Industrial Sickness in Indian Manufacturing

Doctoral Dissertation

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Widmung und Danksagung

Diese Arbeit ist meinen Eltern gewidmet.

Meinem Vater, weil er sich seit dem ersten Schulzeugnis für meine akademischen Leistungen interessiert und meiner Mutter, die diese zugunsten tausend wichtigerer Dinge im Leben in aller Regel ignoriert. Aus dem einen kommt der Ansporn, aus den anderen die Kraft.

Über die Autorin

Hausi Mams-Harel lebt in Wien in einer fast echten Ritterburg und ist heute 2 Jahre älter als die Schuhgröße ihrer Tochter Noomi. Ihr Sohn Jossi begann sein Leben auf ihrem Schoß liegend am Schreibtisch. Wenn er mal groß ist, will er aber was Richtiges werden: Panzer-Polizist. Ihr Mann Martin ist gut aussehend, kann inzwischen kochen und macht sie mit seiner leichten Lebensart meistens sehr glücklich.

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1 Introduction

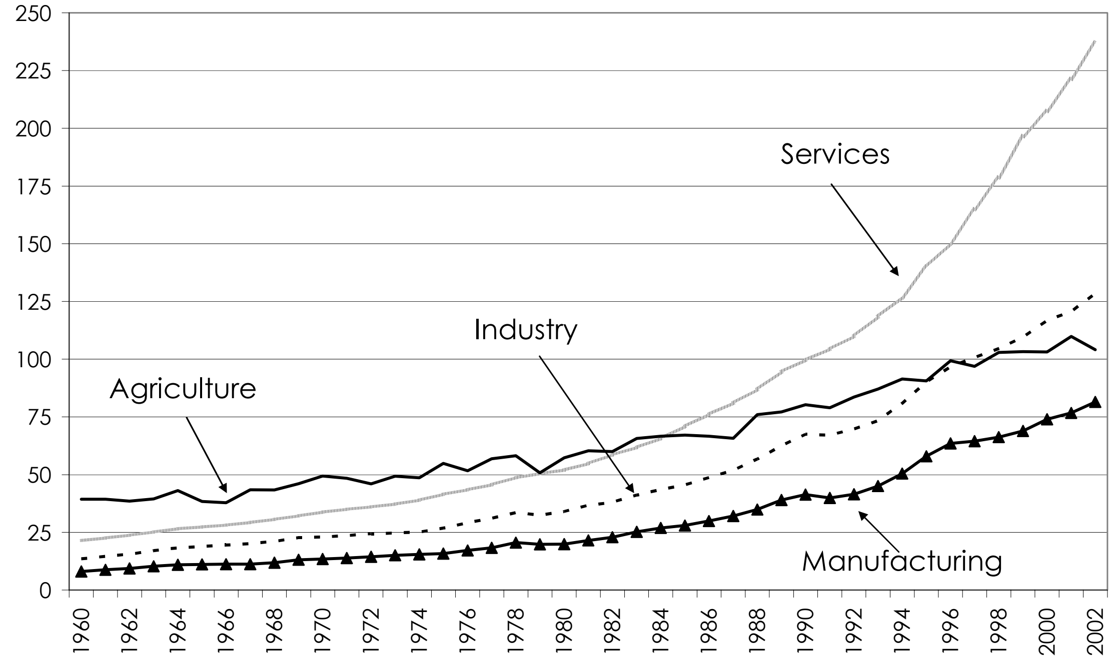
Following Independence in 1947, India has made great efforts to foster industrialization with the aim of promoting economic development. Jawaharlal Nehru, its first prime minister, had great faith in the merits of a planned economy, which, he was persuaded, would be most effective and efficient to realize the four long-term objectives of industrial growth, full employment, the reduction of inequality and the establishment of social justice. Accordingly, the first Five-Year Plan commenced shortly after Independence in 1950/51, and it has been followed by a series of Five-Year Plans up to the very present.

An examination of India's macroeconomic performance since Independence reveals some interesting trends. For the first three decades, its GDP grew at an average rate of 3 - 3.5 percent annually. This came to be known as the "Hindu rate of growth", alluding to the cliché of acquiescence in a disappointing but not disastrous outcome, for the Hindu religion reputedly puts more emphasis on the hereafter. During the 1980s, the average annual growth rate was much higher, at around 5.5 percent. The Indian economy had a mini crisis in 1990-91, but otherwise grew rapidly during the 1990s, with growth now about 6 - 6.5 percent p.a.

Knowledgeable scholars make the point that the transition to a high rate of growth occurred around the early 1980s, i.e. a full decade before the 1991 New Economic Policy (NEP) reforms.[1] Among the factors, which are held responsible for this development, two stand out. First, in the course of the globalization process the Indian service sector has been experiencing a remarkable upswing. The rapid advancement of information and communication technologies (ICT) provides a great opportunity for the nearly legendary Indian software industry, its call centers and other ICT- or customer-related services. In fact, during the last two decades, the growth of GDP seems to have been driven mainly by the service sector (see Figure 1-1).

1) See, for instance, Chandrasekhar and Ghosh (2001), Williamson and Zagha (2002), De Long (2003) and Rodrik and Subramanian (2004).

Figure 1-1: Sectoral[a] Value Added in India: 1960 – 2002 (in bn. US-$, const. 1995 prices)

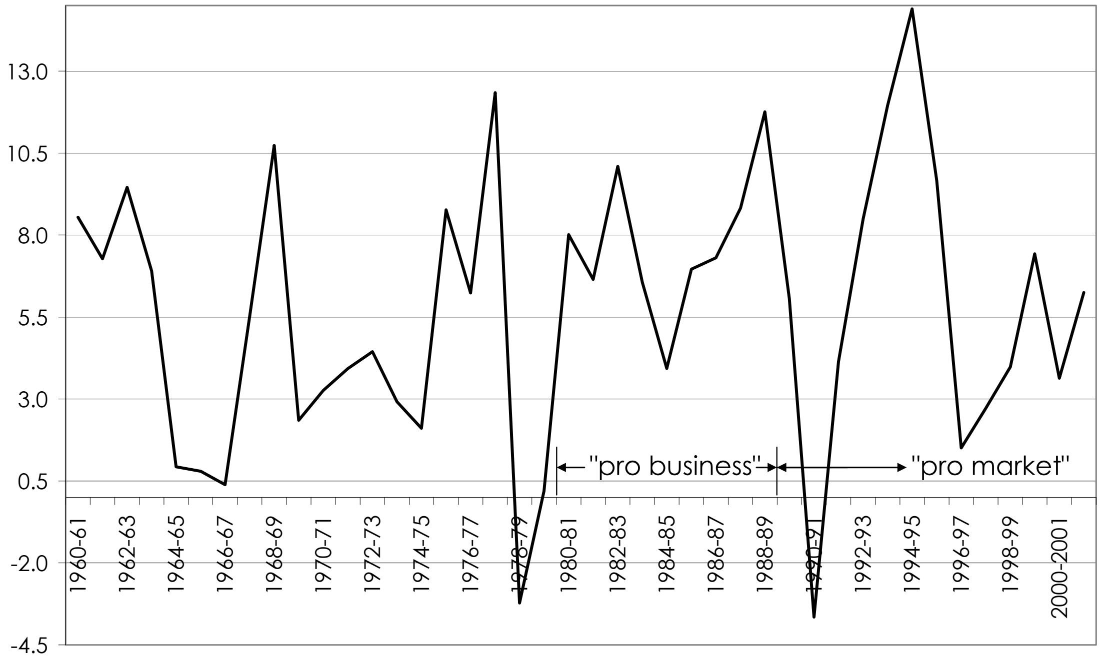


Source: World Development Indicators (World Bank); own calculations

[a] The industrial sector comprises manufacturing, mining & quarrying, construction, and electricity

Second, it is argued that the reforms already started in the 1980s, and that the reform agenda of these early years differed substantially from the agenda of the 1990s. Rodrik and Subramanian (2004, p. 2 ff.) distinguish between the pro-business orientation of the 1980s and the pro-market orientation of the 1990s. The former focuses on raising the profitability of the established companies. Measures such as removing price controls, reducing corporate taxes, and easing restrictions on capacity for established enterprises (all of which took place during the 1980s) tend to favor incumbents and producers. In contrast, pro-market reforms focus on removing impediments to the functioning of markets, they allow for increased competition, both from abroad and domestically. These measures favor entrants (and consumers) and did not take place on any significant scale until 1991. The cited authors see the shift towards a pro-business orientation as the initial trigger for the boom of the 1980s. While the policy change towards pro-market reforms added comparatively little to aggregate economic performance, it greatly affected the business environment of the manufacturing sector, which took a turn for the worse (see Figure 1-2). It is against this background that industrial sickness must be seen.

Figure 1-2: Annual Change of Gross Value Added – Manufacturing



Source: World Development Indicators (World Bank); own calculations

In India, the term 'sick' units refers to economically unviable firms which are kept alive 'in the public interest' by means of subsidies of various kinds. Since this practice is common, and large parts of the industrial sector are affected, this phenomenon is referred to as industrial sickness. To give some idea of the scale of the problem, in 1985 there were already 120,000 sick units, of which only about 60 closed during that year (World Bank, 1989). Recognizing that scarce resources were locked up in unviable units on a great scale, the Government of India eventually enacted special legislation to tackle the problem, namely, the Sick Industrial Companies (Special Provisions) Act, 1985. Apart from determining sickness, the main objectives of this act are to expedite the closure of unviable units and the revival of potentially viable units. Since the probability of successful recovery hinges on the timely detection of sickness, the law applies to the group of so-called 'weak' units (marginally viable units), too.

1.1 Motivation

There are three good reasons to write a thesis on industrial sickness. Most importantly, it is a real problem in the Indian economic landscape. Second, it is associated with heavy economic losses. Third, thus far, the problem has not aroused the interest of academic researchers in the measure it deserves.

The Reserve Bank of India (RBI) estimates the amount of outstanding credit locked up in sick units to have increased at the rate of 17.8 per cent per year during the 1982-1990 period.[2] More recently the total number of both sick and weak units declined by 20 percent from March 1999 to March 2001, but it still stood at just over a quarter of a million (see Table 1-1).

Table 1-1: Industrial sickness in India: number of sick/weak units

	Large & medium enterprises		Small-scale enterprises		
End	absolute figures	as % of total	abs. figures	as % of total	total
Dec. 1980	1,401	5.7	23,149	94.3	24,550
Sep. 1992	2,427	1.0	233,441	99.0	235,868
Mar. 1996	2,374	0.9	262,376	99.1	264,750
Mar. 1997	2,368	1.0	235,032	99.0	237,400
Mar. 1998	2,476	1.1	221,536	98.9	224,012
Mar. 1999	2,792	0.9	306,221	99.1	309,013
Mar. 2001	3,317	1.3	249,630	98.7	252,947

Source: Report on Currency and Finance (RBI), various issues

A closer look at the statistics for the period March 1999 to March 2001 reveals that indeed the extent of sickness, as measured by the number of units, declined in the small-scale industrial sector, but increased in the medium and large scale sector. More importantly, within the same period the amount of outstanding bank credit rose to Rs. 25,775 crore,[3] an increase of 23 percent in real terms (see Table 1-2). While, in March 2001, the medium and large scale sector accounted for a meager 1.3 percent of total sick/weak units, its share in total bank credit outstanding to sick units amounted to 83 percent, so regaining its level in 1980.

2) All figures in this section are taken from the RBI's 'Report on Currency and Finance', various issues.

3) Indian unit of measurement: 1 crore equals 10 million

Table 1-2: Industrial sickness in India: outstanding bank credit locked up in sick/weak units

End	Large & medium enterprises in Rs. Crore			Small-scale enterprises in Rs. Crore			Total in Rs. Crore	
	current prices	constant prices	as % of total	current prices	constant prices	as % of total	current prices	constant prices
Dec. 1980	1,502	4,589	83.1	306	935	16.9	1,808	5,523
Sep. 1992	9,241	10,117	73.4	3,346	3,663	26.6	12,587	13,780
Mar. 1996	10,026	7,822	72.9	3,722	2,904	27.1	13,748	10,726
Mar. 1997	10,178	7,455	73.8	3,609	2,644	26.2	13,787	10,099
Mar. 1998	11,825	8,028	75.4	3,857	2,619	24.6	15,682	10,647
Mar. 1999	15,150	9,905	77.8	4,313	2,820	22.2	19,463	12,725
Mar. 2001	21,269	12,899	82.5	4,506	2,733	17.5	25,775	15,632

Source: Report on Currency and Finance (RBI), various issues; own calculations

Of the total number of sick units in the small-scale industrial sector, a mere 8.6 percent were identified as 'potentially viable' (as of the end of March 1998). One should not conclude, however, that the remaining 91.4 percent have since been liquidated: even though firms which are determined to be non-viable are subject to an obligatory winding-up 'recommendation', actual liquidation hardly ever takes place; and when it does so, only after years (or even decades) of delays. Similarly, even though the corresponding share of companies in the non small-scale industrial sector was as low as 25 percent (as of the end of December 2000), this does not at all mean that the remaining firms were identified as viable, but only that, for most of them, viability studies have not yet been conducted.[4] Also, it remains questionable whether a turnaround is in fact feasible even for those firms for which good chances for recovery have been attested. To understand why, one has to examine the investigation process that determines a firm's viability. The former chairman of the Committee on Industrial Sickness and Corporate Restructuring, Omkar Goswami, notes that in many cases the bureaucrats in charge of the investigation process attest viability if the company's debt service coverage ratio is not less than 1.33.[5] Since the denominator, i.e. past and current debt plus interest thereon, is well-defined and fixed at the time of investigation, the bureaucrat would simply arrive at a level of current income that averages at least 1.33 times the denominator and then constructs revenue and cost streams to generate the numerator (Goswami, 1996, p. 83).

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4) BIFR (2001) at www.bifr.nic.in as on February 15th and July 4th, 2001. For details see Table 6-1 in chapter 6 of this thesis.

5) Technical expressions are defined in the Concepts-and-Definitions Appendix (chapter 8), table A-1.

In any event, whether it is because the investigation process is marked by substantial delays, or rehabilitation proposals are based on wildly optimistic assumptions concerning expected income streams, or, in general, winding-up recommendations do not result in actual liquidation, in India sick firms rarely ever die.

Idle investments in sick units involve a waste of resources no economy can afford over a long period – certainly no developing country can do so. With a 1999 per capita GDP of 2,171.6 US-$ (purchasing power parities at constant 1995 prices), India ranks slightly above the Solomon Islands and Nicaragua (2,132.4 PPP US-$ and 2,105.7 PPP US-$) and just below Bolivia (2,174 PPP US-$).[6] By comparison, Germany had a per capita GDP of 23,328 US-$ in 1999 (PPP at constant 1995 prices).[7]

India's social indicators are far from impressive[8], with 1999 adult illiteracy rates ranging between 32 percent for males and 56 percent for females.[9] In 1999/2000, the infant mortality rate was 68 per thousand, the mortality rate for children younger than five years amounted to 94 per thousand, and 47 percent of the children under age five suffered from malnutrition. Considering that at the beginning of the 21st century only 31 percent of the Indian population has access to improved sanitation facilities and 14 percent have no access to protected drinking water sources, the unproductive and wasteful use of public funds is inexcusable. We conclude that industrial sickness is not only a real problem, but also must be regarded as an important obstacle to the whole process of economic development in India.

1.2 Previous Research

In light of the seriousness of the problem, academic research on industrial sickness is surprisingly thin. With some minor exceptions, it has been either institutional or descriptive in nature.[10] Broadly speaking, the former starts by explaining how various policy measures and financial institutions helped to create the problem of sickness in the past and then proceed to explain the design of another set of policy measures undertaken and institutions founded to cure the problem.[11] While we certainly appreciate the contributions of institutionalists and political economists, if the effects of

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6) Source: World Bank: World Development Indicators 2004.

7) The figures for France (22,424 PPP US-$) and the UK (22,152 PPP US-$) may be of particular interest to the doctoral committee.

8) Source for the following: World Bank: World Development Indicators 2004

9) Figures refer to adults aged 15 and older.

10) Some discussion of the respective literature will follow in the respective chapters 2 and 3.

11) For example, Gupta (1990), Biswasroy et al. (1990) and various contributions in Ramakant et al. (1993a, 1993b).

institutionally imposed (dis)incentives on the operation of enterprises were really understood, as several thorough explanations and theories seem to suggest, then why has the problem of industrial sickness not been solved long ago?

The descriptive category of papers provides a detailed picture of the development and dimensions of industrial sickness. In India, there seems to be no region and no industry that has not yet been the object of interest of these scholars.[12] Any treatment of a problem should start by describing it; but this line of approach always runs the risk of losing itself in plain 'bean-counting'. In fact, hardly any of the descriptive studies of industrial sickness offers points of reference other than chronological ones. A text on, say, the textile sector states that at the outset a certain number of units were unviable, and that 10 years later two or three times as many firms had fallen sick. But what is the relative weight of the sick firms in the aggregate sector? This is a much more relevant question.

Third, there are a few econometric studies that attempt to explain the incidence of sickness. In this respect, the pioneering work is due to Altman (1968), who applied Multiple Discriminant Analysis (MDA) to distinguish between bankrupt and non-bankrupt firms prior to actual bankruptcy. In the context of industrial sickness, MDA seeks to derive linear or quadratic combinations of those characteristics that best discriminate between sick and non-sick units. The 1970s and early 1980s brought refinements of MDA-techniques (e.g. Gupta, 1983 and Bhattacharya, 1982), which were eventually superseded by multiple regression models in a qualitative response framework (Chattopadhyay, 1995; Anant et al., 1992). The relevant literature will be reviewed in chapter 5 when we present estimates of the probability that a firm falls sick.

Finally, a note is needed on the theoretic foundations of the concept of a sick unit. In the industrial organization literature, the discussion of "barriers to exit" is clearly related to the Indian practice of maintaining unprofitable firms in operation by all means. Also, Kornai's (1980) notion of the soft budget constraint has some relevance. In a more narrow sense, however, the only theoretical paper on industrial sickness of which I am aware is Pursell (1990), who adopts a macroeconomic partial equilibrium approach and shows that the spread of so-called 'secondary' sickness is driven by the massive subsidization of 'primarily' sick firms. The emergence of primary sickness, however, is not explained. In contrast to Pursell's 'domino-theory', Wohlschlegel (2002) made a first attempt to develop a micro-economic theory of the sick firm - more on this below.

12) Compare various contributions in Ramakant et al. (1993a, 1993b).

1.3 The Contribution of the Thesis

Based on a panel of some 4,400 Indian manufacturing firms for the period 1988-1999, this thesis explores the dimensions and characteristics of industrial sickness and digs into the causes thereof. In doing so, the thesis deals with a peculiarity of Indian industrial policy. It therefore starts, in chapter 2, by briefly describing the basic features of Indian economic policy that seem to be vital for the emergence of industrial sickness. Chapter 2 also outlines the law enacted to solve the sickness problem, the Sick Industrial (Special Provisions) Act, 1985.

The economic environment for Indian manufacturing firms in the 1990s is characterized by the gradual withdrawal of barriers to entry, while discrete barriers to exit remained in force. The former concerns the dismantling of public sector product reservation policies, broad de-licensing measures, the abolition of discriminatory practices against large and/or foreign-owned firms and the liberalization of foreign trade policies. Against these achievements stand the yet unresolved barriers to exit of both labor and firms. To the extent that exit provisions may be applicable, they are generally considered as ineffective. This is especially true of Indian bankruptcy legislation, which apparently has not helped to settle the problem of sick firms.

Chapter 3 discusses various concepts of sickness, explores the dimensions of sickness in a 12-year (unbalanced) panel of some 4,400 manufacturing firms and presents key characteristics of distressed firms. The main finding is that the spread of industrial sickness in the late 1990s is much more extensive than it used to be in pre-reform days. Furthermore, the prospects of sick firms seem to have deteriorated in qualitative terms as well, especially with respect to profitability ratios and capital productivity.

Chapter 3 goes beyond previous research in three ways. First, although descriptive evidence is extensive when it comes to aggregate data, it is very sparse with regard to the situation of the individual firm. This deficiency is, of course, due to the limited availability of useful datasets, which has been (partially) overcome only recently. Second, the descriptive evidence presented in chapter 3 allows us to examine the spread of industrial sickness:

- within industries over time
- within states over time
- industrywise across various age groups
- industrywise across size classes
- industrywise across types of ownership.

Furthermore, we take a look at the course of sickness at the level of the individual firm. This is a novelty in the descriptive analysis of industrial sickness, and the degree of detail provided here constitutes a clear improvement over earlier work. Third, and most importantly, we are able to depict the *relative* incidence of industrial sickness (within industries, states, etc.) and the characteristics of distress. In contrast, most other studies give mere numbers of sick firms or calculate average performance ratios, but do not furnish their argument with benchmarks (from sound firms within the same industry, state, etc.). In this study, the relevant population is a set of firms, both sick and sound, and not just a set of sick firms.

We find decreasing failure rates in the early days of reforms, but erratic rises in industrial sickness from the mid 90s onwards. This finding raises two questions: (i) have the reforms ultimately failed to foster productive efficiency? or (ii) is increased sickness in the mid and late 90s just a reflection of the New Economic Policy and its attempt to harden budgets? Chapter 4 is dedicated to the first issue and chapter 5 is concerned with the latter.

Accordingly, chapter 4 analyses productivity and efficiency in 10 separate Indian manufacturing industries. There is a rich body of literature exploring the effects of the New Economic Policy (NEP) reforms from the early 1990s on productivity in the Indian manufacturing sector.[13] From an analytical point of view, our study does not add anything to the ongoing debate over its impact. The merits of our work rest rather on a very thorough specification of, for instance, the firm-level capital stock or the dynamic nature of productive efficiency scores. The distinguishing feature of our work is that it exploits the most recent data, allowing for changes in productivity over three important sub-periods, viz. pre-reform (1989-'91), transition phase (1992-'96), and post-reform (1997-'99). It is reassuring that our results corroborate previous results on the general downturn of aggregate manufacturing performance after 1991. In contrast to other studies, however, our firm-level data set allows us to qualify these results. We calculate simple coefficients of variation of firm-specific productive efficiency scores and show that at the onset of reforms these were generally declining, but that after some turning point in the interim phase diverging performance levels are observable[14].

The main conclusion from Chapter 4 is that industrywise downturns in productivity and mean efficiency went with greater variation in firm performance. Diverging firm-wise

13) Less on efficiency, though – owing to the limited availability of appropriate (firm-level) datasets.

14) An exception is the non-metallic mineral sector and the chemical sector for which sigma convergence and sigma divergence, respectively, hold throughout the entire 1989-1999 period.

efficiency scores combined with increasing failure rates lead to the supposition that NEP reforms have not been generally unsuccessful, but on the contrary, that economically viable firms have considerably benefited from the changes in policy.

To the best of my knowledge, there are no papers on industrial sickness that are framed within a broader context of manufacturing productivity analyses, yet linking these issues seems an obvious step. However, the main purpose of the analysis in chapter 4 was to derive firm-specific, time-varying measures of productive efficiency to be employed in chapter 5. It is a worthwhile task in itself to document the production of this intermediate output. Therefore, the "side results" were collected into a separate chapter.

The line of argument in the institutional economic-policy papers is that the barriers to profit-maximization in the days of central planning and the residue thereof in more recent years gave rise to the phenomenon of industrial sickness. To explore this hypothesis, one would need measures of the policy constraints that operated at the level of the individual firm. Alas, such data are broadly unavailable!

We do, however, know something about the types of firms which would have been particularly bound by policy-imposed constraints and which types of firms would have benefited from special protection. The hypothesis to be tested is that preferential treatment irrespective of economic viability establishes systematic disincentives to perform well, and once these are withdrawn, then firms fall into sickness. We test this hypothesis by running a panel probit model in chapter 5, wherein observed health status in the late nineties is regressed against (i) dummy variables that capture the effect of the policy shock on formerly protected types of firms, (ii) pre-reform measures of budget softness, and (iii) pre-reform measures of economic distress. The latter have been constructed in chapter 4.

The null hypothesis is rejected: public sector undertakings, firms located in backward regions, and firms that had been highly subsidized before the policy turnaround came into effect faced a considerably higher probability of finding themselves in a state of severe distress by the late nineties. Conversely, we found that formerly constrained firms, e.g. firms operating on a large scale or with substantial foreign investment, benefited from the reforms in terms of lower sickness probabilities thereafter. Does this prove that the reforms discriminate against the right set of firms? Not necessarily; for it might be the case that initially inefficient and highly assisted firms were already characterized by distinctive higher sickness probabilities prior to the policy reform.

The second part of chapter 5 takes up the effects of the latest reforms more directly. Here the analysis is restricted to the set of firms whose state of health actually changed in the 1990s (in one direction or the other). In other words, the sample consists only of firms which were non-sick at the beginning of the transition period but then registered as sick at least once until 1999, or vice versa. The simple question is: why do at-risk candidates eventually fall sick? Is it because they are not sufficiently nourished, i.e. a process of sustainable budget-hardening set in? Or do at-risk firms fall sick regardless of the level of assistance because formerly protected firms have become less efficient? What, then, determines efficiency at the firm level? Our results suggest that the trade-off between budget hardening and sickness prevention (by means of soft loans and subsidies to loss-making firms) is not that severe. Instead, a persistently unequal distribution of (technical) capital imports and increased market competition were much more powerful determinants of sickness in the mid and later 90s.

The analyses of chapter 5 contribute to ongoing research on this topic in several ways. First, there are hardly any econometric studies of the determinants of sickness. Those based on disaggregated firm level data suffer from various econometric weaknesses. We improve on such studies by addressing issues like unobservable firm effects, dynamics and potential endogeneity of the covariates, all of which have been largely ignored so far. Second, previous econometric work is confined to cross-section methods, whereas we have pursued a panel approach.[15] To the extent that panel methods process information on individual behavior over time, they are clearly superior to cross section methods. But the main criticism is conceptual in nature: conventional regression approaches employ "explanatory" variables that describe the symptoms of sickness, but they do not catch the claimed causes thereof. For instance, Anant et al. (1995) find that sickness in the textile sector is predominantly driven by high ratios of both wages to net sales and interest payments to net sales. It is well documented that sick firms face relatively high labor costs and suffer from high interest obligations;[16] likewise, sales performance (and net sales in particular) is generally poor. But these are

15) Though Anant et al. (1992) have firm-level information for several years, they ignore the panel structure and estimate in pooled format.

16) Whether they merely provide for interest in their accounts or whether they actually service their debt contracts is another question.

the very characteristics of sick firms, and the extra insight into the underlying causes thereof is not that great.[17]

While chapter 5 concentrates more or less on reductions in barriers to entry, chapter 6 is more concerned with the remaining barriers to exit (of labor and firms). The starting point is the notion that the status of sickness entails great advantages to the incumbent management and the shareholders. The legal environment has long been made responsible for the poor performance of quite a substantial part of the Indian manufacturing sector. But no empirical study has yet evaluated if and how the revised sickness law itself may induce financially distressed firms to fall sick rather than encouraging timely reconstruction and rewarding good performance. We bring together data on the malfunctioning of the BFIR (the bureaucracy in charge of and executing the sickness law) and argue that it might pay firms to gamble in order to obtain the sickness status. Recently, Wohlschlegel (2002) set up a political economy framework, in which politicians follow non profit-maximizing goals and provide perverse performance incentives to businessmen. In particular, the number of workers (who are hard to fire) establishes an argument in the manager's choice of the capital structure. He then analyzes the relationship between these incentives, the choice of capital structure and the incidence of sickness. In chapter 6 we will test the consistency of his main hypotheses with our firm-level data set. Inference from single-equation estimation mostly supports the model. However, allowing the left hand-size variables (a particular choice of the capital structure and the sickness status) to be interdependent, we find a clear direction of causality between the respective variables viz. from the share of subsidized loans to sickness, but not vice versa. Endogenizing the provision of soft loans results in changing signs in the sickness part of the model and thereby contradicts the theoretically derived hypotheses.

After some concluding remarks, which make up chapter 7, chapter 8 contains an elaborate Appendix. Appendix A (Concepts and Definitions) defines technical expressions and provides the details on income-expenditure and balance accounts for Indian manufacturing firms. Appendix B provides first the codes and boundaries for the qualitative variables of PROWESS, the main database for the empirical work of this thesis. Such lists were utterly missing and had to be reconstructed. Second, Appendix B contains cookbook-like notes on how to construct consistent output and input

17) Incidentally the cited study is co-authored by the great Omkar Goswami, the first chairman of the government-appointed Committee on Industrial Sickness and Corporate Restructuring. The seminal report had been published in 1993.

measures (labor and capital stock) from firms' annual reports and lists the relevant deflators. I found it extremely annoying that most studies – and not only those in the Indian context – remain remarkably silent or vague on these technicalities, which take considerable time to research and produce. Hopefully, forthcoming empirical studies on the Indian manufacturing sector will not only benefit from the service character of Appendix B, but will also build upon it, improve it and, if they do, provide the relevant information.

This study is inherently empirical in nature, and large parts of the evidence presented are based on a panel of Indian manufacturing firms. The remainder of this chapter will therefore introduce the dataset, present the sampling methods and lay out its basic features.

1.4 The Firm-Level Dataset

The main data source of this study is PROWESS, a highly comprehensive database of the Indian corporate sector constructed by the Centre for Monitoring the Indian Economy (CMIE). PROWESS provides information at the firm level. Although the general focus is on listed companies, the CMIE includes large unlisted companies having significant presence in their sectors in order to make the database more comprehensive. It is important to note that the collected data are in principle available to the public and their collection does not involve monetary payments to the firms. The companies covered account for more than 70 percent of the economic activity in the organized industrial sector in India. By most measures (e.g. gross value added, gross fixed asset formation and value of output), the database is broadly representative.[18]

1.4.1 Sampling Design, Reliability and Content

PROWESS covers the entire corporate sector, which is divided into manufacturing, services and infrastructure. From this we compiled a 12-year panel of manufacturing firms for the period 1988-1999. 1988 is the initial year in PROWESS, and by the time I compiled my dataset (February/March 2000 in Mumbai) the latest available data referred to 1999.[19] The panel is unbalanced in a double sense. For one, there are no

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18) Private communication from Mr. P.K. Surendran, analyst at the CMIE's head office in Mumbai.

19) The data were re-compiled between December 2001 and March 2002. By that time data from the year 2000 would have been available, too. I decided to do without the 2000 records for reasons that I wish to set out in full. Compiling data is cumbersome work, and early in 2002 there were enough other things to do. The only reason for re-compiling the data was to check whether the selective early sample distorted the results. Selectivity was of the kind that only firms which had turned in their 1999 statements by February 2000 were included. In my view, the bias was immaterial to the research question, but unfortunately the ultimate proof

uniform years of entry and exit, and second, the panel has 'holes', i.e. some firms do not continuously report information. As it is not mandatory for the firms to send in their balance sheets and other details to the data collecting agency, however, a hole or even final exit from the sample does not mean that the firm has exited from the industry.

The original CMIE manufacturing panel 1988-1999 includes 5,017 firms. We excluded 14 firms because they did not report their location. 130 firms with missing year of incorporation were dropped, as were another 21 firms which reported some future year of foundation. 386 companies left the sample because they were not really engaged in manufacturing, but rather in primary articles, mining or some kind of electricity generation. Also we excluded joint ventures and cooperatives; the reason for doing so is that only 35 and three firms, respectively, belonged into these ownership types – too few to form a representative sub-group. We eventually ended up with 29,682 observations on 4,428 companies.

The database mainly consists of selected variables from balance sheet and income-expenditure accounts of the years 1988-1999, while cash flow statements are available only from 1995 onwards and then only for listed companies.[20]

As is common knowledge, drawing inference from company accounts is a bit delicate. Companies are indeed required to prepare statutorily audited annual accounts and to submit "true and fair" statements. But even if every firm adhered to the basic tenets of accounting practices, there would still remain much scope for ambiguity. In other words, there are several shades of "trueness and fairness".[21] Recognizing this problem, the CMIE has evolved a methodological framework under which information provided

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would come only by direct comparison. So this is the result: The new dataset comprises more than twice as many firms; previously the number of firms amounted to somewhat less than 2000. Apart from the mere size effect (resulting in reduced standard errors), there were no substantial changes in the empirical results in chapters 3 and 6 and from a preliminary version of chapter 5. The whole exercise has been a great waste of time where finalizing the thesis is concerned, but the learning effects for later work will eventually outweigh this cost: be very careful with the data; but be highly aware of your own time resources as well. If you have good reason to believe that you are right, don't run into the number-one female type of error (readily giving in, acknowledging that there is a point in the criticism), but switch to (male) 'matter-of-fact-terminology' and just claim your arguments to be true. Stand up to your boss, who cannot appraise the effort it takes to compile data, and also to your husband, who would spend most of his 60-hour work week on compiling data with the help of a well-functioning back office. This strategy is mostly highly rewarding, though it might win few credits for style.

20) Table A-3 in in the Concepts-and-Defitions Appendix (chapter 8) presents the structure of income-expenditure accounts for Indian manufacturing firms. Tables A-4 to A-7 sketch and detail the setup of balance accounts.

21) See Goswami (2001, chapter 5) for a discussion of the quality of financial and non-financial disclosures mandated by the Indian Company Act.

in individual accounts are reclassified to present a consistent and comparable set of statistics on the performance of enterprises.[22]

Apart from accounting statements, PROWESS provides some quite useful basic background information such as industry affiliation, type of ownership, location, year of incorporation, and – for companies listed at the Mumbai stock exchange – equity holding patterns. It has to be said that PROWESS is not very user-friendly where the processing of qualitative variables is concerned. Some of them are coded, but there are no lists assigning codes to unambiguously defined contents! Instead, it remains for the researcher to match, for instance, six digit codes to office addresses – a not so easy task for non-Indians, since many addresses are incomplete (missing district, missing code) and quite a few managers, or whoever wrote down the address, have a poor command of orthography.[23] On top of that, for several cities and districts, both the old and a new, "Indianized" name coexist, while some managers simply succumb to their preference for western-style abbreviations (most prominently: Madras versus Chennai, or just MGD – Madras Greater District). Eventually one and the same city may have several names, or rather it is the other way round: several names all refer to the same place. This makes it cumbersome to write a routine that would assign location codes to locations.

With respect to industry affiliation, the job is similarly troublesome: a company-wise list of products manufactured is at hand, which then has to be classified under the correct industry code. Even though, in principle, a 12-digit code is assigned to each product, difficulties arise, once again, due to differences in spelling. Also, for some products there is no single unambiguously defined name, so that companies signify the same by different names (e.g. methanol vs. methyl alcohol). A last problem with product names is that the degree of detail provided in the product names varies across companies. To take an actual case, Bharat Pumps & Compressors manufactures "Pumps", Kirloskar Bros. manufactures "Power driven pumps", Shriram Honda Power Equipment manufactures "Pumping sets", and Worthington Pump India manufactures "Vertical pumps" and "Horizontal pumps".

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22) Reference may be taken to PROWESS's three volume manual which explains some methodological issues as well as the composition and content of all variables in great detail.

23) For some places, derivatives of the original name are more or less straight forward. Variations of Gautam Budh Nagar, for example, include Gautam Budha Nagar, Gautam Baud Nagar, Gautam Budnagare and Gautham Bud Nagar. In other cases, it is harder to deal with poetic licence, as, for instance, is the case with Hooghly, or Hugli, respectively.

Other qualitative information, such as the number of factories a firm maintains or the number of products it manufactures, is wholly uncoded, or simply missing. An example of the latter is the lack of information on backwardness/non-backwardness of districts, which is an important variable in view of the existence of policies that provide various measures of assistance to firms in remote areas. Fortunately, an earlier version of PROWESS organized companies under a district classification system. This system classified companies into four broad regions (north, south, east, west), and within each region, companies were further classified into backward and non-backward districts. From that older PROWESS version we were able to derive a list of backward areas. Equipped with this list, we went through all 4,428 addresses, checked districts and assigned a backward dummy should the occasion arise.

In short, the task of reconstructing codes was very time-consuming and annoying, and it is incomprehensible why the CMIE keeps back essential information on the contents of codes or even dispenses with a stringent classification system.[24]

Yet, while coding might take (unreasonable) effort, in the end it is only a matter of processing available information. The most serious limitation of PROWESS refers to missing employment figures; all we have here is a company's annual wage-bill. We generated rough employment figures by dividing a company's total wage bill by the average sectoral wage, which again had to be calculated from Annual Survey of Industries (ASI) data (see Appendix B, Table B-5).

1.4.2 Basic Features of the Sample

Table 1-3 gives the sample distribution over time and industries. The CMIE classifies a company under an industry group if more than half of its sales are derived from products that fall into the respective industry. If a company produces a large number of goods and services from different groups such that none of the products account for more than half of the sales, then the company is listed as a diversified company ("miscellaneous"). A company's industry affiliation has been obtained by matching its top product with a 12-digit code provided by PROWESS. This resulted in 90 industry groups at the 3 digit level and 18 industries at the two-digit level, respectively.[25] We merged some of these industries to obtain a sufficient number of observations in each industry group. Eventually, we were left with eleven industrial sectors.

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24) With respect to the industrial sector and ownership types, tables B-1 to B-3 in Appendix B assign codes to contents. A similar list which codes location and backwardness of some 283 districts is available upon request.

25) The complete list with respective boundaries is presented in tables B-1 (3 digit) and B-2 (2 digit) in Appendix B.

Table1-3: Distribution of firms by industry (1988-1999)

Industry	1988		1989		1990		1991		1992		1993		1994	
Food & Beverages	51	(12.85)	107	(9.46)	109	(8.5)	136	(8.29)	162	(8.65)	204	(9.07)	295	(10.3)
Textile & Leather	66	(16.62)	187	(16.53)	212	(16.54)	278	(16.94)	308	(16.45)	381	(16.95)	477	(16.66)
Wood & Paper	15	(3.78)	50	(4.42)	55	(4.29)	74	(4.51)	79	(4.22)	90	(4)	117	(4.09)
Chemicals	54	(13.6)	193	(17.06)	221	(17.24)	283	(17.25)	326	(17.41)	395	(17.57)	503	(17.56)
Rubber & Plastic	29	(7.3)	73	(6.45)	77	(6.01)	110	(6.7)	121	(6.46)	165	(7.34)	216	(7.54)
Non-metallic Mineral products	32	(8.06)	78	(6.9)	86	(6.71)	110	(6.7)	125	(6.68)	140	(6.23)	172	(6.01)
Basic metal & Metal products	47	(11.84)	147	(13)	168	(13.1)	211	(12.86)	249	(13.3)	295	(13.12)	362	(12.64)
Machinery & Machine tools	54	(13.6)	155	(13.7)	189	(14.74)	226	(13.77)	259	(13.84)	283	(12.59)	335	(11.7)
Electronics	11	(2.77)	55	(4.86)	67	(5.23)	92	(5.61)	104	(5.56)	139	(6.18)	205	(7.16)
Transport Equip.	36	(9.07)	81	(7.16)	93	(7.25)	112	(6.83)	126	(6.73)	137	(6.09)	159	(5.55)
Miscellaneous	2	(0.5)	5	(0.44)	5	(0.39)	9	(0.55)	13	(0.69)	19	(0.85)	23	(0.8)
Total firms	397		1131		1282		1641		1872		2248		2864	

Industry	1995		1996		1997		1998		1999		Total [a]	
Food & Beverages	355	(10.26)	372	(10.17)	367	(9.88)	365	(9.88)	358	(9.62)	2881	(9.71)
Textile & Leather	595	(17.2)	625	(17.09)	636	(17.12)	635	(17.18)	610	(16.4)	5,010	(16.88)
Wood & Paper	154	(4.45)	165	(4.51)	164	(4.42)	165	(4.46)	163	(4.38)	1,291	(4.35)
Chemicals	620	(17.92)	649	(17.75)	659	(17.74)	650	(17.59)	654	(17.58)	5,207	(17.54)
Rubber & Plastic	272	(7.86)	299	(8.18)	301	(8.1)	295	(7.98)	296	(7.96)	2,254	(7.59)
Non-metallic mineral products	201	(5.81)	205	(5.61)	202	(5.44)	198	(5.36)	205	(5.51)	1,754	(5.91)
Basic metal & Metal products	407	(11.76)	423	(11.57)	426	(11.47)	417	(11.28)	430	(11.56)	3,582	(12.07)
Machinery & Machine tools	382	(11.04)	398	(10.88)	404	(10.88)	406	(10.98)	400	(10.75)	3,491	(11.76)
Electronics	267	(7.72)	302	(8.26)	324	(8.72)	342	(9.25)	386	(10.38)	2,294	(7.73)
Transport Equip.	173	(5)	183	(5)	195	(5.25)	189	(5.11)	188	(5.05)	1,672	(5.63)
Miscellaneous	34	(0.98)	36	(0.98)	36	(0.97)	34	(0.92)	30	(0.81)	246	(0.83)
Total firms	3460		3657		3714		3696		3720		29,682	

Source: CMIE manufacturing panel; own calculations

[a] "total" abbreviates "total number of firm years throughout the period 1988-1999"

Initial submission of annual accounts is very modest and then steadily increases in subsequent years until the second half of the nineties when the sample comprises about 3,700 firms. Apart from the first year (when the low number of observations seems to result in an unrepresentative sample), the composition of industry shares remains relatively stable over time, an exception being Electronics and to a lesser extent Machinery and Transport Equipment. While we observe shrinking shares for the latter, the opposite is true for the former. This development, of course, reflects the shift towards new technologies that has been taking place since the 1990s. The electronics sector started with negligible initial weight and then gained increasing importance. In 1999 more than 10 percent of the companies were in Electronics, most of them in computers. Even though the relative importance of the machinery sector decreased, it still belongs to the larger sectors, the largest being Chemicals, closely followed by Textiles & Leather. To be more precise, between 17 and 18 percent of the firms are affiliated with Chemicals in every, but the first (unrepresentative) year. Wood and Paper and Transport Equipment are the smallest sectors, to which approximately one out of twenty companies belongs.

Table 1-4 gives the distribution of firms classified by industry across 19 major states (headquarters location) as recorded in the first year a firm would enter the sample. In the margins, we list absolute figures as well as percentage figures with respect to industry affiliation of firms across all states (bottom lines) and location across all

Table 1-4: Distribution of firms by state and industry (on entering the sample)

		INDUSTRY												
LOCATION	1991 share of national pop.	Food & Bev.	Text. & Leath.	Wood & Paper	Che-mi-cals	Rub. & Plast.	Non-met. min. prod.	Basic metal & met. prod.	Mach. & mach. tools	Elec-tro-nics	Trans. Equip	Misc.	All firms	in %
Delhi	1.11	30	46	18	33	19	20	36	33	62	32	3	332	7.5
Andhra Pradesh	7.86	59	41	11	77	20	29	37	20	42	8	1	345	7.79
Assam	2.65	2	0	4	4	1	2	2	0	0	0	0	15	0.34
Bihar	10.21	1	0	0	3	2	2	14	3	0	2	0	27	0.61
Gujarat	4.88	37	96	15	124	64	25	50	65	29	11	7	523	11.81
Haryana	1.95	13	24	2	7	12	4	13	3	7	16	1	102	2.3
Himachal Pr.	n.a.	6	2	0	3	2	2	4	0	4	3	1	27	0.61
Jammu & Kash.	0.91	0	0	0	0	0	0	1	0	0	0	0	1	0.02
Karnataka	5.31	25	17	8	21	11	8	22	32	49	13	3	209	4.72
Kerala	3.44	12	10	6	12	12	5	4	2	9	1	0	73	1.65
Madhya Pradesh	7.82	30	16	3	17	12	7	18	16	6	4	2	131	2.96
Maharashtra[a]	9.33	79	174	74	295	114	72	164	157	130	45	11	1,315	29.7
Nagaland	n.a.	0	0	1	0	0	0	0	0	0	0	0	1	0.02
Orissa	3.74	5	1	4	1	3	11	13	3	0	0	0	41	0.93
Punjab[b]	2.40	17	35	10	18	1	0	19	12	5	11	0	128	2.89
Rajasthan	5.20	15	46	0	19	8	11	13	5	7	3	1	128	2.89
Tamil Nadu[c]	6.60	44	130	13	59	36	19	42	58	56	43	4	504	11.38
Uttar Pradesh	16.44	32	35	16	29	12	9	12	13	14	9	3	184	4.16
West-Bengal	8.04	34	68	14	52	20	19	48	44	22	16	5	342	7.72
All states	97.88	441	741	199	774	349	245	512	466	442	217	42	4,428	100
in %		9.96	16.73	4.49	17.48	7.88	5.53	11.56	10.52	9.98	4.9	0.95	100	

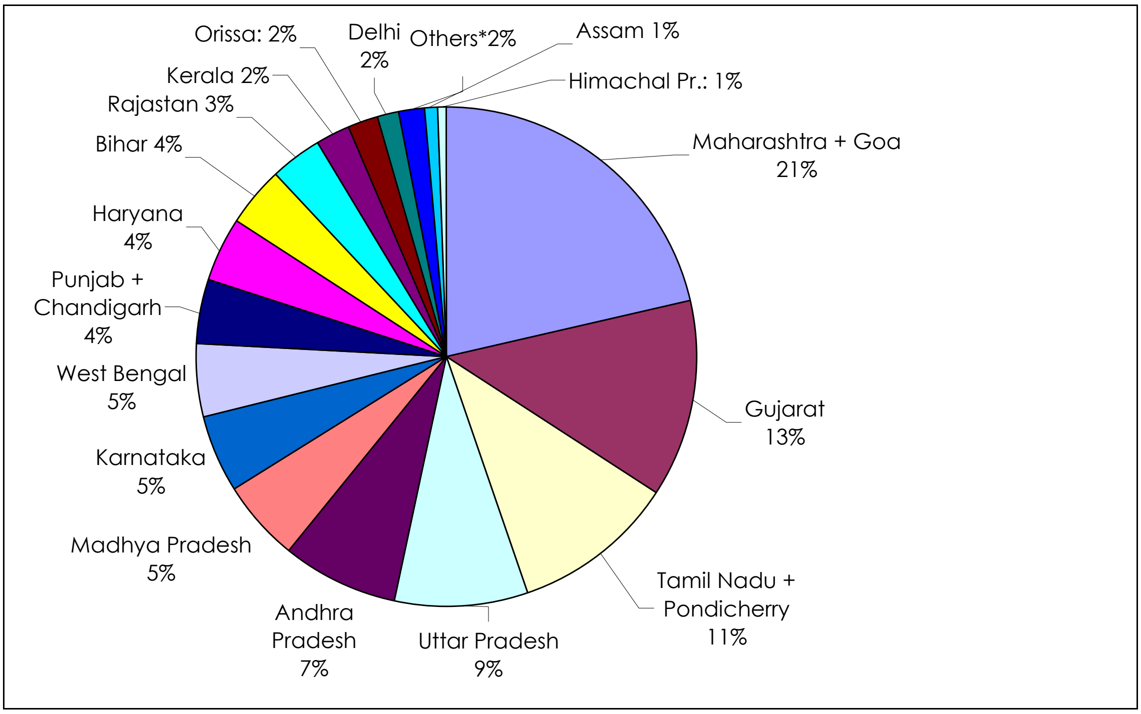
Source: Ötzler et al. (first column). All other data: CMIE manufacturing panel; own calculations

[a] includes Goa, [b] includes Chandigarh, [c] includes Pondicherry

industries (right margin).[26] With 1,315 firms Maharashtra leads the list, followed by Gujarat (523 firms) and Tamil Nadu (504 firms). Firms from these three states constitute more than half of the sample (53 percent), while nearly every third sample firm is located in Maharashtra alone.

The second column in Table 1-4 lists population shares of states in national population according to the 1991 census.[27] Comparing these figures with data from the last column, we find that the heavy geographical bias towards West-coast states (Maharashtra and Gujarat) greatly exceeds these states' shares in total population and the same applies to Tamil Nadu and Delhi. A look at Figure 1-3 reveals that firms in Delhi and Maharashtra are likewise over-represented relative to their weights in industrial output. The fact that the CMIE is based in Mumbai and that Delhi is the Union's capital

Figure 1-3: State-wise share in aggregate industrial output[a)] (1997-1998)



Source: Annual Survey of Industries (Factory Sector); own calculations

a) Value of products and by-products; * others include the states of Manipur, Meghalaya, Jammu & Kashmir, Nagaland and Tripura and the Union Territories Andaman & Nicobar Islands, Dadra & Nagar Haveli and Daman & Diu.

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26) The last column in Table 1-3 might deviate from the last line in Table 1-4 because the former is based on firm year observations while in the present context each firm only enters only once, viz. in its first sample year. Discrepancies are therefore due to different sample duration of firms.

27) In India, the census is accomplished once in ten years

apparently leads on an over-representation of Maharashtra and Delhi in the sample. On the other hand, firms in Madhya Pradesh and Uttar Pradesh are under-represented relative to those states' weights in total population and industrial output.

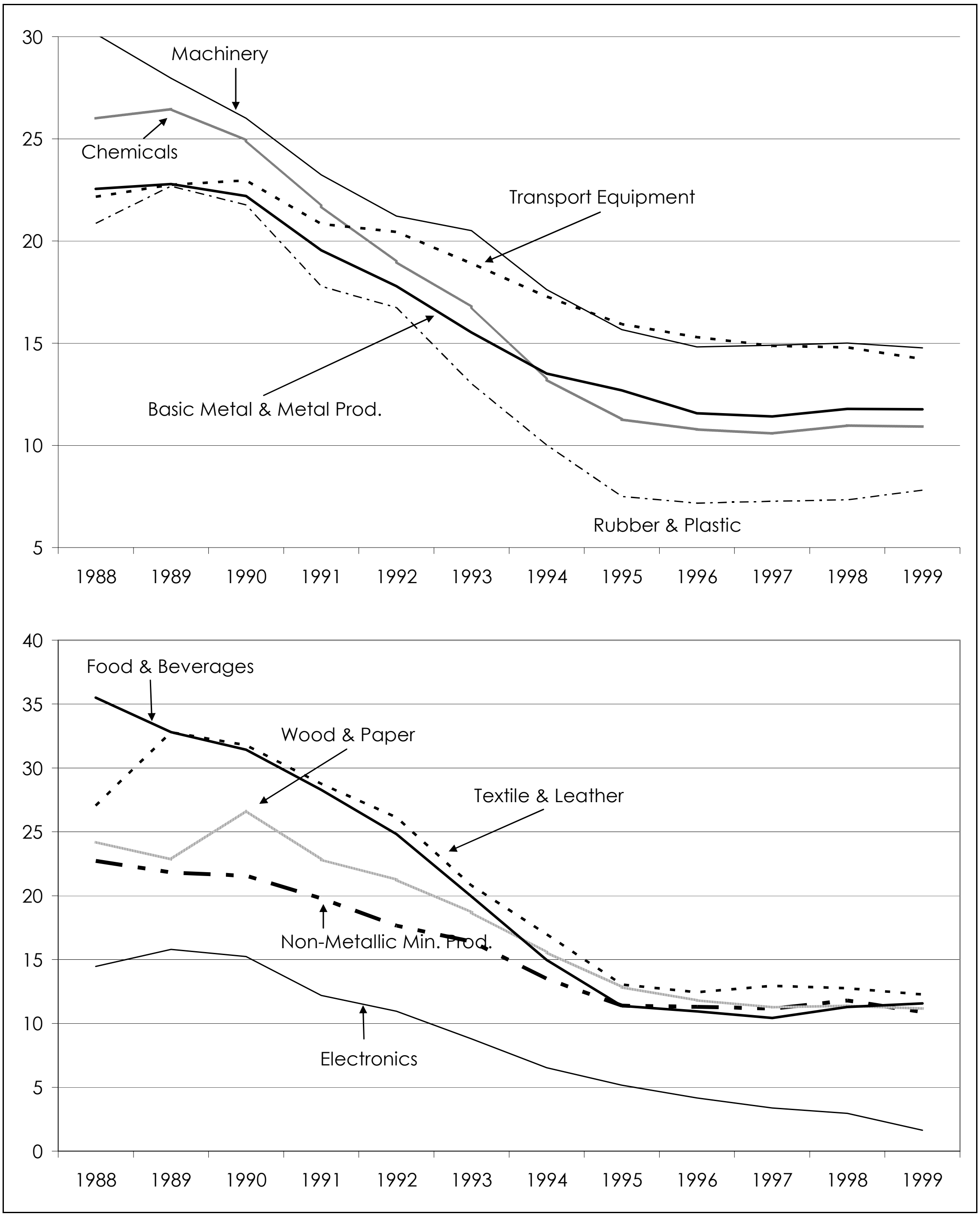
A still closer look at the inner state distribution of districts reveals heavy clustering in just those seven cities where the CMIE maintains offices. This pattern is most obvious for West-Bengal where 88 percent of this state's firms appearing in the CMIE's sample are located in Kolkotta, as opposed to ten percent in other non-backward regions and merely two percent in remote areas.[28]

Figure 1-4 depicts 'real' average firm age by industries for the sample period. Heavy industries appear in the upper panel and light industries in the lower. We define a firm's age as the difference between calendar years and the year of incorporation, and then subtract (t – 1988) for t = 1989, …, 1999 from the year-and industrywise averages. The latter subtraction is advisable to avoid statistical artifacts of increasing average firm age with progressing time.

For most industries, the average age profiles are downward sloping until the end of the transition phase (1995-1996) and the inter-sectoral variation in average firm age is continuously declining. A detailed (unreported) look into the data reveals that the CMIE included old (and large) companies early on when constructing the PROWESS database, whereas younger (and smaller) firms were brought in as the coverage of the database broadened in subsequent years. The year of incorporation pertains to the most recent incarnation of the company (point-in-time information given only once). For some firms that have been reorganized, the year of incarnation deviates from the year of foundation, which makes inference regarding the firm's age imprecise. But this does not contribute to the downward slopes, because such firms do not leave and re-enter the sample. Instead, the only thing that changes in their records is their year of incorporation, but the history of incorporation years is unavailable. Consistent with the evidence from Table 1-3, firms in the electronic sector are comparably young. The fact that average age is decreasing throughout the entire sample period is presumably due to persistent new business foundations in that sector. Average firm age in Food & Beverages, Textile & Leather as well as in the machinery and transport sector is relatively high in the beginning, but converges from the early 1990s onwards.

28) Further offices are maintained in Bangalore where 80 percent of Karnataka's companies are located, Mumbai (67 percent, head-office), Chennai (65 percent), Hyderabad (54 percent), Ahmadabad (30 percent) and Delhi.

Figure 1-4: Average 'real' firm age by industry (1988-1999)a)



Source: CMIE manufacturing panel; own calculations

a) Firm age is simply the difference between calendar years and the year of incorporation. To arive at 'real figures' we subtract (t-1988) from the year- and industrywise weighted averages.

Table 1-5 presents the distribution of firms by type of ownership, which remained unchanged throughout the sample period. We distinguish public sector firms from privately held companies, and within the latter category, private Indian firms from foreign firms.[29] The body of Table 1-5 gives proportions that sum up to 100 within each industry. The overwhelming majority of the sample comprises private indigenous firms; 282 firms are in foreign (private) ownership and 165 companies make up the group of public sector firms. The highest share of public sector undertakings is found in Transport Equipment, a good reflection of the policy that reserved the production of strategically important infrastructure facilities for the public sector.[30] In the early days of gradual reforms, foreign collaboration had been encouraged first in sectors where FDI would be most promising in helping to upgrade otherwise obsolete technology. Accordingly, the share of companies in private foreign ownership is highest in Machinery (13 percent), Electronics (9 percent) and Chemicals (9 percent). From 1991 onwards manufacturing firms were allowed to have up to 51 percent of their equity in foreign hands, with the exception of Beverages & Tobacco, Textile & Leather, or Wood & Paper. In line with this policy, we observe a well below-average penetration of foreign ownership in Textile &

Table 1-5: Industrywise distribution of firms by ownership form[a)]

Industry	Type of ownership			Total
	public	Priv. Indian	Priv. for.	obs. (firms)
Food & Beverages	1.8	90.5	7.7	441
Text. & Leather	3.2	95.0	1.8	741
Wood & Paper	5.0	93.0	2.0	199
Chemicals	4.7	86.3	9.0	774
Rubber & Plastic	2.0	94.6	3.4	349
Non-metallic Mineral Products	2.5	91.4	6.1	245
Basic Metal & Metal Products	4.3	92.8	2.9	512
Machinery	4.1	82.8	13.1	466
Electronics	3.6	87.3	9.1	442
Transport Equipment	6.9	86.2	6.9	217
Miscellaneous	4.8	88.1	7.1	42
All industries	3.7	89.9	6.4	4,428
Total observations (firms)	165	3,981	282	

Source: CMIE manufacturing panel; own calculations

[a)] The firms' ownership status remained unchanged throughout the sample period.

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29) PROWESS also covers joint ventures and cooperatives. Since only 35 Joint ventures and not more than three cooperatives meet all our selection criteria, we drop them. The classification system (codes and contents) is given in table B-3 in Appendix B.

30) More on this in chapter 2

Leather and Wood & Paper.

Finally, Table 1-6 gives the size distribution of firms for the period 1988-1999. In this thesis, size is defined by the boundaries governing the special provisions for small-scale industries (SSI) and large (monopolistic) firms as defined by the Monopolies and Restrictive Trade Practices Act (MRTP): if gross fixed assets do not exceed six million Rs. (before 1997), or 30 million Rs., respectively, (from 1997 onwards), the company is defined to be small. The boundaries for gross fixed assets investments are invariably expressed in nominal terms. In real terms, the ceiling almost tripled between 1990 and 1997. A company is defined as large if its gross fixed assets exceed one billion Rs., or, alternatively, if it has a market share of at least 25 percent and employs gross fixed assets worth one million or more. The relevant market comprises all firms within the same 3-digit industry class.[31] On these criteria, 13 percent of the firm-year observations fall into the large size category, 7.3 percent into the small-scale sector and the remaining 23,623 observations (79.6 percent) pertain to medium-sized firms. The effect of relaxed boundaries for gross fixed assets after 1996 is apparent. From 1997 onwards, the share of firms benefiting from the SSI-status increased by 10 percentage points. At the same time, the proportion of large companies rose as well, presumably because the market-share part of the MRTP-definition gained in importance.

Table 1-6: Distribution of firms by size class (1988 – 1999)

Year	Small[a]	Medium	Large[b]	total obs. (firm years)
1988	1.5	71.0	27.5	397
1989	1.5	83.1	15.4	1,131
1990	1.6	84.2	14.3	1,282
1991	2.8	85.1	12.1	1,641
1992	3.4	84.4	12.3	1,872
1993	3.5	84.8	11.7	2,248
1994	4.3	85.4	10.3	2,864
1995	4.1	85.7	10.2	3,460
1996	3.2	84.7	12.2	3,657
1997	14.0	72.8	13.2	3,714
1998	13.5	71.6	14.9	3,696
1999	14.6	69.4	16.1	3,720
total	7.3	79.6	13.1	29,682

Source: CMIE manufacturing panel; own calculations

[a] Size is measured by the criteria for SSI and MRTP firms. Small firms: gfa < 6 million Rs. until 1996 and gfa< 30 million Rs. since 1997. Large firms: gfa > 1 billion Rs. *or* gfa > 1 million Rs. *and* market share of at least 25 %.

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31) See table B-1 in Appendix B.

Table 1.7 in this chapter's Appendix presents detailed evidence on the industrywise distribution of firms by size classes. Since publicly owned firms have been exempted from MRTP regulations, the high share of public sector undertakings in Transport Equipment goes along with a comparatively high share of large firms. To a somewhat lesser extent this argument also relates to the Wood & Paper industry. Furthermore, the share of large firms is comparably high in Non-metallic Mineral Products and in Basic Metal. On the other hand, the electronics sector comprises both a very high share of young and small firms, establishing once more a positive correlation between a firm's age and size.

