Rise of Regions after Reforms: Late Development Strategies for the Software Industry in Tamil Nadu, Andhra Pradesh, and Kerala in India

By

Rajendra Kumar

B.Tech. Civil Engineering
Indian Institute of Technology, Kanpur, 1988

M.Tech. Management and Systems
Indian Institute of Technology, Delhi, 1992

Indian Administrative Service, 1992

M.C.P.
Massachusetts Institute of Technology, 2004

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Author_____
Department of Urban Studies and Planning
July 12 2007

Certified by_____
Professor Alice H Amsden
Barton L Weller Professor of Political Economy
Thesis Supervisor

Accepted by_____
Professor Eran Ben-Joseph
Chair, Ph.D. Committee
Department of Urban Studies and Planning

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ABSTRACT

Emergence of India as a major center in the world for software production since the early 1990s has been a remarkable success story of economic development. However, within the country, the growth in this industry has been concentrated in mainly the southern and the western parts. Regional growth of this industry has been driven by the policies of the regional governments, especially after the early 1990s when the central government initiated wide-ranging economic and policy reforms. In this dissertation, I examine the development strategies pursued by three states in southern India for development of this industry within an overall neo-liberal policy framework of the central government. Two of these states (Tamil Nadu and Andhra Pradesh) have been highly successful in attracting software firms since the mid 1990s, while the third state (Kerala) has lagged behind. I argue that the success of these states in establishing a technologically sophisticated industry within a short time is based on four critical factors: availability of adequate skilled labor and specialized infrastructure, pro-employer labor and policy reforms, ethnic linkages of immigrant professionals abroad who returned to establish firms in their native states, and their existing technological capabilities at the beginning of reforms. In a liberalizing economy, these states provided specialized infrastructure and skilled labor; implemented pro-employer policy reforms; attracted expatriate professionals; and facilitated production and marketing linkages between the local firms and foreign markets. This allowed the local firms to exploit the opportunities due to increasing vertical specialization by firms in the developed economies. While the influence of dominant class coalitions consisting of industrialists and professionals in Tamil Nadu and Andhra Pradesh ensured the success of these policies, the relatively autonomous nature of the state in Kerala, its lack of genuine labor and policy reforms, its distrust of large private enterprises, and its focus on redistribution rather than growth prevented it from achieving similar success. Contrary to common explanations in the literature, the state has not played a significant role in providing specialized R&D or finance to the industry. This research shows that developing regions have multiple options available to them to promote hi-tech industries even within an overall neo-liberal policy framework.

Dissertation Supervisor: Prof. Alice H Amsden
Title: Barton L Weller Professor of Political Economy

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ABBREVIATIONS

AICTE	All India Council of Technical Education
AP	Andhra Pradesh
ASB	Asian School of Business
BPO	Business Process Outsourcing
DOE	Department of Electronics, Government of India
DRDO	Defense Research and Development Organization
ELCOT	Electronics Corporation of Tamil Nadu
EOU	Export Oriented Unit
EPZ	Export Processing Zone
ESC	Electronics and Computer Software Export Promotion Council of India
FERA	Foreign Exchange Regulation Act
FSI	Floor Space Index
FDI	Foreign Direct Investment
GTECH	Group of Technopark Companies in Kerala
IT	Information Technology
ICT	Information and Communications Technologies
ISB	Indian School of Business, Hyderabad
ITES	Information Technology Enabled Services
IPR	Intellectual Property Regime
FDI	Foreign Direct Investment
FSI	Floor Space Index
HIID	Harvard International Institute for Development

HYSEA	Hyderabad Software Exporters Association
IEG	Institute for Electronic-Governance
IIT	Indian Institute of Technology
IIIT	Indian Institute of Information Technology
ISB	Indian School of Business
MNCs	Multinational Corporations
NASSCOM	National Association of Software and Services Companies
NeGAP	National e-Government Action Plan
NISG	National Institute for Smart Governance
SMEs	Small and Medium Enterprises
STP	Software Technology Park
STPI	Software Technology Parks of India
SW	Software
TN	Tamil Nadu

1 Introduction

1.1 Rise of Regions after Reforms: The Puzzle

Developing countries around the world have tried to promote high-technology industries, such as information and communications technology (ICT) based industries, in a bid to catch up on industrialization. The boom in the ICT industry in the Silicon Valley has sparked renewed interest in using it as a tool to accelerate regional development in developing countries around the globe. However, efforts to establish ICT based industries in developing countries have met with mixed results. India is one of the few developing countries that have successfully established an internationally competitive software and software services industry during the last two decades, especially after the start of the economic reforms in the early 1990s.

The rise of India as a leading center for software production and exports in the world has been an unexpected development. A very poor and technologically and industrially backward country that remained largely isolated from the world till the early 1990s has suddenly risen to become one of the world's leaders in software development (Saxenian, 2004). The rise of India in this industry is puzzling as it challenges two central ideas in the contemporary economic development literature. First, it shows that industrially backward economies can become global players in a hi-tech industry within a short span of less than two decades, something that the existing literature does not consider feasible. Second, it focuses sharply on the role of the state in such leapfrogging by developing economies in hi-tech industries within an overall neo-liberal policy

regime, an aspect that the contemporary economic development literature is mostly pessimistic about.

India's success story becomes more interesting and complicated when we consider the regional variations in the growth of this industry within the country. The growth of this industry has been geographically highly uneven across the different regions within the country. Particularly the southern region of the country has become the leading region in this industry (Ramachandran & Ray, 2005). Within this region, Karnataka, with its Bangalore cluster, has been the leading state in this industry in the entire country. However, three other southern states have achieved remarkable success in promoting this industry during the 1990s and later, though in different and contrasting ways. These states are: Tamil Nadu with its Chennai cluster, Andhra Pradesh with its Hyderabad cluster and Kerala, with its Trivandrum and Kochi clusters. Though Kerala did not perform well during the 1990s, it has achieved considerable success during the current decade. It is important to note here that all these latecomer states achieved this success after the central government initiated wide-ranging economic reforms in the country in 1991. These reforms resulted in the abolition of central government controls on investment and industrial location decisions and in market oriented reforms in trade and foreign exchange policies (Bajpai & Sachs, 1999; Chakravorty, 2000; Srinivasan, 2005).

The story of India's success in software development thus presents us with multiple puzzles that can help us in advancing the current state of the literature. First, it can help us in understanding how the state (the central and the regional governments) can play a role in industrial leapfrogging in knowledge intensive and innovation based

industries, especially within a neo-liberal policy framework when the state becomes much less interventionist in directing and controlling industrial investment. Second, examining the contrasting ways in which the three different states in the country have established their software industries can provide us with an understanding of the multiple pathways that are available to developing regions for industrial development and how they affect the type and structure of the industry that evolves. Finally, examining the relationships between the local software industry and the global IT production networks presents us with an opportunity to understand how vertical fragmentation and firm specialization offer new opportunities for industrial development of the backward economies.

In this dissertation, I examine the above issues with respect to the development of the software industry in three southern states in India. These states are: Tamil Nadu, Andhra Pradesh, and Kerala. In particular, I examine the role of the regional governments in these three latecomer states in establishing a successful software industry within their regions within an overall neo-liberal policy framework. How have these three latecomer states succeeded in attracting software firms and in establishing themselves as successful centers for software production and exports within a relatively short time of less than two decades? What were the macro and micro level policies adopted by these states to attract these industries? How did these policies affect the type and structure of the industry that evolved within their regions? Can the growth of this industry be catalyzed in developing regions? If so, how and under what conditions? What are the implications of success of these states for the regional development of lagging regions within an overall neo-liberal

policy framework? In this research, I examine the late development strategies adopted by these three states in a comparative framework to answer these questions. In framing these questions and laying out the theoretical framework, I draw partly upon Breznitz (2005).

The main literature on role of the state in industrial development in developing countries has focused on two central themes: timing of industrialization and learning and technology transfer based catching up. However, these arguments do not apply to knowledge based industries such as software as the technologies are constantly evolving and markets are not well-defined. Hence strategic planning by the state for large scale investments in manufacturing capabilities is not helpful. A more recent variant of this literature is the neo-developmental statist argument that stresses the "flexible developmental state" or "networked state" as the main explanation for the rapid advancement of some emerging economies in hi-tech industries in a system of global production networks and vertical specialization. However, this model calls for an extremely flexible bureaucracy with deep knowledge of industrial domains that can respond very quickly to the fast changing needs of the industry. This feature is missing in the classical Weberian style bureaucracies, such as the one in India, with its separation of general and technical wings, long and stable career patterns, and little involvement of outside experts in policy making. Hence, even this framework is unable to explain the Indian advance in this industry.

Current explanations for the advancement of the Indian software industry focus mainly on the economic liberalization policies of the central government during the 1990s, availability of abundant skilled labor and resulting cost advantages, and cross-national linkages with the Indian-origin diaspora in the US. These explanations are certainly helpful, but they mostly take the whole country as a unit and are unable to

explain why only certain regions within the country have succeeded in establishing this industry and not others. This is especially relevant considering the fact that the central government policies have been the same for the entire country. There is very little investigation of how the macro and micro level policies adopted by different states within the country have affected the differential development of the industry across these states. They also do not explain how the different policies at the sub-national level have affected the type and structure of the industry that evolved within those regions. In this dissertation, I seek to fill a portion of this gap in the literature.

In this research, I focus on the role of the regional (sub-national) governments in promoting this industry within their regions. The approach that I adopt here is to present and examine arguments about the role of the regional governments in the development of this industry within their regions. My focus here is to examine the systematic linkages between state policies and the growth of the software industry in these states within a comparative framework. The central argument that I examine here is that in a liberalizing economy, the regional governments influenced the industry-wide factor conditions by providing specialized infrastructure and increasing the availability of skilled labor; implemented pro-employer policy reforms; and facilitated the production and marketing linkages between the local firms, foreign firms, and foreign markets. This allowed the local firms to exploit the opportunities thrown up by increasing vertical specialization by firms across a wide range of industries in the developed economies. While the influence of the dominant class coalition consisting of industrialists and professionals in the political economy of decision making in Tamil Nadu and Andhra Pradesh ensured the successful implementation of policies to attract the industry, the relatively autonomous

nature of the state in Kerala prevented it from implementing these policies due to its distrust of large private enterprises, failure to carry out genuine labor and other policy reforms, and its focus on redistribution rather than growth.

The strategies adopted by these states are also in sharp contrast to the prevailing thinking in the regional development literature which places emphasis on four related factors as the sources of national or regional industrial competitiveness. These factors are: supply of specialized factors of production; influencing the demand conditions in the domestic market; presence of related and supporting industries; and firm structure and rivalry (Porter, 1990, 1998). The states in India influenced the factor conditions in a big way by providing industry-specific infrastructure and increasing the availability of skilled labor. However, they did not try to influence the demand conditions at home except in a very limited way[1]. Also the competition among the local firms was mainly for specialized labor (Dossani, 2005) and not for the local market as the main markets for firms were exports and not domestic.

As the discussion in the preceding paragraphs indicates, the existing analytical frameworks are unable to fully account for the success of these states in developing this industry. The success of these industrially backward regions in a technologically sophisticated industry calls for new thinking on the role of the state in industrial development. This dissertation seeks to explain how these states succeeded in developing an innovation based industry in a relatively short period of time.

My goals in this dissertation are three fold. First, I hope to contribute to our understanding of the role of the state (specifically at the sub-national level) in the

[1] Some attempts were made by these states to attract firms to their region by initiating e-government projects. However, these had very limited impacts as I discuss in the chapters six to eight.

development of high technology based industries such as software. As noted before, the existing literature does not adequately explain the role of the state in the development of such industries. My aim is not only to explain the role of the state in the development of this industry in these specific regions, but also to go further and propose a new theoretical framework for regional development strategies for hi-tech industries in developing regions. My second goal in this dissertation is to examine how the different policies of the three states influenced the development path of this industry within their regions and how it affected the type and structure of the industry that finally evolved. My third goal here is to examine the institutional and the political economy reasons behind the specific macro and micro level policies that these states adopted.

1.2 Plan of the Dissertation

I use both quantitative and qualitative techniques for this research. First, I analyze the data for software exports from all the 14 major states in India using a multivariate time-series regression model to examine the factors associated with the growth in software exports from these states. Then I examine the three states (Tamil Nadu, Andhra Pradesh, and Kerala) in detail using a comparative multiple case study approach. This method focuses on inductive-iterative theory building (Eckstein, 1975; Ragin, 1987; Yin, 1994, 2003). This research tradition aims at building the theory based on empirical evidence through a close and intimate examination of the empirical reality. The selection of the three states as cases is based on replication logic where cases are picked up based on either a literal replication or a theoretical replication or both (Yin, 2003). The selection of cases in this case is guided by the initial theoretical framework developed. The criteria in this case are to select cases that help in building up a theoretical

framework for examining the role of the state in promoting the development of high-technology industries in developing economies under an overall neo-liberal policy framework. These three states are selected as they fit well within these criteria. While I use Tamil Nadu and Andhra Pradesh as successful cases to build a theoretical framework for successful regional policies for development of hi-tech industries such as software, I use the relatively unsuccessful case of Kerala as the shadow case to help generalize the findings.

As the scope of research in the area covered here is vast, it is important to note the specific areas that I do not cover in this research. For example, I do not specifically analyze the role of the central government in India in the development of this industry, though I discuss how these policies formed an overall national framework within which these regions formulated their own policies. I take the national policy framework as given and then analyze the differential impacts of the policies of the three states. I also do not cover the development of the electronic hardware industry in these regions.

The data for this research comes from both primary and secondary sources. The primary sources of data include detailed interviews with senior government officials concerned with policy formulation and implementation in the IT sector and the firms engaged in software production and exports in these states. A total of 57 interviews were conducted between September 2006 and May 2007. These included interviews with 43 different software firms in the three states and 14 interviews with officials in the three state governments and their agencies concerned with formulating policies for the industry. The interviews with the firms were conducted with CEOs and senior level managers while the government officials included the senior civil servants in-charge of

policy making and senior officials of government agencies. All interviews with the government officials were conducted face-to-face while most of the interviews with the software firms were conducted over phone as the interviewees found it to be more convenient for them.

The secondary sources of data include official documents published by the three state governments and the central government regarding their IT policies; published studies and scholarly research done on the IT industry in India and other countries; statistical data and reports published by the government and other governmental agencies, the industry associations, and the firms; and reports and analyses published by the multinational private consulting firms, newspapers, magazines, etc.

The dissertation is structured as follows. After the first introductory chapter, the second chapter presents a comprehensive review of the literature and discusses how the current literature is unable to fully explain the role of the regional governments in development of this industry in India. This chapter also presents a brief description of the three cases and the main arguments that I examine in this research. Chapter three discusses in detail the research design and methodology that I adopted for this research. It also explains the sampling technique followed for choosing the firms in detail and also explains how interviews were conducted in each state. Chapter four discusses the evolution of the software export industry in India and examines how the policies of the central government influenced its development. Chapter five presents a simple multivariate time-series regression model that analyzes the factors associated with regional variation in the growth of software exports in the country since the start of the reforms. Chapters six to eight present the three empirical case studies of the three states

examined in this research. These case studies closely examine the role of the regional governments in the evolution of the software industry in their respective states and examine how it affected the type and structure of the industry that finally evolved in each region. They also explain the reasons why the existing analytical and theoretical frameworks within the literature are unable to fully explain the reasons for the success of these states. Chapter nine synthesizes the research findings from the three case studies using a comparative multiple case-study framework. Finally, the chapter ten presents a new analytical framework for regional development for hi-tech industries in developing countries and presents the conclusions.

2 Literature Review and the Main Arguments

2.1 Late Development Strategies: A Conceptual Framework

To explain the reasons for the remarkable growth of the software industry in the three Indian states examined here, we need to draw on multiple strands in the literature as no single framework is adequate to fully explain this phenomenon. There are five major features of the success of these states that need to be explained: first, the role of the state policies in catalyzing the growth of this industry; second, the institutional peculiarities in these regions that offered distinct incentives for learning and innovation; third, the linkages that the local industry formed with the global production networks to exploit the opportunities thrown up by vertical specialization by firms in the advanced economies; fourth, the institutional and political economy reasons that allowed Tamil Nadu and Andhra Pradesh to successfully implement policies that attracted these firms while Kerala lagged behind; and last, the specific sources of regional competitiveness that allowed these states to develop this industry far more successfully relative to others within the same overall national policy framework. We need to draw on insights from the literature on each of these areas to form a coherent conceptual and analytical framework to explain the success of Tamil Nadu and Andhra Pradesh and the relative failure of Kerala.

The first major body of literature that I draw on focuses on the late development and the developmental state theories. This literature seeks to explain the role of the state in industrialization and economic development in developing countries. The second body of literature that I draw on is the literature on Asian innovation systems that emphasizes

the institutional peculiarities in these economies that offer distinct incentives for learning and innovation. The third major body of literature that I draw on is that of innovation economics and the role of institutions in promoting innovation. This literature argues that policies are needed for innovation due to market imperfections and inherent uncertainties in innovations. Competition policy, public support for R&D, and regulatory reforms can provide such incentives to promote innovations. The fourth major strand of literature that I draw on focuses on the global networks of production, international geography of innovations, and mobility of knowledge through vertical specialization. This literature focuses on how the systems of production and innovation have changed in the post-Fordist era due to vertical specialization and how it is affecting the mobility of knowledge internationally. The fifth major body of literature that I discuss is that on the political economy of development in India. This literature discusses how the state actions in India are influenced by the dominant class interests and how it has affected the industrial development in the country. This literature is important here as there are regional variations due to the extent of worker and social mobilization and organization in different regions. For example, the state actions seem to be relatively more autonomous of the dominant class interests due to greater peasant and worker mobilization and organization in Kerala. The last major strand of literature that I draw upon is that on regional development of lagging regions under the post-reforms policy framework. This literature focuses on the sources of regional industrial competitiveness and how regional governments can play a role in enhancing such competitiveness.

I discuss below how these major bodies of literature are relevant in building a conceptual framework for examining the late development strategies adopted by the three

Indian states. The discussion in the first section below on the late development and developmental state theories draws partly upon (Breznitz, 2005).

(i) Late Development and Developmental State Theories

The concept of late development started with the work of (Gerschenkron, 1962), who argued that latecomer countries needed to adopt different strategies for economic development when compared to those of the developed economies. These strategies are dependent on the degree of 'backwardness' or distance from the technological frontier of the latecomer countries when they start to develop. Theorists in this area have further argued that more economically backward states need more state intervention to grow and that the timing of industrialization matters as states have different paths of industrial development built around different institutions (Gerschenkron, 1962), and that the latecomer states need to compensate for the lost time and lack of resources (Abramovitz, 1986). They have also argued that backward economies enjoyed certain advantages due to the fact that the product markets were already developed and defined by the pioneering economies that had already invested in research and development. Thus the backward economies can 'leapfrog' by investing in the latest technologies instead of going through the same stages of industrial development as experienced by the pioneering economies.

Other scholars have also advanced the idea that backward countries have specific paths of development that depend on the timing of their industrialization. For example, (Amsden, 1989) has argued that late industrialization occurs through learning rather than inventions or innovations and that this learning has been based on a similar set of institutions (Amsden, 1989, p.4).

A more recent version of the late development theory argues that it is a specific state structure combined with a capable bureaucracy that enables backward economies to build an export-oriented industrial structure based on technology-transfer based catching up (Johnson, 1982). Other researchers have applied similar arguments to the cases of South Korea and Taiwan (Amsden, 1989; Amsden, 2001; Amsden & Chu, 2003; Cheng, 1990; Fields, 1997; Park, 2000).

Another variant of this theory is the neo-developmental statist argument that stresses the "flexible developmental state" or "networked state" as the main explanation for the rapid advancement of some emerging economies in hi-tech industries in a system of global production networks and vertical specialization (Ansell, 2000; Calder, 1993; Chibber, 2003; Evans, 1995; O'Riain, 2004). This framework calls for an extremely flexible bureaucracy with deep knowledge of industrial domains that can respond very quickly to the fast changing needs of the industry. Contrary to the earlier developmental state theorists, this model does not call for long-term national planning and control and power over the industry and the developmental process, but a flexible state structure that responds quickly to the changing needs of the industry and allows it to grow on its own as it develops.

It is helpful to examine how far the late developmental and neo-developmental state theories apply to the Indian case. It can be seen that the assumptions of the earlier late developmental state theories do not apply to the case of knowledge intensive and innovation based industries such as software. This is because of several reasons. First, in these industries the market is not well defined and thus strategic planning by the state for large investments in manufacturing capabilities is not useful. Second, the technologies

are constantly evolving and thus development of industrial capability based on incremental innovations to products developed by the pioneering firms elsewhere is difficult. Third, vertical specialization or outsourcing by the multinational firms provides an important opportunity for learning for the latecomer firms, especially those with advanced human capital (Athreye, 2005b; Ernst, 2004; Soubbotina, 2005). Finally, several firms engaged in software development in India have become pioneering firms internationally through development of process and project execution capabilities on their own (Athreye, 2005b). Thus the arguments for an industrial strategy based on technology-transfer based catching up do not apply to the Indian case.

Even the more recent variants of the theory, such as the neo-developmental statist argument, do not apply fully to the Indian case. As noted before, this framework calls for extremely flexible bureaucracies with deep knowledge of industrial domains that can respond very quickly to the fast changing needs of the industry. This feature is missing in the classical Weberian style bureaucracies, such as the one in India, with its separation of general and technical wings, long and stable career patterns, and little involvement of outside experts in policy making. Hence, even this framework is unable to explain the Indian advance in this industry.

As discussed above, the existing literature on late development and developmental state theories is unable to fully explain the role of state intervention in the development of innovation based industries such as software and is not applicable fully to the Indian case.

(ii) Asian Innovation Systems

The second major body of literature that I draw on is the literature on Asian innovation systems that emphasizes 'learning by interaction'(Lundvall, 1993) and the institutional peculiarities in developing economies that offer distinct incentives for learning and innovation (Amsden & Chu, 2003; Lall, 2000; Segal, 2003; Yusuf, 2003). As the latecomer countries faced substantial barriers to innovation, they developed and adopted their own specific approaches and policies to promote innovation. This literature also points out that as latecomers, they also had certain advantages, such as in learning from the mistakes of the leading firms and from the problems of the earlier latecomer firms. It also provides a framework to understand how the state-industry interactions affect the development of industrial capabilities within states. This literature primarily focuses on the domestic (local, regional, and national) linkages and interactions among local firms, and private and public institutions as key sources of industrial upgrading and competitiveness (Humphrey & Schmitz, 2002; Scott, 1996).

Unfortunately, this research is largely confined to the East Asian countries and does not include the Indian experience, which is different in several aspects. First, while the East Asian countries focused on assimilation of new technologies from advanced nations through imitation and then innovated through improvements in process and product technologies (Cardoza, 1999; Kim, 1997; Nelson & Kim, 2000; Nelson & Pack, 1999; Pack & Westphal, 1986), India had a more inward looking strategy focused on self-reliance in key technologies (Krishnan, 2003). In fact, the protectionist government policies adversely affected the growth of the software industry in the country till the 1980s by limiting imports of advanced hardware and software (Dossani, 2005). Second,

the East Asian countries focused on diffusion of technologies after making improvements in process and product technologies (Cardoza, 1999), while the technologies developed in India remained localized in isolated research laboratories with little diffusion among the industrial production system (Dedrick & Kraemer, 1993; Krishnan, 2003; Kumar, 2001). Third, while the corporate sector contributed a large share of the national R&D efforts in the East Asian economies, in India it is largely the public sector that has been engaged in R&D (Kumar, 2001). The interactions among the public R&D and academic institutions, and the industry have been very weak in India leading to poor diffusion and commercialization of the new technologies developed (Kumar, 2001), with the possible exception of the pharmaceutical industry (Krishnan, 2003). Thus, the innovation system in India has been different in several aspects when compared to those in the East Asian economies and hence requires to be examined closely as to its role in the development of the software industry in India. While there are some studies with respect to the role of the innovation system in the development of the software industry in India at the national level[2], research on their role at regional level is almost completely lacking.

(iii) Innovation Economics and the Role of Institutions

Third, I draw on the literature on innovation economics and the role of institutions in promoting innovation. The broad framework is that of (Arrow, 1962a, 1962b) who argued that policies are required to correct for 'market imperfections' due to the uncertainties inherent in innovations. Thus polices are needed to provide incentives for innovation. Researchers have pointed out the role of competition policy and regulatory reforms in providing such incentives (Mowery & Nelson, 1999). These policies include

[2] see for example, (Krishnan, 2003; Kumar, 2001).

incentives for innovation and 'public goods', such as infrastructure, education, protection for intellectual property rights, etc. (Lundvall, 2001). This body of literature is relevant in the Indian case, as trade and industrial policy reforms by the central government have played a significant role in boosting software exports from the country (Dossani, 2005; Parthasarathy, 2004).

(iv) Global Systems of Production and International Geography of Innovations

Fourth, I draw on the literature on global systems of production, international geography of innovations, and mobility of knowledge through vertical specialization. The literature on global value chains emphasizes the importance of international linkages among firms in global production and distribution systems in industrial upgrading and improving technological competitiveness (Gereffi, 1999; Gereffi & Kaplinsky, 2001; Gereffi & Korzeniewicz, 1994). This is especially important for local producers who are relatively new to the international market as they learn significantly from global buyers about improving their production processes and achieving high quality (Piore & Ruiz Duran, 1998; Schmitz & Knorringa, 2000). The knowledge required for such upgrading flows through the global value chains (Humphrey & Schmitz, 2002, p. 1020). For example, the role of vertical specialization (or outsourcing) and contract manufacturing in the development of technological capabilities in the east Asian electronics manufacturing firms is well-recognized (Ernst, 2004; Sturgeon & Lee, 2001).

The emphasis in this literature on knowledge flows through cross-border linkages in global value chains is in contrast to the innovations systems literature, which emphasizes local linkages among firms and public and private institutions as the major

sources of competitiveness. This literature is important in understanding the sources of competitiveness in the Indian software industry, where the firms are focused mainly on the export market and vertical specialization by multinational firms has played a major role in the expansion of the industry and in the development of project execution and technological capabilities within the Indian firms (Patibandla & Petersen, 2002). However, it is important to point out here that this literature largely ignores the role of two additional factors that have played an important role in knowledge transfer across geographical boundaries: ICT-enabled information exchange and cross-national networks of immigrant communities. Scholars have pointed out the role of these two factors in knowledge transfer in the case of the Indian software firms (Saxenian, 2004; Taeube, 2004). Though the role of cross-national networks with Indian-origin diaspora in the Silicon Valley in the growth of Indian software firms has been recognized, there is inadequate research on the implications it has for the role of the state in formulating appropriate development strategies.

To understand the implications of this phenomenon for the development strategies of emerging economies, it is necessary to understand the reasons behind the growing fragmentation or vertical specialization in production. This process has been driven by a number of factors: lower transportation and telecommunications costs that allow leveraging the lower costs of labor and production in developing economies and decrease the cost of remote coordination and supervision; codification of the design that allows production off-site without the offshore firms necessarily having design capabilities; de-linking of the various stages of the product life cycle, such as innovation, design, production, and marketing; and deregulation of trade in emerging economies that has

allowed them access to advanced equipment and has lowered the cost of production and exports. In the case of software, growing 'modularization' that made coding independent of the hardware platform for which it was being written, was one of the major reasons that allowed fragmentation in the production process and outsourcing to outside firms (Dossani, 2005). This development, that started in the 1970s and grew massively in the 1980s and 1990s, provided a great opportunity to the Indian firms to specialize in customized software development (Athreye, 2005b; Dossani, 2005).

Another development that is relevant in the Indian case is the growing fragmentation and offshoring even in the R&D activities that the multinational firms rely on. Researchers have found that large MNCs in advanced economies increasingly rely on R&D done outside their home regions (Dunning, 1994; Pearce, 1999; Reddy, 2000; Reddy & Sigurdson, 1994). Though scholars have pointed out that such R&D activities by the MNCs in developing countries may be happening mainly in non-core and peripheral areas (Amsden *et al.*, 2001), such relocation nevertheless presents an opportunity for developing countries to build up their R&D capabilities and innovation systems and facilitate linkages between the domestic firms and the multinationals (UNCTAD, 2005). This phenomenon holds important implications for development policy that are yet to be examined fully.

(v) Political Economy of Development in India

For examining why the state governments took actions that they did to promote the software industry in their regions and how it affected the differential development of the industry, it is helpful to understand the political economy of development in India in

the post-independence period and particularly after the economic reforms in the early 1990s. The dominant line of thinking in this area has been to focus on the class character of the state in India. This literature discusses how the dominant classes influenced the actions of the state and in turn benefited by it. The main argument is that the state actions in India can be understood as a result of bargaining by a few dominant classes to protect and advance their interests (Bardhan, 1984, 1998; Byres, 1994; Chaudhuri, 1995; Datta-Chaudhuri, 1990). These dominant classes are: industrialists, rich farmers, and the 'professionals' consisting of bureaucrats, military and white-collar workers. These classes are not homogeneous, but are heterogeneous and fragmented by regional differences (Datta-Chaudhuri, 1990). They exert collective influence over the state and influence its actions to protect and advance their own interests. Datta-Chaudhuri (1990) explains how these dominant groups influenced policy-making by the state in India during the pre-reform period. For example, the rich farmers in India ensured that land reforms were not pushed beyond a point, the agricultural income and wealth was not taxed, and the state provided high prices for agricultural outputs and low prices for the major inputs forcing the government to provide heavy subsidies for agriculture. Similarly, during the pre-reform period, the industrialists extracted concessions to protect their domestic market from foreign competition and forced the public sector to subsidize intermediate goods. The business associations sought favors from the government in exchange for supporting it and the politicians (Sinha, 2005). It was a classic rent-seeking arrangement (Krueger, 1974). The working or the professional class ensured that their employment was protected making it difficult for the firms to reduce surplus and inefficient labor. Pressure from backward regions ensured that the central government

allocated public sector investments in those regions. Provision of heavy subsidies and protection of an inefficient industrial sector reduced the resources available for public and private investment and slowed down the growth rate (Bardhan, 1998).

There has been fragmentation and realignments in the dominant coalition after reforms. While one section of industrialists supported the reforms, others sought state support to protect their inefficient production. The rich farmers have diversified into trade, small industry, and real estate and the bureaucracy has accepted that the reforms were necessary (Bardhan, 1998). Support for reforms has mainly come about due to these realignments.

It is helpful to examine whether the above framework is applicable to the actions of the regional governments in India during the post-reforms period. While the class character of the state can be seen in almost all the states in India, in Kerala the state was relatively autonomous of the dominant class coalitions (Cairo, 2001; Dre`ze & Sen, 1995). In Kerala, politics has been marked by mobilization and organization of traditionally marginalized castes and social groups as a result of many caste and social movements during the pre-independence era (Cairo, 2001; Desai, 2001). The communist party in the state played an active role in this mobilization and organization. The empowerment of these groups exerted pressures on the state for distributing the economic and social benefits widely. This has resulted in the state focusing on distribution rather than capital accumulation and growth (Cairo 2001). The model of governance in Kerala thus has been relatively more autonomous of the dominant class interests unlike in the other parts of the country. The state was also perceived to be a hotbed of trade union

activities and hostile to private enterprise (Dayasindhu & Pradeep, 2003; Tharamangalam, 1998).

