1361	1361	1361	1361
Number of industries	44	44	44	44	44
R-squared	0.71	0.71	0.71	0.72	0.72

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

Table 7b
Investment Post-Delicensing—Results from Equation 2

	(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	0.01***	0.01***	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			-0.06*		-0.038
			[1.76]		[1.05]
Labor intensity*delicensing*GVA			0.01*		0.007
			[1.74]		[1.57]
Financial dep*GVA				0.36**	0.28
				[2.34]	[1.64]
Financial dep*delicensing*GVA				-0.02**	-0.02*
				[2.22]	[1.76]
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	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

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

D. Robustness of Results

We do extensive tests for the robustness of our results. These include checking the robustness to different time periods, omitted variables, and potential outliers. We account for the lags between policy and implementation; 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 that 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% level of significance. Details on each robustness test follow.

Though in the methodology used here the omitted variables that vary only by industry or 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 that 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 that 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—that without sufficient infrastructure development, financial depth, and progress on factors inhibiting labor-intensive industries, Indian industry is unlikely to realize its potential—would hold. 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 reform measures, e.g., delicensing and trade reforms, in the same specification, then the coefficient for a particular policy measure would become weaker and probably even lose its 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 include other industrial characteristics in the regressions, 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 in Table 7. The reported results are for the dependent variable log value-added. In order to address the concerns related to autocorrelation we reduce the sample length to the period from 1980 onward (see column 1). We can restrict the period further but then we would start losing our control period. In the results reported in column 2 we calculate the standard errors corrected for Newey West adjustment.

Table 7
Robustness Tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	1980s and beyond	Newey2	Without tobacco, petroleum	Trade reform	Trade and delicensing	Delicensing lagged two years	Cluster SEs
Delicensing	0.71***	0.9***	1.1***		0.62***	0.95***	0.93**
	[4.69]	[5.12]	[8.41]		[3.18]	[7.80]	[2.86]
Trade openness				1.04***	0.72***		
				[6.33]	[3.46]		
Infrastructure* Delicensing	-0.22**	-0.18*	-0.18***		0.03	-0.23***	-0.18
	[2.57]	[1.83]	[2.62]		[0.29]	[3.43]	[1.37]
Labor intensity* Delicensing	-0.45***	-0.51**	-0.60***		-0.30*	-0.50***	-0.51***
	[2.97]	[2.32]	[4.08]		[1.94]	[3.38]	[4.26]
External finance* Delicensing	-0.94***	-1.2***	-1.37***		-1.09***	-1.11***	-1.22
	[3.52]	[3.80]	[6.21]		[2.88]	[4.97]	[1.57]
Infrastructure* Trade openness				-0.41***	-0.45***		
				[5.26]	[5.01]		
Labor intensity* Trade openness				-0.05	0.03		
				[0.97]	[0.55]		
Financial dep* Trade openness				-0.52**	0.13		
				[2.01]	[0.36]		
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1056	1361	1299	1056	1056	1361	1361
Number of industries	44	44	42	44	44	44	44
R-squared	0.67		0.71	0.68	0.69	0.71	0.71

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

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. In columns (4) and (5) 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 have seen in the earlier tables.

To control for the fact that there may be a lag between reform and actual implementation or the effect of the reform is felt with a delay, in column 6 we lag the delicensing dummy by 2 years. In other words, if an industry was delicensed in 1991, we assume that the effect was felt 2 years later, i.e., 1993 onward. Our benchmark results hold qualitatively.

V. CONCLUDING REMARKS

In this paper, we have analyzed the performance of the registered Indian manufacturing sector in India 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, the industries more dependent on infrastructure; industries with greater dependence on sources of finance external to the firms; as well as those with high labor intensity have not performed well.

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.

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.

As regards the weak performance of labor-intensive industries, certain elements of Indian labor regulation may well be an important causal factor as argued by a number of observers of the Indian economy. 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.