1.5 Appendix to chapter 1

Table 1-7: Industrywise distribution of firms by size class (1988 – 1999)

Industry	size class	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Food	small	0.0	1.9	0.9	2.9	3.1	4.9	5.1	5.4	1.3	11.2	12.6	12.3
&	med.	78.4	84.1	85.3	86.8	87.0	87.3	88.8	87.6	89.3	79.8	76.7	76.0
Beverages	large	21.6	14.0	13.8	10.3	9.9	7.8	6.1	7.0	9.4	9.0	10.7	11.7
Textile	small	1.5	0.0	0.9	1.4	2.6	3.7	4.8	3.5	2.2	9.0	8.4	10.8
&	med	81.8	90.4	89.6	89.9	87.3	86.9	86.8	87.9	86.9	78.6	76.9	71.8
Leather	large	16.7	9.6	9.4	8.6	10.1	9.5	8.4	8.6	10.9	12.4	14.8	17.4
Wood	small	0.0	0.0	1.8	2.7	1.3	1.1	0.0	2.6	2.4	12.8	10.9	12.9
&	med.	80.0	82.0	81.8	83.8	86.1	88.9	87.2	87.0	84.9	72.0	72.7	67.5
Paper	large	20.0	18.0	16.4	13.5	12.7	10.0	12.8	10.4	12.7	15.2	16.4	19.6
Che-	small	1.9	1.0	0.9	3.5	5.2	4.3	4.4	3.4	2.9	14.6	13.7	12.8
micals	med.	72.2	83.4	84.6	83.4	81.3	83.0	83.9	85.2	84.1	70.9	70.5	69.4
	large	25.9	15.5	14.5	13.1	13.5	12.7	11.7	11.5	12.9	14.6	15.9	17.7
Rubber	small	0.0	0.0	2.6	5.5	5.0	3.0	2.3	1.1	2.0	12.6	12.9	10.5
&	med.	86.2	84.9	83.1	82.7	80.2	84.2	87.0	89.7	87.3	76.4	73.2	75.0
Plastic	large	13.8	15.1	14.3	11.8	14.9	12.7	10.7	9.2	10.7	11.0	13.9	14.5
Non-met.	small	3.1	5.1	3.5	4.6	5.6	5.7	5.2	9.0	6.3	18.8	15.7	17.1
Mineral	med.	68.8	71.8	73.3	76.4	77.6	76.4	78.5	75.1	75.1	60.4	61.1	56.1
Products	large	28.1	23.1	23.3	19.1	16.8	17.9	16.3	15.9	18.5	20.8	23.2	26.8
Basic	small	0.0	0.7	0.6	1.0	0.8	1.4	1.7	2.0	1.4	8.7	8.4	8.8
Metal	med.	70.2	83.7	84.5	85.3	84.3	84.4	85.4	84.3	81.1	73.2	71.9	73.0
& Prod.	large	29.8	15.7	14.9	13.7	14.9	14.2	13.0	13.8	17.5	18.1	19.7	18.1
Machinery	small	3.7	2.6	2.7	3.1	4.6	1.8	4.2	3.7	2.5	15.4	14.5	17.0
& Mach.	med.	44.4	81.3	84.7	86.3	85.7	86.9	85.4	86.1	85.9	72.3	70.9	69.0
Tools	large	51.9	16.1	12.7	10.6	9.7	11.3	10.5	10.2	11.6	12.4	14.5	14.0
Elec-	small	9.1	1.8	1.5	4.4	2.9	7.9	9.3	9.0	10.6	31.2	29.8	35.5
tronics	med.	36.4	85.5	86.6	87.0	86.5	83.5	85.9	85.4	82.8	62.0	62.6	56.7
	large	54.6	12.7	11.9	8.7	10.6	8.6	4.9	5.6	6.6	6.8	7.6	7.8
Transport	small	0.0	3.7	2.2	1.8	1.6	1.5	3.8	3.5	3.3	11.3	11.6	7.5
Equip.	med.	80.6	76.5	79.6	83.9	85.7	84.7	84.3	83.8	82.5	73.3	70.9	72.3
& Parts	large	19.4	19.8	18.3	14.3	12.7	13.9	12.0	12.7	14.2	15.4	17.5	20.2

Source: CMIE manufacturing panel; own calculations

2 The Policy Background

In this chapter, we highlight and analyze some of the basic features of post-war Indian economic policy that seem to be important for the genesis of industrial sickness.[32] According to the literature, the key factors responsible for the emergence of industrial sickness are:

- the licensing system,
- the promotion of priority sectors, such as small-scale or backward industries, on ideological grounds,
- restrictions on foreign trade and foreign collaboration,
- labor market rigidities, and
- development financing.

As the ultimate aim of subsequent chapters is to analyze the impact of reforms of these policies on productive efficiency and the (re-)emergence of industrial sickness, each of the above will be discussed in turn, with a sketch of the initial position and then the major changes brought about by the 1991 deregulation policies.

It should be remarked that chapter 6 takes a different perspective and departs from the line that the Sick Industrial Companies Act enacted in 1987 provided incentives for firms to register as sick. So as not to overload that chapter with the policy background, the workings of the sickness law are sketched in the last section of the present chapter.

2.1 Industrial Licensing[33]

Originally, the license system had been established to direct the process of industrial growth. In a resource-scarce economy such as India, licensing served as an instrument for translating the broad priorities and targets of economic policy into concrete industrial capacities. Until 1991, entrepreneurial decisions had been guided and limited by this practice, the legal provisions in respect of which were outlined in the Industries (Development and Regulation) Act, 1951 (IDRA for short). Unless a proper license was granted, it was not at the management's own discretion to:

- establish a new undertaking, nor to close down an established one,
- manufacture a new article,

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32) Useful references include inter alia Ahluwalia (1985), Kuchhal (1989), Datt and Sundharam (1993) and Goswami (1996a).

33) Major reference: Sundriyal (1996)

- expand capacity,
- change location,
- import capital goods,
- secure foreign collaboration,

to name only the most important restrictions. While the choice of the production mix was generally restricted by a license system, the production of some articles was completely reserved for public sector undertakings. In particular, IDRA identified a list of industries considered important on strategic grounds that should be exclusively owned by the government (arms, atomic energy, railways etc.)[34]. Furthermore, some key or basic industries (e.g. coal, iron and steel) and infrastructure facilities (e.g. aircraft, ships and telephones) were subjected to the control of both the national and the state governments. The rationale behind such practice was grounded in the mistrust of private profit-maximization and the belief that only state-owned enterprises could reliably supply basic needs in these fields.

Where the government did not maintain direct control, it retained at least final control. Regardless of industry affiliation, any firm had to reckon with government interference in such matters as a substantial fall in production, a marked deterioration in the quality of products, an 'unjustifiable' rise in the prices of products, or general mismanagement.

The 1991 NEP virtually dismantled licensing. Only eight industries would remain on the list reserved for the public sector, and compulsory industrial licensing was abolished for all but 16 industries (see Table 2-3 and Table 2-4 in the Appendix to this chapter). These exemptions from licensing were, however, subject to certain locational restrictions; in particular, they come into effect only if the proposed project is located at least 25 km from the periphery of a city having a population of more than one million. Where licensing remained mandatory, its provisions have been relaxed. For example, so-called 'broad-bands' had been defined, i.e. industries whose design and production facilities are similar. Units falling within a 'broad-band' were permitted to produce any item covered under the generic description of the industry, and not only a tightly specified product, as before.

For de-licensed industries, managers are merely required to file an 'industrial entrepreneurs memorandum' on new projects and substantial expansions. Though the Government of India has been claiming that an acknowledgement could be obtained

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34) Refer to Table 2-3 in the Appendix attached to this chapter.

almost immediately, available evidence shows that this may not always have been the case (Sundriyal, 1996, p. 50).

2.2 Promotion of Priority Sectors: Small-Scale and Backward Industries[35]

With the objective of encouraging the diffusion of entrepreneurship, promoting employment and improving the standard of living in backward regions, small scale industries (SSI for short) as well as companies located in remote areas benefit from preferential treatment in many respects.

The definition of SSI firms varies as to whether the firm employs power or not: for industrial undertakings using power, a small scale firm may employ no more than 50 persons. An undertaking that produces without power may employ no more than 100 persons. Regardless of the number of persons employed, fixed capital investment (i.e. plant and machinery) may not exceed Rs. 500,000 (1960), Rs. 750,000 (1966), Rs. 1,000,000 (1975), Rs. 2,000,000 (1980), Rs 3,500,000 (1985), Rs 6,000,000 (1990) and Rs. 30,000,000 (1997) (Economic Survey, various years). However, the real ceiling rose substantially only after 1997 when it almost tripled.[36]

SSI firms were exempted from the requirement to obtain an entry-license and were allowed to expand capacity at their own discretion. Other measures encompassed areas like infrastructural support, priority lending at concessional rates of interest and favorable repayment schemes, lower rates of duty or even full exemption from excise duty, technology up-gradation and export incentives. Furthermore, the government maintained preferential purchasing contracts and followed a policy of generous product reservation. The extent of small-scale product reservation rose steadily until by 1991, the manufacturing of 836 items was exclusively reserved for small scale industrial undertakings.[37]

Not surprisingly, these forms of favorable treatment of the small sector has led to widespread abuses of the system: "*Small industries in India have because of government policy been encouraged to remain small, and when they grow, to split so that they remain within the definition of small scale units, as a result of which they enjoy special protection and incentives*" (Rao, 1994, p. 9). The phenomenon of industrial sickness is especially wide-spread among small firms, and it is obscure why it is precisely

35) Major refernce: Economic Survey (various years, online at http://www.indiabudget.nic.in/), chapter on 'small scale sector'.

36) The real ceilings in constant 1993 Rs. amounted to 6.4 Mio. Rs. (1960), 6.3 Mio. Rs. (1966), 4.5 Mio. Rs. (1975), 6.2 Mio. Rs. (1980), 7.2 Mio. Rs. (1985), 8.1 Mio. Rs. (1990) and 22 Mio. Rs. (1997).

37) 1967: 180 items, 1977: over 500 items, 1980: 807 items.

the small scale sector that is exempt from the regulations of the Sick Industrial Companies (Special Provision) Act.[38] The Economic Survey 1992-1993 estimates that between 30-40% of the registered small-scale units are '*non-functional*'. This may mean either that they fall short of minimum efficiency scales and in consequence are technologically non-viable, or that the units exist, but do not actually function.

The liberalization process of the early 1990s had limited direct effects on the small-scale industrial sector. Despite de-licensing in general, it continues to be protected through the policy of reservation. Only if a non-SSI firm subscribes to an export obligation of at least 75 percent (since 1996: 50 percent), will it obtain a product license originally reserved for small firms.

On the other hand, large firms suffered from manifold forms of discrimination. If private sector firms had a market share of 25% or more, they were automatically classified as 'dominant'. According to the definition in the Monopolies and Restrictive Trade Practices Act (MRTP), 1970, a dominant firm was viewed as a monopoly if its gross fixed assets exceeded ten million Rupees. Beyond that, any private company was automatically classified as possessing monopoly power if its gross fixed assets exceeded one billion Rupees (since 1985).[39]

With a view to controlling the power of such monopolies, their activities were subjected to further licensing. Government approval was required for:

- substantial expansion of capacity,
- diversification of existing activities,
- merging or amalgamation with any other undertaking, or
- takeover of the whole or parts of any other undertaking.

Most revealingly, state monopolies were not considered harmful to the public interest, and accordingly the regulations of the MRTP did not apply to government undertakings.

A first step towards reform was taken when the government declared that the provisions of the MRTP would not apply within 90 so-called 'zero industry districts', i.e. absolutely remote areas of the country. Since 1982, exemptions would also be granted if additional capacity of any good was meant exclusively for exports. The threshold

38) See section 2.6 below.

39) Originally: 200,000,000 (1970 figure).

limits of assets in respect of MRTP companies and dominant undertakings were raised in 1985. Eventually the government conceded that the interference in investment decisions of large companies had become harmful in its effect on industrial growth. Accordingly, the threshold limits were removed in 1991, and no particular prior approval is necessary anymore with regard to the establishment of a new undertaking, expansion, amalgamation or takeovers.

2.3 Foreign Trade and Foreign Collaboration

India's post-Independence foreign trade policy was guided by massive trade protection in the course of an import substitution strategy.[40] Import substitution policy was based upon the 'infant industry' argument, according to which infant industries can neither develop nor mature without protection from foreign competition. As further arguments, the need to conserve scarce foreign exchange often appears in the literature, as do the emotive appeal of self-reliance and Prebisch's export pessimism (i.e. inelastic foreign demand for domestically produced goods). In order to provide protection to domestic industries, a complex system of import licensing was set up, supplemented by high tariff rates. Capital goods were divided into a restricted category and an Open General License (OGL) category, respectively. Although, in principle, items from the latter group could be imported without a license, several conditions had to be fulfilled, notably the "actual user condition". This provision stated that OGL-imported goods had to be used by the importing firm itself and could not be sold within the next five years unless the industrial licensing authority approved the deal. Intermediate goods were divided into the banned, restricted and limited permissible categories plus an OGL category. The latter was likewise subject to the actual-user conditions. Furthermore, licenses for the import of capital goods or raw materials were granted only if the applying firm could successfully convince the bureaucrat that the respective item was 'absolutely essential' in production and 'locally not available'. In practice the concept of 'local availability' was open to rather generous interpretation. At times, the mere advertisement for some good was taken as sufficient evidence that the item was locally available. The principles of essentiality and local availability gave enormous discretionary powers to the respective bureaucrats, and they conferred special advantages on, and provided particular disincentives to domestic producers in the import substituting industry, since neither cost nor quality mattered. Lastly, imports of

40) Major references include Ahluwalia (1985, 1996) and, more recently, Chand and Sen (2002) and Das (2003a).

consumer goods were generally banned unless they were canalized through state import agencies.

Designed systematically to dismantle the high-cost industrial sector that emerged from extreme inward-orientation and to make it globally competitive, the NEP trade reforms substantially reduced import duties and largely swept away quantitative import restrictions except for the consumer goods industries. To the extent import licensing was still in place it would be administered with less stringency (Pursell, 1992). Moreover, many formerly licensed items would be shifted to the OGL category. The 1991 trade reforms have been well documented (for instance in Joshi and Little, 1996).

Table 2-1: Indicators of trade barriers in Indian manufacturing

	1986-1990	1991-1995	1996-2000
	Effective rate of protection (percent) [a]		
Intermediate goods	149	88	40
Capital goods	78	54	33
Consumer goods	112	81	48
All Industries	126	80	40
	Import coverage ratio (percent) [b]		
Intermediate goods	98	42	28
Capital goods	77	20	8
Consumer goods	88	46	33
All Industries	92	38	25
	Import penetration rates (percent) [c]		
Intermediate goods	0.13	0.15	0.18
Capital goods	0.12	0.12	0.19
Consumer goods	0.04	0.04	0.10
All Industries	0.11	0.12	0.16

Source: Das (2003 b)

[a] The effective rate of protection is calculated as the difference between value added at domestic and at world prices, divided by value added at world prices. The appeal of this value-added based concept of protection is that it takes account of the level of protection on intermediate inputs as well as of the final product. It brings out the point that, if a good is exported without any export subsidy but the exporter must purchase protected domestically-produced intermediate inputs, the primary factors involved in the value-added process are actually penalised compared to free trade; [b] The import coverage ratio gives the share of an industry's own imports that is subject to a particular non tariff barrier, or any one of a specified group of non tariff barriers; [c] The import penetration is defined as the ratio of manufacturing imports to apparent consumption of manufactured goods (domestic production minus exports plus imports).

In a recent study, Das (2003 b) calculates sundry measures of trade liberalization, namely the effective rate of protection (ERP), the import coverage ratio and import penetration rates, for the use-based classification (consumer goods, intermediate goods and capital goods) under the different phases of trade reforms (see Table 2-1).[41] It is worth mentioning that these concepts have met with criticism as regards their theoretical foundations and their applications for empirical work.[42] It is not a top priority of this section to enter into this discussion. However, it has to be kept in mind that there is a discussion of the informational value of these concepts – as is the case with any composed indicator designed to capture complex relations in just one figure.

Keeping these remarks in mind, we conclude from Table 2-1 that trade liberalization has been the most extensive for the intermediate goods sector. Here, the effective rate of protection fell by 109 percentage points, equivalent to a reduction of 73 percent. In contrast, the effective rate of protection has been reduced by only 57-58 percent in the capital goods and consumer goods sectors. Although, in relative terms, domestic producers of capital and consumer goods have been deprived of protection to a lesser degree, they did not enjoy as much protection against foreign competition at the outset of the reforms.

Both the 1991-1995 and the 1996-2000 periods saw drastic reductions in the percentage of intermediate goods subject to import licensing. The same holds true for the capital goods sector, though here attempts to free imports from non-tariff barriers had already started in the mid eighties. Accordingly, the capital goods industries turn out to be the most liberalized by the late nineties. For the consumer goods sector the withdrawal of non-tariff barriers has been slower than in the other sectors. By the late nineties, around 33 percent of imports of this category were still subject to licensing.

To assess the joint impact of lower tariffs and relaxed import controls on the competitiveness of manufacturing industries, Das also presents figures on import penetration rates (see lowest panel of Table 2-1). Surprisingly, the success in trade liberalization documented in the first two panels of Table 2-1 brings about hardly any measurable increases in import penetration, and then only with a considerable time lag (i.e. in the last phase).

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41) These measures are defined in the footnotes of Table 2-1.

42) Where the ERP is concerned, it is argued, for instance, that in developing countries factor prices often fail to reflect opportunity costs, due to the presence of subsidies to inputs of capital and labor market imperfections (such as minimum wage legislation). In the presence of inappropirate factors costs, the net direction of resource pulls will be influenced by both the height of protection and the degree of divergence from a well-functioning market (see Krueger (2002)).

Evidence on the Effects of Trade Liberalization

For a first appraisal of the effects of trade deregulation policies, we converted the use-based measures into respective measures at the NIC-87 two-digit level and calculated pairwise correlation coefficients between changes in the ERP and the import coverage ratio, respectively, and concentration ratios in imports, exports and sales (see Table 2-2). In each case the respective degree of concentration is measured as the top ten percent firms' share in imports (or exports, or sales, respectively) in total imports (or exports, or sales, respectively) of all firms belonging to the same two-digit industry.

Preliminary bivariate evidence from Table 2-2 suggests that only a minor part of the Indian manufacturing sector has managed to take advantage of liberalized trade policies and, as a result, concentration measures of both sales and exports have ultimately increased. Similarly and contrary to expectations, the decline in both (2-digit) effective rates of protection and import coverage ratios has not induced the great majority of firms significantly to intensify their import activities; but if at all, then the relative position of the top ten percent of importing firms has been strengthened.

Table 2-2: Effects of foreign trade liberalization: Bivariate correlation coefficients (1986-2000)[a)]

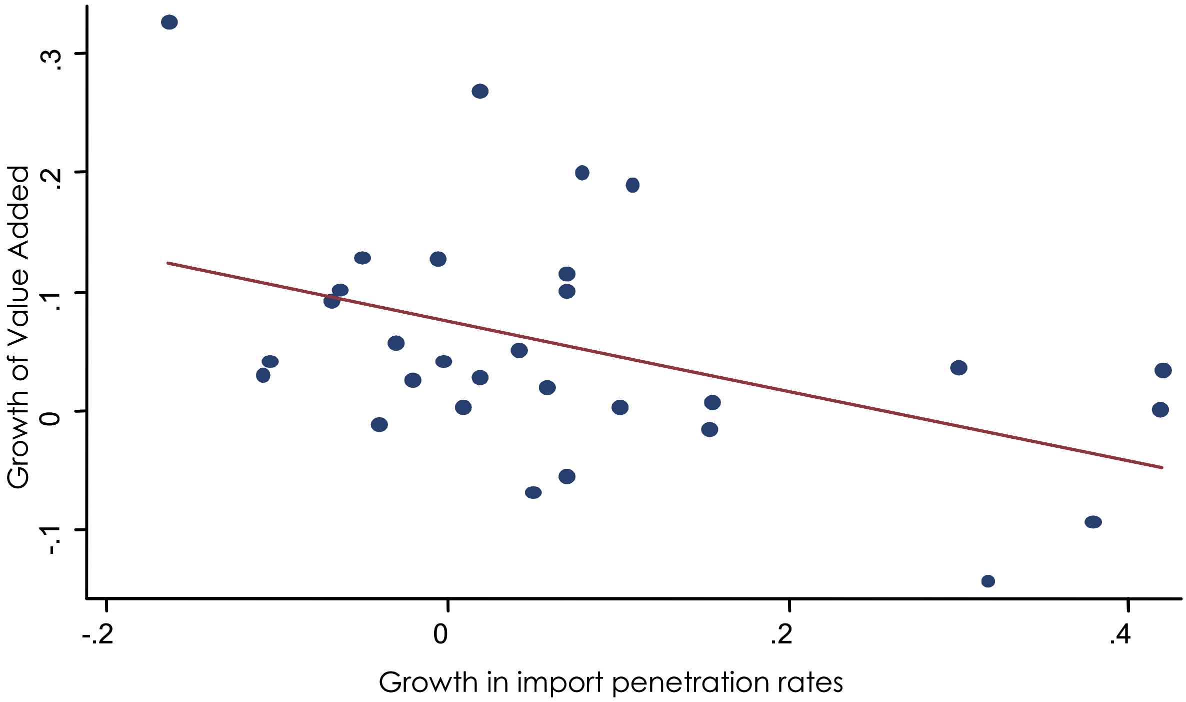
	Change in ERP	Change in import coverage ratio
Import concentration	-0.3620 (0.0493)	-0.2625 (0.1611)
Export concentration	-0.1639 (0.3868)	-0.4793 (0.0074)
Sales concentration	-0.4147 (0.0227)	-0.3280 (0.0768)

Source: Das (2003 b) and CMIE; own calculations; the CMIE sample has been matched with indicators from Das (2003b), which have been converted into respective measures at the NIC-87 two-digit level.

[a)] Marginal significance level in parentheses

While the anticipated positive effects of foreign trade liberalization on foreign trade participation do not seem to be borne out in practice, their stimulating effects on industry performance seem even more questionable. For the 1986-2000 period, the correlation between sectoral value added and sectoral import penetration rates turns out to be not only highly significant (p-Value: 0.012), but also negative, with a correlation coefficient of -0.4567 (see Figure 2-1). If the results from these preliminary bivariate exercises are confirmed by multivariate analyses, they imply that not only did reforms have relatively little effect on foreign trade participation, but that the effects also went into the wrong direction. This issue will be explored in section 5.2.

Figure 2-1: Correlation between (2-digit) sectoral value added growth and change in (2-digit) import penetration rates (1986 – 2000)



Source: Das (2003 b) and CMIE; own calculations; the CMIE sample has been matched with indicators from Das (2003b), which have been converted into respective measures at the NIC-87 two-digit level.

2.3.1 FDI Provisions

Apart from import restrictions, another barrier to imports of modern technology had been set up by the Foreign Exchange Regulation Act (FERA), 1973. By definition, so-called FERA companies held foreign equity of 40 percent or more. These FERA firms were subjected to the RBI's supervision and had to seek its periodical approval. FERA-firms were neither allowed to buy shares of other companies, nor to expand either capacity or output. To promote the inflow of foreign direct investment (FDI), in 1991 high priority sectors were specified in which automatic approval of FDI up to 51 percent of equity is given[43]. The list covers practically the entire manufacturing sector, excluding beverages, tobacco, textiles, leather and wood & paper.

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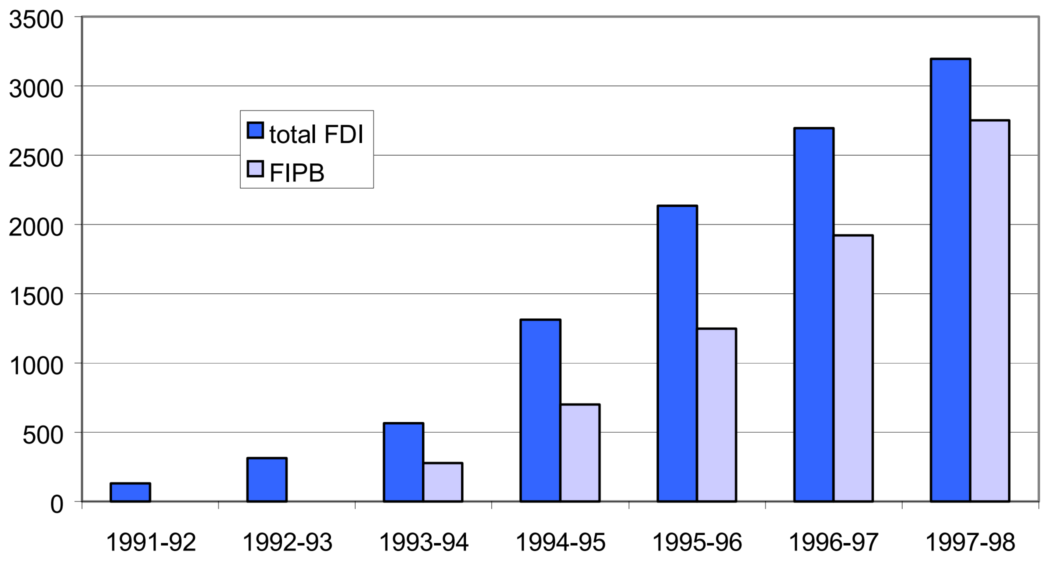
43) Up to 100 percent equity in wholly export-oriented units and up to 24 percent in industries reserved for the small scale sector.

Figure 2-2: Foreign Direct Investment: total FDI vs. FIPB-approved FDI (in million US-$)[a]



Source: RBI, Report on Currency and Finance, Vol. 1 (various years)

a) Until 1993-94 the share of FDI which comes through the FIPB route is not separately listed

Firms engaged in these industries as well as firms aiming at foreign-equity participation of over 51 percent still had to seek approval by the Foreign Investment Promotion Board (FIPB). With respect to FDI, policy reform has been highly effective. Ahluwalia (1996, p. 30) recalls a prominent example: when Pepsi-Cola entered the Indian market in 1990, it had filed its applications for five years. In 1992 it took only three months to grant approval to Coca-Cola. The upward trend in FDI can be seen from Figure 2-2, which also depicts the growing importance of the FIPB. In 1997 and 1998, eighty-six percent of total FDI has come through the FIPB-route.

2.4 Labor Market Rigidities

In India there are numerous labor laws on the books. Vakilno1.com, a Delhi-based internet portal offering legal advice to the business sector, lists by far the most entries in the labor law category.[44] The mere number of labor-related laws may serve as a first indicator that labor issues assume overwhelming importance in India.[45] For the small

44) Other categories refer to similarly broadly defined topics, e.g. "banking", "consumers" and "environment". The "corporate law" section under www.vakilno1.com gives inter alia the text of the following laws: Company Act, 1956, The Industries (Development and Regulation) Act, 1951, MRTP Act, Sick Industrial Companies (Special Provisions) Act, 1985 and Foreign Trade (Development and Regulation) Act, 1992.

45) Mathur (1994; pp. 101-104) provides a (non-exhaustive) list of 71 labour related laws and classifies them into 10 broad categories.

fraction of workers who find employment in the organized sector (estimates range between three and ten percent of the total working population), the terms of employment, including the social security system, are generally considered good – possibly too good. Several studies have pointed to the inflexibility of Indian labor legislation and have analyzed how its rigid interpretation encourages and manifests labor market imperfections.[46] Most of them argue that the NEP have not brought about fundamental changes in this domain and consider labor matters as "the unresolved issue".

A significant obstacle to more flexibility in the labor market certainly is that major sections of the employees are inadequately insured against unemployment. Though the legislation requires severance or retrenchment payments on termination of employment, only a small minority of the working population is effectively covered, viz. workers in larger companies in the formal sector (ILO, World Labour Report 2000). In consequence, it remains extremely difficult to fire labor. "*The problem from the employers' point of view is not with prior notice for lay-offs, retrenchments, lock-outs or closures, but with prior permission from the government to implement any of the above managerial decisions*" (Ratnam, 1995, p. 288). If attempts at closures and retrenchments are made, litigation may take decades. In public sector undertakings, where unpopular decisions can be countered by vote withdrawal, the management is supposedly especially reluctant to fire workers.

Second, the practice of wage determination has been considered equally important for the emergence of industrial sickness; for increases in wages were not always linked to increases in productivity. For example, virtually all studies of industrial sickness refer to the fate composite textile mills suffered in the 1970s:[47] strong union pressure contributed to steadily rising real wages, while at the same time measures to increase productivity were prevented by strict government controls on capacity and the types of machinery used in manufacturing. When sharp competition from the non-unionized power-loom sector arose, this was the end of most textile mills.

Apart from these factors, which are widely agreed to have been damaging to the economy, Narayanan (1994) disputes that labor problems are the major cause of industrial sickness. He analyzed the determinants of sickness in 472 companies and, contrary to popular impression, found out that only in 52 cases did labor problems

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46) Reference may be taken to the various articles published in the compendiums edited by Deshpande and Rogers (1994), Raghavan et al. (1995) or Papola et al. (1993).

47) See, for example, Kumar (2001).

actually constitute the major cause. Still, he concludes that even if labor-related factors were not mainly responsible for the emergence of industrial sickness, it would be virtually impossible to solve the problem without imposing severe hardship on labor. It is precisely for this reason, he argues, that the process of restructuring is prolonged and industrial sickness is allowed to continue. Where social security systems are in an infant state and alternative job opportunities are very limited, it is hard to close companies and to solve the sickness problem in a rigorous manner.

2.5 Development Finance Institutions

Industrialization hinges upon the availability of adequate sources of finance: new industrial undertakings require funds to finance initial fixed capital expenditure and working capital needs. By the time of Independence, conventional sources of finance such as shares and debentures, commercial banks and indigenous bankers proved to be insufficient to meet the growing demand for capital funds.[48] With the best of intentions to overcome such an obstacle to industrial development, the Indian government subsequently established various term lending institutions for various types of customers. A short list of the most important term lending institutions includes the Industrial Finance Corporation of India (IFCI, established in 1948), the Industrial Credit and Investment Corporation of India (ICICI), and the Industrial Development Bank of India (IDBI, established in 1964). The Small Industries Development Bank of India (SIDBI), a wholly-owned subsidiary of the IDBI, has been established as the principal institution for the promotion, financing and development of small scale industries. At the state level, it is assisted by the State Financial Corporations (SFCs). Financial assistance to exporters and importers is provided by the Export-Import Bank of India (Exim Bank), which has been set up to take over the operations of the international finance wing of the IDBI. Last but not least, the Industrial Investment Bank of India (IIBI), the successor of the former Industrial Reconstruction Bank of India (IRBI), looks after the special needs of sick units.

These (and other) institutions have been set up for other reasons than short-term profit-maximization. Rather, they were conceived in the role as catalysts to industrial development and accordingly are referred to as development finance institutions (DFIs for short). In fulfillment of their role, the DFIs run programs to promote balanced regional development, to develop priority sectors and to assist priority customers, because the

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48) Major references include Datt and Sundharam (1993), chapter 42, and essays in Rangarajan (1998) and Gupta (2001).

free market was regarded as unable "*to optimally allocate resources over time, that is, for investment because of the 'myoptic' nature of markets*" Rangarajan (1998). Accordingly, the 1969 nationalization of the 14 largest private banks was justified with the "*need to control the commanding heights of the economy and to meet progressively the needs of development of the economy in conformity with national policy objectives*"[49]. In 1979, the government mandated that 33 percent of all credit extended by banks should be reserved to certain priority sectors. In 1985 this ratio was increased to 40 percent of net loans, which is also the current ratio. The lending requirement involves agriculture (18 percentage point) and advances to "weaker sectors" (10 percentage points).[50]

It is widely believed that the consequences of directed lending policies have been very damaging and that such policies became an obstacle to achieving the long-run objective of economic growth.[51] Banks have been constrained in their ability to allocate credit freely and the lack of sufficient numbers of viable projects in the priority sector has led to poor quality loans. Some authors such as Goswami (1996a and 1996b) and Hanson (2001) go as far as to doubt the commitment to fundamental commercial principles in total, and argue that rather the principle of loan maximization was followed. They argue that very low lending quality and poor collection are the prime reason for the high share of non-performing assets (loans) in the Indian banking sector. According to these authors, the politics of priority sector lending (or loan-maximization, respectively) entailed diluted criteria for initial project appraisal and the broad absence of careful monitoring practices to evaluate current projects and the debtors' entrepreneurial abilities. Where interest rates were subsidized and often negative in real terms and where the creditor would not credibly enforce loan repayment, firms would become excessively leveraged and increasingly exposed to the risk of default in bad states of business. Once these had actually plunged a firm into financial distress, additional loans were readily sanctioned with the hope that granting ever more finance would protect outstanding claims and could thereby ensure debt repayment at some point in the future. When it eventually became apparent that such efforts

49) Preamble of the Banking Companies (Acquisition and Transfer of Undertakings) Act, 1969.

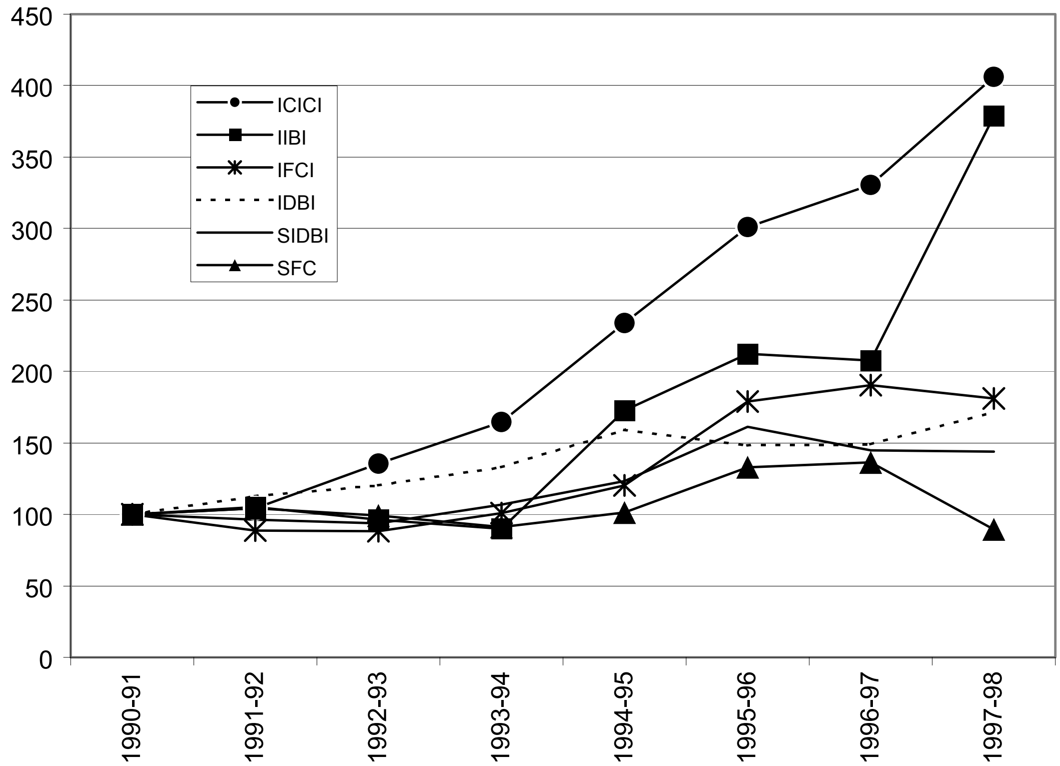
50) Accessed at www.rbi.org.in, Priority lending FAQ. Foreign banks which have been allowed to enter India in 1994 face a lower priority sector lending requirement of 32 percent; of which at least 10 percentage points are directed to the SSI sector and 12 percentage points must be export credit.

51) See, for instance, Bhattacharya and Urjit (2002, section II.7.2) on priority lending, Goswami (1996a, 1996b) and Hanson (2001).

would be in vain, the continuation of loose credit supply was all too often justified by an appeal to employment protection.

Recognizing that the merits of development financing are ambivalent, if not doubtful, to its beneficiaries as well as to the suppliers of funds, a committee was established in 1991 (known as the Narasimham Committee) to develop a strategy for overdue reforms in the financial system.[52] From Figure 2-3 it is apparent, however, that the flow of financial assistance has not been cut down in general. True, from the mid-nineties onwards the small-scale industrial sector has experienced considerable reductions in financial support; but this is counterbalanced by the IIBI's intensified effort to nurse sick units.

Figure 2-3: Financial assistance disbursed by DFIs (Index numbers) [a)]



Source: Report on Currency and Finance (various years)

[a)]Index number series are based on real figures in constant 1980 prices. The appropriate deflator is calculated from the respective GDP-series at factor cost (at current and constant prices).

52) The fate of many financial institutions would be another story worth telling. Substantial numbers of these dug their own grave by practices such as loan maximization and interest subsidization and eventually fell into sickness themselves.

2.6 The Sick Industrial Companies (Special Provisions) Act, 1985 (SICA)

The Sick Industrial Companies (Special Provisions) Act, 1985 (SICA henceforth) came into force in 1987. The law applies to both public and private companies which have been registered for at least five years, employ at least 50 workers and do not belong to the small scale or ancillary sector. Any such company is declared sick if its accumulated losses exceed its net worth position.

2.6.1 Timing and Sequencing under SICA[53]

When a company meets the sickness criteria, the law requires it to make reference to the Board for Industrial and Financial Reconstruction (BIFR for short) within 60 days.[54] The BIFR exercises the jurisdiction and powers and discharges the functions and duties imposed under SICA. The BIFR has to determine within a period of another 60 days if the company in concern is indeed sick. If it does, it has to make an official declaration on the matter. It may appoint one or more special directors to safeguard the financial and other interests of the firm. If the presumption of sickness is verified, the BIFR has to decide whether or not it is in principle practicable to restore the company to economic viability via reconstruction. Where this is not the case, it might still be "*in the public interest*" to prevent winding-up. Also, at this stage the BIFR has to decide whether or not the company is able to recover "*within reasonable time*" (which translates into 7-10 years) without external expertise and without financial assistance. If the answer is negative, the BIFR appoints so-called Operating Agencies (OAs for short) and charges them to work out a scheme of suitable measures.[55] A company may also set up an endogenously determined scheme.[56] Either way, rehabilitation of the sick company may come about through one or more of the following:

- Financial reconstruction
- Dismissal of the old and establishment of a new, proper management
- Amalgamation
- (Partial) Sale or lease of any industrial undertaking owned by the company

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53) The precise wording of the sickness law can be found in Narayanan (1994), Appendix 2. For an evaluation of SICA's effectiveness, compare Anant and Mitra (1998, p. 43 ff) and Goswami (2001, p. 20 ff.) and, of course, the expositions in section 6.1 of this Thesis.

54) Registration may also come through outsiders (typically banks). If they have sufficient reason to believe that any company meets the sickness criteria, they must make reference to the Board.

55) Possible OA-candidates include any public financial institution, state level institution or scheduled banks.

56) If the company does not comply with the provisions of the endogenously determined scheme or if it fails to revive but it is "in the public interest" that the company should recover, then, too, operating agencies will work out a plan.

– Adjustment of the labor force "in accordance with law."[57]

In working out a plan that specifies the necessary measures to fulfill the above aims, the operation agencies enjoys ample decision scope with regard to the reduction of both the shareholders' and creditors' rights. With regard to the latter group, section 22 specifies: "... *no suit for the recovery of money or for the enforcement of any security against the industrial company or of any guarantee in respect of any loans, or advance granted to the industrial company shall lie or be proceeded with further, except with the consent of the Board*..." Also, the BIFR may declare any existing obligations and/or liabilities to be suspended for seven years at most and order "*adaptations*" with respect of any such postponed obligations and/or liabilities. In return, a sick company loses the right to dispose of its assets, except with the consent of the Board.

Next, the draft plan needs to be approved – not merely by the BIFR, but also by representatives of the sick company (management and workers) and by shareholders and creditors, no matter how small their stake may be. Since a plan can only be sanctioned by unanimous consent, the process of revision is typically quite time-consuming. The scheme all parties eventually agree on carefully prescribes the necessary measures to be taken, where in general financial assistance will play a key role. In this respect Article 19 of SICA specifies: "*...the [rehabilitation] scheme may provide for financial assistance by way of loans, advances or guarantees or relieves or concessions or sacrifices from the Central Government, a State Government, any scheduled bank or other bank, a public financial institution or any institution or other authority [...] to the sick industrial company*."

Sanctioning and actual implementation of the draft scheme then hinges on the consent of those persons or institutions, respectively, that are required to provide financial assistance. If no approval is received within 60 days, "*it shall be deemed that consent has been given*" (SICA, 19(2)). If any person or institution, respectively, explicitly refuses to provide financial assistance "*the Board may adopt [...] other measures, including the winding up of the sick industrial company, as it may deem fit*" (SICA, 19(4)). If the BIFR actually recommends winding up, its responsibility with respect to the sick company comes to an end and the High Court takes over. Figure 2-4 depicts the timing and sequencing under SICA.

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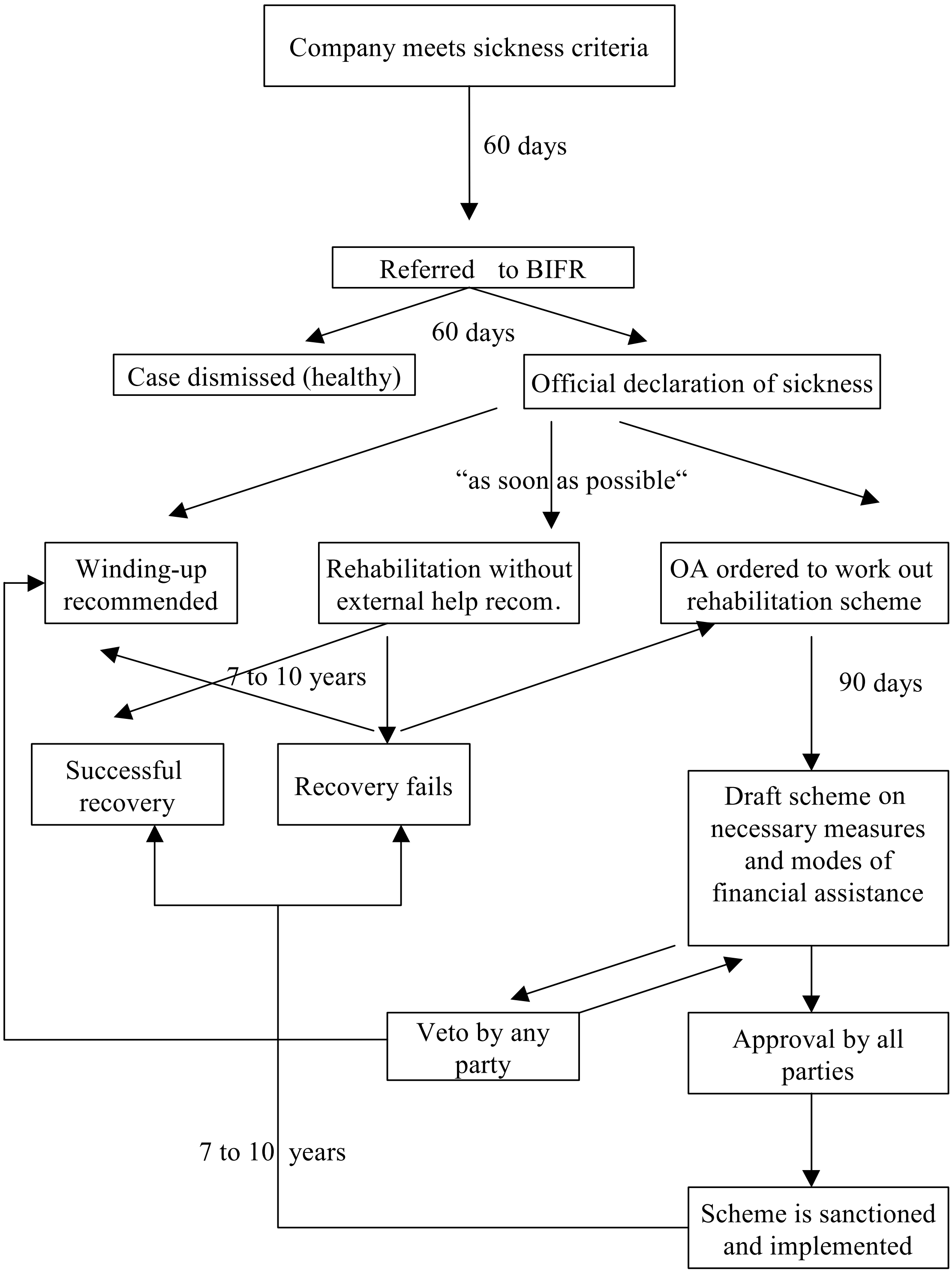
57) Rationalization of labor has only been provided for since 1994.

Figure 2-4: Timing and sequencing under the sickness law



Source: Sick Industrial Companies (Special Provisions) Act, 1985; own illustration

2.6.2 Provisions for Weak Companies

Since the successful recovery of any sick unit hinges upon the timely detection of sickness, SICA also gives clear guidelines on how to proceed with potentially sick or 'weak' companies. By definition, a company is regarded as weak if its accumulated losses have resulted in the erosion of 50 percent or more of its peak net worth during the immediately preceding four financial years. Within 60 days these companies, too, must submit a reference to the Board and hold a general meeting where the shareholders consider the causes for such erosion. The shareholders may fire the director, in which case he is not entitled to any compensation (no 'golden handshake'). If the BIFR is of the opinion that a weak company is not able to recover '*within a reasonable time*', it can direct operating agencies to write a report on this matter. The Board may publish a notice in the daily newspaper "*for suggestions and objections, if any, [...] as to why the company should not be wound up*" (SICA, 23A(3)). If the BIFR comes to the conclusion that the firm will most likely not become viable in future time, it will order winding-up.

As compared to the provisions for sick companies, SICA proceeds in a remarkably rigid manner where weak companies are concerned. In particular, it has been repeatedly stressed that a weak company has to meet all its financial obligations while recovering, i.e. neither a suspension of debt repayment nor a deferral of liabilities will be granted, and, in particular, no financial assistance is available. Nor will outside expertise be available to work out a rehabilitation scheme. It may very well be the case, therefore, that managers of marginally viable firms anticipate the proceedings of SICA and change their capital structure so as to qualify for the proceedings for a sick firm instead of those for a weak firm. In this case, a strategic manager would rather realize negative net worth than allow for an erosion of net worth of 50 percent.

2.6.3 Malfeasance Provisions

So far SICA provides immense incentives for firms to register themselves as sick. The attractions of actively running the company into sickness are limited by the malfeasance proceedings outlined in section 24 of SICA. These provisions apply to both present and past directors, managers or leading staff. If it becomes apparent that any of these "*has misapplied or retained, or become liable or accountable for any money or property of the sick industrial company; or has been guilty of any misfeasance, malfeasance or non-feasance or breach of trust in relation to the sick industrial company*", then this person is personally liable for the material damage and must repay the money or restore the property, respectively (SICA, 24(1)). Furthermore, this person "*or any firm of which such person is a partner or any company [...] of which such person is a director*" will be denied financial assistance for ten years (SICA, 24(2)).

2.7 Summary and Conclusion

Four features of the industrial reforms in the last decade have helped gradually to dismantle the barriers to entry. First, a number of industries hitherto reserved exclusively to the public sector have been exposed to competition from private sector entrepreneurs. Similarly, broad de-licensing and the repeal of the MRTP act have reduced the barriers to entry into the industrial sector. Third, restrictions with respect to foreign collaboration have been diluted, so stimulating FDI. Fourth, foreign competition has been allowed to enter the formerly closed economy through the gradual removal of quantitative import restrictions and the reduction of tariffs. Yet while the barriers to entry have been removed to a large degree, the barriers to exit remained an unresolved issue in the late nineties. This applies to both exit provisions for labor, as well as exit provisions for firms.

Although the respective sickness law claims to address the problem, the detection of sickness comes at a very late stage. When net worth has eroded, the probabilities for a successful turnaround are not that overwhelming anymore. Furthermore, the procedure under SICA/BIFR operates cumbersome and is time consuming. The (anti-) sickness law does not provide for sufficient flexibility to enforce reallocation of resources from unproductive and economically non-viable units to more vibrant sectors of the economy other than "by mutual consent" of all stakeholders. Until the firm is actually would up, the BIFR does not allow creditors to exercise any claims, it violates the absolute priority rule,[58] and mostly leaves debtors (shareholders and incumbent management) in possession.

58) Senior creditors have to be settled in full before junior creditors are entertained at all.

2.8 Appendix to chapter 2

Table 2-3: List of industries reserved for the public sector

Industries	Delicenced
• Arms + ammunition and allied items of defence equipment; defence aircraft and warships	after 1999
• Atomic energy	
• Coal and lignite	in 1999
• Mineral oils	in 1999
• Mining of iron ore, manganese ore, chrome ore, gypsum, sulphur, gold and diamonds	in 1994
• Mining of copper, lead, zinc, tin, molybdenum and wolfram	in 1994
• Minerals specified in the schedule to the Atomic Energy (Control of Production and Use) Order, 1953	after 1999
• Railway transport	

Source: Economic Survey. Government of India (various years) and Secretariat for Industrial Assistance (2004)

Table 2-4: List of industries in respect of which industrial licensing is compulsory

Industries	Delicenced
• Coal and lignite	1998-99
• Petroleum (other than crude) and its distillation products	1998-99
• Distillation and brewing of alcoholic drinks	
• Sugar	1998-99
• Animal fats and oils	1997-98
• Cigars and cigarettes of tobacco and manufactured tobacco substitutes	1997-98
• Asbestos and asbestos-based products	1997-98
• Plywood, decorative veneers of all types and other woodbased products such as particle board, medium density fibre board and other block board	1997-98
• Chamois leather	1997-98
• Tanned or dressed furskins	1997-98
• Paper and newsprint except bagasse-based units	1997-98
• Electronic aerospace and defense equipment; all types	
• Industr. explosives, incl. detonating fuse, safety fuse, gun powder, nitrocellulose+matches	
• Hazardous chemicals	
• Drugs and pharmaceuticals (according to drug policy)	
• Entertainment electronics (VCRs, color TVs, CD players, tape recorders)	1996-97

Source: Economic Survey. Government of India (various years) and Secretariat for Industrial Assistance (2004)

3 Concepts, Dimensions and Characteristics of Industrial Sickness

This chapter starts out with a thorough discussion of various concepts of industrial sickness. The relevant definition for this study, viz. the negative net worth criterion, is especially applicable in empirical work. Section 3.2 explores the spread of industrial sickness in our sample of some 4400 manufacturing firms for the 1988-1999 period. We explore the spatial and sectoral diffusion of sickness, describe its temporal evolution and present detailed patterns of sickness at the firm level. The dimension of sickness across types of ownership, age and size classes is also investigated. This section contributes to the descriptive evidence on industrial sickness in two ways. First, the level of detail is much greater. Second, and more importantly, it provides an account of the variation in the incidence of industrial sickness (within industries over time, within states, across various age cohorts, size classes and types of ownership). This is largely missing in other studies, which concern themselves with the mere numbers of sick firms, but without reference to the entire population. In this study, by contrast, the relevant population is a set of firms, both sick and sound, and not just a set of sick firms.

Section 3.3 goes a step further and inquires into the reasons for sickness. Here we present summary statistics on some key variables such as profitability, single factor productivity measures, as well as the level and composition of debt. This is done separately for the group of sound and sick firms at two points in time (1990 and 1999), and tests of the significance of period-wise and group-wise differences are conducted. The purpose is to assemble the first stylized facts that bear upon, or reflect a company's health status and thereby present the central issues to be taken up in the course of this study. Subsequent chapters will then explore the nature of and direction of, and direction of causality between, the characteristics of sick firms and status of sickness.

3.1 Alternative Concepts of Sickness and their Suitability for Applied Work

Industrial sickness means different things to different people, depending on the stake they have in the affairs of a company. In consequence, there are numerous definitions of industrial sickness, some of which are rather vague, others are more clear-cut.[59] However it be defined, industrial sickness poses a tremendous problem to the Indian economy, and that is why a special law has been enacted, the Sick Industrial Companies (Special Provisions) Act, 1985.[60] The official, legal definition of sickness is stated in SICA, chapter 1, section 3o: any company that has been registered for at least five years is regarded sick if its accumulated losses equal or exceed its net worth, i.e. its paid up capital plus its free reserves. Initially, the definition of sickness was narrower, viz. in addition to the above criteria, the company had to have generated negative pre-depreciation profits for two or more consecutive years, including the current year. Also, the law pertained only to companies which had been registered for at least seven years. The wider definition has been in force since 1994. SICA applies to both private and public sector companies, though quite interestingly the latter have been brought within the purview of the SICA only through the 1991 amendment act. Furthermore, the law applies only to firms which (i) employ more than 50 workers, (ii) do not involve ships and other vessels drawn by power and, (iii) do not meet the criteria for a small scale or ancillary industrial undertaking as defined in the Industries (Development and Regulation) Act, 1951.

3.1.1 Problems with the SICA Definition

Since there is a legal definition of sickness at hand, it naturally suggests itself as the basis for the empirical analysis. However, there are some practical problems with the SICA definition;[61] in particular, the determination of *accumulated* losses poses some difficulties. The first wave of our company panel relates to the 1988 accounting period, but most sample firms report an earlier year of incorporation. For these companies, it is impossible to calculate accumulated losses. On the other hand, if the company was

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59) See, for example, Gupta (1990, chapter 2), who presents and discusses eight different concepts of sickness.

60) See section 2.6.

61) Apart from practical problems, there are more fundamental problems with the legal definition of sickness which will not be discussed at this point. Most importantly, ever since its introduction, SICA's definition has been criticized for primarily identifying terminally sick firms for which any reorganization or rehabilitation package would come too late. See 'Report of the Committee on Industrial Sickness' (July 1995). Second, SICA may mistakenly declare non-sick firms as sick if companies fudge accounts to get shelter under the BIFR (Soni, 1999, p. 4). We address this issue in chapter 6.

founded after 1987 (and if it actually belonged to the CMIE-sample right from the beginning!), five years must pass until SICA applies. In our dataset, only 18 companies, with 51 firm-year observations in total, satisfy the legal definition (see Table 3-1).

Apart from the problem mentioned above, the absence of information on employment in PROWESS is also crucial; a company must employ a minimum of 50 workers in order for SICA to apply. Similarly, SICA does not apply to small scale or ancillary industries, and the definitions of these hinge not only on employment numbers, but also on a company's technology (power-driven or not). This kind of information is missing in our data set.[62]

3.1.2 Alternative Definitions of Sickness

The broad objective of SICA - as incorporated in its preamble - is to tackle the problem of industrial sickness with regard to the crucial sectors where public money is locked up. Ever since its introduction, SICA's definition has been criticized for primarily identifying terminally sick firms for which any reorganization or rehabilitation package would come too late.[63] SICA recognizes that timely detection of sick and potentially sick industrial companies is essential, and defines an 'early warning indicator' accordingly. Section 23 of SICA identifies a company to be potentially sick or 'weak' whenever its accumulated losses have resulted in erosion of 50 percent or more of its peak net worth during the immediately preceding four financial years. Erratic declines in net worth are observable and therefore we could apply the weakness-definition instead of the sickness-definition. However, a non-weak firm might be sick if it experienced a more gradual slowdown in net worth. Technically this concept is awkward to handle because complete records from the four immediately preceding years need to be known, but our panel has holes. Also we would have to exclude all firms that entered the sample after 1995 (since four years of survey participation have to elapse until we could make a statement on a firm's 'weakness'-status). In other words, this concept is too restrictive to permit the exploitation of available data. It should be noted that for small scale industrial units, the official sickness criterion is an extended version of this weakness concept: if an SSI firm is weak in the above sense and if in addition principal or interest in respect of any of its borrow accounts has remained overdue for a period exceeding two and a half years, it is considered as sick.

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62) Since we know the names and addresses of the companies, all of these problems could in principle be overcome – yet at tremendous search costs.

63) See 'Report of the Committee on Industrial Sickness' (July 1995).

Table 3- 1: Evolution of profits and net worth for the sample firms that satisfy the SICA definition[a)]

Firm	Year	Profit	Acc. profit	Net worth[b)]	Legal-ly sick	Weak	Two consec. years of profit <0	Net-worth <0	Cur-rent ratio [c)] <1	Current ratio<1 and worsening debt-eq. -ratio
1	1992	0	0	0.94						
	1993	0	0	16.28						
	1994	3.36	3.36	16.66						
	1995	2.7	6.06	16.84						
	1996	8.85	14.91	19.76	no	no	no	no	yes	No
	1997	8.62	23.53	23.81	no	no	no	no	no	No
	1998	2.43	25.96	21.29	no	no	no	no	yes	Yes
	1999	13.68	39.64	54.76	no	no	no	no	no	No
2	1994	0.95	0.95	5.05						
	1995	3.73	4.68	14.85						
	1996	0.65	5.33	14.88						
	1997	-8.58	-3.25	6.18						
	1998	-11.67	-14.92	-5.68	yes	yes	yes	yes	yes	Yes
	1999	-7.72	-22.64	-13.48	yes	yes	yes	yes	yes	Yes
3	1994	0	0	0						
	1995	6.08	6.08	17.33						
	1996	10.35	16.43	25.19						
	1997	14.7	31.13	34.42						
	1998	20.29	51.42	47.39	no	no	no	no	no	no
	1999	22.76	74.18	71.14	no	no	no	no	no	no
4	1992	0.02	0.02	0.23						
	1994	0.08	0.1	0.2						
	1995	0.26	0.36	2.93						
	1996	-0.04	0.32	2.82	no	n.a.	no	no	no	n.a.
	1997	0.02	0.34	2.87	no	no	no	no	no	n.a.
	1998	0.02	0.36	2.95	no	no	no	no	no	n.a.
	1999	0.14	0.5	3.1	no	no	no	no	no	n.a.
5	1992	1.93	1.93	13.26						
	1993	4.51	6.44	19.69						
	1994	6.78	13.22	23.25						
	1995	8.15	21.37	27.48						
	1996	7.99	29.36	31.15	no	no	no	no	yes	yes
	1997	10.91	40.27	37.09	no	no	no	no	yes	no
	1998	14.67	54.94	50.39	no	no	no	no	no	no
	1999	13.92	68.86	60.73	no	no	no	no	no	no
6	1995	0	0	0						
	1996	0	0	7.71						
	1997	0	0	8.71						
	1998	0.47	0.47	8.92						
	1999	0.42	0.89	9.21	no	no	no	no	no	no

Table 3- 1: continued

Firm	Year	Profit	Acc. profit	Net worth b)	Legal-ly sick	Weak	Two consec. years of profit <0	Net-worth <0	Cur-rent ratio c) <1	Current ratio<1 and worsening debt-eq. -ratio
7	1995	0	0	1.03						
	1996	0.03	0.03	3.74						
	1997	-0.59	-0.56	3.09						
	1998	-0.15	-0.71	2.87						
	1999	-0.06	-0.77	2.75	no	no	yes	no	no	n.a.
8	1992	0.01	0.01	0.46						
	1993	6.41	6.42	19.74						
	1994	4.16	10.58	23.6						
	1995	5.18	15.76	24.96						
	1996	4.23	19.99	29.25	no	no	no	no	no	no
	1997	4.24	24.23	33.9	no	no	no	no	no	no
	1998	5.33	29.56	33.37	no	no	no	no	no	no
	1999	-13.43	16.13	7.84	no	yes	no	no	yes	yes
9	1995	0.01	0.01	1.1						
	1996	0.13	0.14	5.36						
	1997	-0.06	0.08	5.24						
	1998	0.23	0.31	5.11						
	1999	0.57	0.88	5.28	no	no	no	no	no	no
10	1993	0	0	-0.06						
	1995	1.47	1.47	43.68						
	1996	7.49	8.96	47.88						
	1997	3.57	12.53	49.94	no	n.a.	no	no	no	no
	1998	9.27	21.8	50.16	no	no	no	no	no	no
	1999	2.27	24.07	48.35	no	no	no	no	no	no
11	1995	-0.06	-0.06	2.09						
	1996	0.06	0	4.65						
	1998	0.1	0.1	4.71						
	1999	0.06	0.16	4.73	no	n.a.	no	no	no	no
12	1989	0.22	0.22	0.27						
	1990	1.39	1.61	4.78						
	1991	2.73	4.34	6.56						
	1992	2.9	7.24	9.97						
	1993	1.47	8.71	25.44	no	no	no	no	no	no
	1994	6.99	15.7	37.69	no	no	no	no	no	no
	1995	8.36	24.06	41.34	no	no	no	no	no	no
	1996	9.36	33.42	38.75	no	no	no	no	no	no
	1997	-16.92	16.5	33.44	no	no	no	no	no	no
	1998	-4.41	12.09	22.73	no	no	yes	no	no	no
	1999	-26.13	-14.04	-7.96	yes	yes	yes	yes	yes	yes

Table 3- 1: continued

Firm	Year	Profit	Acc. profit	Net worth[b)]	Legal-ly sick	Weak	Two consec. years of profit <0	Net-worth <0	Cur-rent ratio [c)] <1	Current ratio<1 and worsening debt-eq. -ratio
13	1993	0	0	0						
	1994	0.13	0.13	5.81						
	1995	3.49	3.62	8.66						
	1996	1.57	5.19	10.41						
	1997	0.91	6.1	11	no	no	no	no	no	no
	1998	1.11	7.21	11.86	no	no	no	no	no	no
14	1994	0	0	22.42						
	1995	4.85	4.85	48.77						
	1996	5.87	10.72	48.53						
	1997	5.57	16.29	48.76						
	1998	5.01	21.3	46.72	no	no	no	no	no	no
	1999	-4.27	17.03	39.05	no	no	no	no	no	no
15	1994	1.1	1.1	3.39						
	1995	1.07	2.17	4.11						
	1996	2.43	4.6	9.72						
	1997	2.2	6.8	11.5						
	1998	1.8	8.6	12.48	no	no	no	no	no	n.a.
	1999	3.74	12.34	14.93	no	no	no	no	no	n.a.
16	1994	0.79	0.79	2.25						
	1995	0.67	1.46	5.38						
	1996	2.38	3.84	11.08						
	1997	0.1	3.94	11.22						
	1998	-1.84	2.1	8.94	no	no	no	no	no	no
	1999	-13.92	-11.82	-5.51	yes	yes	yes	yes	yes	yes
17	1990	-0.13	-0.13	4.17						
	1991	2.31	2.18	5.77						
	1992	4.53	6.71	8.83						
	1993	3.23	9.94	10.06						
	1994	2.15	12.09	10.23	no	no	no	no	no	no
	1995	2.97	15.06	12.56	no	no	no	no	no	no
	1996	0.83	15.89	12.62	no	no	no	no	no	no
	1997	-1.51	14.38	10.3	no	no	no	no	no	no
	1998	-5.04	9.34	4.47	no	yes	yes	no	yes	yes
	1999	-0.49	8.85	3.15	no	yes	yes	no	yes	yes
18	1992	0.21	0.21	0.06						
	1993	0.19	0.4	1.41						
	1995	8.59	8.99	12						
	1996	-1.71	7.28	9.47	no	n.a.	no	no	no	no
	1997	0.86	8.14	9.48	no	no	no	no	no	no
	1998	-0.5	7.64	18.3	no	no	no	no	no	no

Source: CMIE manufacturing panel; own calculations;

[a)] Figures in Rs. crore, where 1 crore = 10 million; n.a. means "not available"; [b)] Net worth = paid up capital plus free reserves; [c)] Current ratio = current assets /(current liabilities + provisions) ; see glossary in Appendix A, Table A-1.