The above analysis indicates why Kerala failed to show comparable progress in the growth of this industry as compared to the other two states. While the influence of dominant class interests in the policy-making process in Tamil Nadu and Andhra Pradesh ensured the successful implementation of policies for the growth of the software industry, the relatively autonomous nature of the state in Kerala prevented it from implementing these policies due to its deep suspicion of large private enterprise, failure to carry out genuine labor and other policy reforms to support the growth of the industry, and its focus on redistribution rather than growth.

It is also useful to analyze how the interests of the rapidly growing software industry since the early 1990s influenced the state policies in these regions. The software industry in India has been dominated by domestic entrepreneurial firms, which were not part of the traditional dominant business and industrial elites of the country. Till the late 1980s, most of the firms in the industry were small and had little influence with the government for lobbying for policy changes for the industry. The founding of the National Association of Software and Services Companies (NASSCOM) in 1988 bridged this gap in the institutional capacity of the industry to influence policy making by the government. Though it was a very small association in the beginning with just 38 members, it grew in influence rapidly as the exports of software boomed during the 1990s and its membership grew. During this period, NASSCOM played a key role in the evolution of government policies for the software industry (Athreye & Chaturvedi, 2007).

(vi)Regional Development under the Post-Reforms Policy Framework

Lastly, I draw on the literature on comparative regional development under the post-reforms policy framework. This literature is important in the Indian context as the three states have achieved remarkable success in late development after the central government embarked upon wide-ranging economic, industrial, and trade policy reforms in 1991. These reforms resulted in the abolition of industrial licensing and controls on location and size of private investment, privatization of state owned industrial enterprises, encouragement of multinationals and foreign direct investment, a market determined exchange rate, and devolution of more powers to the states for framing their own economic and industrial policies (Bajpai & Sachs, 1999; Chakravorty, 2000). We may expect these policy changes to lead to greater competition among regions to attract investments (Cook & Hulme, 1988). With abolition of controls on size of investment and location, it can also be expected that regions having better infrastructure, better labor skills, and more industry friendly policies would attract greater industrial investments in the post-reforms period (Ahluwalia, 2001). Researchers have found evidence to support the argument that more reform oriented states performed relatively better during the post-reforms phase, including in attracting investments in high-technology areas such as software (Ahluwalia, 2001; Bajpai & Sachs, 1999). I discuss below why this should be expected in the post-reforms phase.

The literature predicts different roles for the state under the pre- and the post-reforms phases. While the state tries to control the path of industrial development in the pre-reforms or nationalist phase through industrial licensing and location decisions and state ownership of heavy industries and infrastructure, the post-reforms or neo-liberal

state encourages private ownership of industries, abolishes licensing and location controls, and encourages foreign direct investment and entry of multinationals (Chakravorty, 2000). The policies under both phases have different implications for regional development. I discuss these implications below in brief.

In the pre-reforms phase, as noted before, the central government tried to spread investments evenly across the different regions of the country through industrial licensing, subsidies for lagging regions and controls on size of investment. This led to sub-optimal allocation of resources, fragmentation of capacities and lack of economies of scale (Ahluwalia, 2001). Under the post-reforms phase, with the abolition of industrial licensing and location controls, we may expect the investments to be decided on economic efficiency grounds and thus favor those regions that have better infrastructure, better labor skills, and more industry-friendly policies (Ahluwalia, 2001). Thus we may expect the regions focusing on these policies to be able to attract a greater share of private investments, including in high-technology areas.

Another major body of literature that is relevant in examining how nations and regions become technologically competitive is the framework presented by (Porter, 1990, 1998) on how industrial clusters form and become a source of competitive advantage for nations. This model suggests that competitive advantage of nations arises due to the presence of four interlinked advanced factors: demand conditions, factor conditions, related and supporting industries, and firm structure and rivalry. The key demand conditions he emphasizes are the presence of demanding consumers in an economy who force the firms to innovate constantly; the key factor conditions are the availability of specialized factors of production, such as skilled labor, capital, and infrastructure;

presence of related and supporting industries enhances the exchange of ideas and promotes innovation; and direct competition between firms forces them to increase productivity and become innovative. Porter also suggests that the government can play a pro-active role in making the nation or the region competitive by influencing these factors. However, this model is also not able to explain the rise of countries like India in advanced innovation based industries such as software. This is due to the fact that in these industries, innovation occurs not merely as a result of direct competition, but often through collaboration and specialization in different stages of production. It is also often difficult to influence the demand conditions in these industries as the major market is international and not domestic. Moreover, the related and supporting industries may not necessarily be present in the same spatial location or region. Hence, the phenomenon of vertical specialization and a globalized and networked form of production in these industries call for new research to enhance our understanding of the sources of competitiveness of emerging regions and nations. In this research, I propose to provide explanations for this phenomenon.

Conclusion on the Review of Literature

It is clear from the discussion in the preceding sections that the existing literature only provides partial explanations for the rise of emerging economies in high technology and knowledge based industries. The reasons for this lie in several key differences in the methods and organization of production between traditional manufacturing based industries, with which the existing literature is predominantly concerned, and the post-

Fordist production that characterizes knowledge based industries such as software. I outline these key differences in the Table 2.1 below.

Table 2.1 Key differences in organization and methods of production between traditional and Post-Fordist industries

Area	Traditional Production	Post-Fordist Knowledge-based Production
Type of Firm	Vertical Integration	Vertical Specialization
Type of Innovation	Sequential (imitation to innovation)	Concurrent
Mode of R&D	Mainly internal	Increasingly collaborative
Technology	Mature and comparatively static	Constantly changing
Technological competitiveness	Relatively much below the technological frontier	Closer to the technological frontier
Technology Upgradation	Incremental improvements to borrowed technology	Process improvements to generic technologies (routines/modules in software)
Sources of Technology	Imitation, reverse engineering, suppliers	Cross-national knowledge networks, immigrant communities, vertical specialization
Location of Production	Lowest cost for mature products	Cost and competitiveness
Labor	Low skilled	Highly skilled
Finance	Large capital requirements	Comparatively lower capital requirements for the software industry
Market	First domestic then exports	Mainly exports
Main reason for state intervention	Lack of international competitiveness in the local industry	Lack of highly skilled labor, and appropriate international production and marketing linkages for the local firms
Mode of state intervention (Macro)	Artificial exchange rates, protection from foreign competition, facilitate technology transfer, lax intellectual property regime (IPR)	Market exchange rates, encouragement to competition, facilitate linkages, relatively strict IPR
Mode of state intervention (Micro)	Subsidies for production based on performance standards, R&D	Subsidies for developing production and marketing linkages, R&D

Source: Author's compilation based on literature review

Thus, though the existing literature is helpful in understanding the development of industrial capabilities within emerging economies in the traditional manufacturing based industries, it is not very helpful in explaining why latecomer states adopt innovation strategies for developing knowledge-based industries and what macro and micro level strategies are appropriate for building technological capabilities within sub-national regions within an overall post-reforms policy framework of the national government. As mentioned before, it is also not very helpful in explaining the role of the state in the development of knowledge and innovation based industries such as software. Innovations in policies by latecomer states to promote these industries have also not been researched adequately. With respect to the Indian case, research is almost completely lacking on how the different strategies adopted by the sub-national regions influenced the specific development path of the industry in their regions. In this research, I hope to fill a portion of this gap in the literature by developing a theory on the role of the sub-national governments in the development of knowledge and innovation intensive industries within an overall post-reforms policy framework at the national level.

2.2 A Brief Historical Description of the Three Cases

Before laying out the main arguments for examining the three case studies in detail, it is helpful to discuss the three cases in brief. In the following sections, I briefly discuss the development of the software industry in the three states and discuss how the specific policies adopted by each of them affected the development of the industry within their regions. The three cases are discussed in detail in the chapters six to eight.

2.2.1 Tamil Nadu

Software industry in Tamil Nadu started much later after it had taken roots in Bombay in the 1970s. Among the member firms of the National Association of Software and Service Company (NASSCOM) as on January 2007, only six software companies were founded in the state before 1990 (NASSCOM, 2007b). Their share in the total software exports from the country was negligible. However, the industry has shown very remarkable growth in the state during the post-reforms period. Total software exports from the state grew from a mere US$ 0.6m in 1993 to US$3,188.4m in 2005, registering an average annual growth rate of over 50%. During the same period, the number of software exporting firms in the state increased from only 10 in 1993 to 1,427 during 2005 (ELCOT, 2006).

It is important to point out here that Tamil Nadu had an important advantage at the start of the reforms as it already had an internationally recognized advanced academic and R&D institute, the Indian Institute of Technology (IIT), in Chennai. The state had also taken a significant policy initiative in 1984 to allow the private sector to open engineering colleges imparting undergraduate engineering education. The state thus had a significant pool of highly skilled labor within the state. Many of the graduates from the IIT and other engineering colleges in the state had emigrated to the US and other countries during the 1970s and 1980s. This immigrant community with ethnic roots in the state was a very significant resource which the state could rely upon later to invest in the software industry in the state. While the IIT graduates with advanced technical skills provided the leadership for the industry, the graduates from the state level engineering colleges formed the bulk of the skilled labor force.

Type and Structure of the Industry

The growth in the software industry in the state has been led by the Indian entrepreneurial and the foreign-expatriate Indian[3] firms, though multinational firms entered the state in a big way after 1995. While the proportion of multinational firms in this industry in the state was only 11% in 1995, it had increased to a little over 22% by January 2007 (NASSCOM, 2007a). As on January 2007, Indian entrepreneurial, foreign-expatriate Indian, and multinational firms comprised 44%, 21% and 22% respectively of the total number of firms in Chennai that were members of NASSCOM (NASSCOM, 2007a). Majority of the leading firms in the state are Indian entrepreneurial and foreign-expatriate Indian firms. Most of the Indian entrepreneurial and foreign-expatriate firms are engaged in the customized software development and IT enabled services business, while most of the MNC subsidiaries cater to the software development and R&D requirements of their parent firms. The industry is focused mainly on the export market.

State Policies for the Software Industry

The state had no specific policy for the industry until the mid 1990s. The first major policy initiative in the state came from the central government in 1995 when it set up a dedicated software technology park in Chennai under the national Software Technology Parks of India (STPI) scheme. This was five years after the first three parks had come up at Pune, Bangalore, and Bhubaneshwar in 1990.

[3] Foreign-expatriate Indian firm refers to firms that have been started by expatriate Indians or are subsidiaries of foreign firms in other countries founded by expatriate Indians in those countries.

The first major direct policy initiative for the software industry came from the state government in 1997 when it announced its first state-wide IT policy for the industry. Before this policy was announced, the software firms could avail of only the general incentives available for all the industries in the state. These incentives included investment and tax subsidies for mega and super mega projects involving an investment of over US$ 15m and US$1500m respectively. IT policy of 1997 marked the first major attempt by the state to specifically target the software industry for development.

The 1997 policy addressed several major concerns of the industry. These included creation of dedicated infrastructure facilities such as IT parks in association with the private sector, establishment of an advanced technical institute and upgradation of curricula in universities to provide skilled labor for the industry, exemption to IT firms from several state laws such as the Pollution Control Act and subsequently from some intrusive labor laws such as the Factories Act and the Shops and Establishments Act, 'single window clearance' to ease the process of granting approvals for starting a new firm, etc. The state also facilitated the opening of a large number of private engineering colleges in the state that provided undergraduate education to meet the growing requirement of skilled labor for the industry.

During this period, the state also took a number of initiatives to build up institutional capacity within the state structure to acquire domain expertise and formulate appropriate policies for the industry. These included involving outside experts from academia and the industry in the policy making process of the state, creation of a separate department for exclusively dealing with the IT industry, and designating a state

government agency (ELCOT) as the nodal agency for interacting with the industry and providing inputs for formulating appropriate policies.

While the focus of the state upto the end of 1990s was to provide specialized infrastructure, skilled labor, and to involve the industry in policy making, there was a distinct change in its strategy after 2000. The focus during this period distinctly shifted to attracting big MNCs and facilitating linkages between the local firms and the international market. The focus on attracting MNCs was partly due to the success of the neighboring state of Andhra Pradesh in attracting large MNCs to the state during the late 1990s. To facilitate linkages with the international market, the state government started organizing an annual series of mega conferences, called 'Connect', in association with the industry associations and the local firms. In addition to these, the local firms, particularly, the small and medium enterprises (SMEs), were encouraged to participate in national and international conferences and exhibitions to showcase their abilities. The state government itself started participating in these conferences to promote investments in the state, particularly by the MNCs and large national firms. This was one of the main policy objectives announced by the state in its second IT Policy in 2002. During this period, the state also actively encouraged the professional expatriate community from the state to actively invest in the state. The expatriate community, with deep ethnic linkages in the state and looking for a profitable economic opportunity to invest, responded positively by opening new firms or subsidiaries of existing firms in foreign countries.

Another major initiative during this period included efforts by the state government to promote e-governance in its various departments and agencies. All departments and agencies were asked to formulate action plans for computerization and

e-governance. However, these efforts had very limited impact on attracting software firms to the state as these firms were focused much more on exports than the domestic market.

It is important to note here that the state (including both central and the state governments) did not take any major initiatives to provide R&D or venture capital to the industry. This is in sharp contrast to the development strategies for hi-tech industries adopted by some other developing countries such as Israel and Taiwan (Breznitz, 2006). This was due to the unique nature of this industry in India. The software firms in India were focused on exports right from the beginning and had developed expertise in custom software development on their own through in-house development of process and project execution capabilities (Athreye, 2005b). They were also internationally competitive at prevailing market rates. In such circumstances, the states never felt a pressing need for providing R&D and finance to the industry.

2.2.2 Andhra Pradesh

Like in Tamil Nadu, the industry has grown spectacularly in Andhra Pradesh too. The total software exports grew from a mere US$7.1m in 1994 to US$ 2,828.3m in 2005. The share of the state in the country's total software exports grew from only 1.5% in 1994 to 11.9% in 2005, only slightly behind that of Tamil Nadu. The number of firms in the state increased from seven in 1992 to 1,186 as on January 2007[4].

Similar to Tami Nadu, Andhra Pradesh also had an advantage at the start of the reforms in the form of a strong R&D base in Hyderabad. The city was home to a network of defense R&D labs established by the Defense Research and Development

[4] Number of companies counted as per the list of registered companies at http://www.hyd.stpi.in/ehouses/ehouses.html (accessed in January 2007).

Organization (DRDO) of the central government. It was also home to a number of pharmaceutical companies at that time. The state also had a large pool of skilled engineers as it had permitted the private sector to open undergraduate technical institutions much earlier (in 1977). The state also had a sizable immigrant community living abroad as a large number of engineering graduates from the state had migrated to the west in the 1970s and 1980s in search of better career prospects. These immigrant professionals, with deep ethnic roots in the state, contributed significantly to the growth of the industry after the reforms.

Type and Structure of the Industry

Till the early 1990s, structure of the industry in Andhra Pradesh closely resembled that of Tamil Nadu. The number of firms was seven in the state in 1990 compared to six in Tamil Nadu and none of them were significant players in software exports at that time. However, the industry expanded very quickly in the state after 1995. The number of firms, particularly the multinational firms, grew sharply after 1995. Among the firms in Hyderabad that were members of NASSCOM as on January 2007, 39.3% were MNC subsidiaries, 34.8% were Indian entrepreneurial firms, and 19.6% were foreign-expatriate Indian firms. Thus the multinational firms have played a much larger role in the growth of the industry in the state. This is in contrast to Tamil Nadu where the industry is dominated by Indian entrepreneurial and foreign-expatriate Indian firms. However, it is relevant to note here that though MNCs comprise the largest share of the industry in terms of number of firms, there are only two MNCs among the top ten leading firms in the state in terms of number of employees. Most of the MNC subsidiaries function as

captive units of their parent firms for software development or R&D. Relatively much bigger presence of the MNCs in the state has happened due to specific policies pursued by the state government as I explain in brief below.

State Policies for the Software Industry

Like in Tamil Nadu, the government in Andhra Pradesh also had no specific policies for the software industry till the mid 1990s. The first specific policy initiative for the industry in the state came from the central government in the form of a software technology park in 1991 under the Software Technology Parks of India (STPI) scheme.

The first specific policy initiatives by the state came after the election of a new Chief Minister of the state, Chandrababu Naidu, in 1995. He started two mega projects in the city to build infrastructure and provide dedicated 'plug and play' facilities for the IT firms. The government provided land and ready built space at concessional rates to attract the IT firms. During this period, the government took a conscious decision to target the large multinational firms by offering them incentives such as land and investment subsidies on a case by case basis. The chief minister himself displayed entrepreneurial leadership by personally contacting the senior management of MNCs and offering them huge incentives to invest in the state. He succeeded in persuading Bill Gates to open a development center of Microsoft in Hyderabad in 1998. Entry of Microsoft into the state attracted a large number of other MNCs and Indian firms to the city.

Another initiative taken by the state during this period was to increase the availability of skilled labor in the state. Besides facilitating the opening of a large number of engineering colleges in the private sector providing undergraduate engineering

education, the state established an advanced post-graduate academic and research institute in collaboration with major private firms in the industry. The industry supported R&D at this institute was a unique initiative by the state government as a similar initiative in Tamil Nadu failed to take off due to apathy by the state government[5].

Another major initiative by the state government during this period was to involve the industry and outside experts in policy making for the industry. The government created a separate department dealing exclusively with the industry and incorporated industry representatives in newly created advisory bodies headed by the chief minister to provide inputs in policy making.

During this period, the state also promoted e-governance in various government department and agencies in a big way. However, though these projects helped in creating a local demand for software solutions in government departments to some extent, it had only a limited impact on the growth of the industry in the state as most of the firms were focused on the lucrative export market and not on the domestic market.

After 2000, the state turned its attention to promoting linkages between the local firms and the international market. It started an annual series of mega international exhibitions in the state for the industry aimed at providing a forum for the local firms to showcase their capabilities and facilitating interactions with the leading multinational firms. The state also provided subsidies to the small and medium sized firms to participate in international exhibitions. The government also actively encouraged the professional expatriate community from the state to invest in this industry in the state.

[5] This was the establishment of TANITEC (Tamil Nadu Institute of Information Technology) by the state government in 1998. However, this institute failed to take off and was later merged with the state funded Anna University in Chennai.

It is relevant to note here that the state did not provide any venture capital to the industry. As in the case of Tamil Nadu, the national firms in the state were focused on custom software development and IT services and were already internationally competitive. However, unlike Tamil Nadu, the state did try to facilitate R&D for the industry to a limited extent by setting up an advanced academic and R&D institute.

2.2.3 Kerala

Unlike Tamil Nadu and Andhra Pradesh, Kerala failed to achieve similar success in this industry during the same time period. The share of the state in the All India exports for software and services has stagnated at around 0.4% during 1998 to 2005, though the absolute value of software exports grew from US$ 11.4m to US$102.1m during the same period. The number of firms in the state grew from 53 to 208 during the same time.

Unlike the other two states, Kerala did not have a sizable pool of skilled labor and a diversified industrial base at the start of reforms. The state did not allow the private sector to open technical institutions until 1992. The state was also known for its militant labor unions and the government was perceived to be hostile to large private enterprise. Though the state had an advanced R&D institute for space research established by the central government, lack of a sizable base of skilled labor, a diversified private sector, and a hostile policy environment at the start of the reforms contributed to the state lagging behind the other two states in the growth of this industry during the post reforms period. Unlike the other two states, this state also did not have a sizable professional expatriate community who could invest in this industry in the state. The expatriates from the state comprised mostly of skilled and unskilled workers working in the gulf region.

Type and Structure of the Industry

Unlike Tamil Nadu and Andhra Pradesh, Kerala had virtually no exports in software till the late 1990s. In fact, till 1995, it had just three firms in Trivandrum, which were members of NASSCOM. Even in January 2007, this number rose to only eight, against 128 in Chennai and 124 in Hyderabad (NASSCOM, 2007a). Two of these firms were multinationals, two were foreign-expatriate Indians, and the remaining four were Indian entrepreneurial firms. None of these firms were among the top 20 leading software exporters from the country.

State Policies for the Software Industry

Kerala was the slowest among the three states to implement specific policy initiatives for the industry. This was despite the fact that its capital city, Trivandrum, had relatively better infrastructure and the cost of operations were comparatively about 30-40% lower[6]. The state had also established Technopark in the early 1990s, much earlier than similar facilities came up in the other two states. The state also had a STPI center established by the central government in 1992.

Despite having good infrastructure and relatively lower cost of operations, the state fared poorly in this industry relative to the other two states. The reasons for this lay in the perception of the state as being hostile to large private enterprise and as a hotbed of militant labor union activities (Dayasindhu & Pradeep, 2003). The state failed to carry out effective labor and other policy reforms to attract private capital. The state was ruled by a left front coalition from 1996 to 2001 that was not perceived to be friendly to large

[6] Source: interviews with firms in Trivandrum.

private enterprises. The state also did not have a sufficiently large pool of skilled labor, which was required for a massive expansion of the industry. In 2000, while Kerala produced only 3,800 graduates with engineering degrees, Tamil Nadu and Andhra Pradesh produced 15,500 and 8,100 respectively (Arora & Bagde, 2006). The low turnout of skilled labor from the state was due to the fact that the state did not permit private engineering colleges until 1992.

The state also failed to acquire domain expertise and did not involve the industry adequately in its policy making process. Though the state created a separate department and a separate directorate for facilitating direct interaction with the industry, they were not effective as the government itself was perceived to be unfriendly to private enterprise.

The state changed its policies towards this industry after 2001 when a new congress led government came to power in the state. This government was far more private investor friendly in its ideology and believed in private and foreign investment as engines for economic growth (Krishnakumar, 2005). After coming to power, the new government announced the second IT policy of the state in 2001. This policy sought to directly address the concerns of the private industry on the labor front. In 2002, the government permitted the IT firms to file self-certifications for compliance with labor laws and exempted them from many of its provisions. These measures were similar to what Tamil Nadu and Andhra Pradesh had done earlier. It also exempted the firms in Technopark from the strikes and other disruptions caused due to labor unrest in the state[7].

After 2001, the state also took specific policy initiatives to attract large multinational and national firms to the state. It started an annual series of mega

[7] This was specifically done to address the concerns raised by the firms in Technopark. The vehicles ferrying employees in and out of Technopark were provided police protection during the strikes.

exhibitions, called IT Kerala, in 2002 to promote the state and provide a forum for the firms in the state to showcase their abilities. More importantly, this event served to project the state as private investor-friendly. The state also allowed a large number of private engineering colleges to open in the state, thereby increasing the availability of skilled labor substantially. The number of engineering graduates from the state went up to over 23,000 in 2006 compared to only 3,800 in 2000. However, delays in consensus building over crucial decisions continued to hamper the growth of the industry during this period. One example was the Smart City project in Cochin. This project was mooted in 2003 to attract foreign direct investment in electronics and software industry. However, continuous negotiations over the project and political opposition led to prolonged delays and the project was yet to be finally approved in 2006.

Why were the state policies so different in Kerala when compared to those in Tamil Nadu and Andhra Pradesh? The reasons for this lie in the political economy of decision making in Kerala. As noted before, scholars have noted the class character of the Indian state and how constant bargaining by the dominant class coalition consisting of rich farmers, industrialists, and working class professionals to protect and advance their interests has affected the actions of the state after independence (Bardhan, 1984, 1998; Byres, 1994; Chaudhuri, 1995; Datta-Chaudhuri, 1990). While this phenomenon helps to explain the actions of the state in most parts of the country, in Kerala, the state was relatively autonomous of the dominant class coalitions (Cairo, 2001; Dre`ze & Sen, 1995). In this state, politics has been marked by mobilization and organization of traditionally marginalized castes and social groups as a result of many caste and social movements during the pre-independence era (Cairo, 2001; Desai, 2001). The model of

governance in Kerala thus has been relatively more autonomous of the dominant class interests unlike in the other parts of the country. The relative autonomous character of the state in Kerala was partly responsible for its failure to implement policies similar to what the other two states did.

2.3 Rise of Tamil Nadu, Andhra Pradesh, and Kerala – the Argument in Brief

Based on the brief historical description of the three cases in the preceding section, we can now present the main arguments for the outstanding success achieved by Tamil Nadu and Andhra Pradesh and the relative failure of Kerala in promoting this industry during the post-reforms period. In the post-reforms era, these states adopted several specific macro and micro level policies to attract private investments, both domestic and foreign, in the software industry. I discuss these policies in brief below.

The first major initiative taken by these states to attract investments was to build and provide world-class infrastructure in their capital cities. This consisted of dedicated 'plug and play' premises with all infrastructural facilities and dedicated data communication links where the software companies could just buy or rent built up space and start operations immediately. Even for those firms wanting to set up their own campuses, the states offered land at concessional rates and the procedures required for obtaining approvals were greatly simplified through a 'single window' system.

The second major initiative taken by these states related to providing adequate skilled labor for these firms. All three states took initiatives to allow privately run technical education institutions providing undergraduate education in engineering and computer science disciplines. As the work done by software firms in India consisted mainly of custom software development and services requiring large numbers of skilled

personnel, availability of adequate skilled labor was a major attraction for them to locate in these states. Kerala was the last among the three states to allow private technical institutions. The low turnout of skilled labor in Kerala was a major reason for its failure in attracting software firms to the state.

Third, these states adopted and implemented far-reaching reforms in their labor and industrial policies. All three states enacted pro-employer labor policy reforms during the post-reforms period (Aghion *et al.*, 2006). They also undertook several other pro-employer industrial policy reforms such as single window clearances, fiscal and tax incentives for investments, etc. (Bajpai & Sachs, 1999). Kerala was the last among the three states to implement these reforms (Bajpai & Sachs, 1999) and consequently the growth of the industry suffered there.

Fourth, these states promoted linkages between the domestic firms and the foreign markets through multinational clients. Such linkages and leveraging resources such as knowledge and market access channels through them have been crucial to the Indian firms in developing process and project execution capabilities (Athreye, 2005b). The strategies adopted to promote such linkages included holding mega exhibitions in the state, networking with the expatriate professionals from the state settled abroad to advance the cause of the state in attracting software firms, and participating in trade shows and conferences held abroad to showcase the incentives and facilities available in the state for attracting investments. They also tried to attract these non-resident professionals to invest in their states. Kerala again was the least successful among the three states as the state was not perceived to be private capital friendly and it did not have a sizable professional expatriate community.

Fifth, the successful states, particularly Andhra Pradesh, displayed entrepreneurial leadership in attracting large multinational and national firms. Entrepreneurial leadership of the chief minister of Andhra Pradesh was particularly successful in persuading a number of large multinational firms to open their subsidiaries in the state. This in turn was helpful in attracting a number of other firms to the state.

Sixth, these states also focused on improving industry-specific domain knowledge among the bureaucracy and encouraging state-industry interaction in policy making. All three states created a separate government department headed by a senior government official to deal exclusively with policy making for this industry. They also formed separate state level bodies headed by the chief minister with direct representation from the industry and academia to provide specialized inputs into the policy making process. Kerala again failed to incorporate the private industry adequately into the policy making process.

Seventh, these states also benefited from the technological expertise in electronics and software development already available at the start of reforms in the state within the public R&D and academic institutions. The presence of a cluster of defense research labs in Hyderabad in Andhra Pradesh and the internationally renowned Indian Institute of Technology (IIT) in Chennai in Tamil Nadu also contributed to make these states attractive for software firms. Kerala did not have the advantage of this 'prior experience' and also did not have a sizable base of skilled labor, which possibly contributed to the relatively slow growth of the industry in that state.

Eighth, these states also adopted pro-active policies for e-governance aimed at computerizing their government departments and delivering services to the citizens

through online websites. Andhra Pradesh was particularly active in this area with the then Chief Minister of the state (during 1995-2004) himself displaying entrepreneurial leadership and taking keen personal interest in implementing e-governance projects and promoting the software industry in the state (Ramachandran & Ray, 2005). Though these policies had only a limited impact on attracting firms to the state as most of the firms were focused on exports and not on the domestic market, they were still helpful in projecting the state as friendly to the software industry. Though Kerala also implemented several e-governance projects, they had only a very limited impact in attracting software firms to the state as the state was not perceived to be private investor friendly.

Ninth, Andhra Pradesh also provided limited R&D support to the firms by establishing an advanced technical institution in computer science and information and communications technologies. This institute was set up in collaboration with the private industry in 1998. Though Tamil Nadu did not provide any specific R&D support to the industry, it already had the IIT, Chennai that was engaged in advanced training and research in software technologies. These institutions have top-class faculty trained abroad and have established themselves as leading centers in software training and research in India. Though the linkages between these institutions and the software firms for R&D have not been strong due to the excessive dependence of the Indian firms on custom software development and IT services instead of products and cutting edge R&D (D'Costa, 2006), these institutes still contributed significantly to the growth of the industry in these states by providing highly skilled professionals. Again, Kerala was the last to establish such an institution in 2000.

Tenth, these states also adopted a number of other micro (firm) level policies to attract software firms to their regions. These included specific fiscal and tax incentives depending on the size of the investment (Bajpai & Sachs, 1999). All these states focused on attracting large firms (both multinational and national) to their states through specific incentives. These included specific case by case incentives such as grant of land at subsidized rates, investment subsidies, and concessional rates for infrastructural facilities such as electricity, etc. They also provided subsidies to small and medium firms for participating in trade shows abroad. Though Kerala also offered similar incentives to the industry, the hostile image of the state towards private capital prevented it from attracting firms to the state.

Lastly, the influence of dominant class interests in the political economy of the decision making process in these states was crucial in determining which states were more successful in adopting and implementing policies to promote this industry. While the influence of a coalition of industrialists and professionals in the policy making process of Tamil Nadu and Andhra Pradesh ensured the success of these policies in these states, the relatively autonomous nature of the state in Kerala prevented it from shedding its anti private capital and pro-labor image and achieving similar success.

The brief analysis presented above points to the importance of regional level policies in promoting investments in high-technology industries within an overall neo-liberal policy framework of the central government. More importantly, it shows that the state retains its relevance as an important actor in the development of high-technology and export oriented industries in industrially underdeveloped economies even under an overall neo-liberal economic policy framework.

3 Research Design and Methodology

3.1 Research Design and Methodology

Research Design

I use a multiple comparative case study design for this research (Eckstein, 1975; Lijphart, 1975; Yin, 2003). This design focuses on explanatory and inductive-iterative theory building through analytical techniques such as pattern matching, process tracing, explanation building and cross-case comparative analysis and synthesis (George & Bennett, 2005a; King *et al.*, 1994; Ragin, 1987; Yin, 1994, 2003). However, before conducting detailed case studies of these three states, I build a multivariate time-series regression model using panel data on software exports from all the major states in India to examine the factors that are associated with the growth in software exports from these states. Then I conduct detailed case studies of the three states using a multiple comparative framework. I use crucial and shadow cases to examine and analyze the data and generalize the results. I examine two states that are highly successful, namely, Andhra Pradesh and Tamil Nadu, as crucial cases to build a theoretical model to explain the role of state policies in the development of innovation based industries at a regional level under an overall neo-liberal policy framework of the central government. I analyze Kerala as the shadow case as it has lagged behind its more successful neighbors in developing this industry. The purpose of selecting a shadow case is to help in testing the theory and generalizing the findings. The selection of the three states as cases is based on replication logic where cases are picked up based on either a literal replication or a

theoretical replication or both (Yin, 2003, p.47). The selection of cases in this case is guided by the initial theoretical framework developed. The criteria in this case are to select cases that help in building up a theoretical framework for examining the role of the state in promoting the development of high-technology industries in developing economies under an overall neo-liberal policy framework. These three states are selected as they fit well within these criteria.