However, other factors cannot be ruled out—such as the policy of reserving a whole range of labor-intensive products for production by small-scale firms as recently as 2001. 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—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 given the stance of labor regulations (as they actually apply to firms and not just on paper), carrying out this analysis at the state level should be very useful. We take up this issue in our forthcoming work.

In the meantime, our econometric analysis has served to highlight from where the 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 perception of managers suggest that steps to improve infrastructure and the financial system should go a long way in improving manufacturing performance. Additionally, 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 3-digit level. After the concordance from NIC87 and NIC70 into NIC 98 classification, we have data on 49 industries. Data are available for 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 and 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 noneconomic 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.

Appendix Table A.1
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 onward, when it refers to total manufacturing output, employment etc., refers to the registered manufacturing excluding the above five industries. The real values have been calculated using respective WPI deflators (unless otherwise noted, e.g., for the capital formation or capital stock variables).

APPENDIX TABLE A.2
CONSTRUCTION OF VARIABLES

VARIABLE	DATA SOURCE	DESCRIPTION/CONSTRUCTION
Value-added	ASI	Increment to the value of goods and services that is contributed by the factory obtained by deducting the value of total input
Workers (blue-collar)	ASI	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 in the 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	Blue collared workers as defined above; persons receiving wages and holding clerical or supervisory or managerial positions; persons engaged in administrative office, store keeping and welfare section, sales department; persons 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, used, or own constructed; or 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	Excess of fixed capital at the end of accounting year over that at the beginning of the year
Number of factories	ASI	A factory for the purposes of ASI is one that is registered under sections 2m (i) and 2m (ii) of the Factories Act, 1948; also premises with 10 or more workers with the aid of power, or 20 or more workers without the aid of power
Labor productivity	ASI	Ratio of value-added to total employment
Labor intensity	ASI	Employment/real invested capital)*1000, where deflator used is the wholesale price index for the NIC classification 319 (other electrical equipment, to proxy for the capital goods)[1]
Infrastructure dependence	CMIE	Ratio of distribution and power and 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 1991–1995
Export intensity	CMIE	Ratio of total foreign exchange earnings to gross value-added.
Trade reforms	Hasan, Mitra, and Ramaswamy (2007)	Nominal rate of protection

[1] Results do not depend on the deflator used or whether we use only fixed capital, rather than invested capital, which includes 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.

Appendix Table A.3
Summary Statistics of 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

APPENDIX TABLE A.4
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 vehicles
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; nonmetallic; iron and steel; basic precious/nonferrous metals; fabricated metal products; insulated wire and cable; accumulators, cells/batteries; optical and photographic equipment; watches; ships and boats; railway locomotives; transport equipment not elsewhere classified; furniture; and manufacturing not elsewhere classified
1993	293 Total number of industries delicensed: 43	Domestic appliances
1997	201,223,232 Total number of industries delicensed: 45	Saw milling, recorded media, refined petroleum products

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

Appendix Table B.1
Industry Characteristics

NIC98 3-digit	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	Nonmetallic mineral products	1	1	0
271	Basic iron and steel	1	1	0
272	Basic precious and nonferrous metals	1	0	0
281	Metal products	0	0	1
289	Fabricated metal products	1	1	1
293	Domestic appliances, electric lamps, And equipment	0	0	1
300	Office, accounting, and computing machinery	0	0	0
311	Electric motors, generators, and transformers	0	1	0
313	Insulated wire and cable	0	1	0
314	Accumulators, cells, and 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 and photographic equipment	0	1	0
333	Watches and 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 and spacecraft	0	0	0
359	Transport equipment not elsewhere classified	0	0	1
361	Furniture	0	1	1
369	Manufacturing not elsewhere classified	0	0	1

Appendix Table B.2
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

* indicates significant at 10%; ** indicates significant at 5%; *** indicates significant at 1%.
FDI = foreign direct investment
Source: Authors' calculation.

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