Second, we may apply the 'two successive years of negative profits'-criterion to companies that are registered for at least five years. Various financial institutions employ this definition, although not as the one and only indicator. After all, an economically viable firm might face temporary distress, yet flow items from the profit & loss account do not reveal information on the history of its performance. This shortcoming suggests that one should rather rely on stock information from balance sheets.

Where the sum of total paid up capital and free reserves has turned negative, poor performance is certainly more than a transitory phenomenon. Our third, alternative definition of sickness therefore refers to firms older than four years which report a negative net worth position, i.e. total debt (plus specific reserves) exceeds total liabilities.[64] The negative net worth criterion could in principle conflict with the legal sickness definition if accumulated profits outweighed the net worth deficit. In this case, the negative net worth criteria would mark the firm as sick, while the legal sickness definition would mark it as sound. The reverse case, i.e. accumulated losses that outweigh a *positive* net worth statement, will hardly be encountered in reality, since a company's net worth reflects the history of its profitability.[65]

A fourth definition of sickness suggests itself from the provisions of the Industries (Development and Regulation) Act, 1951 (IDRA for short), which devotes a whole chapter to the 'Reconstruction or Liquidation' of industrial undertakings. Reconstruction is recommended if a company is not in a position to meet its current liabilities out of its current assets[66] (chapter 18 FD-1a of IDRA), but 'public interest' rules out winding it up. As under SICA, reconstruction under IDRA goes along with provisions of financial assistance, suspension of legal proceedings, existing contracts and outstanding obligations (Chapter III-AB, section 18 FB). In fact, the obviously similar tenor of the relevant chapters in both laws gives rise to the question of why a new law with a whole new bureaucracy had to be established.

Of course, the caveat with respect to short-term versus long-term distress applies even more to this concept. The Reserve Bank of India therefore proposes a fifth definition, according to which any company registered for at least five years shall be deemed

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64) See the (stylized) schemes on balance accounts in the Concepts-and-Definitions Appendix (chapter 8), Tables A-4 and A-5.

65) Meanwhile the BIFR itself indicates a company as revived as soon as its net worth becomes positive, but the official SICA definition has not changed.

66) In other words, the current ratio is below unity.

sick if its current ratio (of current assets to current liabilities and provisions) is less than one and if, in addition, its debt-equity ratio is worsening.[67]

In Table 3-1 we depicted the evolution of profits and net worth for all sample firms to which the original legal definition of sickness is applicable. The last five columns indicate the companies' health status according to the five different definitions discussed above. The definitions of 'legally sick' and 'legally weak' conflict with each other in three out of 51 cases, while 'legally sick' and 'negative net worth' never conflict. In six cases, we can verify temporary distress for firms which are healthy in the legal sense.

Table 3- 2: Share of sick firms: various definitions of sickness

	Definition of Sickness				
Year	Potentially sick or 'weak'	Two consec. years of negative profits	Negative net worth	Current ratio < 1	Current ratio<1 and worsening debt-eq.-ratio
1992	9.1	8.3	12.8	15.2	10.0
1993	13.8	9.2	11.7	16.8	11.6
1994	13.0	8.9	9.4	15.8	10.7
1995	12.0	7.5	8.4	14.8	10.5
1996	12.6	8.8	8.4	16.4	12.4
1997	16.6	13.4	10.7	20.3	15.8
1998	19.3	18.3	13.3	24.5	20.3
1999	23.2	22.4	15.9	28.4	24.2
Total cases of sickness 1992-99	2,255	2,921	2,849	4,940	3,312
Total cases of sickness 1992-99 (in percent)	16.8	13.0	11.3	19.6	15.3
Total no. of firm-year observations 1992-99 (sick and sound)	13,460	22,505	25,231	25,231	21,619

Source: CMIE manufacturing panel; own calculations

Table 3-2 reports the (year-wise) share of sick firms in our dataset according to the various definitions of sickness outlined above. This study will be based on the third sickness concept, i.e. a firm that has been registered for at least five years is regarded sick if its net worth is negative. In focusing only on current, but not on past realizations, it makes the most of the available data, i.e. it exploits information from the most firm-year observations, while at the same time turning out to be the most restrictive in nature: no other concept implies a lower share of 'sick' in total observations. Second, we argue

67) For general definitions of failure (i.e. not specifically in the Indian context), Karels and Prakash (1987, p. 576) present tables with diverse definitions. See also the study of Laitinen and Laitinen (2000).

that the 'negative net worth'-criterion comes closest in spirit to the original legal definition. After all, if a company realizes a negative net worth, economic distress will be more than a temporary phenomenon. A third justification for our choice comes through the Board for Industrial and Financial Reconstruction (BIFR for short), the top restructuring body of sick companies. Though SICA defines sickness otherwise, the BIFR considers a company as successfully revived if its net worth position has turned positive.

A problem common to all the above definitions arises from their backward view. Putting the focus on future earning potentials rather than on historical book values would certainly give a more accurate image of a firm's health status. However, whether potentials are actually realized involves extensive collection of data, so this concept is cumbersome to handle. As none of the above definitions follows this approach, we opted for the second-best concept.

3.2 Dimension of Sickness

Having defined sickness for the purpose of this study, we proceed to some descriptive statistics on its dimensions in our company panel. To start with, we present patterns of sickness for those companies that meet our criterion at least once. In Table 3-3 we record the number of firms experiencing s (= 1,2, …,12) years of sickness, classifying firms by the number of years they appeared in the sample.[68] In total, we have 3,447 firm-years of sickness for the 987 firms that ever fell sick.[69] This means that 11.6 percent of the total 29,682 firm-years in the sample fall under 'sick' and 22 percent of the sample firms experienced sickness in the 1988-1999 period. Exactly one third of these latter firms (33.7 percent) experienced just one period in sickness; another third (34.7 percent) did so for at least four (not necessarily subsequent) periods. 191 firms, i.e. approximately every fifth firm of the 987, remained sick throughout its whole period in the sample (sum of elements on the main diagonal). However, it is generally not true that a sick unit in one period remained sick in the next, as is evident from the complete 'sickness'-spells (see table 3-14 in this chapter's Appendix). Nor do companies that suffer one or more years of sickness always do so in their last appearance in the sample. In other words, a sick firm, in general, does not exit. Some may recover, permanently, or temporarily. If a firm

68) Whereas "gross" duration is calculated simply as a firm's last sample year minus its first year, "net" duration takes into account that the panel has holes.

69) The number of firm-year observations is arrived at by summing over the product of "years in sickness" and "number of firms experiencing the said years in sickness", i.e. (1·333 + 2·195 + … 11·37), as set out in the row labeled "Total sick".

indeed leaves the sample, we cannot tell whether it is because of sickness or for other reasons.

Table 3- 3: Patterns of sickness (by firms that ever fell sick)

years in sample (net)	Number of years in sickness 1	2	3	4	5	6	7	8	9	10	11	12	Total sick firms	Sick Firms (in %)[a]	Sick obser-vations (in %)[a]
1	15	--	--	--	--	--	--	--	--	--	--	--	15	6.8	6.8
2	13	18	--	--	--	--	--	--	--	--	--	--	31	12.0	9.5
3	29	4	11	--	--	--	--	--	--	--	--	--	44	14.1	7.5
4	34	15	4	18	--	--	--	--	--	--	--	--	71	17.5	9.1
5	43	22	12	3	17	--	--	--	--	--	--	--	97	16.6	7.5
6	49	26	14	10	6	12	--	--	--	--	--	--	117	21.2	8.6
7	35	24	16	8	4	4	6	--	--	--	--	--	97	26.7	9.8
8	22	19	7	6	5	6	2	14	--	--	--	--	81	29.7	13.4
9	18	18	11	11	5	3	4	5	17	--	--	--	92	30.2	14.4
10	20	18	13	7	4	2	1	7	8	26	--	--	106	42.1	21.8
11	44	21	23	10	12	12	16	7	6	5	37	--	193	28.4	13.5
12	11	10	6	2	3	1	1	2	3	4	0	0	43	19.1	6.2
Total sick	333	195	117	75	56	40	30	35	34	35	37	0	987	22.3	11.6
In %	33.7	19.8	11.9	7.6	5.7	4.1	3.0	3.5	3.4	3.5	3.7	0	100		

Source: CMIE manufacturing panel; own calculations

[a] in relation to all firms which are classified by the same number of net years in the survey

The analysis is further complicated by the existence of gaps. In 886 cases a period of sickness is followed by a missing record; in 422 cases, a missing record is preceded by a period of soundness (refers to firms that ever fell sick, see Table 3-4).

Table 3-4: Sample characteristics by health status

	Sample: Firms that ever fell sick	Firms that never fell sick	total
number of firms	987	3,441	4,428
number of observations	7,534	22,148	29,682
Median no. of observations	8	6	6
Maximum no. of observations	12	12	12
Number of miss. records at (t+1)			
When the firm is sick in t	886	0	886
When the firm is sound in t	422	4,092	4,514
Number of firms with gaps	282	606	888
Number of gap “observations“	494	967	1,461
Median no. of gaps	1	1	1
Maximum no. of gaps	8	7	8

Source: CMIE manufacturing panel; own calculations

282 firms (29 percent) of the firms that ever fell sick had at least one gap in their record, as compared to 606 firms (18 percent) of the firms that remained sound throughout the sample period. The mean numbers of gaps is higher for potentially sick firms.

Table 3-5 reports the health status before and after the gap for firms that ever fell sick. A simple $\chi^2 -$ test for homogeneity rejects the null-hypothesis, meaning that observed health status in (t+1) is not independent of observed health status in (t-1). Though gaps in the records of potentially sick firms do not necessarily 'conceal' a period of sickness, this is more likely than the other situation, i.e. that a period of soundness was not recorded. There is no way to get indicative evidence on whether gaps in the spells of sound firms involved periods of soundness or sickness.

Table3-5: Gap-analysis for firms that ever fell sick[a)]

	Health status in t+1			
Health status in (t-1)	Sound	Sick	missing record	Total
Sound	85	45	49	179
Sick	17	94	31	142
missing record	29	51	93	173
Total	131	190	173	494

Source: CMIE manufacturing panel; own calculations

a) "t" refers to year in which a gap occurred. The above table details the evidence from Table 3-14 in this chapter's Appendix.

Next, we examine the industry-wise distribution of sick firms over time. In Table 3-6 the lower lines refer to the share of sick units in the respective industry in a given year.[70] Absolute numbers are also listed (upper lines), in order to show the incidence across branches.

Going by absolute figures, the evidence in Table 3-6 matches the sectoral affiliation of cases registered with the BFIR remarkably well.[71] Over the entire period, the most cases of sickness are found in Textiles & Leather, followed by Basic Metals & Metal Products, Chemicals, Machinery, Food & Beverages and Non-Metallic Mineral Products. Both data confirm that there were comparatively few cases of sickness in Rubber & Plastic and Electronics. The value of Table 3-6 in relation to what other researchers have already established (i.e. counted), is that it depicts the relative incidence of industrial sickness within industries.

70) The total number of firms in each industry in a given period has been reported in Table 1-3.

71) See this chapter's Appendix, table 3-15.

Table 3-6: Incidence of sickness by industry: 1988 – 1999 (number of firms)

Industry	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total sick obs.
Food &	5	8	8	12	10	15	12	22	24	38	55	72	281
Beverages	9.8	7.48	7.34	8.82	6.17	7.35	4.07	6.2	6.45	10.35	15.07	20.11	
Textile &	9	39	49	55	58	56	53	50	57	79	96	130	731
Leather	13.64	20.86	23.11	19.78	18.83	14.7	11.11	8.4	9.12	12.42	15.12	21.31	
Wood &	2	9	8	12	13	12	12	12	13	18	22	19	152
Paper	13.33	18	14.55	16.22	16.46	13.33	10.26	7.79	7.88	10.98	13.33	11.66	
Chemicals	3	19	22	27	29	35	42	41	44	58	77	88	485
	5.56	9.84	9.95	9.54	8.9	8.86	8.35	6.61	6.78	8.8	11.85	13.46	
Rubber &	1	9	9	11	14	20	17	12	12	19	31	37	192
Plastic	3.45	12.33	11.69	10	11.57	12.12	7.87	4.41	4.01	6.31	10.51	12.5	
Non-met.	5	13	18	24	23	26	27	27	25	24	29	38	279
Min. Prod.	15.63	16.67	20.93	21.82	18.4	18.57	15.7	13.43	12.2	11.88	14.65	18.54	
Metal	2	19	21	24	28	32	42	52	48	66	72	89	495
	4.26	12.93	12.5	11.37	11.24	10.85	11.6	12.78	11.35	15.49	17.27	20.7	
Machin-	3	16	23	32	29	28	27	31	29	38	42	55	353
Ery	5.56	10.32	12.17	14.16	11.2	9.89	8.06	8.12	7.29	9.41	10.34	13.75	
Electro-	2	5	8	10	8	12	11	17	27	27	39	35	201
Nics	18.18	9.09	11.94	10.87	7.69	8.63	5.37	6.37	8.94	8.33	11.4	9.07	
Transp.	3	14	14	21	25	24	24	23	26	25	24	25	248
Equip.	8.33	17.28	15.05	18.75	19.84	17.52	15.09	13.29	14.21	12.82	12.7	13.3	
Miscel.	0	1	1	2	2	2	2	2	2	6	6	4	30
	0	20	20	22.22	15.38	10.53	8.7	5.88	5.56	16.67	17.65	13.33	
All Indu-	35	152	181	230	239	262	269	289	307	398	493	592	3447
Stries	8.82	13.44	14.12	14.02	12.77	11.65	9.39	8.35	8.39	10.72	13.34	15.91	

Source: CMIE manufacturing panel; own calculations

[a] Homogeneity tests across industries are rejected in every period except for the first one; Homogeneity tests across time are not rejected for Wood & Paper, Non-netallic Minerals, Electronics, Transport and the Miscellaneous category.

Chi-square tests for homogeneity confirm that there are significant differences in the incidence of sickness across industries in every year except for the first (unrepresentative) one. Homogeneity tests also reject the null hypothesis that the incidence of sickness is invariant over time in Food & Beverages, Textiles & Leather, Chemicals, Rubber & Plastics, Metals and Machinery. The last line of Table 3-6 (i.e. share of sick companies across all industries) suggests that one should partition the 1989-1999 period into three distinct phases: The first phase (1989-1991) is characterized by relatively constant rates around 14 percent. After 1991, the share of sick firms declined steadily until 1995-96, when there followed a strong revival. By 1999, nearly 16 percent of the sample firms were classified as sick, ranging from some 21 percent in the textile & leather sector to nine percent in Electronics.

Table 3-7: Incidence of sickness by state: 1988-1999 (number of firms)[a),b)]

State	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total sick obs.
Delhi	3	7	9	12	13	14	16	22	21	24	32	48	221
	8.57	10	10.98	12	11.93	9.52	8.29	8.98	8.33	9.27	11.9	16.11	
Andhra	2	12	15	21	21	23	22	25	22	28	42	55	288
Pradesh	11.11	21.05	24.59	23.08	18.26	15.13	9.95	9.26	7.53	9.72	14.79	18.84	
Assam	0	1	2	1	1	1	2	2	3	4	3	4	24
	0	33.33	40	20	14.29	12.5	18.18	16.67	25	36.36	27.27	36.36	
Bihar	0	2	2	4	4	3	3	2	2	3	2	6	33
		20	18.18	33.33	26.67	18.75	15.79	9.52	8.33	12.5	9.09	25	
Gujarat	1	12	15	23	21	22	23	24	29	30	47	55	302
	3.23	12.24	13.39	15.23	11.67	9.91	7.69	5.88	6.4	6.79	11.19	13.06	
Haryana	0	3	2	3	3	3	5	6	6	11	13	19	74
	0	9.09	6.67	7.89	7.69	6.82	7.69	6.98	6.74	11.83	14.61	21.11	
Himachal	0	0	1	1	2	2	2	3	4	4	5	4	28
Pradesh	0	0	14.29	14.29	18.18	13.33	11.11	12.5	16	17.39	22.73	20	
Karnataka	2	13	14	17	14	14	15	14	16	24	25	34	202
	10	23.64	20.9	19.54	14.29	12.28	11.11	9.33	10.39	13.87	13.97	18.48	
Kerala	0	4	2	3	3	5	7	5	6	5	8	9	57
	0	18.18	9.09	10	9.09	13.89	15.56	8.93	9.23	7.04	11.94	14.75	
Madhya	2	1	2	2	1	4	4	5	7	8	17	23	76
Pradesh	20	2.94	6.45	4.55	2.17	6.15	4.26	4.42	5.83	7.08	15.74	23.71	
Maharash-	12	48	51	56	63	69	72	74	78	101	127	146	897
tra[c)]	9.68	13.48	12.53	11.2	10.7	9.76	8.13	7.15	7.23	9.32	11.5	12.67	
Nagaland	0	1	0	1	1	1	1	1	1	1	1	1	10
		100		100	100	100	100	100	100	100	100	100	
Orissa	1	3	4	4	5	6	4	6	7	5	6	8	59
	50	21.43	33.33	21.05	23.81	30	14.29	18.18	19.44	14.29	16.67	22.22	
Punjab [d)]	0	1	1	2	3	3	4	5	9	8	11	13	60
	0	2.86	3.03	4.17	5.26	4.55	4.88	4.95	7.69	6.84	9.73	12.5	
Rajasthan	3	2	2	6	8	7	9	10	14	18	20	16	115
	20	6.06	5.41	12.24	14.81	10.45	9.89	8.93	11.86	16.22	18.52	16.16	
Tamil	5	7	12	19	21	24	25	25	25	46	56	67	332
Nadu [e)]	10.87	5.11	7.45	9	9.13	9.16	7.81	6.85	6.46	10.8	13.4	16.18	
Uttar	1	12	15	20	21	24	22	22	23	32	31	25	248
Pradesh	4.55	22.22	22.73	25	23.86	22.43	16.3	13.33	13.94	19.28	20.13	20.33	
West	3	23	32	35	34	37	33	38	34	46	47	59	421
Bengal	7.5	20.18	23.19	20.83	18.99	18.69	15	14.45	12.73	16.67	16.15	20.14	
All	35	152	181	230	239	262	269	289	307	398	493	592	3447
States	8.82	13.44	14.12	14.02	12.77	11.65	9.39	8.35	8.39	10.72	13.34	15.91	

Source: CMIE manufacturing panel; own calculations

[a)] Homogeneity tests across states are rejected in every year except for the first (unrepresentative) one; Homogeneity tests across time are rejected for Andhra Pradesh, Gujarat, Haryana and Karnataka (both at the 10%-significance level), Madhya Pradesh, Maharastra and Tamil Nadu. [b)] Apply the rule of three to get the total number of firms in states in a given year; [c)] includes Goa, [d)] includes Chandigarh, [e)] includes Pondicherry

Except for Textile & Leather, the industries most severely affected were Metals (20.7 percent) and Food & Beverages (20.1 percent). However, and in contrast to Textile & Leather, Metals experienced distinctly above-average rates only in more recent years. Sickness rates for food manufacturers were among the lowest throughout the first two phases. Throughout the entire period, we observe comparatively constant and low sickness rates for chemicals and – not surprisingly - for electronics.

Table 3-7 presents the incidence of sickness by state. In absolute terms, most sick units were located in Maharashtra, West Bengal, Tamil Nadu and Gujarat. In relative terms, Gujarat and Maharashtran firms were doing fine, as were Delhi-based firms. Here, the share of sick firms in total firms was below average in all but one (early) year. In Tamil Nadu, the rates were also way below average in the pre-reform phase, approached the average in the middle phase and eventually surpassed it in the last. The states where the incidence of industrial sickness was most widespread were Karnataka, Andhra Pradesh and, to an even greater extent, West Bengal and Uttar Pradesh. Here rates amounted to 20 percent or more for most years.

Table 3-8 sets out the risk of sickness by age class. According to the definition used in this study, a firm is at risk to fall sick only if it has been registered for at least five years. We computed hazard rates and find that these are (almost) uniformly increasing with the firm's age. This finding is very different from the corresponding evidence in industrialized countries, where (financial) vulnerability is highest in the group of young firms. But note, first, that the Indian data are from firms in the formal industry only and, second, that the year of incorporation pertains to the most recent incarnation of the company, which might differ from the year of foundation.

Table 3-8: Hazard rates for sickness by age class

Firm age	no.of sick firm years	hazard rate	95% confidence interval	
5 to 7 years	204	2.84	2.48	3.26
8 to 10 years	357	5.87	5.29	6.51
11 to 15 years	686	11.44	10.61	12.32
16 to 20 years	569	15.70	14.46	17.04
21 to 30 years	566	13.05	12.02	14.17
31 to 50 years	569	13.89	12.80	15.08
> 50 years	496	19.91	18.23	21.74
total	3,447	7.91	7.65	8.18

Source: CMIE manufacturing panel; own calculations

Table 3-9 shows that public sector undertakings face an extraordinarily high risk of sickness: nearly every other firm-year observation qualifies for sickness. The risk of public sector undertakings falling sick varies significantly across industries. The prospects of public sector undertakings in Textile & Leather (failure rate of 87 percent) and Transport Equipment (62 percent) seem especially poor, if not desperate. By virtue of pure numbers, it is of course the group of privately owned Indian companies that constitute the majority of the BIFR's "customers": out of the 987 firms which ever fell sick, 837 companies were privately owned by Indians (untabulated result).

Table 3-9: Industrywise incidence of sickness by form of ownership[a), b)]

	Form of ownership			Total sick
Industry	public	private Indian	private foreign.	observations
Food & Beverages	12	246	23	281
	21.8	9.6	8.5	
Textile & Leather	195	535	1	731
	87.1	11.4	1.0	
Wood & Paper	31	121	0	152
	32.6	10.4	0.0	
Chemicals	140	332	13	485
	44.0	7.8	2.2	
Rubber & Plastic	28	153	11	192
	41.8	7.3	11.8	
Non-metallic Mineral Products	24	235	20	279
	43.6	14.9	17.2	
Basic Metals & Metal Products	55	424	16	495
	27.8	13.1	11.3	
Machinery & Machine Tools	92	230	31	353
	52.0	8.4	5.5	
Electronics	33	155	13	201
	24.3	8.0	6.3	
Transport Equipment	93	137	18	248
	61.6	9.8	15.4	
Miscellaneous	10	20	0	30
	76.9	9.5	0.0	
All industries	713	2,588	146	3,447
	47.9	10.0	6.4	

Source: CMIE manufacturing panel; own calculations

[a)] Homogeneity tests across industries and across form of ownership are always rejected. [b)] Apply the rule of three to get the total number of firms in an industry with given form of ownership.

Evidence from Tables 3-10 and 3-11 supports the view that industrial sickness is primarily a risk for the SSI sector and for medium-sized companies. Rates for large firms were distinctively lower in all industries except for Chemicals, where the incidence of sickness does not differ across size class (see Table 3.10). Within the SSI sector, failure rates of 20 percent or more are found in Metals, Machinery and Transport equipment, whereas small firms in Electronics and Rubber & Plastics do comparatively well. From Table 3-11 we find, however, that the incidence of sickness in the SSI sector does not change significantly across time (nor does it for large firms), which supports the notion that the 1991 reforms did not really cut the special claims of the SSI sector.

Table 3-10: Industrywise incidence of sickness by size class[a), b)]

	Size class[c)]			
Industry	small	Medium	large	
Food & Beverages	18	256	7	281
	9.4	10.6	2.5	
Textile & Leather	35	651	45	731
	13.3	15.6	7.8	
Wood & Paper	10	133	9	152
	13.7	12.9	4.8	
Chemicals	42	374	69	485
	11.1	9.1	9.4	
Rubber & Plastic	7	169	16	192
	5.0	9.2	5.8	
Non-metallic Mineral Products	15	226	38	279
	8.7	18.4	10.7	
Basic Metals & Metal Products	29	406	60	495
	20.7	14.2	10.3	
Machinery & Machine Tools	54	275	24	353
	20.6	9.9	5.4	
Electronics	35	160	6	201
	8.0	9.5	3.4	
Transport Equipment	22	204	22	248
	25.3	15.4	8.5	
Miscellaneous	3	27	0	30
	11.1	13.4	0.0	
All industries	270	2,881	296	3,447
	12.4	12.2	7.6	

Source: CMIE manufacturing panel; own calculations

[a)] Homogeneity tests across industries are rejected for each size class; Homogeneity across size class are rejected for all industries except for Chemicals [b)] Apply the rule of three to get the total number of firms in an industry for each size class.; [c)] Size is measured by the criteria for SSI and MRTP firms. Small firms: gfa < 6 million Rs. until 1996 and gfa< 30 million Rs. since 1997. Large firms: gfa > 1 billion Rs. or gfa > 1 million Rs. and market share of at least 25 %.

Possibly, the temporal patterns of sickness would turn significant if the analysis was based on the official (less demanding) sickness criteria applying to small-scale units.[72] If so, this would also drive up the overall sickness rate of some 12 percent in the SSI sector.

Table 3-11: Incidence of sickness by size class: 1988 – 1999 (number of firms)[a), b), c)]

Size Class	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total sick obs.
Small	0	1	2	7	8	9	11	9	14	62	74	73	270
	0.0	5.9	10.0	15.2	12.7	11.5	9.0	6.3	12.1	11.9	14.8	13.4	
Medium	30	135	166	208	215	231	235	255	267	300	378	461	2,881
	10.6	14.4	15.4	14.9	13.6	12.1	9.6	8.6	8.6	11.1	14.3	17.9	
Large	5	16	13	15	16	22	23	25	26	36	41	58	296
	4.6	9.2	7.1	7.6	7.0	8.4	7.8	7.1	5.8	7.4	7.4	9.7	
All size classes	35	152	181	230	239	262	269	289	307	398	493	592	3,447
	8.8	13.4	14.1	14.0	12.8	11.7	9.4	8.4	8.4	10.7	13.3	15.9	

Source: CMIE manufacturing panel; own calculations

[a)] Homogeneity across size classes are not rejected in the first two sample years and in the years 1993-1995; Homogeneity tests across time are rejected for medium-sized firms only. [b)] Apply the rule of three to get the total number of firms in each size class in each year. [c)] Size is measured by the criteria for SSI and MRTP firms. Small firms: gfa < 6 million Rs. until 1996 and gfa< 30 million Rs. since 1997. Large firms: gfa > 1 billion Rs. or gfa > 1 million Rs. and market share of at least 25 %.

3.3 Characteristics of Distress

Having explored the phenomenon of sickness across time and region, by industry, age of establishment, size and ownership-types, we now go a step further and present summary statistics on certain key variables that influence, or reflect, a firm's health status. We compare the group of sound and sick firms with respect to:

- a simple profitability measure,
- single factor productivity ratios for capital and labor, and
- measures of financial distress.

While it will be the object of subsequent chapters to determine the direction of causality, we confine ourselves to purely descriptive statistics at this stage. Table 3-12 and Table 3-13 present industry-wise unweighted averages for both 'sound' and 'sick'

72) Firms operating on a small scale are declared sick if, compared to their peak values in the immediately preceding four financial years, their net worth drops 50 percent or more and if they fall behind in payment of principal or interest in respect of any of their creditors for a period exceeding two and a half years.

units in 1990 and 1999, respectively.[73] 1990 is the last year before vast deregulation measures under the NEP were implemented, and 1999 is simply the last sample year. The last columns in each 'box' display results of Bonferroni multiple comparison tests of the null hypothesis that, within the same period, differences in the means of the two sets of firms, viz. sound and sick firms, are not statistically different from zero. Similarly, the last rows display results of Bonferroni multiple comparison tests of the null that, within each group, differences over time are not statistically different from zero.

3.3.1 Profitability

Profitability is measured by the ratio of gross profits to gross fixed assets and is an indicator of health. From Table 3-12 we see that mean sectoral profitability ratios decreased over the 1990-1999 period, especially among sound firms, suggesting that sickness had gained in importance, not only in quantitative, but also in qualitative terms. In fact, within the group of sick firms, mean profitability turned negative in 1999 for Rubber & Plastic, Non-Metallic Mineral Products and Metals, while for Textiles and Leather, mean profitability was negative in 1990 as well. The same applies to Chemicals, Machinery and Transport. In contrast to Textiles & Leather, however, these deteriorations in average profitability ratios do not turn out to be statistically significant. Mean profitability ratios within the group of sound firms deteriorated in some sectors as well, while improvements in others were statistically insignificant. Comparing the two subgroups, sound firms were significantly more profitable in at least one period. Since sick firms are characterized by persistent loss-making, this is at least encouraging where our definition of sickness is concerned.

3.3.2 Single Factor Productivity Measures

Single factor productivity measures are defined as the quantity of output that can be produced with a unit of factor input. Capital and labor productivity ratios are calculated as the ratio of gross value added to gross capital stock and labor, respectively, where all value figures are given at constant 1988 prices.[74]

73) Unweighted averages, $(1/N)\cdot\sum_{i=1}^{N}(x_i/y_i)$, are interpreted in terms of, e.g., profitability pertaining to the "average" fictitious firm i within some group of firms at time t. In contrast, weighted averages, $\sum_{i=1}^{N}x_i/\sum_{i=1}^{N}y_i$ give the share of, e.g., aggregate profitability falling on the i-th firm.

74) For the derivation of firm-specific capital stock and labor inputs, see Appendix B (chapter 8).

Table 3- 12: Characteristics of distress: profitability and single factor productivity measures

Industry	Year	PROFITABILITY Sound	sick	sig.	LABOR PRODUCTIVITY sound	sick	sig.	CAPITAL PRODUCTIVITY Sound	sick	sig.
Food &	1990	0.41	0.05		3.44	2.63		0.55	0.16	
Beverages	1999	0.18	-0.10	*	5.40	2.52	*	0.34	0.15	*
sig.[a]		*			*			*		
Leather &	1990	0.31	-0.03	*	3.42	1.52	*	0.42	0.36	
Textiles	1999	0.52	-0.26		4.20	1.42	*	0.56	0.17	
sig.			*		*				*	
Wood &	1990	0.29	0.19		3.48	2.29	*	0.31	0.26	
Paper	1999	0.12	0.02		3.26	1.65	*	0.21	0.06	*
sig.		*	*					*	*	
Chemicals	1990	0.35	-0.01	*	5.12	3.44	*	0.55	0.21	*
	1999	0.66	-0.11		5.92	2.75	*	0.43	0.14	*
sig.					*			*		
Rubber &	1990	0.28	0.07	*	4.17	1.58	*	0.43	0.26	
Plastic	1999	0.17	-0.18	*	7.23	3.38	*	0.44	0.26	
sig.		*	*		*					
Non-metallic	1990	0.62	0.05		4.37	2.31	*	0.71	0.12	
Min. products	1999	0.32	-0.11	*	6.02	3.92	**	0.51	2.42	*
sig.		**	*		*					
Metal	1990	0.34	0.08	*	3.85	2.29	*	0.39	0.24	*
	1999	0.19	-0.08	*	5.33	2.17	*	0.30	0.13	*
sig.		*	*		*			*	*	
Machinery	1990	0.45	-0.04	*	2.83	1.66	*	0.65	0.33	*
	1999	0.21	-0.21	*	4.34	1.76	*	0.50	0.25	*
sig.		*			*			*		
Electronics	1990	0.48	0.11	*	3.75	2.17	**	0.69	0.61	
	1999	0.52	0.86		7.08	2.55	*	1.46	0.27	*
sig.					*			*		
Transport	1990	0.33	-0.84	*	2.83	1.12	*	0.45	0.28	*
	1999	0.22	-0.29	*	3.85	1.35	*	0.60	0.23	
sig.		*			*					

Source: CMIE manufacturing panel; own calculations; [a] * (**) indicates significance at the 5% (10%)-level

With respect to labor productivity, Table 3-12 reveals that this index increased over the 1990-1999 period only for the group of sound firms, these changes being statistically significant in all industries. Labor productivity in sound firms exceeds that in sick firms in both periods, and these differences are statistically significant at the 10% level or better in all but one branch (Food & Beverages in 1990).

In contrast, capital productivity tended to decline over time, not only for the group of sick firms, but also for sound firms, the differences being frequently significant at conventional levels. The only notable exception is sound firms in Electronics, which realized an increase in capital productivity over the 1990 – 1999 period. Finally, sick firms are generally characterized by a lower level of capital productivity than sound firms in the same industry, the differences being often statistically significant.[75]

Admittedly, single factor productivity ratios are very rudimentary in nature, and it remains open how the sector-wise evidence in Table 3-12 will require revision in the light of more sophisticated productivity measures. Preliminary evidence from this chapter suggests, however, that the new economic policy worked in favor of greater dispersion in productivity.

3.3.3 Measures of Financial Distress

Table 3-13 presents industry-wise evidence on the capital and debt structure, respectively.[76] The former is simply measured as the share of total borrowings in total liabilities, while the latter is given by the share of debt owed to the government and development finance institutions in total borrowings.

We find that the overall indebtedness of sick firms far exceeds that of sound units. The differences are necessarily significant for all industries in both periods because our definition of sickness implies that the total of long- and short-term debt plus specific reserves exceed total liabilities in sick units. Thus, the mean values of the ratio of total (long-term) borrowings to total liabilities are significantly higher for sick firms 'by definition'. Important is the finding that sound firms are much more homogenous with respect to leverage – not only within the same industrial sector (not reported here), but also across industries. While mean borrowing-to-liability ratios decreased between 1990 and 1999 for sound firms, the corresponding changes are statistically insignificant for sick firms. For the latter, financial distress was particularly severe in Leather & Textiles and Transport in both years. Virtually all studies of the determinants of industrial sickness point to an inadequate supply of term loans and high debt-service charges, so causing working capital shortages.[77] In this context, section 2.1.5 has discussed the prominent role of development financing in India's industrialization strategy and examines the common view that DFIs are required to assist sick units and supply them with various soft loans, and thereby promote their rehabilitation. Table 3-13 supports this notion, in that

75) Further evidence (not reported here) reveals that the group of sound firms exhibits much greater dispersion with regard to both productivity measures.

76) Readers unfamiliar with accounting terminology may find it helpful to refer to the balance sheet scheme in Table A-5 of the Concepts-and-Definitions Appendix (chapter 8).

77) See, for example, Singh and Bhatia (1993), Mohapatra (1993), Gupta (1990), Chattopadhyay (1995), Girdhari and Joshi (1993).

sick firms in general do rely more on these sources of funds. The differences between the two subgroups are statistically significant for all sectors but Wood & Paper, Textiles & Leather and Rubber and Plastic (see the last column of Table 3-13). While Textile & Leather firms in general exhibit the highest borrowings-to-liability ratios, trends in the composition of liabilities vary between the two subgroups of sound and sick firms: the former reduced the share of loans obtained from DFIs and the government within the observed 10-year period, whereas the latter subgroup increased its share by three percentage points. In contrast, sick firms in Transport, Machinery and Non-metallic Mineral Products relied less on government and DFI funds in 1999 than in 1990.

Table 3- 13: Characteristics of distress: debt ratios

		BORROWINGS/LIABILITIES			SHARE OF DFI+GOVT. DEBT IN TOTAL DEBT		
Industry	Year	sound	Sick	sig.	sound	sick	sig.
Food &	1990	0.40	0.75	*	0.21	0.30	
Beverages	1999	0.38	0.95	*	0.24	0.35	*
sig.[a]							
Leather &	1990	0.46	1.45	*	0.36	0.30	
Textiles	1999	0.43	2.30	*	0.29	0.33	
sig.					*	*	
Wood &	1990	0.44	1.10	*	0.39	0.36	
Paper	1999	0.38	1.01	*	0.36	0.36	
sig.		*					
Chemicals	1990	0.44	0.97	*	0.26	0.47	*
	1999	0.34	1.38	*	0.27	0.38	*
sig.		*					
Rubber &	1990	0.46	0.97	*	0.29	0.23	
Plastic	1999	0.38	1.00	*	0.30	0.31	
sig.		*					
Non-metallic	1990	0.48	1.01	*	0.41	0.63	*
min. products	1999	0.37	1.22	*	0.29	0.47	*
sig.		*			*	**	
Metal	1990	0.43	0.79	*	0.26	0.38	*
	1999	0.38	1.39	*	0.29	0.32	
sig.		*					
Machinery	1990	0.32	1.05	*	0.24	0.39	*
	1999	0.30	1.29	*	0.22	0.25	
sig.						*	
Electronics	1990	0.36	1.02	*	0.21	0.48	*
	1999	0.22	1.77	*	0.19	0.28	**
sig.		*					
Transport	1990	0.41	1.91	*	0.30	0.54	*
	1999	0.33	2.47	*	0.27	0.35	
sig.		*				**	

Source: CMIE manufacturing panel; own calculations

[a] * (**) indicates significance at the 5% (10%)-level

Although sick firms are found to be relatively more generously supplied with DFI and government funds, the remedial merits of this intervention must be questioned. Where the share of soft loans changed significantly over the 1991-1999 period, the sectoral share of sick firms changed as well – and in the same direction: greater (less) reliance on government and DFI loans in 1999 corresponds to higher (lower) sickness rates. This finding supports Hanson (2001) and Goswami (1996), who argue that development financing was a cause of, rather than a remedial measure for, the sickness problem.

3.4 Summary and Conclusion

The 1989-1999 period is marked by three distinct phases of industrial sickness. The early years are characterized by relatively constant sickness rates around 14 percent. After 1991, the rate declined steadily until 1995 or 1996, whereupon there followed a strong revival. By 1999, nearly 16 percent of the sample firms had met the sickness criterion. From the analysis of profitability ratios and borrowings-to-liability ratios, moreover, we found that the prospects of sick manufacturing firms deteriorated in qualitative terms as well. The sectoral evidence pointed to the rather unhealthy state of the textile & leather industries, in both absolute and relative terms and throughout the entire period. Furthermore, the risk of sickness is found to be increasing in the firm's age, decreasing in its size and disastrously high for public sector undertakings.

Preliminary evidence from this chapter also suggests that the new economic policy has worked in favor of greater divergence in single factor productivity levels of labor, while single factor capital productivity levels declined for both sound and sick firms. When (for the group of sound firms) labor productivity is rising and at the same time capital productivity is falling, this points at rising levels of capital intensity. Possibly sound firms were able to sustain economic viability by substituting labor by capital input. Admittedly, single factor productivity ratios are rudimentary in nature and it remains open how the sector-wise findings in Table 3-13 respond to more sophisticated productivity measures. We will take up this issue in the next two chapters, where we analyze productivity in greater detail and establish a link between the new environment after the 1991 economic reforms and the changes in productive efficiency that followed.

3.5 Appendix to Chapter 3

Table 3-14: Detailed pattern of sickness (by firm)[a)]

Firm	88	89	90	91	92	93	94	95	96	97	98	99
1 / 12	0	0	0	0	0	0	0	0	0	0	0	X
	0	0	0	0	0	0	0	0	0	0	0	X
	0	0	0	0	0	0	0	0	0	0	0	X
	0	0	0	0	0	0	0	0	0	0	0	X
	0	0	0	0	0	0	0	0	0	0	0	X
	0	0	0	0	0	0	0	0	0	0	0	X
	0	0	0	0	0	0	0	0	0	0	0	X
	0	0	0	0	0	0	0	0	0	0	0	X
	0	0	0	0	0	0	0	0	0	0	0	X
	0	0	0	0	0	0	0	0	0	0	--	X
	0	0	0	0	0	0	0	0	0	--	0	X
	0	0	--	0	0	0	0	0	0	0	0	X
	0	--	0	0	--	--	--	--	--	--	--	X
	0	--	--	--	--	0	0	0	0	--	0	X
	0	--	0	0	--	0	0	0	0	X	--	0
	0	0	0	0	0	X	0	0	0	0	0	0
	0	0	X	0	0	0	0	0	0	0	0	0
	X	--	--	0	0	0	0	0	0	0	0	0
2 / 12	0	0	0	0	0	0	0	0	0	0	X	X
	0	0	0	0	0	0	0	0	0	0	X	X
	0	0	0	0	0	0	0	0	0	0	X	X
	0	0	0	0	0	0	0	0	0	0	X	X
	0	0	0	0	0	0	0	0	0	0	X	X
	0	0	0	0	0	0	0	0	0	X	--	X
	0	0	X	X	0	0	0	0	0	0	0	0
	0	--	0	0	0	0	0	0	--	0	X	X
	0	--	0	0	0	0	0	--	0	X	--	X
	0	--	--	--	--	X	X	0	0	0	0	0
	X	0	0	0	0	0	0	0	0	0	0	X
	X	X	0	0	0	0	0	0	0	0	0	0
	X	X	0	0	0	0	0	0	0	0	0	0
	X	X	0	0	0	0	0	0	0	0	0	0
	X	X	--	--	--	--	--	--	--	0	0	0
3 / 12	0	0	0	0	0	0	0	0	0	X	X	X
	0	0	0	0	0	0	0	0	X	--	X	X
	0	0	0	0	0	X	X	X	0	0	0	0
	0	0	--	0	0	0	0	0	--	X	X	X
	0	0	X	X	X	0	0	0	0	0	0	0
	0	--	0	0	0	--	0	0	--	X	X	X
	0	--	0	0	0	--	X	X	--	--	--	X
	0	--	--	--	--	--	0	0	0	X	X	X
	0	X	X	X	0	0	0	0	0	0	0	0
	X	X	0	0	0	0	0	0	0	0	0	X
	X	X	X	0	0	0	0	0	0	0	0	0
4 / 12	0	0	0	0	0	0	0	0	X	X	X	X
	0	0	0	0	0	0	0	X	--	X	X	X
	0	0	0	0	0	0	0	X	X	X	--	X
	0	0	0	X	X	X	X	0	0	0	0	0
	0	--	0	0	0	0	0	0	X	X	X	X
	0	--	--	--	--	--	--	--	X	X	X	X
	X	--	--	X	X	X	0	0	0	0	0	0
	X	X	X	0	0	X	0	0	0	--	0	0
	X	X	X	X	--	--	--	--	--	--	0	0
5 / 12	X	X	X	0	0	X	0	0	0	0	0	X
	X	X	X	X	--	--	--	--	--	--	--	X
	X	X	X	X	X	0	0	0	0	0	0	0
	X	X	X	X	X	0	0	0	0	0	0	0
6 / 12	0	0	0	0	0	0	X	X	X	X	X	X
	0	0	0	--	0	0	X	X	X	X	X	X
	X	0	0	--	0	X	X	0	X	X	X	0
	X	X	--	X	X	X	X	0	0	0	0	0
7 / 12	0	0	0	0	X	X	X	X	X	--	X	X
	0	--	X	X	X	X	X	0	0	0	X	X
	X	--	--	--	--	--	X	X	X	X	X	X
	X	--	X	X	X	X	X	X	0	0	0	0
	X	X	X	X	--	X	X	X	0	0	0	0
	X	X	X	X	X	X	X	0	0	0	0	0
8 / 12	0	0	0	X	X	X	X	X	X	X	X	0
	0	0	--	0	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	0	0	0	0
9 / 12	0	0	0	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	0	0	X	--	X
	X	X	X	X	X	X	X	X	X	0	0	0
	X	X	X	X	X	X	X	X	X	0	0	0
10 / 12	0	X	X	X	X	X	X	X	X	--	X	X
	0	X	X	X	X	X	X	X	X	X	X	0
	X	0	0	X	X	X	X	X	X	X	X	X
	X	0	0	X	X	X	X	X	X	X	X	X
	X	X	--	X	X	--	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X	0	0
11 / 12	X	X	X	X	X	X	X	X	X	X	--	X
	X	X	X	X	X	X	X	X	X	X	--	X

	88	89	90	91	92	93	94	95	96	97	98	99
1 / 11	0	0	0	0	0	0	0	0	0	0	X	--
	0	0	0	0	0	0	0	0	0	0	X	--
	0	0	0	0	0	--	0	0	0	0	X	--
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	0	X
		0	0	0	0	0	0	0	0	0	--	X
		0	0	0	0	0	0	0	0	0	--	X
		0	0	0	0	0	0	0	0	0	--	X
		0	0	0	0	0	0	0	0	--	0	X
		0	0	0	0	0	0	0	--	--	--	X
		0	0	0	0	0	0	0	X	0	0	0
		0	0	0	0	0	--	--	--	0	0	X
		0	0	0	0	0	X	0	0	0	0	0
		0	0	0	0	--	0	0	0	0	0	X
		0	0	0	0	--	--	0	0	--	--	X
		0	0	0	0	--	--	--	--	0	0	X
		0	0	0	0	X	0	0	0	0	0	0
		0	0	0	0	X	0	0	0	0	0	0
		0	0	0	--	0	0	0	0	0	0	X
		0	0	0	X	0	0	0	0	0	0	0
		0	0	0	X	0	0	0	0	0	0	0
		0	0	--	--	--	--	--	--	--	--	X
		0	0	X	0	0	0	0	0	0	0	0
		0	0	X	0	0	0	0	0	0	0	0
		0	--	0	0	0	0	0	0	0	0	X
		0	--	0	0	--	0	0	0	0	0	X
		0	--	--	--	0	0	0	0	--	0	X
		0	X	0	0	0	0	0	0	0	0	0
		0	X	0	0	0	0	0	0	0	0	0
		X	0	0	0	0	0	0	0	0	0	0
		X	0	0	0	0	0	0	0	0	0	0
		X	0	0	0	0	0	0	0	0	0	0

	88	89	90	91	92	93	94	95	96	97	98	99
1 / 11		X	0	0	0	0	0	0	0	0	0	0
		X	0	0	0	0	0	0	0	0	0	0
		X	0	0	0	0	0	0	0	0	0	0
		X	0	0	0	0	0	0	0	0	0	0
		X	0	0	0	--	--	--	0	0	0	0
2 / 11	0	0	0	0	0	0	0	0	0	X	X	--
	0	X	X	0	0	0	0	0	0	0	0	--
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	0	X	X
		0	0	0	0	0	0	0	0	--	X	X
		0	0	0	0	0	0	0	0	X	--	X
		0	0	0	0	0	0	0	0	X	--	X
		0	0	0	0	0	0	0	0	X	X	0
		0	0	0	0	0	0	0	--	--	X	X
		0	0	0	0	0	0	--	0	0	X	X
		0	0	0	0	0	0	--	0	X	--	X
		0	0	0	0	0	X	X	0	0	0	0
		0	0	0	0	--	0	X	0	--	--	X
		0	0	0	--	0	0	0	0	0	X	X
		0	0	0	--	0	0	--	0	0	X	X
		0	0	0	X	X	0	0	0	0	--	0
		0	0	--	--	0	0	0	0	0	X	X
		0	--	0	X	X	0	0		0	0	0
		X	0	0	0	0	0	0	0	0	0	X
		X	X	0	0	0	0	0	0	0	0	0
		X	X	0	0	0	0	0	0	0	0	0
		X	X	0	0	0	0	0	0	--	0	0
		X	X	0	0	0	0	--	0	0	0	0
		X	X	0	--	--	--	--	--	--	0	0
3 / 11	0	0	0	0	0	0	0	0	X	X	X	--
	0	--	0	0	0	0	0	0	X	X	X	--
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X

	88	89	90	91	92	93	94	95	96	97	98	99
3 / 11		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	0	X	X	X
		0	0	0	0	0	0	0	X	--	X	X
		0	0	0	0	0	0	0	X	--	X	X
		0	0	0	0	0	0	0	X	X	0	X
		0	0	0	0	0	0	--	X	X	--	X
		0	--	0	0	0	0	0	0	X	X	X
		0	--	0	0	0	0	0	0	X	X	X
		0	--	X	X	X	0	0	0	0	0	0
		0	X	X	0	0	0	0	0	0	0	X
		0	X	X	X	0	0	0	0	0	0	0
		X	--	--	--	X	X	--	--	0	0	0
		X	--	X	X	0	0	0	0	0	0	0
		X	X	X	0	0	0	0	0	0	0	0
		X	X	X	0	0	0	0	0	0	0	0
		X	X	X	0	0	0	0	0	0	0	0
		X	X	X	0	0	0	0	0	0	0	0
4 / 11	0	0	0	0	0	0	0	X	X	X	X	--
		0	0	0	0	0	0	0	X	X	X	X
		0	0	0	0	0	X	X	X	X	0	0
		0	0	0	0	--	--	--	X	X	X	X
		0	0	--	--	--	X	X	X	X	0	0
		0	X	--	--	--	--	--	--	X	X	X
		X	X	X	0	0	0	0	0	0	0	X
		X	X	X	X	0	0	0	0	0	0	0
		X	X	X	X	0	0	0	0	0	0	0
5 / 11		0	0	0	0	0	0	X	X	X	X	X
		0	0	0	0	0	X	X	X	X	X	0
		0	0	0	X	X	X	X	X	0	0	0
		0	--	--	--	--	--	X	X	X	X	X
		0	X	X	X	0	0	0	0	X	--	X
		X	X	0	0	0	0	0	0	X	X	X
		X	X	0	0	0	0	0	0	X	X	X
		X	X	0	X	X	0	0	0	0	0	X
		X	X	X	0	0	0	0	--	--	X	X
		X	X	X	X	X	0	0	0	0	0	0
		X	X	X	X	X	0	0	0	0	0	0
		X	X	X	X	X	0	0	0	0	0	0
		X	X	X	X	X	0	0	0	0	0	0
		X	X	X	X	X	0	0	0	0	0	0
		X	X	X	X	X	0	0	0	0	0	0
6 / 11	0	0	--	--	--	X	X	X	X	X	X	--
		0	0	0	0	0	X	X	X	X	X	X
		0	0	0	0	0	X	X	X	X	X	X
		0	0	0	0	0	X	X	X	X	X	X
		0	0	0	0	X	0	X	X	X	X	X
		0	0	0	0	X	X	--	X	X	X	X
		0	0	X	0	X	X	X	X	X	0	0
		0	X	X	X	X	X	X	0	0	0	0
		X	X	X	X	X	X	0	0	0	0	0
		X	X	X	X	X	X	0	0	0	0	0
		X	X	X	X	X	X	0	0	0	0	0

	88	89	90	91	92	93	94	95	96	97	98	99
6 / 11		X	X	X	X	X	--	--	--	--	--	X
7 / 11	0	0	0	0	X	X	X	X	X	X	X	--
		0	0	0	0	X	X	X	X	X	X	X
		0	0	0	0	X	X	X	X	X	X	X
		0	0	X	X	X	X	X	X	0	0	X
		0	X	X	X	X	X	X	0	X	--	0
		0	X	X	X	X	X	X	X	0	0	0
		X	0	0	0	0	X	X	X	X	X	X
		X	X	0	0	0	X	X	0	X	X	X
		X	X	X	X	X	0	X	0	0	0	X
		X	X	X	X	X	--	--	X	X	--	0
		X	X	X	X	X	X	0	0	0	0	X
		X	X	X	X	X	X	X	0	0	0	0
		X	X	X	X	X	X	X	0	0	0	0
		X	X	X	X	X	X	X	0	0	0	0
8 / 11		0	0	0	X	X	X	X	X	X	X	X
		0	X	X	X	X	X	--	X	X	X	0
		0	X	X	X	X	X	X	X	X	0	0
		0	X	X	X	X	X	X	X	X	0	0
		X	X	X	--	X	X	X	X	--	--	X
		X	X	X	X	0	X	X	0	0	X	X
		X	X	X	X	--	--	--	X	X	X	X
		X	X	X	X	X	--	X	X	X	0	0
		X	X	X	X	X	X	X	0	0	0	X
		X	X	X	X	X	X	X	--	--	--	X
		X	X	X	X	X	X	X	X	0	0	0
9 / 11	0	X	X	--	X	X	X	X	X	X	X	--
		0	0	X	X	X	X	X	X	X	X	X
		0	X	X	--	X	X	X	X	X	X	X
		0	X	X	X	X	X	X	X	--	X	X
		X	--	X	X	X	--	X	X	X	X	X
		X	X	X	--	--	X	X	X	X	X	X
		X	X	X	X	0	0	X	X	X	X	X
		X	X	X	X	X	X	--	X	--	X	X
		X	X	X	X	X	X	X	0	0	X	X
		X	X	X	X	X	X	X	0	0	X	X
		X	X	X	X	X	X	X	X	X	0	0
10 / 11		0	X	X	X	X	X	X	X	X	X	X
		0	X	X	X	X	X	X	X	X	X	X
		0	X	X	X	X	X	X	X	X	X	X
		X	0	X	X	X	X	X	X	X	X	X
		X	--	X	X	X	X	X	X	X	X	X
		X	--	X	X	X	X	X	X	X	X	X
		X	--	X	X	X	X	X	X	X	X	X
		X	X	X	X	--	X	X	X	X	X	X
		X	X	X	X	X	--	X	X	X	X	X
		X	X	X	X	X	X	--	X	X	X	X
		X	X	X	X	X	X	X	--	X	X	X
		X	X	X	X	X	X	X	--	X	X	X
		X	X	X	X	X	X	X	X	X	--	X
		X	X	X	X	X	X	X	X	X	--	X
		X	X	X	X	X	X	X	X	X	--	X

	88	89	90	91	92	93	94	95	96	97	98	99
11 / 11		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
		X	X	X	X	X	X	X	X	X	X	X
1 / 10		0	0	0	0	0	0	0	0	0	X	--
		0	0	0	0	0	0	0	0	0	X	--
		0	0	0	0	0	0	0	0	0	X	--
		0	0	0	0	--	0	0	0	0	X	--
			0	0	0	0	0	0	0	0	0	X
			0	0	0	0	0	0	0	0	0	X
			0	0	0	0	0	0	0	0	0	X
			0	0	0	0	X	0	0	0	0	0
			0	0	0	--	0	0	0	0	0	X
			0	0	0	--	--	--	--	--	0	X
			0	0	X	0	0	0	0	0	0	0
			0	0	X	0	0	--	--	0	0	0
			0	X	0	0	0	0	0	0	0	0
			X	0	0	0	0	0	0	0	0	0
			X	0	0	0	0	0	--	--	0	0
			X	0	--	--	--	0	0	0	0	0

	88	89	90	91	92	93	94	95	96	97	98	99
2 / 10	X	0	X	0	0	0	0	0	0	0	--	--
		0	0	0	0	0	0	0	0	X	X	--
		0	0	0	--	0	0	0	X	--	X	--
		0	0	--	0	0	--	0	0	X	X	--
			0	0	0	0	0	0	0	0	X	X
			0	0	0	0	0	0	0	0	X	X
			0	0	0	0	0	0	0	0	X	X
			0	0	0	0	0	0	0	X	--	X
			0	0	0	--	0	0	--	0	X	X
			0	0	0	--	--	--	--	0	X	X
			X	0	0	0	0	0	0	0	0	X
			X	X	0	0	0	0	0	0	0	0
			X	X	0	0	0	0	0	0	0	0
			X	X	0	0	0	0	0	0	0	0
			X	X	--	0	0	0	--	0	0	0
3 / 10		0	X	--	--	--	--	--	--	X	X	--
			0	0	0	0	0	0	0	X	X	X
			0	0	0	0	0	0	0	X	X	X
			0	0	0	0	X	X	X	0	0	0
			0	0	--	X	X	X	0	0	0	0
			X	X	X	0	0	0	0	0	0	0
			X	X	X	0	0	0	0	0	0	0
4 / 10		0	0	0	0	0	0	X	X	X	X	--
		0	0	0	0	0	0	X	X	X	X	--
		0	0	0	0	0	0	X	X	X	X	--
		0	0	0	0	X	X	--	--	X	X	--
		0	0	X	X	0	X	X	0	0	0	--
		X	X	X	--	--	--	X	0	0	0	--
			0	0	0	0	0	0	X	X	X	X
			X	X	X	--	0	0	0	0	X	0
			X	X	X	X	0	0	0	0	0	0
5 / 10	X	X	X	X	X	0	--	--	0	0	--	--
		0	0	0	X	0	0	X	X	X	X	--
			0	0	0	X	--	X	X	--	X	X
			0	X	--	--	--	--	X	X	X	X
			X	X	X	X	X	0	0	0	0	0
			X	X	X	X	X	0	0	0	0	0
6 / 10			X	X	X	X	X	X	0	0	0	0
7 / 10		0	0	X	X	--	X	X	X	X	X	--
			0	X	X	X	X	X	--	X	X	0
8 / 10	X	--	X	X	X	X	X	X	0	X	--	--
		0	0	X	X	X	X	X	X	X	X	--
		X	X	X	X	X	0	0	X	X	X	--
		X	X	X	X	X	X	X	X	0	0	--
			0	0	X	X	X	X	X	X	X	X
			X	X	X	X	0	X	--	X	X	X
			X	X	X	X	X	X	--	X	X	0
			X	X	X	X	X	X	X	X	0	0
9 / 10		0	X	X	X	X	X	X	X	X	X	--
		0	X	X	X	X	X	X	X	X	X	--
		X	0	X	X	X	X	X	X	X	X	--
		X	X	X	X	--	X	X	X	X	X	--
		X	X	X	X	X	X	X	X	X	0	--

	88	89	90	91	92	93	94	95	96	97	98	99
9 / 10			X	X	X	X	X	--	X	X	X	X
			X	X	X	X	X	X	X	X	X	0
10 / 10		X	X	X	X	X	X	X	X	X	X	--
		X	X	X	X	X	X	X	X	X	X	--
		X	X	X	X	X	X	X	X	X	X	--
		X	X	X	X	X	X	X	X	X	X	--
		X	X	X	X	X	X	X	X	X	X	--
		X	X	X	X	X	X	X	X	X	X	--
		X	X	X	X	X	X	X	X	X	X	--
		X	X	X	X	X	X	X	X	X	X	--
		X	X	X	X	X	X	X	X	X	X	--
			X	X	X	X	X	X	X	X	X	X
			X	X	X	X	X	X	X	X	X	X
			X	X	X	X	X	X	X	X	X	X
			X	X	X	X	X	X	X	X	X	X
			X	X	X	X	X	X	X	X	X	X
1 / 9		0	0	0	0	0	0	0	0	X	--	--
				0	0	0	0	0	0	0	0	X
				0	0	0	0	0	0	0	0	X
				0	0	0	0	0	0	0	0	X
				0	0	0	0	0	0	0	0	X
				0	0	0	0	0	0	0	0	X
				0	0	0	0	0	0	0	0	X
				0	0	0	0	0	0	0	0	X
				0	0	0	0	0	0	0	0	X
				0	0	0	0	0	0	0	--	X
				0	0	0	0	0	0	0	--	X
				0	0	0	0	0	0	0	--	X
				0	0	0	0	0	0	--	--	X
				0	0	0	0	--	--	--	--	X
				0	0	0	0	X	0	--	0	0
				0	0	--	0	0	0	0	0	X
				0	0	X	0	0	0	0	0	0
				0	X	0	0	0	0	0	0	0
				X	0	0	0	0	0	0	0	0
				X	0	0	0	0	0	0	0	0
				X	0	0	0	0	0	0	0	0
2 / 9		0	0	0	0	0	0	0	X	X	--	--
		0	0	0	0	0	0	X	--	X	--	--
			0	0	0	0	0	0	0	X	X	--
				0	0	0	0	0	0	0	X	X
				0	0	0	0	0	0	0	X	X
				0	0	0	0	0	0	0	X	X
				0	0	0	0	0	0	0	X	X
				0	0	0	0	0	0	X	X	0
				0	0	0	0	--	0	0	X	X
				0	0	--	0	0	X	X	0	0
				0	X	0	0	0	0	0	0	X
				0	X	X	0	0	0	0	0	0
				X	0	0	0	0	0	0	0	X
				X	X	0	0	0	0	0	0	0
				X	X	0	0	0	0	--	0	0
				X	X	0	--	--	0	0	0	0

	88	89	90	91	92	93	94	95	96	97	98	99
2 / 9				X	X	--	--	0	0	0	0	0
				X	X	--	--	0	0	--	--	0
3 / 9		0	0	0	0	X	0	X	--	X	--	--
				0	0	0	0	0	0	X	X	X
				0	0	0	0	0	0	X	X	X
				0	0	0	0	0	0	X	X	X
				0	0	0	0	0	X	--	X	X
				0	0	0	0	0	X	--	X	X
				0	0	0	0	--	--	X	X	X
				0	0	--	0	0	0	X	X	X
				0	0	X	--	X	0	X	0	0
				0	X	0	0	0	0	0	X	X
				0	X	X	X	0	0	0	0	0
				X	X	X	0	0	0	0	0	0
				X	X	X	0	0	0	0	0	0
				X	X	X	0	0	0	0	0	0
4 / 9				0	0	0	0	0	X	X	X	X
				0	0	0	0	0	X	X	X	X
				0	0	0	0	0	X	X	X	X
				0	0	X	0	0	0	X	X	X
				0	0	X	X	X	X	0	0	0
				0	X	0	0	0	0	X	X	X
				X	X	X	X	0	0	0	0	0
				X	X	X	X	0	0	0	0	0
				X	X	X	X	0	0	0	0	0
				X	X	X	X	0	0	0	0	0
				X	X	X	X	0	--	0	0	0
5 / 9		X	X	X	X	0	0	0	X	--	--	--
				0	0	0	0	X	X	X	X	X
				0	X	X	X	X	X	0	0	0
				X	X	X	X	--	--	--	--	X
				X	X	X	X	X	0	0	0	0
				X	X	X	X	X	0	0	0	0
6 / 9			0	X	0	--	X	X	X	X	X	--
				0	0	0	X	X	X	X	X	X
				0	0	X	X	--	X	X	X	X
				0	0	X	X	X	X	X	--	X
				X	X	X	X	X	X	0	0	0
				X	X	X	X	X	X	0	0	0
7 / 9			0	0	X	X	X	X	X	X	X	--
				X	0	0	X	X	X	X	X	X
				X	X	--	--	X	X	X	X	X
8 / 9				0	X	X	X	X	X	X	X	X
				X	X	X	X	X	0	X	X	X
				X	X	X	X	X	X	--	X	X
				X	X	X	X	X	X	--	X	X
				X	X	X	X	X	X	X	--	X
9 / 9			X	X	X	X	X	X	X	X	X	--
				X	X	X	X	X	X	X	X	X
				X	X	X	X	X	X	X	X	X
				X	X	X	X	X	X	X	X	X
				X	X	X	X	X	X	X	X	X
				X	X	X	X	X	X	X	X	X