Figure 3.1 below depicts the research design for this study.

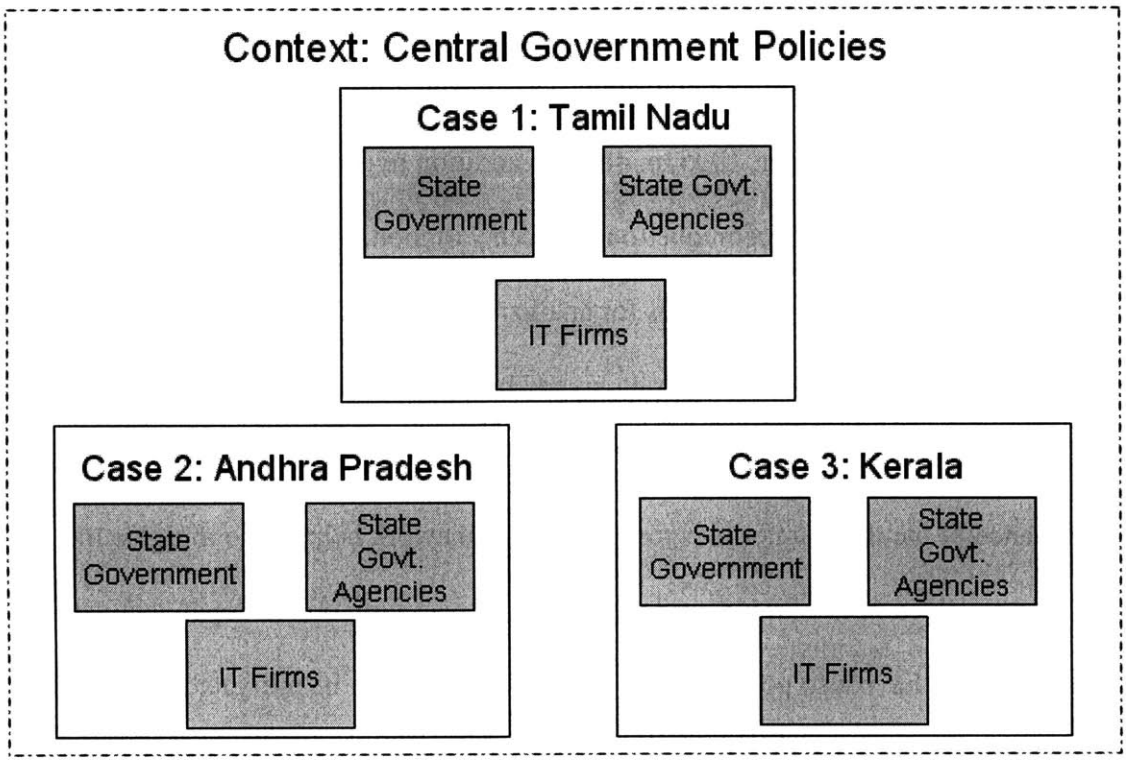

Figure 3.1: Multiple (comparative) case study design with embedded units of analysis

Selection of States

It is relevant to note here that the three cases in this research are selected purposefully based on the outcome, i.e., the dependent variable. While Tamil Nadu and Andhra Pradesh represent the successful cases, Kerala represents the relatively

unsuccessful case that I use as a contrasting case to help generalize the findings. The three cases selected here do not represent the full range of variation possible on the dependent variable. Scholars have pointed out that constraining variation on the dependent variable may induce selection bias and thus may lead to inappropriate conclusions in establishing causal linkages (Geddes, 1990; King et al., 1994).

However, scholars have noted that with appropriate research design, this issue can be mitigated adequately. For example, use of a contrasting or negative case in a comparative framework can make the conclusions more persuasive (Geddes, 1990, p.142) and can serve to eliminate plausible rival explanations using Mill's methods of comparative analysis (Collier, 1995, p. 464). In addition to using these methods, in this research, I also use another technique to introduce variation on the dependent variable. This is by using different time periods for analyzing the performance of the three states, specifically that of Kerala. While Kerala lagged behind the other two states upto 2000, it showed significant success after 2001. Thus, use of two distinct periods to analyze the performance of the three states in a comparative framework helps us to mitigate the problems of selection bias as it introduces sufficient variation on the dependent variable.

Scholars have also pointed out that selection bias can be mitigated by introducing variations in the sub-units of analysis, for example at the level of firms and industrial sectors (Collier, 1995, p. 464-465). In this research, I use firms and government agencies as the sub-units of analysis in each state that contain sufficient variation on the outcomes of interest for those units, namely, the performance of these units. The firms and the government agencies that I examine in the three states show sufficient variation in their performance.

Units of Analysis

The unit of analysis in this research is the region or state. However, the research design consists of multiple cases with embedded units of analysis as shown in the Figure 1. The embedded units are the regional government, its supporting agencies, and the IT firms in these states. These units are relevant for analyzing the role of the state in the development of this industry in these regions.

Methodology

As noted before, I use both quantitative and qualitative methods for this research. I first use a multivariate time-series regression model using panel data for software exports from all the states in India to isolate the factors that are associated with the growth in software exports. Then I conduct detailed case studies of the three states in an explanatory and inductive-iterative theory building framework. The main analytical techniques that I use are pattern matching, process tracing, explanation building, chronologies to trace policy interventions over time to establish systematic causal linkages, and comparative or cross-case analysis and synthesis. The dependent variable in this case is the growth of the software industry in these states during the post-reforms period. The main explanatory or independent variables are the government policies adopted by the regional government in these states. As all the three states are neighboring states within the same region of the country and as the time period for analysis is the same for all of them, these factors can be held constant in a cross-case comparative analysis allowing us to focus on the systematic linkages or covariation between

government policies and the growth of this industry. Cross-case comparison using the methods of agreement, difference, indirect difference, and congruence (George & Bennett, 2005b; Mill, 1888) also permit us to analyze and eliminate plausible rival explanations and validate theoretically relevant linkages between the explanatory and the dependent variables (Waldner, 1999, p. 235). I attempt to generalize analytically to theory-building for state intervention for regional development through high technology industries in developing economies.

Figure 3.2 below depicts the research methodology followed for this study.

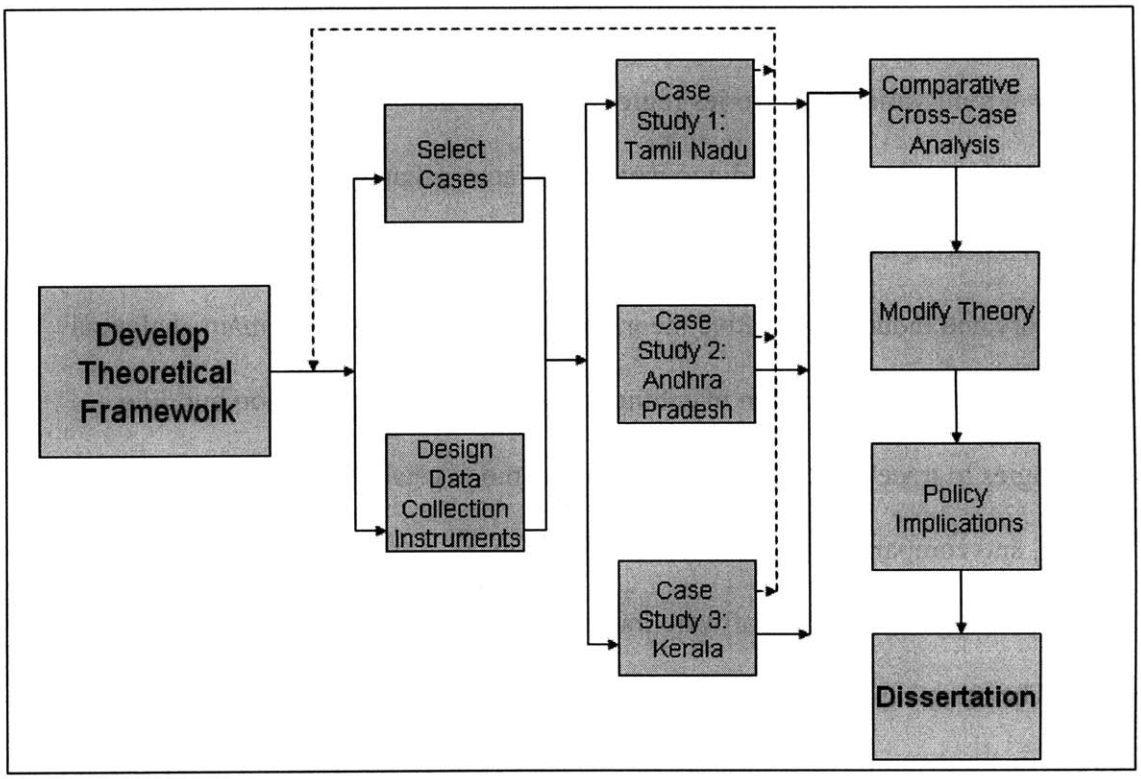

Figure 3.2: Research methodology for this study
Source: adapted from Yin (2003).

Analytical Focus of the Study

It is relevant to note here that the analytical focus of this research is to examine the systematic linkages between regional state government policies and the growth of the software industry in these states. Though I employ institutional analysis and analyze the political economy of decision making in these states to examine how the influence of dominant class coalitions affected the policy context and adoption and implementation of policies for this industry, I do not focus on explaining the origins of these institutions. I take these structural and institutional contexts as starting points or given and focus on examining the systematic linkages between state policies and the growth of the industry.

3.2 Sources of Data

I use both primary and secondary sources of data for this research. The primary sources of data include detailed interviews with senior government officials concerned with policy formulation and implementation in the IT sector in these three states and the firms engaged in software production and exports in these states. A total of 57 interviews were conducted between September and December 2006. These included interviews with 43 different software firms in the three states and 14 interviews with government officials. The number of firms interviewed was 18 in Chennai, 15 in Hyderabad, and 10 in Trivandrum. The interviews with the firms were conducted with promoters, CEOs and senior level managers while the government officials included the senior civil servants in-charge of policy making in these states and officials in state government agencies dealing with the software industry. All interviews with the government officials were conducted face-to-face while most of the interviews with the software firms were conducted over phone as the interviewees found it to be more convenient for them. The interviews with

government officials took around one hour each, while those with the firms lasted around 30-45 minutes each.

Interviews with the Software Firms

Interviews with the software firms focused mainly on eliciting information on the major factors that influenced the firm to choose the state for locating its unit and how the state policies affected that decision, its operational aspects, the relationship of the firm with the local industry, and its linkages with the international market. It consisted of questions on the following 11 major aspects:

(i) Location Decision by the Firm

(ii) Impact of Policy Initiatives by the State on the location decision

(iii) Linkages with the State/Central Govt. Owned and Private Local IT Firms

(iv) Involvement of Your Firm in E-Governance Projects of the State/Central Government

(v) Availability of Skilled Labor in the State

(vi) Labor Relations in the State

(vii) Awareness among Civil Servants about the Needs of the IT Industry

(viii) Involvement of Your Firm in the Policy Making Process of the State/Central Government

(ix) Linkages with Global Production Networks

(x) Access to Finance by the Firm

(xi) R&D and Technology Upgradation by the Firm

Interviews with Government Functionaries

Interviews with the government officials and agencies were focused mainly on collecting information on how the state and its agencies had formulated and implemented policies for this sector and how these policies had evolved over time. They also focused on how the state had involved the industry in the policy-making process. The interviews consisted of questions on the following 13 major aspects:

(i) Policy Initiatives by the State for IT/ITES Industry

(ii) Policy Initiatives by the State for Balanced Regional Development of the IT Industry

(iii) Role of the State in Promoting State Owned and Private Local IT Firms

(iv) Reasons for Preference for the State as an Investment Location

(v) State Policies for Increasing the Availability of Skilled Labor in the State

(vi) State Policies for Labor Relations in the State

(vii) Awareness among Civil Servants about the Needs of the Industry

(viii) Involvement of Outside Experts in the Policy Making Process

(ix) State Policies for Promoting Linkages with Global Production Networks

(x) Role of the State in Provision of Finance for the IT Industry

(xi) Role of the State in Technology Upgradation by the IT Industry

(xii) Policies towards entry of MNCs and FDI in the IT sector

(xiii) Future Initiatives Planned by the State for the IT Industry

Secondary Sources of Data

The secondary sources of data included official documents published by the three state governments and the central government regarding their IT policies; published studies and scholarly research done on the IT industry in India and other countries; statistical data and reports published by the government and other governmental agencies, the industry associations, and the firms; and reports and analyses published by the multinational private consulting firms, newspapers, magazines, etc.

3.3 Selection of Firms

Selection of the firms was done using a combination of stratified and convenience sampling. I first collected the complete list of software and services firms in the capital cities of the three states using the NASSCOM register of member companies in the country as on January 1, 2006. This produced a list of 123 companies in Chennai, 110 companies in Hyderabad, and 10 companies in Trivandrum. Then I classified these companies into different types as per their origin: business house subsidiaries, Indian entrepreneurial firms, foreign-expatriate Indian firms, multinational companies (MNCs), joint ventures between an Indian and a foreign firm, public sector firms, and others. For Chennai and Hyderabad, I randomly selected five firms in each of these categories except in the categories of joint ventures, public sector firms, and others, where the number of firms was too low. Then I contacted these firms individually for scheduling an interview. As not all the firms responded positively, I contacted more firms from the list. For firms in Trivandrum, as the number of firms in the NASSCOM list was very small, I collected the list of firms registered with the state government owned Technopark and interviewed a total of 10 firms using both the lists.

Though the sample of firms selected using the technique described above is not a fully random sample, I believe this is still a representative sample of the firms in the three cities and is the best sample that could be obtained given the constraints of time and the unwillingness of several firms contacted to share information. I believe that the results based on data obtained from these firms can be generalized to the software industry in these cities. Though not all firms in these cities are members of NASSCOM, they represent over 95% of the revenues in the industry (NASSCOM, 2006a, p.8).

4 Evolution of the Software Industry in India – Role of National Policies

The software industry in India has achieved remarkable success during the last two decades, especially since the 1990s. The total exports from this industry, consisting mainly of computer software and services, have grown from a mere US$ 139.4 million in 1990 to US$ 23.7 billion in 2005, including the IT enabled services (ESC, 2006). The industry has sustained annual growth rates of around 30-40% for well over a decade (Arora & Gambardella, 2004). Figure 4.1 shows the remarkable growth of this industry in India since the 1980s. During the same period, the number of firms in the industry grew from 21 in 1980 to 3,170 in 2004 (Dossani, 2005). In this chapter, I discuss the policy initiatives by the central government in India that have contributed to the evolution of this industry in the country.

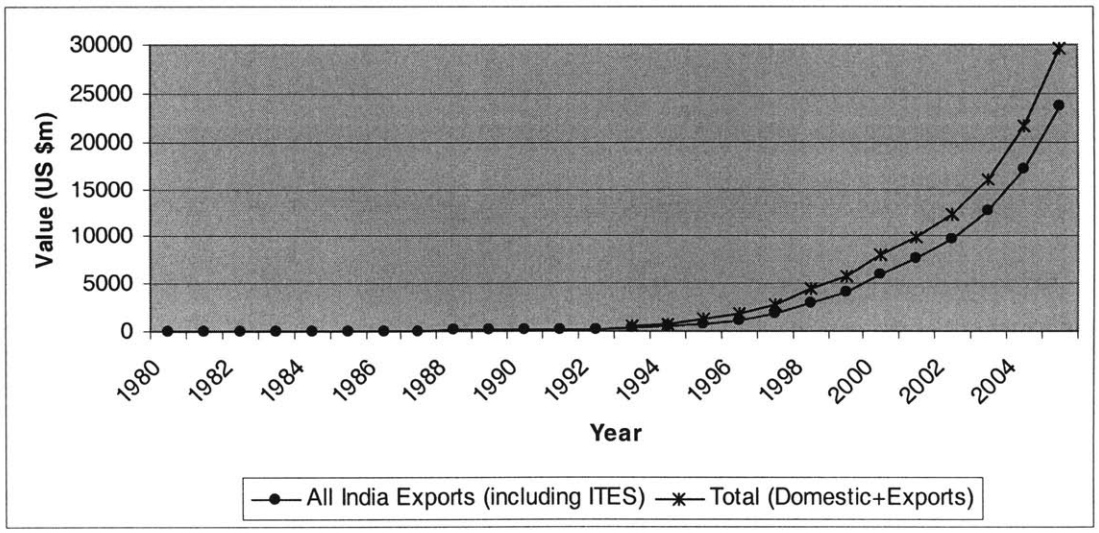

Figure 4.1: Growth of the software industry in India
Source: The data from 1988 to 2005 are from (ESC, 2006). The data from 1980 to 1987 are from Athreye (2005b).

4.1 Policy Initiatives by the Central Government

Central government policies towards this industry in India have evolved continuously since 1970 when it established a separate Department of Electronics (DOE) and identified computer software as a thrust area for exports. A list of the major central government policy initiatives that had a direct bearing on the software industry in the country is presented in the Table 4.1 below.

Table 4.1: Major Central Government Policy Initiatives in India for the Software Industry

Year	Policy Initiative	Details of the Policy
1970	Department of Electronics Established	A separate department was set up to develop the hardware and software industry in India
1971	Electronics Commission Established	This body was entrusted with the task of formulating policies for the hardware and software industry
1972	Software Export Scheme	Permitted hardware imports with the condition that the importing firm earned an equivalent amount of foreign exchange within five years
1973	Foreign Exchange Regulation Act (FERA)	Had a major adverse impact on presence of MNCs in the industry as it reduced the foreign equity ownership in Indian firms to 40%, IBM left the country in 1978 as a result
1976	Liberalization of Policies for Software Exports	Reduced the import duty on hardware from 100% to 40%; export incentives for units in Export Processing Zones (EPZs); incentives for non-resident Indians who were allowed to import hardware for exporting software with an equivalent export obligation
1981	Software Export Policy, 1981	Import duties on hardware raised, but the firms were allowed to use hardware for both domestic and export markets for software, firms could also use imported 'loaned' hardware
1984	Computer Policy	Software was recognized as an industry making them eligible for bank financing; import duties on hardware and software was reduced to 60%; access to foreign exchange was made easier; however, income tax exemption on net export earlings was reduced from 100% to 50%
1986	Software Policy	100% export oriented units (EOUs) could import hardware duty free; foreign produced software could be sold in India
1987	AICTE Bill Passed	Made the All India Council of Technical Education (AICTE) a statutory body to promote and control the development of technical education in the country and maintain uniformity in standards and grant approvals to technical institutions
1988	Software	Established software parks with dedicated infrastructure

	Technology Parks of India (STPI) Scheme	facilities and satellite communication links to encourage small and medium software exporters; granted tax exemption for five years to 100% EOUs (later extended to ten years and now continued till 2009); allowed import of hardware duty-free and simplified the procedures for customs clearances; software firms in their own premises could also get themselves declared as STPs and avail of the benefits
1991	Economy-wide liberalization of industrial licensing, trade, and foreign exchange policies	The currency was devalued and made partially convertible; telecom charges were reduced; import duties on application software were reduced to 20% and to 65% for system software, these were further reduced to 10% for both in 1995; import duties on computers reduced to 15% by 2000 from 55% in 1995 and to 0% for components such as storage devices, microprocessors, etc.
2000	Relaxation on Equity Ownership by Foreign Firms	Rules on extent of equity ownership by foreign firms were further relaxed

Source: (Heeks, 1996; Kumar & Joseph, 2004)

From the Table 4.1, three clear phases can be identified in the evolution of the national policy framework for this industry. The first phase during 1960s and 1970s was characterized by the goal of achieving self-reliance and import substitution in the electronics industry. Hence, this phase was marked by very high import duties on hardware and software (Dossani, 2005; Heeks, 1996). The first clear break in policy came in 1984 when the central government announced a new computer policy which reduced the duties substantially and granted a number of other concessions to the industry (Dossani, 2005). The third phase in evolution of the policy framework started in 1991 when the central government embarked upon wide ranging reforms in trade and foreign exchange policies, relaxed the industrial licensing system, and eased the restrictions on the entry of foreign firms. I discuss below these phases in the evolution of the central government policy in detail and discuss how they affected the development of the software industry in the country.

4.2 Origins of the Industry - The Early Phase (1960s till 1984)

The origins of this industry in India can be traced to the late 1960s when the country's first major IT company, Tata Consultancy Services (TCS), was set up in 1968 in Bombay by the country's well known diversified business group, the Tatas. It was among the first firms to export software beginning in 1974 (Heeks, 1996). During the 1970s, a number of other companies started operations. Most notable among them were Datamatics in 1975 in Bombay, CMC Limited in 1976 in Delhi, PSI data Systems in 1976 in Bangalore, and Tata Burroughs Limited in 1978 in Bombay. The industry during this period was mainly based in Bombay and exports consisted of supplying programmers to firms located overseas (Dossani, 2005). By 1980, there were 21 firms in India with total exports of US$ 4m with another $4m of domestic sales (Heeks, 1996, p.72).

The government policies during 1960s and 1970s were marked by very high import tariffs on hardware and software and there were strict controls on transactions in foreign exchange. The government policies also favored state owned enterprises and discouraged private entrepreneurs in software.

How did government policies affect the development of the industry during this period? Some researchers have argued that the software industry during this period benefited from an enlightened "hands off" policy of the central government (Arora & Athreye, 2002). However, other researchers have argued that the extreme protectionist policies of the government during this period hurt the industry as it prevented competition due to high entry barriers and stifled innovation (Dossani, 2005; Saxenian, 2002). This seems to be true as the main exports during this period consisted not of any

software developed within the country but on-site services by sending programmers abroad (Dossani, 2005; Lateef, 1997). The high entry barriers also permitted the large domestic firms from large diversified business groups to dominate the industry during this period (Dossani, 2005).

Another distinct feature of the national policy framework during this time was the attempt to link the production of software to the production of hardware within the country, rather than on the basis of imported hardware. This was a specific goal of the software policy in 1981 (Athreye, 2005b). This policy raised duties on import of hardware to encourage production of domestic hardware. This slowed down the growth in the production of software for exports. However, liberalization in policies favoring the software industry started in the mid-1980s which led to the boom in this industry in the subsequent years. I discuss this phase next.

4.3 The Steady Growth Phase – 1984 to 1991

The domestic policy framework took a dramatic turn during this period. The first decisive break from the protectionist policies of the past came with the New Computer Policy in 1984 when import duties on hardware were reduced from 100% to 60% for those engaged in software development. Access to foreign exchange was made easier for the software exporting firms and exports were promoted through satellite communication links with computers abroad. The national computer network, Indonet, was also made available for exports by state owned enterprises and small and medium firms.

The second major policy change came in 1986 with the announcement of the new Software Policy. Import duties on hardware were abolished for software exporters though export obligations for them were increased. This policy also delinked the development of

the software industry from the growth of the domestic hardware industry. This freed the domestic software industry and allowed it to grow independently.

Another important policy initiative during this period was bringing uniformity in standards of technical education in the country, especially in the private sector. The central government passed the All India Council of Technical Education (AICTE) Act in 1987 making AICTE a statutory body, though it was established as an organization in 1945 itself. Its primary role was to promote the development of technical education in the entire country and bring uniformity in standards across all institutions, especially those in the private sector[8].

This period also witnessed the single most important policy initiative taken to promote the software industry in the country. This was the Software Technology parks of India (STPI) scheme in 1988. This policy established Software Technology Parks (STPs) in major urban centers of the country with dedicated infrastructure and satellite telecommunication facilities for small and medium software exporters. These exporters were granted five year tax holidays and access to office space, computer, and communication facilities. The STPs also provided 'single window clearances' for projects and provided import certification, software valuation certifications, and marketing support. Firms having their own campuses could also declare their premises as a STP and avail themselves of the incentives. This scheme dramatically lowered the cost of operations for the software exporters by lowering the cost of telecommunication and infrastructure facilities (Athreye, 2005b). The first STP was set up in Pune in 1990 and during the same year, two more parks came up in Bangalore and Bhubaneshwar (Bajpai

[8] Source: http://www.aicte.ernet.in/AboutAICTE.htm (accessed in May 2007)

& Shastri, 1998). STPs were subsequently set up in other major centers of the country such as New Delhi, Trivandrum, Hyderabad and Chennai.

The policy initiatives noted above had major impacts on the structure of the industry in the country during this period. Lower hardware costs and freeing of the software development activity encouraged fresh entry and consequently the number of firms increased from only 35 in 1984 to over 700 in 1990 and exports increased from US $ 25.3m to 105.4m during the same period. Majority of these firms were small and medium enterprises (Dossani, 2005).

This period also saw another important development. This was the entry of MNCs in India to set up fully owned subsidiaries to develop software for their global operations. Citibank established a fully owned and export oriented subsidiary for offshore software development in Bombay in 1985. Subsequently Texas Instruments set up its own subsidiary in Bangalore in 1986. These fully owned subsidiaries were allowed to be set up by the government as special cases despite the fact that the rules existing then did not permit them. This shows that a definite shift was taking place in the mind-set of the bureaucracy towards liberalization even as early as mid-1980s.

The main reason for the MNCs coming to India during this time despite the considerable restrictions on foreign investments was to take advantage of the comparatively much lower cost of Indian software engineers (Athreye, 2005b). Texas Instruments became the fifth largest software exporter from the country in 1990. Three other MNCs also figured among the top eight software exporters during 1990. These were Citibank, DEIL, and Mahindra-British Telecom. However, the other major software exporting firms during this period were all Indian.

Another major development that took place during this time was the founding of the National Association of Software and Service Companies (NASSCOM) in 1988. Starting with only 38 members, this body played a major role in advocacy with the central government to further liberalize the economic policies towards the software industry (Nidumolu & Goodman, 1993). NASSCOM has subsequently grown to have over 1200 members as on January 2007 covering about 95% of the total revenues of the industry (NASSCOM, 2007a). It has played a very important role in advising both central and regional governments on policies for the software industry during the 1990s and later[9].

4.4 The Explosive Growth Phase – Post 1991

The central government embarked upon major policy reforms in almost all areas of economic activity in 1991. These included devaluation of the rupee and making it partially convertible, reduction in import duties on hardware, abolition of tax on foreign exchange for travel abroad, and reduction in telecommunication charges. Export obligations on software technology parks were removed and software exports were exempted from income tax. Import duties on software were also lowered to 65% on system software and 20% on application software in 1994. These were further lowered to 10% for both categories in 1995. FDI norms were liberalized and 100% equity ownership for foreign firms was allowed.

The above initiatives substantially lowered the cost of operations for software firms and lowered the entry barriers. Consequently the number of firms increased from 700 in 1990 to 6,500 in 2005 (ESC, 2006). Exports during the same period grew from US

[9] Source: author's interviews with government officials and firms in Chennai, Hyderabad, and Trivandrum.

$139.4m to 16,941.5m (excluding the IT enabled services exports). Entry of foreign firms during this period increased the technological sophistication of the software development work done within the country and also increased competition for specialized labor for high-end software development (Athreye, 2005b).

The abolition of licensing and removal of incentives for location of investments in backward areas as a result of reforms created a level playing field for all regions within the country for attracting investments. Before 1991, licenses were needed for most investments and it took innumerable trips to New Delhi and upto two years to get a license. After the reforms, licenses were not needed for most industrial investments and decision making became much quicker (Borrell, 2000).

Abolition of central government controls on industrial activity also provided the states with an incentive to create the necessary infrastructure and improve the business climate within their own regions to attract investments. It was in this overall policy environment that the southern states surged ahead in attracting investments in hi-tech industries, particularly software. During this period, three southern states, namely, Karnataka, Tamil Nadu, and Andhra Pradesh developed as the most important regions for software production and exports. The total share of these three states in software exports from the entire country rose from 9% in 1993-94 to 61.6% in 2005-06 (ESC, 2006). Kerala lagged behind its more illustrious neighbors but has achieved significant success after 2001 in attracting software firms. Though Karnataka with its Bangalore cluster had emerged as the leading center for software exports by the mid 1990s displacing Maharashtra (with its Bombay cluster), it was the rise of Tamil Nadu with is Chennai cluster, and Andhra Pradesh with its Hyderabad cluster, and subsequently Kerala with its

Trivandrum and Kochi clusters that was the most important development during this period. In the next chapter, I examine the determinants of the inter-state variation in software exports from India using panel data from 1990 onwards. Then in the following chapters, I explore how these three states succeeded in establishing themselves as the leading centers for this industry during a relatively short span of less than fifteen years.

5 Determinants of Regional Variation in Software Exports from India

How can we explain the regional variation in the growth of the software industry in India? As noted before, researchers have attributed the growth of the industry in India principally to the availability of abundant skilled labor in the country. In this chapter, I analyze the determinants of growth of this industry in various states in India. First, I build a multivariate time-series regression model to analyze the factors that may be associated with the growth in software exports from the entire country as a whole. Then, using panel data on software exports from 14 major states in India, I build a multivariate time-series regression model to examine the main factors that are associated with the growth of this industry in the different states in the country. I use the data on software exports as exports constitute nearly 80% of the total software industry in the country and reliable data at the state level are available. The time period that I take for analysis is from 1990 to 2003 as this represents the relevant period during which the industry witnessed rapid growth in the country. 2003 is the latest year for which reliable data at state level on different indicators are available.

5.1 Analysis of Growth in Software Exports from India

Before we analyze the regional variation in software exports, it is useful to examine the factors that are associated with the growth in total software exports from the entire country. In particular, it is useful to analyze whether availability of skilled labor in

the country has played a role in the growth of the industry. The basic model that I analyze here is as follows;

$$\Delta Y_t = \beta_0 + \beta_1 \Delta X_{1t} + \beta_2 \Delta X_{2t} + \ldots + \varepsilon_t$$

The dependent variable in this case is the annual change in total software exports from the country in various years. The main explanatory variable is the change in the stock of skilled labor in the country. As the main skilled labor employed by the industry consists of engineering graduates (Arora *et al.*, 2001), I use the total number of engineering graduates passing out of all the technical institutions in the country as the main explanatory variable. These graduates are not only from computer science and electrical and electronics engineering disciplines but also from other engineering disciplines involving four years of undergraduate education. Software firms that employ engineers from other disciplines often provide them with short duration specialized training in programming and software tools which make them employable in the industry (Arora & Bagde, 2006). The other explanatory variables that may be associated with the growth in software exports from the country include growth in the production of the secondary and the tertiary sectors of the economy. I use growth in the per capita income in the country as another control variable.

The data on the software exports from India, the total number of engineering graduates passing out every year, the production in the secondary and the tertiary sectors in the economy, and the per capita incomes in the country in each year during 1990 to 2003 are given in the Table 12.1 in the Appendix A. For the model specified above, I use

the change in the annual software exports from the country as the dependent variable and the lagged number of engineering graduates every year as the independent variable. I use the one year lagged values of the annual changes in the other variables as the other control factors. The number of fresh engineering graduates every year represents the change in the stock of human capital in the industry. I use the one-year lagged values of the number of engineering graduates as change in the number of engineers may lead to changes in software exports only after a year. A simple time-series regression with the above model gave the results as shown in the Table 5.1. The DW statistic shows that serial correlation is not a serious problem in this specification. However, correcting for serial correlation using the Prais-Winston method and specifying the Cochran-Orcutt option gives the results shown in the column 3 of the table.

Table 5.1Association between Software Exports and Availability of Skilled Labor in India (1990-2003)

Explanatory Variable	**Dependent Variable: Annual change in the Software Exports (Rs. Million)**	**Dependent Variable: Annual change in the Software Exports (Rs. Million)**
Lagged number of fresh engineering graduates	0.833* (0.1975)	0.391 (0.379)
Lagged annual change in per capita income	13.99 (22.40)	-20.374 (23.545)
Lagged annual change in secondary sector production in the country	-0.0389 (0.055)	-0.077 (0.071)
Lagged annual change in services sector production in the country	0.0126 (0.0128)	0.0181 (0.0142)
Constant	-31997.85 (14447.09)	14885.95 (36003.13)
Adj.- R^2	0.677	0.313
F-statistic	6.76**	2.14
Mean Variance Inflation Factor	1.39	1.39

(VIF)		
Durbin-Watson Statistic (original) Durbin-Watson Statistic (transformed)	1.94	1.94 2.27
No. of observations	12	12

Standard errors are in parentheses
* Significant at 1%
** Significant at 5%

Though the small number of observations and problems due to multi-collinearity prevent us from using additional control variables in the above regression, the above result is still useful in that it indicates a possibly significant association between the annual change in software exports and the additional yearly stock of skilled labor available in the country, though correcting for serial correlation shows that there is no significant association between the two variables. We can analyze this association more closely by examining the inter-state variation in the growth of the industry as that would give us more observations to yield more robust results. I do this analysis in the next section.

5.2 Analysis of Regional Variation in Software Exports

We can analyze the regional variation in software exports from different states within the country using a similar time-series model with the changes in the stock of skilled labor as the main explanatory variable. The main assumption here is that the skilled labor is relatively immobile across states. Researchers have noted that the mobility of skilled labor is in fact relatively low across various states in India (Arora & Bagde, 2006). As I discuss in a subsequent section below, the relatively small

measurement error due to limited mobility of skilled labor can be addressed by using an instrumental variable.

Before analyzing the times-series data, it is useful to examine whether the initial conditions in different states at the start of reforms are associated with the growth in software exports at a later period. The initial conditions that may affect the subsequent growth of the industry in a state include the availability of skilled labor in the state at the start of reforms, literacy rate (which may indicate the prevalence of knowledge of English in the general population in different states), tele-density in different states indicating the level of infrastructure, public sector R&D expenditures, population (to control for size effects), etc. Using the difference in the level of software exports from each state during 2003 and 1992 as the dependent variable, the results of this regression are shown in the Table 5.2 below. I use the values of explanatory variables as in 1991, thus lagging them by a year compared to the initial year (1992) for calculating change in software exports.

Table 5.2 Association between Growth in Software Exports during 1992-2003 and Initial Conditions in 1991 in Various States in India

Explanatory Variable	**Dependent Variable: Change in Software Exports (2003-1992) (Rs. Million)**
Number of fresh engineering graduates in 1991	5.880* (1.196)
Tele-density in 1991	3064.868** (1200.876)
Public R&D Expenditure in 1996[+]	3.975* (1.081)
Literacy rate in 1991	-154.798 (198.66)
Population in 1991	-0.1967** (0.084)
Constant	5978.943 (10479.84)

R^2	0.901
F-statistic	15.49*
Mean VIF	1.64
No. of observations	14

Standard errors are in parentheses
* Significant at 1%
** Significant at 5%
+ In the absence of reliable state-wise data for 1991, I use the data for 1996. As the number of public R&D units remained almost the same between 1991 and 1996, there may not be significant relative changes in the inter-state variation during this period.

As the results above show, availability of engineering graduates, the public sector R&D expenditures, and tele-density during 1991 are significantly positively associated with the increase in software exports between 2003 and 1992. Population during 1991 has a negative association. Significantly initial literacy rate does not show any association with the growth of software exports. These results underscore the fact that the states with relatively better initial conditions, such as large availability of skilled labor, good infrastructure, and higher public R&D spending performed better in attracting this industry. Presence of public sector R&D institutions seem to have influenced the growth of this industry, possibly by generating initial local demand for software and supplying skilled and experienced professionals to the industry. Researchers have noted that the presence of a number of higher public academic and R&D institutions in Bangalore created a trained labor force and spawned a number of software firms. For example, Wipro Technologies, the third largest leading software firm in India, was founded by a group of alumni of Indian Institute of Science (IIS) at Bangalore, a premier research institute in India (Dossani, 2005). It is relevant to note here that all these higher level

academic and R&D institutes in India were established and funded by the central government.

Analysis of Regional Variation in Software Exports using Panel Data

Though the above analysis shows that initial conditions in different states at the start of reforms might have played an important role in the subsequent success of some states in developing this industry, it is helpful to examine whether these factors continued to be important in explaining the growth of the industry in various states in the country during the post-reforms period. To examine this, I use a time-series regression model with the availability of skilled labor in various states as the key explanatory variable. This model can be specified as follows (Arora & Bagde, 2006):

$$\Delta Y_{it} = \alpha_i + \gamma_t + \beta_1 \Delta X_{1it} + \beta_2 \Delta X_{2it} + \ldots + \varepsilon_{it}, \quad i = 1,\ldots N$$

The dependent variable in the above model is the annual change in the software exports from different states within the country. The main independent variable is the change in the stock of graduate engineers in each state. The above specification includes a state fixed effect represented by 'α_i' and a time or year fixed effect represented by 'γ_t'. Using state fixed effects, we can control for omitted variables that vary across states but are constant over time. Using the time or year fixed effects, we can control for omitted variables that vary over time but are constant between cases. If these effects are significant, they may indicate the presence of omitted variables that are not considered in the model. These omitted variables may include factors such as policies of the state, etc.

I use the annual changes in per capita income, and secondary and tertiary sectors of the economy as the additional explanatory variables. Growth in the secondary and the tertiary sectors of the economy may lead to higher demand for software and thus may attract software firms to the state. It is relevant to point out here that I do not use the public sector R&D expenditures as an explanatory variable as reliable state-wise time-series data are not available and the available data show that there may not have been significant changes in the relative inter-state variation in these expenditures[10].

Though India consists of 28 states in total, there are only 14 major states where this industry has a significant presence (Arora & Bagde, 2006). These states are Karnataka, Tamil Nadu, Maharashtra, Andhra Pradesh, Delhi, Haryana, Uttar Pradesh, West Bengal, Orissa, Kerala, Madhya Pradesh, Gujarat, Punjab, and Rajasthan. These 14 states accounted for 83.5% of the country's population in 2003 and their combined share in the country's net domestic product was 79.2% in 2001 (Arora & Bagde, 2006). In the model specification above, I use only these 14 states for analysis. The data for these 14 states on the variables mentioned above are given in the Tables 12.2 to 12.7 in the Appendix A.

The results of the above time-series analysis are presented in the Table 5.3 below. The third and the fourth columns show the regression results with both state and year fixed effects. The fourth column shows the results of regression with the lagged values of teledensity in different states included as an additional explanatory variable. I show these results separately as reliable state-wise time-series data for teledensity are available only for a limited number of years. As we can see from the results, the coefficient on availability of skilled labor is positive as expected and highly significant. As the results in

[10] Source: www.indiastat.com (accessed in May 2007)

the third column (with both state and year fixed effects) show, an increase in the number of engineering graduates in the state by 1 is associated with an increase of Rs. 426,000 in software exports (at 1993-94 prices). At current prices, this would be roughly equivalent to around US$ 20,000. This is roughly consistent with the average revenue per employee in the industry (Athreye, 2005a).

As the results in this table show, annual growth in the services sector of the economy also seems to be positively associated with growth in software exports from the state. Annual changes in the secondary sector of the state's economy and the population of the state are negatively associated with the growth in software exports from the state. Teledensity in different states is not significantly associated with growth in software exports when we consider panel data, though these results are based on data for a limited number of years only. It is important to note here that the state fixed effects are significant in all the three specifications, though the time effects are insignificant. The relatively low value of R^2 (ranging from 0.23 to 0.33) also possibly indicates the presence of significant omitted variables. As noted earlier, these omitted variables may include other factors that may be related to the growth of the software exports, such as state policies.

Table 5.3 Regional Variation in Software Exports from Different States in India (1990-2003)

Explanatory Variable	Dependent Variable: Annual change in the Software Exports (Rs. Million)	Dependent Variable: Annual change in the Software Exports (Rs. Million)	Dependent Variable: Annual change in the Software Exports (Rs. Million)
Lagged number of fresh engineering graduates in the state	0.503* (0.132)	0.426* (0.158)	0.469*** (0.245)
Lagged annual change in per capita income of the state	0.044 (0.512)	0.271 (0.534)	-0.358 (0.966)

Lagged annual change in secondary sector production in the state	-0.0505** (0.0234)	-.059** (0.025)	-0.085** (0.036)
Lagged annual change in services sector production in the state	0.0737* (0.0268)	0.046*** (0.028)	0.079 (0.054)
Lagged annual change in population in the state	-2.585*** (1.332)	-2.604*** (1.404)	-2.696 (2.181)
Lagged teledensity in the state	Not included	Not included	-20.44 (264.926)
Constant	1167.505 (1580.209)	874.944 (1740.16)	724.243 (2608.262)
R^2	Within: 0.239 Between: 0.403 Overall: 0.256	Within: 0.30 Between: 0.337 Overall: 0.276	Within: 0.257 Between: 0.330 Overall: 0.272
F-statistic	9.39*	3.70*	2.08**
No. of observations	168	168	98
State Fixed Effects Year Fixed Effects	Yes* No	Yes* Yes (year dummies are not significant)	Yes* Yes (year dummies are not significant)

Standard errors are in parentheses
* Significant at 1%
** Significant at 5%
*** Significant at 10%

Outliers in the Regression Specification

It is possible that there are some high-performing states that are outliers in the above regression specifications. Outliers are those states that show unusually high values on the dependent variable given the values on the explanatory variables. Statistically, we can identify these outlying observations by their relatively high values of residuals.

Using standardized residuals from the specification with both state and year fixed effects (i.e., with both state and time dummies included), I use a threshold absolute value of 2.0 of standardized residual in an observation to identify it as an outlier. Summing up the standardized residuals with an absolute value of 2.0 or above, we find that there are four states that are outliers in this data set. These states are: Karnataka, Uttar Pradesh,

Delhi, and Tamil Nadu. While Karnataka has six values above 2.0 with a total score of 17.5, Delhi has three values of 2.0 or above with a total score of 8.6, Uttar Pradesh has two values above 2.0 for a total score of 6.1 and Tamil Nadu has one value at 2.6. None of the other states is a significant outlier. Significantly, Andhra Pradesh is not an outlier.

To estimate the impact of these outliers on the sign and significance of the coefficients, we can run the above regressions again by omitting these outlier states. The regression results, with the outlier states omitted, are shown in the Table 5.4 below. As we can see, the sign and the significance of the coefficients are unchanged for most of the variables, though the magnitudes of the coefficients have changed to some extent. The standard errors are smaller and R^2's are higher. The main explanatory variable, availability of skilled labor, remains positive and highly significant.

Table 5.4 Regional Variation in Software Exports from Different States in India (1990-2003)

Explanatory Variable	**Dependent Variable: Annual change in the Software Exports (Rs. Million)**	**Dependent Variable: Annual change in the Software Exports (Rs. Million)**
Lagged number of fresh engineering graduates in the state	0.458* (0.084)	0.461* (0.096)
Lagged annual change in per capita income of the state	0.044 (0.315)	0.366 (0.334)
Lagged annual change in secondary sector production in the state	-0.025** (0.013)	-.027*** (0.013)
Lagged annual change in services sector production in the state	0.032* (0.014)	0.019 (0.014)
Lagged annual change in population in the state	-1.691* (0.837)	-1.526*** (0.842)
Lagged teledensity in the state	Not included	Not included
Constant	352.285 (885.555)	191.818 (946.315)
R^2	Within: 0.426 Between: 0.700	Within: 0.516 Between: 0.698

	Overall: 0.492	Overall: 0.546
F-statistic	15.56*	6.26*
No. of observations	120	168
State Fixed Effects Year Fixed Effects	Yes* No	Yes* Yes (year dummies are not significant)

Standard errors are in parentheses
* Significant at 1%
** Significant at 5%
*** Significant at 10%

Endogeneity in the Model Specification

Though the results above underscore the importance of availability of skilled labor in the state in the growth of its software exports, there is a possibility that the relationship between availability of skilled labor and the growth in the software exports is endogenous. That is, the production of skilled labor in a state may be influenced by the expectation of future growth in software exports from that state. Also, as noted before, there may be a small measurement error due to limited mobility of skilled labor across various states. To take into account both these possibilities, I use a two-stage least squares model using an instrumental variable. The choice of a suitable instrument is important here as a weak instrument may affect the robustness of the results. I use the plan expenditure by the state on primary education as an instrument as this variable may be influencing the availability of students for enrolment in technical education after a gap of seven years after they complete their five years of primary education. As engineering education takes four years to complete, I use the plan expenditure by the state on primary education eleven years ago as the instrument. This variable is unlikely to be related to the growth in software exports from the state as this expenditure was incurred during the late 1970s and 1980s when software exports from the country were very small. The data on

plan expenditures by various states in the country is given in the Table 12.8 in the Appendix A. Plan expenditure on primary education represents the total expenditure on creating new primary schools or expanding the existing ones through addition of new classes, etc.

The results of the two-stage regression using the above instrumental variable are shown in the Table 5.5 below. Please note that in this specification, I include all the 14 states, including the four outliers identified above. As the results show, availability of skilled labor is highly significant in the first regression (presented in the second column) when we consider only the state fixed-effects. However, this variable becomes insignificant when we consider the time fixed-effects (results presented in the third column). However, as the time dummies are not significant on the whole, we may conclude that the results with only the state fixed-effects considered are more significant. Thus, we may conclude that the availability of skilled labor in a state is significantly associated with the growth in its software exports.

Table 5.5 Determinants of Regional Variation in Software Exports from Different States in India (1990-2003)

Explanatory Variable	**Two-stage LS Dependent Variable: Annual change in the Software Exports (Rs. Million)**	**Two-stage LS Dependent Variable: Annual change in the Software Exports (Rs. Million)**
Lagged number of fresh engineering graduates in the state	1.027* (0.399)	1.822 (4.783)
Lagged annual change in per capita income of the state	0.260 (0.560)	0.392 (0.786)
Lagged annual change in secondary sector production in the state	-0.042*** (0.025)	-.043 (0.063)
Lagged annual change in	0.024	-0.026

services sector production in the state	(0.045)	(0.249)
Lagged annual change in population in the state	-1.519 (1.594)	-1.013 (5.723)
Constant	-1652.597 (2608.536)	-4494.054 (18511.94)
R^2	Within: 0.159 Between: 0.569 Overall: 0.301	Within: Not reported Between: 0.593 Overall: 0.289
Wald Chi^2	87.13*	69.86*
No. of observations	168	168
State Fixed Effects Year Fixed Effects	Yes* No	Yes* Yes (year dummies are not significant)

Standard errors are in parentheses
* Significant at 1%
** Significant at 5%
*** Significant at 10%

Importance of Skilled Labor in the Growth of the Industry

Arora and Bagde (2006) have found similar results on the positive association of availability of skilled labor in various states in the country with the growth in software exports from those states. Several other researchers have also noted the importance of abundant availability of skilled labor in the country in the rapid growth of the software industry (Arora *et al.*, 2001; Arora & Bagde, 2006; Dossani, 2005). As the results in the preceding sections show, large variation in the availability of skilled labor across the different states in the country has clearly played a role in the differential growth of this industry across the different states. The four leading states in software exports in the country, namely, Karnataka, Maharashtra, Tamil Nadu, and Andhra Pradesh, together accounted for 70% of the total outturn of fresh engineering graduates in the country in 2003 (Table 12.3 in Appendix A). The share of these four states was 67.9% in 1990. The

share of Tamil Nadu and Andhra Pradesh increased from 23.3% in 1990 to 37.5% in 2003. Kerala's share fell slightly from 5.5% in 1990 to 3.1% in 2003.

It is relevant to mention here that a vast majority of the engineering graduates in these states come from private self-financed institutions (Arora and Bagde 2006). While the central government funded Indian Institutes of Technology (IITs) and the central and state government supported Indian Institutes of Information Technology (IIITs) produce highly skilled technical professionals who fill the top level research and development and leadership positions within the industry, bulk of the skilled labor comes from these privately owned technical institutions. The role of the state governments has been mostly limited to allowing the private sector to open new technical institutions with control on the quality of infrastructure and education being imparted by the All India Council of Technical Education (AICTE). The leading states in this industry had all allowed the private sector to open engineering colleges much earlier than the other states. For example, Karnataka had allowed private engineering colleges in 1957, Maharashtra in 1983, Tamil Nadu in 1984, and Andhra Pradesh in 1977 (Arora and Bagde 2006). Kerala allowed private engineering colleges only in 1992.

Role of IITs and Second Tier Institutions

It is also relevant to emphasize here the distinct roles played by the skilled labor from the top tier institutions in the country such as the IITs and those from the large number of private self-financed institutions in these states. As noted before, the top level leadership and research and development positions in the industry are filled by the graduates from the IITs. They also form the bulk of the highly skilled immigrants in the

US and other developed countries occupying senior positions in the firms there. It is mostly these highly placed professionals who have taken the lead in establishing firms and forging business linkages in India (Saxenian, 2004). These professionals started coming to the US in the mid 1960s as the IITs were established in the late 1950s and early 1960s in different regions of the country. It is also relevant to mention that the entire southern region (consisting of Karnataka, Tamil Nadu, Andhra Pradesh, and Kerala) has only one IIT. Hence, in the early decades of migration, the proportion of emigrating professionals with native linkages from these states is unlikely to be higher than in the other states in the country. This suggests that the states that have benefited from these cross-national linkages with expatriates might have taken specific policy initiatives to attract them back to their native states. I explore these linkages in greater detail in the three case studies presented in the subsequent chapters.

Type of Skilled Labor in Various States

It is also relevant to note here that in the southern states, majority of the intake in the private AICTE approved technical institutions are in computer science or related fields. These disciplines are directly relevant for the IT industry, though firms have been employing engineers from other disciplines too and imparting them in-house training in programming skills (Arora & Bagde, 2006). Table 5.6 shows the total and the computer science related intake in the AICTE approved institutions in the 14 major states in India in 2003. Tamil Nadu and Andhra Pradesh had the highest proportion of students in IT related disciplines in 2003.

Table 5.6: Total Intake and Percentage in IT Related Disciplines in Various States in India in 2003

State	Total Intake	IT related disciplines*	Percentage in IT Related Disciplines
Karnataka	53,891	18,054	33.5%
Tamil Nadu	101,821	58,455	57.4%
Maharashtra	66,029	28,980	43.9%
Andhra Pradesh	92,397	45,400	49.1%
Delhi	11,108	2,260	20.3%
Haryana	13,954	6,835	49.0%
Uttar Pradesh	42,625	16,394	38.5%
West Bengal	17,333	6,520	37.6%
Orissa	15,624	6,260	40.1%
Kerala	23,071	8,850	38.4%
Madhya Pradesh	23,955	7,320	30.6%
Gujarat	14,911	4,308	28.9%
Punjab	15,276	5,810	38.0%
Rajasthan	14,665	5,668	38.6%

* These disciplines consist of Computer Science and Engineering, Information Technology, and Electronics and Communication Engineering
Source: www.indiastat.com

Conclusion

The analysis above shows that the availability of skilled labor for the industry has played an important role in the regional growth of the industry in the country. It is relevant to mention here that there could be a number of other time-variant factors that may affect the location of firms and growth of the industry in the state. The likely influence of these factors is also indicated by the highly significant state fixed effects in the quantitative analysis presented above. These factors may include availability of general and industry-specific infrastructure, government policies for incentives and subsidies, R&D, cross-national linkages with the skilled immigrants abroad, production and marketing linkages with international markets, role of entrepreneurial leadership by the state, etc. To understand the importance of these factors in the regional growth of this industry, I conducted detailed case studies of three southern states using data from

interviews with firms and government agencies. I discuss these case studies in detail in the following chapters.

6 Development of the Software Industry in Tamil Nadu – Getting the Basics Right – Focus on Factor Conditions

The software industry has grown remarkably during the last 13 years in Tamil Nadu. The total value of software and services exports from the state grew from a mere US $0.6m in 1993 to US $3,188.4m during 2005, showing average annual growth rate of close to 100%. However, more remarkable has been its rising share in the total software and services exports from India. This share has grown from 0.2% in 1993 to 13.4% in 2005. Figure 5.1 presents the growth in exports from this industry in Tamil Nadu. During the same period, the number of software exporting firms in the state grew from only 10 in 1993 to 1,427 during 2005 (ELCOT, 2006).

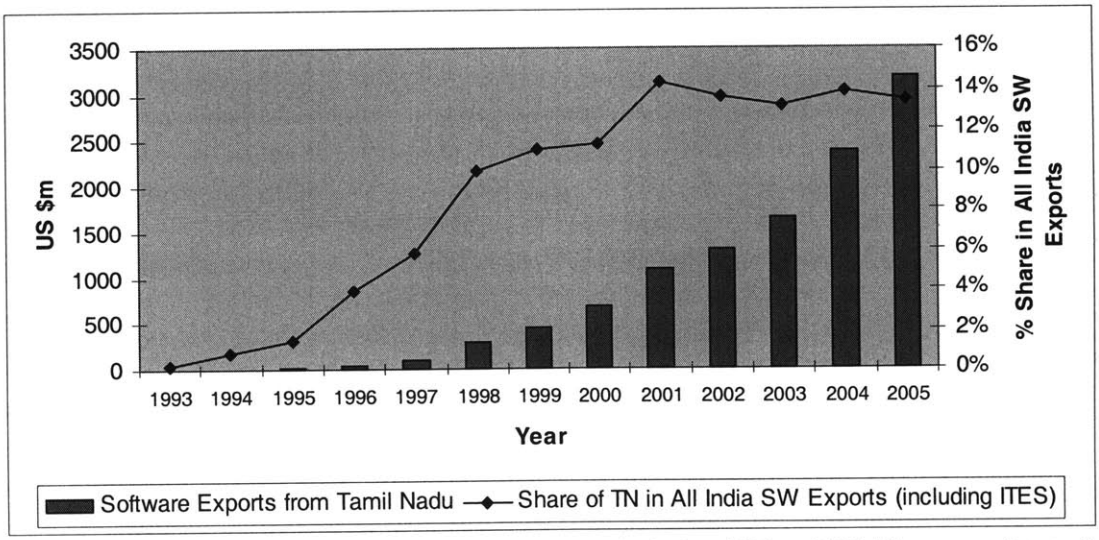

Figure 6.1 Software and services exports from Tamil Nadu during 1993 to 2005. The years relate to the financial year in India, which is from April 1 to March 31.
Source: (ESC, 2002, 2004, 2005, 2006).

6.1 Development of the Software Industry in Tamil Nadu

The software industry in Tamil Nadu started long after it had taken roots in the 1970s in Bombay. In fact, among the member firms of NASSCOM as on January 2007, only six software companies were founded in the state before 1990 (NASSCOM, 2007b). All these companies were established by the local promoters. Interviews with the firms indicate that they mainly catered to the software operations and maintenance needs of the local manufacturing firms and businesses during this period. They were small and relatively insignificant players in software exports. None of these companies were among the top 20 software exporters from the country in 1990.

The early 1990s witnessed a number of software firms starting their operations in Chennai. However, still the growth in the industry remained limited till 1995. The number of software exporting firms had increased to only 10 by 1993 and 34 by 1995 (ELCOT, 2006). The volume of software and services exports grew to US $11.0 m in 1995 from US$ 0.6m in 1993[11].

Though the growth in the industry remained limited up to the mid 1990s, the period from 1991 to 1995 saw an important development in the form of multinational companies (MNCs) starting operations in the state. Two MNCs started operations in Chennai during this period. However, the growth in the industry during this period within the state was led by the entrepreneurial firms started by Indian entrepreneurs. Interviews with the firms in Chennai indicate that these entrepreneurs hailed originally from within the state. In fact, Indian entrepreneurial firms have led the growth in the industry even during subsequent periods as the data in Table 6.1 shows, even though MNCs and firms

[11] http://www.chennai.stpi.in/perform_export.htm (accessed in January 2007)

run by foreign-expatriate Indians entered the state in a big way during 1996 to 2000. This table shows the distribution of the type of firms that entered Chennai over the last two decades and their present shares in total employment in the industry. The data covers 117 software and services firms in Chennai who are members of NASSCOM as on January 1, 2007.

Table 6.1 Distribution of the type of firms in Chennai by their establishment year

Type of Firm	Upto 1990	1991 to 1995	1996 to 2000	2001 to 2006	Total	% in Total	Share in Employment in 2006
Indian Business House Subsidiaries	1	1	5	5	12	10.3%	6.5%
Indian Entrepreneurial Firms	4	13	24	10	51	43.6%	46.6%
MNC	0	3	14	9	26	22.2%	21.6%
Foreign-Expatriate Indian	1	4	13	7	25	21.4%	24.8%
Joint Ventures	0	0	1	2	3	2.6%	0.5%
Public Sector Firms	0	0	0	0	0		0
Total	**6**	**21**	**57**	**33**	**117**	**100%**	**100%**

Source: Author's calculations based on NASSCOM (2007b), company websites and author interviews. Foreign-expatriate Indian firm refers to firms in Chennai that have been started by expatriate Indians or subsidiaries of foreign firms in other countries founded by expatriate Indians in those countries.

Structure of the Firms at State and National Levels

Comparison of the type of the firms in Chennai with that of all the firms in the country reveals some interesting differences between the structures of the industry at the two levels. While business house subsidiaries played a relatively more important role at the national level, their share in the industry within Tamil Nadu is comparatively low. Also, foreign-expatriate Indian firms played a greater role in the development of the industry within the state compared to their share at the national level. I present this comparative analysis in the Table 6.2 below for all the firms in Chennai and for those within the entire country that were members of NASSCOM during 2001.

Table 6.2: Comparison of the structure of the software industry in Chennai and all India

Type of Firm	No. of Firms in 2001		% of Firms in 2001		Share in Employment for All India in 2001
	Chennai	All India	Chennai	All India	
Indian Business House Subsidiaries	8	87	9.0%	15.3%	26.9%
Indian Entrepreneurial Firms	42	251*	47.2%	44.2%	34.9%
MNC	19	128	21.3%	22.5%	16.3%
Foreign-Expatriate Indian	19	58	21.3%	10.2%	7.9%
Joint Ventures	1	44**	1.1%	7.7%	8%
Public Sector Firms	0		0		
Total	89	568			

Source: Data for Chennai are based on author's calculations based on (NASSCOM, 2006b). Data for All India are from Athreye (2005b).
* Includes data on entrepreneurial firms and entrepreneurs with prior IT experience.
** Also includes public sector firms

Leading Firms in the State

Analysis of the leading firms in the state reveals that the industry in the state is led by foreign-expatriate Indian and Indian entrepreneurial firms. Among the top ten firms in the state in terms of number of employees, only two are MNCs, while another two are business house subsidiaries (Table 6.3). Nine of the ten firms are engaged mainly in customized software development, software management, IT enabled services (ITES), and business process outsourcing (BPO). Only one firm is involved in software products. Most of the activities of these firms involve mainly generic software and programming skills with relatively low intensity of R&D.

Table 6.3 Top Ten Leading Software and Services Firms in Chennai

Sl. No.	Name of the Company	Type of Firm	Legal Structure	Year Estd.	Total Employees (2006)	Main Areas of Business
1	Cognizant Technology Solutions India Pvt. Ltd.	Indian Entrepreneurial	Pvt. Ltd.	1994	17,050	Applied Custom Software

2	Sutherland Global Services	Foreign-Expatriate Indian	Pvt. Ltd.	2000	9,070	BPO
3	Lason India Ltd	MNC	Public Ltd.	1993	6,000	BPO
4	Polaris Software Lab Ltd	Indian Entrepreneurial	Public Ltd.	1993	6,000	Software products and solutions for Financial sector
5	Covansys India Ltd	Foreign-Expatriate Indian	Public Ltd.	1991	3,800	e-Business, IT Consulting
6	Scope International Pvt Ltd	MNC	Pvt. Ltd.	2000	3,557	BPO
7	Allsec Technologies Ltd	Indian Entrepreneurial	Public Ltd.	1999	3,000	IT Enabled-Services/BPO
8	HTC Global Services (India) Pvt Ltd	Foreign-Expatriate Indian	Pvt. Ltd.	1990	2,370	Custom Software Development
9	Ramco Systems Ltd	Business House Subsidiary	Public Ltd.	1989	2,020	Enterprise Solutions and Services
10	Accel Frontline	Business House Subsidiary/Joint Venture	Pvt. Ltd.	1995	1,700	Enterprise Solutions and Services, ITES

Source: NASSCOM (2006b), interviews by the author, and company websites (accessed in Jan. 2007)

6.2 Policy Initiatives by the State for the Development of the Industry

The state government had virtually no specific policy for the software industry till the mid 1990s[12]. It was only after 1995 that the government started thinking of the software industry as an engine for economic development and employment generation in the state. The state was not on the priority list of even the central government till 1995. This is evident from the fact that the first Software Technology Park in the state under the central government's STPI scheme started functioning in Chennai only in 1995, seven years after it was launched and five years after the first three parks had come up at Pune, Bangalore, and Bhubaneshwar. The first major policy initiative for this industry by the state government came only in Nov. 1997 when the government announced its first IT policy for the state. However, the software firms during this period could avail of the

[12] A senior government official stated that the software as a separate industry did not enter the thinking of the government until 1995.

general incentives available for all the industries in the state, which included investment and tax subsidies for mega and super mega projects involving an investment of US $15m and US $1500m respectively.

Table 6.4 lists the major initiatives taken by the state government during the 1990s and the current decade for the development of the software industry in the state. After 1995, the state's policies for this industry can be divided into two distinct phases. The first phase was from 1995-2000 when the main focus was on creating the physical infrastructure and improving the availability of skilled labor. Another important initiative during this period was an effort by the state to understand the needs of the industry and make them stakeholders in the decision-making process of the state concerning the industry. This was done by involving representatives from the industry and the academia into the policy making process of the state.

Towards the end of 1990s, the state had started focusing on attracting the large multinational and national companies and on improving the marketing and production linkages between the local firms and the global market. This was done through a number of industry level incentives and initiatives. I discuss these initiatives in detail in the subsequent sections.

One major feature of the state's policy was to focus more on industry wide incentives and not on specific firm level incentives. The specific industry wide incentives included creation of industry specific infrastructure, exemption from some state laws, and increasing the availability of skilled labor. The specific firm level incentives, such as

allotment of land and investment subsidies, were aimed at attracting the relatively large firms. For example, allotment of land was offered to several large national firms[13].