	88	89	90	91	92	93	94	95	96	97	98	99
9 / 9				X	X	X	X	X	X	X	X	X
				X	X	X	X	X	X	X	X	X
				X	X	X	X	X	X	X	X	X
				X	X	X	X	X	X	X	X	X
				X	X	X	X	X	X	X	X	X
				X	X	X	X	X	X	X	X	X
1 / 8		0	--	0	X	--	0	0	0	--	--	--
			0	0	0	0	0	0	0	X	--	--
			0	0	0	0	0	0	--	X	--	--
				0	0	0	0	0	0	0	X	--
					0	0	0	0	0	0	0	X
					0	0	0	0	0	0	0	X
					0	0	0	0	0	0	0	X
					0	0	0	0	0	0	0	X
					0	0	0	0	0	0	0	X
					0	0	0	0	0	0	0	X
					0	0	0	0	0	0	--	X
					0	0	0	0	0	0	--	X
					0	0	0	0	0	--	0	X
					0	0	0	0	0	--	--	X
					0	0	0	0	0	--	--	X
					0	0	0	0	0	X	0	0
					0	0	0	0	--	0	0	X
					0	0	0	0	X	0	0	0
					0	0	0	0	X	0	0	0
					0	0	--	0	0	0	0	X
					0	0	--	--	--	--	--	X
					0	--	0	0	0	0	0	X
					0	X	0	0	0	0	0	0
					0	X	--	0	0	0	0	0
2 / 8			X	X	--	--	0	0	0	0	--	--
				0	0	0	0	0	0	X	X	--
					0	0	0	0	0	0	X	X
					0	0	0	0	0	0	X	X
					0	0	0	0	0	0	X	X
					0	0	0	0	0	0	X	X
					0	0	0	0	0	--	X	X
					0	0	0	0	0	X	--	X
					0	0	0	0	0	X	--	X
					0	0	0	0	--	0	X	X
					0	0	X	0	X	0	0	0
					0	0	X	X	0	0	0	0
					0	--	0	0	0	--	X	X
					0	X	X	0	0	0	0	0
					X	X	0	0	0	0	0	0
					X	X	--	0	0	0	0	0
					X	X	--	--	--	0	0	0
3 / 8					0	0	0	0	0	X	X	X
					0	0	0	0	--	X	X	X
					0	0	0	0	X	X	X	0
					0	0	--	--	--	X	X	X
					0	X	0	0	0	X	--	X

	88	89	90	91	92	93	94	95	96	97	98	99
4 / 8				0	0	0	0	X	X	X	X	--
				X	X	X	X	0	0	0	0	--
					0	0	X	X	X	X	--	0
					0	--	0	X	X	X	--	X
5 / 8					0	0	0	X	X	X	X	X
					0	0	0	X	X	X	X	X
					0	0	X	--	X	X	X	X
					0	X	0	X	X	--	X	X
6 / 8				0	0	X	X	X	X	X	X	--
				X	X	X	X	X	0	0	X	--
					X	X	--	X	X	--	X	X
					X	X	X	X	--	X	--	X
7 / 8				X	X	X	--	X	X	X	X	--
					X	X	X	--	X	X	X	X
					X	X	X	X	X	0	X	X
8 / 8			X	X	X	X	X	X	X	X	--	--
				X	X	X	X	X	X	X	X	--
				X	X	X	X	X	X	X	X	--
					X	X	X	X	X	X	X	X
					X	X	X	X	X	X	X	X
					X	X	X	X	X	X	X	X
					X	X	X	X	X	X	X	X
					X	X	X	X	X	X	X	X
1 / 7				0	0	0	0	0	0	X	--	--
					0	0	0	0	0	0	X	--
					0	0	0	0	0	0	X	--
						0	0	0	0	0	0	X
						0	0	0	0	0	0	X
						0	0	0	0	0	0	X
						0	0	0	0	0	0	X
						0	0	0	0	0	0	X
						0	0	0	0	0	0	X
						0	0	0	0	0	0	X
						0	0	0	0	0	0	X
						0	0	0	0	0	0	X
						0	0	0	0	0	0	X
						0	0	0	0	0	0	X
						0	0	0	0	0	0	X
						0	0	0	0	0	--	X
						0	0	0	0	0	--	X
						0	0	0	0	0	--	X
						0	0	0	X	0	--	0
						0	0	0	--	--	--	X
						0	X	0	0	0	0	0
						0	X	0	0	0	0	0
						X	0	0	0	0	0	0
						X	0	0	0	0	0	0
						X	0	0	0	0	0	0
						X	0	0	0	0	0	0
						X	0	0	0	--	--	0
						X	0	0	--	0	0	0
						X	0	--	--	0	0	0
						X	0	--	--	--	0	0

	88	89	90	91	92	93	94	95	96	97	98	99
2 / 7				0	0	--	0	0	X	X	--	--
					0	0	0	0	0	X	X	--
					0	0	0	0	0	X	X	--
					0	0	0	0	--	X	X	--
					0	0	0	X	0	0	X	--
					X	0	0	0	0	0	X	--
						0	0	0	0	0	X	X
						0	0	0	0	0	X	X
						0	0	0	0	0	X	X
						0	0	0	0	0	X	X
						0	0	0	0	0	X	X
						0	0	0	0	0	X	X
						0	0	0	0	0	X	X
						0	0	0	0	0	X	X
						0	0	0	0	0	X	X
						0	0	0	0	0	X	X
						0	0	0	0	0	X	X
						0	0	0	0	0	X	X
						0	0	0	--	0	X	X
						0	0	--	0	--	X	X
						X	X	0	0	0	0	0
						X	X	--	0	0	0	0
3 / 7			X	X	X	0	0	0	0	--	--	--
				0	0	X	0	0	X	X	--	--
					X	0	0	0	0	X	X	--
						0	0	0	0	X	X	X
						0	0	0	0	X	X	X
						0	0	0	0	X	X	X
						0	0	0	0	X	X	X
						0	0	0	0	X	X	X
						0	0	0	0	X	X	X
						0	0	0	0	X	X	X
						0	0	0	--	X	X	X
						0	0	0	X	--	X	X
						0	0	0	X	X	X	0
						0	X	--	--	--	X	X
						X	X	0	0	--	--	X
4 / 7					0	0	0	X	X	X	X	--
					0	0	0	X	X	X	X	--
						0	0	0	X	X	X	X
						0	0	0	X	X	X	X
						0	0	0	X	X	X	X
						0	0	--	X	X	X	X
						X	X	X	X	0	0	0
5 / 7					X	--	X	0	X	X	X	--
						0	0	X	X	X	X	X
						0	X	X	--	X	X	X
						X	X	--	--	X	X	X
						X	X	X	--	--	X	X
						X	X	X	X	0	--	X
						X	X	X	X	X	0	0

	88	89	90	91	92	93	94	95	96	97	98	99
6 / 7					0	X	X	X	X	X	X	--
					X	X	X	--	X	X	X	--
						0	X	X	X	X	X	X
						X	0	X	X	X	X	X
						X	X	X	X	X	X	0
7 / 7						X	X	X	X	X	X	X
						X	X	X	X	X	X	X
1 / 6				0	0	0	0	0	X	--	--	--
					0	0	0	0	0	X	--	--
					0	0	0	X	--	0	--	--
					0	0	--	0	0	X	--	--
						0	0	0	0	0	X	--
						0	0	0	0	0	X	--
						0	0	0	0	0	X	--
						0	0	0	0	0	X	--
						0	0	0	0	0	X	--
						0	0	0	0	0	X	--
						0	0	0	0	0	X	--
						0	0	0	0	0	X	--
						0	0	0	0	0	X	--
						0	0	0	--	0	X	--
						0	0	--	0	0	X	--
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	0	X
							0	0	0	0	--	X
							0	0	0	0	--	X
							0	0	0	0	--	X
							0	0	0	--	0	X
							0	0	0	--	--	X
							0	0	0	--	--	X
							0	0	0	--	--	X
							0	0	0	--	--	X
							0	0	0	X	0	0
							0	0	--	--	--	X

	88	89	90	91	92	93	94	95	96	97	98	99
1 / 6							0	0	X	0	0	0
							0	0	X	0	0	0
							0	X	0	0	--	0
							0	X	--	0	0	0
							X	0	0	0	0	0
							X	0	0	0	0	0
							X	0	0	0	0	0
							X	0	0	0	0	0
							X	0	0	0	0	0
							X	0	0	0	0	0
							X	0	0	0	0	0
							X	0	0	0	--	0
							X	--	0	0	0	0
2 / 6				0	0	0	--	X	X	--	--	--
						0	0	0	0	X	X	--
						0	0	0	0	X	X	--
						X	0	0	X	0	0	--
						X	X	0	0	0	0	--
						X	X	--	0	0	0	--
							0	0	0	0	X	X
							0	0	0	0	X	X
							0	0	0	0	X	X
							0	0	0	0	X	X
							0	0	0	0	X	X
							0	0	0	0	X	X
							0	0	0	0	X	X
							0	0	0	0	X	X
							0	0	0	0	X	X
							0	0	0	0	X	X
							0	0	0	0	X	X
							0	0	0	0	X	X
							0	0	0	--	X	X
							0	0	0	--	X	X
							0	0	0	X	--	X
							0	0	0	X	X	0
							0	0	0	X	X	0
							0	0	X	--	--	X
							X	X	0	0	0	0
							X	X	0	--	--	0
3 / 6						0	0	0	X	X	X	--
						0	0	0	X	X	X	--
						0	--	0	X	X	X	--
							0	0	0	X	X	X
							0	0	0	X	X	X
							0	0	0	X	X	X
							0	0	0	X	X	X
							0	0	0	X	X	X
							0	0	0	X	X	X
							0	0	0	X	X	X
							0	0	0	X	X	X
							0	0	--	X	X	X
							X	0	0	0	X	X

	88	89	90	91	92	93	94	95	96	97	98	99
4 / 6						0	0	X	X	X	X	--
						0	0	X	X	X	X	--
						X	X	0	0	X	X	--
							0	0	X	X	X	X
							0	0	X	X	X	X
							0	0	X	X	X	X
							0	0	X	X	X	X
							X	X	0	--	X	X
							X	X	--	--	X	X
5 / 6						X	X	X	--	X	X	--
							0	X	X	X	X	X
							X	X	X	X	--	X
6 / 6						X	X	X	X	X	X	--
						X	X	X	X	X	X	--
							X	X	X	X	X	X
							X	X	X	X	X	X
							X	X	X	X	X	X
							X	X	X	X	X	X
							X	X	X	X	X	X
							X	X	X	X	X	X
1 / 5						0	0	0	0	X	--	--
						0	0	0	0	X	--	--
							0	0	0	0	X	--
							0	0	0	0	X	--
							0	0	0	0	X	--
							0	0	0	0	X	--
							0	0	0	0	X	--
							0	0	0	0	X	--
							0	0	--	0	X	--
							0	X	0	0	0	--
							X	0	0	0	0	--
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	0	X
								0	0	0	--	X
								0	0	0	--	X
								0	0	0	X	0
								0	0	--	0	X
								0	0	--	--	X
								0	0	X	--	0
								0	X	0	--	0
								X	0	0	0	0

	88	89	90	91	92	93	94	95	96	97	98	99
1 / 5								X	0	0	0	0
								X	0	--	0	0
								X	0	--	0	0
								X	--	0	--	0
2 / 5							0	0	0	X	X	--
							0	0	0	X	X	--
							0	0	0	X	X	--
								0	0	0	X	X
								0	0	0	X	X
								0	0	0	X	X
								0	0	0	X	X
								0	0	0	X	X
								0	0	0	X	X
								0	0	0	X	X
								0	0	0	X	X
								0	0	--	X	X
								0	0	X	--	X
								0	0	X	--	X
								X	0	0	0	X
								X	0	0	--	X
								X	X	--	0	0
3 / 5					0	0	X	X	X	--	--	--
						0	0	X	X	X	--	--
						0	0	X	X	X	--	--
								0	0	X	X	X
								0	0	X	X	X
								0	0	X	X	X
								0	0	X	X	X
								X	X	X	0	0
4 / 5								X	X	X	--	X
								X	X	X	--	X
								X	X	X	--	X
								X	X	--	X	X
								X	X	--	X	X
5 / 5							X	X	X	X	X	--
							X	X	X	X	X	--
								X	X	X	X	X
								X	X	X	X	X
								X	X	X	X	X
								X	X	X	X	X
								X	X	X	X	X
								X	X	X	X	X
								X	X	X	X	X
								X	X	X	X	X
								X	X	X	X	X
1 / 4								0	0	0	X	--
								0	0	0	X	--
								0	0	0	X	--
								0	0	0	X	--
								0	X	0	0	--
									0	0	0	X
									0	0	0	X
									0	0	0	X

	88	89	90	91	92	93	94	95	96	97	98	99
1 / 4									0	0	0	X
									0	0	0	X
									0	0	0	X
									0	0	0	X
									0	0	0	X
									0	0	0	X
									0	0	0	X
									0	0	0	X
									0	0	0	X
									0	0	--	X
									0	0	--	X
									0	0	--	X
									0	--	0	X
									X	0	0	0
									X	0	0	0
									X	0	--	0
2 / 4								0	0	X	X	--
								X	0	0	X	--
								X	X	0	0	--
								X	X	0	0	--
									0	0	X	X
									0	0	X	X
									0	0	X	X
									0	X	--	X
									X	X	0	0
3 / 4								0	X	X	X	
									0	X	X	X
4 / 4						X	X	X	X	--	--	--
							X	X	X	X	--	--
								X	X	X	X	--
								X	X	X	X	--
								X	X	X	X	--
								X	X	X	X	--
								X	X	X	X	--
									X	X	X	X
									X	X	X	X
									X	X	X	X
									X	X	X	X
									X	X	X	X
1 / 3								0	0	X	--	--
								0	0	X	--	--
								0	0	X	--	--
									0	0	X	--
									0	0	X	--
									X	0	0	--
										0	0	X
										0	0	X
										0	0	X
										0	0	X
										0	0	X
										0	0	X
										0	X	0
										0	X	0

	88	89	90	91	92	93	94	95	96	97	98	99
1 / 3										0	X	0
										X	0	0
										X	0	0
										X	0	0
										X	0	0
2 / 3									0	X	X	--
										0	X	X
										0	X	X
3 / 3								X	X	X	--	--
									X	X	X	--
										X	X	X
										X	X	X
										X	X	X
										X	X	X
										X	X	X
										X	X	X
										X	X	X
										X	X	X
										X	X	X
1 / 2									0	X	--	--
										0	X	--
										0	X	--
										0	X	--
											0	X
											0	X
											X	0
											0	X
											X	0
											0	X
											X	0
											0	X
											X	0
2 / 2										X	X	--
										X	X	--
										X	X	--
										X	X	--
										X	X	--
										X	X	--
											X	X
											X	X
											X	X
											X	X
											X	X
											X	X
											X	X
											X	X
											X	X
											X	X
											X	X
											X	X

	88	89	90	91	92	93	94	95	96	97	98	99
1 / 1										X	--	--
												X
												X
												X
												X
												X
												X
												X
												X
												X
												X
												X
												X
												X
												X

[a] 0: sound; X: sick; -- missing record; 1/12 means one period of sickness in twelve gross sample years.

Table 3-15: Number of cases registered with the BFIR: by year and industry[a)]

Industry	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
Food & Beverages	38	15	11	15	8	12	15	15	13	32	51	35	260
Textile & Leather	60	43	23	26	37	32	20	21	12	38	65	63	440
Wood & Paper	36	26	8	9	10	13	8	5	3	11	19	13	161
Chemicals	32	18	19	23	23	17	18	8	14	29	55	42	298
Rubber & Plastic	2	2	6	1	3	0	3	2	4	6	0	7	36
Non-Metallic Mineral Products	14	16	18	9	11	7	19	1	3	13	28	24	163
Basic Metal & Metal Products	50	28	36	32	31	18	34	11	12	25	50	55	382
Machinery	43	23	13	13	14	9	22	8	8	14	49	41	257
Electronics	8	6	3	5	7	13	11	10	8	15	2	6	94
Transport Equipment	7	12	6	2	4	1	2	0	0	1	2	2	39
Miscellaneous	8	13	8	20	29	30	41	34	20	49	49	125	426
Total	298	202	151	155	177	152	193	115	97	233	370	413	2556

Source: BIFR (2001) at http://www.bifr.nic.in/vsbifr/status.htm as on September 1st, 2001

[a)] Original industries are more disaggregated and have been reclassified according to the 2-digit NIC (compare Tables 1-6 and 1-7 in the Appendix attached to chapter 1)

4 Manufacturing Productivity and Efficiency in the 1990s

When we explored the distributions of sick companies across time (chapter 3, Table 3-6), we argued that the entire period 1989-1999 can be partitioned into three distinct phases: the pre-reform years 1989-1991 were characterized by relatively high and constant failure rates. Following liberalization of the NEP (transition period) the share of sick firms within each industry decreased until 1995 or 1996, and rose again thereafter.

If the incidence of sickness solely mirrored economic distress (as opposed to financial distress), one should find an inverse relationship between changes in sectoral productivity and the incidence of sickness prevailing within individual industries. This is the first question to be addressed, in the form of some multi factor productivity analyses of the 10 categories of manufacturing industries.[78] In comparison to the single factor productivity analyses of the last chapter, this approach takes account of the efficiency of the combined factor input. Only then it is possible to disentangle the effects of technical change from a mere reallocation of factor inputs on the firm's productivity.

We start with some growth accounting exercises and then move on to more sophisticated econometric approaches to the measurement of productivity and efficiency. Technicalities such as the construction of the output measure and firm-specific inputs of both capital and labor are relegated to Appendix B in chapter 8.

Compared to other recent productivity studies of the Indian manufacturing sector, the distinguishing feature of our work is that it exploits very recent data and allows for variation in productivity over the three sub-periods identified in chapter 3, viz. pre-reform (1989-'91), transition phase (1992-'96), and post-reform (1997-'99). Our data set allows us to calculate coefficients of variation of firm-specific, productive efficiency scores. We show that at the outset of the reforms, these were generally declining, but that after some turning point in the interim phase, performance levels begin to diverge. In this chapter, the analysis remains strictly factual, in that changes in productivity are investigated but not explained.

78) The miscellaneous category has been left out.

4.1 Review of the Empirical Literature

In India, most productivity studies of the manufacturing sector relate to the pre-liberalization period or to the years immediately after 1991, when the reforms in Indian industry were in the initial stage; but very few studies explore productivity in the later nineties. Those studies that do make use of more recent data generally come to the conclusion that productivity in the nineties was no higher than in the eighties. These findings are quite robust to the level of data aggregation (firm-level data versus aggregate data from the Annual Accounts or the A.S.I.) and to the (econometric) methods employed. Findings to the contrary are rare. In this connection, two recent studies by Unel (2003) and by Tata Services Limited (2003) found TFP growth in Indian manufacturing to have risen after the 1991 reforms when compared to the pre-reform period. Goldar (2004) subsequently demonstrated, however, that these findings are rather attributable to methodological shortcomings.

The ICICI carried out a study of the manufacturing firms it provides with financial assistance and found an average TFP growth rate of 2.1 percent per annum for the period 1987/88-1991/92 (ICICI, 1994). Trivedi et al. (2000) estimate somewhat higher average annual TFP growth rates for the pre-reform manufacturing sector (3.6 percent), but their sample period starts in 1980/81. For the entire period 1980/81 to 1997/98, their study yields quite low productivity growth rates, averaging around 1 percent per annum. Another study that applies the original growth accounting approach is Singh (2001). Using annual data from National Accounts Statistics and the A.S.I., he computes the Solow-residual for 10 industries within the manufacturing sector. His results confirm that for all industries, the TFP indices between 1989 and 1991 exceed those in the years immediately after 1991. Moreover, he finds that the immediate years before the vast deregulation measures of the NEP came into effect were generally associated with local peaks in the indices of TFP. Srivastava (2000) confirms these findings using disaggregated data on about 3,000 companies. His econometric estimates of productivity growth and technical efficiency in Indian manufacturing for the period 1980/82-1996/97 reveal a significant decline in the rate of productivity growth in the 1990s as compared to the 1980s.

The estimates of Balakrishnan et al. (2000) not only exhibit a decline in productivity after 1991, but average annual growth in TFP (TFPG) in fact turns negative (-1 percent). TFPG estimates are obtained residually as the difference between the growth rate of output and a weighted average of the growth rates of factor inputs, where the weights are the corresponding input shares in total output. Like Srivastava's study, these findings are based on company data (PROWESS) of some 2,300 firms, but the sample consists only of firms engaged in Machinery, Textiles, Chemicals and Transport Equipment for the accounting years 1988/89-1997/98. Their measure of TFP growth is derived from the econometric estimation of a production function. Unfortunately, they only report results for the pooled sample, and fail to give estimates of industry-wise TFP growth. Sectoral productivity growth rates for the period 1986-1993 are provided by Krishna and Mitra (1998), who estimate annual productivity growth rates of 3 percent for electrical machinery, 5 percent for non-electrical machinery, and 6 percent for Electronics. Finally, Kathuria's analysis (2002) adopts a more flexible framework, as proposed by Cornwell et al. (1990), and calculates time-varying, firm-specific productive efficiency measures. The average changes in productive efficiency between 1990 and 1996 he presents are of uncertain impact, however, as he omits standard errors or any other measure that reflects the statistical reliability of the results.[79] His choice of sectoral disaggregation is also unusual, which makes it hard to draw comparisons with other studies. Recalculation of performance measures for the standard sectoral classification is impossible, since there is no information on the number of firms within sub-sectors.

To sum up, the empirical literature has documented broad evidence of declining productivity trends in Indian manufacturing in the 1990s. This finding holds across different data sets (ASI, RBI), as well as different levels of disaggregation (industry and firm level). Furthermore, the estimates are quite robust to the use of alternative methods for measuring productivity.

4.2 The Growth Accounting Approach to Productivity Measurement

Before proceeding to the econometric estimation of Total Factor Productivity Growth (TFPG), we start with the traditional growth accounting approach (Solow, 1957), which gives easy-to-derive benchmark estimates.[80] The growth accounting approach attributes any output growth which cannot be explained by the mere growth of physical inputs to growth in productivity.

The analysis starts from a standard neoclassical production function at the firm level

(4.1) $$Y_{it} = F(K_{it}, L_{it}; t),$$

79) He finds that 14 sectors experienced a gain and ten sectors a loss in productive efficiency, see Kathuria, 2002, table 1, p. 700.

80) The growth accounting approach is outlined, for instance, in Diewert and Nakamura, (1998), chapter 2 and Barro and Sala-i-Martin (1995), chapter 10.4.

where the explicit appearance of time (t) as an argument catches all forms of technical change which result in changes in production with unchanged levels of inputs of capital, K_{it}, and labor, L_{it}. By assumption, $F(\cdot)$ is strictly increasing in all inputs, twice continuously differentiable and exhibits constant returns to scale (CRS). The assumption of CRS, coupled with Euler's Theorem, implies

$$Y_{it} = \frac{\partial F}{\partial K_{it}} \cdot K_{it} + \frac{\partial F}{\partial L_{it}} \cdot L_{it},$$

or,

$$\frac{\partial F}{\partial K_{it}} \cdot \frac{K_{it}}{Y_{it}} + \frac{\partial F}{\partial L_{it}} \cdot \frac{L_{it}}{Y_{it}} = 1:$$

the elasticities of output with respect to factor inputs sum up to one under CRS.

Solow focuses on the case of Hicks-neutral technical change, which involves a simple renumbering of the isoquant map, so that the production function may be written as

$$Y_{it} = A_{it} \cdot f(K_{it}, L_{it}). \tag{4.2}$$

The multiplicative factor A_{it} is an index of the level of technology at time t, or, equivalently, of Total Factor Productivity. Total differentiation with respect to time yields

$$\frac{dY_{it}}{dt} = \frac{dA_{it}}{dt} \cdot f(\cdot) + A_{it} \cdot \left[\frac{\partial f}{\partial K_{it}} \cdot \frac{dK_{it}}{dt} + \frac{\partial f}{\partial L_{it}} \cdot \frac{dL_{it}}{dt} \right], \tag{4.3}$$

or, equivalently,

$$\dot{Y}_{it} = \dot{A}_{it} \cdot f(\cdot) + A_{it} \cdot \frac{\partial f}{\partial K_{it}} \cdot \dot{K}_{it} + A_{it} \cdot \frac{\partial f}{\partial L_{it}} \cdot \dot{L}_{it},$$

where dots denote time derivatives, i.e. instantaneous rates of change of the respective variable. Dividing (4.3) by Y_{it} we obtain the rate of growth of output:

$$\frac{\dot{Y}_{it}}{Y_{it}} = \dot{A}_{it} \frac{f(\cdot)}{Y_{it}} + \frac{\partial f}{\partial K_{it}} \cdot A_{it} \cdot \frac{\dot{K}_{it}}{Y_{it}} + \frac{\partial f}{\partial L_{it}} \cdot A_{it} \cdot \frac{\dot{L}_{it}}{Y_{it}}. \tag{4.4}$$

Since $f(\cdot)/Y_{it} = 1/A_{it}$, $\frac{\partial Y_{it}}{\partial K_{it}} = A_{it} \cdot \frac{\partial f}{\partial K_{it}}$ and $\frac{\partial Y_{it}}{\partial L_{it}} = A_{it} \cdot \frac{\partial f}{\partial L_{it}}$, equation (4.4) may be rewritten as

$$\frac{\dot{Y}_{it}}{Y_{it}} = \frac{\dot{A}_{it}}{A_{it}} + \frac{\partial Y_{it}}{\partial K_{it}} \cdot \frac{\dot{K}_{it}}{Y_{it}} + \frac{\partial Y_{it}}{\partial L_{it}} \cdot \frac{\dot{L}_{it}}{Y_{it}}. \tag{4.4'}$$

Finally, the second term on the right hand-side is multiplied by K_{it} / K_{it} and the last expression is multiplied by L_{it} / L_{it}. Rearranging the resulting equation we arrive at

(4.5) $$\frac{\dot{A}_{it}}{A_{it}} = \frac{\dot{Y}_{it}}{Y_{it}} - \frac{\partial Y_{it}}{\partial K_{it}} \cdot \frac{K_{it}}{Y_{it}} \cdot \frac{\dot{K}_{it}}{K_{it}} - \frac{\partial Y_{it}}{\partial L_{it}} \cdot \frac{L_{it}}{Y_{it}} \cdot \frac{\dot{L}_{it}}{L_{it}} .$$

Under the additional assumption of competitive input markets, factor inputs are paid their marginal products. In this case, the growth rate of labor is simply weighted by labor's share in value added at time t, s_{it}, and the growth rate of capital is weighted by capital's share in value added, (1-s_{it}):

(4.6) $$TFPG_{it} \equiv \frac{\dot{A}_{it}}{A_{it}} = \frac{\dot{Y}_{it}}{Y_{it}} - (1 - s_{it}) \cdot \frac{\dot{K}_{it}}{K_{it}} - s_{it} \cdot \frac{\dot{L}_{it}}{L_{it}} ,$$

For empirical purposes the continuous-time formula in equation (4.6) has to be modified when applied in discrete time. Törnqvist (1936) measures the growth rate between two points in time, t-1 and t, by logarithmic differences:

(4.7) $$TFPG_{it} \equiv \ln Y_{it} - \ln Y_{i,t-1} - (1 - \bar{s}_{it}) \cdot (\ln K_{it} - \ln K_{i,t-1}) - \bar{s}_{it} \cdot (\ln L_{it} - \ln L_{i,t-1}) ,$$

where $\bar{s}_{it} \equiv 0.5(s_{i,t-1} + s_{it})$.

In the empirical analysis that follows, the output measure is value added, in keeping with the above exposition. As material inputs can also be used inefficiently, gross output in principle serves as a better measure of the output variable. However, when annual report data are used, the high correlation across plants between gross output and materials violates the assumption of prior choice of inputs and renders the production function's coefficients unstable and frequently unsatisfactory (Caves et al., 1992). The use of value added as the output measure rests on the assumption of separability between materials and labor and capital input. Appendix B (chapter 8) deals with the technicalities of the construction of the output measures; appropriate measures of labor and capital inputs are also constructed from balance sheet data.

We obtain sectoral measures of TFPG by weighting the individual firm-specific growth rates by their average output shares in the aggregate output of sector j:

$$\bar{\eta}_{ijt} \equiv \frac{1}{2} \cdot \left(\frac{Y_{ij,t-1}}{Y_{j,t-1}} + \frac{Y_{ijt}}{Y_{jt}} \right) ,$$

where the aggregate output of sector j is $Y_{jt} \equiv \sum_{i=1}^{N_{jt}} Y_{ijt}$.

Hence, the rate of growth of TFP in industry j at time t is

(4.8) $\mathrm{TFPG}_{jt} =$

$$\sum_{i=1}^{N_{jt}} \overline{\eta}_{ijt} (\ln Y_{ijt} - \ln Y_{ij,t-1}) - \sum_{i=1}^{N_{jt}} \overline{\eta}_{ijt} \cdot \{(1-\overline{s}_{ijt})(\ln K_{ijt} - \ln K_{ij,t-1}) + \overline{s}_{ijt} (\ln L_{ijt} - \ln L_{ij,t-1})\}.$$

Finally, aggregating over the 10 distinct sectors in the economy we arrive at an economy-wide measure of total factor productivity growth:

(4.9) $\mathrm{TFPG}_{t} =$

$$\sum_{j=1}^{10} \overline{\eta}_{jt} (\ln Y_{jt} - \ln Y_{j,t-1}) - \sum_{j=1}^{10} \overline{\eta}_{jt} \cdot \{(1-\overline{s}_{jt})(\ln K_{jt} - \ln K_{j,t-1}) + \overline{s}_{jt} (\ln L_{jt} - \ln L_{j,t-1})\}.$$

where

$\overline{\eta}_{jt} \equiv \frac{1}{2} \cdot \left(\frac{Y_{j,t-1}}{Y_{t-1}} + \frac{Y_{jt}}{Y_t} \right)$ is the average share of sector j in the output of the (industrial) economy, $Y_t = \sum_{j=1}^{10} Y_{jt}$. $\overline{s}_{jt}$ denotes labor's average share in value added of sector j, $K_{jt} = \sum_{i=1}^{N_{jt}} K_{it}$, and $L_{jt} = \sum_{i=1}^{N_{jt}} L_{it}$.

4.2.1 Growth Accounting: Results

Table 4-1 reports average annual sectoral TFP growth for the three periods in question.

Table 4-1: Average annual sectoral TFP growth for selected subperiods

Industry	1989-1991	1992-1996	1997-1999
Food & Beverages	0.063	0.027	-0.029
Textile & Leather	0.061	-0.027	-0.078
Wood & Paper	0.191	0.024	-0.161
Chemicals	-0.012	0.033	-0.012
Rubber & Plastic	0.025	0.130	-0.105
Non-metallic mineral products	0.149	0.018	-0.046
Basic metal & metal products	0.015	0.039	-0.069
Machinery	-0.014	0.034	0.025
Electronics	0.047	0.039	0.056
Transport Equipment	0.047	0.093	-0.074
Total industry	0.025	0.051	-0.030

Source: CMIE manufacturing panel; own calculations

We noted above that if industrial sickness was purely a reflection of economic distress, then productivity should be increasing in the first half of the nineties and decreasing in the second half. For aggregate manufacturing this holds true (see last line in Table 4-1). Throughout the entire 1989-1999 period, such an inverse relationship between sickness rates and productivity changes is observable in Chemicals, Rubber & Plastics, Metals, Machinery and Transport Equipment.

Although sectoral TFP in the remaining industries decreased sharply in the third sub-period,[81] which perfectly matches the high sickness rates in the late nineties, the transition period is also characterized by a decline in both productivity and sickness rates. For firms in Textiles & Leather, average TFP actually decreases (-2.7 percent annually). Even if one takes account of the deficiencies of the growth accounting approach (see below), the evidence in Table 4-1 suggests that factors other than a mere decline in productivity were at work in afflicting large parts of manufacturing with industrial sickness.

4.2.2 Limitations of Growth Accounting

The growth accounting approach to productivity measurement enjoys great popularity among empirical researchers; but it is not without its weaknesses. First, and most importantly, the growth accounting approach is often rejected on the grounds of its unrealistic assumptions: constant returns to scale and competitive markets, with production factors being paid their marginal products. Second, with firm-level data, there is another technical problem, which biases the estimates upwards. While, at the aggregate level, the share of labor (capital) in gross value added is invariably positive, for highly unprofitable firms the absolute value of (negative) pbdit[82] might outweigh the (positive) sum of lease rent and wages, turning gross value added – and hence the factor share - negative. A mechanical application of the growth accounting framework to such firms would yield nonsensical results, i.e., the growth rate of labor would not be subtracted from the growth rate of output, but rather added to it. For this reason, firms with negative gross value added have been removed from the sample. This shortcoming could, in principle, be remedied by applying the regression approach to growth accounting. Here, the common point of departure is to estimate a (Cobb-Douglas) production function of the form

$$\ln Y_{it} = \beta_K \ln K_{it} + \beta_L \ln L_{it} + u_{it}. \quad (4.10)$$

81) The only exception relates to Electronics.

82) pbdit abbreviates profit before depreciation, interest and tax. See the glossary in Appendix A (Table A-1).

In the logarithmic CD-specification the resulting coefficients $\hat{\beta}_K$ and $\hat{\beta}_L$ correspond to the constant output elasticities with which the growth rates of capital and labor are weighted. As before, $TFPG_{it}$ is then calculated as the difference between the growth rate of output and the weighted sum of the growth rates of capital and labor input,

$$TFPG_{it} = (\ln \hat{u}_{it} - \ln \hat{u}_{it-s}) = (\ln Y_{it} - \ln Y_{it-s}) - \hat{\beta}_K (\ln K_{it} - \ln K_{it-s}) - \hat{\beta}_L (\ln L_{it} - \ln L_{it-s}),$$

(s<t) where $\underline{\hat{\beta}}$ is the estimated parameter vector of the underlying production function rather than observed factor shares.

We did not follow this route, but rather stuck to Solow's original accounting approach. When interpreting the results (Table 4-1) it has to be kept in mind, therefore, that the technical requirements of the growth accounting approach with firm level data lead to a sample selection problem, which arises from an overrepresentation of more successful firms.

4.3 Econometric Approaches to Productivity and Productive Efficiency

In the following, the common point of departure is the standard panel setting

(4.11) $y_{it} = \alpha + \underline{x}_{it}^{'} \underline{\beta} + u_{it}$,

where log value added, y_{it}, is explained in terms of log inputs of capital and labor, and a time trend, the coefficient on which represents technological progress. This is a very popular and easy-to-handle setup, and is employed in many of the above-cited papers. The explanatory variables are captured in $\underline{x}_{it}$. For now and the following, underlined small letters denote vectors and underlined capital letters denote matrices.

The main interest here is in the trend coefficient, so we estimate an error component model. If, in the relevant 3-5 year periods (viz. 1989-91, 1992-96 and 1997-99), the behavior of firms within industries was uniform, then pooled OLS estimation would yield consistent estimates of $\underline{\beta}$. The underlying assumptions are, however, very strong: independently and identically distributed errors, u_{it}, with mean zero and constant variance for all firms at any point in time rule out serial correlation or any kind of correlation across firms, and u_{it} is homoscedastic by assumption. Pooled OLS-results for the three sub-periods are given in Table 4-2 and will be discussed in relation to the more plausible fixed-effects results (see section 4.3.3 below).

As an alternative, we apply the covariance model, which is the starting point for efficiency measurement in the stochastic frontier approach. Technically, estimation of the two models is almost identical, and for that reason they are often not properly distinguished form each other. But the kind of inference that can be derived from the two respective models is different.[83]

4.3.1 Inference from the Error Component Model

In the error component model, firm heterogeneity enters through the composed error, which is partitioned into an unobservable, time-invariant, firm-specific effect, μ_i, and a remainder white noise disturbance, v_{it}[84],

(4.12) $u_{it} = \mu_i + v_{it}$.

We can think of the μ_i as the unobservable entrepreneurial or managerial skills of the firm's executives. In the fixed-effects specification, these are assumed to be fixed and uncorrelated across firms. In contrast to the white noise error term, v_{it}, however, these fixed effects may be correlated with the vector of explanatory variables.

In matrix form, (4.11) combined with (4.12) may be written as

(4.13) $\underline{y} = \alpha \underline{\iota}_{NT} + \underline{X}\underline{\beta} + \underline{Z}_\mu \underline{\mu} + \underline{v}$.

In eq. (4.13)

$$\underline{y}' = (y_{11}\, y_{12} \dots y_{1T}\, y_{21} \dots, y_{2T} \dots y_{N1} \dots y_{NT})$$

and

$$\underline{v}' = (v_{11}\, v_{12} \dots v_{1T}\, v_{21} \dots v_{2T} \dots v_{N1} \dots v_{NT})$$

are $[N \cdot T \times 1]$-column vectors, α is the scalar constant, $\underline{\iota}_{NT}$ is a column vector of ones of dimension $[N \cdot T \times 1]$, $\underline{\mu}$ is the $[N \times 1]$ column vector of fixed effects (one for each firm) and $\underline{Z}_\mu$ is a $[N \cdot T \times N]$ selector matrix of ones and zeros, or simply the matrix of firm dummies: $\underline{Z}_\mu = \underline{I}_N \otimes \underline{\iota}_T$, where $\underline{I}_N$ is an identity matrix of dimension $[N \times N]$, $\underline{\iota}_T$ is

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83) Useful references on linear panel models with fixed effects include Baltagi (1995, chapters 2-4), Hansen and Janz (1998, chapter 1), Hsiao (1986, chapter 3) and Mátyás and Sevestre (1996, chapters 2-4).

84) "White noise" entails that the informational content of the error is zero, i.e. v_{it} is random, assumed to be independent $\forall\, i, t$ and to follow a normal distribution with mean zero and variance-covariance matrix $\sigma_v^2 I_{NT}$.

a column vector of dimension $[T \times 1]$ and $\otimes$ denotes the Kronecker product. In our specification, $\underline{X}$ denotes the $[N \cdot T \times 3]$ matrix of explanatory variables, $\ln L_{it}$, $\ln K_{it}$ and the time trend, and $\underline{\beta}' = [\beta_L \; \beta_K \; \gamma]$. The so-called within-estimator pre-multiplies equation (4.13) by the matrix $\underline{Q} = \underline{I}_{NT} - (\underline{I}_N \otimes \underline{J}_T)$, where $\underline{J}_T$ is a $[T \times T]$-matrix with elements 1/T, and $\underline{I}_{NT}$ ($\underline{I}_N$) is an identity matrix of dimension $[NT \times NT]$ ($[N \times N]$).

(4.14) $\underline{Q}\underline{y} = \underline{Q}\underline{\iota}_{NT}\underline{\alpha} + \underline{Q}\underline{X}\underline{\beta} + \underline{Q}\underline{Z}_{\mu}\underline{\mu} + \underline{Q}\underline{v}$.

Estimating (4.14) by OLS

(4.15) $\underline{\hat{\beta}} = (\underline{X}'\underline{Q}\underline{X})^{-1}\underline{X}'\underline{Q}\underline{y}$

is equivalent to regressing $\underline{\tilde{y}} = \underline{Q}\underline{y}$ with typical elements $(y_{it} - \bar{y}_{i.})$ on $\underline{\tilde{X}} = \underline{Q}\underline{X}$ with typical elements $(x_{it,k} - \bar{x}_{i.,k})$ for the k[th] regressor, k = 1,2,…K, where

$$\bar{y}_{i.} = \frac{1}{T}\sum_{t=1}^{T} y_{it}$$

and

$$\bar{x}_{i.,k} = \frac{1}{T}\sum_{t=1}^{T} x_{it,k} \, .$$

That is to say, pre-multiplying (4.13) by $\underline{Q}$ yields the deviations of individual observations from their respective means across time. Since the overall constant α and the firm effects μ_i are time-invariant, the $\underline{Q}$-transformation wipes out these effects and only the sum of $(\alpha + \mu_i)$ is estimable.[85] This poses no problems because our main, actually only, interest is in the trend term. On this account, estimates of β_K and β_L are relegated to the Appendix to this chapter (Table 4-5), and Table 4-2 in the results section 4.3.3 lists only the estimates of the trend coefficient. Provided the model as specified in (4.13) is

85) In our case, however, with small T and large N, estimates of $(\alpha + \mu_i)$ would not be consistent – the number of the respective parameters increases as N increases. For separate estimates of α and μ_i we would need to impose the restriction $\sum_{i=1}^{N}\mu_i = 0$ to avoid the dummy variable trap, or perfect multicollinearity. In this case, $\hat{\alpha} = \bar{y}_{..} - \underline{\bar{x}}_{..}'\underline{\hat{\beta}}$, where the double dot symbolizes averages over time as well as across observations, and $\hat{\mu}_i = \bar{y}_{i.} - \hat{\alpha} - \underline{\bar{x}}_{i.}'\underline{\hat{\beta}}$.

the true one, then $\hat{\underline{\beta}}$ from (4.15) above is the best linear unbiased estimator (BLUE) that yields consistent estimates if T *or* (as in our case) N→ ∞.

4.3.2 Inference from the Covariance Model

In the covariance model, heterogeneity enters through firm-specific intercepts $\alpha_i = \alpha + \mu_i$. The slope coefficients are estimated as in eq. (4.15) and

(4.16) $\hat{\alpha}_i = \bar{y}_{i.} - \underline{\bar{x}}_{i.}^{'}\hat{\underline{\beta}}$.

The literature on frontier economics and efficiency measurement interprets μ_i in negative terms, viz. as a measure of technical inefficiency, reflecting the shortfall of y_{it} from the stochastic frontier $(\alpha + \underline{x}_{it}^{'}\underline{\beta} + u_{it})$.[86] The frontier is taken as the benchmark of attainable output that applies to all firms within an industry and μ_i reflects the shortfall specific to firm i.[87] By definition, then, the most efficient firm establishes the production frontier $(\mu_i = 0)$. For the remaining firms, the specific measures of technical inefficiency are calculated as

(4.17) $\hat{\mu}_i = (\hat{\alpha}^* - \hat{\alpha}_i)$,

where $\hat{\alpha}^* = \max_i (\hat{\alpha}_i)$.

Equivalently, a normalized index of firm-specific efficiency can be derived as

(4.18) $\hat{\tilde{\mu}}_i^0 = \exp\{\hat{\alpha}_i - \hat{\alpha}^*\}$,

so that the most efficient firm is characterized by a level of technical efficiency of one, and the index approaches zero as the firm's shortfall from the frontier grows large.

Although μ_i, or the efficiency index, $\tilde{\mu}_i^0$, are in principle estimable, we have little interest in them, because the fixed effects estimator of the individual effects will only be consistent if T→ ∞. For small T and N → ∞, as in our case, the number of parameters to be estimated increases as N increases, so making the estimates inconsistent. This is not the case, however, if productive efficiency was modeled as time-varying in nature. Cornwell et al. (1990) suggest extending the former model with heterogeneity in

86) It is stochastic because the error is so: the error decomposition from the error component model does not apply anymore.

87) See Mátyás and Sevestre (1996, chapter 32) for a comprehensive review of the literature.

intercepts $(\alpha_i = \alpha + \mu_i)$ to a model where the firm-specific intercept is also a function of time with time-coefficients that vary over firms

(4.19) $\alpha_{it} = \theta_{i1} + \theta_{i2} \cdot t + \theta_{i3} t^2 = \underline{w}_{it}^{'} \underline{\delta}_i$,

where $\underline{w}_{it}^{'} = (1 \;\; t \;\; t^2)$ and $\underline{\delta}_i^{'} = (\theta_{i1} \;\; \theta_{i2} \; \theta_{i3})$.

Within a sector, productivity varies across firms due to differences in production technology and differences in the efficiency of the production process. While the traditional approach to productivity measurement focuses on the temporal variation, the model above allows the rate of productivity growth to vary over firms. Conversely, the traditional approach to efficiency measurement focuses on the cross-sectional variation, and the model above allows efficiency levels to vary over time (Cornwell et al. (1990), p. 192).

Following Cornwell et al., the first step is to estimate $\underline{\hat{\beta}}^{'} = [\hat{\beta}_L \;\; \hat{\beta}_K \;\; \hat{\gamma}]$ by a generalization of the within-estimator as given in eq. (4.15). With firm-specific, time-varying deviations from the overall constant, the $\underline{Q}$ in (4.15) changes to $\underline{Q} = \underline{I}_{NT} - \underline{M}(\underline{M}^{'}\underline{M})^{-1}\underline{M}^{'}$, where $\underline{M} = \mathrm{diag}(\underline{W}_i)$ with dimension $[N \cdot T \times N \cdot 3]$ (ibid., p 187-188). The residuals $(y_{it} - \underline{x}_{it}^{'}\underline{\hat{\beta}})$ give the joint estimate of the productive efficiency and the error term, i.e. $\alpha_{it} + u_{it}$. In order to separate out the error term and derive firm-specific, time-variant productive (in)efficiency measures, an OLS-regression is performed in which the above residuals are regressed on $\underline{w}_{it}$. The fitted values from this regression, $\underline{w}_{it}^{'}\underline{\hat{\delta}}_i$, provide an estimate of the efficiency indicator $\hat{\alpha}_{it}$ that is consistent for all i and t as T→ ∞ (ibid, p. 192).[88]

Finally, to derive normalized indices of firm-specific technical efficiency, we proceed as in (4.18) above and calculate

(4.18.a) $$\hat{\tilde{\mu}}_{it}^{0} = \exp\{\hat{\alpha}_{it} - \hat{\alpha}_t^{*}\},$$

where $\hat{\alpha}_t^{*} = \max_i (\hat{\alpha}_{it})$.

The firm-specific productivity growth rates as well as the time-varying efficiency scores are clearly hard to lay out in tabular form. Instead, they enter as explanatory arguments in the next chapter when we explore the risk of falling sick at the firm level. At this stage,

88) For published applications of this approach see, for instance, Wu (1995), Fecher and Pestieau (1993), Kathuria (2001 and 2002).

we only list the common trend coefficient within industries for the 1989-1999 period (column 2 in Table 4-3) and the annual rate of change in mean sectoral efficiency levels (column 3 in Table 4-3). Mean sectoral efficiency levels are calculated as (unweighted) averages of $\hat{\alpha}_{it}$ in sector j and are depicted in Figure 4-1.

4.3.3 *Results*

Table 4-2 presents productivity estimates for the three distinct subperiods. Comprehensive results, including estimates of β_L and β_K, are shifted to the Appendix

Table 4- 2: Productivity estimates for various subperiods

Industry		1989-1991	1992-1996	1997-1999
Food & Beverages	$\hat{\gamma}$ -OLS	0.005 (0.041)	0.024 (0.021)	-0.045 (0.046)
	$\hat{\gamma}$ -FE	0.014 (0.021)	0.028* (0.014)	-0.021 (0.027)
Textile & Leather	$\hat{\gamma}$ -OLS	0.140* (0.029)	-0.074* (0.015)	-0.156* (0.043)
	$\hat{\gamma}$ -FE	0.121* (0.019)	-0.085* (0.010)	-0.134* (0.027)
Wood & Paper	$\hat{\gamma}$ -OLS	0.107* (0.046)	0.041** (0.022)	-0.217* (0.061)
	$\hat{\gamma}$ -FE	0.122* (0.029)	0.062* (0.015)	-0.174* (0.039)
Chemicals	$\hat{\gamma}$ -OLS	0.009 (0.026)	0.024** (0.013)	-0.074* (0.038)
	$\hat{\gamma}$ -FE	0.038* (0.014)	0.037* (0.009)	-0.060* (0.021)
Rubber & Plastic	$\hat{\gamma}$ -OLS	0.156* (0.052)	0.040** (0.027)	-0.078 (0.078)
	$\hat{\gamma}$ -FE	0.169* (0.035)	0.106* (0.020)	-0.076* (0.038)
Non-metallic mineral products	$\hat{\gamma}$ -OLS	0.104** (0.058)	0.011 (0.030)	-0.133** (0.080)
	$\hat{\gamma}$ -FE	0.128* (0.027)	-0.008 (0.016)	-0.081** (0.049)
Basic metal & metal products	$\hat{\gamma}$ -OLS	0.020 (0.039)	0.003 (0.017)	-0.202* (0.043)
	$\hat{\gamma}$ -FE	-0.040 (0.026)	0.011 (0.013)	-0.166* (0.028)
Machinery	$\hat{\gamma}$ -OLS	0.047 (0.031)	0.032* (0.014)	-0.042 (0.035)
	$\hat{\gamma}$ -FE	0.034 (0.022)	0.039* (0.009)	-0.018 (0.023)
Electronics	$\hat{\gamma}$ -OLS	0.022 (0.058)	0.058* (0.020)	0.053 (0.061)
	$\hat{\gamma}$ -FE	0.034 (0.045)	0.028* (0.014)	0.049 (0.033)
Transport Equipment	$\hat{\gamma}$ -OLS	0.071 (0.071)	0.065* (0.013)	-0.115* (0.041)
	$\hat{\gamma}$ -FE	0.058* (0.024)	0.057* (0.009)	-0.112* (0.021)

Source: CMIE manufacturing panel; own calculations

Standard errors in parentheses

a) Significance at the 5 percent (10 percent) level is marked by one (two) stars to this chapter (Table 4-5), for they are of no particular interest for our purpose. [89]

Significance at the 5 percent (10 percent) level is marked by one (two) stars. Regardless of the estimator, OLS or fixed effects, the results on γ (technological progress) are fairly robust. Although the fixed effects approach yields somewhat higher estimates of the rate of technical progress in the first two sub-periods and slightly lower ones for the 1997-1999 period, the estimates are of similar magnitude. The overall picture that emerges from Table 4-2 is that the rate of technical progress is almost everywhere decreasing over the time period in question. Where the hypothesized inverse U-shaped productivity-trend can indeed be verified (Machinery and Electronics), we observe a zero rate of technological progress in the first and the last period, and statistically significant positive rates for the interim period. In the last sub-period, the γ-coefficients have a negative sign without exception. Where the growth accounting approach yielded positive TFP growth in the late 90s (Machinery and Electronics), the corresponding γ-coefficients now turn out to be insignificant. With an annual productivity decrease of – 7.4 percent (OLS), or - 6.4 percent (FE), respectively, the downturn (if significant) is lowest for firms in the chemical industry, which again corroborates the growth accounting results in Table 4-1 (- 1.2 percent). In Textiles & Leather, the rate of technical progress had already turned negative in the mid-nineties. With an annual decrease of - 7.4 percent (OLS), or - 8.5 percent (FE), respectively, the regression approach to productivity measurement again establishes a sharper drop in productivity than does the growth accounting approach (- 2.7 percent). Where the two approaches agree is that, except for the textile & leather sector, all other industries still experienced positive rates of technical change in the transition period.

Taking the period as a whole, productivity trends are quite diverse across sectors (see Table 4-3). The results corroborate the findings from previous productivity analyses for the Indian manufacturing sector and agree well with the results in Tables 4-1 and 4-2. The only definite success story comes from Machinery, with an annual rate of technical change of +1 percent and an increase of mean efficiency at an annual rate of 2.2 percent. Where productivity estimates are likewise positive, this comes to the cost of significant reductions in mean efficiency (Rubber & Plastics, Electronics and Transport Equipment) (see Figure 4-1).

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89) Still, it comes as good news that the capital coefficient is statistically significant in almost all cases. This is by no means a foregone conclusion if the regression includes a trend term, as in our case. By contrast, many studies in the field of productivity analyses yield significant trend estimates only at the cost of insignificant capital coefficients. We take this as encouraging evidence that the elaborate work of constructing estimates of the capital stock has been worth it.

Table 4- 3: Productivity and annual rate of change in mean sectoral efficiency (1989-99)

Industry	$\hat{\gamma}$ a)	Annual rate of change in Mean sectoral efficiency b)
Food & Beverages	0.001 (0.004)	-0.004
Textile & Leather	-0.038* (0.004)	-0.034
Wood & Paper	-0.011** (0.007)	0.025
Chemicals	0.001 (0.004)	-0.055
Rubber & Plastic	0.055* (0.008)	-0.029
Non-metallic Mineral Products	-0.012** (0.006)	0.078
Basic Metal & Metal Products	-0.004 (0.005)	0.054
Machinery	0.010* (0.004)	0.022
Electronics	0.021* (0.006)	-0.029
Transport Equipment	0.042* (0.004)	-0.050

Source: CMIE manufacturing panel; own calculations

a) Standard errors in parantheses. Significance at the 5% (10 %) level is marked by one (two) stars

b) Mean sectoral efficiency levels are calculated as (unweighted) averages of $\hat{\alpha}_{it}$ in sector j

Figure 4-1a: Mean sectoral efficiency 1989-1999 (light industries)

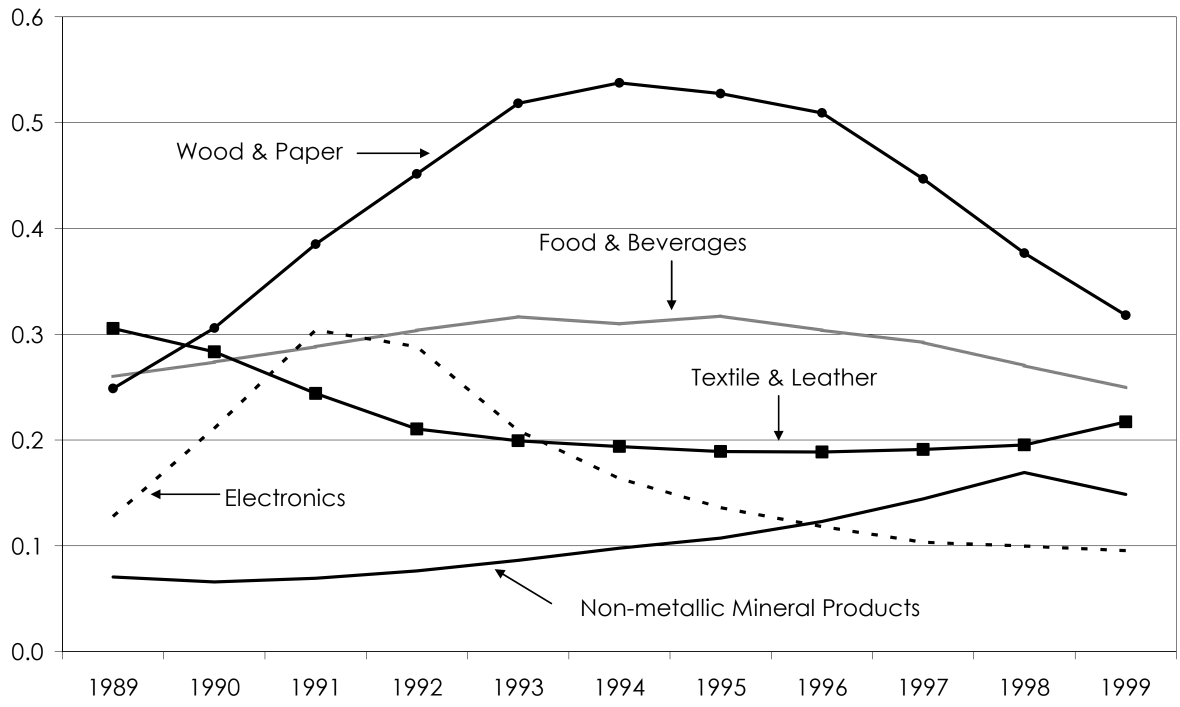
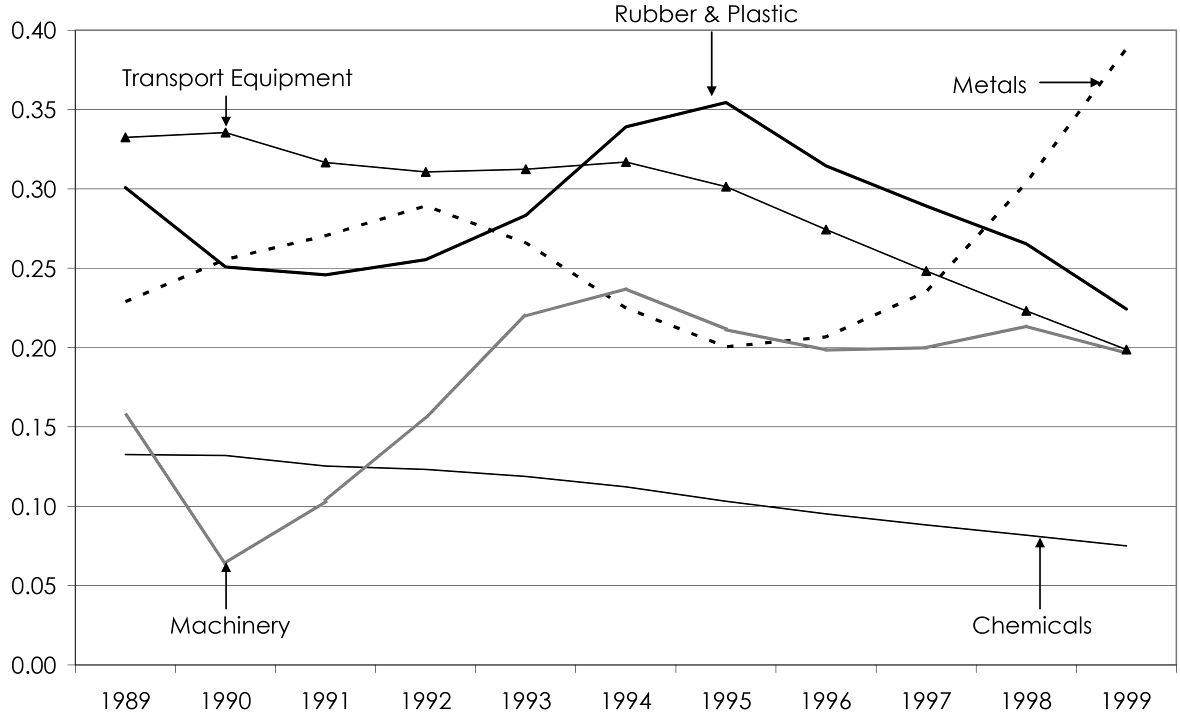


Figure 4-1b: Mean sectoral efficiency 1989-1999 (heavy industries)



Source: CMIE manufacturing panel; own calculations

4.3.4 *Has Firm Performance Become More Heterogenous within the 1990s?*

For most industries, mean efficiency has been declining throughout the nineties, and certainly in the late nineties (see Figure 4-1). In this last sub-section we present some evidence on the relationship between the incidence of sickness within industries, mean sectoral efficiency and a measure of relative variability in individual firms' efficiency scores, namely, the coefficient of variation.[90] It is important to note that the results in Table 4-4 rely on a series of cross-section regressions (i.e. one for each industry and year), so that a maximum number of firms would be included; for the ultimate purpose of this analysis is to establish a link between productive efficiency and sickness. In contrast, the estimates in Tables 4-2 and 4-3 are based on the sub-sample of firms with at least one observation in each of the three distinct phases, whereas even firms with only one valid record contribute to Table 4-4. By construction, the efficiency index is highly sensitive to positive outliers. To remove such outliers from the sample is not a

90 The coefficient of variation is defined as the ratio of standard deviation and mean, both with respect to sectoral efficiency.

good idea, however, because the logic of efficiency measurement is precisely to define an optimum in terms of production possibilities and then to compare observed and optimal values thereof. Purging the sample would thus come down to an (arbitrary) leveling of the production frontier. In order to deal with the outlier problem, but in such a way that the logic of efficiency measurement is preserved, an index number approach is applied. On this basis, we can make inference about temporal

Table 4-4: Incidence of sickness[a)], mean technical efficiency and firm heterogeneity: Index numbers (1989 = 100)

Industry		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Food	Sickness	100	98.1	118	82.5	98.3	54.4	82.9	86.2	138	201	269
&	Mean efficiency	100	107	113	113	114	112	114	112	113	110	109
Beverages	Coef. of Var.	100	97.3	95.4	93.4	95	93.7	93.3	95	94.7	100	102
Textile	Sickness	100	309	264	252	197	149	112	122	166	202	285
&	Mean efficiency	100	132	138	128	124	122	118	114	111	99.4	87
Leather	Coef. of Var.	100	104	96.7	91.2	86.3	89.1	88.9	91.6	95.5	102	110
Wood	Sickness	100	80.8	90.1	91.4	74.1	57	43.3	43.8	61	74.1	64.8
&	Mean efficiency	100	103	106	108	113	114	115	121	123	110	98.6
Paper	Coef. of Var.	100	98.1	90.2	85.8	79.3	78.8	80.3	80.6	82	94.3	99.2
Chemicals	Sickness	100	101	97	90.4	90	84.9	67.2	68.9	89.4	120	137
	Mean efficiency	100	95.7	91.8	85.9	80.5	75	70.2	66.4	63.5	60.7	56.7
	Coef. of Var.	100	113	116	116	118	122	127	133	140	145	154
Rubber	Sickness	100	94.8	81.1	93.8	98.3	63.8	35.8	32.5	51.2	85.2	101
&	Mean efficiency	100	117	142	164	168	173	177	167	156	141	134
Plastic	Coef. of Var.	100	99.9	87.6	82.1	80.2	77.4	79.3	86.3	90.3	96.9	101
Non-metallic	Sickness	100	126	131	110	111	94.2	80.6	73.2	71.3	87.9	111
Mineral	Mean efficiency	100	104	114	126	143	160	177	202	234	268	265
Products	Coef. of Var.	100	90.7	83.9	77.5	71.2	65.9	61.4	56.9	53.3	50.5	49.8
Basic Metal	Sickness	100	96.7	87.9	86.9	83.9	89.7	98.8	87.8	120	134	160
& Metal	Mean efficiency	100	112	115	120	125	132	132	123	112	102	90.2
Products	Coef. of Var.	100	95.8	94.1	92.3	90.3	90.7	91.4	90.9	92.9	95.7	101
Machinery	Sickness	100	118	137	109	95.8	78.1	78.7	70.6	91.2	100	133
& Machine	Mean efficiency	100	66.2	75	86.1	99	113	132	146	132	116	106
Tools	Coef. of Var.	100	136	124	113	106	101	99.1	101	105	111	119
Electronics	Sickness	100	131	120	84.6	94.9	59.1	70.1	98.3	91.6	125	99.8
	Mean efficiency	100	120	131	136	107	86.1	71	59.1	48.1	41.4	34
	Coef. of Var.	100	90.4	85.2	85.5	88.4	94.9	107	124	146	173	206
Transport	Sickness	100	87.1	109	115	101	87.3	76.9	82.2	74.2	73.5	77
Equipment	Mean efficiency	100	104	106	110	111	101	94.6	87.1	80.8	75.1	69.1
	Coef. of Var.	100	88.6	85.6	81.9	79.7	81.2	82.3	85	90	95.1	100

Source: CMIE manufacturing panel; own calculations

[a)] Calculated from Table 3-6 in chapter 3.

patterns within industries, but comparisons between sectors are not permissible.

Again, the expectation that deregulation and increased competition immediately after 1991 fostered efficiency is generally not supported by Table 4-4. Although mean efficiency initially rose for Wood & Paper (at an annual rate of 2.6 percent between 1989-1997), for Rubber & Plastics (at an annual rate of 10 percent between 1989-1995), and for Basic Metals (at an annual rate of 5.8 percent between 1989-1994), only the machinery sector experienced a significant turn for the better right after 1991. Here, the index of mean efficiency dropped from 100 to 75 between 1989 and 1991, but increased thereafter to a level of 146 in 1996. It is, of course, legitimate to argue that deregulation started prior to 1991. In fact, many studies that aim to evaluate the effects of liberalization on enterprise performance date the beginnings back to the mid 1980s. If we accept this view (and do not regard it as a means to resolve the non-availability of more recent data), Electronics and Transport would also provide supporting evidence.[91]

The second insight from Table 4-4 confirms conclusions drawn earlier in this chapter, viz. that within the course of reforms (whenever they might have set in), the initially positive effects on enterprise performance have since vanished. Third, downturns in mean efficiency in most cases went with increases in the incidence of sickness. In particular, this held true for the late nineties. Fourth, we observe that upward movements in mean efficiency were mostly mirrored by downward movements in the coefficient of variation, in other words, increases in mean efficiency went along with sigma-convergence and vice versa. Although these findings accord with intuition,[92] they do not necessarily have to prove true, but the question of sigma-convergence/sigma-divergence ultimately hinges upon the relationship of the growth factors of mean and standard deviation. Only if the growth factor of the standard deviation of $\hat{\tilde{\mu}}_{it}^{0}$ exceeds the growth factor of mean efficiency within sector j will the coefficient of variation rise, indicating sigma-divergence, i.e. the sample has become more heterogeneous with respect to the efficiency measure. By the last year in the sample period, this holds true (or rather is not rejected) for all but the firms in non-metallic mineral products. Indeed, this is the only sector in which mean efficiency increased throughout the entire sample

91) For Electronics, mean efficiency between 1989-1992 increased at an annual rate of 10.6 percent and for Transport the average annual growth rate amounted to 2.6 percent.

92) A reduced efficiency index just means that the productivity gap to the best practice firm has widened, so performance-diverging factors are at work. Conversely, an increase in the efficiency index means that the productivity gap to the best practice firm has narrowed, so performance-converging factors should prevail.

period. This does not, however, rule out the possibility that the sectoral rate of technical change for the entire period ($\hat{\gamma}$ in Table 4-3) is negative, which was exactly the case. In other words, the frontier moved downwards, but the average inefficiency gap declined, indicating sigma-convergence to an overall lower performance level. For all other industries, movements towards convergence in the early nineties were subsequently counterbalanced (and eventually dominated) by divergence that set in in the mid nineties, or, as in the case of the chemical industry, strict sigma-divergence was observable for the whole sample period.

4.4 Conclusion

In this chapter, we have analyzed changes in productivity in Indian manufacturing firms in the decade ending in 1999. Our results reveal a quite diverse picture. In qualitative terms we find support for the consensus in most other studies that sectoral productivity in the later 90s was generally no higher than in the pre-reform period. Furthermore, the late 90s witnessed noticeable declines in mean sectoral technical efficiency, indicating that the mean gap relative to the best-practice firm in each sector has widened. It is, however, incorrect to conclude from this that the NEP reforms led to a deterioration in either productivity or efficiency at the firm level. Instead, as indicated in the preceding chapter, increasing sickness rates in the late nineties lie behind increasing variations across firms in relation to the mean level of efficiency in the industry. Diverging performance levels combined with increasing sickness rates lead to the tentative conclusion that NEP reforms have not been generally unsuccessful, but rather that economically viable firms have benefited a great deal from the policy reform. The next chapter will address this issue in detail. It investigates whether increased sickness in the mid and late 90s rather reflects a successful pick-the-winner strategy that also denies providing further nursing to weak firms, which then fail.

4.5 Appendix to chapter 4

Table 4-5: Production function estimates a)

Industry	Period	Intercept	$\hat{\beta}_L$	$\hat{\beta}_K$	$\hat{\gamma}$
Food	89-91	0.913 (0.294)	0.964 (0.091)	0.044 (0.119)	0.014 (0.021)
&	92-96	0.628 (0.217)	0.280 (0.072)	0.305 (0.087)	0.028 (0.014)
Beverages	97-99	1.176 (0.398)	0.903 (0.130)	0.091 (0.123)	-0.021 (0.027)
	1989-1999	0.288 (0.096)	0.674 (0.038)	0.374 (0.039)	0.001 (0.004)
Textile	89-91	0.984 (0.370)	0.855 (0.076)	-0.050 (0.132)	0.121 (0.019)
&	92-96	0.488 (0.141)	0.822 (0.065)	0.363 (0.055)	-0.085 (0.010)
Leather	97-99	2.692 (0.475)	0.900 (0.115)	-0.115 (0.118)	-0.134 (0.027)
	1989-1999	0.500 (0.087)	0.722 (0.036)	0.290 (0.033)	-0.038 (0.004)
Wood	89-91	1.893 (0.452)	0.795 (0.162)	-0.278 (0.142)	0.122 (0.029)
&	92-96	0.320 (0.249)	1.216 (0.107)	0.098 (0.090)	0.062 (0.015)
Paper	97-99	2.542 (0.700)	0.568 (0.199)	0.181 (0.172)	-0.174 (0.039)
	1989-1999	0.550 (0.152)	0.878 (0.064)	0.218 (0.053)	-0.011 (0.007)
Chemicals	89-91	1.359 (0.210)	0.867 (0.053)	0.022 (0.078)	0.038 (0.014)
	92-96	0.843 (0.142)	0.674 (0.059)	0.220 (0.051)	0.037 (0.009)
	97-99	1.802 (0.487)	0.841 (0.133)	0.131 (0.142)	-0.060 (0.021)
	1989-1999	1.006 (0.078)	0.901 (0.034)	0.178 (0.029)	0.001 (0.004)
Rubber	89-91	0.546 (0.374)	0.952 (0.127)	0.124 (0.146)	0.169 (0.035)
&	92-96	1.536 (0.237)	0.472 (0.089)	-0.071 (0.092)	0.106 (0.020)
Plastic	97-99	2.658 (1.507)	1.322 (0.259)	-0.183 (0.434)	-0.076 (0.038)
	1989-1999	1.290 (0.135)	0.814 (0.056)	-0.004 (0.053)	0.055 (0.008)
Non-metallic	89-91	1.822 (0.409)	0.655 (0.123)	-0.158 (0.133)	0.128 (0.027)
Mineral	92-96	0.657 (0.332)	0.981 (0.088)	0.272 (0.104)	-0.008 (0.016)
Products	97-99	-1.140 (0.738)	-0.063 (0.211)	1.100 (0.150)	-0.081 (0.049)
	1989-1999	0.552 (0.165)	0.754 (0.051)	0.321 (0.053)	-0.012 (0.006)
Basic Metal	89-91	0.409 (0.438)	0.988 (0.064)	0.297 (0.158)	-0.040 (0.026)
&	92-96	0.641 (0.166)	0.791 (0.076)	0.257 (0.062)	0.011 (0.013)
Metal Products	97-99	2.518 (0.601)	0.776 (0.110)	0.185 (0.156)	-0.166 (0.028)
	1989-1999	0.644 (0.089)	0.823 (0.036)	0.253 (0.033)	-0.004 (0.005)
Machinery &	89-91	0.740 (0.306)	1.210 (0.096	-0.014 (0.131)	0.034 (0.022)
Machine	92-96	0.575 (0.141)	0.849 (0.072)	0.156 (0.060)	0.039 (0.009)
Tools	97-99	1.304 (0.478)	0.818 (0.127)	0.052 (0.151)	-0.018 (0.023)
	1989-1999	0.712 (0.079)	0.934 (0.038)	0.124 (0.036)	0.010 (0.004)

Table 4-5 concluded

Industry	Period	Intercept	$\hat{\beta}_L$	$\hat{\beta}_K$	$\hat{\gamma}$
Electronics	89-91	1.523 (0.371)	1.129 (0.132)	-0.236 (0.188)	0.034 (0.045)
	92-96	0.240 (0.172)	0.760 (0.089)	0.443 (0.080)	0.028 (0.014)
	97-99	1.321 (0.508)	0.864 (0.151)	-0.091 (0.155)	0.049 (0.033)
	1989-1999	0.873 (0.102)	1.025 (0.051)	0.114 (0.049)	0.021 (0.006)
Transport Equipment	89-91	1.390 (0.613))	1.149 (0.086)	-0.253 (0.208)	0.058 (0.024)
	92-96	0.133 (0.218)	0.948 (0.090)	0.220 (0.087)	0.057 (0.009)
	97-99	1.702 (0.456)	0.941 (0.175)	0.205 (0.177)	-0.112 (0.021)
	1989-1999	1.027 (0.104)	0.984 (0.037)	-0.052 (0.041)	0.042 (0.004)

Source: CMIE manufacturing panel; own calculations

a) For each industry, the first three lines pertain to Table 4-2, and the last one to Table 4-3 (fixed effects estimates). Standard errors in parantheses.

5 Impact of the New Economic Policy Reforms on Sickness

Although industrial sickness has been endemic in Indian industriy since the late seventies, there have been very few attempts to quantify the factors causing it. An extensive list of contributions from the early nineties divides the "factors responsible for sickness" into two broad classes, viz. external vs. internal, depending on whether they are perceived as beyond or within the control of the individual firm (see, for instance Biswasroyee et al. (1990, pp. 20-29), Gupta (1990, p. 22-23), and various contributions in Ramakant et al. (1993a, b).[93] It is especially the former that have attracted considerable attention from Indian scholars. The suggestive argument runs that the typical Indian manufacturing firm has been prevented from employing the least cost-intensive input mix, for instance, because of capacity constraints or shortage of essential raw materials. These restrictions were reinforced by "unfavorable government policies" in respect of taxation, labor, or credit supply. Economic distress and eventually the phenomenon of industrial sickness then occurred as a natural consequence. Empirical evidence – if supplied at all - comes in the form of a binary indicator model ("1" for sickness, zero otherwise), or a linear model with the ratio of net worth to total assets as the left-hand side variable and explanatory variables such as the interest-sales ratio, the wage-sales ratio, the ratio of gross profits to net worth or the share of deferred liabilities per Rupee of sales.[94] Yet it is obvious that these "explanatory" variables describe the symptoms of sickness rather than catching its claimed causes. To address the latter, a firm's health status would have to be related to the degree to which it is subject to external constraints on performance. Unfortunately, however, this kind of information is simply unavailable as long as datasets consist of "observable" realizations, and are not supplemented by either "desirable" outcomes (as often is the case in survey data), or by fixed upper limits on, say, installed capacity, import quotas, or supplies of basic raw materials. In effect, the "tightness of constraints" at the firm-level remains an unknown.

For all the difficulties of establishing its causes, there is no doubt that the incidence of industrial sickness in the late nineties was much higher than it used to be in the pre-reform days. In the previous chapter, we established that industrywise downturns in productivity and mean efficiency were accompanied by greater variation in performance across firms. Greater divergence in efficiency scores combined with

93) From Ramakant et al. (1993a): Singh and Bhatia, pp. 35; Farsole, pp. 45; Kaur and Singh, pp. 98; Rao and Chari, pp. 157. From Ramakant et al. (1993b): Khanka; Girdhari & Joshi; Jain; Mishra

94) Chattopadhyay (1995), chapter 3; Anant et al. (1995), section 3.4

increasing sickness rates suggest that the NEP reforms enabled economically viable firms to benefit a great deal. From chapter 2, we know what kinds of firms were highly regulated before 1991 and what types of firms operated under artificially "soft" conditions. Accordingly, as a first step, we take a static view and explore the hypothesis that the New Economic Policy discriminates against the right set of firms. Just as the planned economy favored selected types of firms (e.g. small scale units, public sector undertakings, or companies located in remote areas), we expect the NEP reforms to work to their disadvantage. To anticipate our findings, the answer is in the affirmative. But what if these 'natural sickness candidates' already faced a considerably higher risk of sickness in earlier years? In this case, we would only have demonstrated that the NEP reforms did not lower their chances of experiencing sickness.

This question leads us to take up the outcomes of the reforms more directly: Why do at-risk candidates eventually fall sick and then recover (or not), and what role is there for progressive changes in the economic environment? In particular, we investigate whether firms fall sick because government assistance measures have become less generous, or because, coincidentally, formerly protected firms have deteriorated in terms of their productive efficiency. If so, what drives the level of firm efficiency, and would these factors adversely affect sickness rates in turn? Here, we are confronted with core questions in industrial economics: how does the market structure impinge on the survival (or failure) of firms, and what effects are observable from increased competition or from deregulation policies?

5.1 Pre-Reform Distress, Pre-Reform Relief and Past-Reform Health Status

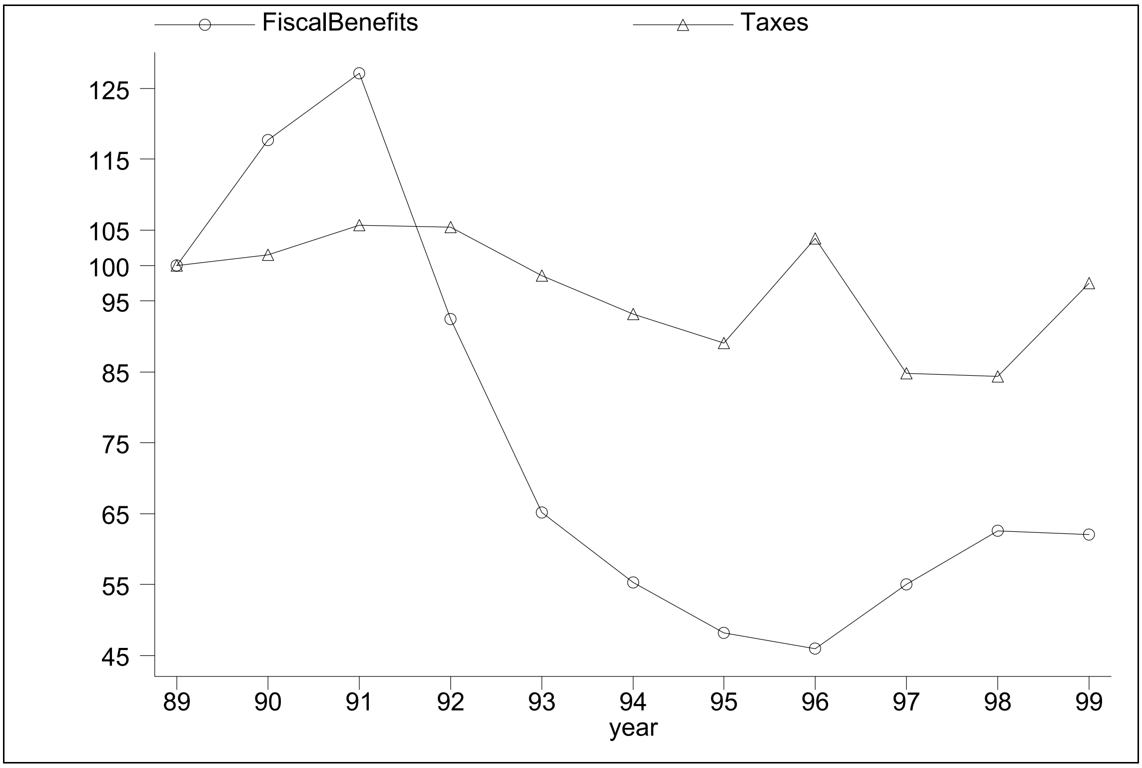
In the first part of this chapter, we proceed as in Zingales (1998) and Kovenock and Phillips (1997), and estimate a panel probit model in which observed health status in the post-reform period (1997-1999) is regressed against pre-reform measures of economic distress ("fitness") and budget softness ("fatness"). Dummy variables are included to capture the effect of the policy shock on formerly protected types of firms.

The concept of soft budget constraints was originally formulated by Kornai (1980). It refers to the lack of financial discipline at the firm level that results from the expectation of reliable government intervention to prop up chronic loss-makers in order to avert their financial failure. We begin by presenting some descriptive evidence on the temporal evolution of soft-budget indices at the enterprise level.

5.1.1 *Measures of Budget Softness at the Firm Level*

The direct means of rescue or support can be classified into two main groups (Kornai (2001) and Kornai et al. (2003)). The first consists of fiscal instruments in the form of government subsidies, tax concessions or tolerance of tax arrears. Corresponding indicators at the macro-level include state subsidies as a percentage of the total budget or GDP, or tax arrears similarly expressed.[95] With firm data available, we follow Hay et al. (1994, chapter 10), who propose taking the share of fiscal benefits in gross sales, or the share of the total tax burden (direct plus indirect taxes) in gross sales, respectively. The second group of 'softening' instruments involves granting some form of credit, e.g. preference for distressed firms in credit allocation. Alternatively, firms that have already obtained loans may have the servicing and repayment terms in their loan contracts relaxed. In what follows, we represent access to such credit by calculating the share of soft loans from DFIs and the (central or state) government in total borrowings, and the share of long-term borrowing in total borrowings. Figures 5.1 and 5.2 depict index numbers of these measures for the 1989-1999 period.

Figure 5-1: Fiscal benefits vs. tax burden (index numbers)



Source: CMIE; own calculations

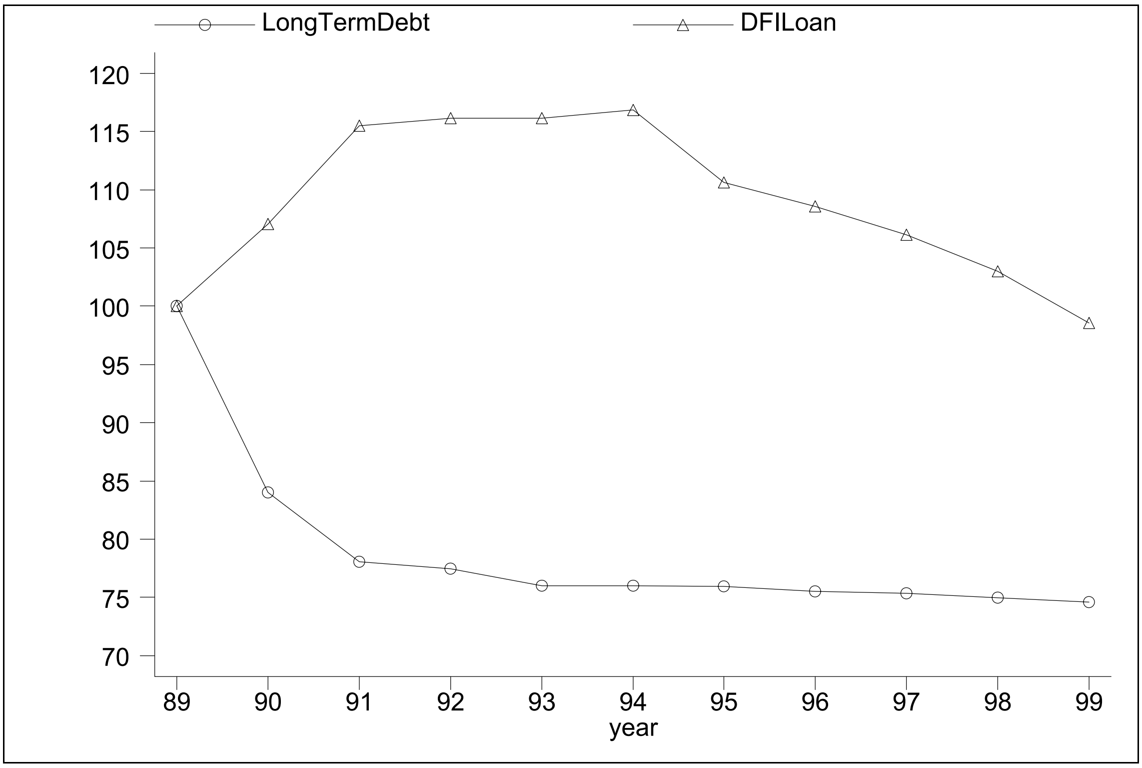
95) For a comprehensive review and discussion of these concepts, see Raiser (1997)

The first year of the NEP brought with it sharp reductions in fiscal benefits. As elaborated in chapter 2, various support schemes to assist certain industries and/or to promote specific objectives were withdrawn, and the data mirror such changes quite well. True, the tax-sales ratio also declined until 1997/98, but these changes appear moderate in comparison with the withdrawal of subsidies – though the latter itself goes a little into reverse after 1996.

It is possible that central and state governments initially attempted to soften the effects of the economy-wide recession of the late nineties, but then reversed course again. This suspicion is supported by the opposite movements of the tax and subsidy measure between 1998 and 1999: the tax load rose and simultaneously fiscal relief was cut down. In view of Figure 5.1, the dramatic level of sickness in 1999 is understandable and provides support for the idea that sickness is a reflection of more stringent budgetary policies.

The budget-hardening argument for the re-emergence of industrial sickness in the later 1990s is further supported by Figure 5.2. In the pre-reform phase, the aggregate share of soft loans in total borrowings climbed by roughly 15 percentage points and then stabilized.

Figure 5-2: Long-term debt and soft loans (index numbers)



Source: CMIE; own calculations

A closer look at the data reveals that in these years, loans from DFIs and central and state governments made up one-third of total borrowings. Starting in 1995, a steady retreat began, ending with a recovery of the status quo ante in 1991. In contrast, the share of long-term debt in total borrowings declined throughout the entire 1989-99, with the strongest drop early on.

Lastly, we present some further evidence from cash-flow statements. The basic accounting principle is that the financial statements are prepared on accrual basis. But just as reported sales might not have translated into actual cash receipts, so the outlays shown in the expenditure account might not have translated into actual cash payments. This implies that a company's financial position, as revealed by the income-expenditure accounts and balance sheet statements, is not necessarily the same as that revealed from cash flow statements.[96] Accordingly, Table 5-1 relates data from cash-flow statements to data from expenditure accounts to see how far firms actually meet their interest obligations (columns 2-4) or pay back loans, respectively (columns 5-8). Columns 2 - 4 set out the difference between $int_{exp.acc.}$, "interest on accrual basis", and int_{cf} , "cash outflow on account of interest payments" divided by $int_{exp.acc.}$ throughout the 1995-99 period. If a firm meets none of its interest obligations, the respective ratio equals 100; if all interest obligations are met the ratio equals zero.

In 1995, on average, 60 percent of interest due was unpaid; for the sample of sick firms, the figure was 75 percent. Starting with the 1996 accounting period, we observe a drastic drop, conceivably the result of attempts to harden budgets.

Table 5-1: Hardening budgets: (combined) evidence from cash-flow and expenditure statements

	$\left(\frac{int_{\cdot exp.acc.} - int_{\cdot cf}}{int_{exp.acc.}}\right) \cdot 100$			Share of companies reporting "no loan repayment"			
				Expenditure Statement		Cash Flow Statement	
Year[a)]	Total	sound	sick	Sound	Sick	sound	Sick
1995	60.39	59.01	75.03	0.51	0.58	0.74	0.79
1996	39.81	37.47	65.12	0.42	0.54	0.56	0.69
1997	38.58	35.86	61.42	0.40	0.53	0.50	0.64
1998	40.54	37.52	60.54	0.42	0.48	0.53	0.67
1999	43.99	41.23	58.54	0.42	0.47	0.53	0.65

Source: CMIE; own calculations

a) In Prowess, cash flow statements are available only from 1995 onwards and that only for listed firms.

96) Prowess User's manual, Vol. 2, p. 72

In 1999 the average payment morale with respect to interest due within the sample of sick firms was about the same as it was for the set of sound firms in 1995.

When it comes to the repayment of loans, the first striking feature is that roughly half of the firms did not do so. A closer examination of the data reveals an (unweighted) average share of long-term borrowing in total borrowings of more than 60 percent in the relevant period 1995-1999. There is no further information on the terms of these loan contracts, but obviously the initial grace period is rather long (if not virtually unlimited). For this reason, an equivalent index of repayment behavior as reported above cannot be constructed. Instead, the share of companies reporting "no loan repayment" is used.[97] Starting from an arguably extraordinarily high level of budget softness, we again find clear evidence of some budget hardening throughout the mid and later nineties. Still, only about every third sick firm reports cash outlays on loan repayments. The payment morale of healthy firms proves to be somewhat better, though it is not really overwhelming either.

5.1.2 Econometric Model and Issues

The purpose of the following analysis is to establish whether there is a link between the incidence of sickness in 1997-1999 and pre-reform measures of budget softness and efficiency. The ex post failure risk for formerly protected types of firms will be also quantified. Sickness is a binary variable, taking the value of unity if the sickness criteria are met and zero otherwise. We specify the model for firm i in period t as[98]

(5.1) $$y^*_{it} = \underline{x}'_{it}\underline{\beta} + u_{it} \qquad (i = 1, 2, \ldots, N, \qquad t = 1, 2, 3)$$

and

$$y_{it} = \begin{cases} 1 & \text{if } y^*_{it} > 0 \\ 0 & \text{otherwise.} \end{cases}$$

While y_{it} is the firm's observed 'health' status, the latent variable y^*_{it} denotes the unobservable individual propensity to fall sick, which depends on the vector of K individual characteristics, $\underline{x}_{it}$, the corresponding parameter vector, $\underline{\beta}$, and on an

97) Shares refer to the set of firms that report having outstanding loans.

98) The following is based closely on Arulampalam (1999) and Arulampalam and Booth (2000); another useful reference is Greene (1997), chapter 19.

unobservable error term u_{it}.[99] $\underline{x}_{it}$ may include both time-varying as well as time-invariant observable firm characteristics, x_k, which meet the strict exogeneity assumption:

$E(x_{kis}u_{it}) = 0$ (s, t = 1, 2, ...T).

Depending on the informational content of the error term, it is common to distinguish between two basic models. When u_{it} is white noise, a static model can be estimated by pooling the data. If y^*_{it} is distributed normally, parameter estimates of the pooled probit model are consistent (Maddala, 1987). However, the pooled format is unable to control for individual-specific unobservable effects that may otherwise bias the estimates of the impact of observable firm characteristics. A more refined approach is called for if one allows for the possibility that unobserved and possibly unobservable effects may also affect the firm's risk of failure, i.e. if some of the inter-firm heterogeneity cannot be captured by $\underline{x}_{it}$ alone (possibly not even in principle) and so remain in the error term. Assuming that unobservable firm-specific heterogeneity in the 3-year period 1997-1999 is time-invariant, the well-known error-decomposition from eq. (4.12) applies again,

(5.2) $u_{it} = \mu_i + v_{it}$.

A fixed effects specification of the μ_i entails the serious drawback that time-invariant covariates cannot be estimated; but these are the ones we are particularly interested in, e.g. in the past-reform failure risk of public sector undertakings, or of firms located in remote areas. We therefore treat μ_i as random and estimate the random effects panel probit model.[100] This approach brings other difficulties, however: because of the common μ_i, firm i's T_i observations are jointly normally distributed, which means that firm i's likelihood function for the probability of sickness in years 1997-1999 involves integration of the joint density of the u_{it}'s.

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99) Notational conventions: underlined small letters represent column vectors and underlined capital letters denote matrices.

100) "therefore" means that we switch horses as a matter of convenience. The random effects model treats the observations as random draws from a larger population, about which one seeks to draw inference. In the view of the large number of firms in the CMIE data, which account for more than 70 percent of the economic activity in India's organized industrial sector, this claim does seem to be justifiable. What are the alternatives? Unconditional fixed effects probit models yield biased estimates. A fixed effects (conditional logit) specification with and without slope dummies for various types of firms has been tried. We comment on this in the result section 5.1.4.

A less general approach is the Butler/Moffitt specification, which assumes both error components to be normally and independently distributed, v_{it} ~IN(0, σ_v^2) and μ_i ~IN(0, σ_μ^2), with the regressors strictly exogenous with respect to both, $E(x_{kis}\mu_i) = 0$ and $E(x_{kis}v_{it}) = 0$ ($\forall$ s, t = 1, 2, ...T), and the firm specific effect is uncorrelated with the residual term. These assumptions imply that

Var(u_{it}) = Var(μ_i) + Var(v_{it}), or

Normalizing Var(v_{it}) to unity,

$\sigma_u^2 = \sigma_\mu^2 + \sigma_v^2 = \sigma_\mu^2 + 1$ and,

(5.3) Corr(u_{it}, u_{is}) = $\dfrac{\sigma_\mu^2}{\sigma_\mu^2 + 1} \equiv \rho$, $\quad \forall t, s (t \neq s)$.

Eq. (5.3) says that the correlation of firm i's error across all periods is constant ('equicorrelation'). Technically speaking, $\hat{\rho}$ gives the proportion of the total variance contributed by the panel-level variance component μ_i. The parameters of this equicorrelation model can be estimated. Heckman (1981) showed that conditioned on μ_i, the distribution of y_{it}^* is independent and normal. We have

(5.4) Prob(y_{it} =1 | $\underline{x}_{it}, \mu_i$) = Prob($v_{it} > -\underline{x}_{it}'\underline{\beta} - \mu_i$) = $\Phi\left(\underline{x}_{it}'\underline{\beta} + \mu_i\right)$ $\quad \forall\, i, t$,

where Φ denotes the cumulative normal distribution.

The likelihood function is then marginalized with respect to μ_i,

(5.5) L_i = Prob($y_{i1}, y_{i2}, \ldots, y_{iT_i}$) =

$$\int_{-\infty}^{+\infty} \prod_{t=1}^{T_i} \Phi\,(\underline{x}_{it}'\underline{\beta} + \mu_i)^{y_{it}} \cdot (1 - \Phi(\underline{x}_{it}'\underline{\beta} + \mu_i))^{1-y_{it}}\, \phi\left(\frac{\mu_i}{\sigma_\mu}\right) d\left(\frac{\mu_i}{\sigma_\mu}\right),$$

where $\phi(\cdot) = \dfrac{1}{\sqrt{2\pi}} \exp\{-0.5 \cdot (\cdot)^2\}$ denotes the standard normal density.

Black box routines of popular software packages such as STATA, which has been used here, yield random effects panel probit estimates ($\hat{\underline{\beta}}/\hat{\sigma}_v$), but pooled RE probit estimates ($\hat{\underline{\beta}}/\hat{\sigma}_u$) = $\hat{\underline{\beta}}$, i.e. the coefficient vector when normalization is on $\hat{\sigma}_u$ (= 1). To make these two comparable, we multiply the former by $\sqrt{1-\hat{\rho}} = \sqrt{\hat{\sigma}_v^2/(\hat{\sigma}_\mu^2+\hat{\sigma}_v^2)} = \hat{\sigma}_v/\hat{\sigma}_u$. In the following $\underline{\hat{\beta}}* = (\underline{\hat{\beta}}/\hat{\sigma}_v)\cdot\sqrt{1-\hat{\rho}}$ always refers to the vector of such adjusted estimates.

5.1.2.1 Marginal Effects of Continuous Covariates and their Standard Errors

The marginal effects measure the impact of an infinitesimally small change in a particular continuous covariate at its mean value on the outcome probability. For instance, what would be the average effect of an incremental change in pre-reform efficiency scores on the probability of sickness in the late 1990s? STATA's blackbox-routine provides the marginal effects and the associated standard errors of the RE pooled probit model, but not so for the RE panel probit. Where the latter are concerned, the routine had to be extended. Marginal effects are calculated as

(5.6) $m_k = \phi(\underline{\bar{x}}'\,\underline{\hat{\beta}}^*)\cdot\hat{\beta}_k^*$ (∀ k = 1,2, ...K),

where $\underline{\bar{x}}'$ denotes the row vector of mean covariates, both over i and t. The associated variance covariance matrix is calculated as

(5.7) Asy. Var $[\phi(\underline{\bar{x}}'\underline{\hat{\beta}}^*)\cdot\underline{\hat{\beta}}^*]$ = Asy. Var $[\underline{\hat{m}}] = \left[\frac{\partial\underline{\hat{m}}}{\partial\underline{\hat{\beta}}^*}\right]\underline{A}\,\underline{\Omega}\,\underline{A}'\left[\frac{\partial\underline{\hat{m}}}{\partial\underline{\hat{\beta}}^*}\right]'$,

where

(5.8) $\left[\frac{\partial\underline{\hat{m}}}{\partial\underline{\hat{\beta}}^*}\right] = \phi(\underline{\bar{x}}'\underline{\hat{\beta}}^*)\cdot\underline{I} - \phi(\underline{\bar{x}}'\underline{\hat{\beta}}^*)\cdot(\underline{\hat{\beta}}^*\underline{\bar{x}}')$

is the [(K+1)×(K+1)] matrix of derivatives of the marginal effects with respect to the adjusted coefficients, $\underline{\Omega}$ is the estimated asymptotic BHHH variance-covariance matrix of the original, unadjusted coefficients $(\underline{\hat{\beta}}/\hat{\sigma}_v)$ and $\hat{\rho}$, and

$$(5.9)\quad \underline{A} = \begin{vmatrix} \sqrt{1-\hat{\rho}} & 0 & \ldots\ldots & \ldots & -\hat{\beta}_1^*/(2\cdot\sqrt{1-\hat{\rho}}) \\ 0 & \sqrt{1-\hat{\rho}} & 0\cdots & \ldots & -\hat{\beta}_2^*/(2\cdot\sqrt{1-\hat{\rho}}) \\ \vdots & & \ddots & \ldots & \vdots \\ 0 & \ldots & \ldots & \sqrt{1-\hat{\rho}} & -\hat{\beta}_K^*/(2\cdot\sqrt{1-\hat{\rho}}) \end{vmatrix}$$

is a matrix of dimension [(K+1)×(K+2)], the k[th] row of which contains the derivatives of $\hat{\beta}_k^*$ with respect to all (K+1) estimates $(\hat{\beta}/\hat{\sigma}_v)$ as well as $\hat{\rho}$. The standard errors of the marginal effects are the square roots of the elements on the main diagonal of

Asy. Var $[\phi(\underline{\overline{x}}'\underline{\hat{\beta}}^*)\cdot\underline{\hat{\beta}}^*]$ from equation (5.7).

5.1.2.2 Marginal Effects of Discrete Covariates and their Standard Errors

For discrete covariates it does not make much sense to measure the impact of infinitesimally small changes on the outcome probability. Where dichotomous variables are concerned, we are rather interested in the change in the outcome probability when the value switches from zero to one. For instance, what would be the risk of sickness for firms located in remote areas compared to firms located in urban regions? We calculate

Prob(y = 1 | $\underline{\overline{x}}_1'\underline{\hat{\beta}}^*$) = $\Phi(\underline{\overline{x}}_1'\underline{\hat{\beta}}^*)$,

where the subscript "1" in $\underline{\overline{x}}_1$ indicates that the mean of the dummy in question is replaced by one. Analogously, we calculate

Prob(y = 1 | $\underline{\overline{x}}_0'\underline{\hat{\beta}}^*$) = $\Phi(\underline{\overline{x}}_0'\underline{\hat{\beta}}^*)$,

viz. the expected outcome probability for a randomly drawn firm with dummy realization 'zero'. The difference,

(5.10) $\hat{m}_d = \Phi(\underline{\overline{x}}_1'\underline{\hat{\beta}}^*) - \Phi(\underline{\overline{x}}_0'\underline{\hat{\beta}}^*)$,

gives the appropriate impact of a change in the dummy from 0 to 1 on the outcome probability for sickness. To calculate the standard errors, (5.8) is replaced by the following row vector of dimension (K+1):

(5.11) $\left[\frac{\partial \underline{\hat{m}}}{\partial \hat{\beta}_d^*}\right] = \phi(\underline{\overline{x}}_1'\underline{\hat{\beta}}^*)\underline{\overline{x}_1'} - \phi(\underline{\overline{x}}_0'\underline{\hat{\beta}}^*)\underline{\overline{x}}_0'$,

where $\hat{\beta}_d^*$ gives the adjusted estimate of the dummy in question.

When the number of discrete values the variable in question may take on exceeds two, the variable is referred to as 'polychotomous'. For sequential polychotomous covariates, the appropriate question would be: how does the outcome probability change when the variable switches from the first class to the second, from the second to the third etc. The vector of means has to be changed accordingly.

We conclude this sub-section with an illustrative example: suppose we have three covariates, one of which is continuous, x, one is dichotomous, d, and the last one is sequential polychotomous, p, with four different possible realizations

(p = 1, p = 2, p = 3, p = 4). Marginal effects for the continuous variable x are based on the vector of means, $\underline{\bar{x}}' = [\bar{x}\ \bar{d}\ \bar{p}_2\ \bar{p}_3\ \bar{p}_4]$. For the dummy, the (omitted) reference group is d = 0, and for the polychotomous variable the reference group is p = 1.

For the 'marginal' effect of the dummy, the appropriate mean vectors would be given by $\underline{\bar{x}}_1' = [\bar{x}\ 1\ \bar{p}_2\ \bar{p}_3\ \bar{p}_4]$ and $\underline{\bar{x}}_0' = [\bar{x}\ 0\ \bar{p}_2\ \bar{p}_3\ \bar{p}_4]$. Finally, the effect of a switch from, say, p = 2 to p = 3 on the expected outcome probability would be given by

$$\hat{m}_{p_3} = \Phi[\bar{x}\ \bar{d}\ 0\ 1\ 0]\underline{\hat{\beta}}^* - \Phi[\bar{x}\ \bar{d}\ 1\ \ 0\ 0]\underline{\hat{\beta}}^*.$$

5.1.3 Empirical Specification and Hypotheses

As measures of budget softness, we include the share of fiscal benefits in total sales as realized in the pre-reform years 1989-1991, the share of soft loans from the government and DFIs in total borrowings, and the share of total borrowings in total liabilities. Initially, therefore, "fat" firms are highly indebted units, having been generously supplied with loans at rather favorable conditions and all kinds of fiscal benefits.

To capture economic distress, we apply the time-varying, firm-specific efficiency scores from eq. (4.18a), again as realized in the 1989-1991 period. We argue that, regardless of adverse developments in sectoral productivity in the late 1990s, reforms can be considered as effective and in fact successful if initially efficient firms make use of their competitiveness and survive the unfavorable conditions that rule economy-wide, while "fat" firms face a significantly higher probability of becoming sick. This hypothesis will be tested below.

The following qualitative variables have been included to capture the effect of the policy shock on formerly protected firm types: type of ownership, firm-size and whether a company is located in a remote area. It is also advisable to include industry dummies as heterogeneity controls. From the descriptive statistics, we expect foreign-owned firms to show better performance, while public sector undertakings should be exposed to a greater risk of sickness once their preferential treatment has come to an end in a liberalized setting. By symmetric reasoning, large undertakings belong to the winners of NEP-reforms and, accordingly, the dummy-coefficient of large-scale units should enter with a negative sign. Backward areas and small-scale industries used to be promoted through infrastructural support, priority lending at concessional rates of interest and favorable repayment schemes, a policy of product reservation, and the absence of the need for entry licenses and of limits on installed capacity. In chapter 2 we noted, however, that SSIs have been exempted from major policy changes, particularly in the product reservation scheme. But even if former privileges continued to apply (which they do not)[101], reforms still undermine the relative competitiveness of small-scale firms; for, in contrast to others, they do not belong to the beneficiaries of deregulation. Hence, while we expect industries in backward areas to be identified as natural sickness candidates in the past-reform years, the sign on the SSI-dummy should enter either with a positive sign or turn out to be statistically insignificant.

So far, the presumptive winners and losers of NEP-reforms have been addressed, but none of the reform measures has been approached in a direct way. As noted above, this approach is largely doomed to fail, since we have no idea on the precise extent to which individual firms are subject to constraints. However, in addition to characteristics such as ownership, headquarter location, year of incorporation etc., the "basic background" part of PROWESS also contains information on the number of product groups manufactured and the number of plants operated by a company. This information is of the 'one point in time' – kind, and it is reasonable to assume that the basic background questions were posed when the company first entered the sample. Table 5-2 below presents the percentile distributions of the sequential polychotomous variables "number of products manufactured" and ''number of factories maintained".

Table 5-2: Percentile distribution of "number of product groups" and "number of plants"

	25%	*33%*	*50%*	*75%*	*90%*	*95%*	*99%*	max.	N
Number of product Groups	1	2	3	4	8	10	18	64	4870
Number of plants			1	2	3	4	8	28	4356

Source: CMIE; own calculations

Under the licensing system, the number of products manufactured and the number of plants set up by a company used to be subject to the approval of the state's representatives. The median number of factories is one and the median number of products is three. Arguably, greater variety in manufacturing products would give the firm more flexibility. Single-factory firms and firms that only manufacture a few product groups should therefore face a higher risk of failure.

101) From the mid 1990s onwards, the small-scale industrial sector has had to cope with considerable reductions in financial support from the SIDBI and from SFCs (see sections 2.2 and 2.5 and in particular Figure 2.3).

To conclude, there is the cardinal problem of identifying strictly exogenous determinants of the panel probit model. Recall that a firm is legally defined to be sick if it has been registered for at least five years and realizes negative net worth, where net worth is the sum of total paid up equity capital plus reserves. Since our data set basically consists of income-expenditure and balance sheet statements, the task of identifying 'truly' exogenous regressors with respect to the key variable net worth is more than troublesome – at least if contemporaneous observations on any balance sheet or income-expenditure variables were to be included as explanatory variables. In our case, however, the critical variables enter with eight-period lags: in any year between 1997 and 1999 (the regression period), the entire time series of eight years of lagged variables constructed from annual accounts are known, including 'future' values. This settles the potential endogeneity problem. The included dummies satisfy the strict exogeneity assumption with respect to net-worth realizations as well, at least in a statistical sense.[102]

5.1.4 The Results

Table 5-3 presents the first findings on the impact of the NEP on the incidence of industrial sickness in the late 90s. The LR test statistic indicates that the assumption of no random effects can be rejected, i.e. it would be a bad idea to run pooled probit estimations, as one would expect. By assuming that the inter-individual heterogeneity can be captured by the observed variables, the pooled model attributes unobservables, such as competence of the management, to observable proxies, such as form of ownership or the efficiency index, so that the marginal effects on these tend to be lower (in absolute terms) in the panel model. Even so, the adjusted coefficients and the marginal effects from the panel model do not look very different from those from the simple pooled model (see Table 5-6 in the Appendix to this chapter).

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102) A variable x is defined as strictly exogenous if its entire time series, including future realizations, are known. Strictly exogenous variables do not correlate with the error at any time:

$E(x_{is} v_{it}) = 0 \qquad$ (s, t = 1, 2, ...T).

A variable is defined as pr*edetermined* (synonymously: weakly exogenous), if its present and past realizations are known, but not so its future realizations,

$$E(x_{is} v_{it}) \begin{cases} = 0 & \text{for } t \geq s \\ \neq 0 & \text{otherwise.} \end{cases}$$

A variable is defined as *endogenous* if only past realizations are known, but neither present, nor future realizations.

$$E(x_{is} v_{it}) \begin{cases} = 0 & \text{for } t > s \\ \neq 0 & \text{otherwise.} \end{cases}$$ (See Janz, 1997, p. 41).

Column two in Table 5-3 contains the estimates of the adjusted coefficients, which are to be interpreted as the change in the probit index when the respective covariate increases by one unit. Columns three to five list the marginal effects, their associated standard errors and t-statistics for the null-hypothesis $H_0 : \hat{m}_k = 0$. The last column displays the marginal effects of discrete regressors, as described in section 5.1.2.2. They give the percentage point increase/decrease in sickness probability caused by a switch of the discrete explanatory variable. Column three in turn says how the probability of sickness increases/decreases (in percent) if the continuous covariate changed by one percent.

Table 5-3: Pre-reform firm characteristics and past-reform health status:
Panel probit estimates for the probability of sickness (1997-1999)

Regressor[a)]	Adj. Coef.	Marg. Effect	Std. Err	t-value[b)]	Marg.Effect on Dummy
EFFICIENCY-INDEX (t - 8)	-0.928	-0.192	0.092	-2.087	
TOTAL BORROWINGS (t - 8)	-0.004	-0.001	0.001	-0.837	
SOFT LOANS (t - 8)	0.017	0.003	0.021	0.166	
FISCAL BENEFITS (t – 8)	1.707	0.353	0.174	2.027	
Public Sector	1.044	0.216	0.088	2.447	0.322
Private, foreign firms	-0.286	-0.059	0.038	-1.556	-0.046
Small-scale Sector	-0.071	-0.015	0.023	-0.636	-0.017
Large-scale Sector	-0.395	-0.082	0.037	-2.235	-0.078
Single-product firms	0.114	0.024	0.020	1.165	0.028
Multiple-product firms	-0.258	-0.053	0.022	-2.409	-0.053
Multiple-factory firms	-0.246	-0.051	0.027	-1.908	-0.051
Backward-Dummy	0.389	0.081	0.033	2.471	0.094
Sector Dummy variables					
Food & Beverages	-0.253	-0.052	0.028	-1.878	-0.051
Textiles & Leather	0.219	0.045	0.027	1.668	0.057
Wood & Paper	-0.742	-0.154	0.068	-2.266	-0.112
Chemicals	-0.027	-0.006	0.023	-0.242	-0.006
Non-metalic Mineral products	-0.166	-0.034	0.029	-1.176	-0.035
Basic Metals	0.018	0.004	0.025	0.146	0.004
Machinery	-0.180	-0.037	0.028	-1.318	-0.038
Electronics	-0.303	-0.063	0.039	-1.620	-0.060
Transport	-0.651	-0.135	0.069	-1.956	-0.104
Constant	-0.644	-0.133	0.061	-2.188	
Number of firms	1510				
Number of firm-years	3495				
Loglikelihood	-1007.07				
LR-Test $(H_o : \rho = 0)$	622.43	(0.000)			

Source: CMIE; own calculations

[a] Reference group for sector dummies: rubber & plastic; reference group for type of ownership: private Indian; reference for number of products manufactured: 2-3; reference group for number of factories: 1; reference for backwardness: no backward area; [b)] Critical values for two-tailed tests: 1.645, 1.960 and 2.576 (significance at the 10/5/1-percent level).

The empirical findings widely support the hypothesis that it was first and foremost initially highly inefficient and highly subsidized (public sector) firms which were the most likely to have become sick by the late 1990s. Evaluated at the mean efficiency level (0.139), a one percent increase therein would reduce the risk of failure by 0.192 percent. Getting fat on subsidies, however, was dangerous for future health: the marginal effect of FISCAL BENEFITS is both large and significant at conventional levels. Financing decisions, on the other hand, have no bearing on the chances of falling sick later. Note that these findings remain unaltered in qualitative terms if either the R.E. pooled probit (see Table 5-6 in the Appendix attached to this chapter), or the fixed-effects conditional logit model (untabled results) is employed instead. The attempt to estimate the latter model with slope dummies for different firm types (to capture the effect of the time-invariant firm characteristics) failed, however, inasmuch as the coefficients on these were not statistically significant.

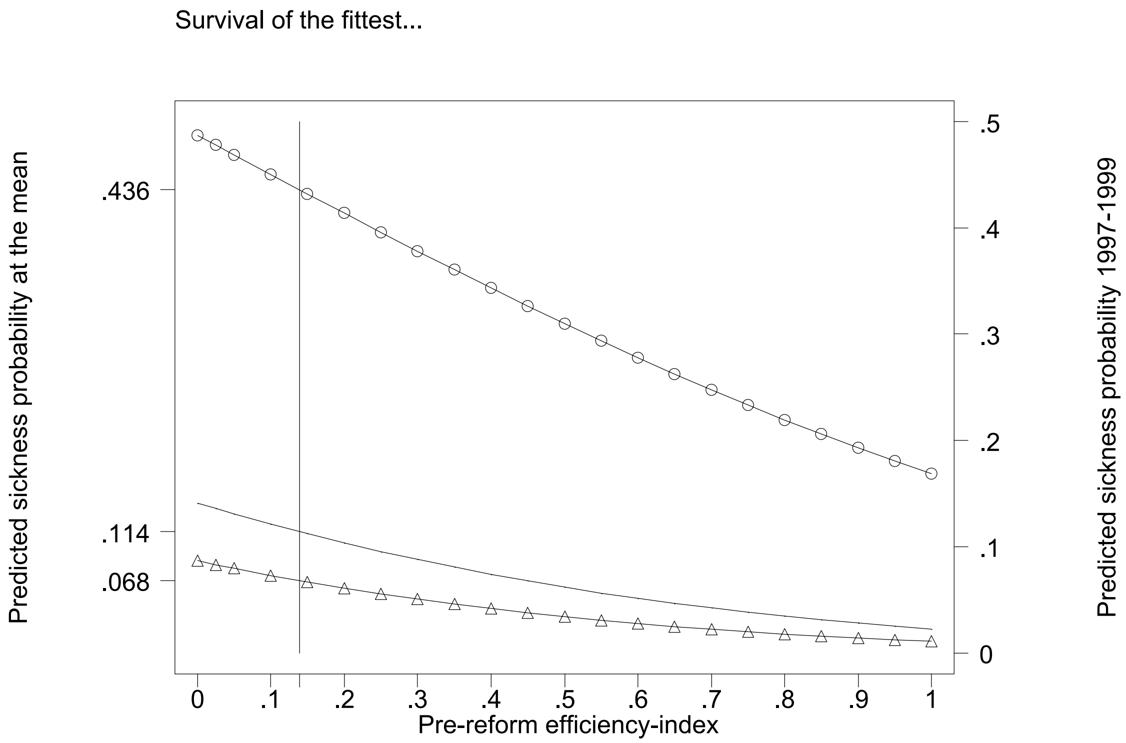
As expected on the basis of earlier discussions, the predicted sickness probabilities of public sector undertakings greatly exceeded those of private Indian firms - by no less than 32.2 percentage points – and the coefficient is highly significant. Foreign firms faced a slightly lower risk (- 4.6 percentage points), but the coefficient is at best borderline significant. These effects are calculated at the means, where the reference group (private Indian firms) faced a probability of falling sick of 11.4 percent. Thus, public sector undertakings faced a probability of 11.4 + 32.2 = 43.6 percent and foreign firms one of 11.4 - 4.6 = 6.8 percent (see Figure 5-3). The upper panel of Figure 5-3 illustrates the fall in the probabilities of sickness with rising efficiency levels. The impact of different ownership forms on the predicted probabilities is lower, the higher is initial efficiency.

In chapter 2.1 we saw that positive discrimination in favor of public sector undertakings manifested itself in the generous provision of all kinds of fiscal benefits. Accordingly, the lower panel of Figure 5-3 analyzes the ownership effect on the predicted probability of becoming sick for a whole range of values the (subsidy/sales)-ratio may possibly take. The probabilities as functions of ownership have been calculated as

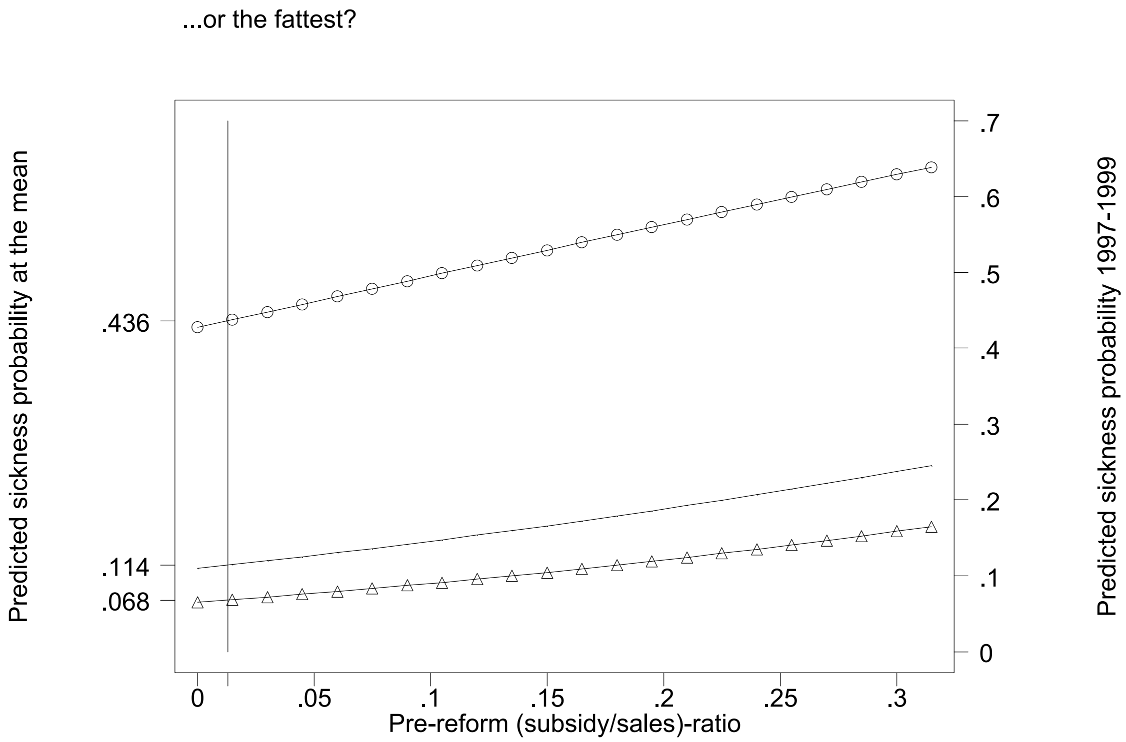
$$\text{Prob(type = a)} = \Phi[(\underline{\bar{x}}'\underline{\hat{\tilde{\beta}}}^*) + \hat{\beta}_a \cdot z],$$

where $\underline{\hat{\tilde{\beta}}}^*$ denotes the vector of adjusted coefficients in which the estimated coefficient for type a is set to zero and $z \in [0,1]$. The vertical line in Figure 5-3 is the mean subsidy-sales ratio in the sub-sample used in estimation. With increases in the pre-reform (subsidy/sales)-ratio, past-reform sickness probabilities for each ownership group

Figure 5-3: Effect of ownership type on predicted sickness probabilities



o = Public Sector; __ = Private Indian; Δ = Private Foreign



rise. Eventually, at the highest observable degree of subsidization (ratio of fiscal benefits to sales of 30 percent), the predicted probability of falling sick among public sector undertakings would exceed 60 percent, while that among foreign-owned firms would remain at a comparably low level (17 percent). Evaluated at the vector of means, a one percent increase in the ratio of fiscal benefits to total sales would increase the probability of sickness by 0.353 percent in the whole sample. A highly significant and positive coefficient on the backwardness dummy supports the hypothesis that the withdrawal of preferential schemes had a negative impact on those former beneficiaries (the probability of sickness increased by 9.4 percentage points). Firms that operated on a large scale before the NEP seem to have made good use of the abolition of the MRTP-restrictions – at least they faced a substantially lower chance of falling sick in the post-reform years: their probability was 7.8 percentage points lower than the reference group of medium-sized firms and the coefficient is significant at conventional levels. No such effect can be found for small-scale firms, which is consistent with the suspicion that deregulation did not really involve cuts in their special claims.

Multi-product and multi-factory firms faced a significantly lower risk of failure. This result appears to be highly robust, since it is derived from a regression wherein the size effect is explicitly controlled for.

The following conclusions may be drawn: While the NEP of the early nineties generally did not succeed in raising sectoral productivity, at least not in a sustainable way, it has been effective in exposing the 'right' set of firms to the risk of sickness. The lower the ex ante efficiency levels, the higher were the firm's chances of being sick in the late 1990s. This effect has been reinforced by sharp cuts in the provision of direct subsidies. Ex ante financing decisions, in contrast, appear to have had no impact on ex post sickness probabilities. This finding supports the claim that the incidence of sickness is mostly a matter of economic distress, and not of financial distress.

5.2 Links Between Market Structure, Efficiency and Re-Emerging Sickness

As noted in chapter 2, the NEP reforms have been primarily successful in removing barriers to entry. A number of industries hitherto reserved exclusively to the public sector have been exposed to competition from private undertakings. Similarly, competition from abroad has been sharpened through the gradual removal of quantitative import restrictions and the reduction of import tariffs. The remainder of this section will explore whether and to what extent removal of entry barriers and better access to (foreign) know-how and technology have helped to foster firm efficiency and whether factors that boost firms' efficiency scores would at the same time reduce failure rates.

5.2.1 A Quick Inquiry into the Determinants of Efficiency

In chapter 4, we employed data on inputs and output to derive a vector of firm-specific time-variant productive efficiency scores. Thus far, these data have been interpreted at the aggregate sectoral level (section 4.3) and utilized as an explanatory variable in section 5.1. They are now used as dependent variables and regressed against a set of explanatory variables. This approach has much in common with Kathuria (2001, 2002). He, however, rather focuses on the determinants of year-to-year changes in absolute firm-specific, time-varying productivity scores $(\hat{\alpha}_{it})$. Since our main interest is in the forces that have been at work in making for divergence over the post-1991 period, a relative performance measure is more appropriate, and hence we focus on firms' technical efficiency scores. More precisely, the log values of time-varying, firm-specific technical efficiency scores are regressed against a set of 2-digit log concentration measures, viz. concentration ratios of sales, of capital goods imports, of the amount of royalties paid, of exports, and R&D expenditures.[103] In each case, the respective measure of concentration is the share of sales (or exports, capital goods imports, technical know-how fees and R&D spending) of the top ten percent firms in total sales (or exports, capital goods imports, technical know-how fees and R&D spending, respectively) of all firms belonging to the same two-digit industry. For lack of better data, changes in these concentration ratios are supposed to capture the effects of weakening the constraints on entry. The rationale is that if deregulation policies have been effective, then the distribution of any of these indices, which are well-known to be associated with greater efficiency, should be less concentrated. Lower concentration in both input and output markets points to increased competition where the notion of competitiveness comprises two dimensions. On the one hand, firms certainly experience distress as a result of increased sales (or export) competition; on the other hand, NEP reforms should have put them in a better position to respond to such challenges. In particular, better access to, and availability of, formerly scarce high-quality inputs from abroad should enable firms to move to the best-practice frontier, i.e. to reduce inefficiency gaps.

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103) A level specification has also been tested. In qualitative terms, results remain robust (see the Appendix to this chapter (Table 5-7), which also provides for some robustness checks). The log-specification is preferable because the coefficients are more straightforward to interpret in terms of elasticities.

To test this hypothesis, we fit a two-way error component model with additional time effects (λ_t), where the latter capture unobservable temporal shocks applying to all firms in the same way. In keeping with the exposition in section 4.3.1, this boils down to an OLS regression of $(y_{it} - \bar{y}_{i.} - \bar{y}_{.t} + \bar{y}_{..})$ on a transformed regressor matrix with typical elements $(x_{it,k} - \bar{x}_{i.,k} - \bar{x}_{.t.,k} + \bar{x}_{..,k})$. In addition to the usual slope coefficients, the results set out in Table 5-4 include the estimates of these time effects calculated as $\lambda_t = \bar{y}_{.t} - \bar{y}_{..} - \sum_k (\bar{x}_{.t,k} - \bar{x}_{..,k})\hat{\beta}_k$.

Turning to the results, we find that except for the coefficient on capital goods imports, all concentration ratios enter with a statistically significant, negative sign, which is highly plausible: sharper competition in (domestic) sales and export markets put pressure on firms to be efficient. The log-specification entails that the coefficients are interpretable as elasticities. In particular, if the lower 90 percent of firms increase their aggregate sales market share by one percent, then firms' efficiency levels increase by 1.5 percent.