Table 6.4 Major Policy Initiatives by the State Government for Development of the IT Industry in the state

Year	Policy Initiative	What the Policy Did
1992	Policy for Mega Projects	Fiscal and tax concessions for mega projects with an investment of over Rs. 500 million (US $15m); capital subsidy of 20% of fixed assets subject to a maximum of Rs. 2 million, incentives for locating in backward areas and for employing women
1992	Other existing incentives	No Entry or Purchase Tax, unrestricted movement of capital equipment
1996	Policy for Super Mega Projects	Fiscal and tax concessions for mega projects involving an investment of over Rs. 5000 crores (US $1500m)
1997	Soft Loan to Small scale entrepreneurs	Initiated a scheme for granting soft loan to small scale and tiny entrepreneurs, including in IT industries
1997	Harvard University invited by the state	Government invited HIID to provide policy advice on wide-ranging state-level economic reforms.
1997	State's First IT policy	First major policy initiative by the state: IT Parks to be set up at Chennai and three other cities in association with the private sector; private ITPs to have the same status as those by the government; incentives such as exemption from stamp duty and registration charges; single window clearances to all IT units; stand alone units outside the govt./private parks also to get the same incentives; no locational restrictions for setting up of software units; exemption from state Pollution Control Act; a new venture capital fund; a new institute (TANITEC) to be set up for specialized manpower and technology upgradation for the industry; to create centers of excellence in universities and fund research programs; training institutes for hardware and software to be deemed as industries making them eligible for bank finance and registration as SSI; computers to be introduced in all schools; 50% relaxation in FSI for IT parks; ELCOT to be the nodal government agency to promote IT industry
1998	State Level Task Force Appointed	State Level Task Force for Information Technology Industry and a Sub-Committee of the Information Technology Task Force were created incorporating members from the government, industry and academia; a new Dept. of IT was created
1999	Exemption from statutory Acts and allotment of land	IT units granted exemption from the Factories Act, 1948 and later also from the Shops and Establishments Act; allotment of land to private firms through ELCOT;
2000	New Policy Initiatives	An 'Action Plan' drawn up for both supply and demand side initiatives for promotion of the IT industry based on report by Harvard university; a new advisor to Chief Minister appointed
2000	Standards for Local Language Software, creation of a Tamil Virtual University	Prescribed standards for Tamil software; created a Tamil Virtual University (TVU), funded by the Govt. and aimed at providing online resources for Tamilians and others living worldwide for learning Tamil, its history, art, literature and culture.

[13] The allotment of land by the state government was made to seven large IT companies. Six of them were large national firms. Only one of them was an MNC.

2000	Infrastructure Initiatives	Private companies allowed to lay fiber optic cables along the highways and roads in cities; TIDEL Park inaugurated
2001	Annual IT Conference to promote the state and its industry	Annual "Connect" conference series started; organized by the state government, industry associations, and firms, it aimed at promoting the state and improving the linkages of the state's firms to the international market
2002	New Infrastructure initiatives	Announced the creation of an IT Corridor and Knowledge Industry Township within the city, fulfilling a major need for additional infrastructure for IT firms
2002	New IT Policy	Continued focus on SMEs; encouraged participation in International / National events to position Tamil Nadu as the Destination of Choice; focus on e-Governance and taking IT to the rural areas; focus on developing R&D.
2002	Policy to attract MNCs	Steps to make the state attractive for large MNCs in the face of competition from other states
2003	Subsidy for SMEs	SMEs given subsidy for attending national and international IT Exhibitions
2003	New communications infrastructure	Setting up of a state-wide area network to connect all government offices in the state including those in small towns
2005	Separate ITES Policy	Separate ITES policy to make Tamil Nadu the Global ITES Capital; to attract higher FDI and create large-scale employment
2005	State Apex Committee for NeGAP	A State Apex Committee and State e-Governance Group set up to Implement National e-Governance Action Plan (NeGAP)
2006	IT Parks in Smaller cities	New IT Parks to come up in smaller cities in association with STPI
2006	A new specialized institute for IT education proposed	State and central governments to set up a new Indian Institute of Information Technology, Design and Manufacturing in the state
2006	Separate Directorate for e-Governance established	To introduce e-Governance in 12 Government Departments under the National e-Governance Program

Source: Author's compilation based on published documents by the state government and interviews with senior officials

6.2.1 The First Phase (1995-2000) – Focus on Infrastructure and Skilled Labor

During this period, the major thrust of the state's policy was on creating physical and telecommunication infrastructure, simplifying the procedures for the IT firms to get various clearances from state government agencies, and increasing the availability of skilled and trained labor. I discuss these polices in detail below.

Industry Specific Infrastructure

State's first IT policy in 1997 aimed at creating new IT parks in Chennai and three other smaller cities. It also encouraged private developers to develop IT parks by

providing incentives like 50% more floor space index (FSI) and single window clearances for such projects. The infrastructure initiatives resulted in creation of massive infrastructure for the IT industry in the city. The state government promoted TIDEL park with a built-up area of 1.3 million square feet was inaugurated in July 2000. However, the major infrastructure creation came from the private sector in the state after 1997. It was estimated that 143 IT parks with a built-up area of over 48 million sq. ft. were in various stages of completion in the city as of September 2006 (ELCOT, 2006). The involvement of private sector in creating such huge infrastructure happened mainly due to the increased FSI allowed for these buildings and quicker permissions by the government agencies.

Increasing the Availability of Skilled Labor

Another important initiative of the state during this period was to increase the availability of skilled labor in the state that was required for a massive expansion of the industry. This was done by allowing the private sector to open new engineering colleges for imparting undergraduate technical education in computer science and other engineering disciplines. The annual number of new engineering graduates in the state increased from 6,660 in 1995 to 28,107 in 2003. As noted in the chapter five, the industry employed not only graduates from computer science and related disciplines, but also from other engineering disciplines as the firms were focused on mostly custom software development for which only generic programming skills were sufficient. The firms often

provided in-house training to these graduates to make them suitable for employment[14]. As the Senior Vice-President of a major foreign-expatriate firm in the city stated:

> "...the quality of the engineering graduates in the state is very good. However, the firm has to train the graduates. Some kind of pre-certification system after the graduates leave the university would be helpful..."

This view was echoed by several firms in the city.

Regulatory Reforms

Another major reform initiative by the government during this period was to make the procedures for obtaining clearances much simpler for the IT firms. These policies were aimed specifically at the IT industry and made their operational procedures much easier. The specific policies included single window clearances, uninterrupted supply of electricity, and exemption from several state laws such as Pollution Control Act, etc. Subsequently, the IT firms were also granted exemption from some labor laws, such as the Factories Act and the state Shops and Establishments Act. These exemptions virtually eliminated the inspections and harassments by the junior level officials from the state agencies and eliminated a major complaint by these firms[15].

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[14] Source: interviews with firms in the city.

[15] This factor was emphasized in several interviews with the local IT firms. Liberalization by eliminating the unnecessary provisions under the various Acts was an important factor in reducing the time it took to start a firm in the state.

Involvement of Outside Experts and Industry in Policy Making

The state government took another important step during this period to obtain policy advice from outside experts on policy reforms needed to promote the IT sector. This was done by involving the Harvard International Institute for Development (HIID) in 1997 to conduct research and provide policy inputs to the government on economic policy reforms. HIID conducted research and produced several policy papers to the government. On the software industry, it advised the government to focus on creating infrastructure, improving the availability of skilled labor, attracting multination companies, and providing marketing assistance to the small and medium firms (Bajpai & Sachs, 1999).

In another important initiative, the state also tried to involve the industry and the academia into its policy making process. This was an attempt to utilize outside expertise and sensitize its own bureaucracy to the needs of a new industry in which it had no previous experience. This was done by creating a state level task force on IT in 1998 by incorporating high level representatives from the industry (both local and national), academia, and some senior government officials. Its primary role was to provide policy inputs to the government on the needs of the IT industry. The government also created a separate Department of Information Technology in 1998 to focus exclusively on the industry and for better coordination between the industry and the government. Incorporation of outsiders into the policy making process of the state did not produce any resistance from the permanent bureaucracy of the state as these bodies were temporary and only advisory. The ultimate decision making powers were still vested with the

government[16]. In 2000, the government also created a separate post of advisor to the Chief Minister on IT. Involving outside experts in the policy-making process of the state was an important departure from the traditional mode of governance earlier based on a top-down approach and little interaction with the industry. In fact, earlier the government discouraged deep interaction between the bureaucracy and the private industry due to fear of corruption[17]. In such an environment, the new initiatives of the government to encourage deeper interaction with the industry for policy making were important signals to the industry that the state was seriously interested in creating a business-friendly environment.

6.2.2 The Second Phase (2001-2006) – Going Global

There were important changes in the state's strategy towards this industry during the current decade. While the focus on creating and expanding infrastructure and increasing skilled labor continued, the state adopted new policies during this period aimed at attracting the large firms (both multinational and national) and forming linkages between the local firms, multinationals, and the international market. This shift in the state's strategy was due to two major reasons. First, there was a growing realization within the state's bureaucracy and political leadership that the state was losing out on investments by the big MNCs and this was hurting the growth in software exports from the state. The share of the state in all India exports of software and services had declined in 2002 and 2003 from its high in 2001 (Fig. 6.1). The second reason for this shift in the

[16] In this aspect, this model differs significantly from what some other countries have followed in developing their high technology industries. For example, Israel followed a policy of allowing outside experts to join the government as decision makers (Breznitz, 2005).
[17] Source: interviews with senior government officials.

state's thinking was the success of the neighboring state of Andhra Pradesh in attracting several big MNCs to Hyderabad[18].

Attracting Large Firms

The state turned its attention during this period towards attracting large companies. It announced a specific policy in 2002 to make the state attractive for these firms, especially the multinationals. The state's second IT policy in 2002 offered a number of incentives to these firms depending on the size of the investment. It also offered developed land to these firms. Developed land was allotted to seven companies in 2003 in the Siruseri IT Park in the city.

It is relevant to note here that though this policy aimed at attracting the large firms, it did not aim exclusively at attracting the large MNCs alone. Though the state announced a separate policy in 2002 to attract the MNCs, it did not make all out efforts aimed exclusively at attracting them. Out of the seven firms that were allotted land in the city, only one was a multinational. This was in sharp contrast to the policies of the neighboring state of Andhra Pradesh, where the state focused much more on attracting the large MNCs from the beginning itself. I discuss the policies of that state in more detail in the next chapter.

[18] Competition from Andhra Pradesh in attracting investments in the software industry was one of the main reasons for the changes in the state's policy during this period. This was confirmed during interviews with senior government officials in the state. As one senior government official stated: "the state had realized by the end of 1990's that it was losing out to Andhra Pradesh in attracting large investments in the software industry, especially from the multinationals. This was the main reason for announcing a specific policy in 2002 aimed at attracting large firms to the state".

Facilitating Linkages with MNCs, and the International Markets

Another major policy initiative during this period involved efforts to create linkages between the local firms, MNCs, and the international market. The government started organizing an annual series of exhibitions called "Connect" in 2001 in association with the industry associations and the local firms. These conferences were aimed at projecting the state as an ideal destination for investments in the IT industry and to provide a platform for the local firms to showcase their capabilities. Large MNCs, their CEOs and other high ranking executives, and internationally known experts on the development of the IT industry were invited to participate in these conferences. In addition to these, the local firms, particularly the SMEs, were encouraged to participate in national and international exhibitions to showcase their abilities. A specific policy initiative in 2003 offered 30% subsidy in stall rents to the SMEs with a turnover not exceeding Rs. 100 million (approx. US$22 million) to participate in international and national trade shows and exhibitions. The state government itself started participating in national and international conferences to promote investments in the state by the large firms, including both national and multinational firms. This also was one of the main policy objectives announced in the state's second IT policy in 2002. In another policy initiative, the state announced a separate policy for the IT Enabled Services (ITES) industry in 2005, focusing again on attracting higher foreign direct investments (FDI).

Stimulating Local Demand through e-Government Projects

Another major initiative during this time was an effort by the state to introduce massive computerization in its departments and agencies. All departments were asked to

formulate action plans for e-governance. A new project was launched in 2003 to set up a state-wide area network to connect all government offices, including those in small towns, called Talukas. The new National e-Governance Action Plan announced by the central government came in handy to secure additional funds from the central government for computerization of several departments. A new State Apex Committee was set up in 2005 to oversee this project and a new directorate for e-governance was created in 2006. Though these initiatives influenced the demand conditions for the IT industry within the state to some extent, their overall influence in attracting new firms was limited as the firms were focused far more on the export market than the domestic market.

6.3 Impact of the State's Policies on the Growth of the Software Industry

How did the policies of the state affect the growth of the industry? What were the major factors that influenced the software firms to choose Chennai for locating their units? Did the state help in obtaining finance, upgrading technology, improving linkages with the international market, etc.? To help understand how exactly the state influenced the development of this industry, I conducted in-depth interviews with 18 firms in Chennai during November and December 2006. Seven of these firms were foreign-expatriate Indian, seven were Indian entrepreneurial, and two each were multinational and Indian business house subsidiaries. I discuss below the main conclusions from these interviews.

Major factors that influenced firms to locate in Chennai

Among the common factors for choosing Chennai that emerged from all the interviews with firms were good availability of infrastructure and skilled labor, good international air transportation links due to the presence of an international airport in the city, competitive costs of living in the city, and supportive state government policies towards the industry that reduced delays in obtaining clearances. However, while all the firms said that the government policies were supportive, one multinational firm asked for more concessions and exemptions from the government, especially on labor laws concerning conferment of permanent status on workers and declaration of holidays.

For the non-MNC firms in the city, ethnic linkages of the main promoter(s) of the firm within the state were the most important factor for choosing Chennai. This was true of all the firms interviewed in the categories of Indian entrepreneurial, foreign-expatriate Indian, and Indian business house subsidiaries. They said that they chose Chennai despite its relatively higher costs compared to Hyderabad and Trivandrum because they wanted to maintain their ethnic and cultural links with their native state and wanted to contribute to the development of their state. As the Senior Manager of a prominent US-based foreign-expatriate Indian firm in the city stated:

> "The founder of the company that evolved into this firm is from Chennai. This was the most important reason for locating the firm's operations here. Second, availability of adequate skilled labor in the state (even during 1994 when the firm opened its center in Chennai)..."

It is useful to examine the educational background of the promoters of the foreign-expatriate Indian firms in Chennai. Out of the seven foreign-expatriate Indian firms interviewed, promoters of five firms graduated from leading public universities of the state (Anna university, Madras University, and Annamalai university)[19]. Four of them went on to study and/or work in the US while one went to work in the Gulf. Promoters of two firms are Indian Americans who hailed originally from the state. These expatriates left the state in the 1970s and 1980s, i.e., much before the current boom in the industry. The relevant point to note here is that the international linkages that have helped the industry to grow in the state have been formed by expatriates from the top public universities in the state and not by the graduates from the second level private technical institutions in the state who form the vast majority of the labor force in the industry.

On support from the government, while most of the firms stated that the state government policies were supportive of the industry, only two of them said that they had actually availed of a firm level incentive from the state government. This incentive was allotment of land to them in a state promoted IT park in the city. Interviews with a government official confirmed that only seven firms had been allotted lands for building their own campuses in government promoted IT parks in the city. Most of them were large national IT firms, with only one MNC being allotted land there. These lands were allotted at prevailing market rates with very little subsidy. This was in line with the state government's focus on providing industry level incentives rather than firm specific incentives.

[19] Source: interviews with the firms and information from firm websites.

Linkages with the State Owned and Privately Owned Local IT Firms

Exports were the most important source of revenue for all the firms interviewed. Most of the firms interviewed said that they virtually had no linkages with the state owned or local private IT firms. Only two firms stated that they had participated in tenders floated by ELCOT for some e-governance projects of the state government.

Availability of Skilled Labor in the State

Availability of adequate skilled labor within the state was cited by all the firms as a major factor for choosing the state for locating their units. However, four of them said that the graduates passing out of the local technical institutions possessed only generic skills in applications software and lacked the specialized skills for product development. These firms are engaged in product development on behalf of their foreign clients. Lack of labor with specialized skills in the state might be a constraint for growth in the higher-end of the value chain in the industry.

Labor Relations in the State

Most of the firms said that the state was pro-active in ensuring a business-friendly environment for the industry. The state has granted exemptions to the software firms from several provisions of the labor laws that were deemed as not business-friendly. However, one MNC firm interviewed wanted more exemptions under these laws from maintaining forms and registers and also from provisions of conferment of permanent status on workmen.

Awareness among Civil Servants about the Needs of the IT Industry

Most of the firms interviewed said that awareness among government officials about the needs of the industry had increased over the last decade and that they had made increased efforts to support the industry in the state.

Involvement of the Firm in the Policy Making Process of the State/Central Government

Most of the firms interviewed said that they had no direct involvement in the policy-making process of the state. However, they had periodic interactions among themselves in forums like NASSCOM on how the government could support the industry. NASSCOM was represented in the government bodies concerned with policy making for the industry and this arrangement had served the industry adequately.

Linkages with Global Production Networks

All the non-MNC firms interviewed said that their major clients were firms in advanced countries who outsourced a part of their work to them. Serving the domestic market was only a very small fraction of their total activity. This was true of even the relatively smaller firms as even they are focused mainly on the export market. The MNC subsidiaries are mostly engaged in serving their parent firms exclusively.

Access to Finance

For most of the Indian entrepreneurial and foreign-expatriate Indian firms, the main source of finance has been promoters' equity, though some have taken loans from

Indian banks for construction of buildings and working capital. For the MNC subsidiaries, finance has come from their parent firms. Significantly, none of the firms said that they had availed of any venture capital. This was primarily due to lack of availability of such financing for the local firms.

Significantly, the state's role has been very limited in providing or facilitating access to finance for these firms[20]. Even the venture capital fund announced by the government in 2002 did not succeed. The most important reason for this was the relatively easy availability of finance for these firms from outside sources, such as banks and promoters' equity. Moreover, the amount of fund available from the government promoted venture capital fund was relatively small and the procedures required were cumbersome. Companies could get amounts only in the range of Rs. 20 million to Rs. 50 million (US $400,000 to US $1 million)[21].

R&D and Technology Upgradation by the Firm

All the non-MNC firms said that the main source of R&D for their activities was from within the firm itself. For the MNC subsidiaries, their parent firms provided the technology. Significantly, the role of the government has been extremely limited in providing R&D to the industry. Even the publicly funded higher academic institutions in the state, such as the Indian Institute of Technology in the city, do not have any significant linkages with the local firms for R&D.

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[20] One senior government official stated that "software firms could get finance from outside sources (banks, promoters' equity, etc.) and did not need financial support or subsidies from the state...". This view was echoed by several firms, which said that the software firms, especially the large and medium ones, could take care of themselves and did not need financial sops from the government.

[21] http://www.elcot.com/fund.html (accessed May 2007).

6.4 Analysis of the State Government's Role in the Development of the Software Industry in the State

What is the best analytical framework that we can use to understand the role of the state in the development and evolution of the industry within its region? Are the existing theoretical paradigms sufficient to explain the role of the state in this case? In this section, I shall try to analyze how the state's policies affected the development of the industry within its region and how these differ sharply from the dominant existing paradigms in the literature on the role of the state in industrial development in emerging economies.

Before trying to analyze how the policies of this state differ from the dominant existing paradigms, it is useful to briefly recapitulate what the state did to catalyze the development of this industry. The policies of the state for this industry can be divided into four main categories: provision of industry-specific factors (physical and communications infrastructure and increasing the availability of skilled labor); acquiring industry-specific domain knowledge relevant to policy-making by incorporating academicians and industry representatives into its policy making process; attracting large MNCs (to a limited extent); and improving the linkages between the local industry and their global clients. There were also attempts to influence the local demand conditions by introducing e-governance projects in several government departments, but they had only very limited impacts on attracting software firms[22].

These policies are in sharp contrast to the dominant thinking within the literature on the role of the state in industrial development in emerging economies. First, the most

[22] This was confirmed during interviews with several firms in the city.

prominent thinking in the literature on the role of the state in late development pertains to strategies for technological catch-up based on technologies developed in the advanced economies. This literature talks about long-term national planning for industrial development and providing incentives for creation of a few large and vertically integrated national firms who first operate in the domestic market and then compete internationally based on incremental improvements in technology through their own R&D. Scholars in this area also talk about specific state structures that can help implement these strategies. These specific state structures mainly pertain to creation of a dominant or nodal agency that has power and control over the industry and other government agencies to force the implementation of its policies and monitor the results using certain performance standards.

It is clear that the actions of the state in this case differ sharply from this paradigm. The state did not try to create or promote large locally owned firms. There was also no attempt to create state owned enterprises. The state also did not try to control the industry by providing incentives selectively. Most of the incentives to the industry, such as creation of physical infrastructure, increasing the availability of skilled labor, etc., were general to the industry as a whole and not specific to the firm. Even in cases where large firms were given land, the full market cost was recovered from them[23].

The second dominant line of thinking on the role of the state is that of "neo-developmental state", "flexible developmental state", or "networked state". This literature suggests that for a state to play an effective role in development of high technology based industries, it must interact deeply with the industry and be extremely flexible to change

[23] Several firms said that the allotment of land by the government benefited them only by cutting down the time and effort required to purchase the land on their own. It was not a source of financial benefit to them.

its policies dynamically in line with the changing requirements of the industry. In short, it calls for an "embedded" state that acts more as a supporter of the industry than as its controller and leader. The state's success is "defined by its ability to promote post-Fordist networks of production and innovation, to attract international investment, and to link these local and global technology and business networks together in ways that promote development" (O'Riain, 2000a). This model calls for extremely flexible bureaucracies that understand deeply the constantly changing needs of a technology intensive industry.

However, even the neo-developmental state framework is unable to fully explain the policies of the state in this case. The state did not try to embed itself deeply into the industry, though it did make attempts to incorporate them into its policy-making process. The bureaucracy in the state, styled as it is on the English model with its separation of general and technical expertise and long and stable career patterns, did not acquire sufficient domain knowledge to understand deeply the constantly changing needs of a rapidly growing industry.

The dominant insights from the regional development literature are also unable to fully explain the role of the state in this case. The main line of thinking on the sources of regional industrial competitiveness and the role of the state is that of the state influencing the specialized factor and demand conditions, presence of related and supporting industries, and competition among local firms. In this case, though the state influenced the factor conditions by providing industry specific infrastructure and specialized labor, there was little attempt to influence the demand conditions. Competition among the local firms was mainly for the local skilled labor and not for the domestic market. Thus even

this framework is unable to fully explain the role of the state in a hi-tech industry with global linkages in production and markets.

The discussion above suggests the need for a new analytical framework that draws on insights from several existing paradigms and provides a new understanding of the role of regional governments in the development of hi-tech industries in emerging economies. I attempt to build this framework after presenting the two other case studies in the next two chapters.

7 Development of the Software Industry in Andhra Pradesh – Attracting the Big Multinational Firms and Charismatic Leadership

Like in Tamil Nadu, the growth of the software industry has been spectacular in Andhra Pradesh too. The total value of software and services exports from the state has grown from only US $7.1 million in 1994 to US $2,828.3 million in 2005. The annual average growth rate has been over 75% during this period. Like in Tamil Nadu, this state has also shown a remarkable rise in its share of software and services exports from the country. The share of the state has grown from 1.5% in 1994 to 11.9% in 2005 (Fig. 7.1), only slightly behind that of Tamil Nadu at 13.4%. The number of firms in the state registered with the STPI, Hyderabad grew from seven in 1992[24] to 1,186 as on January, 2007[25].

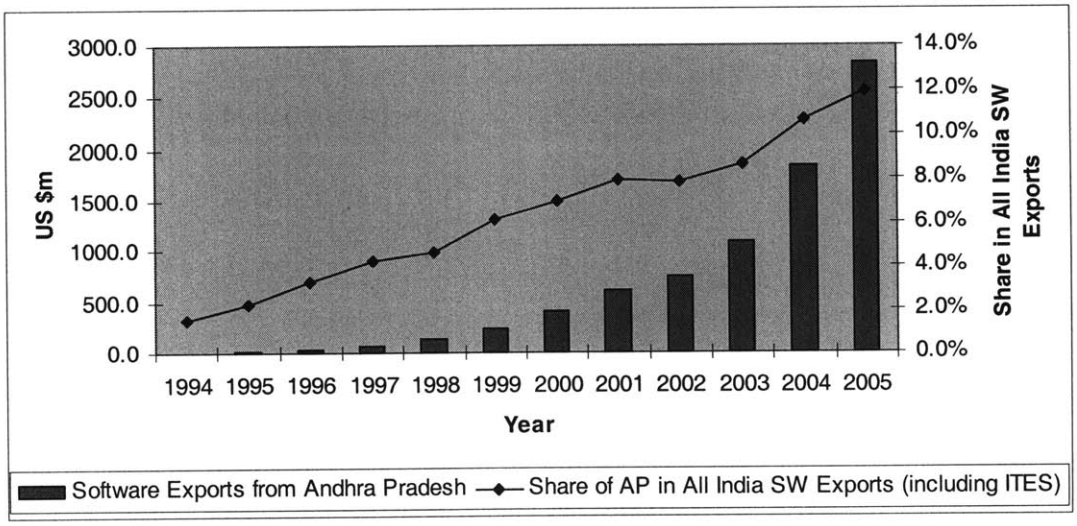

Figure 7.1: Software and software services exports from Andhra Pradesh.
Source: Annual reports of ESC from 1998 to 2005.

[24] http://www.domain-b.com/infotech/itnews/200205may/20020509_stpi.html
[25] Number of companies counted as per the list of registered companies at http://www.hyd.stpi.in/ehouses/ehouses.html (accessed in January 2007).

7.1 Development of the Software Industry in Andhra Pradesh

The structure of the industry in the state till the early 1990s closely resembled that in the neighboring state of Tamil Nadu. The state had seven software firms in 1990 compared to six in Tamil Nadu. Like in Chennai, the firms in Hyderabad also were relatively insignificant players in software exports. None of the firms in the state were among the top 20 software exporters from the country in 1990.

However the period from 1991 to 1995 saw a sharp divergence in the growth of the industry in the two states. While 21 new firms started operations in Chennai during this period, only 9 firms were established in Hyderabad during the same period (NASSCOM, 2007a)[26]. However, the number of firms in Hyderabad rose sharply after 1995. 51 new firms started operations in Hyderabad during 1996 to 2000 and another 45 firms started during 2001 to 2006. The corresponding numbers for Tamil Nadu were 57 and 33.

The period after 1995 also saw a large number of multinational firms coming to the state. While there were only 3 MNCs in the state till 1995, 18 new MNCs started operations during 1996 to 2000 and another 22 MNCs started during 2001 and 2006. The proportion of MNCs among all software firms in Hyderabad rose to 39.3% in 2006. This was almost double that of Tamil Nadu. Table 7.1 below shows the distribution of the type of firms in Hyderabad that were members of NASSCOM as on January 2007 by their establishment year.

[26] The data on the number of firms refer to only those firms that were members of NASSCOM as on January 1, 2007.

Table 7.1 Distribution of the type of firms in Hyderabad by their establishment year

Type of Firm	Upto 1990	1991 to 1995	1996 to 2000	2001 to 2006	Total	% in Total	Share in Employment in 2006*
Indian Business House Subsidiaries	1	0	4	2	7	6.3%	20.6%
Indian Entrepreneurial Firms	3	7	18	11	39	34.8%	41.7%
MNC	1	2	18	23	44	39.3%	22.8%
Foreign-Expatriate Indian	2	0	11	9	22	19.6%	14.9%
Joint Ventures	0	0	0	0	0	0.0%	0.0%
Public Sector Firms	0	0	0	0	0		0
Total	**7**	**9**	**51**	**45**	**112**	**100%**	**100%**

*The employment shares are based on 100 firms whose data were available.
Source: Author's calculations based on NASSCOM (2006), company websites and author interviews.
Foreign-expatriate Indian firm refers to a firm that has been started in the state by expatriate Indians or is a subsidiary of foreign firms in other countries founded by expatriate Indians in those countries.

Comparative Structure of the Industry in Andhra Pradesh and Tamil Nadu

A comparison of the figures in the Tables 6.1 and 7.1 reveals some interesting facts regarding the structure of the industry in the two states. First, the role of the multinational firms has been far more important in the growth of the industry in Hyderabad than in Chennai. The share of the MNCs among all firms in Hyderabad is almost double that in Chennai. Second, while the share of the foreign-expatriate Indian firms is almost the same in the two cities, the Indian entrepreneurial firms have played a significantly lesser role in Hyderabad compared to their role in Chennai. The significantly higher share of the MNCs in Hyderabad arose due to a conscious policy decision of the state government to focus on attracting large multinational firms after 1995. I discuss this in more detail in the subsequent sections.

Structure of the Industry at State and National Levels

Comparison of the structure of the industry at the state and national levels reveals some interesting differences (Table 7.2). Indian business house subsidiaries form a comparatively lower proportion of the total firms in Hyderabad than at the national level, while multinational and foreign-expatriate Indian firms occupy a larger share in the state.

Table 7.2: Comparison of the structure of the software industry in Hyderabad and all India

Type of Firm	No. of Firms in 2001		% of Firms in 2001		Share in Employment for All India in 2001
	Hyderabad	All India	Hyderabad	All India	
Indian Business House Subsidiaries	5	87	6.6%	15.3%	26.9%
Indian Entrepreneurial Firms	31	251*	40.8%	44.2%	34.9%
MNC	23	128	30.3%	22.5%	16.3%
Foreign-Expatriate Indian	17	58	22.4%	10.2%	7.9%
Joint Ventures	0	44**	0	7.7%	8%
Public Sector Firms	0		0		
Total	89	568			

Source: Data for Chennai are based on author's calculations based on (NASSCOM, 2006b). Data for All India are from (Athreye, 2005b).
* Includes data on entrepreneurial firms and entrepreneurs with prior IT experience.
** Also includes public sector firms

Leading Firms in the State

Analysis of the top ten leading firms in Hyderabad (in terms of number of employees) reveals that the industry is led by business house subsidiaries and foreign-expatriate Indian firms. However, the largest firm is an Indian entrepreneurial firm (Table 7.3). Only two of the top ten firms are MNCs. Seven of the top ten firms are engaged in IT solutions and services (essentially, customized software development), and business process outsourcing (BPO). Only three firms are engaged in R&D, engineering design, and product development.

Table 7.3: Top Ten Leading Software and Services Firms in Hyderabad

Sl. No.	Name of the Company	Type of Firm	Legal Structure	Year Estd.	Total Employees (2006)	Main Areas of Business
1	Satyam Computer Services Ltd.	Indian Entrepreneurial	Public Ltd.	1987	18,124	IT Solutions
2	Karvy Global Services Ltd.	Business House Subsidiary	Public Ltd.	1983	6,000	IT Services/BPO
3	E2E SerWiz Solutions Ltd	Business House Subsidiary	Public Ltd.	2004	4,000	BPO
4	Microsoft India (R&D) Pvt. Ltd.	MNC	Pvt. Ltd.	1997	3200	Software R&D for parent company
5	Infotech Enterprises Ltd.	Indian Entrepreneurial	Public Ltd.	1991	2,000	GIS, Engg. Design, IT services
6	GE Consumer Finance Servicing	MNC	Pvt. Ltd.	2005	1,800	BPO
7	Nipuna Services Limited	Business House Subsidiary	Public Ltd.	2002	1,750	IT Enabled-Services/BPO
8	AppLabs Technologies Pvt Ltd.	Foreign-Expatriate Indian	Pvt. Ltd.	2001	1,500	IT Services
9	Virtusa (India) Pvt Ltd	Foreign-Expatriate Indian	Pvt. Ltd.	2002	1,500	Technology and Product Innovation
10	Intelligroup Asia Pvt Ltd	Foreign-Expatriate Indian	Pvt. Ltd.	1996	1,338	IT Outsourcing

Source: (NASSCOM, 2006b), interviews by the author, and company websites (accessed in Jan. 2007)

7.2 Policy Initiatives by the State for the Development of the Industry

In terms of policy initiatives, Andhra Pradesh, like Tamil Nadu, too did not have any specific policies till 1995. As in the other parts of the country, the first specific policy initiative for the IT industry in Hyderabad came from the central government. This was the setting up of a new software technology park under the STPI scheme in Hyderabad in 1991. In 1992, the unit had seven registered software exporting firms in Hyderabad[27]. Thus Hyderabad had a lead in providing infrastructural support to the IT industry over

[27] http://www.domain-b.com/infotech/itnews/200205may/20020509_stpi.html

Chennai where the first STPI unit started functioning only in 1995. However, except for this STPI unit, there were no other specific government initiatives either from the central or the state government for this industry until 1995.