Table 5-4: Determinants of Firm Efficiency (1992-1999)[a)]

Log Concentration ratios in:	Coefficient	Std. Error	p-value
Sales	-1.493	0.134	0.000
Exports	-0.737	0.106	0.000
Imports of Capital Goods	0.931	0.113	0.000
Imports of Disembodied Technical Capital	-0.311	0.143	0.030
R&D Expenditure	-1.045	0.159	0.000
Year Dummy 1992	0.029	0.023	0.210
Year Dummy 1993	0.009	0.021	0.646
Year Dummy 1994	0.037	0.017	0.032
Year Dummy 1995	0.135	0.016	0.000
Year Dummy 1997	-0.098	0.017	0.000
Year Dummy 1998	-0.070	0.017	0.000
Year Dummy 1999	-0.047	0.018	0.010
Constant	-2.984	0.056	0.000
# of obs. (firms)	11448 (1618)		

Source: CMIE manufacturing panel; own calculations

a) Results from the two-way error component model in the fixed effects specification.

The findings for R&D expenditures and imports of disembodied technical capital (captured by the fees paid to foreigners for technical know-how) point to converging production efficiencies among firms belonging to the same 2-digit industry: the inefficiency gaps with respect to the best practice frontier diminish. However, while less concentration in R&D inputs raises efficiency scores, as expected, more evenly distributed capital goods imports work against them – an awkward finding. More strikingly, however, the very success of the NEP reforms must be questioned in light of the annual dummy coefficients. Before 1996 (the omitted reference year), the unobservable time effects improve firm efficiency; but they work to reduce it thereafter. Specifically, between 1996 and 1999, firm efficiency decreased by some $(\exp(\ 0.047) - 1) = 4.6$ percent, while between 1994 and 1996, there was an increase in firm efficiency of 3.8 percent.[104] Hence, while the hypothesized inverse relationship between concentration ratios and firms' efficiency scores is generally confirmed, the evidence in Table 5-4 suggests that by the late 90s, markets had become more concentrated, from which adverse effects on efficiency resulted.

A closer look at the data mostly affirms this presumption. Throughout the 1991-1999 period, monotone decreases in concentration ratios are observable only for R&D expenditures. By contrast, imports of disembodied technical capital had been highly unbalanced at the outset. For quite a number of 2-digit industries, the early years were promising; a more even spread of technical know-how fees paid to foreigners was observable for Beverages, Tobacco & Tobacco Products, Wool, Silk & Synthetic Fibers, Textile Products, Chemicals; Non-Metallic Mineral Products, Machinery and Transport Equipment. In the mid 1990s, however, a reverse process set in, and by 1999, we mostly observe greater concentration than in pre-reform years. The early 1990s witnessed sharper sales competition for several 2-digit industries, but in the mid nineties concentration ratios started to move upwards again.[105] As usual in empirical work, there is again an exception, viz. manufacturers of Leather and Leather & Fur Products faced harsher sales markets conditions from 1995 onwards. Furthermore, whereas the distribution of capital goods imports had been comparatively even (as in Textile Products, Wood & Wood Products, Leather & Leather Products), by 1999 the top ten percent firms accounted for 83 percent and more of total capital goods imports.

To summarize, we have verified that harsher market conditions do, in principle, work in favor of higher firm efficiency. By the later 1990s, however, the stress of competition, as measured by various concentration ratios, had declined. Eventually the upper ten

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104) See Halvorsen et al. (1980) on the correct interpretation of dummy variables in semilogarithmic regression equations.

105) This holds true for Food Products (turning point 1996), Beverages, Tobacco & Tobacco Products (1994), Jute, Hemp & Mesta Textiles (1997), Chemicals & Chemical Products (1994), Basic Metals & Alloys Industries (1999), Machinery, Machine Tools & Parts except Electrical Machinery (1997) and for other manufacturing industries (NIC-87 = 38) throughout the entire period.

percent firms came to dominate 2-digit industries, while the prospects of the rest appear worse than before. The empirical results from this section corroborate the hypothesis that the NEP reforms have brought into play forces that cause performance among firms to diverge.

5.2.2 Why do at-Risk Firms Ultimately Fall Sick or Sick Ones Recover?

In section 5.1, we found that a one percent increase in productive efficiency in the pre-reform years reduced the chances of falling sick in the 1997-1999 period by 0.192 percent and the same increase in the subsidy-sales ratios in the initial phase raised the risk by 0.353 percent. Initially efficient firms faced low risks, while initially budget-softened firms faced high risks. The budget-hardening effect seems to have been more important than the issue of economic viability. But what if the fit (fat) firms had been less (more) afflicted with sickness in the initial years as well? We could repeat the above exercise and restrict the sample to the set of initially sound firms. In this case, however, it would be equally impossible to trace their recovery (if they indeed recovered) should they fall sick. Below, we reinvestigate the fitness/fatness-issue for the set of firms that actually change their health status in one direction or the other.

We estimate a panel logit regression for the entire 1992-1999 period and test three different specifications. In the first, economic viability is measured by the firm-specific, time-varying efficiency indices, as before. In the other two, these are replaced by various input and output market concentration ratios, as in the previous sub-section.

To scrutinize how changing (government) provisions for at-risk firms impinge on the risk of failure, the budget-hardening effect is captured by the one-year lagged share of fiscal benefits granted to loss-making units in the total amount of such subsidies within 2-digit industry classes. Similarly, the respective shares of soft loans and total borrowings enter as explanatory variables, where in each case a negative coefficient would support the hypothesis that a process of gradual budget-hardening gave rise to the re-emergence of industrial sickness in the 1990s.

While a negative relationship between output market concentration ratios and efficiency scores is intuitively plausible and has mostly been confirmed, the question of whether increased (reduced) sales market competition works in favor of, or against, sickness is not that clear.[106] The appraisal of the effects of the latest NEP reforms depends on the answer.

If the coefficient on the sales market concentration ratio is statistically significant and positive, then this suggests that firms respond to increased competition by adjusting their formerly sub-optimal production processes, and so improve and succeed in business. As we have shown, competitive pressure has enhanced firm efficiency. The hypothesis to be tested at this point is that these gains in efficiency brought about lower failure rates.

On the other hand, a negative coefficient would point to overdue adjustment processes, which were taking effect: tougher competitive conditions (indicated by reduced sales market concentration ratios) send increasingly inefficient firms into sickness. A negative coefficient then implies that vulnerable firms are not in a position to survive once market forces are free to work and it would seem right to let them exit. The results are displayed in Table 5-5.

5.2.1.1 The Econometric Model

When analyzing the factors responsible for *changes* in firms' state of health in the course of the 1990s, the sample set becomes highly restricted, as firms that remain invariably sound or sick are omitted. Apparently, a fixed effects specification of the μ_i is applicable to this kind of problem. As opposed to the random effects approach used in the previous section, inference is now being drawn with respect to the effects that lie within the specific sample (and not with respect to the total population). The question of which distribution to use (normal vs. logistic) is unresolved on theoretical grounds. In most applications the particular choice does not make much of a difference, and the choice is rather governed by practical reasons (Greene, 1997, p. 875).[107] While the probit model lends itself well to the random effects treatment, the logit model lends itself better to a fixed effects treatment. In the context of modeling company failure (or recovery), the fixed effects logit specification has been adopted, for instance, by Hunter and Isachenkova (2000, 2002), Sudarsanam and Lai (2001) and Keasey and Mc Guinness (1990).

Recalling section 5.1.2, a firm's probability of being sick at time t is given by

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106) Recall that the notion of efficiency used here is a relative concept, whereas the state of sickness is defined to prevail if the (absolute) negative net worth criterion is satisfied.

107) A thorough treatment of such models is given in Hsiao (1992), or Chamberlain (1984); for a less algebraic account, see Greene (1997).

(5. 12) $\Pr ob(y_{it}^{*} > 0) = \Pr ob(v_{it} > -\underline{x}_{it}^{'}\underline{\beta} - \mu_i) = \Lambda(\underline{x}_{it}^{'}\underline{\beta} + \mu_i) = \dfrac{e^{\underline{x}_{it}^{'}\underline{\beta}+\mu_i}}{1+e^{\underline{x}_{it}^{'}\underline{\beta}+\mu_i}}$, where

$\Lambda(\cdot)$ is the commonly used notation for the logistic cumulative distribution function. In the nonlinear case, it is impossible to sweep out the time-invariant fixed effects by subtracting means across time (i.e. to apply the Q-transformation from eq. (4.14)), thus giving rise to the well-known incidental parameter problem (Neyman and Scott, 1948),[108] and ML estimates of the μ_i and the $\underline{\beta}$ will be inconsistent if N becomes large but T is small – as in our case.

Chamberlain (1980) suggests an approach based on the conditional maximum likelihood function, where the conditioning is on the number of episodes of sickness, $\sum_{t=1}^{T} y_{it}$.

In the logit model, the joint probability of $\underline{y}_i$ is given by

(5.13) $\Pr ob(\underline{y}_i) = \dfrac{\exp\left\{\left(\sum_{t=1}^{T} y_{it}\right)\mu_i + \left(\sum_{t=1}^{T} \underline{x}_{it} y_{it}\right)\underline{\beta}\right\}}{\Pi_{t=1}^{T}[1+\exp\{\underline{x}_{it}^{'}\underline{\beta}+\mu_i\}]}$,

the corresponding log-likelihood function is given by

(5.14) $\log L = -\sum_{i=1}^{N}\sum_{t=1}^{T}\log[1+\exp\{\underline{x}_{it}^{'}\underline{\beta}+\mu_i\}] + \sum_{i=1}^{N}\sum_{t=1}^{T}(\underline{x}_{it}^{'}\underline{\beta}+\mu_i)y_{it}$.

Taking partial derivatives with respect to μ_i yields

(5.15) $\dfrac{\partial \log L}{\partial \mu_i} = \sum_{t=1}^{T}\left[-\dfrac{\exp\{\underline{x}_{it}^{'}\underline{\beta}+\mu_i\}}{1+\exp\{\underline{x}_{it}^{'}\underline{\beta}+\mu_i\}} + y_{it}\right] = 0$:

Hence,

(5.16) $\sum_{t=1}^{T} y_{it} = \sum_{t=1}^{T}\dfrac{\exp\{\underline{x}_{it}^{'}\underline{\beta}+\mu_i\}}{1+\exp\{\underline{x}_{it}^{'}\underline{\beta}+\mu_i\}}$, $(i = 1, 2, \ldots, N)$.

Note that the probability of $\sum_{t=1}^{T} y_{it}$ episodes in T trials is

108) In total we have K+N unknown parameters to be estimated. The number of unknown parameters μ_i increases with the number of firms. Increasing N yields no further information about μ_i ; this is gained only by an increase in the number of periods.

$$(5.17)\ \mathrm{Prob}\left(\sum y_{it}\right) = \frac{T!}{(\sum y_{it})!(T - \sum y_{it}!)} \cdot \frac{\exp\{(\sum y_{it})\mu_i\}}{\Pi_{t=1}^{T}[1 + \exp\{\underline{x}_{it}^{'}\underline{\beta} + \mu_i\}]}$$

$$\times \left\{ \sum_{d \in B_i} \exp\left[\left(\sum_{t=1}^{T} \underline{x}_{it} d_{it}\right)\underline{\beta}\right] \right\},$$

where $B_i = \left\{(d_{i1}, d_{i2}, \ldots, d_{iT}) \mid d_{it} = 0 \quad \text{or} \quad 1, \quad \text{and} \quad \sum_{t=1}^{T} d_{it} = \sum_{t=1}^{T} y_{it}\right\}$.

Accordingly, the joint probability of firm i's vector of outcome observations, $\underline{y}_i$, conditioned on (technically: divided by) the probability of $\sum_{t=1}^{T} y_{it}$ is

$$(5.18)\quad \mathrm{Prob}\left(\underline{y}_i \mid \sum_{t=1}^{T} y_{it}\right) = \frac{\exp\{(\underline{x}_{it} y_{it})\underline{\beta}\}}{\sum_{d \in B_i} \exp\{(\sum_{t=1}^{T} \underline{x}_{it} d_{it})\ \underline{\beta}\}} \times \frac{(\sum y_{it})!\,(T - \sum y_{it})!}{T!}.$$

The important thing to see in eq. (5.18) is that conditioning on $\sum_{t=1}^{T} y_{it}$ (or rather the probability thereof) results in a term where the μ_i can be factored out and cancelled thereafter.[109]

The conditional log-likelihood function for this problem is given by

$$(5.19)\quad \log L = \sum_{i=1}^{N} \log\left(\frac{\exp\{(\sum_{t=1}^{T} \underline{x}_{it} y_{it})\underline{\beta}\}}{\sum_{d \in B_i} \exp\{(\sum_{t=1}^{T} \underline{x}_{it} d_{it})\underline{\beta}\}} \right).$$

Taking partial derivatives with respect to $\underline{\beta}$ and solving for $\underline{\beta}$ gives the conditional ML estimator, which - under mild regularity conditions - is consistent and asymptotically normal.[110] From these estimates, the marginal effects m_k are derived as again evaluated at the mean,

$$(5.20)\quad m_k = \Lambda(\underline{\bar{x}}'\underline{\hat{\beta}}) \cdot [1 - \Lambda(\underline{\bar{x}}'\underline{\hat{\beta}})] \cdot \hat{\beta}_k .$$

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109) Also note that for invariably sound or sick firms ($\sum y_{it} = 0$ and $\sum y_{it} = T$, respectively), the RHS of eq. (5.18) equals 1; hence their contribution to the likelihood function is zero and they would drop out on technical grounds if we had not omitted them anyway.

110) Also, if we were interested in the fixed effects, for given $\hat{\beta}$ corresponding estimates could be derived by solving eq. (5-16) for μ_i .

5.2.1.2 Estimation Results

The first thing to note from the results is that all three specifications do fairly well. Between 68-69 percent of the observations are correctly predicted by the respective models, quite a number of regressors are statistically significant, and the null that all coefficients equal zero is comprehensively rejected.[111] However, according to specification one, the explanatory power of the budget-hardening argument vanishes now that the sample is effectively reduced to the set of firms that actually changed its health status over the 1992-1999 period. Univocal effects come only through total loans provided to loss-making units, with the right, viz negative, sign and statistically

Table 5-5: Re-emergence of industrial sickness: competitive pressure vs. budget hardening (Panel logit estimates (1992-1999))

	Marg. Effects.	p-value	Marg. Effects.	p-value	Marg. Effects.	p-value
Firms's Efficiency Index (t-1)	-1.4666	0.000				
Lagged two-digit concentration ratios in:						
Sales			-0.0025	0.015	-0.0019	0.026
Exports			0.0020	0.004	0.0013	0.015
Imports of Capital Goods			0.0008	0.178	0.0007	0.139
Imports of Disembodied Technical Capital			0.0025	0.009	0.0016	0.039
Embodied Technical Capital (R&D)			0.0004	0.630	0.0008	0.249
Lagged Share of…						
Softloans to loss-making units	0.0154	0.141	0.0001	0.012		
Subsidies to loss-making units	-0.0138	0.207	-0.0001	0.087		
Total borrowings by loss-making units	-0.0532	0.004	-0.0003	0.000		
Year Dummy 1992	0.0912	0.001	0.0002	0.130	0.0001	0.361
Year Dummy 1993	0.0943	0.001	0.0002	0.092	0.0000	0.648
Year Dummy 1994	0.0399	0.142	0.0000	0.683	0.0000	0.727
Year Dummy 1995	0.0110	0.654	0.0000	0.632	-0.0001	0.275
Year Dummy 1997	0.0062	0.800	0.0002	0.000	0.0002	0.000
Year Dummy 1998	0.0407	0.136	0.0004	0.000	0.0004	0.000
Year Dummy 1999	0.1768	0.000	0.0006	0.000	0.0005	0.000
Number of observations (firms)	307	(2033)	615	(3609)	616	(3633)
LR-χ^2- test on the null that all coeff. equal 0[a)]	259 (11)	0.000	524 (15)	0.000	497 (12)	0.000
Log-Likelihood	-624		-1130		-1152	
Correctly classified observations in %	68.86		69.05		68.51	

Source: CMIE manufacturing panel; own calculations

[a)] In parentheses degrees of freedom equal to the number of regressors included

111) Combining aggregate data and micro data may result in standard errors that are biased downwards owing to intragroup error-term correlations. To cope with this problem we applied the correction procedure suggested in Moulton (1990).

significant. The greater the share thereof in aggregate 2-digit borrowings, the lower the individual firms' risks of falling sick. Note, however, that total borrowings include all kinds of loans, and not only government and DFI loans. The corresponding soft-loan coefficient is not significant in specification one, in which the efficiency index is highly significant. [112] If, however, the efficiency drivers are included instead, as in the second specification, then the lagged share of soft loans has a positive and highly significant coefficient. This finding not only rejects the budget-hardening argument for the re-emergence of industrial sickness, but casts serious doubts on the notion that soft loans may exert a beneficial influence upon companies' health.

As with government assistance in the form of fiscal benefits, soft loans do seem to prop up weak firms, and a less generous supply thereof in turn increases firms' risk of falling sick. As stated above, however, the overall explanatory power of the budget-hardening argument is quite low in comparison with the efficiency argument.

As with the role of market conditions (specifications 2 ond 3) we find that the availability of foreign technical know-how exerts a positive impact on firms' health status, as is plausible. More (less) evenly distributed imports of knowledge within 2-digit industries not only leads to higher (lower) efficiency scores (Table 5-4), but is also associated with a reduction (increase) in sickness probabilities. In principle, imports of capital goods and R&D expenditures work in the same direction, but the respective coefficients are not statistically significant at conventional levels. In the light of the unambiguously negative coefficient on sales concentration ratios and, in the alternative specification one, a negative coefficient on efficiency, our results strongly support the position that the introduction of self-regulating market elements raises the chances that less efficient companies will fall sick. Competitive forces drive up efficiency scores, but more vulnerable firms meet the sickness criterion. Yet the shake-out process remains incomplete as long as de facto exit constraints remain in place and sick firms are not actually liquidated.

112) In the first specification, a clearly significant and positive coefficient is verified if the soft-loan regressor entered contemporaneously.

5.3 Conclusions

The incidence of industrial sickness in the late nineties was much higher than it had been in pre-reform days. This finding, combined with the results of chapter 4 (diverging sectoral productive efficiency scores), leads to the supposition that sickness in the mid and late nineties was not so much the result of effective constraints on performance that put the fate of a firm beyond its control, but rather that weak firms fell sick once government measures of assistance were withdrawn from them. At first sight, the empirical tests support this view: public sector undertakings, firms located in backward regions, and those that had been highly subsidized before the policy reform all faced a considerably higher probability of finding themselves in a state of severe financial distress by the late nineties when compared to private sector firms, urban firms or firms with initially low levels of subsidization. Also, we found that firms that had formerly operated under heavy constraints, e.g. firms operating on a large scale or with substantial foreign investment, benefited from the reforms at least in terms of lower sickness probabilities (compared to medium-sized firms and private Indian firms as reference group).

However, a second and more direct test of the contribution of NEP reforms to the heavier incidence of industrial sickness in the later nineties revealed that at-risk firms did not primarily fall sick because state financial assistance was withdrawn, but rather because their (relative) efficiency deteriorated. Low efficiency levels were found to be the key determinant of sickness, and efficiency, in turn, is adversely affected by policies that restrict competition in output and input markets. Hence, although the common view that the erosion of firms' net worth is policy-induced could not be evaluated by means of a direct test, the indirect evidence unambiguously points in this direction.

The intuition is that the NEP reforms removed various barriers to entry, so that Indian manufacturing firms have come under greater pressure from (worldwide) competition. A more even distribution of (foreign) technology inputs and capital goods imports have likewise fostered efficiency among viable firms, while the unviable ones have been less able to meet the challenges of a liberalized policy regime. The working hypothesis that the NEP reforms unleashed forces that make for divergence in performance has found some support; in particular, the factors that account for gains in productive efficiency for viable firms, also account for the greater risk of sickness among the others.

Returning once more to the budget-hardening explanation for the re-emergence of industrial sickness, we found that the two different measures of capital structure in the regression analysis produced opposite effects on sickness probabilities.[113] Greater provision of total loans to loss-making units strengthened vulnerable firms, but a more generous supply of soft loans increased their risk of failure. This is a peculiar finding - after all, funds are funds – but the creditors are not the same. Presumably, financially weak and economically unviable firms were able to attract loans only from the government and its associated financial institutions, while financially distressed, but none the less economically viable, firms were able to tap a wider range of loan schemes (including market debt). In the next chapter, we will explore the relationship between preferential terms of finance and sickness, and analyze the role the law plays therein.

113) This finding pertains to one-year lagged financing decisions. When financing variables enter with eight-year lags (as in section 5.1), they exert no statistically significant influence on ex post sickness probabilities.

5.4 Appendix to Chapter 5

Table 5-6: Pre-reform firm characteristics and past-reform health status:

Pooled probit estimates for the probability of sickness (1997-1999)

Regressor[a]	Coefficient	Marg. Effect	p-value
EFFICIENCY-INDEX (t - 8)	-1.403	-0.289	0.000
TOTAL BORROWINGS (t - 8)	-0.003	-0.001	0.588
SOFT LOANS (t - 8)	0.002	0.000	0.983
FISCAL BENEFITS (t – 8)	1.320	0.272	0.010
Public Sector	1.138	0.350	0.000
Private, foreign firms	-0.531	-0.085	0.000
Small-scale Sector	-0.011	-0.002	0.940
Large-scale Sector	-0.440	-0.083	0.000
Single-product firms	0.140	0.031	0.095
Multiple-product firms	-0.108	-0.022	0.102
Multiple-factory firms	-0.333	-0.069	0.000
Backward-Dummy	0.199	0.044	0.013
Sector Dummy variables			
Food & Beverage	0.032	0.007	0.827
Leather & Textile	0.224	0.050	0.083
Wood & Paper	-0.514	-0.079	0.008
Chemicals	-0.037	-0.008	0.780
Non-metalic Mineral products	-0.001	0.000	0.993
Basic Metals	0.071	0.015	0.595
Machinery	-0.145	-0.028	0.295
Electronics	-0.366	-0.062	0.033
Transport	-0.526	-0.082	0.003
Constant	-0.616		
Number of firm-years	3495		
Loglikelihood	- 1318.28		

Source: CMIE; own calculations

[a] Reference group for sector dummies: rubber & plastic; reference group for type of ownership: private Indian; reference for number of products manufactured: 2-3; reference group for number of factories: 1; reference for backwardness: no backward area

Table 5-7: Robustness Checks on the Determinants of Firm Efficiency – Level Specification[a)]

	Static Model		Dynamic Panel Data Model		
	Coeff.	Marginal Signif. Lev.	Short-run Coeff.	Marginal Signif. Lev.	Implied long run Coeff.
lagged Efficiency Index			0.299	0.000	
Concentration ratios in…					
Sales	-0.120	0.005	-0.052	0.107	-0.074
Exports	-0.154	0.000	-0.045	0.013	-0.064
Imports of Capital Goods	0.059	0.014	0.240	0.000	0.342
Imports of Disembodied Technical Capital	-0.131	0.000	-0.348	0.000	-0.496
Embodied Technical Capital (R&D)	-0.078	0.016	-0.047	0.038	-0.067
Year Dummy 1992	0.003	0.516	0.016	0.000	
Year Dummy 1993	0.009	0.021	0.036	0.000	
Year Dummy 1994	0.008	0.011	0.033	0.000	
Year Dummy 1995	0.025	0.000	0.055	0.000	
Year Dummy 1997	-0.009	0.005	0.018	0.000	
Year Dummy 1998	-0.004	0.149	0.039	0.000	
Year Dummy 1999	0.003	0.431	0.030	0.000	
Constant	0.523	0.000	-0.030	0.000	
# of obs. (firms)	11448 (1618)		10200 (1575)		

Source: CMIE manufacturing panel; own calculations

[a)] Results from the two-way error component model in the fixed effects specification and from a dynamic panel data model that uses the one-step GMM estimator in first differences. The partial adjustment coefficient is (1-0.299) = 0.7

6 Sickness as a Strategic Device

In this chapter, we depart from the notion that being officially declared sick may entail great advantages. The main features of India's bankruptcy statutes have already been highlighted in chapter 2, wherein we motivated why and how the (anti-) sickness law may induce financially distressed firms to slip into sickness rather than to encourage their timely reconstruction and to reward good performers. In particular, sick units do not have to honor their debt contracts: they are exempted from debt repayment or other obligations, e.g. to suppliers, to the extent that the BIFR may suspend any existing obligations and liabilities for up to seven years. Outside experts are called on to help to work out a rehabilitation scheme, in which generous financial assistance usually plays a key role. For poorly performing firms, it might therefore pay to gamble in the hope of acquiring the status of sickness. This should be especially true for potentially sick or weak firms which do not appreciate the above privileges, but still face the same risk to be sent into liquidation (see sub-section 2.6.2).

Section 6.1 starts with an inquiry into the effectiveness of the BIFR, the SICA's main executive body. The most important finding is that SICA's performance in tackling the problem of industrial sickness is disappointing, if not utterly woeful. We seek to understand why so few firms are eventually sent into liquidation. In particular, we ask, first, how employment considerations impinge on the BIFR's recommendation ('winding up' vs. 'rehabilitation') and, second, how leverage affects a firm's probability of qualifying for the rehabilitation process. Some sectoral evidence on employment, unionization and indebtedness will be presented, which motivates the theoretical model of section 6.2.

This model takes account of the adverse incentives under SICA and approaches the incidence of sickness among firms as the result of conscious and rational behavior. The principal actor is a politician, who assists highly indebted firms with further government and DFI funds precisely in order to run them into sickness. The model predicts that both a firm's probability of falling sick, and its provisioning with soft loans are:

- increasing in its liquidation value
- decreasing in the firm's future economic potential (if it survives)
- the higher, the greater the politician's benefit from obtaining control (over the sick firm).

Conversely, the probability that a firm is run into sickness will be the lower, the higher the utility of the incumbent management to remain in control (of a sound firm).

Section 6.3 tests the model's predictions. To begin with, we estimate single-equation models of the incidence of sickness and the firm's provisioning with funds from the government and its development finance institutions. Subsequently, we take into account the simultaneous nature of failure and financial assistance, and specify a two-equation model in which they are interdependent. As a by-product, we address the question of causality, i.e. whether industrial sickness may be viewed as the result of the law that was introduced to prevent it.

6.1 Execution of the Sickness Law

In the following, we evaluate the working of the BIFR, the institution in charge of implementing the law. We present some descriptive evidence supporting our main argument, namely, that the poor implementation of the law leaves wide scope for politicians to misuse their control rights over sick firms, especially by undertaking vote-catching 'rescue' operations.

6.1.1 Performance of the BFIR

Table 6-1 lists the status of all companies that have ever been registered with the BIFR since the introduction of SICA in 1987. The second column lists the number of companies which registered with the BIFR in a given year, while the third column gives the cumulative figures. The BIFR's jurisdiction over registered cases remains in force until the company is either considered as revived[114] (column six) or fatally sick and sent for liquidation (column seven). Note that a winding-up recommendation does not necessarily entail actual liquidation; instead, 'winding-up recommended' merely indicates an *intention*.[115] The BIFR may turn down a company's 'application' for sickness status and dismiss it immediately if its net worth position has turned positive at the inquiry stage (column eight). Presumably, firms in this group are attracted by the various relief measures under SICA, but then fail to qualify for sickness status. If the BIFR considers an applicant not to be 'fatally sick' or if continuation of the firm is in the 'public interest', then a revival scheme is worked out (column five). The difference between the accu-

114) Interestingly, the BIFR classifies a company as revived if its net worth position has turned positive. A revived company may therefore still meet the SICA sickness criteria.

115) Mathur (1993) has analyzed delays in liquidation for 1859 Indian firms: For 27 percent of the firms, winding-up had been executed after 10-20 years, and for every third firm, actual liquidation took place only after at least 20 years had passed.

Table 6-1: Status of companies registered with the BIFR

col. 1	2	3	4	5	6	7	8	9	10
Year	No. of new cases	Accum. cases	No. of benches	Cases under revival	Revived cases	Winding-up recommended	Dismissed cases	Total cases decided	Pending cases
1987	311	311	24	0	0	0	8	8	303
1988	298	609	36	0	1	12	29	42	559
1989	202	811	42	6	1	31	78	116	645
1990	151	962	48	7	3	44	44	98	698
1991	155	1,117	42	12	4	48	28	92	761
1992	177	1,294	36	12	7	30	42	91	847
1993	152	1,446	36	17	12	64	59	152	847
1994	193	1,639	45	33	37	80	48	198	842
1995	115	1,754	48	50	25	64	30	169	788
1996	97	1,851	38	56	93	86	25	260	625
1997	233	2,084	25	26	37	86	22	171	687
1998	370	2,454	11	27	21	50	36	134	923
1999	413	2,867	27	31	10	66	71	178	1,158
2000	429	3,296	36	26	38	163	168	395	1,192
Total		3,296	494	303	289	824	688	2,104	1,192

Source: BIFR (2001) at http://www.bifr.nic.in/vsbifr/status.htm as on February 15th, 2001 and July 4th, 2001

mulated number of registered cases (column three) and the accumulated number of cases decided by the BIFR in column 9 (which equals the sum of columns five to eight) constitutes the 'pending cases' category. Until the mid-1990s, we observe generally falling numbers of companies registering under SICA, with a local peak in 1994, which was (arguably) due to the wider sickness definition in that year's Amendment Act.[116] In contrast, the 1991 Amendment Act, which brought public sector firms under the purview of SICA, seems not really to have affected the number of new cases. The late 1990s saw steadily rising numbers of registered cases, starting in 1997.

In the first 14 years of SICA's existence, 494 benches (tribunals) took place, i.e. an average of three sessions per month. If the sum of decisions taken by the Board in each year is related to the respective number of benches (column 9 divided by column 4), one finds that the effectiveness of the hearings has increased remarkably during the 14-year period. When the first revival schemes were developed in 1989, SICA had been in force for more than two years, i.e. it took at least 60 tribunals to pass the first 6 schemes.

116) Prior to 1994, the law pertained only to companies which had been registered for at least seven years (rather than at least five years). Furthermore, accumulated losses equal to or exceeding the net worth position would not suffice to be declared sick; an additional criterion was that the respective firm had realized negative pre-depreciation profits for two or more consecutive years, including the current year.

In contrast, approximately 11 cases on average were decided per hearing in 2000. Even though the pace of BIFR decision-making has improved, it is still far from swift: By December 2000, approximately one out of three companies ever registered under SICA was a 'pending case'. While pending cases cannot expect to receive direct transfers, they indirectly benefit from this status in as much as the suspension provisions under article 22 of the sickness law come fully into force. Although a winding-up recommendation is one of the possible outcomes when the decision is eventually taken, it is hardly an immediate threat in view of the time it takes the BIFR to reach this next decision, to say nothing of the delays in liquidation itself.

Table 6-1 shows that only in 2000 were a considerable number of companies sent into liquidation. A similar number of cases were dismissed, so that comparatively few cases entered the revival process in this year. In all earlier years, however, a considerable fraction of cases was allowed to meander through rehabilitation schemes. By 2000, not even nine percent of registered firms had been successfully revived with the Board's help[117] – and revival may not even be permanent. As of 31.12.2001, the number of survivors had dropped from 289 to 254, indicating that 35 firms had suffered a relapse.[118] If success rates are that low, what justifies the maintenance of an extensive bureaucracy that allocates public resources to evidently lost cases? A preliminary answer may come from Tables 6-2 and 6-3.

6.1.2 The Role of Employment, Unionization and Indebtedness: Sectoral Evidence

Table 6-2 classifies the 3,296 firms that have ever been registered with the BFIR until December 2000 by industries and gives the associated total employment as the sum of the reported levels of employment upon application (yearly figures on employment are not available). Firms are asked to give this information when making first application to the Board.[119] We compare these figures with the 1993 employment data in the manufacturing sector available from the Statistical Abstract India (see Table 6-3; 1993 marks the halfway point of the 1987-2000 period). What is most striking is that it is exactly the industries employing the greatest number of workers (viz. Textiles & Leather, Basic

117) Firms that fall into the 'dismissed' category have managed to recover without external help.

118) Information from the BIFR's homepage

119) Nonetheless, nearly 10 percent of BIFR-registered firms did not follow this instruction.

Table 6-2: Employment data for BIFR-registered firms: cumulative position in 2000

Industries	Total no. of firms	Accumulated employment	Employment. share in total
Food & Beverages	321	72,193	3.83
Textile & Leather	620	671,242	35.62
Wood & Paper	213	58,705	3.12
Chemicals	332	80,434	4.27
Rubber & Plastic	46	8,188	0.43
Non-metallic mineral products	130	34,571	1.83
Basic Metal & Metal Products	485	152,814	8.11
Machinery	165	80,138	4.25
Electronics	82	13,921	0.74
Transport Equipment	50	31,213	1.66
Other Manufacturing Miscellaneous	852[a)]	681,146	36.14
Total	3,296	1,884,565	100.00

Source: BIFR (2001) at http://www.bifr.nic.in/vsbifr/status.htm as on July 4th, 2001

[a)] Of these, only 534 firms actually fall into the 'miscellaneous' class; for the remaining 318 firms, sector affiliation and accordingly 'total cases' are known, but no break-down is available as to the accumulated number of workers. 15 firms belong to Food & Beverages, 42 to Chemicals, 60 to Non-metallic Mineral Products, 22 to Electronics and, notably, 179 firms belong to the machinery sector.

Metals & Metal Products and Food & Beverages[120]) which are the most frequently affected by sickness. To qualify this finding, the last column in Table 6-3 gives a measure of labor-intensity in 1993: the number of persons engaged divided by the value of net fixed assets and physical inventories. In order to facilitate inter-sectoral comparisons, we present this measure in index form, where the (L/K)-ratio of Food & Beverages, the highest, is set to 100. The leading sickness sector, viz. Textiles & Leather, is right behind, with 98.7. The Metal sector ranks number two in the absolute list of sickness cases, but its labor intensity is the lowest. This suggests that the BFIR-sample of sick Metal firms is characterized by small firms in employment terms, and that the comparatively high figure of accumulated factory employment in Table 6-2 rather results from the sheer number of factories in that sector. For Textiles, both arguments (sheer frequency and labor- intensity) apply, so that one out of three workers employed in a sick company was engaged in Textiles & Leather.

120) With 336 sick cases, Food & Beverages ranks number five behind Chemicals (374 cases) and Machinery (344 cases). See footnote to Table 6-2.

Table 6-3: 1993 employment data from the Annual Survey of Industries[a)]

Industry	Total no. of factories	Total factory employment	Share in total manufacturing empl.	Labor intensity index
Food & Beverages	63,185	1,427,245	17.1	100
Textile & Leather	26,564	2,065,828	24.8	98.7
Wood & Paper	33,137	519,462	6.2	73.2
Chemicals	9,748	333,896	4.0	24.4
Rubber & Plastic	11,224	678,224	8.1	23.3
Non-metallic Mineral Products	16,723	657,290	7.9	54.1
Basic Metal & Metal Products	23,698	1,051,100	12.6	23.0
Machinery	16,505	918,288	11.0	51.3
Electronics	874	6,4404	0.8	38.5
Transport Equipment	3,760	490,702	5.9	57.7
Other Manufacturing	2,326	12,2947	1.5	52.8
Total	207,744	8,329,386	100	

Source: CSO (ASI Summary Results for Factory Sector)

[a)] Formal sector only. Figures relate to factories employing 20 workers or more. Factories employing at least 10 workers are covered if manufacturing takes place with the aid of power.

Table 6-4 reports the degree of unionization (as measured by both the number of workers' trade unions and the number of union members per 100,000 employees) and average annual wages.

Table 6-4: Sectoral union data

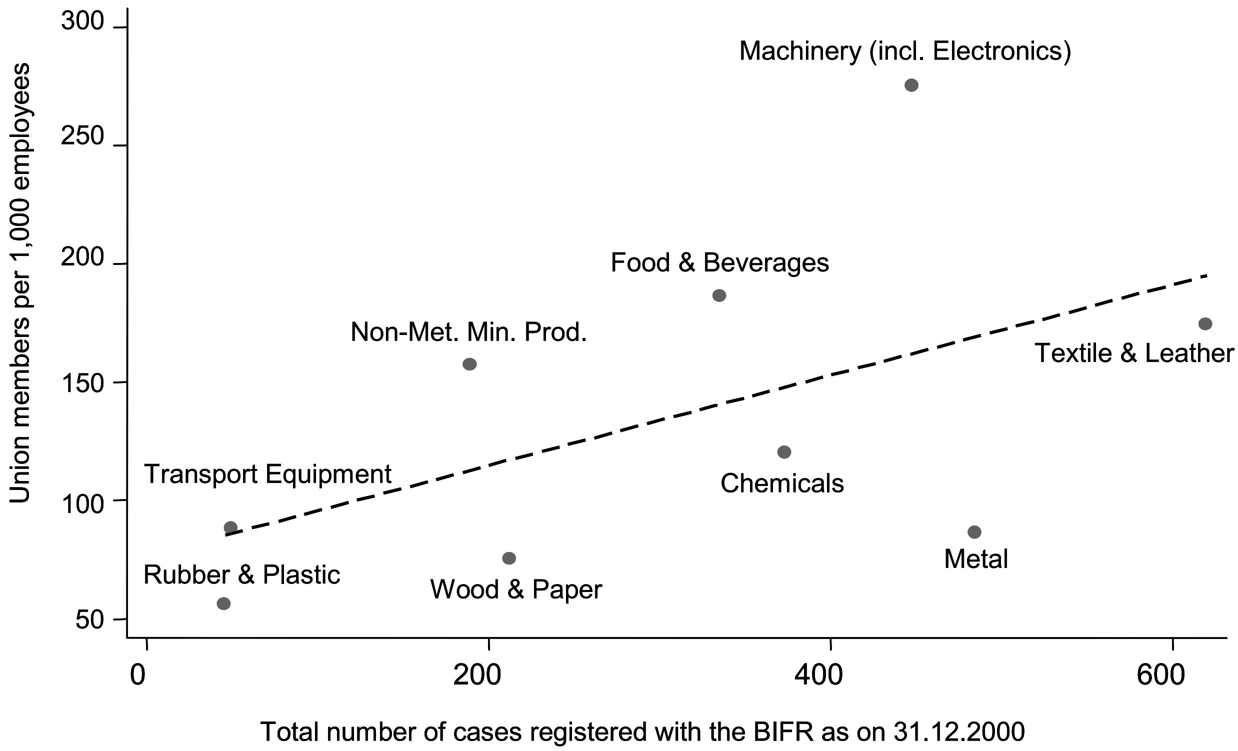
Industry	Number of workers' trade unions per 100,000 empl.[a)]	Union members per 1,000 employees[a)]	Average 1993 earnings per employee in Rs.[b)]
Food & Beverages	43	186	17,572
Textile & Leather	42	174	26,399
Wood & Paper	54	75	31,872
Chemicals	53	120	46,492
Rubber & Plastic	28	56	36,974
Non-metallic Mineral Products	30	157	24,147
Basic Metal & Metal Products	23	86	41,189
Machinery [c)]	48	275	45,310
Transport Equipment	14	88	45,610
Other Manufacturing	76	309	34,600
Total	38	154	33,343

Sources: columns 2-3, Statistical Abstract India, 1999, tables 24.5 and 25.3; column 4, CSO: ASI - summary results for factory sector

[a)] Figures only relate to unions which have been registered under the Indian Trade Unions Act; [b)] Calculated as (total emoluments/total employees); [c)] Also contains numbers for the electronic sector, for which no separate data on unionization are available.

While a high degree of unionization does not necessarily result in above-average wage rates, we do observe a strong positive correlation between the degree of unionization and the number of sick cases registered (see Figure 6-1).

Figure 6-1: Unionization vs. sickness[a)]



[a)]T The correlation coefficient is + 0.54 but significant only at the 14% level

The evidence at hand suggests that industrial sickness is not necessarily attributable to strong unions enforcing high wage rates. Instead, politicians seem to seek the support of a highly politicized working-class by securing employment. We shall argue that the presence of a self-confident working class undercuts the willingness to rationalize and retrench labor. In response, the management will put pressure on the government to soften the budget. Eventually, many such firms will fall sick – but sickness hardly ever entails winding-up. For instance, in 1992 there were 19,458 sick units in the cotton textile industry, but a mere 130 mills were closed in that year.[121] Besides Textiles, the Food and Machinery sectors serve as prominent examples of this kind of opportunism.

121) Report on Currency and Finance 1992-93, table IV-25A

Finally, we try to provide some intuition for the practice of endlessly nursing sick units instead of sending them into liquidation. Goswami (1995 b, p. 128) and Hanson (2001) argue that the banks' desire to preserve a firm's value would be the greater, the higher the level of leveraging and outstanding debt. They reason that this would be especially so if it was just the creditor with the largest exposure who was entrusted to design the rehabilitation plan – as is the case with many sick units which primarily rely on DFI-funds. In such a situation, the operating agency, or creditor, respectively, would presumably be tempted to pump in additional funds, in the hope that the subsequent turnaround would protect existing claims.

Table 6-5: Outstanding bank credit and net worth deficit

	ASI-Data	*BIFR-Data*		
Industry	Outstanding bank credit to factories in Rs. Crore[a)]	Acc. Net worth deficit of sick firms in Rs. Crore	Number of sick units	Net worth deficit per unit in Rs. crore
Food & Beverages	8,380	1,674	336	4.98
Textile & Leather	14,368	6,296	620	10.15
Wood &Paper	3,953	708	213	3.32
Chemicals	20,927	4,533	374	12.12
Rubber & Plastic	5,147	218	46	4.74
Non-Met. Mineral Prod.	5,615	790	190	4.16
Basic Metal & Met. Prod.	29,640	2,785	485	5.74
Machinery	6,932	2,629	344	7.64
Electronics	2,351	481	104	4.62
Transport	5,261	4,576	50	91.52
Miscellaneous		641	534	1.20
Other Manufacturing	983			
Total	103,557	25,332	3,296	7.69

Sources: column 2: CSO: ASI Summary Results for Factory Sector; columns 3-5: BIFR (2001) at http://www.bifr.nic.in/vsbifr/status.htm as on July 4th; a) as on March 1993

According to the ASI figures, which cover both sound and sick firms, outstanding bank credit is highest in the Metals sector, followed by Chemicals and Textile & Leather (see Table 6-5). In the latter two sectors, the average net worth deficit of BIFR-registered firms is comparatively high as well. This observation suggests that outstanding sectoral bank credit is large, not only due to the sheer number of firms within Chemicals and Textile & Leather, but also because the average indebtedness of (sick) firms within these sectors is high as well. According to the CMIE's evaluations, however, the share of public money locked up in sick units in 1993 was a low 3.3 percent in the chemical industry, in contrast to 19.7 percent in cotton industries and over 25 percent in Jute (CMIE, 1996).

Hence, in aggregate, the chemical sector does not fare too badly; but once chemical firms register as sick, they can be expected to be terminally ill.

Based on these facts, we have tried to establish an argument as to why certain industries are more prone to fall into sickness. In particular, we hypothesize that politicians do not hesitate to intervene in order to ward off liquidation of even fatally sick companies as long as their workers are strongly organized and numerous enough or, if excessive leveraging rules out coverage of existing claims anyway, value-preservation would possibly leave some scope for future debt repayment.

We leave to section 6.3 the task of clarifying how leverage affects debt renegotiation in the BIFR, and whether the reorganization schemes approved by the BIFR are correctly designed in the first place, taking into account basic economic principles and incentive effects. The next section outlines a theoretical approach that takes these considerations explicitly into account.

6.2 A Micro-Theoretical Approach to the 'Economics of Sickness'

Wohlschlegel (2002) has recently developed a microeconomic analysis of sickness. A brief description will suffice here. He considers two periods and three agents: a manager, a private investor and a politician. The manager possesses some entrepreneurial abilities, but lacks the funds to finance the enterprise, while the private investor owns funds but lacks managerial skills. The politician can influence the disposal of public funds, which may be invested in the firm or elsewhere.

At the start, the manager investigates potential forms of finance for his project and signs financial contracts with the private investor and/or politician accordingly. In period one, the project generates some random level of output drawn from the interval $[\underline{\pi}_1, \overline{\pi}_1]$. At the end of the first period, the firm either defaults - in which case it is regarded as sick - or meets all its debt repayment obligations. In Wohlschlegel's model, default implies sickness, and sickness entails replacement of the incumbent management in favor of a government-controlled director. These assumptions are very strong. Recall the evidence from Table 5-1: the incidence of loan default is not only high among sick firms, but the repayment morale of sound firms is quite poor as well. Hence, default might be a necessary indicator for sickness to occur, but it is by no means a sufficient one.

The director appointed by the government realizes some constant '2nd period output in sickness', S; but the original manager would realize an output of either zero or $\overline{\pi}_2$ in the second period. The probability of realizing the high second-period outcome is assumed to be continuous and increasing in π_1. Wohlschlegel assumes that $S \in (0, \overline{\pi}_2)$. He derives equilibrium leverage levels in a bargaining game between the politician and the manager, in which the parties involved have diametrically opposed interests: Whereas the manager obtains the utility B_M only when he has continued control over a non-defaulting firm, the investor's interest is focused exclusively on cash flow maximization. The politician, for his part, seeks to trade off the two objectives of high cash-flow on the one hand and the benefits B_P he would derive from controlling a sick firm on the other. Notice that the strategic conflict between the politician and the manager rests on the assumption that the incumbent management is replaced in case of default (sickness). There is, however, some evidence that management replacements are rather the exception than the rule.[122]

In the event of default, an investigation process is initiated with the aim of exploring the firm's recovery potential. Since this process potentially culminates in a winding-up recommendation, and politicians are the only ones who can prevent liquidation, one can easily imagine politicians taking advantage of this situation. Hence, if a politician derives utility from (indirectly) controlling the affairs of the firm when it is sick, he will prefer to invest in precisely those projects which are 'promising' candidates for default, viz. highly leveraged firms. At the same time, the leverage level preferred by the politician, and thus the probability of sickness, will be the higher, the greater is the firm's value in sickness, S, and the greater the politician's benefits from obtaining control over the sick firm, B_P. We will argue below that his benefits from control are increasing in the number of (potential) beneficiaries of his regency. On the other hand, the firm's future economic potential when it is sound, namely $\overline{\pi}_2$, reduces the probability that it will default in the present.

A second proposition in Wohlschlegel (2002) states that the government's stake in a firm is increasing in S and B_P and decreasing in $\overline{\pi}_2$. The intuition is that the government, as a proxy for sitting politicians, seeks to control as many firms as possible but possesses only limited resources. Hence, available funds should be allocated in the most efficient manner, given the objectives in question.

The manager is eager to avoid default because he fears dismissal in the case of sickness. The leverage preferred by the manager is therefore strictly smaller than that

122) Soni (1999), p. 8.

preferred by the politician. Wohlschlegel distinguishes between two different scenarios. If a project cannot be financed by private funds alone, so that government funds are essential, the politician has the power to dictate the terms of the firm's debt contract, in accordance with his own utility-maximization. If, on the other hand, purely private financing is available, then the utility the manager would obtain if the firm was purely privately financed constitutes his threat point. Therefore, the leverage preferred by the manager, and thus the probability of sickness, will decrease with the size of the manager's benefit from control, B_M.

There are two key features of the model. The first is a Shleifer-Vishny (1994) kind of argument: the politician benefits from controlling a sick firm, because only a politician-manager would be in a position to enforce the 'sacrifices in the public interest' that prevent the firm from being sent into liquidation. Needless to say, concessions in the form of employment guarantees are at the same time vote-catching concessions that work in favor of the incumbent politician's popularity and his chances of getting re-elected. Second, since default implies sickness, sickness hinges entirely on the leverage level. Sickness is therefore ultimately a matter of accounting and does not necessarily reflect the economic value of the firm. In particular, firms can manipulate their health status by changing their capital structure.

6.3 Econometric Approach

We begin by fitting two different models: Proposition one on the optimal probability of a firm falling sick is tested by means of a panel probit model along the lines of sub-section 5.1.2, where a "1" is assigned to the observation if the sickness criteria are met, and a zero otherwise. For Proposition two, on the optimal share of subsidized debt in total debt, we estimate a panel tobit model, since the provision of loans from governmental bodies or development finance institutions is censored at zero. In both models, the endogenous variable is regressed against *ex ante* firm characteristics in order to capture the model's sequential structure. Second, it has been argued that the higher a sick firm's amount of outstanding debt, the greater is the banks' desire to preserve the firm's value and pump in additional money. This is especially the case when the creditor with the largest claim is also the operating agency in charge of examining the company's recovery potential. Such financing practice is grounded on the (often vain) hope of a subsequent turnaround (Goswami,1996b, p. 128 and footnote 32; Hanson, 2001). Hence, once sick, companies that relied heavily on institutional finance can expect to extract fresh finance from old creditors. However, only if the government provides these funds in excess will over-leveraging eventually lead to sickness. Since the key variables in this setting, viz. government debt and the probability of sickness, are both endogenous and mutually dependent, the well-known simultaneous model is in order:

(6.1) $y_1 = \gamma_{12} y_2 + \underline{\beta}_1' \underline{x}_1 + u_1$

(6.2) $y_2 = \gamma_{21} y_1 + \underline{\beta}_2' \underline{x}_2 + u_2$.

In matrix notation the two-equation system is represented by

(6.3) $$\begin{pmatrix} y_1 & y_2 \end{pmatrix} \begin{pmatrix} 1 & -\gamma_{21} \\ -\gamma_{12} & 1 \end{pmatrix} = \begin{pmatrix} x_1 & x_2 & \ldots & x_K \end{pmatrix} \begin{pmatrix} \beta_{11} & \beta_{21} \\ \beta_{12} & \beta_{22} \\ \vdots & \vdots \\ \beta_{1K} & \beta_{2K} \end{pmatrix} + \begin{pmatrix} u_1 \\ u_2 \end{pmatrix},$$

or compactly written,

(6.4) $\underline{y}' \underline{\Gamma} = \underline{x}' \underline{B} + \underline{u}$,

where $\underline{x}$ is the $[K \times 1]$ vector of all the exogenous variables in $\underline{x}_1$ and $\underline{x}_2$ and $\underline{B}$ denotes the matrix of structural parameters belonging to it. $\underline{x}_1$ includes $K_1 < K$ exogenous variables and $\underline{x}_2$ includes $K_2 < K$ exogenous variables such that $(2K - 2) \geq (K_1 + K_2) \geq K$.[123]

Whenever $x_k \notin \underline{x}_1$ $(x_k \notin \underline{x}_2)$, the associated coefficient β_{1k} (β_{2k}) is set to zero. Multiplying eq. (6.4) by $\underline{\Gamma}^{-1}$, we arrive at the reduced form equations,

(6.5) $y_1 = \underline{\pi}_1' \underline{x} + v_1$

(6.6) $y_2 = \underline{\pi}_2' \underline{x} + v_2$,

where $\underline{\pi}_1 = \begin{pmatrix} \beta_{11} + \gamma_{12}\beta_{21} \\ \beta_{12} + \gamma_{12}\beta_{22} \\ \vdots \\ \beta_{1K} + \gamma_{12}\beta_{2K} \end{pmatrix} \div (1 - \gamma_{12}\gamma_{21})$ and $\underline{\pi}_2 = \begin{pmatrix} \beta_{21} + \gamma_{21}\beta_{11} \\ \beta_{22} + \gamma_{21}\beta_{12} \\ \vdots \\ \beta_{2K} + \gamma_{21}\beta_{1K} \end{pmatrix} \div (1 - \gamma_{12}\gamma_{21})$.

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123) This identifying condition means that the two sets of explanatory variables have to differ in respect of at least one exogenous regressor and that one set cannot be a perfect subset of the other.

Reduced-form coefficients take into account not only how $\underline{x}_1$ ($\underline{x}_2$) directly impinges on y_1 (y_2), but also that $\underline{x}_2$ $(\underline{x}_1)$ indirectly affects y_1 (y_2) via γ_{12} (γ_{21}).

The peculiarity of our specification is that one endogenous variable (the share of government loans in total loans) is censored at zero,[124] while the other endogenous variable (the sickness probability) is modeled as dichotomous in nature.[125] Let y_1 be the censored variable and y_2 be the binary variable. We specify

$$y_1 = \begin{cases} y_1^* \text{ if } y_1^* > 0 \\ 0 \text{ otherwise} \end{cases} \quad \text{and} \quad y_2 = \begin{cases} 1 \text{ if } y_2^* > 0 \\ 0 \text{ otherwise.} \end{cases}$$

The reduced form of equation (6.5) now involves the latent variable y_1^*:

(6.7) $y_1^* = \underline{\pi}_1^{'}\underline{x} + v_1$.

Second, when y_2 is binary, reduced form estimation of (6.6) only identifies the ratio ($\underline{\pi}_2 / \sigma_2$), where $\sigma_2^2 = \mathrm{Var}(v_2)$.[126] Therefore, we write (6.6) as

(6.8) $y_2^{**} \equiv \dfrac{y_2^*}{\sigma_2} = \dfrac{\underline{\pi}_2^{'}}{\sigma_2}\underline{x} + \dfrac{v_2}{\sigma_2} = \underline{\pi}_2^{*'}\underline{x} + v_2^*$.

The first step involves estimation of eq. (6.7) by tobit and estimation of eq. (6.8) by ML probit techniques. We store fitted values $\hat{y}_1^* = \hat{\underline{\pi}}_1^{'}\underline{x}$ and $\hat{y}_2^{**} = \hat{\underline{\pi}}_2^{*'}\underline{x}$, calculate the variance-covariance matrix of reduced form residuals, $E(v_1 v_2^{*'})$, and extract the variance σ_1^2 and covariance (σ_{12} / σ_2).

For the second step, we recall that we have $y_2^* = \sigma_2 y_2^{**}$ (from (6.8)) and estimate the new structural form equations, where endogenous regressors have been replaced by their fitted values:

(6.9) $y_1^* = \gamma_{12}\sigma_2\hat{y}_2^{**} + \underline{\beta}_1^{'}\underline{x}_1 + u_1$

and

124) In the estimation sample, there is no firm for which total borrowings equal loans from the government and from DFIs, that is, there are no cases of censoring at unity.

125) A useful reference on this type of model is Maddala (1986, pp. 242 ff., 'Model 5')

126) Strictly speaking, the left-hand side variable in (6.6) now becomes the latent variable y_2^* instead of y_2.

(6.10) $y_2^{**} = \frac{\gamma_{21}}{\sigma_2}\hat{y}_1 + \frac{\underline{\beta}_2^{'}}{\sigma_2}\underline{x}_2 + \frac{u_2}{\sigma_2}.$

RE tobit estimation of (6.9) gives a vector of two-stage coefficients $\underline{\alpha}_1^{'} = (\gamma_{12}\sigma_2, \underline{\beta}_1^{'})$ and ML probit estimation of (6.10) gives a vector of two-stage coefficients $\underline{\alpha}_2^{'} = \left(\frac{\gamma_{21}}{\sigma_2}, \frac{\underline{\beta}_2^{'}}{\sigma_2}\right)$. Standard errors for these two-stage estimates are derived by bootstrap-methods. For the sake of easier interpretation, we will not present the coefficients for the probit part, but rather the marginal effects and associated standard errors (see section 5.1.2).

The main purpose of the present analysis is to test the predictions from the theoretical model. As a 'by-product', we also attempt to shed some light on the nature and direction of causality between the two endogenous variables SICAsick and GOVDEBT, the share of loans from the government and its financial institutions in total borrowings. Strictly speaking, Wohlschlegel's theoretical model suggests an SUR-structure, i.e.

$$E(v_{1i}v_{2j}^{*'}) = \begin{cases} \frac{\sigma_{12}}{\sigma_2} \text{ if } i = j \\ 0 \text{ otherwise.} \end{cases}.$$

In this case, the endogenous variables do not interact, but both equations would be influenced only by common factors which are not explicitly captured in $\underline{x}$, so that $\underline{\Gamma} = \underline{I}$.

For the recursive model, we would verify a clear direction of causality, e.g., y_1 depends only on $\underline{x}_1$, while y_2 is directly affected by both $\underline{x}_2$ and y_1, so that $\underline{x}_1$ would indirectly impinge on y_2, too. Technically, all elements either beneath or above the main diagonal of $\underline{\Gamma}$ would be equal to zero, $\underline{\Sigma}$ would be a diagonal matrix, and the error terms of the two basic equations would be uncorrelated for each firm ('con-individual uncorrelation').

The simultaneous approach will be based on the 1999 cross-section, while single-equation estimation uses the 1992-1999 panel. The different handling of the data rests upon their limitations: testing the simultaneous model requires the inclusion of (at least) one identifying variable per equation. For the government loan equation, the availability of this variable (viz. equity shares held by DFIs, government companies and corporate bodies as percentage of total equity shares; see below) is confined to the most recent sample year.[127] In principle, however, a simultaneous panel approach would follow along just the above lines.

6.3.1 Empirical Specification

The theoretical considerations in section 6.2 lead to two propositions, both of which rest on the basic assumption that highly leveraged, but profitable firms are generously supplied with government loans. The rationale behind this is that politicians want to push firms into financial distress in order to take over control once they have fallen into sickness. Since government funds are scarce, they will be spent on the most promising candidates for sickness, viz. on highly leveraged firms – ideally, also profitable ones. To test this basic assumption, both a proxy for financial distress, LEVERAGE, and profitability, MEANPROF, enter the soft loan equation. LEVERAGE is defined as the share of total borrowings in total liabilities as realized in the previous period, while MEANPROF is mean R.o.A. (pbdit divided by total assets) over the last three years.[128] If the key idea of the model is correct, both LEVERAGE and MEANPROF should enter the government loans equation with a positive sign.

The main message from the descriptive statistics in section 6.1 is that a sick firm is never closed down immediately: it takes a very long time until the BIFR recommends liquidation, even of fatally sick firms. Actual liquidation can take much longer. As long as the firm continues to operate, jobs are relatively safe. For government-controlled sick firms, politicians can therefore present themselves as the ones who preserve jobs. Since control over jobs and workers eventually means control over voters, we proxy B_P, the politician's benefit from control, by EMPLOYMENT, the one-year lagged number of employees scaled by total borrowings.[129] From the theoretical model, we expect positive signs on EMPLOYMENT in both equations.

Second, a firm's 'value in sickness' contributes to the opportunity costs of reducing the firm's probability of falling sick. Hence, the theory predicts that, in equilibrium, an

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127) See PROWESS User's Manual, Vol. II, section on equity holding pattern datafields (page 11) „The equity holding pattern is a point-in-time kind of information. In the PROWESS package such information is available for the latest available date."

128) R.o.A. = return on assets; pbdit = profits before depreciation, interest and tax. See the glossary in Appendix A (chapter 8, Table A-1).

129) Dividing by total borrowings is compelling, since the endogenous variable of the tobit model is scaled by total borrowings, too. Otherwise a negative relation between employment and the share of subsidized loans in total loans could result just because large firms with many workers in general dispose of higher balances.

increase in S raises this probability. In the empirical specification, S is measured by the firm's LIQUIDATION VALUE, defined as the share of net fixed assets in total assets.

A healthy firm's future prospects are captured in the theoretical model by $\overline{\pi}_2$, which contribute to the opportunity cost of increasing the firm's probability of falling sick. Therefore, the manager, as the firm's residual claimant, will be the more reluctant to increase the leverage of his firm the higher is $\overline{\pi}_2$. From this argument, the theoretical model yields the result that good future prospects will reduce both the probability of sickness and the share of subsidized loans in total borrowings. We reason that (unobservable) future output is proxied best by a firm's future growth potential which, in turn, is captured by observed growth rates in the most recent past. In the empirical analysis, the relevant regressor is AVERAGE GROWTH, the average period-to-period growth rate of sales over the last three years.

In the equation for government loans, we include three further indicators of good future growth potential, namely, INTANGIBLE ASSETS (defined as the share of intangible assets in total assets), a dummy on R&D-activity, and MARKET DEBT (defined as the share of market debt in total debt). According to the theory, we should expect negative coefficients on all three; for those possessing good prospects will take advantage of their outside option and so refuse "excessive" government financing.

Finally, proposition one states that the probability that a firm will fall sick is decreasing in B_M, the manager's private benefit from controlling the company's affairs. We follow Jensen and Meckling (1976) in arguing that the manager's position goes with a high reputation and desirable fringe benefits. In accordance with the empirical literature on the choice of capital structure, we reason that both of these rewards of office are increasing in firm size, so that the 'large firm' dummy is expected to enter the sickness regression with a negative sign. Size is measured by the official criteria that define monopolies and small-scale industries, respectively, as outlined in chapter 2.2.

The panel probit model includes MEANPROF and RISK, defined as firm-specific standard deviations of R.o.A. over the last three years. Inclusion of these variables is justified on the grounds that unprofitable and highly risky projects considerably raise the chances of the firm falling into sickness, so we should control for them.

At the same time, RISK serves as the identifying variable in the probit equation of the simultaneous system. Since loans from the government and DFIs are long-term in nature, volatile income streams in the most recent past are not expected to have any impact on access to such term finance. As for the identifying variable in the tobit part of the simultaneous system, we employ EQGOVT, i.e. equity shares held by DFIs, government companies and corporate bodies as a percentage of total equity value. According to Wohlschlegel's model, EQGOVT should not affect the probability of sickness, for if the state and its institutions already maintain a considerable stake in a company, it is useless (and in fact wasteful) intentionally to push the firm into sickness. On the other hand, Goswami (1996b, p. 128 and footnote 32) and Hanson (2001) point to the role of institutional credit suppliers in India, which often provide precisely those companies with loans in which the state maintains large shares. While this view would be supported by a positive coefficient on EQGOVT, the theoretical model in section 6.2 implies a negative or insignificant coefficient. The empirical results of the following section will show which of the two opposing hypotheses is supported by the data.