Table 7.4 lists the major initiatives taken by the state for the development of the software industry in the state during 1995-2005. As can be seen from this table, the state did not have a comprehensive IT policy till 1999 when it announced its first IT policy for the state. This policy provided a host of incentives to the industry, such as financial incentives in the form of concessions in the price of land, exemptions from intrusive provisions under certain labor laws, and single-window clearances for starting new units. However, it is relevant to note here that though the state did not have a comprehensive IT policy till 1999, the government was deeply involved in promoting the industry by creating huge infrastructure in the city and giving case by case incentives to the big multinational and domestic firms. In fact, the initial strategy of the state during 1996-2000 was clearly focused on attracting the large multinational and national companies to the city. I discuss this in more detail below.

It is helpful to divide the policy initiatives by the state into two phases. The first phase, from 1995-2000, was focused on building infrastructure and attracting the big multinational and national companies to the city while the second phase, from 2001 onwards, was focused on promoting production and marketing linkages for the local firms in the international market.

Table 7.4: Major Policy Initiatives by the State Government for Development of the IT Industry in Andhra Pradesh

Year	Policy Initiative	What the policy Did
1997	A New post of Secretary, IT & Computers created	A new post was created for speedier decision-making and better coordination
1998	Exemption to IT units from statutory power cuts	Ensured uninterrupted power supply to IT units
1998	Exemption from AP Pollution Control Act	Faster clearances for setting up a unit
1998	Hitec City at Madhapur, Phase One opened (Cyber Towers)	Largest IT Park in India
1998	IIIT Hyderabad started with seed support from Govt. of AP	Involved major national and foreign IT Cos. to set up specialized centers on campus for advanced training and mid-level R&D
1999	First IT Policy – Incentives for IT and ITES Industry	Exemption from Pollution Control Act and power cuts, 25% concessional electricity tariff, exemption from sales tax, rebate on cost of land, exemption from land zoning regulations, rebate on registration and transfer of property, investment subsidy for new firms, special subsidy for mega projects, etc., focus on creating infrastructure, e-governance, skilled labor, establishment of a venture capital fund
1999	New International Airport in Hyderabad	Approvals for a new airport obtained and bidding process started by the state
1999	ISB Hyderabad Founded with support from the state government	Enhanced the reputation of the city as a major international center for higher education
1999	Separate IT Dept. Established	A separate department was established for better coordination and faster decision-making
2000	Policy for Laying Optic Fiber Cables	
2000	Constitution of two state level committees for promotion of IT	Involved industry representatives and academicians in the government decision-making process for the industry
2000	A.P.FIRST, Information Technology Policy	Same incentives as in the IT policy of 1999
2000	Consultative Committees formed	A Standing Consultative Committee Comprising Government Officials and the Industry Representatives was formed
2000	Launch of MS (IT) program in collaboration with CMU, USA	A new Post-graduate program was launched in collaboration with CMU, USA
2000	Public Sector Venture Capital Fund Hyderabad Information Technology Venture Enterprises Limited (HITVEL) launched	Jointly promoted by Andhra Pradesh Industrial Infrastructure Corporation (APIIC), Andhra Pradesh Industrial Development Corporation (APIDC) and public sector Small Industries Development Bank of India (Sidbi) in 2000, HITVEL set up a Rs 150 million IT venture capital fund. It invested about Rs 125 million in six IT and ITeS companies till 2005.

2001	Exemption from Inspections under Factories Act, Contract Labor Act, Shops and Establishments Act, Minimum Wages Act, etc.	Allowed the IT firms to file self-certification under these Acts
2001	Conduct of Mega IT Event in Hyderabad	Conducted a mega event on the lines of IT.Com of Karnataka
2002	Second IT Policy	Automatic incentives to IT units and some other incentives on application, single window clearances; firm level incentives such as investment subsidies, concessional power tariff, exemption from zoning regulations, rebate in cost of land, special incentives for mega projects, etc.; subsidy to SMEs for participation in international exhibitions for small and medium IT firms; promoted e-Government as a major driver for IT industry by giving preferential treatment to local IT units.
2002	Special Concessional Land Pricing Policy around Hitec City	Land to be given at concessional rates to IT Companies
2002	Separate Policy for the ITES Sector	A New Policy for ITES sector was announced
2002	First Mega ICT event GITEX-India	Started an annual series of mega IT events in Hyderabad in association with GITEX-Dubai
2002	National Institute of Smart Governance (NISG) established	Established with NASSCOM (National Association of Software and Service Companies), Central and State governments to promote excellence in the area of e-Governance with focus on Strategic Planning, developing appropriate architectures and standards, providing high-level consultancy services and capacity building at the national level.
2004	Institute of Electronic Governance (IEG) established	To support Electronic Governance initiatives through a cadre of technical experts whose services various Departments and Organizations of the Government could utilize.
2005	Third ICT Policy	Focused on e-Governance and Investment promotion, increasing availability of skilled labor, and promoting secondary cities for IT industry. First time focused on providing incentives for R&D by providing free space to such companies for five years, venture funding for new IT firms, closer industry-academia collaboration, etc.

Source: Author's compilation based on published documents by the state government and interviews with senior officials

7.2.1 The First Phase (1995-2001): Focus on Infrastructure and Large MNCs

The government realized the importance of creating world-class infrastructure for the industry early. Under the leadership of the new Chief Minister of the state, Mr.

Chandrababu Naidu, who assumed charge in 1995, the government started two mega projects in Hyderabad. The first was Cyber City, a new industrial park on the outskirts of the city where the firms could get land at concessional rates. The government also provided basic infrastructural facilities to the park. By early 1997, 12 software companies had been allotted land in this park. Most of them were Indian entrepreneurial firms, with only one firm, Intelli Group Asia, being foreign-expatriate Indian. The second initiative was to build a huge 10 storey tower called Hi-tech City where firms could buy or rent ready-built space. Built at a cost of US$850 million in association with a leading private developer, this building is the largest of its kind in India (Kshetri & Dholakia, 2005).

The provision of infrastructure at concessional rates attracted several software firms to the city. However, the state was still not able to attract the relatively large firms. It was also losing out to Chennai which was attracting more firms due to higher availability of skilled labor, presence of relatively better infrastructure at that time, and an international airport[28]. That Chennai was still more attractive until 1996 is evident from the fact that among the member firms of NASSCOM, six and ten new firms started operations in Chennai during 1995 and 1996 respectively, while the corresponding figures for Hyderabad were only two and six.

Attracting Large Multinational Companies

In this scenario, the state took a conscious decision to attract large software companies, particularly the multinationals[29]. This was done by offering them incentives on a case by case basis and by taking decisions very quickly on their requests. In the case

[28] Source: Interview with firms in Chennai and Hyderabad.
[29] Source: Interviews with government officials in Hyderabad.

of Microsoft, the government responded to its requests within a single day, even on a holiday (Kshetri & Dholakia, 2005). The Chief Minister himself took personal interest in meeting top executives of large firms and making presentations on what the state could offer them if they set up their centers in Hyderabad. In March 1997, when Bill Gates visited India, Chandrababu Naidu got an exclusive interview with him and discussed his dream of making Hyderabad as a global center for software development (Kshetri & Dholakia, 2005). After this meeting, Microsoft seriously considered Hyderabad for locating its development center along with other Indian cities and ultimately selected it over seven other Indian cities. Extremely fast and favorable responses to many of the firm's demands by the state government were a key factor in the firm choosing the city[30].

Microsoft's entry in Hyderabad in 1997-98 considerably strengthened the city's reputation as a major emerging IT center in the world. Among the major MNCs that started their operations in Hyderabad after Microsoft's entry were Oracle, GE Capital, IBM, Toshiba, Baan, and Ericsson. It probably also attracted the foreign-expatriate Indian firms to enter the state. In fact, during 1997-2000, 56% of the total 46 firms that started operations in Hyderabad were either MNCs or foreign-expatriate Indian. The break up was 37% and 19.5% for MNCs and foreign-expatriate Indian respectively.

Entry of MNCs to Hyderabad, in all likelihood, contributed positively to the overall growth of the industry in the state. This was because the MNCs and the local firms essentially operated in different markets. While most of the MNC subsidiaries were focused on serving their parent firms through R&D in software and product development, the local Indian and Foreign-expatriate Indian firms were focused on securing

[30] Source: Interviews with government officials in Hyderabad. One senior official stated that in several instances, replies to the requests of the firm would be sent within hours.

outsourcing deals based on custom software development. They were competing mainly for the local skilled labor and not in the export markets[31].

Another major initiative by the state for building infrastructure in the city was to start construction of a brand new international airport in the city. This was to fulfill a major demand by the large IT firms for easier and faster international connections to the city. By 1999, the state had invited bids for the airport and had started acquiring land[32]. The actual construction started in 2005.

Provision of Skilled Labor and R&D

Increasing the availability of skilled labor was another major policy initiative of the state. For increasing the availability of skilled professionals with undergraduate technical education, the state facilitated the opening of private technical institutions in the state. As a result of these initiatives, the annual number of new engineering graduates in the state went up from 5,610 in 1995 to 20,099 in 2003.

In addition to facilitating the supply of more engineering graduates from private institutions, the state government took another major policy initiative to provide highly skilled technical and managerial labor for the industry. The first major initiative was the setting up of the Indian Institute of Information Technology (IIIT), Hyderabad in 1998 with seed support from the state government and active collaboration from national and international IT companies. In November 1997, the state government signed an agreement with Microsoft to establish the Microsoft School for Software Technology at this institute (Kshetri & Dholakia, 2005). Other firms that set up corporate schools on the

[31] Source: interviews with firms in Hyderabad.
[32] Source: http://www.newhyderabadairport.com/media_information_press_coverage_aug30_2000.html (accessed in April 2007)

IIIT campus were IBM, Signal Tree, Motorola, Oracle and Satyam[33]. The infrastructure for these firms was provided by the state government through the institute. These corporate schools were aimed at imparting advanced skills to graduate students in software technology and were also engaged in mid-level R&D in this area, though the extent and sophistication of R&D conducted was relatively low[34]. It is worth noting here that the industry in Chennai lacked this level of support from the state in providing highly skilled professionals and industry supported R&D. The Tamil Nadu government had started an institute on similar lines in Chennai in 1998, but the school did not succeed and was wound up in 2004. Though the state had other centers of higher education in computer science, namely, the internationally renowned Indian Institute of Technology and Anna University at Chennai, they did not have the same level of industry involvement as in the case of IIIT, Hyderabad. Hence, the focus of these institutes in Chennai remained on providing generic programming skills to the students instead of industry-specific technologies.

Another major initiative of the state that put Hyderabad on the map of international centers for quality higher education was the setting up of the Indian School of Business (ISB) in 1999. The school was founded through the initiative of leading expatriate Indian academicians and business leaders in the US. It also had collaborations with the leading business schools in the US, such as Wharton and Kellogg's. The chief minister took personal interest in meeting the founders and convincing them to choose Hyderabad for locating the school. Starting of this school attracted considerable media

[33] Source: http://www.iiit.ac.in/institute/institute.php (accessed in April 2007)
[34] Source: interviews with firms in Hyderabad.

attention internationally and helped in enhancing the reputation of the state as an emerging international center for higher education.

Involving the Industry in Policy Making

During this period, the state also took a conscious decision to involve the industry representatives and academicians in the policy-making process of the state for the industry. The government had created a separate post of Secretary, It and Computers in 1997 to deal exclusively with the IT industry in the state. It also established a separate department for IT in 1999. As noted before, the state was already involved in interacting with the IT firms from 1996 itself as the Chief Minister of the state himself was personally leading the efforts to attract these firms to the state. The first IT policy of the state in 1999 formalized these efforts by creating two state level advisory bodies. In early 2000, the government announced the establishment of two state level bodies. The first, called 'AP First', was aimed at formulating the broad policies for promoting the industry within the state, and the second, called the 'State Information Technology promotion Committee', was for implementing and monitoring the infrastructure and other IT projects in the state, such as for e-governance. The first body consisted of industry leaders and an academician from the US, while the second body comprised the senior officials in the state involved with implementation of the projects. It is relevant to note here that though the formal initiative came only in 2000, the political leadership and the bureaucracy of the state were already receiving inputs from industry leaders from 1996 itself through their interactions with them for providing incentives for the industry.

7.2.2 The Second Phase (2001-2006): Local Firms, International Linkages, and E-Governance

The state had succeeded in attracting a large number of both multinational and domestic firms by the end of 2000. During 1996-2000, 51 new firms started operations in Hyderabad, out of which 18 (35.2%) and 11 (21.6%) were MNCs and foreign-expatriate Indian firms respectively. In terms of number of new firms, it was only slightly behind Chennai where 57 new firms had started operations during the same period. However, the proportion of MNCs, at 24.6%, was comparatively much lower in Chennai. The presence of a relatively large number of MNCs in Hyderabad had helped the city emerge as a major destination for IT firms internationally.

In this scenario, the second IT policy of the state in 2002 attempted to further boost the investment climate for IT firms in the state. It focused on four major aspects: first, providing firm level incentives, such as investment subsidy, rebate in the cost of the land, concessional power tariff, reduced stamp duty, exemption from zoning regulations, special concessions for mega projects involving investment of Rs. 500 million (US $10 million) and above; second, it made obtaining clearances from the state agencies faster by providing exemptions from several state laws and providing for a single window clearance; third, it promoted the small and medium units in the state by providing them subsidy for participating in international events; and fourth, it promoted e-government projects as a major driver for further growth of the industry in the state by giving preference to state registered units in such projects. In 2001, the state had already exempted the IT firms from the provisions of several laws such as the Factories Act,

Contract Labor Act, Shops and Establishments Act, Minimum Wages Act, etc. and had allowed them to file self-certifications under these Acts without intrusive inspections.

Promoting International Linkages

During this period, the state government consciously tried to promote production and marketing linkages between the international market and the local firms. It started an annual series of mega events for the IT industry, called GITEX-Hyderabad in 2002, in association with the Dubai World Trade Center[35]. This event was aimed at bringing the Indian and the global IT players on a single platform. The government also started giving financial subsidy to the small and medium firms in the state (with a turnover of less than US $ 2 million) to participate in international events.

Promoting e-Governance to Attract Software Firms

The state tried to promote e-governance in a big way during this period to attract software firms. In addition to promoting e-government projects to improve service delivery to the public in all its departments, the state took several other initiatives to promote e-governance. These were establishment of two training and research institutions to promote e-governance. These institutes were established with strong institutional support from the industry. The first was the National Institute of Smart Governance (NISG), established in 2002 in collaboration with NASSCOM and the central government. This institute aimed at planning, and research and development in e-governance at national level. The second was the Institute of Electronic Governance (IEG), established by the state government in 2004 in collaboration with NISG and IIIT,

[35] http://www.gitexindia.in/index.html (accessed in March 2007)

Hyderabad. The main purpose of this institute was to train professionals who could work on various e-government projects of different departments of the state. These two initiatives of the state helped in establishing Hyderabad as a center for innovation in e-governance in the country.

The third ICT policy of the state announced in 2005 focused again on e-governance and investment promotion for the IT industry. However, it went further and provided incentives for firms engaged in R&D activities. It offered free space to the firms engaged in high-end R&D for five years in IT parks. However, interviews with the government officials indicate that very few firms have availed of this incentive so far due to lack of qualified applicants. Another initiative of this policy was on promoting the secondary cities in the state for development of infrastructure.

Conclusion

As can be seen from the discussion above, the development strategy of the state to attract the software firms was focused on five major areas: provision of industry specific infrastructure and skilled labor, industry wide and firm level subsidies, attracting the large multinational firms, promoting international production and marketing linkages for the local firms, and promoting e-governance as a tool to attract software firms. During the first phase from 1995-2000, the focus was on developing the infrastructure, increasing the availability of skilled labor, and providing incentives to attract the large multinational firms. During the second phase from 2001-2006, the state focused on promoting linkages between the local firms and the international market, provided incentives to the local small and medium firms, and promoted e-governance in a big way to emerge as a major

national center in this area. To achieve these goals, the state effected major changes in its policy-making process. To acquire domain expertise, it incorporated industry representatives and academic experts in its policy making process and also changed several existing rules and procedures to make the process of granting approvals for the firms easier and faster.

7.3 Impact of the State's Policies on the Growth of the Software Industry

It is clear from the preceding discussion that the state adopted a number of strategies to attract the software firms to Hyderabad. How did these policies affect the growth of the industry? What were the major factors that influenced the software firms to choose Hyderabad for locating their units? Did the state help in obtaining finance, upgrading technology, improving linkages with the international market, etc.? To understand how exactly the state influenced the development of this industry, I conducted in-depth interviews with 15 firms in Hyderabad during November and December 2006. Six of these firms were Indian entrepreneurial firms, six were MNCs, and three were Foreign-expatriate Indian firms. I discuss below the main conclusions from these interviews.

Major factors that influenced firms to locate in Hyderabad

The common factors that emerged from all interviews for choosing Hyderabad were: availability of good infrastructure, especially after 1997, availability of skilled labor, comparatively lower costs of living in the city, and a pro-active state government that built infrastructure at great speed, provided land at concessional rates to many large firms, and eliminated delays in obtaining clearances from various departments and

agencies of the government. The pro-active role of the government and personal initiatives and leadership shown by the Chief Minister, Chandrababu Naidu were mentioned as major factors by several firms. As the Senior Manager of a prominent multinational subsidiary in the city stated:

> "Hyderabad was coming up fast, Naidu had rolled out a red carpet for all IT firms, the city has a conducive atmosphere, government subsidies (land at a concessional rate) were also a big factor...."

For the non-MNCs in the city, ethnic linkages of the main promoters of the firm with the state were the main reasons for choosing the city. This seemed to be an important factor even for the relatively smaller MNCs with expatriate Indian staff in high positions in the management team. They stated that they were looking for a right opportunity to come back to their native state and the building of infrastructure and a supportive policy environment after 1995 encouraged them to come here. As the Head of the Human Resources division of a multinational firm with an expatriate Indian professional in a high position stated:

> "...CEO (of the Indian unit) is from Hyderabad, Hyderabad was booming in 1997 when the firm started its operations here. This was the main reason for locating in the city..."

It is helpful to further examine the background of the promoters of the foreign-expatriate Indian firms to understand the nature of international linkages that have helped the industry in the state to grow. Promoters of all the three foreign-expatriate firms interviewed in the city studied in leading technical institutions in India (Indian Institutes of Technology at Delhi and Madras and Birla Institute of Technology and Science at Pilani in Rajasthan)[36] before going to the US to study and work. In the case of one MNC, there was one Indian staff in high management position who graduated from an IIT. The educational background of the promoters of these firms indicates that it is the graduates of leading technical institutes in India with ethnic roots in the state who have been instrumental in forming the international linkages for the industry in the state. They have established firms or subsidiaries in the state with deep production and marketing linkages with firms and markets abroad. These firms in turn have benefited from the wide availability of graduates from the undergraduate level private technical institutions in the state.

On the role of government incentives, they seem to have played a more important role in Hyderabad when compared to that in Chennai. While very few firms have availed of specific firm level incentives in Chennai, many firms have availed of such incentives in Hyderabad. Nine of the fifteen firms interviewed said that they had availed of a specific firm incentive from the state government in Hyderabad. The most important incentives were the quick allotment of land to several large firms at concessional rates and investment subsidies. Under the ICT Policy of 1999, 26 firms were given land investment subsidies till 2001 (Govt. of Andhra Pradesh, 2002). This allowed the firms to

[36] Source: interviews with firms and company websites (accessed in March 2007).

start operations quickly. However, these incentives were aimed at attracting the relatively large firms and small and medium firms did not benefit from them.

Linkages with the State Owned and Privately Owned Local IT Firms

Like in Chennai, exports were the most important source of revenue for almost all the firms interviewed. The lone exception was one firm focused on developing software systems for the Indian Railways. Most of the firms interviewed said that they virtually no linkages with the state owned or local private IT firms. They had no subcontracting relationships with the other local firms in Hyderabad.

Availability of Skilled Labor in the State

Like in Chennai, all the firms interviewed stated that availability of adequate skilled labor within the state was a major factor for choosing Hyderabad. Regarding quality and availability of labor, there was no significant difference between Chennai and Hyderabad. Like in Chennai, the engineering graduates in Hyderabad possessed only generic programming skills and the firms needed to train them in specific skill areas.

Labor Relations in the State

Like in Chennai, most of the firms said that the state was pro-active in ensuring a business-friendly environment for the industry. The state had granted exemptions to the software firms from several provisions of the labor laws that were intrusive and not business-friendly.

Awareness among Government Officials about the Needs of the IT Industry

Unlike in Chennai, the bureaucracy in the state has been far more pro-active in Hyderabad. All the firms interviewed said that the government was very business friendly and were taking decisions quickly on demands put forth by the industry. They all said that this had happened due to the pro-active leadership of the chief minister, Mr. Chandrababu Naidu.

Involvement of the Firm in the Policy Making Process of the State/Central Government

Most of the firms interviewed said that they had no direct involvement in the policy-making process of the state. However, unlike in Chennai, the firms in Hyderabad are more organized. They have formed an association, called HYSEA (Hyderabad Software Exporters' Association), of all the local software firms in the city. This association conducts periodic meetings and interacts with the government on all issues concerning the industry. The firms said that also had periodic interactions in forums like NASSCOM on how the government could support the industry. Representatives of the industry are also represented in AP-FIRST, the apex government body concerned with policy making for the industry. The firms said that this arrangement had served the industry adequately.

Linkages with Global Production Networks

Like in Chennai, all the non-MNC firms interviewed said that their major clients were firms in developed countries who outsourced a part of their work to them. Serving the domestic market was only a very small fraction of their total activity. This was true of

even the relatively smaller firms as even they are focused mainly on the export market. The MNC subsidiaries are mostly engaged in serving their parent firms exclusively.

Though firms in both Chennai and Hyderabad are focused on serving the international market, the linkages with global production networks are stronger in Chennai as most of the firms there are local and foreign-expatriate Indian. In Hyderabad, as most MNC subsidiaries are engaged in serving their parent corporation, the linkages of the local industry with the global production networks are relatively weak.

Access to Finance

Like in Chennai, most of the Indian entrepreneurial and Foreign-expatriate Indian entrepreneurial firms obtained finance from their promoters' equity and banks. The MNC subsidiaries stated that they obtained finance from their parent firms. Significantly, none of the firms said that they had availed of any venture capital due to lack of availability of such financing for the local firms.

Like in Chennai, the state's role has been very limited in providing or facilitating access to finance for these firms, though the state did make some efforts to launch a venture capital fund for local entrepreneurs in its third ICT Policy in 2005[37]. Like in Chennai, the most important reason for this is the relatively easy availability of finance for these firms from outside sources, such as banks and promoters' equity.

[37] The Third ICT Policy launched a scheme of 'Andhrapreneurs' to encourage entrepreneurship among local technical graduates. It also provided for allotment of space in IT parks to start-ups at concessional rates and tie-ups with venture capitalists for providing venture capital to local firms. However, interviews with government officials indicate that these provisions are yet to be fully implemented.

R&D and Technology Upgradation by the Firm

The level of technological sophistication of the work being done by the industry in Hyderabad is higher when compared to that in Chennai. This is due to the presence of a relatively large number of MNCs in Hyderabad that are doing relatively more sophisticated work (such as product development or working on specific technologies or components for new products) for their parent companies. However, the nature of work for the other firms is almost the same in both cities.

Like in Chennai, all the non-MNC firms said that the main source of R&D for their activities came from within the firm. For the MNC subsidiaries, their parent firms provide the technology. However, the government in Andhra Pradesh seems to have played a bigger role in providing R&D to the industry than in Tamil Nadu. This is due to several initiatives taken by the government in Andhra Pradesh to provide R&D support to the industry. The most important initiative was the establishment of advanced schools within IIIT Hyderabad aimed at specific technologies in association with large multinational firms. Though these schools worked mainly on the technologies being used by the sponsoring firms, they also imparted training in these technologies to students and other professionals who were then free to go out and employ it in their own firms. This helped in improving the technical skills of the professionals. Unlike in Chennai, the linkages of the industry with the IIIT in Hyderabad are relatively stronger for training professionals in high-end technologies.

7.4 Analysis of the State Government's Role in the Development of the Software Industry in the State

How can we understand the role of the state in the development of this industry in this region? In this section, I try to analyze how the state's policies affected the development of the industry and how they differ sharply from the existing dominant paradigms in the literature on the role of the state in industrial development in emerging economies.

It is useful to briefly recapitulate what the state did to promote the development of this industry within its region. The policies of the state in this case can be divided into six main categories: provision of industry specific factors (physical and communications infrastructure and increasing the availability of skilled labor); acquiring industry-specific domain knowledge relevant to policy-making by incorporating industry representatives and academicians into the policy making process; attracting large MNCs; improving the linkages between the local industry and their global clients; provision of R&D (to a limited extent); and influencing the demand conditions using e-government as a tool to attract software firms to the state.

It is clear from the discussion in the preceding sections that the actions of the state in Andhra Pradesh differ from those in Tamil Nadu in four crucial aspects. First, the state in Andhra Pradesh clearly focused its strategies on attracting the large multinational firms right from the beginning and its policies of providing firm level incentives were clearly geared towards this goal; second, the state here used firm level incentives much more than in Tamil Nadu to attract firms; third, the state here focused on supply of R&D to the

industry significantly more than in Tamil Nadu; and finally, the state here promoted e-governance as a tool to encourage the growth of the industry.

It is interesting to note that the policies of the state in this case too differ sharply from the dominant paradigms within the literature on the role of the state in industrial development in developing economies. As discussed in the previous chapter, the most prominent model in the literature on the role of the state in late development pertains to strategies for industrial development based on technological catch-up with the advanced countries. This model argues that developing countries need long-term planning for industrial development and need to provide incentives for creation of a few large vertically integrated national firms. These firms first operate in the domestic market and then compete internationally based on incremental improvements to technology based on their own R&D. Theorists in this area also talk about specific state structures that can help implement these strategies. These specific state structures mainly pertain to creation of a dominant or nodal agency that has power and control over the industry and other government agencies to force the implementation of its policies and monitor the results using certain performance standards.

It is clear that the policies of the state in Andhra Pradesh differ sharply from this model in several aspects. First, the state did not try to create large locally or state owned firms, though it made serious efforts to attract large multinational firms. Though the state already had a relatively large locally owned firm[38] before it started its own strategies to attract more firms, it was clearly focused on attracting the large multinational firms. Hence, the dominant agent for industrialization here was the multinational company. It must be noted, however, that the direct impact of the MNCs on the growth of the local

[38] This firm was Satyam Computers Ltd. that was started in 1987 in the city.

firms has been very limited as these MNC subsidiaries are mostly engaged in development work for their own parent firms with little linkages with the local firms. It must be stated, though, that they probably contributed positively to the overall growth of the industry in the state as the MNCs and the local firms operate in two distinct markets. Second, though the state did try to influence the growth of the industry by selectively providing incentives to the large multinational firms to enter the state, its role was far more limited in other areas relevant for the development of the industry, such as technology acquisition and access to finance. It was left to the industry to develop or acquire specific technologies and get finance.

The second dominant line of thinking on the role of the state is that of "neo-developmental state", "flexible developmental state", or "networked state". As discussed in the previous chapter, this model calls for extremely flexible bureaucracies that understand deeply the constantly changing needs of a technology intensive industry.

It is clear that the role of the state in this case differs sharply from this model too. Though the state in Andhra Pradesh interacted far more deeply with the industry than in Tamil Nadu, it was not an 'embedded' or a 'networked' state. It had the same bureaucratic structure as in Tamil Nadu with little domain knowledge of the industry or specific technologies. However, the bureaucracy in the state tried harder to understand the needs of the industry as the Chief Minister himself was leading the efforts to attract the software industry to the state.

The regional development literature is also unable to fully explain the role of the state in this case. As in the case of Tamil Nadu, the state influenced the factor conditions by providing specialized infrastructure and improving the availability of skilled labor.

Similarly, like in Tamil Nadu, competition among the local firms was for the skilled labor and not for the domestic market. However, in Andhra Pradesh, the state did try to influence the demand conditions by making e-governance as one of the major goals of the state government. Though this did attract some firms to the state that were focused mainly on providing e-governance solutions, its overall impact on the growth of the industry was limited as most of the firms in the industry are focused on exports and not on the domestic market.

The discussion above suggests the need for a new analytical framework for explaining the role of regional governments in the development of hi-tech industries with global linkages in production and markets. I develop this framework in the chapter ten after analyzing the third case of the state of Kerala in the next chapter.

8 Development of the Software Export Industry in Kerala – Reining in Labor and Shedding the Leftist Image

Unlike in Tamil Nadu and Andhra Pradesh, the growth of the software industry in Kerala has been much less than spectacular. The total value of software and software services exports grew from US$11.4m in 1998-99 to US$ 102.1m in 2005-06, averaging an annual growth of just over 39%. However, the share of the state in the exports of software and services from the country has stagnated at around 0.4% during this period (Fig. 8.1). The number of firms in the state registered with STPI, Trivandurm grew from 53 in 1998 to 208 as on January 2007[39]. One remarkable feature of the growth of this industry in the state has been the noticeable jump in the exports after 2002 (Fig. 8.1).

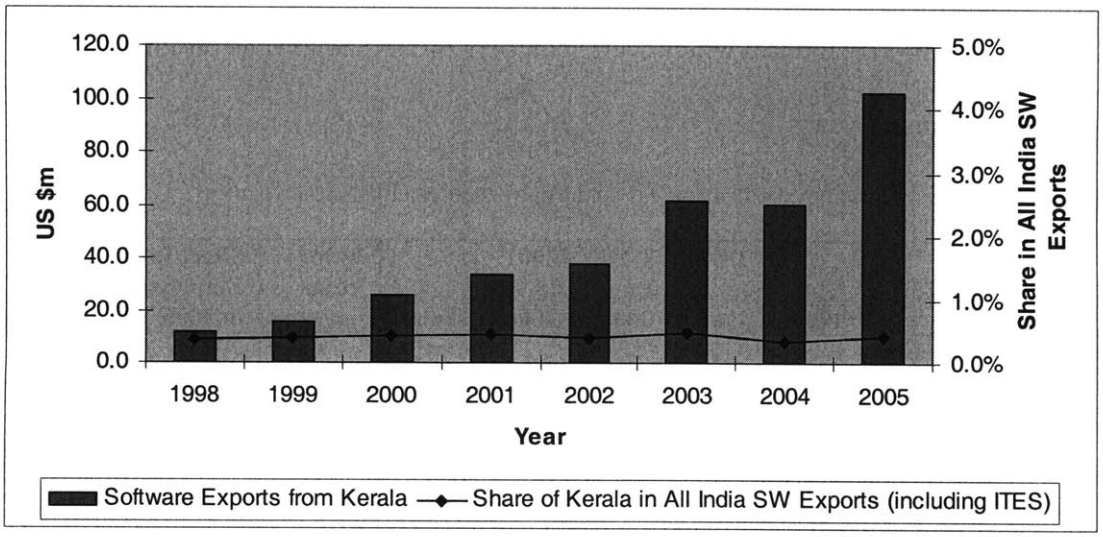

Figure 8.1: Growth of software and software services exports from Kerala
Source: (ESC, 2002, 2004, 2005, 2006)

[39] Number of companies counted as per information available at: www.stpt.soft.net (accessed February 2007)

8.1 Development of the Software Industry in Kerala

Kerala has been the slowest among the three states to develop its software industry. Unlike Tamil Nadu and Andhra Pradesh, it had virtually no exports in software till the late 1990s. In fact, till 1995, it had just three firms in Trivandrum, which were members of NASSCOM. Even in January 2007, this number rose to only eight, against 128 in Chennai and 124 in Hyderabad (NASSCOM, 2007b). Two of these were multinationals, two were foreign-expatriate Indian, and the remaining four were Indian entrepreneurial firms. None of these firms were among the top 20 leading software exporters from the country.