In PROWESS, data on equity holding patterns is a point-in-time kind of information which is available for the most recent year only. Furthermore, information on these patterns is limited to companies listed on the Bombay Stock Exchange (BSE for short). For this reason, all estimation in this chapter is confined to the sample of Indian privately owned BSE-listed firms, and the relevant sample for the simultaneous system is further restricted to the 1999 cross-section.[130]

Finally, industry affiliation and, in particular, a location dummy enter all regressions as heterogeneity controls, where the location dummy is set to one if the headquarters of the firm are located in a backward area. This dummy aims to capture the effect of India's ideologically motivated practice of priority lending on the financial soundness of firms in backward regions.

6.3.2 *Discussion of the Results*

Table 6-6 presents the results from the panel tobit model, with which we estimate the supply of soft loans from the government or its development finance institutions. The key idea of the theoretical model is verified: access to such funds is preferentially given to financially distressed but profitable firms. Another of the model's predictions is not borne out, however: it is not high-employment firms which mainly benefit from the provision of government funds. Instead, the share of such funds in total investment is higher, the *lower* is EMPLOYMENT, the coefficient on which is borderline significant. Furthermore, not

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130) The sample is selective, but the selectivity criterion (firms listed at the BSE) is immaterial to the research question. Tables 4-1 and 4-2 in Wohlschlegel (2002, p. 124 and p. 126) present the results for the single equation approach, which is based on the (nonselective) sample of some 2,500 privately held Indian manufacturing firms. Comparing these tables with their 'selective' counterparts (Tables 6-6 and 6-7 in this study), we find no substantial changes in the results.

Table 6-6: Testing the basic model: soft loan determinants (panel estimates) [a)]

		predicted sign	Coefficient	Marg. signif. level
	Model Assumptions:			
	LEVERAGE(t-1)	(+)	0.076	0.000
	MEANPROF	(+)	0.161	0.000
	Testable Hypotheses:			
B_P:	EMPLOYMENT(t-1)	(+)	-0.017	0.085
S:	LIQUIDATION VALUE (t-1)	(+)	0.391	0.000
$\overline{\pi}_2$:	AVERAGE GROWTH	(-)	0.002	0.649
	INTANGIBLE ASSETS (t-1)		0.123	0.283
	MARKET DEBT (t-1)		-0.240	0.000
	Dummy for R&D-activity (t-1) (ref. group: no R&D)		0.001	0.892
	Dummy for large firms[b)]		0.011	0.152
	Dummy for small firms[b)]		-0.161	0.000
	Backward-Dummy (ref. group: non.backward)		0.034	0.003
Industry	Food & Beverages		-0.094	0.000
Dummies	Textile & Leather		0.010	0.605
	Wood & Paper		-0.001	0.979
(ref. industry:	Chemicals		-0.001	0.969
Rubber &	Non-metallic Mineral products		0.032	0.154
Plastic)	Basic metal & Metal products		0.014	0.508
	Machinery & Machine tools		-0.044	0.048
	Electronics		-0.032	0.209
	Transport Equipment		0.000	0.985
	Miscellaneous		-0.064	0.174
Year	1992		0.087	0.000
Dummies	1993		0.078	0.000
	1994		0.073	0.000
(ref. Year:	1995		0.057	0.000
1999)	1996		0.050	0.000
	1997		0.032	0.000
	1998		0.017	0.002
	Constant		0.047	0.025

Source: CMIE; own calculations

[a)] Results from the tobit panel model. The dependent variable is the share of government and DFI loans in total loans. Number of firms: 1,916; Number of obs.: 8,300; 1,191 left-censored observations; Wald-Teststatistic: $\chi 2(28)$ = 1,336.14; LogLikelihood: 1,258.88; [b)] Reference group: medium-sized firms. Size is measured by the criteria for SSI and MRTP firms. Small firms: gfa < Rs. 6 million until 1996 and gfa< Rs. 30 million since 1997. Large firms: gfa > Rs. 1 billion or gfa > Rs. 1 million and market share of at least 25 %.

even the large-firm dummy has a statistically significant positive sign, i.e. there is no evidence that politicians direct the disbursement of generous subsidies wherever this enhances the chances of gaining influence over as many workers (and voters) as possible.[131] The descriptive statistics in section 6.1 suggest the following ranking with respect to the degree of political awareness amongst workers (i.e. unionization): Machinery, Food & Beverages, Textile & Leather, Non-metallic Mineral Products. But the coefficients on the first two are negative and significant; those on the latter pair are positive, but statistically insignificant. The reference case is Rubber & Plastic, which is the least unionized.

It is possible, of course, that EMPLOYMENT is a poor proxy for B_P, and that a more promising approach would be to use political variables in a narrower sense, such as the number of parties within states or turnout. In the spirit of Wohlschlegel's model, one could argue that the government would be particularly eager to make funds available just before elections, when parties compete for votes and a high turnout indicates that people respond to political events. We did some research in this direction and screened data sources that were kindly provided by the Political Science Department of the South Asia Institute, Heidelberg. The problem is that elections are not held on an annual basis. To maintain the variation in time, it is hard to think of any such variable that would not be ultimately related to annual firm employment data, e.g. turnout of the last state assembly election multiplied by the number of employees as a proxy for political awareness. We constructed an index of workers' political awareness by linking sectoral union data to firm employment. However, the resulting regressor, viz. the number of unionized workers within a firm, also entered the tobit equation with a negative sign.

While a firm's LIQUIDATION VALUE clearly has a positive sign, just as the theory predicts, the results for regressors which aim to capture the prospects of high future returns are mixed. The coefficient on AVERAGE GROWTH ($\overline{\pi}_2$) itself is statistically insignificant. In other words, we cannot confirm the hypothesis that managers of promising projects avoid relying unduly on government funds, and thereby minimize the risk of sickness. However, MARKET DEBT is highly significant and enters with a negative sign. If it were the case that only firms with high growth potentials managed to attract private funds, then this result would be perfectly in line with the predictions from the theory.

The remaining coefficients mirror India's DFI-policy of the 1990s quite well:[132] Firms located in remote areas rely more heavily on soft loans. The progression of the annual dummies (all highly significant) nicely reflects the steady decline in the disbursement of

131) Though size is defined in terms of gross fixed assets and not via employment, these two alternative size concepts are highly correlated in general.

132) Recall section 2.5.

overall financial assistance. In particular, the small-scale industrial sector suffered especially heavy reductions in financial support from the mid-'90s onwards, as indicated by the negative and highly significant coefficient on small firms.

Table 6-7 reports results of the panel probit model, in which the firm's probability of falling sick is regressed against its ex-ante characteristics. We present classical marginal effects with corresponding standard errors and z-values, and, for discrete regressors, the last column gives the change in the outcome probability when the dummy switches from zero to one. The first result is that, once again, there is no empirical support for the

Table 6-7: Testing the basic model: the case of sickness (panel estimates) [a)]

		predicted sign	Marg. Eff. (classic)	Std. Err.	z-value	Marg. Eff. (Dummy)
Testable Hypotheses:						
B_P:	EMPLOYMENT(t-1)	(+)	-0.046	0.025	-1.851	
S:	LIQUIDATION VALUE (t-1)	(+)	0.093	0.027	3.452	
$\overline{\pi}_2$:	AVERAGE GROWTH	(-)	-0.012	0.005	-2.357	
B_M:	Dummy for large firms[b)]	(-)	-0.048	0.014	-3.499	-0.042
	Dummy for small firms[b)]		-0.048	0.019	-2.506	-0.042
	Backward-Dummy (ref.: non. back)		0.019	0.010	1.876	0.021
	RISK		0.376	0.096	3.929	
	MEANPROF		-0.628	0.135	-4.656	
Industry	Food & Beverages		0.033	0.019	1.711	0.031
Dummies	Textile & Leather		0.029	0.017	1.702	0.025
	Wood & Paper		-0.003	0.024	-0.129	-0.002
(reference	Chemicals		0.013	0.017	0.772	0.010
Industry	Non-metallic Mineral products		0.055	0.022	2.513	0.058
Rubber &	Basic metal & Metal products		0.055	0.019	2.879	0.059
Plastic)	Machinery & Machine tools		0.000	0.018	-0.021	0.000
	Electronics		0.024	0.021	1.170	0.021
	Transport Equipment		0.013	0.022	0.610	0.011
	Miscellaneous		-0.015	0.056	-0.260	-0.010
Year	1992		-0.007	0.015	-0.459	-0.008
Dummies	1993		-0.006	0.009	-0.682	-0.008
	1994		-0.027	0.010	-2.682	-0.029
(reference	1995		-0.039	0.011	-3.446	-0.039
Year:	1996		-0.048	0.013	-3.875	-0.045
1999)	1997		-0.018	0.008	-2.282	-0.020
	1998		-0.010	0.007	-1.443	-0.011
	Constant		-0.142	0.033	-4.366	

Source: CMIE; own calculations

a) The dependent variable is observed health status as defined by the negative net worth criterion; Number of firms: 1,927; Number of obs.: 8,328; Wald-Teststatistic: $\chi 2(25) = 496.08$; LogLikelihood: -1525.43; b) Reference-group: medium-sized firms. Size is measured by the criteria for SSI and MRTP firms. Small firms: gfa < Rs. 6 million until 1996 and gfa< Rs. 30 million since 1997. Large firms: gfa > Rs. 1 billion or gfa > Rs. 1 million and market share of at least 25 %.

model's prediction concerning EMPLOYMENT. A one percent increase in EMPLOYMENT reduces the firm's probability of falling sick by 0.046 percent, and the coefficient is significant at conventional levels. At the same time, three of the four most unionized sectors (Food & Beverages, Textile & Leather and Non-metallic Mineral Products) enter the regression with positive coefficients. This certainly confirms the positive bivariate correlation between the degree of unionization and the incidence of sick cases (Figure 6-1). But since firms in these sectors did not manage to attract higher DFI-finance (Table 6-6), with Food & Beverages even facing significantly lower provision, it seems highly questionable whether this finding on the sectoral dummies can be regarded as evidence in favor of the theoretical predictions.

That said, all remaining coefficients are in agreement with Wohlschlegel's theoretical results: A positive coefficient on LIQUIDATION VALUE supports the idea that politicians drive the 'right' firms into sickness, viz. firms which maintain a high value in sickness. Such a policy will indeed be hindered, however, if managers are keen to remain in control, which is presumably the case if the firm is large or high returns are expected in the near future. More specifically, a marginal effect as high as –0.042 implies that for large firms, the probability of falling sick is reduced by 4.2 percentage points in comparison with the reference group of medium-sized firms, and a one percent increase in AVERAGE GROWTH reduces the chances of sickness by 0.012 percent. Also, coefficients on RISK and MEANPROF have the expected signs, and both are highly significant. When profits are unstable and low, any firm will, of course, face a much higher chance of experiencing financial distress. While it is no surprise that industries in backward areas face a higher probability of sickness (plus 2.1 percentage points), the negative and significant coefficient on small firms clearly contradicts the notion that the incidence of industrial sickness was especially high in the SSI sector.[133] Arguably, differences in the concept of sickness account for this counter-intuitive finding, for the sickness criteria that apply to SSI-firms are softer.[134] Hence, it may very well be the case that small firms which met the less demanding SSI sickness criteria still realized positive net worth – in which case, they enter as "sound" in our setting.[135]

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133) See, for example, Chattopadhyay (1995), chapter 2. See also the descriptive evidence in chapter 3 (Tables 3-9 and 3-10).

134) A small scale unit is declared sick if 50 percent or more of its peak net worth during the preceding four years has been eroded and if, in addition, there is a delay in payment of principal or interest in respect of any of its creditors for a period exceeding two and a half years.

135) See section 3.1 for an extensive discussion of various sickness criteria, and when they coincide or conflict with each other.

Tables 9-10 and 9-11 in the Appendix to this chapter present cross-section estimates for the year 1999 when each equation is estimated independently. The changes in the results are minor. Things are different, however, if we estimate the 1999 cross-section simultaneously and allow for interdependence of the left hand-side variables (see Tables 6-8 and 6-9). The first thing to note is that both equations are clearly identified owing to the highly significant variables RISK in the sickness equation and EQGOVT in the soft loan equation. However, the positive sign on the latter again casts some doubt on the validity of Wohlschlegel's model, in that it rather supports the view that the government backs its own holdings with additional funds.

Table 6-8: Model extension: soft loan determinants (1999 cross-section) [a]

		predicted sign	Coef.	Std. Err.	t-value
	SICAsick (fitted value from 1st stage)		-0.033	0.023	-1.391
	Model Assumptions:				
	LEVERAGE(t-1)	(+)	0.351	0.110	3.202
	MEANPROF	(+)	0.278	0.233	1.189
	Testable Hypotheses:				
B_P:	EMPLOYMENT(t-1)	(+)	-0.254	0.112	-2.278
S:	LIQUIDATION VALUE(t-1)	(+)	0.573	0.049	11.797
$\overline{\pi}_2$:	AVERAGE GROWTH	(-)	-0.033	0.014	-2.415
	EQGOVT	(-)	0.001	0.000	2.038
	INTANGIBLE ASSETS (t-1)		-0.051	0.274	-0.187
	MARKET DEBT (t-1)		-0.354	0.057	-6.176
	Dummy for R&D-activity (t-1)		0.011	0.017	0.628
	Dummy for large firms[b]		0.011	0.021	0.524
	Dummy for small firms[b]		-0.233	0.052	-4.480
	Backward-Dummy		0.063	0.018	3.394
Industry	Food & Beverages		-0.018	0.037	-0.475
Dummies	Textile & Leather		0.006	0.031	0.180
	Wood & Paper		0.006	0.051	0.117
	Chemicals		0.029	0.031	0.919
	Non-met. Mineral products		0.043	0.044	0.994
	Basic metal & Metal prod.		0.051	0.034	1.491
	Machinery & Mach. tools		0.031	0.035	0.879
	Electronics		0.002	0.039	0.043
	Transport Equipment		0.082	0.038	2.175
	Miscellaneous		-0.127	0.149	-0.852
	Constant		-0.215		

Source: CMIE; own calculations

[a] The dependent variable is the share of government and DFI loans in total loans.; Number of firms: 1570; 327 left-censored observations; LR –Test: $\chi^2(23)$ = 557.56; LogLikelihood: -375.15; [b] Reference group: medium-sized firms. Size is measured by the criteria for SSI and MRTP firms. Small firms: gfa < Rs. 6 million until 1996 and gfa< Rs. 30 million since 1997. Large firms: gfa > Rs. 1 billion *or* gfa > Rs. 1 million *and* market share of at least 25 %.

With respect to the causal relationship between the probability of sickness and DFI-finance, the evidence suggests that it runs in one direction. The higher the share of government loans in the firm's total debt, the higher is its propensity to register sick (see Table 6.9). When evaluated at the mean, a one percent increase in GOTVTLOAN enhances the probability of sickness by no less than 0.858 percent. Once sick, however, the firm does not boost the proportion of government debt in its total borrowings. The relevant two-stage coefficient of the sickness-dummy in the tobit part of the system is far from statistically significant (see Table 6.8). These findings support the model's key idea that politicians pump in money in order to induce over-leveraging, with the result that, eventually, the probability of default (sickness) would be increasing. Once the firm is declared sick and has come under the authority of the politician-manager, however, he would rather spend scarce resources on capturing other units.

In keeping with the direction of this causal relation, the results on the remaining determinants of subsidized loans remain unaltered in qualitative terms. In quantitative terms, all covariates now exhibit somewhat greater coefficients (Table 6-8 in comparison with Table 6-6). Greater effects of the covariates are found, too, in the probit part of the simultaneous system (see Table 6-9 in comparison with Table 6-7). When soft-loan provisions and the probability of sickness are allowed to be interdependent, however, three out of four "determinants of sickness" (from theory) now switch signs. To begin with, we note that EMPLOYMENT has the anticipated, viz. positive, sign: marginal increases in the labor force raise the chances of falling sick by 0.219 percent. The same applies to the dummy on SSI firms, which now enters positively (and significantly). However, the signs on LIQUIDATION VALUE and AVERAGE GROWTH reverse, too, an awkward finding for the theory. The same applies to firms in backward areas, which have distinctly lower failure risks than those in non-backward ones.

We have already questioned the validity of Wohlschlegel's model on the basis of the results when each equation is estimated separately. The model is unambiguously rejected by the simultaneous estimation approach.

Why not question the latter econometric approach instead? The theoretical model may be rejected because it rests on assumptions that find no exact empirical counterpart. This refers to the claims that default implies sickness and that the manager of a sick company will invariably be replaced. More importantly, the theoretical model ignores the mechanics of BIFR decision-making, as outlined in Figure 2-4: if the BIFR considers a sick case not to be 'terminally ill' or if the continuation of a terminally ill company is in the 'public interest', then a revival scheme is worked out.

Table 6-9: Model extension: the case of sickness (1999 cross section)[a)]

		Predicted sign	Marg. Eff.[c)]	Std. Err.	z-value
	Model Assumption:				
	GOVTLOAN (fitted value from 1st stage)	(+)	0.858	1.288	6.516
	Testable Hypotheses:				
B_P:	EMPLOYMENT(t-1)	(+)	0.219	0.455	4.707
S:	LIQUIDATION VALUE (t-1)	(+)	-0.464	0.924	-4.912
$\overline{\pi}_2$:	AVERAGE GROWTH	(-)	0.021	0.122	1.693
B_M:	Dummy for large firms[b)]	(-)	-0.030	0.157	-2.178
	Dummy for small firms[b)]		0.187	0.553	1.763
	Backward-Dummy		-0.035	0.157	-2.758
	RISK		0.897	1.618	5.427
	MEANPROF		-1.271	1.389	-8.952
Industry	Food & Beverages		0.033	0.317	0.845
Dummies	Textile & Leather		0.033	0.292	0.967
	Wood & Paper		-0.012	0.391	-0.339
	Chemicals		-0.005	0.275	-0.167
	Non-met. Mineral products		0.022	0.364	0.516
	Basic metal & Metal products		-0.016	0.309	-0.576
	Machinery & Machine tools		0.000	0.326	0.012
	Electronics		0.001	0.362	0.020
	Transport Equipment		-0.022	0.373	-0.687
	Miscellaneous		-0.050	0.448	-3.707
	Constant			0.272	-3.430

Source: CMIE; own calculations

[a)] The dependent variable is observed health status as defined by the negative net worth criterion; Number of firms: 1585; LR-Test: $\chi^2(19)$ = 562.53; LogLikelihood: -327.53; [b)] Reference-group: medium-sized firms. Size is measured by the criteria for SSI and MRTP firms. Small firms: gfa < Rs. 6 million until 1996 and gfa< Rs. 30 million since 1997. Large firms: gfa > Rs. 1 billion *or* gfa > Rs. 1 million *and* market share of at least 25 %.; [c)] For continuous regressors classical marginal effects are displayed, while for discrete regressors we report the change in outcome probability when the respective dummy switches from zero to one.

Implementation of the rehabilitation plan requires unanimous approval of all parties involved – including representatives of the sick company (management *and* workers). If the latter vote against the draft, it must be revised. In fact, the unanimous consent provision in SICA allows for endless to-ing and fro-ing, so that the notion that only politicians can prevent liquidation would be limited to terminally ill firms whose continuation is *not* 'in the public interest'. But then, when it is not in the public interest to save the company: why should a politician who supposedly cared so much (or only) about the voting public make efforts to prevent liquidation?

On the other hand, if the BIFR indeed recommends winding-up, its responsibility with respect to the sick company comes to an end, and the High Court takes over. The High Court works too inefficiently for the BIFR's liquidation-recommendation to be more than a distant threat. These considerations lead to serious doubts about the central place given to the politicians' 'benefit from control', because either he cannot realize such benefits, or it is simply not the case that politicians are the only ones who can prevent liquidation.

6.4 Conclusion

This chapter has addressed the political economy of industrial sickness. In particular, we have tested a theoretical model developed for this purpose, whose core idea is that politicians benefit from, and accordingly pay for, sickness. Inference from single-equation estimation mostly supports the model, except for its predictions regarding the politician's benefit from controlling a sick firm. Wohlschlegel (2002, p. 128) concludes that these private benefits are hard to capture empirically and leaves it to "challenging future work" to find appropriate proxies other than variables based on employment. I am more skeptical. First, if the politician's prime goal is to be re-elected, and only that, then he would attempt to rescue firms and secure employment as a means of increasing his popularity. In that case, *not* linking his private benefits to employment would cause the whole line of argument to break down.

Second, let us focus on the estimates themselves and put the theory aside.[136] First and foremost, the state backs its own property holdings with sufficient finance and adheres to its own stated principles of priority-sector banking. Accordingly, soft loans are channeled to firms located in remote areas. These firms are typically small scale in terms of employment. Firms eligible for financing at market conditions are regarded as residual claimants and attract lower shares of soft finance. LEVERAGE, defined as total borrowings (stocks) divided by total liabilities, includes soft loans, so that a positive coefficient reflects persistence in the dependency on such subsidized loan schemes. Controlling for these banking principles, government and DFI loans are increasing in the collateral a firm can offer, which explains why a firm's profitability and its liquidation value enter the soft loan equation with a positive sign.

Third, since the model allows the provision of soft loans to increase the probability that the firm will fall sick, it would be straightforward to include the soft-loan variable in the sickness equation. Proceeding in this way and allowing the left hand-side variables to be interdependent, we find a clear direction of causality between the variables GOVTLOAN and SICAsick, viz. from the former to the latter, but not vice versa. While the

136) The following bears on the results in Tables 6-6 and 6-8.

results from the subsidized loan equation remain more or less stable (see Table 6-8 in comparison with Table 6-6), the findings from the probit (sickness) part are totally different, which accords once more with intuition (see Table 6-9 in comparison with Table 6-7). Endogenizing the provision of soft loans results in changes in signs because dependence on state financial assistance and sickness are highly related phenomena, which depend to a large degree on the same covariates. Given that excessive dependence on soft-loans develops before sickness, it follows that high-employment firms face a considerably higher risk of sickness precisely because government funds have been preferentially directed to low-employment firms. Similarly, firms with a high LIQUIDATION VALUE and low growth potential also qualify for government and DFI funds. Controlling for these selection criteria, these types of firms would face a lower risk of sickness, as would firms in backward areas.

We conclude that the sickness law certainly provides several ways for the firm's stakeholders to find advantages in sickness and thereby to get rid of their financial responsibilities. Wohlschlegel's model is original, but not especially convincing in the empirical context analyzed here.

6.5 Appendix to chapter 6

Table 6-10: Testing the basic model: soft loan determinants (1999 cross-section)[a)]

		predicted sign	Coefficient	Marg. signif. level
	Model Assumption:			
	LEVERAGE(t-1)	(+)	0.221	0.000
	MEANPROF	(+)	0.576	0.000
	Testable Hypotheses:			
B_P:	EMPLOYMENT(t-1)	(+)	-0.284	0.002
S:	LIQUIDATION VALUE(t-1)	(+)	0.573	0.000
$\overline{\pi}_2$:	AVERAGE GROWTH	(-)	-0.034	0.003
	EQGOVT	(-)	0.001	0.053
	INTANGIBLE ASSETS (t-1)		0.002	0.992
	MARKET DEBT (t-1)		-0.353	0.000
	Dummy for R&D-activity (t-1)		0.016	0.360
	Dummy for large firms[b)]		0.027	0.148
	Dummy for small firms[b)]		-0.219	0.000
	Backward-Dummy		0.060	0.001
Industry	Food & Beverages		-0.020	0.558
Dummies	Textile & Leather		-0.002	0.954
	Wood & Paper		0.008	0.851
	Chemicals		0.020	0.477
	Non-met. Mineral products		0.024	0.524
	Basic metal & Metal prod.		0.041	0.182
	Machinery & Mach. tools		0.023	0.473
	Electronics		-0.002	0.954
	Transport Equipment		0.065	0.077
	Miscellaneous		-0.055	0.537
	Constant		-0.136	0.000

Source: CMIE; own calculations

[a)] The dependent variable is the share of government and DFI loans in total loans; Number of firms: 1570; 327 left-censored observations; LR –Test: $\chi^2(22)$ = 553.85; LogLikelihood: -377.01; [b)] Reference group: medium-sized firms. Size is measured by the criteria for SSI and MRTP firms. Small firms: gfa < Rs. 6 million until 1996 and gfa< Rs. 30 million since 1997. Large firms: gfa > Rs. 1 billion *or* gfa > Rs. 1 million *and* market share of at least 25 %.

Table 6-11: Testing the basic model: the case of sickness (1999 cross-section)[a)]

		predicted sign	Marginal Effects[c)]	Marg. signific. level
	Testable Hypotheses:			
B_P:	EMPLOYMENT(t-1)	(+)	-0.124	0.211
S	LIQUIDATION VALUE (t-1)	(+)	0.085	0.017
$\overline{\pi}_2$:	AVERAGE GROWTH	(-)	-0.009	0.320
B_M:	Dummy for large firms[b)]	(-)	-0.026	0.087
	Dummy for small firms[b)]		-0.061	0.001
	Backward-Dummy		0.017	0.304
	RISK		0.978	0.000
	MEANPROF		-1.013	0.000
Industry	Food & Beverages		0.047	0.216
Dummies	Textile & Leather		0.065	0.058
	Wood & Paper		-0.005	0.903
	Chemicals		0.034	0.284
	Non-met. Mineral products		0.091	0.051
	Basic metal & Metal products		0.063	0.090
	Machinery & Machine tools		0.045	0.230
	Electronics		0.020	0.621
	Transport Equipment		0.068	0.185
	Miscellaneous		-0.062	0.315

Source: CMIE; own calculations

[a)] The dependent variable is observed health status as defined by the negative net worth criterion; Number of firms: 1585; LR-Test: $\chi^2(18) = 482.39$; LogLikelihood: -367.32; [b)] Reference-group: medium-sized firms. Size is measured by the criteria for SSI and MRTP firms. Small firms: gfa < Rs. 6 million until 1996 and gfa< Rs. 30 million since 1997. Large firms: gfa > Rs. 1 billion *or* gfa > Rs. 1 million *and* market share of at least 25 %.; [c)] For continuous regressors classical marginal effects are displayed, while for discrete regressors we report the change in outcome probability when the respective dummy switches from zero to one.

7 What Has Been Learned and what Directions Should Future Work Take?

This thesis deals with the phenomenon of industrial sickness in Indian manufacturing. So far, very few studies have explored this phenomenon in an empirically rigorous way. Based on a rich panel data set of some 4,400 manufacturing companies covering the 1988-1999 period, this thesis attempts such an analysis by looking at the problem from three different angles.

First, the descriptive evidence presented in chapter 3 assembles the elements of the picture. We investigated the temporal patterns of sickness for various industries; we identified sectors that are particularly prone to sickness, analyzed firm-wise patterns of sickness and evaluated the risk of sickness by age-class, size-class and by form of ownership. We compared sick and sound firms with respect to key variables which bear upon their health status. In doing so, state-of-the-art methods of analyzing sickness were applied to firm-level panel data. The possibilities of disaggregation over units and time dimension have been fully exploited. The resulting improvements are substantial, but in the end they are attributable to the data.

It is well-known that any bivariate empirical exercise may readily lead to fake interpretation. The merits of econometric approaches are that they allow one to evaluate the impact of any hypothetical determinant of, say, sickness, while controlling for other potential factors. Subsequent chapters therefore follow the multivariate route, and in this spirit, two approaches are pursued. The first (in chapter 5) is inherently empirical in nature, the second (in chapter 6) is model-based.

Industrial sickness increased in the 1990s and, at the same time, a wide deregulation process was also initiated. This is the starting point of chapter 5, which frames the problem of industrial sickness in the broader context of analyses of productive efficiency. Low levels of pre-reform efficiency were found to be the key determinant of sickness. Controlling for this apparent driver, the natural candidates for sickness still perform as (badly as) expected from the bivariate analyses. For instance, a high dependency on state subsidies promotes later failure, public sector firms still face a very high risk of sickness, as do firms that are located in remote areas. Efficiency, in turn, is been found to be negatively affected by policies that restrict competition, both in output and input markets. Admittedly, the established link between (former) policies of erecting barriers to entry and the subsequent rise of industrial sickness is a fragile one. When revising the thesis, I thought of renaming the corresponding section 5.2 as "A

Quick Look into the Relationship Between Market Structure, Efficiency and Re-Emerging Sickness". But since the first subsection therein is already titled as "A Quick Inquiry…" and writing the whole chapter – including the preliminary work later shifted to chapter 4 – was anything but a quick job, I decided to leave the critical appraisal to the thesis committee. In fact, I would highly appreciate suggestions as to how to model this relationship more rigorously. I have challenging future work to do in this field. Though the geographical focus is on the EU member states, I suppose that the channels through which deregulation in product-markets affects macroeconomic performance (through increasing competition, through its impact on exit and entry, and on innovation activities) are fundamental enough to allow for some generalizations.

As for the soft budget argument, Chapter 5 strongly suggests that the provision of assistance results in inefficiencies at the firm level, making the recipients more prone to the risk of sickness. This is especially true when the business climate is getting tougher, subsidies are withdrawn from former beneficiaries, and new entrants challenge the incumbents with keen competition. Using the vocabulary of Rodrik and Subramanian (2004), the conclusion is that industrial sickness results from a policy shift in the 1990s, which changed the "pro-business" economic environment of the 1980s into a "pro-market" environment. To put it the other way round: in spite of comparatively low sickness rates in the pre-reform years, the causes of the disease were arguably prevalent long before and the real extent of the problem was actually revealed in the later period. Economic consultants would conclude that greater exposure to competition forces companies drastically to restructure their ways of doing business, and to the extent that firms are incapable of adapting, adjustment should come in form of the exit of sick units.

Apparently, however, the reforms were insufficiently radical; for it is otherwise incomprehensible why soft loans continued to be granted, even though such measures drive firms into sickness. There is a clear intuition for such gradualism: it is hard to solve the sickness problem in a rigorous manner when large sections of the employees are inadequately insured against unemployment and the chances of comparable employment in other sectors are not that great. Intuitively, this makes sense; but doing applied work, I would be told more than once, "No estimation without theory!".

For this reason I was glad that my good friend and former colleague Ansgar Wohlschlegel worked out a theoretical model that motivates why there might be a generous supply of soft loans to vulnerable firms when employment considerations are important to politicians. (Actually they do not care for labor per se, but for the votes of the working class). The model establishes a rationale for the government's decisions since, in the end, the provision of such loans is in its sphere of influence. Politicians, who can replace the incumbent management of a sick company, benefit from control, and these benefits are high enough that – if certain conditions are met – it is worthwhile to provide soft finance in order to increase the risk of sickness. It is certainly nice to have such a model. But, unfortunately, this model proved to be not really suitable to undergo an empirical test. In particular, what are the politician's ultimate '*benefits from control*'? If the mapping of the model's variables to measurable variables leaves too much room for free association, then it is hard to understand the value added by the theoretical model. Being a brutal empiricist, I ask: what is the point of setting up a model if its predictions cannot be falsified due to data limitations? I accept that deriving pleasure from building models is enough reason to build them. But the assumptions must be very carefully specified to maintain a link with real-world phenomena if that is what we are interested in. If so, it is essential to dig into the "stylized facts" data section and to take a close look at the economic environment. Is the chance that the manager of a sick firm is replaced by a government official more than a distant threat? Is the politician-manager really the only one who can prevent liquidation of a sick unit and who can thereby save jobs? If he was in fact that powerful, would such rescue-actions reward him with greater popularity on such a scale as to get re-elected?

In my view, the theoretical model is rejected by the data. None the less, its key idea remains valid, viz. that the sickness law leaves much room for manipulation by defining sickness in terms of a particular capital structure. I think it would be more promising to rationalize the firm's (as opposed to the government's) decision given the existence of soft loans and the toothless sickness law. For example, it would be interesting to confront the temporal evolution of debt-profiles with the dividend payouts prior to an application for the status of sickness and then to analyze whether the peculiar Indian legislation has resulted in a kind of self-service mentality on the part of entrepreneurs who keep profit as their private property, but "socialize" their losses. The working title of this project would be "Investment in India – how to beat the system".

8 Appendix

A Concepts & Definitions

Table A-1: Glossary (in alphabetical order)

Item	Definition
Break-Even Sales	= 100 * fixed cost / profit volume ratio = fixed cost /(contribution/sales)
Capital Employed	= net worth + long term borrowing
Cash Profit	= profit after tax + (direct) tax + amortization
Combined Leverage	= contribution/pbt (n.n.r.t.)
Contribution	(= producer surplus) = sales – variable cost
Contribution to Fixed Cost	= 100 * contribution / fixed cost
Crore	Indian unit of measurement. 1 crore equals 10 million
Current Assets	= (marketable securities – marketable securities in group companies) + inventories + cash & bank balance – application money + (receivables – receivables from group and other companies)
Current Ratio	= current assets / current liabilities & provisions
Debt Service Coverage Ratio	= (amount of income left for covering debt repayment in each year)/(past and current debt including interest on these)
Debt-Equity Ratio	= total liabilities of a firm divided by total shareholder equity (OECD definition)
Depreciation Rate	= depreciation/gross fixed assets
Financial Leverage	= profit before interest and tax (n.n.r.t.)/profit before tax (n.n.r.t.)
Financial Leverage	= (total debt/equity)
Fixed Cost	= (repairs & maintenance – repairs to plant and machinery) + other expenses + depreciation + interest on short term loans + lease rent + foreign exchange loss + bad debts + amortization + 0.3*(wages & salaries)
Gross Value Added	= profit before depreciation, interest and tax (n.n.r.t.) + wages + lease (and other) rent
Holding Period	(=Number of days) = Average statement/daily statement. Example: average stock of w.i.p./average daily cost of production
Internal Sources of Funds	= retained profit + depreciation
Interest Coverage	= (profit before interest and tax (n.n.r.t.) / (interest payments + interest capitalized)
Interest Incidence	= (interest payments + interest capitalized) / average borrowings
Investment Income	= interest earned + dividend received

Table A-1 continued

Item	Definition
Lakh	Indian unit of measurement. 1 lakh equals 100,000
Leverage	= amount of long term debt relative to equity (OECD-definition)
Long-term Borrowing	= total borrowings – short term bank borrowings – commercial papers
Margin of Safety	= sales – (break-even-sales)
Market Debt	= debentures (= bonds) + fixed deposits
net Debt-to-Capital	= (total debt – cash reserves)/(debt + equity)
n.n.r.t.	= net of non-recurring transactions = extraordinary expense – extraordinary income
Net Sales	gross sales – indirect taxes
Net Value Added	= gross value added – depreciation
Net Worth	= share capital + reserves & surplus – revaluation reserves – misc. expenditures not written off
non-performing assets	repayment defaults for four quarters
Operating Income	= gross sales (synonymously)
Operating Leverage	= contribution / profit before interest and tax (n.n.r.t.)
Operating Profit	= sales – variable cost – fixed cost
Other Income	= dividends receipts + interest earned + rent received + other misc. income
Profit-Volume Ratio	= 0, if contribution < 0 and 100 * (contribution/sales), if contribution ≥ 0
Retained Profit	= profit after tax – dividends
Return on Assets	= profit before interest, depreciation and tax / total assets
Return on Income	= profit before interest, depreciation and tax / total income
Share Capital	= equity capital + preference capital
Solvency Ratio	
Total Income	= operating income + other income + change in stocks of finished and semi-finished goods
Total Liabilities	= net worth + total borrowings + current liabilities & provisions
unit	= factory
Value Added	See gross value added, and net value added, respectively
Value of Output	= gross sales – indirect taxes + change in stocks of finished & semi-finished goods
Variable Cost	= total raw material expenses – change in stocks of finished and semi-finished goods + energy + indirect taxes + 0.7*(wages & salaries) + repairs to plant and machinery + other operating expenses + advertising + marketing + distribution
Working Capital	= current assets - current liabilities & provisions

Table A-2: List of abbreviations

ASI	Annual Survey of Industries.
BIFR	Board for Industrial and Financial Reconstruction
BSE	Bombay Stock Exchange
CMIE	Centre for Monitoring the Indian Economy
CSO	Central Statistical Organisation
DFIs	Development Finance Institutions
Exim Bank	Export-Import Bank of India
FDI	Foreign Direct Investment
FERA	Foreign Exchange Regulation Act, 1973
FIPB	Foreign Investment Promotion Board
GFCF	Gross Fixed Capital Formation
ICICI	Industrial Credit and Investment Corporation of India
IDBI	Industrial Development Bank of India
IDRA	Industries (Development and Regulation Act), 1951
IFCI	Industrial Finance Corporation of India
IGIDR	Indira Gandhi Institute of Development Research
IIBI	Industrial Investment Bank of India
IRBI	Industrial Reconstruction Bank of India
MRTP	Monopolies and Restrictive Trade Practices Act, 1970
NEP	New Economic Policy
OA	Operating Agency
RBI	Reserve Bank of India
Rs	Rupees
SFCs	State Financial Corporations
SICA	Sick Industrial Companies (Special Provisions) Act, 1985
SIDBI	Small Industries Development Bank of India
SSI	Small scale industries

Table A-3: Scheme of income-expenditure account of Indian manufacturing firms

INCOME	*EXPENDITURE*
Sales	Raw Materials, Stores, etc.
Manufacturing	Raw Materials, Stores, etc.
Trading	Stores & Spares
Fiscal Benefits	Packaging Expenses
Internal Transfers	Purchase of Finished Goods
Others	Wages & Salaries
Other Income	Energy (Power & Fuel)
Dividend Received	Other Manufacturing Expenses
Interest earned	Indirect Taxes
Miscellaneous Income	Excise Duties
Change in Stocks	Repairs & Maintenance
Finished Goods	Plant & Machinery
Semi-finished goods	Other Repairs
Non-recurring Income	Selling & Distribution Expenses
Gain on Sale of Assets	Advertising
Gain on Sale of Investment	Marketing
Provisions written back	Distribution
Others	Provision for doubtful/bad debts
	Amortization
	Miscellaneous Expenses
	Non-recurring Expenses
	Loss on sale of Assets
	Loss on Sale of Investment
	Others
	Less: Expenses Capitalized
	Interest Capitalized

= PBDIT

- Interest
    - on short term loans
    - on long term loans
- Lease Rent

= PBDT

- Depreciation

= PBT

- Tax Provision
    - Corporate Tax
    - Other Direct Taxes

= PAT

Appropriation of Profit

Dividends

- Equity Dividends
- Preference Dividends

Retained Earnings

Table A-4: Stylized scheme of balance account

Fixed Assets	Equity + Reserves
Investment	Debt
Current Assets = Inventories + Receivables + Cash	Long-term
Intangible Assets	Short-term

Table A-5: Scheme of balance sheet of Indian manufacturing firms

ASSETS	*LIABILITIES*
Gross Fixed Assets	Net Worth
Land & Building	Share Capital
Plant & Machinery	Equity Capital
Other Fixed Assets	Preference Capital
Capital Work-in-Progress	
Less: Cumulative Depreciation	Reserves & Surplus
Net Fixed Assets	Free Reserves
	Share Premium Reserves
Investments	Other Free Reserves
In Group/Associate Companies	Specific Reserves
In Mutual Funds	Revaluation Reserves
Other Investments	Other Specific Reserves
Inventories	Total Borrowings
Raw Materials & Stores	Bank Borrowings
Raw Materials	Short Term
Stores & Spares	Long Term
Finished and Semi-finished Goods	Loans from Indian development institutions
Finished Goods	Loans from Government
Semi-finished Goods	Debentures/Bonds
Hired Stock	Fixed Deposits
Stock of Shares/Securities	Foreign Borrowings
Other Stock	Loans from Corporate Bodies
	Group/Associate Companies
	Other Companies
	Commercial Paper
	Other Borrowings
Receivables	
Sundry Debtors	Current Liabilities & Provisions
Debtors exceeding 6 Months	Current Liabilities & Provisions
Accrued Income	Sundry Creditors
Advances/Loans to Corporate Bodies	Interest Accrued/Due
Group/Ass. Companies	Share Application Money
Other Companies	Other Current Liabilities
Deposits with Govt./Agencies	Provisions
Advance Payment of Tax	Tax Provision
Other Receivables	Dividend Provision
	Other Provisions
Cash & Bank Balance	
Cash in Hand	
Bank Balance	
Intangible/misc. assets not written off	
Intangible Assets (Goodwill, etc.)	
Miscellaneous Expenses not written off	

TOTAL ASSETS = TOTAL LIABILITIES

Table A-6: Sources of funds - stylized scheme

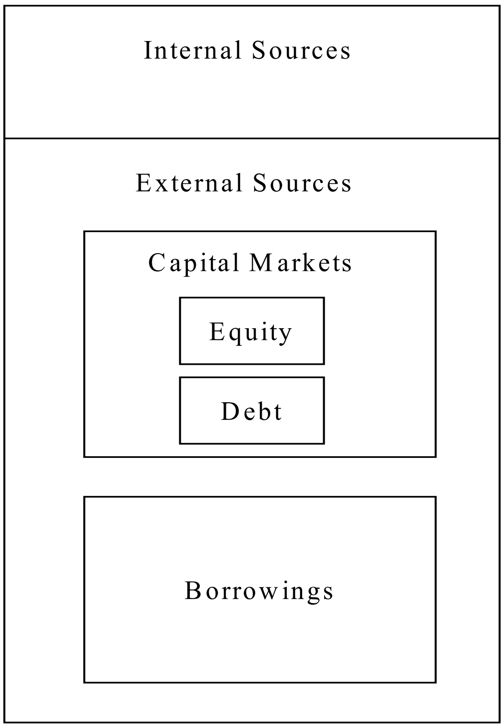

Table A-7: Sources of funds - detailed scheme

- Internal Sources
  - Retained Profit
  - Depreciation
- External Sources
  - Capital Markets
    - Equity
      - ΔShare Capital
      - ΔShare Premium Res.
    - Debt
      - ΔDebentures
      - ΔFixed Deposits
  - Borrowings
    - ΔBank Borrowings
    - ΔFinancial Institutions
    - ΔGovernment Loans
    - ΔForeign Loans
    - ΔLoans from Corporate Bodies
    - ΔCommercial Papers
    - ΔOthers

B Construction of variables from PROWESS database

B-1 Qualitative Variables

Table B-1: Re-classification of industry affiliation at the 3-digit level and wholesale-price deflators used

Product name	Starting with CMIE product-code	WPI-deflat. used[a]
A) Food Products		
Vegetable oils	40,200,000,000	III-A-i
Vanaspati	40,300,000,000	III-A-i
Oil cakes & animal feed	40,603,000,000	III-A-j
Marine foods	50,100,000,000	III-A-c
Dairy products	50,400,000,000	III-A-a
Sugar	50,501,000,000	III-A-f
Cocoa products & confectionery	50,602,000,000	III-A-h
Bakery & milling products	50,701,000,000	III-A-e
Food processing	50,900,000,000	III-A
Starches	51,000,000,000	III-A-l
Food processing	51,100,000,000	III-A
B) Beverages, Tobacco & Tobacco Products		
Beer & Liquors	51,400,000,000	III-B-b
Tobacco products	51,500,000,000	III-B-d
C) Textiles		
Silk textiles	60,100,000,000	III-C-b
Woolen textiles	60,200,000,000	III-C-c
Cotton textiles	60,300,000,000	III-C-a
Jute products	60,400,000,000	III-C-d
Synthetic yarn	60,500,000,000	III-C-b
Manufacture of readymade garments and misc. textiles	60,700,000,000	III-C
Misc. textiles	69,900,000,000	III-C
F) Leather & Leather Products		
Other leather products	70,000,000,000	III-F
Footwear	70,600,000,000	III-F
D) Wood & Wood Products		
Wood	80,100,000,000	III-D
E) Paper & Paper Products		
Paper & Paper Products	90,100,000,000	III-E-a
Books & newspapers	90,300,000,000	III-E-c

Table B-1 (continued)

Product name	Starting with CMIE product-code	WPI-deflat. used[a]
H) Chemical & Chemical Products		
Inorganic chemicals	100,100,000,000	III-H-a
Organic chemicals	100,200,000,000	III-H-b
Drugs & pharmaceuticals	100,300,000,000	III-H-f
Fertilizers	100,400,000,000	III-H-c-1
Pesticides	100,500,000,000	III-H-c-2
Dyes & pigments	100,600,000,000	III-H-e
Paints & varnishes	100,605,000,000	III-H-d
Cosmetics & toiletries	100,700,000,000	III-H-g
Soaps & detergents	100,800,000,000	III-H-g-1
Misc. chemicals	100,900,000,000	III-H
Explosives	101,000,000,000	III-H-i
Photographic films	101,100,000,000	III-H
Misc. chemicals	101,300,000,000	III-H
G) Rubber & Plastic Products		
Primary plastic: thermoplastics, plastic resins and others	110,100,000,000	III-G-b
Plastic products: plastic tubes & pipes, plastic sheets, films, packaging goods and other plastic product	110,200,000,000	III-G-b
Rubber & rubber prod.: tyres & tubes & other rubber prod.	110,300,000,000	III-G-a
I) Non-Metallic Mineral Products		
Cement	120,101,000,000	III-I-c-1
Cement & asbestos products	120,102,000,000	III-I-e
Abrasives and others graphite products	120,105,000,000	III-I-e
Structural clay products: refractories, ceramic tiles	120,200,000,000	III-I-a
Glass & glassware	120,300,000,000	III-I-b
Gems & jewellery	120,400,000,000	III-I-b
J) Basic Metals, Alloys & Metal Products		
Iron: pig iron, sponge iron	130,101,010,000	III-J-a-1
Ferro alloys	130,101,030,000	III-J-a-4
Steel: finished steel, stainless steel	130,102, 000,000	III-J-a-1
Castings & forgings	130,106,000,000	III-J-a-2
Steel tubes & pipes	130,106,040,000	III-J-a-3
Structurals	130,106,060,000	III-J-a-2
Metal tanks & fabrications	130,106,070,000	III-J-c
Steel wires	130,106,100,000	III-J-a-3
Other basic metal products	130,106,110,000	III-J-a
Non-ferrous metals	130,200,000,000	III-J-b
Aluminum & Aluminum Products	130,400,000,000	III-J-b-1
Other non-ferrous metals	130,500,000,000	III-J-b-2
Other metal products	139,900,000,000	III-J-c

Table B-1 concluded

Product name	Starting with CMIE product-code	WPI-deflat. useda
K) Machinery & Machine Tools Including Electrical Machinery		
Prime movers	140,100,000,000	III-K-a-1
Heavy machinery & parts: pumps & compressors, ball bearings, other machinery	140,200,000,000	III-K-a-1
Non-electrical machinery & parts	140,300,000,000	III-K-a
Industrial machinery (excl. chem.& text.)	140,500,000,000	III-K-a-1
Textile machinery	140,502,000,000	III-K-a-2
Chemical machinery	140,506,000,000	III-K-a-1
Industrial machinery (excl. chem.& text.)	140,507,000,000	III-K-a-1
Machine tools	140,600,000,000	III-K-a
Industrial machinery (excl. chem.& text.)	140,700,000,000	III-K-a-1
Misc. electrical machinery	150,000,000,000	III-K-b
Motors & generators	150,100,000,000	III-K-b-1
Transformers	150,200,000,000	III-K-b-1
Switching apparatus	150,300,000,000	III-K-b-1
Welding machinery	150,600,000,000	III-K-b-1
Domestic electrical appliances	150,800,000,000	III-K-b-4
Wires & cables	150,900,000,000	III-K-b-2
Dry cells, storage batteries	151,000,000,000	III-K-b-3
Domestic electrical appliances: air- conditioners, refrigerators and others	151,100,000,000	III-K-b-4
Misc. electrical machinery	159,900,000,000	III-K-b
K-b-5) Electronics		
Electronic equipments	160,000,000,000	III-K-b-5
Consumer electronics	160,100,000,000	III-K-b-5
Electronic equipments	160,200,000,000	III-K-b-5
Computer hardware & software	160,300,000,000	III-K-b-5
Communication equipment	160,400,000,000	III-K-b-5
Electronic components	160,600,000,000	III-K-b-5
L) Transport Equipment & Parts		
Other vehicles	170,100,000,000	III-L
Commercial vehicles, passenger cars, multi utility vehicles, two- and three wheelers	170,400,000,000	III-L-b
Automobile ancillaries	170,500,000,000	III-L-b
Bicycles	170,600,000,000	III-L-b
M) Other Miscellaneous Manufacturing Industries		
Misc. manufactured articles	180,000,000,000	III-M

[a] Codes as in 'Report on Currency and Finance'

Table B-2: National industry classification at the 2-digit level (NIC-87 codes)

NIC-87	Description of Industry	CMIE codes
20-21	Manufacture of Food Products	40,200,000,000-51,399,999,999
22	Manufacture of Beverages, Tobacco & Tobacco Products	51,400,000,000-59,999,999,999
23	Manufacture of Cotton Textiles	60,300,000,000-60,399,999,999
24	Manufacture of Wool, Silk and Synthetic Fibre Textiles	60,100,000,000-60,299,999,999 and 60,500,000,000-60,599,999,999
25	Manufacture of Jute, Hemp and Mesta Textiles	60,400,000,000-60,499,999,999
26	Manufacture of Textile Products	60,700,000,000-69,999,999,999
27	Manufacture of Wood & Wood Products, Furniture & Fixtures	80,000,000,000-89,999,999,999
28	Manufacture of Paper & Paper Products, Printing & Publishing	90,000,000,000-99,999,999,999
29	Manufacture of Leather and Leather & Fur Products	70,000,000,000-79,999,999,999
30	Manufacture of Chemicals and Chemical Products	100,000,000,000-109,999,999,999
31	Manufacture of Rubber & Plastic	110,000,000,000-119,999,999,999
32	Manufacture of Non-Metallic Mineral Products	120,000,000,000-129,999,999,999
33	Manufacture of Basic Metals & Alloys Industries	130,000,000,000-130,199,999,999
34	Manufacture of Metal Products & Parts except Machinery & Transport Equipment	130,200,000,000-139,999,999,999
35	Manufacture of Machinery, Machine Tools & Parts, except Electrical Machinery	140,000,000,000-149,999,999,999
36	Manufacture of Electrical Machinery, Apparatus, Appliances and Supplies & Parts	150,000,000,000-169,999,999,999
37	Manufacture of Transport Equipment & Parts	170,000,000,000-179,999,999,999
38	Other Manufacturing Industries	180,000,000,000-229,999,999,999

Table B-3: Ownership classification system

Ownership-form	CMIE-code
Public Sector	10,000,000,000
Central Government	10,100,000,000
Central Government – Commercial	10,101,000,000
Central Government – Takeover	10,101,010,000
Central Government- Miscellaneous	10,102,000,000
State Government	10,200,000,000
Non-Public Sector	20,000,000,000
Indian	20,100,000,000
Group Firms	20,101,000,000
Private Firms	20,102,000,000
Foreign	20,200,000,000
Group Firms	20,201,000,000
Group1	20,201,010,000
Group2	20,201,020,000
Private Firms	20,202,000,000
Cooperatives	20,300,000,000
Joint Ventures	20,400,000,000

B.2 Quantitative Variables

B.2.1 Construction of the Output Measure

The output measure is gross value added (see glossary in Concepts-and-Definitions Appendix (chapter 8), Table A-1). To obtain real values we deflated the series by the Index Number of Wholesale Prices (base year 1988 = 100) from the RBI's annual 'Report on Currency and Finance' (Vol. 2, various years) and for most recent years from the Statistical Abstract, India. Table B-4 below contains the relevant deflators at the 3-digit level. Details on the proper wholesale price indices for the respective industries are supplied in Table B-1 above.

Table B-4: Output-deflators at the 3-digit level

year	IIIA	IIIAa	IIIAc	IIIAe	IIIAf1	IIIAh	IIIAi	IIIAj	IIIAl	IIIBb	IIIBd	IIIC
1981	67.7	57.2	60.0	67.2	78.9	74.5	58.8	62.8	82.3	59.6	54.7	71.6
1982	65.9	59.8	79.2	72.4	65.6	76.8	61.6	61.6	85.5	63.7	54.6	75.1
1983	72.9	60.4	68.3	76.7	72.6	78.0	69.0	72.8	91.7	63.1	58.5	78.4
1984	77.1	73.2	65.6	77.2	78.9	80.9	74.2	77.6	93.3	64.9	61.0	86.0
1985	79.3	73.8	73.1	79.2	91.3	87.4	68.5	71.4	96.5	75.3	67.4	85.6
1986	87.3	78.8	80.3	87.2	93.0	93.7	84.7	84.5	106.3	83.0	73.0	83.1
1987	95.1	87.6	92.0	93.8	92.4	96.8	103.1	110.3	99.6	96.4	84.9	90.7
1988	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1989	111.8	107.1	102.8	105.4	119.9	107.7	104.3	103.5	128.4	102.3	116.0	113.3
1990	122.9	109.6	102.8	110.9	120.1	116.1	131.2	118.2	139.3	110.1	136.2	122.6
1991	139.6	128.6	109.8	133.5	126.3	122.4	156.2	141.4	158.4	117.1	149.3	134.9
1992	151.4	149.1	140.1	154.4	141.7	134.3	155.6	151.4	180.9	123.0	165.5	143.8
1993	166.9	145.2	153.8	161.4	187.1	138.6	149.6	162.1	184.7	131.1	171.6	157.5
1994	183.0	166.3	146.7	170.2	204.3	158.3	164.5	187.4	205.2	142.8	188.4	184.0
1995	188.6	184.9	146.7	185.1	192.6	174.5	177.2	196.5	220.2	169.9	206.7	211.0
1996	201.2	195.0	146.7	209.7	198.0	183.5	176.9	221.0	238.1	187.8	218.2	217.8
1997	217.4	207.4	146.7	248.5	239.7	188.5	175.9	226.8	255.1	205.6	247.5	222.3
1998	233.2	224.7	146.7	265.3	244.8	195.4	204.8	229.6	259.9	228.1	270.0	229.5
1999	235.6	246.2	157.2	286.8	248.8	200.2	179.7	237.8	291.6	231.7	283.6	230.7

Source: Report on Currency and Finance, Vol. 2 (var. issues) and Statistical Abstract India (var. issues); own calculations

Table B-4 continued

year	IIICa	IIICb	IIICc	IIICd	IIID	IIIEa	IIIEc	IIIF	IIIGa	IIIGb	IIIH	IIIHa
1981	71.1	86.5	79.7	50.8	63.9	59.6	46.0	59.4	73.6	52.7	73.6	65.6
1982	74.3	90.7	84.6	57.4	72.4	62.2	53.7	59.6	82.4	54.5	76.2	67.9
1983	77.3	90.6	84.7	73.5	78.2	71.1	56.8	64.3	82.6	53.0	79.0	72.7
1984	80.3	93.0	89.3	119.0	79.8	79.9	62.4	68.5	86.3	56.2	82.5	74.1
1985	82.7	92.8	92.2	91.2	93.2	83.1	72.4	76.1	94.1	61.8	87.1	83.5
1986	82.4	90.2	90.0	72.0	95.1	88.4	80.8	79.7	92.9	71.4	91.8	89.6
1987	90.5	95.3	96.3	79.5	98.8	93.6	94.5	84.9	96.5	85.1	97.1	92.1
1988	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1989	113.8	112.5	117.5	124.5	100.7	120.3	113.7	110.3	107.3	97.1	103.1	111.7
1990	122.8	115.6	125.0	143.6	101.6	128.2	121.6	133.2	112.8	98.6	108.9	121.4
1991	140.5	124.3	132.7	143.9	103.2	147.5	151.4	138.9	119.4	99.4	124.0	141.7
1992	153.1	132.8	147.0	138.8	203.2	155.0	205.9	135.5	129.4	102.4	141.8	163.3
1993	166.7	139.8	155.4	162.2	243.2	159.1	221.2	145.6	135.1	102.3	153.0	175.9
1994	200.4	145.8	176.9	177.9	268.8	167.2	211.5	155.4	139.7	102.5	171.3	206.1
1995	229.6	161.4	200.2	235.9	282.2	225.7	209.2	164.4	171.2	109.3	184.0	230.5
1996	236.0	167.6	195.1	251.2	284.7	230.7	206.1	167.0	175.9	118.4	190.9	257.6
1997	243.4	168.9	210.3	223.5	327.6	218.2	207.1	172.5	174.0	123.1	198.3	246.4
1998	253.1	169.1	191.1	247.2	386.5	215.5	226.9	176.4	175.7	126.9	207.5	238.0
1999	252.0	171.2	184.1	263.8	376.7	224.3	317.7	204.8	173.9	128.7	220.9	240.8

Source: Report on Currency and Finance, Vol. 2 (var. issues) and Statistical Abstract India (var. issues); own calculations

Table B-4 continued

Year	IIIHb	IIIHc1	IIIHc2	IIIHd	IIIHe	IIIHf	IIIHg	IIIHg1	IIIHi	IIIIa	IIIIb	IIIIc1
1981	92.9	101.1	71.8	n.a.	72.2	73.0	64.4	64.1	62.3	56.2	69.2	75.1
1982	95.4	106.2	78.6	n.a.	72.6	76.3	66.8	66.6	63.0	63.1	70.0	93.5
1983	94.4	100.1	84.2	n.a.	74.7	78.7	72.7	73.2	72.0	73.7	71.0	108.6
1984	94.6	99.5	87.0	n.a.	78.4	81.4	82.4	82.7	74.8	77.8	74.6	118.9
1985	100.3	101.8	88.9	n.a.	86.5	86.3	86.9	87.3	74.2	81.3	79.2	115.2
1986	99.9	108.7	91.0	n.a.	92.9	89.3	90.5	91.3	80.3	88.9	89.3	14.6
1987	97.5	108.8	95.4	n.a.	96.8	93.9	97.8	99.2	95.9	94.2	95.0	104.5
1988	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1989	101.6	100.2	106.5	107.6	110.3	102.6	99.9	99.1	100.4	112.1	104.8	111.0
1990	103.9	100.2	113.6	113.8	116.3	109.3	104.1	103.0	109.8	120.0	107.9	130.0
1991	111.3	125.3	142.3	124.7	138.2	116.7	117.2	117.3	119.3	151.8	117.1	148.0
1992	118.2	162.6	145.5	154.7	157.5	124.5	132.2	128.9	125.9	169.1	124.6	157.5
1993	119.4	183.8	155.2	170.3	160.3	136.3	139.2	129.9	139.5	188.3	128.6	156.3
1994	139.6	197.8	233.3	169.7	166.6	161.1	154.5	146.1	147.6	194.5	132.6	176.9
1995	142.6	213.0	216.5	177.0	185.5	171.9	168.3	161.1	155.1	220.1	156.5	205.2
1996	140.1	214.3	202.4	185.8	182.9	176.9	179.5	173.2	162.4	240.9	165.7	213.0
1997	142.3	226.0	206.4	191.1	180.2	191.5	196.0	189.7	172.0	255.3	164.8	204.4
1998	126.5	229.9	210.6	196.1	179.5	234.4	202.3	194.4	192.5	272.3	174.7	207.8
1999	126.5	237.9	212.0	199.6	174.8	270.5	222.9	177.7	191.2	280.2	174.1	203.8

Source: Report on Currency and Finance, Vol. 2 (var. issues) and Statistical Abstract India (var. issues); own calculations

Table B-4 continued

Year	IIIIe	IIIJa	IIIJa1	IIIJa2	IIIJa3	IIIJa4	IIIJb	IIIJb1	IIIJb2	IIIJc	IIIKa	IIIKa1
1981	65.3	57.3	61.1	54.9	51.8	56.8	50.7	58.6	45.7	58.9	64.8	63.5
1982	72.2	60.3	62.2	62.6	53.0	55.0	50.9	59.1	45.8	61.8	68.0	67.5
1983	73.9	64.4	65.4	67.5	58.3	58.8	55.1	59.7	52.3	65.6	70.8	71.1
1984	82.6	70.6	71.7	74.2	63.5	65.8	61.2	67.0	57.5	73.1	74.7	75.3
1985	87.1	83.3	86.4	82.2	79.1	73.1	64.4	71.6	59.9	77.7	80.9	81.3
1986	88.5	83.3	84.6	83.8	80.3	78.4	66.4	73.6	61.8	80.4	85.0	85.9
1987	94.3	86.8	87.5	86.7	84.9	86.8	78.8	86.4	74.1	83.7	87.4	87.8
1988	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1989	107.4	112.6	115.3	113.0	103.8	117.9	122.9	124.5	121.9	123.2	112.1	109.6
1990	118.2	118.9	123.0	118.5	108.2	122.7	129.6	129.4	129.7	137.0	123.1	120.5
1991	128.6	126.2	129.8	127.0	114.7	130.6	137.5	133.3	140.0	148.9	142.6	142.3
1992	136.9	139.0	142.2	144.2	123.2	136.6	149.7	141.9	152.8	160.1	157.7	165.2
1993	174.6	149.9	154.3	154.0	133.1	146.7	156.1	161.0	153.1	175.7	159.9	162.6
1994	194.8	164.4	165.1	171.2	148.2	180.1	173.1	179.2	169.3	184.8	172.2	183.1
1995	221.4	177.8	177.5	192.2	147.8	214.5	201.5	227.3	185.4	200.5	183.7	198.0
1996	229.7	185.1	186.5	197.5	154.3	221.8	200.6	231.0	181.6	207.1	195.1	209.9
1997	238.9	190.8	192.8	199.8	164.0	224.3	206.9	235.4	189.2	210.7	202.0	217.1
1998	240.5	192.8	195.1	201.5	166.4	225.6	208.9	242.6	188.0	214.3	209.7	230.4
1999	218.1	195.5	197.6	208.4	166.8	225.9	216.2	252.7	192.4	215.9	213.3	236.0

Source: Report on Currency and Finance, Vol. 2 (var. issues) and Statistical Abstract India (var. issues); own calculations

Table B-4 continued

Year	IIIKa2	IIIKb	IIIKb1	IIIKb2	IIIKb3	IIIKb4	IIIKb5	IIIL	IIILb	IIIM
1981	72.5	68.1	64.1	61.1	68.4	82.9	81.7	67.2	68.4	88.4
1982	75.3	68.3	65.0	58.1	73.3	84.2	83.0	69.6	70.5	90.0
1983	79.8	70.7	67.7	62.9	74.3	84.7	82.4	70.9	70.8	89.8
1984	81.6	74.1	71.1	66.1	81.4	86.8	84.8	75.2	74.8	89.7
1985	88.1	80.1	78.6	71.4	88.9	91.2	87.7	82.6	83.2	87.8
1986	90.5	83.7	83.3	74.8	90.5	95.9	88.6	87.0	87.7	94.6
1987	92.1	88.1	87.6	79.4	100.5	96.8	92.8	91.0	91.7	97.1
1988	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1989	107.3	108.1	104.0	112.0	108.5	111.4	109.6	111.6	111.6	103.6
1990	115.4	115.3	109.3	119.5	121.1	119.7	118.0	121.8	121.3	105.2
1991	132.9	133.1	127.5	141.0	143.6	132.3	128.8	136.0	134.4	113.4
1992	142.3	147.4	142.4	160.6	152.9	142.8	136.4	146.5	144.7	122.7
1993	148.4	155.3	155.5	163.8	150.8	154.2	140.7	150.3	147.6	131.0
1994	153.7	176.8	186.7	188.5	156.4	160.1	148.0	160.2	158.2	146.7
1995	157.7	192.1	197.8	223.6	165.5	163.4	149.5	170.9	169.7	150.2
1996	164.8	196.4	205.8	220.5	185.1	167.8	148.4	178.6	178.4	154.8
1997	170.6	194.6	209.4	204.0	197.9	172.3	146.0	184.6	185.2	158.3
1998	171.0	193.3	210.3	189.1	203.6	178.6	155.0	191.9	191.4	159.9
1999	171.3	190.6	208.9	183.6	203.6	176.3	153.0	197.8	197.4	161.6

Source: Report on Currency and Finance, Vol. 2 (var. issues) and Statistical Abstract India (var. issues); own calculations

B.2.2 Construction of Labor Input

The PROWESS-item 'wages' displays a company's total expenses for labor. Besides salaries and wages, items such as payment of bonuses, contributions to employees' provident funds and staff welfare expenses are also included under 'wages'. Dividing this figure by the average annual payment per employee, we get a good estimate for the number of persons employed. This is a widespread, commonly accepted method to derive employment figures at the company level. In the context of Indian manufacturing firms, recent applications include, inter alia, Hasan (2002), or Kathuria (2002). We calculated average annual payments per employee, AvWage, from the ASI data[137] at the 2-digit level:

$$\mathrm{AvWage}_{jt} = \left(\frac{\text{tot. emolum.} + \text{provident \& other funds} + \text{workmen \& staff welf. exp.}}{\text{number of employees}} \right)_{jt}$$

where j denotes the industry index at the two-digit NIC-87-level and t represents time. As of November 2001, the relevant ASI "Summary Results for the Factory Sector" had been available only up to the accounting year 1997-1998. For the two remaining years, i.e. for 1998-99 and 1999-2000, we fell back on ASI internet publications at http://www.nic.in/stat. Here, Annexure III provides for so-called quick estimates of the number of employees ('Employee'), as well as 'Labour Cost' for the accounting years 1996-97 until 1999-2000. After having corrected some obviously faulty entries, we divided 'Labour Cost' by 'Employees' to obtain $\mathrm{AvWage}_{j,1998}$ and $\mathrm{AvWage}_{j,1999}$.

From the two overlapping years (1996-97 and 1997-98), we could verify that AvWage-figures as constructed from Summary Results are almost identical to AvWage as constructed from the Quick Estimates and that the transition from one data source to the other causes no break. Industrywise results for average annual payments per employee are displayed in Table B-5.

From Table B-5 we constructed index numbers of average annual payments per employee, with base year 1988-89 in the form $(\mathrm{AvWage}_{jt} / \mathrm{AvWage}_{j,1988})$ (t = 1988, 1989, ... 1999), i.e. as the growth factors of average annual payments per employee relative to the base year 1988. As a last step, we divided the PROWESS-item 'wages' by this deflator to get firm-wise labor labor inputs into the production function.

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137) Annual Survey of Industries: Summary Results for Factory Sector; Table 5: Selected Characteristics by Major Industry Groups.

Table B-5: Average annual payments[a] per employee, by Industry (in Rs.)

NIC-87	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
20-21	12296	14388	16392	18852	20803	22461	25596	28910	34044	33271	37680	43754
22	8142	8641	9776	10811	11935	15054	15164	16565	18935	19958	20455	20013
23	19528	21445	23810	26434	29191	30989	35368	37406	39766	43290	48637	54913
24	21213	23693	26703	29619	32898	36967	39346	43949	45855	50140	49690	44495
25	20497	22123	26077	26207	31827	34905	38053	42595	44796	54731	57892	65362
26	13922	15054	17587	19219	21506	21953	24338	28527	31696	34954	35865	40492
27	11724	11804	13039	13740	16420	18204	20127	21560	25611	24328	40896	47555
28	22813	27166	29907	33540	37148	41403	52548	54643	61596	64206	68327	65889
29	14026	16317	18768	20805	24409	24901	25803	30618	33257	38737	39912	41416
30	27841	38010	44507	47440	58075	59782	68508	76366	80100	86014	98575	100528
31	33071	31789	34040	37360	41965	46058	50107	63017	65170	71542	75493	83051
32	15558	18093	19483	22196	25890	29103	33765	36572	42562	46096	47497	51487
33	31342	36311	39229	36663	49649	55718	64403	67980	78364	87396	99399	90339
34	23324	22449	26612	28975	34209	37272	43298	49546	50316	59222	63545	62672
35	29870	35761	39314	45751	50904	56071	63124	74287	79806	89422	81525	107088
36	33856	38455	42329	45751	50904	56071	63124	74287	79806	89422	81525	107088
37	32434	37548	40642	46198	50952	54370	62271	76070	80340	92040	101657	101913
38	23142	24980	28041	30693	35806	41792	44173	49295	55024	63409	68426	70852

Source: ASI Summary Results for Factory Sector (1988-1997); For 1998 and 1999: ASI Quick Estimates at www.nic.in/stat/comp96_00.htm

[a] Payments include ASI-categories 'emoluments', 'workmen and staff welfare expenses' and 'provident and other funds'.

B.2.3 Construction of Firm-Specific Capital Stocks

PROWESS provides data on total gross fixed assets, the plant and machinery component thereof, the land and buildings component and a residual which is made of work-in-progress and miscellaneous other capital, for which the breakdown is not available. Investment in each of the three components is obtained as the difference between the current value and the lagged value of the respective gross fixed asset component, which appear in the balance sheet at historic cost (hence the superscript "H"):

(B-1) $gfa^{H}_{kit} - gfa^{H}_{ki,t-1} = p_{kt} \cdot I_{kit}$ (k=1, 2, 3), where

(B-2) $gfa^{H}_{kit} = p_{kt} I_{kit} + p_{k,t-1} I_{ki,t-1} + \ldots + p_{ks} I_{kis}$.

I_{kit} is the physical amount of investment of component k at time t and "s" is the year of incorporation. $p_{kt} I_{kit}$ is referred to as current investment at replacement cost.

The replacement cost series for capital component k is calculated as

(B-3) $$(p_{kt} \cdot K_{kit}) = (1-\delta)\frac{p_{kt}}{p_{k,t-1}}(p_{k,t-1} \cdot K_{ki,t-1}) + (p_{kt} \cdot I_{kit}) \qquad (k = 1, 2, 3).$$

The LHS in eq. (B-3) is the current value, at replacement cost, of the physical stock, K_{kit}, of asset k owned by firm i at time t. The RHS is the sum of the previous year's stock, after depreciation at the rate δ, and current investment, both valued at the current price of asset k.

(i) The problem with the initial year

The recursive perpetual inventory algorithm in eq. (B-3) requires appropriate starting values $(p_{k0}K_{ki,0})$. When long time series are at hand, book values of the respective gross fixed asset type of the first sample year are typically taken, for the resulting approximation error diminishes with the length of the leading period that has been chosen. In our case, this procedure is inappropriate, for one because the time dimension is relatively short (T=12 at the most), and also because we are particularly interested in the effects of policy reforms. Hence, it is crucial to maintain the records of the initial pre-reform years. Instead, we employ transformed book values to derive the initial year capital-stock at base year b (the time a firm enters the sample):

(B-4) $$(p_{kb} \cdot K_{ki,b}) = R \cdot gfa^{H}_{ki,b},$$

where R is the factor that revalues the base year's gross fixed assets at historic cost to their replacement cost values:

(B-5) $$R = (gfa^{R}_{ki,b} / gfa^{H}_{ki,b}).$$

The derivation of the revaluation factor follows in sub-section B.2.3.1 below.

(ii) From replacement cost series to "real" capital component series at constant 1988 prices

The National Accounts Statistics and for more recent years the Statistical Abstract India, provide time series on gross fixed capital formation (gfcf) at current and constant prices, from which implicit deflators can be derived as the ratio between the former and the latter.[138] There are separate time series available for total gfcf, public sector gfcf as well as gfcf for the private corporate sector. Within the latter two sectors gfcf is

138) Within the considered 20-year period, the base year changes from time to time, so the first step is to construct smooth real time series with a uniform base year 1988.

split up into "gfcf construction", from which the "land-and-buildings"-deflator is derived and "gfcf machinery and equipment", an appropriate deflator for the "plant-and-machinery"-component. For the residual capital component (other capital) we apply the aggregate deflator within each ownership sector. The relevant deflators are listed in Table B-6.

Table B-6: Capital stock deflator-series by ownership form and type of asset (base year 88-89)

year	economy-wide	Public sector			Private corporate sector		
		total	construc-tion	machinery &equipment	total	construc-tion	machinery &equipment
1980	0.499	0.490	0.416	0.584	0.570	0.398	0.603
1981	0.559	0.544	0.465	0.642	0.619	0.471	0.645
1982	0.610	0.597	0.533	0.675	0.642	0.560	0.658
1983	0.674	0.645	0.587	0.709	0.716	0.627	0.729
1984	0.733	0.698	0.661	0.743	0.755	0.702	0.764
1985	0.821	0.789	0.758	0.821	0.837	0.768	0.851
1986	0.861	0.848	0.825	0.868	0.889	0.853	0.896
1987	0.902	0.908	0.912	0.905	0.889	0.926	0.887
1988	1	1	1	1	1	1	1
1989	1.104	1.094	1.112	1.119	1.092	1.077	1.108
1990	1.212	1.194	1.197	1.228	1.187	1.156	1.201
1991	1.389	1.370	1.364	1.413	1.349	1.301	1.369
1992	1.512	1.510	1.509	1.544	1.479	1.401	1.504
1993	1.576	1.583	1.632	1.572	1.528	1.517	1.548
1994	1.719	1.726	1.801	1.692	1.672	1.643	1.696
1995	1.856	1.909	2.030	1.823	1.751	1.854	1.752
1996	1.969	2.089	2.230	1.978	1.823	1.925	1.829
1997	2.043	2.211	2.417	2.043	1.847	1.969	1.845
1998	2.122	2.336	2.610	2.102	1.879	2.034	1.871
1999	2.179	2.439	2.748	2.143	1.900	2.072	1.890

Source: National Accounts Statistics (var. issues) and Statistical Abstract India (var. issues); own calculations

The real stock of capital component k at constant 1988 prices is generated by applying the deflators in Table B-6 to eq. (B-3)

(B-6) $$p_{k,1988} \cdot K_{kit} = (1-\delta) \cdot p_{k,1988} \cdot K_{ki,t-1} + p_{k,1988} \cdot I_{kit} .$$

In eq. (B-6) the initial year stock of capital component k at replacement enters "revalued" (see sub-section (i)) if either the firm's year of incorporation is before it entered the sample, and/or if the firm's record has holes. In the latter case gfa^H in the first year after the gap has to be revalued.

(iii) From real capital components to real stock of capital

The three capital component series are summed to give the firm's real capital stock series at constant 1988 prices

(B-7) $$p_{1988}K_{it} = \sum_{k=1}^{3}(p_{k,1988} \cdot K_{kit}).$$

This is the relevant capital stock measure that belongs to the analyses in chapters 3 and 4.

(iv) Remarks on the economic rate of depreciation

Where the economic rate of depreciation is concerned, Srivastava (1996) assumes a uniform rate of δ_i = 7.1 percent.[139] Hasan (2002) assumes the economic rate of depreciation to be at six percent, also uniformly across sectors and type of capital. In principle, the uniformity-assumption could be relaxed: depreciation rates could be endogenously determined from the data, if wear and tear of gross fixed assets were accurately provided for.

(B-8) $$\delta_i = \frac{1}{T_i}\sum_{t=1}^{T_i}(AD_{it} - AD_{i,t-1}) / gfa_{it}^{H},$$

where AD_{it} gives accumulated depreciation, as shown in the balance sheet.[140] The problem with endogenously derived depreciation rates from book values is that they are more likely to reflect accounting acrobatics than actual economic depreciation. In particular, quite a number of sick firms were found to not provide for depreciation at all, probably in an attempt to report lower losses than actually realized. If at all, then, endogenously derived depreciation rates would have to be calculated as the sectoral unweighted average of eq. (B-8) using data from sound firms only. We decided against proceeding this way, not least because the data collecting agency, the CMIE, put a big questionmark on the depreciation data.[141]

139) Srivastava (1996), p. 143.

140) A breakdown of accumulated depreciation for different capital components is not available.

141) See PROWESS User's Manual, Vol. II, section on depreciation.

B.2.3.1 Construction of the Revaluation Factors[142]

The year a firm enters the sample is referred to as the base year (year b). In year b, gross fixed assets as reported in the balance sheet are the sum of past and current (physical) investment valued at historical prices

(B-9) $gfa_b^H = p_b I_b + p_{b-1} I_{b-1} + p_{b-2} I_{b-2} + \ldots + p_{b-\tau} I_{b-\tau}$.[143]

Gross fixed assets at replacement cost are simply defined as the sum of past and current (physical) investment valued at the prices ruling in period b:

(B-10) $gfa_b^R = p_b I_b + p_b I_{b-1} + p_b I_{b-2} + \ldots + p_b I_{b-\tau} = p_b (I_b + I_{b-1} + \ldots + I_{b-\tau})$.

In eqs. (B-9) and (B-10), the earliest vintage of a firms's capital mix is τ years old. Technically, revaluation factors are calculated as the ratio between replacement cost of gross fixed assets and historical cost of gross fixed assets at the time the firm enters the sample, or re-enters the sample after a 'hole'. To make this definition applicable for empirical purposes, some simplifying assumptions are needed:

1) No firm has any capital of a vintage earlier than 1980 when it enters the sample in year b. This implies

$$\tau = \begin{cases} b - 1980 & \text{if year of incorporation} \leq 1980 \\ b - s & \text{otherwise,} \end{cases}$$

where s is the year of incorporation, and $s \leq b$.

2) Physical investment (I) is assumed to grow at a constant rate $g = (I_t / I_{t-1}) - 1$ from 1980 or the date of incorporation (whichever is later) onwards up to the firm's initial year in the sample:

$$(1+g) = \frac{I_t}{I_{t-1}} = \frac{I_{t-1}}{I_{t-2}} = \ldots = \frac{I_{t-\tau+1}}{I_{t-\tau}}.$$

For the empirical analysis, (1+g) is approximated by the growth rate of real gross fixed capital formation $GFCF^r$ between years b and s (or 1980, whichever is later):

$$(1+g) = \exp\left\{\frac{\log(GFCF_b^r) - \log(GFCF_s^r)}{b - s}\right\} \quad (s < t).$$

While g is not firm-specific, ownership of the investing firms matters, as do the year of incorporation, s, (provided the firm has been founded after 1980) and the year of

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142) The exposition closely follows Srivastava (1996, p. 141 ff).

143) The subscript k is left out to simplify the exposition.

entry ("base year"), b. Furthermore, the composition of the capital stock is accounted for by referring to different types of GFCF within ownership classes (see Table B-7, next page).

3) Annual growth rates of capital prices (π) are assumed to be constant over the respective time period between s and b:

$$\pi = (p_t/p_{t-1}) - 1 \rightarrow (1+\pi) = \frac{p_t}{p_{t-1}} = \frac{p_{t-1}}{p_{t-2}} = \ldots = \frac{p_{t-\tau+1}}{p_{t-\tau}}.$$

The growth rate of capital prices is simply the growth rate of the implicit deflator (from Table B-6) between year b and s (or 1980, whichever comes later).

Table B-7: Gross fixed capital formation at constant 1988-89 prices (in Rs. crore)

year	economy-Wide	Public sector			Private corporate sector		
		Total	construc-tion	machinery& equipment	Total	construc-tion	machinery& equipment
1980	52631.25	23857.57	16592.33	8204.78	6214.26	1277.48	5032.32
1981	56242.69	26834.41	18088.04	9637.57	9420.54	1898.62	7653.84
1982	58680.36	31108.90	18434.31	12977.34	11522.96	1775.40	9722.85
1983	59353.38	31729.17	19199.00	12953.38	9406.50	1682.35	7783.26
1984	61710.93	33512.41	18999.42	14591.59	10852.57	1760.31	9099.00
1985	66047.45	34848.83	20189.73	14865.49	11993.29	1898.62	10086.21
1986	72102.57	39237.58	22534.30	16878.59	13720.15	2200.38	11519.76
1987	80030.51	38072.55	21168.44	16873.46	11501.90	1704.98	9749.40
1988	85669	39866	22277	17589	12246	1964	10282
1989	93106.20	40094.52	19766.51	19567.87	14181.70	1828.21	12201.68
1990	102336.10	42032.83	21283.86	20113.94	17609.11	2507.18	14994.10
1991	98239.93	42871.41	22065.38	20261.16	25943.34	3543.25	22190.01
1992	105080.20	39802.75	21074.66	18340.49	28380.96	3940.57	24232.47
1993	116934.40	43494.71	22418.38	20535.40	33630.75	4848.72	28448.94
1994	129214.60	51482.60	25138.25	25757.53	35504.43	4658.22	30485.43
1995	155940.50	47975.38	25570.32	21776.19	55444.13	8504.37	46400.73
1996	158400.50	45152.30	24683.51	19853.28	64815.82	8218.95	55932.60
1997	161879.40	43904.68	22734.01	20620.66	66435.58	10572.78	55224.48
1998	175860.70	47211.02	24163.81	22466.58	61868.84	9792.35	51481.00
1999	190990.40	51084.63	27348.83	23061.52	61056.02	9600.53	50866.56

Source: Report on Currency and Finance, Vol. 2 (var. issues) and Statistical Abstract India (var. issues); own calculations

Under assumptions 1-3 we have

(B-11) $$gfa_b^H = (pI)_b \cdot \sum_{t=0}^{\tau} \left(\frac{1}{(1+g)(1+\pi)} \right)^t$$ and

(B-12) $$gfa_b^R = (pI)_b \cdot \sum_{t=0}^{\tau} \left(\frac{1}{(1+g)} \right)^t .$$

For programming, it is more convenient to re-write eq. (B-11) and (B-12) without the sigma sign. Since both are geometric series, we have

(B-11.a) $$gfa_t^H = (pI)_b \cdot \frac{(1+g)(1+\pi)}{(1+g)(1+\pi)\text{-}1} \cdot \left(1 - \left(\frac{1}{(1+g)(1+\pi)} \right)^{(\tau+1)} \right),$$

and

(B-12.a) $$gfa_b^R = (pI)_b \cdot \frac{(1+g)}{g} \cdot \left(1 - \left(\frac{1}{1+g} \right)^{(\tau+1)} \right).$$

The revaluation factor is then obtained as the ratio between (B-12.a) and (B-11.a)

(B-13) $$R = \frac{gfa_b^R}{gfa_b^H} = \frac{[(1+g)(1+\pi)-1]}{g \cdot (1+\pi)} \cdot \left(\frac{1 - \left(\frac{1}{(1+g)} \right)^{\tau+1}}{1 - \left(\frac{1}{(1+g)(1+\pi)} \right)^{\tau+1}} \right).$$

Table B.8a to B-8g report the revaluation factors for initial year capital stocks for various types of gross fixed assets.

B.2.3.2 Revaluation Factors by Form of Ownership and Capital Component (1981-1999)

Table B-8a: Revaluation factors for initial year capital stock (total economy)

	Year of incorporation																		
year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1981	1.0547																		
1982	1.0973	1.0421																	
1983	1.1488	1.0926	1.0497																
1984	1.1918	1.1353	1.0921	1.0415															
1985	1.2480	1.1916	1.1481	1.0967	1.0546														
1986	1.2676	1.2121	1.1691	1.1181	1.0765	1.0222													
1987	1.2854	1.2311	1.1889	1.1386	1.0976	1.0440	1.0223												
1988	1.3337	1.2800	1.2379	1.1873	1.1462	1.0926	1.0713	1.0496											
1989	1.3775	1.3247	1.2832	1.2325	1.1917	1.1385	1.1178	1.0969	1.0472										
1990	1.4159	1.3644	1.3236	1.2733	1.2330	1.1806	1.1606	1.1406	1.0912	1.0443									
1991	1.4928	1.4406	1.3990	1.3469	1.3056	1.2520	1.2326	1.2134	1.1627	1.1147	1.0698								
1992	1.5287	1.4776	1.4367	1.3848	1.3440	1.2910	1.2725	1.2542	1.2039	1.1562	1.1113	1.0407							
1993	1.5359	1.4865	1.4467	1.3961	1.3563	1.3048	1.2870	1.2695	1.2203	1.1736	1.1295	1.0597	1.0197						
1994	1.5653	1.5175	1.4789	1.4292	1.3904	1.3402	1.3234	1.3071	1.2589	1.2132	1.1700	1.0998	1.0601	1.0410					
1995	1.5735	1.5287	1.4923	1.4448	1.4080	1.3604	1.3451	1.3302	1.2843	1.2407	1.1996	1.1309	1.0925	1.0744	1.0347				
1996	1.6006	1.5563	1.5200	1.4725	1.4358	1.3885	1.3737	1.3596	1.3137	1.2703	1.2293	1.1596	1.1211	1.1035	1.0638	1.0293			
1997	1.6163	1.5723	1.5364	1.4890	1.4525	1.4054	1.3911	1.3775	1.3319	1.2887	1.2479	1.1776	1.1392	1.1220	1.0823	1.0478	1.0184		
1998	1.6211	1.5784	1.5434	1.4970	1.4614	1.4155	1.4019	1.3890	1.3444	1.3022	1.2624	1.1927	1.1550	1.1384	1.0992	1.0656	1.0364	1.0181	
1999	1.6203	1.5787	1.5447	1.4993	1.4645	1.4198	1.4067	1.3945	1.3509	1.3096	1.2707	1.2019	1.1648	1.1487	1.1103	1.0774	1.0484	1.0304	1.0126

Table B-8b: Revaluation factors for initial year capital stock (public sector undertakings)

	Year of incorporation																		
year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1981	1.0489																		
1982	1.0910	1.0432																	
1983	1.1286	1.0808	1.0375																
1984	1.1668	1.1194	1.0768	1.0389															
1985	1.2266	1.1798	1.1381	1.0993	1.0599														
1986	1.2556	1.2103	1.1701	1.1316	1.0927	1.0335													
1987	1.2941	1.2486	1.2084	1.1692	1.1297	1.0687	1.0350												
1988	1.3406	1.2960	1.2571	1.2175	1.1780	1.1164	1.0833	1.0470											
1989	1.3878	1.3437	1.3057	1.2655	1.2256	1.1629	1.1301	1.0927	1.0447										
1990	1.4293	1.3864	1.3498	1.3095	1.2698	1.2068	1.1747	1.1364	1.0880	1.0425									
1991	1.5004	1.4589	1.4243	1.3833	1.3436	1.2795	1.2483	1.2081	1.1588	1.1116	1.0681								
1992	1.5658	1.5242	1.4900	1.4476	1.4069	1.3404	1.3093	1.2671	1.2161	1.1669	1.1221	1.0506							
1993	1.5789	1.5389	1.5063	1.4647	1.4249	1.3595	1.3294	1.2875	1.2371	1.1883	1.1437	1.0727	1.0224						
1994	1.5981	1.5612	1.5319	1.4918	1.4539	1.3909	1.3630	1.3214	1.2726	1.2247	1.1813	1.1117	1.0613	1.0394					
1995	1.6657	1.6292	1.6008	1.5594	1.5208	1.4557	1.4282	1.3846	1.3343	1.2844	1.2396	1.1670	1.1133	1.0917	1.0523				
1996	1.7286	1.6924	1.6650	1.6225	1.5833	1.5163	1.4892	1.4437	1.3920	1.3403	1.2943	1.2189	1.1623	1.1409	1.1013	1.0463			
1997	1.7684	1.7325	1.7058	1.6627	1.6232	1.5552	1.5284	1.4818	1.4293	1.3766	1.3299	1.2528	1.1946	1.1732	1.1332	1.0766	1.0289		
1998	1.7846	1.7504	1.7255	1.6832	1.6446	1.5778	1.5523	1.5058	1.4542	1.4018	1.3557	1.2791	1.2206	1.1997	1.1606	1.1035	1.0556	1.0265	
1999	1.7918	1.7592	1.7358	1.6944	1.6570	1.5915	1.5672	1.5212	1.4705	1.4188	1.3735	1.2977	1.2393	1.2190	1.1808	1.1238	1.0759	1.0467	1.0206

Table B-8c: Revaluation factors for initial year capital stock (public sector undertakings - construction)

	Year of incorporation																		
year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1981	1.0531																		
1982	1.1213	1.0674																	
1983	1.1698	1.1157	1.0470																
1984	1.2343	1.1793	1.1083	1.0599															
1985	1.3041	1.2494	1.1770	1.1279	1.0660														
1986	1.3417	1.2883	1.2165	1.1678	1.1059	1.0403													
1987	1.4047	1.3502	1.2756	1.2253	1.1607	1.0925	1.0516												
1988	1.4517	1.3979	1.3229	1.2725	1.2071	1.1385	1.0978	1.0447											
1989	1.5308	1.4751	1.3958	1.3431	1.2737	1.2015	1.1597	1.1029	1.0562										
1990	1.5651	1.5107	1.4320	1.3797	1.3102	1.2385	1.1973	1.1397	1.0928	1.0357									
1991	1.6379	1.5845	1.5048	1.4524	1.3812	1.3089	1.2685	1.2082	1.1607	1.0998	1.0639								
1992	1.7094	1.6555	1.5734	1.5197	1.4458	1.3716	1.3310	1.2676	1.2188	1.1543	1.1179	1.0515							
1993	1.7464	1.6940	1.6125	1.5594	1.4855	1.4118	1.3722	1.3079	1.2592	1.1933	1.1570	1.0902	1.0379						
1994	1.7825	1.7328	1.6532	1.6016	1.5286	1.4568	1.4190	1.3542	1.3064	1.2391	1.2036	1.1372	1.0842	1.0465					
1995	1.8518	1.8033	1.7230	1.6714	1.5970	1.5250	1.4884	1.4211	1.3729	1.3021	1.2668	1.1990	1.1438	1.1056	1.0591				
1996	1.9204	1.8721	1.7899	1.7376	1.6609	1.5877	1.5514	1.4812	1.4322	1.3578	1.3223	1.2526	1.1950	1.1563	1.1091	1.0478			
1997	1.9969	1.9478	1.8624	1.8084	1.7285	1.6528	1.6163	1.5425	1.4920	1.4134	1.3771	1.3047	1.2443	1.2046	1.1561	1.0922	1.0420		
1998	2.0294	1.9821	1.8979	1.8450	1.7654	1.6910	1.6560	1.5816	1.5317	1.4518	1.4162	1.3440	1.2829	1.2435	1.1956	1.1312	1.0802	1.0372	
1999	2.0250	1.9805	1.8995	1.8487	1.7716	1.7001	1.6672	1.5942	1.5460	1.4670	1.4328	1.3624	1.3023	1.2638	1.2173	1.1539	1.1035	1.0606	1.0241

Table B-8d: Revaluation factors for initial year capital stock (public sector undertakings – machinery & equipment)

	Year of incorporation																		
year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1981	1.0433																		
1982	1.0616	1.0214																	
1983	1.0858	1.0450	1.0246																
1984	1.1048	1.0652	1.0462	1.0218															
1985	1.1506	1.1117	1.0957	1.0704	1.0494														
1986	1.1717	1.1344	1.1202	1.0952	1.0748	1.0262													
1987	1.1918	1.1547	1.1414	1.1162	1.0960	1.0467	1.0204												
1988	1.2366	1.2008	1.1908	1.1650	1.1458	1.0956	1.0703	1.0490											
1989	1.2817	1.2482	1.2422	1.2161	1.1983	1.1481	1.1241	1.1021	1.0528										
1990	1.3235	1.2914	1.2885	1.2621	1.2453	1.1944	1.1713	1.1489	1.0990	1.0458									
1991	1.3896	1.3596	1.3620	1.3347	1.3194	1.2672	1.2454	1.2221	1.1710	1.1174	1.0700								
1992	1.4454	1.4157	1.4214	1.3930	1.3784	1.3239	1.3025	1.2785	1.2254	1.1699	1.1207	1.0466							
1993	1.4418	1.4133	1.4196	1.3919	1.3780	1.3249	1.3041	1.2807	1.2288	1.1744	1.1259	1.0533	1.0083						
1994	1.4494	1.4241	1.4331	1.4066	1.3945	1.3440	1.3253	1.3026	1.2531	1.2017	1.1550	1.0851	1.0406	1.0325					
1995	1.5081	1.4825	1.4947	1.4667	1.4550	1.4014	1.3827	1.3588	1.3065	1.2526	1.2031	1.1285	1.0801	1.0734	1.0406				
1996	1.5633	1.5384	1.5543	1.5251	1.5142	1.4585	1.4403	1.4155	1.3613	1.3058	1.2543	1.1762	1.1247	1.1190	1.0865	1.0428			
1997	1.5750	1.5509	1.5681	1.5391	1.5288	1.4734	1.4558	1.4311	1.3771	1.3220	1.2707	1.1925	1.1407	1.1352	1.1027	1.0587	1.0159		
1998	1.5766	1.5538	1.5718	1.5434	1.5339	1.4796	1.4628	1.4385	1.3856	1.3317	1.2812	1.2041	1.1526	1.1474	1.1156	1.0717	1.0293	1.0136	
1999	1.5832	1.5608	1.5795	1.5513	1.5421	1.4880	1.4716	1.4475	1.3948	1.3411	1.2907	1.2136	1.1620	1.1569	1.1253	1.0813	1.0387	1.0231	1.0095

Table B-8e: Revaluation factors for initial year capital stock (private sector undertakings)

	Year of incorporation																		
year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1981	1.0324																		
1982	1.0473	1.0164																	
1983	1.1023	1.0737	1.0604																
1984	1.1233	1.0972	1.0839	1.0246															
1985	1.1677	1.1463	1.1351	1.0727	1.0492														
1986	1.1893	1.1709	1.1609	1.0983	1.0759	1.0277													
1987	1.2008	1.1805	1.1697	1.1051	1.0818	1.0304	1.0000												
1988	1.2538	1.2392	1.2311	1.1624	1.1406	1.0898	1.0619	1.0569											
1989	1.2857	1.2759	1.2702	1.2002	1.1800	1.1308	1.1043	1.0968	1.0408										
1990	1.3071	1.3022	1.2987	1.2290	1.2107	1.1641	1.1395	1.1298	1.0758	1.0370									
1991	1.3276	1.3295	1.3293	1.2615	1.2464	1.2046	1.1832	1.1698	1.1198	1.0844	1.0509								
1992	1.3572	1.3634	1.3653	1.2960	1.2824	1.2419	1.2218	1.2069	1.1577	1.1238	1.0927	1.0438							
1993	1.3551	1.3623	1.3649	1.2977	1.2852	1.2466	1.2278	1.2133	1.1661	1.1340	1.1047	1.0573	1.0149						
1994	1.3850	1.3962	1.4009	1.3318	1.3207	1.2830	1.2655	1.2494	1.2027	1.1717	1.1441	1.0996	1.0571	1.0438					
1995	1.3574	1.3686	1.3735	1.3114	1.3020	1.2690	1.2539	1.2382	1.1968	1.1696	1.1457	1.1073	1.0693	1.0569	1.0178				
1996	1.3572	1.3693	1.3747	1.3143	1.3058	1.2743	1.2603	1.2447	1.2050	1.1793	1.1569	1.1209	1.0841	1.0728	1.0346	1.0186			
1997	1.3611	1.3734	1.3791	1.3188	1.3106	1.2794	1.2656	1.2505	1.2109	1.1855	1.1634	1.1273	1.0906	1.0797	1.0414	1.0253	1.0065		
1998	1.3754	1.3888	1.3951	1.3331	1.3250	1.2932	1.2794	1.2642	1.2237	1.1979	1.1755	1.1387	1.1010	1.0903	1.0507	1.0346	1.0155	1.0089	
1999	1.3821	1.3959	1.4025	1.3400	1.3321	1.3002	1.2865	1.2713	1.2306	1.2047	1.1823	1.1451	1.1072	1.0965	1.0565	1.0404	1.0213	1.0147	1.0057

Table B-8f: Revaluation factors for initial year capital stock (private sector undertakings - construction)

	Year of incorporation																		
year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1981	1.0667																		
1982	1.1540	1.0900																	
1983	1.2168	1.1528	1.0577																
1984	1.2731	1.2123	1.1145	1.0547															
1985	1.3158	1.2430	1.1595	1.0987	1.0437														
1986	1.3565	1.3054	1.2067	1.1456	1.0913	1.0481													
1987	1.4322	1.3784	1.2698	1.2030	1.1442	1.0983	1.0465												
1988	1.4583	1.4101	1.3028	1.2365	1.1789	1.1339	1.0837	1.0356											
1989	1.5113	1.4645	1.3523	1.2831	1.2235	1.1773	1.1261	1.0745	1.0385										
1990	1.5054	1.4676	1.3627	1.2973	1.2419	1.1990	1.1518	1.1005	1.0671	1.0298									
1991	1.5137	1.4867	1.3887	1.3270	1.2759	1.2366	1.1944	1.1417	1.1114	1.0738	1.0483								
1992	1.5340	1.5114	1.4147	1.3535	1.3037	1.2655	1.2250	1.1709	1.1420	1.1045	1.0817	1.0348							
1993	1.5392	1.5222	1.4296	1.3707	1.3234	1.2876	1.2500	1.1956	1.1688	1.1319	1.1123	1.0692	1.0357						
1994	1.5830	1.5695	1.4740	1.4132	1.3652	1.3291	1.2918	1.2339	1.2076	1.1694	1.1518	1.1097	1.0760	1.0406					
1995	1.5352	1.5295	1.4483	1.3959	1.3555	1.3255	1.2954	1.2415	1.2201	1.1853	1.1732	1.1409	1.1115	1.0817	1.0420				
1996	1.5575	1.5532	1.4705	1.4171	1.3764	1.3462	1.3162	1.2609	1.2398	1.2046	1.1936	1.1615	1.1323	1.1030	1.0645	1.0192			
1997	1.5294	1.5258	1.4488	1.3991	1.3612	1.3332	1.3054	1.2533	1.2338	1.2008	1.1910	1.1614	1.1341	1.1067	1.0706	1.0281	1.0099		
1998	1.5552	1.5528	1.4734	1.4222	1.3835	1.3551	1.3270	1.2729	1.2534	1.2195	1.2105	1.1807	1.1531	1.1254	1.0883	1.0450	1.0261	1.0170	
1999	1.5675	1.5657	1.4854	1.4337	1.3948	1.3662	1.3381	1.2833	1.2639	1.2298	1.2211	1.1913	1.1636	1.1358	1.0983	1.0547	1.0355	1.0265	1.0094

Table B-8g: Revaluation factors for initial year capital stock (private sector undertakings – machinery & equipment)

	Year of incorporation																		
year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
1981	1.0265																		
1982	1.0345	1.0091																	
1983	1.0848	1.0620	1.0574																
1984	1.1026	1.0819	1.0771	1.0212															
1985	1.1483	1.1327	1.1305	1.0709	1.0511														
1986	1.1665	1.1533	1.1521	1.0927	1.0738	1.0238													
1987	1.1715	1.1563	1.1546	1.0939	1.0742	1.0208	0.9945												
1988	1.2253	1.2159	1.2176	1.1523	1.1344	1.0816	1.0578	1.0584											
1989	1.2623	1.2584	1.2630	1.1959	1.1799	1.1291	1.1070	1.1042	1.0467										
1990	1.2838	1.2841	1.2909	1.2237	1.2096	1.1613	1.1408	1.1359	1.0805	1.0359									
1991	1.3068	1.3135	1.3233	1.2574	1.2463	1.2031	1.1855	1.1764	1.1250	1.0849	1.0522								
1992	1.3371	1.3480	1.3603	1.2925	1.2831	1.2412	1.2250	1.2145	1.1637	1.1252	1.0949	1.0448							
1993	1.3350	1.3466	1.3592	1.2934	1.2848	1.2448	1.2295	1.2196	1.1708	1.1341	1.1055	1.0565	1.0131						
1994	1.3637	1.3792	1.3941	1.3265	1.3195	1.2806	1.2667	1.2552	1.2070	1.1718	1.1450	1.0991	1.0558	1.0442					
1995	1.3365	1.3511	1.3650	1.3039	1.2980	1.2636	1.2515	1.2403	1.1973	1.1661	1.1424	1.1021	1.0630	1.0521	1.0128				
1996	1.3352	1.3503	1.3644	1.3054	1.3003	1.2679	1.2568	1.2456	1.2046	1.1753	1.1534	1.1160	1.0784	1.0685	1.0302	1.0196			
1997	1.3409	1.3564	1.3709	1.3115	1.3066	1.2740	1.2631	1.2523	1.2111	1.1817	1.1597	1.1217	1.0838	1.0742	1.0353	1.0244	1.0042		
1998	1.3536	1.3701	1.3853	1.3244	1.3197	1.2865	1.2756	1.2649	1.2228	1.1928	1.1705	1.1314	1.0926	1.0831	1.0430	1.0322	1.0116	1.0073	
1999	1.3595	1.3764	1.3920	1.3307	1.3262	1.2927	1.2819	1.2715	1.2290	1.1989	1.1766	1.1372	1.0980	1.0886	1.0480	1.0373	1.0167	1.0124	1.0050

9 References

Aggarwal, Aradhna (2001), Liberalisation, multinational enterprises and export performance: evidence from Indian manufacturing, Working Paper No. 69, Indian Council for Research on International Economic Relations, New Delhi.

Ahluwalia, Isher Judge (1985), Industrial growth in India, Oxford University Press, Oxford.

Ahluwalia, Isher Judge (1996), India's opening up to trade and investment, in: Ahluwalia, Isher Judge, Rakesh Mohan and Omkar Goswami (eds.), Policy Reform in India, OECD, Paris.

Alderson, Michael J., and Brian L. Betker (1995), Liquidation costs and capital structure, Journal of Financial Economics, Vol. 39, pp. 45-69.

Altman, Edward I. (1968), Financial ratios, discriminant analysis and the prediction of corporate bankruptcy, Journal of Finance, Vol. 23, pp. 589-609.

Anant, T.C.A., Shubhashis Gangopadhyay, Omkar Goswami (1992), Industrial sickness in India: characteristics, determinant and history, 1970-1990, in: Government of India (ed.), Studies in Industrial Development, New Delhi.

Anant, T.C.A. and Omkar Goswami (1995), Getting everything wrong: India's policies regarding 'sick' firms, in: Mookherjee, Dilip (ed.), Indian industry: policy and performance, Oxford University Press, Delhi.

Anant, T.C.A., Tamal D. Chaudhuri, Subhashis Gangopadhyai and Omkar Goswami (1995), Industrial sickness in India. Corporate restructuring – its agency problems and institutional responses, Government of India, Ministry of Industry, Studies in Industrial Development, Paper No. 17.

Anant, T.C.A. and N.L. Mitra (1998), The role of law and legal institutions in Asian economic development: the case of India, Development Discussion Paper No. 662, Harvard Institute for International Development.

Andersen, E. B. (1970), Asymptotic properties of conditional maximum likelihood estimators, Journal of the Royal Statistical Society, Series B, Vol. 32, pp. 283-301.

Andersen, E. B. (1973), Conditional inference and models for measuring, Mentalhygiejnisk Forlag, Copenhagen.

Arellano, Manuel, Stephen Bond (1991), Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, Review of Economic Studies, Vol. 58, pp. 277-297.

Arellano, Manuel, Stephen Bond (1998), Dynamic panel data estimation using dpd98 for Gauss: a guide for users, http://www.cemfi.es/~arellano/index.htm#dpd.

Arulampalam, Wiji (1999), A note on estimated coefficients in random effects probit models, Oxford Bulletin of Economics and Statistics, Vol. 61, pp. 597-602.

Arulampalam, Wiji, Alison L. Booth (2000), Union status of young men in Britain: a decade of change, Journal of Applied Econometrics, Vol. 15, pp. 225-252.

Balakrishnan, Pulapre, K. Pushpangadan and M. Suresh Babu (2000), Trade liberalisation and productivity growth in manufacturing: evidence from firm-level panel data, Economic and Political Weekly, Oct. 7.

Baltagi, Badi H. (1995), Econometric analysis of panel data, John Wiley & Sons, Chichester.

Barro, Robert J. and Xavier Sala-i-Martin (1995), Economic Growth, McGraw-Hill, New York.

Bhagwati, Jagdish N. (1994), India in transition: freeing the economy, Oxford University Press, Delhi.

Bhagwati, Jagdish N., Arvind Panagariya, and T.N. Srinivasan (1998), Lectures on international trade, 2nd edition, MIT Press, Cambridge, Mass.

Bhattacharya, C. D. (1982), Discriminant analysis between sick and healthy units, The Chartered Accountant, Feb. 1982.

Bhattacharya, Saugata and Urjit R. Patel (2002), Financial intermediation in India: a case of aggravated moral hazard?", Center for Research on Economic Development and Policy Reform, Working Paper No. 145, Stanford University.

Biswasroy, Prasanna K., Jagannath Panda, Promod K. Sahu (1990), Corporate sickness and institutional financing in India, Ashish Publishing House, New Delhi.

Castanias, Richard (1983), Bankruptcy risk and optimal capital structure, Journal of Finance, Vol. 38, 5, pp. 1617-1635.

Caves, R.E. et al. (1992), Industrial efficiency in six nations, MIT, Cambridge.

Central Statistical Organisation (CSO): Annual Survey of Industries (various years), Summary results for factory sector, Government of India, New Delhi.

Central Statistical Organisation (CSO): Statistical Abstract India (various years), Government of India, New Delhi.

Centre for Monitoring the Indian Economy (CMIE), Economic Intelligence Service, Corporate Sector (various years), CMIE, Bombay.

Centre for Monitoring the Indian Economy (CMIE), 1996, Economic Intelligence Service: India's Industrial Sector 1996, CMIE, Bombay.

Centre for Monitoring the Indian Economy (CMIE), PROWESS User's Manual: Volume I-III, CMIE, Mumbai.

Chamberlain, Gary (1980), Analysis of covariance with qualitative data, Review of Economic Studies, Vol. 47, pp. 225-238.

Chamberlain, Gary (1984), Panel Data, in Griliches, Zvi and M.D. Intriligator (eds.), Handbook of Econometrics, Vol. II, Elsevier Science Publishers.

Chandhok, H. L. and the Policy Group (1990), India database: the economy. Annual time series data in two volumes, Thomson Press, Faridabad (Haryana).

Chandrasekhar, C.P. and Jayati Ghosh (2001), On the "new" Hindu rate of growth, MacroScan Paper accessible at

http://www.macroscan.com/the/macro/dec01/mac191201Hindu_rate_1.htm

Chattopadhyay, Sadhan Kumar (1995), Industrial sickness in India, Sane Publications, New Delhi.

Chand, Satish and Kunal Sen (2002), Trade liberalization and productivity growth: evidence from Indian manufacturing, Review of Development Economics, Vol. 6, pp. 120-132

Cornwell, Christopher, Peter Schmidt and Robin C. Sickles (1990), Production frontiers with cross-sectional and time-series variation in efficiency levels, Journal of Econometrics, Vol. 46, pp. 185-200.

Cornwell, Christopher and Peter Schmidt (1996), Production frontiers and efficiency measurement, in: Mátyás, László and Patrick Sevestre (eds.), The econometrics of panel data: handbook of theory and applications, Kluver Academic Publishers, Dordrecht.

Das, Deb Kusum (2003a), Manufacturing productivity under varying trade regimes: India in the 1980s and 1990s, Working Paper No. 107, ICRIER, New Delhi.

Das, Deb Kusum (2003b), Quantifying trade barriers: has protection declined substantially in Indian manufacturing? Working Paper No. 105, ICRIER, New Delhi.

Datt, Ruddar and K.P.M. Sundharam (1993), Indian Economy (31st edition), S. Chand & Company Ltd., New Delhi.

De Long, J. Bradford (2003), India since independence: an analytic growth narrative, in: Dani Rodrik (ed.), In search of prosperity: analytic narratives on economic growth, Princeton University Press, Princton, NJ.

Demirgüç-Kunt, Asli and Vojislav Maksimovic (1999), Institutions, financial markets, and firm debt maturity, Journal of Financial Economics, Vol. 54, pp. 295-336.

Deshpande, L. K. and Gerry Rodgers (eds.) (1994), The Indian labour market and economic structural change, B.R. Publishing Corporation, Delhi.

Diewert, W. Erwin and Alice O. Nakamura (1998), A survey of empirical methods of productivity measurement, in: Richard Blundell, Edward Leamer and James J. Heckman (eds.), Handbook of Econometrics, Vol. V, North-Holland, Amsterdam.

Economic Intelligence Service, Indian Corporate Sector, various years, CMIE, Bombay.

Fecher, Fabienne and Pierre Pestieau (1993), Efficiency and competition in OECD financial services, in: Fried, Harold O., C.A. Knox Lovell and Shelton S. Schmidt (eds.), The measurement of productive efficiency: techniques and applications, pp. 374-385, Oxford University Press, Oxford.

Fried, Harold O., C.A. Knox Lovell and Shelton S. Schmidt (eds.), The measurement of productive efficiency: techniques and applications, Oxford University Press, Oxford.

Friend, Irwin, and Larry H.P. Lang (1988), An empirical test of the impact of managerial self-interest on corporate capital structure, Journal of Finance, Vol. 43, 2, pp. 271-281.

Frydman, Roman, Cheryl Gray, Marek Hessel and Andrzej Rapaczynski (2000),

Girdhari, D. G. and J. V. Joshi (1993), Industrial sickness in small-scale industries in Maharashtra, in: Ramakant, Sugan C. Jain and N. D. Mathur (eds.), Management of industrial sickness, Pointer Publishers, Jaipur.

Goldar, Bishwanath (2004), Productivity trends in Indian manufacturing in the pre- and post-reform periods, Indian Council for Research on International Economic Relations (ICRIER), Working Paper No. 137, New Delhi.

Goswami, Omkar (1996 a), Corporate bankruptcy in India: a comparative perspective, OECD, Paris.

Goswami, Omkar (1996 b), Legal and institutional impediments to corporate growth, in: Ahluwalia, Isher Judge, Rakesh Mohan and Omkar Goswami (eds.), Policy reform in India, OECD, Paris.

Goswami, Omkar (2001), The tide rises, gradually: corporate governance in India, OECD Development Centre, Paris.

Government of India, Economic Survey (various years), New Delhi.

Greene, William H. (1997), Econometric Analysis, 3rd edition, Prentice-Hall International, London.

Gupta, D. P. (1990), Industrial sickness and the role of reconstruction agencies, Chanakya Publications, Delhi.

Gupta, L. C. (1983), Financial ratios for monitoring corporate sickness, Oxford University Press.

Gupta, Suraj B. (2001), Monetary economics: institutions, theory and policy, S. Chand & Company Ltd., New Delhi.

Halvorsen, Robert and Raymond Palmquist (1980), The interpretation of dummy variables in semilogarithmic equations, American Economic Review, Vol. 70, pp. 474-475.

Handbook of Industrial Statistics 1993, Office of the Economic Adviser, Ministry of Industry, Government of India, New Delhi.

Hanson, James A. (2001), Indian Banking: Market liberalization and the pressures for institutional and market framework reform, Center for Research on Economic Development and Policy Reform, Working Paper No. 104, Standford University.

Hasan, Rana (2002), The impact of imported and domestic technologies on the productivity of firms: panel data evidence from Indian manufacturing firms, Journal of Development Economics, Vol. 69, pp. 23-49.

Hansen, Gerd, and Janz, Norbert (1998), Panel- und Querschnittsanalysen - Vorlesungsmanuskript, Insititut für Statistik und Ökonometrie, Universität Kiel.

Hausman, Jerry A. and David A. Wise (1979), Attrition bias in experimental and panel data: the Gary income maintenance experiment, Econometrica, Vol. 47, pp.455-473.

Hay, Donald, Derek Morris, Guy Liu, and Shujie Yao (1994), Economic reform and state-owned enterprises in China 1979-1987, Clarendon Press, Oxford.

Hsiao, Cheng (1986), Analysis of panel data, Econometric Society Monographs No. 11, Cambridge University Press, Cambridge.

Hsiao, Cheng (1992), Logit and probit models, in Mátyás, László and Patrick Sevestre (1992) (eds.), The econometrics of panel data (chapter 11); Kluver Academic Publishers, Dordrecht.

Hunter, John and Natalia Isachenkova (2002), A panel analysis of UK industrial company failure, Working Paper No. 228, ESRC Centre for Business Research, University of Cambridge.

Hunter, John and Natalia Isachenkova (2000), Failure risk: a comparative study of UK and Russian firms, Discussion Paper No. 00-1, Department of Economics and Finance, Brunel University.

ICICI (1994), Productivity in Indian manufacturing: private corporate sector, 1972-73 to 1991-92, Industrial Credit and Investment Corporation of India, Mumbai.

International Labour Office (2000), World Labour Report 2000: income security and social protection, ILO, Geneva.

Janz, Norbert (1997), Ökonometrische Panelanalysen des Investitionsverhaltens deutscher Aktiengesellschaften: Analyse von Eulergleichungsmodellen mit robusten verallgemeinerten Momentenmethoden, Nomos, Baden-Baden.

Jensen, M. and W. Meckling (1976), Theory of the firm: managerial behavior, agency costs, and ownership structure, Journal of Financial Economics 3, 305-360.

Johnston, Jack, John DiNardo (1997), Econometric Methods, 4th edition, McGraw-Hill, New York.

Joshi, Vijay and Ian M.D. Little (1996), India's economic reforms 1991-2001, Oxford University Press, Delhi.

Karels, Gordon V. and Arun J. Prakash (1987), Multivariate normality and forecasting of business bankruptcy, Journal of Business Finance Accounting, pp. 573-593.

Kathuria, Vinish (2001), Foreign firms, technology transfer and knowledge spillovers to Indian manufacturing firms: a stochastic frontier approach, Applied Economics, Vol. 33, pp. 625-642.

Kathuria, Vinish (2002), Liberalisation, FDI, and productivity spillovers – an analysis of Indian manufacturing firms, Oxford Economic Papers, Vol. 54, pp. 688-718.

Keasey, K. and P. McGuinness (1990), the failure of UK industrial firms for the period 1976-1984: logistic analysis and entropy measures, Journal of Business Finance & Accounting, Vol. 17, 1, pp. 119-135.

Kornai, János (1980), The economics of shortage, North-Holland, Amsterdam.

Kornai, János (2001), Hardening the budget constraint: the experience of the post-socialist countries, European Economic Review, Vol. 45, pp. 1573-1599.

Kornai, János, Eric Maskin and Gérard Roland (2003), Understanding the soft budget constraint, Journal of Economic Literature, Vol. 41, pp. 1095-1136.

Kovenock, Dan, and Gordon M. Phillips (1997), Capital structure and product market behavior: an examination of plant exit and investment decisions, Review of Financial Studies, Vol. 10, 3, pp. 767-803.

Krishna, Pravin and Devashish Mitra (1998), Trade liberalization, market discipline and productivity growth: new evidence from India, Journal of Development Economics, Vol. 56, pp. 447-462.

Krueger, Anne O. (2002), Trade policies in developing countries, in: Jones, R. W. and P. B. Kenen (eds.), Handbook of international economics, Vol. 1, Elsevier, North-Holland.

Kuchhal, S.C. (1989), The industrial economy of India, Chaitanya Publishing House, Allahabad.

Kumar, Rakesh (2001), Efficiency and technology undercurrents in Indian textile industry, The Indian Economic Journal, Vol. 49, No. 2, pp. 73-81.

Laitinen, Erkki K. and Teija Laitinen (2000), Bankruptcy prediction: application of the Taylor's expansion in logistic regression, International Review of Financial Analysis, Vol. 9, pp. 327-349.

Maddala, G.S. (1986), Limited dependent and qualitative variables in econometrics, Econometric Society Monographs No. 3, Cambridge University Press, Cambridge, UK.

Maddala, G.S. (1987), Limited dependent variable models using panel data, Journal of Human Resources, Vol. 22, pp. 307-338.

Majumdar, S.K. (1996), Fall and rise of productivity in Indian industry: has economic liberalisation had an impact?, Economic and Political Weekly, Vol. 31, pp. 46-53.

Mathur, Ajeet N. (1994), Employment security and industrial restructuring in India: separating facts from folklore, in: Deshpande, L. K. and Gerry Rodgers (eds.), The Indian labour market and economic structural change, B.R. Publishing Corporation, Delhi.

Mathur, Ajeet N. (1993), Industrial restructuring in India and the National Renewal Fund, Asian Development Bank, Manila.

Mátyás, László and Patrick Sevestre (1996) (eds.), The econometrics of panel data: handbook of theory and applications, Kluver Academic Publishers, Dordrecht.

Mohapatra, Prafulla Chandra (1993), Industrial sickness: prevention is always better, in: Ramakant, Sugan C. Jain and N. D. Mathur (eds.), Industrial sickness, Pointer Publishers, Jaipur.

Moulton, Brent R. (1990), An illustration of a pitfall in estimating the effects of aggregate variables on micro units, Review of Economics and Statistics, Vol. 72,2, pp. 334-338.

Narayanan, M. S. (1994), The law relating to industrial sickness in India: the role of the BIFR, Konark Publishers pvt ltd., Delhi.

Neyman, J. and E. L. Scott (1948), Consistent estimates based on partially consistent observations, Econometrica, Vol. 16, pp. 1-32.

Nickel, Stephen J. (1996), Competition and corporate performance, Journal of Political

Economy, Vol. 104, pp. 724-746.

Papola, T.S., P.P. Ghosh and Alakh N. Sharma (eds.) (1993), Labour, employment and industrial relations in India, Indian Society of Labour Economics, Patna.

Pinto, Brian, Vladimir Drebentsov and Alexander Morozov (2000),

Pursell, Garry (1990), Industrial sickness, primary and secondary: the effects of exit constraints on industrial performance, World Bank Economic Review, Vol. 4, pp. 103-114.

Pursell, Garry (1992), Trade policies in India, in: Dominick Salvatore (ed.), National trade policies – Handbook of comparative economic policies, Greenwood Press, New York.

Raghavan, K. Harsh Sharma and Leena Sekhar (eds.) (1995), Impact of new economic policy on manpower and employment in India, Agricole Publishing Academy, New Delhi

Raiser, Martin (1997), Soft budget constraints and the fate of economic reforms in transition economies and developing countries, J.C.B. Mohr, Tübingen.

Ramakant, Sugan C. Jain and N. D. Mathur (1993a) (eds.), Industrial sickness, Pointer Publishers, Jaipur.

Ramakant, Sugan C. Jain and N. D. Mathur (1993b) (eds.), Management of industrial sickness, Pointer Publishers, Jaipur.

Rangarajan C. (1998), Indian economy: essays on money and finance, UBS Publishers' Distributors Ltd., New Delhi.

Rao, S. L. (1994), Industry and economic reforms 1991-1994, National Council of Applied Economic Research, Working Paper No. 50, New Delhi.

Ratnam, C.S. Venkata (1995), Economic liberalization and the transformation of industrial relations policies in India, in: Anil Verma, Thomas A. Kochan, Russell D. Lansbury (eds.), Employment relations in the growing Asian economies, Routledge Advances in Asia-Pacific Business, London.

Report of the Committee on Industrial Sickness (1995), Industrial sickness and corporate restructuring, Vol. 4, pp. 343-359.

Report on Currency and Finance, Vol. 1 and 2 (various years), Reserve Bank of India, Bombay.

Rodrik, Dani and Arvind Subramanian (2004), From "Hindu Growth" to productivity surge: the mystery of the Indian growth transition, NBER Working Paper Series, Working Paper No. 10376, National Bureau of Economic Research, Cambridge, MA.

Schmidt, Peter, Seung C. Ahn and Donald Wyhowski (1992), Comment, Journal of Business & Economic Statistics, Vol. 10, pp. 10-14.

Secretariat for Industrial Assistance, 2004, Manual on foreign direct investment in India – policy and procedures, Government of India, New Delhi.

Shleifer, Andrei and Robert W. Vishny (1994), Politicians and firms, Quarterly Journal of Economics, Vol. 109, 4, pp. 995-1025.

Singh, Gurdeep and B.S. Bhatia (1993), Management of industrial sickness, in: Ramakant, Sugan C. Jain and N. D. Mathur (eds.), Industrial sickness, Pointer Publishers, Jaipur.

Singh, Tarlok (2001), Total factor productivity in the manufacturing industries in India, The Indian Economic Journal, Vol. 48, 2, pp. 108-117.

Solow, Robert M. (1957), Technical chance and the aggregate production function, Review of Economics and Statistics, Vol. 39, pp. 312-320.

Soni, Kishore (1999), Bankruptcy restructuring in India, Paper presented at the OECD, Paris. Downloadable: www.oecd.org/dataoecd/29/26/1891326.ppt

Srivastava, Vivek (1996), Liberalization, productivity and competition: a panel study of Indian manufacturing, Oxford University Press, Oxford.

Srivastava, Vivek (2000), The impact of India's economic reforms on industrial productivity, efficiency and competitiveness, National Council of Applied Economic Research, New Delhi.

Sudarsanam, Sudi and Jim Lai (2001), Corporate financial distress and turnaround strategies: an empirical analysis, British Journal of Management, Vol. 12, 3, pp. 183-199.

Sundriyal, G.B. (1996), Industrial policy in India: from licensing to deregulation, Birla Economic Research Foundation, Radiant Publishers, New Delhi.

Tata Services Limited (2003), Reforms and productivity trends in Indian manufacturing sector, Department of Economics and Statistics Tata Services Limited, Mumbai.

Trivedi, Pushpa, Anand Prakash and David Sinate (2000), Productivity in major manufacturing industries in India: 1973-74 to 1997-98, Development Research Group Study No. 20, Department of Economic Analysis and Policy, Reserve Bank of India, Mumbai.

Törnqvist (1936), The Bank of Finland's consumption price index, Bank of Finland Monthly Bulletin, Vol. 10, pp 1-8.

Unel, Bulen (2003), Productivity trends in India's manufacturing sectors in the last two decades, IMF Working Paper No. 03/22.

Ward, Michael (1976), The measurement of capital: the methodology of capital stock estimates in OECD countries, OECD, Paris.

Williamson, John and Roberto Zagha (2002), From slow growth to slow reform, Institute for International Economics, Washington, DC.

Wohlschlegel, Ansgar (2002), The economics of corporate bankruptcy law, Ph.D. thesis at Heidelberg University, http://archiv.ub.uni-heidelberg.de/volltextserver/volltexte/
2002/3087/pdf/DissVeroeff.pdf

Worldbank (1989), India: an industrializing economy in transition, The Worldbank, Washington, D.C.

Worldbank (2004), World Development Indicators 2004, The Worldbank, Washington, D.C.

Wu, Yanrui (1995), Productivity growth, technological progress, and technical efficiency in China: a three-sector analysis, Journal of Comparative Economics, Vol. 21, pp. 207-229.

Zingales, Luigi (1998), Survival of the fittest or the fattest? Exit and financing in the trucking industry, Journal of Finance, Vol. 53, 3, pp. 905-938.

Wording of laws under http://www.vakilno1.com:
The Company Act, 1956
The Foreign Trade (Development and Regulation) Act, 1992
The Industries (Development and Regulation) Act, 1951
The Monopolies and Restrictive Trade Practices Act, 1969
The Sick Industrial Companies (Special Provisions) Act, 1985,

Homepages:
Annual Survey of Industries: http://www.nic.in/stat/stat_act_t3.htm
Board for Industrial and Financial Reconstruction: http://www.bifr.nic.in
Centre for Monitoring the Indian Economy: http://www.cmie.com
Central Statistical Organisation (CSO), Ministry of Statistics and Program Implementation, Government of India http://www.nic.in/stat/
United Nations Statistics Division: http://www.un.org/depts/unsd/social/index.htm
International Labour Organization: http://www.ilo.org
Union budget and Economic Survey (since 1996-97): http://www.indiabudget.nic.in/