Unlike in the other two states, almost the entire growth in the industry in Kerala has taken place after 1995. Seven out of the eight NASSCOM firms in Trivandrum were established after 1995. Similarly, MNCs started coming to the state only after 2000, i.e., much later compared to the other two states. Table 8.1 below shows the distribution of the type of firms in Trivandurm which were members of NASSCOM as on January 2007 by their establishment year.

Table 8.1 Distribution of the type of firms in Trivandurm by their establishment year

Type of Firm	Upto 1990	1991 to 1995	1996 to 2000	2001 to 2006	Total	% in Total	Share in Employment in 2006
Indian Business House Subsidiaries	0	0	0	0	0	0	0.0%
Indian Entrepreneurial Firms	1	1	2	0	4	50.0%	25.8%
MNC	0	0	0	2	2	25.0%	3.1%
Foreign-Expatriate Indian	0	1	1	0	2	25.0%	71.1%
Joint Ventures	0	0	0	0	0	0.0%	0.0%
Public Sector Firms	0	0	0	0	0		0
Total	**1**	**2**	**3**	**2**	**8**	**100%**	**100%**

Source: Author's calculations based on NASSCOM (2007b), company websites and author interviews. Foreign-expatriate Indian firm refers to firms in Trivandrum that have been started by expatriate Indians or subsidiaries of foreign firms in other countries founded by expatriate Indians in those countries.

Structure of the Industry at State and National Levels

Table 8.2 presents a comparative analysis of the structure of the industry at the state and national levels. Though it is difficult to draw conclusions from a comparative analysis of the structure of the firms at the state and national levels due to very small number of firms in the state, we can still gain some insights as to how the structure of the industry differs in the state. While there were no Indian business house subsidiaries and MNCs in Trivandrum in 2001, they had a much larger presence at the national level. The industry in the state is almost entirely dominated by Indian entrepreneurial and foreign-expatriate Indian firms.

Table 8.2: Comparison of the structure of the software industry in Hyderabad and all India

Type of Firm	**No. of Firms in 2001**		**% of Firms in 2001**		**Share in Employment for All India in 2001**
	Trivandrum	**All India**	**Trivandrum**	**All India**	
Indian Business House Subsidiaries	0	87	0	15.3%	26.9%
Indian Entrepreneurial Firms	4	251*	66.7%	44.2%	34.9%
MNC	0	128	0	22.5%	16.3%
Foreign-Expatriate Indian	2	58	33.3%	10.2%	7.9%
Joint Ventures	0	44**	0	7.7%	8%
Public Sector Firms	0		0		
Total	6	568			

Source: Data for Trivandrum are based on author's calculations based on (NASSCOM, 2006b). Data for All India are from (Athreye, 2005b).
* Includes data on entrepreneurial firms and entrepreneurs with prior IT experience.
** Also includes public sector firms

Leading Firms in the State

Table 8.3 presents the details of the eight NASCOM firms in Trivandrum. The leading firm in the state is a Foreign-expatriate Indian firm. Most of the firms are engaged in IT services, custom software development, and BPO.

Table 8.3 Top Ten Leading Software and Services Firms in Hyderabad

Sl. No.	Name of the Company	Type of Firm	Legal Structure	Year Estd.	Total Employees (2006)	Main Areas of Business
1	US Technology International Pvt. Ltd.	Foreign-Expatriate Indian	Pvt. Ltd.	1999	3,500	IT Services
2	IBS Software Services Pvt. Ltd.	Indian Entrepreneurial	Pvt. Ltd.	1997	760	Software Development and Consulting
3	Network Systems and Technologies (P) Ltd.	Foreign-Expatriate Indian	Pvt. Ltd.	1995	460	Software Engg, Hardware, Products
4	IVL India Private Ltd.	Indian Entrepreneurial	Pvt. Ltd.	1995	400	ERP and eBusiness
5	Suntec Business Solutions Pvt. Ltd.	Indian Entrepreneurial	Pvt. Ltd.	1990	240	Software for BPO
6	RM Education Solutions India Pvt. Ltd.	MNC	Pvt. Ltd.	2003	137	Educational Software
7	MDI Datanet India Pvt. Ltd.	MNC	Pvt. Ltd.	2004	37	
8	I Scribes India Pvt. Ltd.	Indian Entrepreneurial	Pvt. Ltd.	2000	35	BPO

Source: (NASSCOM, 2006b), Company websites (accessed in March, 2007)

8.2 Policy Initiatives by the State for the Development of the Industry

Kerala was the last among the three states to adopt specific policy initiatives for the industry. The state did not have any industry-specific policy initiative till 1998. However, it was the first state among the three to build good infrastructure for the industry. The state had established Technopark in the early 1990s, much earlier than similar parks came up in Chennai and Hyderabad, with excellent infrastructure facilities. The park offered both developed land and ready-built facilities for firms at about half the cost of similar facilities in the other two states[40]. The first firms moved in Technopark in 1994-95. The city itself had relatively good infrastructure and the cost of living was about

[40] Source: Interview with government officials in Trivandrum.

30-40% lower than in the other two metros. The city also had an STPI center established by the Government of India in 1992.

However, despite having good infrastructure and lower cost of operations, the state fared poorly relative to the other two states in attracting software firms till the end of 1990s. What were the reasons for this failure? To answer this question, it is helpful to analyze the policy measures adopted by the state in two phases: 1995-2000 and 2001-2006. Table 8.4 lists the major initiatives taken by the state for the development of the software industry in the state during 1995-2006.

Table 8.4: Major Policy Initiatives by the State Government for Development of the IT Industry in Kerala

Year	Policy Initiative	What the Policy Did
1988	Technopark established, companies started moving in from 1995-96	Provided specialized infrastructure for the industry
1992	STPI Trivandrum Established by the Central Government	Provided dedicated infrastructure and tax concessions to the firms
1998	First IT Policy of the State	Provided a host of concessions: exemptions from sales tax for seven years and from Pollution Control Act, priority to IT industry for power, 50% subsidy for captive power generation, 20% subsidy on capital investment subject to a maximum of Rs. 2.5 million
1998	State Advisory Council on IT	Incorporated industry representatives and academicians into the policy making process of the state
2000	New Department of IT Created	Facilitated direct interaction and coordination with the industry
2000	IIITM-K established	Specialized academic institution was established to provide advanced training and R&D support to the industry
2001	Second IT Policy of the State	Provided incentives to Kerala based IT units

		in Government purchases and for creating skilled labor, proposed reforms in labor laws
2002	IT Kerala started	Annual exhibitions on the IT industry in the state aimed at showcasing the state and attracting potential investors
2002	Akshaya Project Launched	A major e-government project launched aimed at providing universal computer literacy in the state
2002	Self-certification for compliance with labor laws for IT units	Allowed the IT firms to file self-certification for compliance with labor laws, thus implementing similar labor reforms in the state as in TN and AP
2005	Asian School of Business established	Established on the lines of the Indian School of Business in Hyderabad, it was aimed at providing professionals with advanced skills in business management

Source: Interviews with government officials and published government documents and reports

8.2.1 The First Phase (1995-2000) – Failure to Rein in Labor and Shed Leftist Image

One of the major problems that the state faced in attracting private enterprise was the perception that the labor in the state was militant and the government was hostile to capitalists. The state was considered to be a hotbed of trade union activities (Dayasindhu & Pradeep, 2003). The state was ruled by a left coalition from 1996 to 2001 and it was not considered to be friendly to large private investors (Krishnakumar, 2005). Unable to shed its pro-labor and anti-private sector image, the state took only hesitant steps to attract software firms during this period. Even these steps were taken more in response to the rapid progress being made in developing the IT industry by its neighboring states of

Tamil Nadu and Kerala, rather than in any genuine belief in the role of large private capital as a vehicle of economic development.

The first specific policy initiative of the state was to announce its first IT policy in 1998. This policy gave a number of fiscal and tax incentives to the industry to attract them to the state: exemptions from sales tax for seven years and from the Pollution Control Act, priority to the industry for power and 50% subsidy for captive power generation, and 20% subsidy on capital investment subject to a maximum of Rs. 2.5 million. The state also formed a new department of IT in 2000 to deal exclusively with policy making for the industry. It also established an Indian Institute of Information Technology and Management (IIITM-K) in the same year to cater to the growing need for specialized professionals for the industry.

Though these policies were on similar lines to those announced by Tamil Nadu and Andhra Pradesh, they did not lead to any major inflow of new investments to the state. There were several reasons for this. First, these policies were brought in considerably later than in the other two states[41]. Second, and more importantly, the prime reason for the relative failure of the state to attract IT firms, as noted before, was the perception of the state as a hotbed of trade union activities and the image of the state as hostile to private enterprise (Dayasindhu & Pradeep, 2003; Tharamangalam, 1998). This view was echoed by a senior government official in the state, who mentioned that "labor is a concern here despite attempts by the government to exempt the IT firms from strikes, etc....". Third, the state was also way behind its neighbors in the availability of skilled labor, which was required to support a massive expansion of the software sector. In 2000,

[41] As one senior state government official stated: "Kerala is a much later entrant compared to its neighboring states in attracting the IT industry.."

while Kerala produced only around 3,800 undergraduates with engineering degrees, Tamil Nadu and Andhra Pradesh produced 15,500 and 8,100 respectively (Arora & Bagde, 2006). Perceived problems due to hostile trade unions and unfriendly climate towards private investments, coupled with inadequate availability of skilled labor in the state, were the major reasons for Kerala lagging behind the other two states in attracting investments in this industry during this period.

Another reason for the failure of the state in attracting big investments in the IT sector during this period was its relatively greater focus on using ICT as an enabler of social and economic development rather than promoting it as a production sector[42]. The state started a number of initiatives for e-governance and improving computer literacy in schools and rural communities. Though this in itself was a noble objective, it did not help in attracting the big software firms to the state.

Another reason was the failure of the state in acquiring domain expertise and involving the industry in policy making. While industry representatives had been incorporated in specific agencies for providing policy inputs in the other two states, this did not happen in Kerala. The government's apathy towards the industry during this period was apparent from the fact that the first visit by a president of NASSCOM to the state was only in 2000 (Dayasindhu & Pradeep, 2003). Though the state created a separate agency (the Kerala State IT Mission) to incorporate the representatives from the industry and academia into policy making, this agency was not effective as the government did not see large private firms as vehicles of economic growth.

[42] One official said that this focus was due to the anti-private capital stance of the government.

8.2.2 The Second Phase (2001-2006) – Shedding the Leftist Image and Reining in Labor

Second IT Policy in 2001: Addressing Concerns on Labor

In 2001, a new congress led government was voted to power in the state. This government was more private investor friendly in its ideology and believed in private and foreign investment as engines for economic growth (Krishnakumar, 2005). After coming to power, the new government announced the second IT policy of the state in 2001. This policy sought to directly address the concerns of the private industry on the labor front. In 2002, the government permitted the IT firms to file self-certifications for compliance with labor laws and exempted them from many of its provisions. These measures were similar to what Tamil Nadu and Andhra Pradesh had done earlier. It also exempted the firms in Technopark from the strikes and other disruptions caused due to labor unrest in the state[43].

Attracting FDI and Expatriate Professionals

It was only after this policy that the state government started to promote the state actively to attract the software firms. It tried to attract the expatriate professionals from the state living in the Gulf and the western countries to invest in the state. In 2002, it started IT Kerala, an annual series of exhibitions aimed at showcasing the facilities and incentives offered by the state and attracting the big software firms to the state. More importantly, it projected the state as investor friendly and free from labor problems for the firms in the hi-tech industry.

[43] This was specifically done to address the concerns raised by the firms in Technopark. The vehicles ferrying employees in and out of Technopark were promised police protection during the strikes.

It also tried to attract foreign direct investment to the state. In 2003, it started a new IT park in Kochi, another major city in the state. In the same year, it approved a major proposal for foreign direct investment by Dubai Internet City for setting up a Smart City in Cochin. However, the project suffered delays due to continuous negotiations over it due to political opposition. Delays in decision making over major investments contributed to slow growth of the industry in the state[44]. With the change in government in the state in 2006, decision over this project was further delayed as the new Left Front government was ideologically opposed to this project.

Increasing the Availability of Skilled Labor

During this period, the state also took steps to improve the availability of skilled labor in the state by allowing a large number of private engineering colleges to open in the state. The number of technical graduates coming out of technical institutions from the state went up to over 23,000 in 2006 from only 3,800 in 2000. It also started a specialized institution, called the Asian School of Business, in collaboration with the private sector in 2005 to cater to the need for specialized management professionals for the industry.

Improving Linkages with the International Market

During this period, the state also made efforts to improve production and marketing linkages of the local firms with the international market. The annual series of

[44] One senior official remarked that consensus building took a long time in the state and delayed decisions over crucial projects: "there is a delay in decision making due to consensus building. Negotiations for the Smart City project took one year almost. Now the govt. has changed (a left front government took charge in 2006) and they want to renegotiate on that...".

exhibitions, called IT Kerala, was aimed at achieving this goal. The state also tried to use these events to showcase its investor-friendly policies to the potential investors.

Making the Bureaucracy more Responsive

The state also tried to make its bureaucracy more responsive through frequent interactions with the potential investors in the IT industry. Kerala IT Mission, a government sponsored agency consisting of government officials and industry representatives set up by the previous government, was given a much greater role in providing inputs for policy making to the government.

Conclusion

As can be seen from the discussion above, this state lagged behind the other two states in the development and growth of this industry. The state was slow in implementing policy reforms in key areas, such as labor reforms, increasing the availability of skilled labor, promoting production and marketing linkages between the local firms and the international market, and in attracting investments from the expatriate professionals. It has also failed to involve the industry in its policy making process. The state tried to follow the policies adopted by the other two states, but it lagged behind in implementing the necessary reforms. The state did try to attract the software firms to the state by implementing e-governance initiatives in several areas, but they had very limited impact in growth of the industry. As noted before, the focus of the state during the first phase (1995-2000) was more on utilizing ICT as an enabler of socio-economic development rather than on promoting it as a production sector as was done in the other

two states. It was only after 2001 that the government focused more on promoting the IT industry in the state as a production sector.

The state was also relatively slow in acquiring domain expertise in its policy making process for the industry. Though it established a state level advisory council on the IT industry in 1998 that included industry experts, this had only a limited impact on the policy making process of the state[45]. The prevailing conditions of labor problems in the state and lack of an investor friendly climate prevented the state from attracting a larger share of the investments in the IT industry coming to the other two states in the region. This was further compounded by the fact that the state did not have adequate availability of skilled labor to support massive expansion of the industry to catch up with the other two states. The leftist political leadership of the state was also not pro-active in attracting the big players in the industry to the state before 2001, as was the case in Andhra Pradesh and Tamil Nadu. It was only after 2001, when a new party came to power, that the state started promoting the industry actively. As noted before, the growth of the industry picked up in the state during this period, especially after 2002.

8.3 Impact of the State's Policies on the Growth of the Software Industry

It is clear from the preceding discussion that the state has achieved only a limited success in the development of software industry within its region. However, the state did attract a number of firms to start operations in the state, including several multinationals. What were the major factors that influenced the software firms to choose the state for locating their units? Did the state help in obtaining finance, upgrading technology, improving linkages with the international market, etc.? To help understand how exactly

[45] One government official said that this was mainly due to the prevailing distrust of the private industry among the leftist political leadership of the state.

the state influenced these firms to locate there, I conducted in-depth interviews with 10 firms in Trivandurm during November and December 2006. As NASSCOM list contained only eight firms in Trivandrum, I collected the list of the other firms from Technopark, Trivandurm. Out of the ten firms interviewed, four were Foreign-expatriate Indian firms, three were MNCs, and three were Indian entrepreneurial firms. I discuss below the main conclusions from these interviews.

Major factors that influenced firms to locate in Trivandrum

For the local and the foreign-expatriate firms, the most important factor that influenced them to choose the state was the ethnic origin of the founders or promoters of the firm. The common factors cited by all the firms included much lower cost of infrastructure and rented space, and significantly lower overall cost of operations. Availability of land and rented space in Technopark was also cited by several firms. The firms said that the cost of infrastructure and rented space in Technopark was almost one third of that in Chennai and Hyderabad and one-fourth of the same in Bangalore. For the multinational firms, the significantly lower cost of infrastructure and operations were the main reasons for choosing the state. Significantly, the one time fiscal and tax concessions offered by the state were not cited by the firms as the major factors influencing their decision to locate in the state. As the company secretary of one Indian entrepreneurial firm stated:

> "..the promoters are mainly from this state and wanted to build an IT corridor in this state. This was the main reason. State incentives were not

the deciding factor. In fact, the firm did not avail of any major incentive, except locating in Technopark.."

Significantly lower cost of operations in the city appeared to be an important factor for location even for firms whose promoters were not from the state. In one particular case of an Indian entrepreneurial firm, the CEO hailed from a north Indian state. However, he stated that had chosen Trivandrum to locate his firm due to almost one third lower costs of operations in the city compared to Chennai[46].

It is useful to further examine the background of the promoters of the foreign-expatriate Indian firms to understand the different roles played by the leading universities in the state and the second level private technical institutions in forming the international linkages. Of the five foreign-expatriate Indian firms interviewed in the city, promoters of three are graduates of leading universities in the state and country (Madras University and Indian Institute of Science at Bangalore)[47]. They emigrated to the west in the 1970s and 1980s and went on to work in leading firms in the US and Canada. Promoters of the remaining two are Indian Americans with ethnic origins in the state. As noted in the other two case studies, this again underscores the important role played by the graduates of the leading universities in the state and the country in forming international production and marketing linkages for the industry in the state. These expatriates provided the entrepreneurial and technical leadership by establishing firms in the state. These firms in turn employed the skilled graduates from the undergraduate level private institutions in the state.

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[46] As the CEO of the firm stated: "rental rates are much cheaper, availability of talent, and the quality of life is better.... The promoter is not from this state and hence that was not a factor.."
[47] Source: interviews with firms and company websites (accessed in March 2007).

Linkages with the State Owned and Privately Owned Local IT Firms

Like in the other two states, exports are the main source of revenue for almost all the firms interviewed. The firms here have virtually no linkages with the state owned or other local IT firms.

Availability of Skilled Labor in the State

Most of the firms stated that skilled labor was not adequately available in the state. This was particularly true at middle and senior levels where the firms were often forced to hire from Tamil Nadu or Andhra Pradesh to make up for the shortfall. They also mentioned that this was a constraining factor for expansion of the industry in the state.

Labor Relations in the State

Several firms mentioned that labor militancy was an issue in the state. However, they said that the government had taken steps to exempt the firms in Technopark from strikes etc. by the labor unions. However, strikes in the city or the state did affect the firms in Technopark as many workers were unable to come due to lack of transport facilities. On the days of strike, the attendance was usually 20-25% lower compared to the same on normal days. A senior executive of a foreign-expatriate firm stated that the firm lost productivity due to strikes on around 10 days in a year when around one-fourth of the employees would be absent and the clients would not be able to come to the office.

Awareness among Government Officials about the Needs of the IT Industry

Most of the firms stated that though the state had taken steps to involve the industry in providing inputs for making policies, the bureaucracy in the state was not very quick and pro-active in addressing the concerns of the industry. This was due to the fact that the political leadership in the state was not seen as very friendly towards private industry till 2001. However, with the change in the political leadership in 2001, the bureaucracy was more pro-active in involving the industry in policy-making. However, there were some problems again on this front after the Left Front came back to power in 2006.

Involvement of the Firms in the Policy Making Process of the State/Central Government

Most of the firms interviewed said that they had no direct involvement in the policy-making process of the state. However, since a large proportion of the firms in Trivandrum were located inside Technopark, they interacted frequently with the officials of the Technopark on issues relating to infrastructure, etc.

Unlike in Chennai and Hyderabad, NASSCOM has not made any major efforts to interact with the state government on policy issues for the industry. In fact, till 2000, when the Left Front government was in power, NASSCOM did not have even a single meeting with the top political leadership of the state[48]. It was only after 2001, when a new government came to power and implemented several pro-industry policy reforms that NASSCOM started interacting actively with the state on these issues.

[48] This was confirmed by a senior government official in the state.

Linkages with Global Production Networks

All the firms interviewed said that they were almost exclusively engaged in exports. Export orientation of the firms here is much more than in Chennai and Hyderabad. The domestic market in the state is miniscule. The MNC subsidiaries are mostly engaged in serving their parent firms. However, as most of the firms are Foreign-expatriate and Indian entrepreneurial, the linkages of these firms with the global production networks are relatively stronger.

Access to Finance

Like in the other two cities, for most of the Indian entrepreneurial and Foreign-expatriate Indian entrepreneurial firms, the main source of finance is promoters' equity. For the MNC subsidiaries, finance has come from their parent firms. Significantly, none of the firms said that they had availed of any venture capital. This was due to lack of availability of such financing for the local firms.

Like in the other two states, the state's role has been very limited in facilitating access to finance for these firms.

R&D and Technology Upgradation by the Firm

All the non-MNC firms interviewed said that they conducted all their R&D in-house. The MNC subsidiaries received R&D from their parent firms. The state's role in providing or facilitating R&D has been very limited. Even the IIITM-K does not have a strong collaboration with the industry for R&D.

8.4 Analysis of the State Government's Role in the Development of the Software Industry in the State

This state is an example of a shadow case where the development of this industry was comparatively much less successful when compared to the other two states. In this section, I discuss how the state's policies affected the growth of this industry in the state.

It is useful to briefly summarize the state's policies to promote the development of this industry within its region and why they failed during the first phase (1995-2000). As discussed in the preceding sections, during this phase, the state clearly failed to establish itself as a major destination for the software industry. This was despite the fact that the state had created a good infrastructure, had relatively lower cost of operations, and had announced its first IT policy in 1998 almost simultaneously with the other two states. This was due to several reasons. First, there was a strong perception among the firms that the labor in the state was militant and that the firms faced frequent difficulties due to numerous strikes, both within firms and city or state wide shutdowns due to political agitations, etc. Though the software firms generally did not face problems from their own workers, they suffered on the days of general city or state wide strikes as the workers were not able to come to office. This was true of firms even in Technopark where the government had given assurances that the workers would be given adequate protection on the days of strikes. Even here, around 15-20% of the employees would not be able to come to office on the days of general strikes in the city of the state. The state evidently failed to carry out the necessary labor reforms to assure the private investors that labor problems would not be allowed to disrupt their operations.

Second, the ruling leftist government in the state during this period was not supportive of the software industry due to its deep distrust of large scale private capital. It instead focused more on using ICTs as a tool for social and economic development in the rural areas by opening computer kiosks in villages and providing government services online. Though this policy had a very noble objective as it aimed at providing information and services to the rural population, it was not effective in attracting firms engaged in software production and exports.

Third, the state did not have adequate availability of skilled labor which was required for a massive expansion of the industry. As noted before, the number of technically qualified graduates passing out each year in the state was much less than in the other two states till the early 2000's.

Fourth, the state failed to involve the industry in policy making. It was not until 2000 that a president of NASSCOM visited the state (Dayasindhu & Pradeep, 2003). Though the state created a separate agency (the Kerala State IT Mission) to incorporate the representatives from the industry and academia into policy making, this agency was not effective as the government did not want to be seen as promoting large private firms in the state.

Fifth, the state also failed to promote linkages between the local firms and the international market. There was little attempt to market the capabilities of the local industry in the international market. The state also made little attempt to involve the expatriate community from the state either to invest in the state or to promote the local industry abroad.

The state did try to influence the local demand for software by investing in e-governance projects and by opening computer kiosks in villages. However, it had only a marginal impact on attracting software firms and certainly failed to attract firms in software production for exports.

During the second phase (2001-2006), the state tried to adopt policies similar to what the other two states had done. The major policy initiatives during this period included implementing labor reforms and exempting firms from the provisions of several state laws, promoting linkages between local firms and the international market, attracting large multinational and nationally owned firms, increasing the availability skilled labor by allowing private technical institutes to produce more graduates, involving the industry more closely in policy making, and attracting expatriates from the state to invest in the state. These initiatives resulted in a significant increase in software exports from the state during this period.

Political Economy of State Policies in Kerala

As the state policies in Kerala differ sharply from those in the other two states, it is useful to analyze the institutional factors and the political economy reasons for the relative failure of the state in developing this industry. As mentioned in the literature review in chapter 2, scholars have noted the class character of the Indian state and how constant bargaining by the dominant class coalitions consisting of rich farmers, industrialists, and working class professionals to protect and advance their interests has affected the actions of the state after independence (Bardhan, 1984, 1998; Byres, 1994; Chaudhuri, 1995; Datta-Chaudhuri, 1990). While this phenomenon helps to explain the

actions of the state in most parts of the country, in Kerala, the state was relatively autonomous of the dominant class coalitions (Cairo, 2001; Dre`ze & Sen, 1995). In this state, politics has been marked by mobilization and organization of traditionally marginalized castes and social groups as a result of many caste and social movements during the pre-independence era (Cairo, 2001; Desai, 2001). The communist party in the state played an active role in this mobilization and organization. The empowerment of these groups exerted pressures on the state for distributing the economic and social benefits widely. This has resulted in the state focusing on distribution rather than capital accumulation and growth (Cairo, 2001). The model of governance in Kerala thus has been relatively more autonomous of the dominant class interests unlike in the other states of the country.

The relatively autonomous character of the state in Kerala has been partly responsible for its failure in implementing policies similar to what the other two states did. The ruling left coalition during 1996-2001 could not have ignored the political implications of being seen in league with the big private capitalists and implementing labor reforms and acting tough with trade unions which were its major support bases. Its defeat in the 2001 elections and coming into power of a more private capital friendly government led to significant changes in the state's policies for the industry and contributed to its relatively higher growth during this period.

9 Comparative Analysis of the States' Role in the Development of the Software Industry in the Three States

From the discussion in the preceding chapters, it is clear that the strategies adopted by the state in the three regions for developing their software industries differ sharply from the dominant paradigms in the literature. Two of the cases (Tamil Nadu and Andhra Pradesh) examined are successful examples of how a pro-active government succeeded in attracting software firms to its region and in increasing its share dramatically in the national exports of software. The third case (Kerala) is an illustration of a relatively unsuccessful case where the state's share in the national exports stagnated during the same period, though it showed some signs of success after 2001.

Though each of the cases examined here present useful illustrations of what worked and what did not in those states, it is helpful to conduct a comparative cross-case analysis of the three cases to analyze the systematic linkages between government policies and the growth of this industry in these states. In this chapter, I try to do this analysis using the analytical techniques of 'method of agreement' and 'method of difference' (Mill, 1888), pattern matching (Yin, 2003), and method of congruence (George & Bennett, 2005b). These methods allow us to analyze the covariations between the explanatory and the dependent variables, help us in understanding the causal mechanisms behind these relationships, and also help us in eliminating the plausible rival explanations. With the help of techniques such as process tracing for analyzing within

cases, we can also understand how interaction effects among the explanatory variables affect the outcome.

I conduct the comparative analysis separately for the two major sub-units examined in this research: government policies and firms in the three states. While a comparative analysis of government policies in the three cases would give us an idea of which policies were effective in developing this industry in these regions, analyzing the firm level responses would help us in understanding the reasons behind the firms' choosing these states and in supporting and validating the overall conclusions drawn from the analysis on government policies. In the next chapter, I draw common strands from both analyses and present an analytical and theoretical framework for successful regional development strategies in developing regions for high technology industries such as software.

9.1 Role of Government Policies

As noted before, I examine the regional government policies for this industry in the three states under the following nine major categories: provision of industry specific factors (physical and communications infrastructure and increasing the availability of skilled labor); labor reforms; subsidies and tax incentives; acquiring industry-specific domain knowledge relevant to policy-making by incorporating industry representatives and academicians into the policy making process; attracting large firms (MNCs and nationally owned); improving the linkages between the local industry and the international market; provision of R&D; providing or facilitating access to finance; and influencing the demand conditions using e-government as a tool to attract software firms to the state. In addition, in this analysis, I also use 'prior' experience of the state in

academic and R&D capabilities and availability of skilled labor at the start of reforms as an explanatory variable as it may help to explain why two of the states succeeded while the third one did not.

It is helpful to examine how and to what extent the three states adopted and implemented these policies. In the Table 9.1 below, I present a comparative picture of how the three states implemented these polices during the two phases after 1991: 1991-2000 and 2001-2006.

Table 9.1: Comparative analysis of the states' policies for the software industry after 1991

Explanatory Variable	**Tamil Nadu**	**Andhra Pradesh**	**Kerala**
Physical and communications infrastructure	Yes	Yes	Yes
Availability of skilled labor	Yes	Yes	No (first phase*) Yes (second phase**)
Labor reforms	Yes	Yes	No (first phase) Yes (second phase)
Subsidies and tax incentives	Yes	Yes	Yes (limited during first phase)
Industry-specific domain knowledge	Yes	Yes	No (first phase) Yes (second phase)
State-industry interaction	Yes	Yes	No (first phase) Yes (second phase)
Attracting large firms	No (first phase) Yes (second phase)	Yes	No (first phase) Yes (second phase)
Promoting linkages between local industry and global market	Yes	Yes	No (first phase) Yes (second phase)
Influencing local demand conditions	Yes	Yes	Yes
Provision of R&D	No	Yes (to a limited extent)	No
Provision of Finance	No	No	No
Prior Experience at the start of reforms in 1991	Yes	Yes	No

* First phase: 1991-2000
** Second Phase: 2001-2006

Policies of the different states had significant impacts on the development and growth of the industry within these states. Employing a cross-case comparative analysis, I discuss below which of these policies significantly affected the growth of the industry in these states.

Physical and Communications Infrastructure

This emerges as one of the most important policy initiatives that all the three states implemented. All the three states built industry-specific physical and communications infrastructure to attract the software firms. As discussed in the individual case studies, availability of good infrastructure was one of the most important factors that attracted software firms to all the three states, though, as noted earlier, Kerala lagged behind due to its inadequate availability of skilled labor, lack of labor and other policy reforms, and its distrust of large private enterprises.

Availability of Skilled Labor

Tamil Nadu and Andhra Pradesh took major policy initiatives to increase the availability of skilled labor for the industry. This was done mainly by allowing the private sector to open new technical institutions for providing undergraduate technical education. This improved the supply of qualified technical graduates to the industry. Andhra Pradesh also started an advanced technical institute (IIIT Hyderabad) to impart advanced post-graduate training to students and provide limited R&D support to the industry. Tamil Nadu also started an advanced institute for training, but it did not succeed and was later merged with a leading state university. However, it already had an

advanced national level institute (IIT Madras) in the city for advanced education and research.

Kerala lagged behind in this aspect upto 2000 and consequently suffered in attracting firms. However, it subsequently allowed a number of new private colleges to open and the availability of technical graduates in the state increased.

Labor Reforms

Both Tamil Nadu and Andhra Pradesh implemented pro-employer labor reforms. They exempted the software industry from provisions of several labor laws, which permitted them flexibility in their operations. Kerala lagged behind in implementing these reforms till 2001. It also suffered from a poor reputation among investors due to a long history of labor problems and militant trade unions. The ruling left party in the state was also not seen to be supportive of large private enterprise. As interviews with the firms indicate, these factors adversely affected the growth of the industry in this state.

Subsidies and Tax Incentives

All the three states provided investment subsidies and tax incentives to attract firms. These included subsidized cost of land and/or built-up space, rebate on registration charges, one time subsidies depending on the size of investment being made, subsidized power, etc. In granting these subsidies, all the three states imposed monitorable performance standards to discourage fly-by-night operators.

However, with the exception of allotment of land, these subsidies and incentives had only a minimal impact on attracting firms. Even in the allotment of land and built-up

space, the chief attraction for the firms was not the subsidy, but the ease of starting operations immediately. As interviews with firms in all the three states indicate, the industry did not need these one-time incentives as it was already internationally competitive at prevailing market prices.

Industry-specific Domain Knowledge and State-Industry Interaction

Both Tamil Nadu and Andhra Pradesh tried to acquire industry-specific domain knowledge to be able to frame better policies for the industry. This was done by involving the industry and academicians into the policy making process. The role of these outside experts was to provide specific advice on the support that the government could give to the industry. Both governments created new state agencies to achieve this. The state level bodies were headed by the chief minister of the state and had representatives from the industry and the academia. They also created a separate government department headed by a senior government official for dealing exclusively with policy making and implementation for this industry and responding quickly to their needs. They also permitted long tenures (usually three-five years) for these career bureaucrats to enable them to acquire industry-specific domain expertise for policy-making. The government officials were encouraged to interact with the industry frequently to understand the issues that the industry was facing. However, it is relevant to note here that the involvement of industry representatives and academicians in these new bodies was only in an advisory capacity, they were never made in-charge of policy formulation or implementation. That task remained with the permanent bureaucracy of the state.

Kerala also created separate agencies for involving outside experts in policy-making. However, these were ineffective till 2001 as the political leadership of the state did not want to be seen promoting large private investments in the state. It was only after 2001 that the state started interacting with the industry closely. On the other hand, the Chief Minister of Andhra Pradesh displayed exceptional entrepreneurial leadership in interacting with the industry and involving them closely in the policy-making process of the state.

Attracting Large Firms

Both Tamil Nadu and Andhra Pradesh focused on attracting large firms to their state. Andhra Pradesh adopted a specific strategy to attract large multinational firms right from the beginning. Getting Microsoft to open a development center in Hyderabad in 1997 was a big success for the state and it facilitated the entry of several other large MNCs to the city. Tamil Nadu adopted this strategy during the second phase after 2001 but it did not focus specifically on large multinationals. The strategy to attract these firms in both states was based on providing them with subsidized land and/or ready built space with all infrastructure, investment and tax incentives, and 'single window' clearances to allow them to start operations immediately. Again, Kerala failed to attract large firms despite having good infrastructure and land as the other conditions were not in place: chiefly, pro-employer labor reforms, adequate availability of skilled labor, and willingness of the state's political leadership to market the state as friendly to private capital.

Promoting linkages between local industry and global market

Both Tamil Nadu and Andhra Pradesh tried to promote linkages between the local industry and the international market. The linkages that they tried to promote were mainly of two kinds: production linkages in outsourcing relationships with firms and marketing linkages to showcase the abilities of the state and the firms to attract more customers. They tried to promote the production linkages with firms in the developed countries by tapping into the huge network of expatriate community of professionals from the state working in those countries. The promotion of marketing linkages was mainly through organizing mega exhibitions in the state, and holding road shows abroad and participating in trade and industry exhibitions, etc.

Kerala was again relatively slow in this regard. It did not make any specific and concerted efforts till 2001 to promote linkages between the local industry and the international market.

Influencing local demand conditions

All three states tried to influence the local demand conditions for the industry by initiating government sponsored projects for e-governance in various government departments and agencies. However, they had only limited impacts in an industry where almost 80% of revenues came from exports. As interviews with the firms indicate, they were focused almost exclusively on exports and had little incentive for participating in government projects that often required tedious and lengthy tender procedures that were awarded on lowest cost.

Provision of R&D

Only Andhra Pradesh made some notable efforts to provide and subsidize R&D for the firms. This was done by setting up exclusive firm-sponsored R&D centers within IIIT-Hyderabad. However, the government did not decide on the type of R&D for the industry. The sponsoring firms were free to conduct R&D on a technology of their choice at the institute. These firm sponsored centers produced a cadre of skilled engineers trained in advanced technologies being developed by the firm. The sponsoring firms for R&D were mostly MNCs. Though it is too early to say whether R&D support by the government had any impact on attracting firms to the state, interviews with the firms indicate that it did increase the supply of engineers with advanced and specialized skills to the market. This definitely was an attraction for the firms doing advanced work on developing new technologies.

Tamil Nadu did not provide any significant support to R&D for the industry, though it did help the industry by increasing the supply of engineers with generic skills by involving the private sector in opening new technical institutions. Kerala failed even in this regard till the turn of the century as noted before.

Provision of Finance

None of the states provided any significant support to the firms in accessing finance. Both Tamil Nadu and Andhra Pradesh tried to set up a separate venture capital fund for the industry, but they did not succeed. Interviews with the firms indicate that the main reason for this was the fact that the demand for venture capital by the firms from the government was low as the firms were generally able to get finance from their promoters

or from the banks. Moreover, the amount available from the government promoted venture capital fund was relatively very low.

Prior Experience at the Start of Reforms

It is important to analyze whether 'prior experience' of the states at the start of the reforms in 1991 mattered in the development of the industry. Both Tamil Nadu and Andhra Pradesh had several local leading software firms in 1991. Tamil Nadu had an advanced academic and R&D institute, the IIT, in Chennai. Both states had permitted the private sector to open technical institutions much before the start of reforms. These institutions provided the bulk of the skilled labor for the industry, while the IIT graduates provided the technical leadership for the industry. As many graduates from the IIT and other engineering colleges had emigrated to the west in search of better career opportunities during the 1970s and 1980s, both states also had very sizable immigrant professional communities living abroad. As noted before, these immigrants contributed significantly to the growth of the industry in both these states.

Tamil Nadu also had a diversified industrial base at that time which had attracted a number of hardware and software firms to provide services to them. Andhra Pradesh had a network of defense R&D labs in the city that employed technical professionals with advanced skills. Many of these professionals later went on to work with local software firms that were coming up in the city. Hyderabad was also home to a number of major pharmaceutical firms in the country at that time. Probably these factors contributed to the growth and development of the software industry in these two states subsequently as they

already had advanced skilled labor, and the basic technical and analytical skills and experience prior to reforms.

Though Kerala also had good technical institutions at that time, they were very few in number as the state did not permit the private sector to open technical institutions till 1992. Kerala also did not have a diversified industrial base in the state as the state did not encourage large private enterprises. The state also had a history of labor problems and militant trade unions, which did not encourage private investment in the state. Though the state had a significant presence in advanced R&D as it was home to an advanced space research center established by the government of India, it did not contribute to the growth of the private software industry in the state as the state did not encourage private investment. This is evident from the fact that the state did not have any local leading software firms before the start of reforms.

In conclusion, we can say that the presence of a sizable base of skilled labor, a large pool of immigrant professionals abroad, and a diversified industrial and R&D base prior to the start of reforms contributed to the success of these states in developing the software industry during the post-reforms period.

Conclusion

From the discussion in the preceding sections, we can see that the following government policies contributed to the success of Tamil Nadu and Andhra Pradesh in this industry: provision of industry-specific factors (physical and communications infrastructure and supply of skilled labor); labor reforms; acquiring industry-specific domain knowledge and state-industry interaction; attracting large firms (MNCs and

nationally owned); improving the linkages between the local industry and the international market; and provision of R&D (to a very limited extent). Prior experience at the start of the reforms mattered as the state already had some leading local firms and a pool of skilled labor. What did not succeed were attempts by the state to influence the local demand conditions through government projects, providing venture capital, and one time subsidies and incentives.

9.2 Impact of the States' Policies on the Growth of the Industry

To examine the extent to which the government's policies helped in the growth of the industry and influenced the firms to locate in the state, it is useful to conduct a comparative analysis of the responses from the firms in the three states. I present this comparative analysis in the Table 9.2 below.

Table 9.2: Comparative analysis of the impact of the states' policies on the software industry after 1991

Explanatory Variable	**Firms in Tamil Nadu**	**Firms in Andhra Pradesh**	**Firms in Kerala**
Major factors that influenced firms to locate:			
Availability of infrastructure	Yes	Yes	Yes
Ethnic linkages of Promoters	Yes	Yes	Yes
Availability of skilled labor	Yes	Yes	Yes (to a limited extent)
Quality of Skilled Labor	Yes	Yes	Yes (to a limited extent)
Subsidies/incentives from Govt.	No	No	No
Entrepreneurial leadership of the Govt.	No	Yes	No
Linkages with the local IT firms:			
State owned	No	No	No
Private firms	No	No	No
Govt. support for labor reforms in the State	Yes	Yes	Yes (after 2001)
Awareness among government officials about the needs of the IT industry	Good	Good	Low before 2001 Improved after 2001
Involvement of the firm in the policy making process of the	No direct involvement	No direct involvement	No direct involvement

state/central government			
Marketing and production linkages with global clients			
Firm's own efforts	Yes	Yes	Yes
Govt. support	Yes	Yes	Yes (after 2001)
Access to Finance			
Promoters' equity	Yes	Yes	Yes
Venture capital	No	No	No
Parent firm	Yes (where applicable)	Yes (where applicable)	Yes (where applicable)
Banks	Yes	Yes	Yes
Govt.	No	No	No
R&D and Technology Upgradation by the Firm			
Own R&D	Yes	Yes	Yes
Academic/R&D Institutions			
Public	No	Yes (to a limited extent)	No
Private	No	No	No

Source: Author's compilation based on field research

Major factors that influenced firms to locate in the state

Availability of infrastructure and ethnic linkages of the main promoters of the firm emerged as the common factors that were cited by firms in all the three states. Availability and quality of skilled labor were cited by firms in the two successful states of Tamil Nadu and Andhra Pradesh while they were of limited attraction for the firms in Kerala. Several firms in Kerala said that lack of adequate skilled labor in the state was a constraint on their further expansion. This was due to the fact that though availability had increased during the recent years, many graduates from the state did not want to work in Kerala as it lacked sufficient opportunities for career advancement.

One time subsidies and tax incentives from the state government were not a major attraction for firms in any of the states, though allotment of land and/or built up space was a big attraction in all the three states. However, what attracted the firms was not the subsidized cost of land by itself, but the ease of starting operations immediately when land and space were made available immediately by the government. Moreover, the

subsidized land was mostly offered to large firms (both multinational and national) and not to small and medium sized firms who could have benefited from the subsidy. The large firms did not need the subsidy as they were already highly profitable and competitive in the international market.

Entrepreneurial leadership of the political executive was a significant factor in attracting firms in Andhra Pradesh, particularly the multinationals. Personal initiative shown by the Chief Minister of the state along with very quick decisions on allotment of land and other regulatory approvals was an important factor for the MNCs to choose the state.

Linkages with the local IT firms

Significantly, firms in all the three states said that they had virtually no linkages for production with the other local firms. They are almost exclusively focused on the export market and the only linkages they have with the other firms are in terms of sharing a common labor pool and interacting in common forums for providing policy inputs to the government. There is virtually no sub-contracting to other local firms due to restrictions placed on them by their clients. Some of the larger domestic firms have set up their own subsidiaries to take up the IT services/BPO work instead of subcontracting to others.

Govt. support for labor reforms in the State

Firms in Tamil Nadu and Andhra Pradesh said that the government was pro-active in implementing pro-employer labor reforms, while those in Kerala said that while they

faced no labor problems in their own firms, the frequent city wide and state wide strikes called by trade unions affected them as a large number of their employees were unable to attend office on those days. They said, however, that the government in Kerala had implemented a number of reforms in labor laws concerning the software industry after 2001 that had eased the procedural difficulties they faced in compliance with the local labor laws.

Awareness among government officials about the needs of the IT industry

Though the firms in all the three states were not directly involved in interacting with the government, in both Tamil Nadu and Andhra Pradesh, they said that the government officials were generally aware of the needs of the industry and what the government should be doing to promote it. This awareness had come about due to the efforts of the government to have regular interactions with the industry. The state had created specific agencies to involve the industry in the policy-making process and this had helped in creating more awareness about the industry among the government agencies and officials.

The firms in Kerala had a different experience. They said that while the state had created separate agencies for dealing with the industry and had involved them in interactions with these agencies, the political leadership in the government was not very enthusiastic about promoting the industry. As there was no clear leadership from the government, the officials felt handicapped in responding quickly to the needs of the industry. However, this had changed after 2001 and the new government was very supportive of the industry.

Involvement of the firm in the policy making process of the state/central government

Firms in all the three states stated that they were not involved directly in the policy making process of the state or the central government. However, the larger firms said that they interacted regularly through industry associations at state and national levels on the needs of the industry and what the government should do. At the state level, Andhra Pradesh and Kerala have city level associations that interacted with the government regularly. At the national level, NASSCOM represented the industry before the central government. NASSCOM also interacted with the state governments, though less frequently. In Kerala, NASSCOM had virtually no interaction with the government till 2000.

Govt. support for marketing and production linkages with global clients

Firms in both Tamil Nadu and Andhra Pradesh said that most of the production and marketing linkages that the firm had were developed by their own with the help of promoters' contacts or through existing relationships with multinational clients. However, the governments in both states had played a supportive role in promoting these linkages. This was done by the government through organizing mega exhibitions in the capital city periodically and also by holding road shows and taking part in exhibitions and trade shows abroad. However, this had benefited mainly the large and the medium firms. The government had also tried to involve the non-resident professionals from the state in the development of the industry by encouraging them to invest in the state.

Firms in Kerala said that the government had not done much till 2001 to promote these linkages. However, after 2001, the government had become more pro-active and was following polices similar to those by the other two states in this regard.

Access to finance

Domestic firms in all the three states said that their main sources of finance were promoters' equity and loan from banks for creating infrastructure and working capital. None of the firms interviewed had availed of venture capital. For the multinational firms, the finance came from their parent firms. Significantly, none of the firms had availed of any direct financial support from the government either in the form of venture capital or other loans.

R&D and technology upgradation by the firm

Domestic firms in all the three states stated that they conducted almost all their R&D within the firm. The MNC subsidiaries engaged in IT services stated that they got their R&D from their parent firms. The captive development centers of the MNCs said that were engaged in conducting R&D on developing new technologies or products for their parent firms. There is virtually no government support for R&D, except in Andhra Pradesh where the government subsidized advanced R&D centers set up by large firms at IIIT Hyderabad.

Conclusion

From the analysis in the preceding sections, it is clear that the major factors that attracted firms to the two successful states were availability of infrastructure, ethnic linkages of the promoters or founders, availability of skilled labor, pro-employer labor policies of the government, and pro-active and entrepreneurial leadership of the government. The firms are mostly focused on exports and have virtually no linkages with the other local IT firms, except for sharing a common labor pool and interacting in common forums like industry associations for providing policy inputs to the government. The firms have developed marketing and production linkages with their global clients mostly on their own, though the process has been facilitated by the government. The firms access finance mainly from their promoters' equity, from their parent firm, or from banks. They have not availed of venture capital. The governments have not played any significant role in providing finance. R&D is mostly done by the firms themselves or is provided by their parent firms in case of multinational subsidiaries. The government's role in supplying R&D has been very limited, except in Andhra Pradesh, where the government made efforts to promote linkages between the industry and an advanced technical institution for R&D.

10 Competitive Flexibility: A New Theoretical Framework on Development Strategies for Hi-tech Industries in Developing Regions

From the discussion in the preceding chapters, we can now see the broad outlines of the development strategies adopted by the two successful states to promote their software industries. The comparative cross-case analysis of the three cases in the last chapter also gives us insights into why Kerala failed to emulate its more successful neighbors in promoting this industry. In this chapter, I attempt to distil the essential elements of the development strategies adopted by these states to succeed in this industry and then discuss their broader implications for developing regions in general.

10.1 Regional Development Strategies in these States

It is useful to briefly recapitulate the strategies adopted by these states that proved successful in attracting software firms to their regions. These strategies can be divided into the following five major categories: provision of specialized factors of production (industry-specific infrastructure, skilled labor); pro-employer regulatory and labor reforms; attracting leading firms to the region; improving industry-specific domain knowledge among the bureaucracy and encouraging state-industry interaction in policy making; and promoting production and marketing linkages between the local industry and the international market. I briefly summarize below what these strategies were and how they helped these states to attract these firms.

10.1.1 Successful State Policies

Provision of specialized factors of production

The most important strategy that all the three states adopted was to provide specialized factors of production for the industry. This consisted of industry-specific infrastructure such as land and ready-built "plug and play" facilities, and provision of professional skilled labor. Most of the infrastructure was created through a novel public-private partnership model where the direct financial subsidy from the government was relatively quite low. The main idea behind creating the industry specific infrastructure was to make it easy for the firms to start operations immediately in the city. This became a major attraction for the firms as the general perception was that it could take several months for a firm to build its own premises or rent one before it could start operations. Scarcity of adequate built up facilities in the private sector suitable for the IT industry was another reason why the government provided infrastructure became a big attraction for these firms.

Another major factor was the adequate availability of skilled labor in Tamil Nadu and Andhra Pradesh. Both these states had permitted the private sector to open undergraduate technical institutions much before the start of reforms. This had helped them in building a sizable base of skilled labor at the start of the reforms when they started attracting the software firms. Kerala was the last to permit the private sector to open technical institutions in 1992 and thus did not have adequate availability of skilled labor during the 1990s to allow a massive expansion of the industry.

It is relevant to point out here that all these private colleges had to follow national guidelines from the All India Council of Technical Education (AICTE) for ensuring

quality of education. This ensured that the quality of graduates from these colleges was good and met the requirements of the industry for skilled professionals. This ensured a steady supply of well-trained professionals to the industry. Andhra Pradesh also started an advanced training and research institution, called the Indian Institute of Information Technology-Hyderabad, to cater to the demand for highly skilled professionals for the industry. Tamil Nadu also started a similar institute, but it did not take off due lack of commitment on the part of the government. However, it already had two advanced institutions: the Indian Institute of Technology (IIT) and Anna University at Chennai that supplied highly trained professionals to the industry. As noted before, Kerala lagged behind in these initiatives. The number of trained engineers coming out of the institutes in this state was much lower compared to the other two states. This adversely affected the development of the industry there.

It is important to note here that these states did not make any notable efforts to provide R&D for the industry, except for some limited support by Andhra Pradesh. Andhra Pradesh established specialized R&D centers at IIIT-Hyderabad in partnership with some leading multinational and domestic firms. However, these centers were engaged more in specialized training for the students on the technologies they were working instead of high-end R&D. However, these centers helped in creating a pool of highly trained professionals who were available to the local firms for employment. Thus they did help the local industry to some extent.

Pro-employer regulatory and labor reforms

Both Tamil Nadu and Andhra Pradesh implemented pro-employer regulatory and labor reforms. This included simplification of procedures for getting statutory approvals for starting a firm through a 'single window system' and implementing pro-employer labor reforms. The labor reforms included granting exemption to the firms from compliance with the provisions of several labor laws, such as Factories Act, Shops and Establishments Acts, etc., and allowing them to file self-compliance reports under other laws. They specifically prohibited government inspectors from inspecting these units for compliance with these laws. However, it must be said that generally these firms did not face any contentions issues with the labor as the demand for labor was high and they were competing for attracting the best skilled workers.

Kerala was relatively slow in adopting these reforms. The perception among the firms that Kerala was not private investor friendly and the trade unions were not supportive of large scale private investments contributed to the relatively slow growth of the industry in that state.

Attracting Leading Firms to the Region

Both Tamil Nadu and Andhra Pradesh adopted strategies to attract large firms to their regions. These strategies included specific case-by-case discretionary investment and tax incentives depending on the size of investments, allotment of land, and provision of infrastructure. However, the focus of the two states varied considerably. While Tamil Nadu did not specifically focus on multinational or national firms, Andhra Pradesh focused specifically on attracting the large multinational firms. The chief minister of the

state himself displayed entrepreneurial leadership in personally interacting with the CEOs of leading multinationals and convincing them to invest in the state. However, it should be noted that the state first quickly developed the necessary infrastructure, increased the supply of skilled labor, and implemented pro-employer labor and regulatory reforms to make the region attractive for the firms. These factors were more important in attracting the firms to the region than the tax incentives and subsidies. Kerala lagged behind in implementing these reforms and hence was unable to attract large firms despite having a good infrastructure.

Industry-specific Domain Knowledge and State-Industry Interaction

Encouraging bureaucracy to acquire industry-specific domain knowledge was a major policy initiative by all the three states, though Kerala was slow in this aspect too. This was done by encouraging deeper state-industry interaction on issues affecting the industry and posting competent and knowledgeable officials in departments and agencies dealing with the industry. All the three states created a separate department for dealing exclusively with policy making and implementation for this industry. They also allowed relatively long tenures for officials in these departments to develop a deeper knowledge of the industry. These polices represented a major departure from the established practice in India of discouraging close interaction between government officials and private industry due to fear of corruption.

All these states also designated a separate public agency as the nodal agency for dealing with the industry on a more regular and sustained basis. These agencies were also headed by government officials. However, the task of these agencies was to interact with

the industry regularly and provide inputs for policies to the government. They were also involved in implementation of certain policies of the government, such as assessing and recommending firms for grant of subsidies and statutory approvals, etc. However, they did not exercise control or power over other government agencies. Other government agencies dealing with the industry functioned as per their own rules and regulations in implementing decisions of the government.

Another strategy to improve the industry-specific domain knowledge within the government and use it for policy making was to involve industry experts and academicians in the policy making process. This was done by creating new state level advisory bodies that had representatives from the industry and academia along with politicians and government officials. The highest level body in the state was headed by the chief minister, the highest political executive in the state. These bodies were outside the traditional bureaucratic structure as the civil service structure in India does not permit recruiting outside experts in traditional government departments.

The role of the Chief Minister of Andhra Pradesh was particularly important in bringing the state and the industry closer. He displayed exceptional entrepreneurial leadership in interacting with the industry and involving them in policy making by the state. His persuasive skills succeeded in attracting several large multinational firms to the state. This acted as a catalyst in attracting other firms subsequently and also helped in attracting and retaining highly skilled labor within the state.

Kerala also created separate agencies for involving outside experts in policy-making. However, these were largely ineffective till 2001 as the political leadership of

the state did not want to be seen promoting large private investment in the state. It was only after 2001 that the state started interacting with the industry more deeply.

Promoting linkages between the local industry and the international market

Promoting production and marketing linkages between the local firms and the international market was another important initiative taken by these states. This was done by attracting the huge expatriate community abroad from these states to start new firms or subsidiaries in their regions. Ethnic linkages of these expatriate Indians were a major factor in these firms' location decisions. These states also organized annual mega exhibitions in the state to showcase the abilities of the local firms and promote the state as an investment destination. Leading firms and industry leaders from India and abroad were invited to participate in these events. The state also organized road shows and participated in trade and industry exhibitions abroad to promote these firms and the state. The state worked closely with industry associations such as NASSCOM for organizing these events.

Kerala was again relatively slow in this regard. It did not make any specific and concerted efforts till 2001 to promote linkages between the local industry and the international market.

10.1.2 Ensuring the Success of Policies

What ensured the successful adoption and implementation of the above policies in these states? As noted before, influence of dominant class coalitions consisting of industrialists and professionals in the political economy of decision making in Tamil Nadu and Andhra Pradesh played a crucial role in successful adoption and

implementation of policies for promoting the industry. The state in Kerala has been relatively more autonomous of the dominant class interests due to its history of labor, caste, and social mobilizations. The relatively autonomous nature of the state in this state prevented it from implementing these policies due to its deep suspicion of large private enterprises, failure to carry out genuine labor and other policy reforms to support the growth of the industry, and its focus on redistribution rather than growth.

10.1.3 Policies that did not work

It is important to note here the policies that did not seem to have any significant impact on the growth of the industry. The most important policy that did not succeed in attracting these firms was the numerous subsidies and tax incentives offered by these states (the long-term tax incentives offered by the central government, such as the ten year tax holiday, were available to all the firms irrespective of location). For most of the firms, these subsidies were not a major factor in choosing the state. The firms in this industry are competitive at international prices and did not need these relatively small subsidies and grants. The more important factors for them were their expectations of long term operational costs, finding adequate skilled labor, and the ease of starting and running a business in a particular state. Ethnic linkages of the promoters of the firms were also very important in choosing location. However, this factor was probably comparatively less important than the other factors just mentioned and worked after the state had already provided the necessary infrastructure and skilled labor. This is supported by the fact that the number of firms started by foreign-expatriate Indians is very low in Kerala. Though the state does not have a big professional expatriate

community like the other two states, still it has a sizable community abroad with ethnic roots in the state that should have allowed it to attract more investment from them.

The second policy that did not prove effective was the effort by the state to stimulate the local demand through government projects. All the three states tried to attract firms by offering e-government projects. However, these efforts did not succeed as most of these firms were export-oriented and the relatively small domestic projects were not attractive for them.

The third policy that did not work was the provision of finance. Both Andhra Pradesh and Tamil Nadu tried to set up separate venture capital funds to provide financial support for new entrepreneurs. However, they were not successful as the amount provided was small and the firms could get finance from their promoters' equity and working capital loans from the banks more easily. For the multinational subsidiaries, their parent firms provided the finance.

10.2 Differences between the Strategies of these States and the Existing Paradigms in the Literature

It is clear from these three case studies that the strategies adopted by these states differ sharply from the dominant paradigms within the literature on the role of the state in late industrialization in developing economies. It is helpful to discuss these differences analytically to build a new framework for understanding the role of the state in regional development through high technology industries.

Researchers have argued that successful strategies for late industrialization in developing countries have been based on technological catch-up with the advanced countries through learning (Amsden, 1997; Amsden, 2001; Waldner, 1999). This thinking

is based on the theory that firms in the latecomer countries lack pioneering technology and hence must catch-up by borrowing technology and then making incremental improvements. However, this need not be the case in all latecomer industries as this research shows. This is dependent on how far the domestic industry is from the technological frontier globally. In the case of the Indian software industry, the domestic firms have developed technological capabilities on their own through improvements in software development processes and project execution capabilities (Athreye, 2005b). Hence, in terms of their technological capabilities for providing software services, they are close to the technological frontier. Hence, the state did not need to provide incentives for technology transfer and upgradation as the domestic firms already had pioneering technology in software services.

Scholars have also suggested the need to promote large national firms in the specific target industries and then providing incentives to them to become internationally competitive (Amsden, 2001). These firms first start selling in the domestic market and when they acquire sufficient experience and achieve good quality, they start exporting. This again is based on the premise that the domestic firms lack a pioneering technology to compete internationally. In the Indian case, this was largely not true as the firms were competing internationally right from the beginning based on the unique onshore and offshore delivery model that they had developed (Dossani 2005). Hence, the state did not need to promote large national firms by giving specific incentives. When these states started attracting these firms in the mid 1990s, the domestic firms were already growing at a very high pace and there were several relatively large domestic firms in the market. The state also did not need to provide any protection from competition for these firms as

they were already competitive in the international market. Hence, the strategies by these states to attract large firms (both national and multinational) rested on different premises. The main reason behind efforts to attract large firms in these states was to use them as catalysts for growth of the industry by attracting other firms. This strategy was particularly successful in Andhra Pradesh where the state tried and succeeded in attracting several large multinational firms in the early stages of the growth of the industry.

Scholars have also noted that latecomer states need to develop specific state structures to implement these strategies. For example, creation of a dominant or nodal agency with power and control over the industry and other government agencies for implementing policies and monitoring the results using performance standards can help in improving the performance of the firms (Johnson, 1982). This is largely based on the premise that a nodal agency would be better able to coordinate the actions of diverse firms and control the development path of the industry. However, in the Indian states, there was no single dominant agency that had power and control over the industry. These states had multiple agencies that interacted with the industry on different aspects, though they had all formed one separate department for overall coordination.

Scholars have also noted the vital role that developmental states have played in providing R&D and technology to the latecomer firms (Amsden & Chu, 2003). This is based on the theory that these firms lack access to the latest technologies and hence the state needs to provide support for the development of technology due to the public good nature of R&D (Waldner, 1999). However, the regional governments in India (and even the central government) made little effort to provide R&D to the industry with the

exception of Andhra Pradesh, which made some efforts in this direction. This was mainly because the firms did not need state intervention in this area as they had mostly developed the technology on their own and were already competitive in the international market. However, it must be stated that non-provision of state support for R&D (by both central as well as the state governments) probably locked the industry in its present trajectory of growth through providing software services and custom software development, which are considered to be relatively low value added segments of the industry (Dossani 2005; Athreye 2005b).

Researchers have also pointed out the importance of state support in providing venture capital and subsidized finance to the latecomer firms (Amsden, 2001; Breznitz, 2006; O'Riain, 2000a). Though the firms in these states had access to working capital from the nationalized banks, these states did not provide venture capital. Even the finance from banks was not subsidized. This was mainly because these firms were earning huge profits and did not need state subsidies. These firms also had access to finance from their promoters' equity and the banks were willing to provide the working capital.

The strategies of these states also differ from that of the 'neo-developmental' or 'flexible developmental states' (O'Riain, 2000a). This model calls for extremely flexible bureaucracies that have adequate domain expertise and can understand deeply and respond to the constantly changing needs of a technologically sophisticated industry in a globalizing market. This is based on the premise that the traditional bureaucracies with long and secured tenures and little involvement of outside experts in policy making are too rigid and inflexible to respond to the constantly changing technology and market conditions. In the case of East Asia, researchers have noted the 'embedded' nature of the

state where the state was embedded in the industry through multiple networks and yet retained sufficient autonomy to implement policies in the national interest (Evans, 1995). However, the experience of the Indian states suggest that there are alterative ways in which even traditional bureaucracies can acquire industry-specific domain knowledge and respond quickly to the constantly changing needs of the industry. Faced with the challenge of quickly catching up with their highly successful neighboring state of Karnataka, these states quickly adopted novel strategies to make their bureaucracy perform without changing its fundamental structure. They quickly created extra-bureaucratic agencies to involve the industry in the policy making process at the highest level. These agencies had representatives from the industry and the academia and were headed by the chief minister, the highest elected head of the state. They also created separate departments to deal exclusively with policy making for this industry and make and implement decisions faster. However, these departments and other state agencies responsible for providing policy inputs and for implementation were all headed by career bureaucrats. There was no involvement of outside experts in implementation. This differs sharply from the experiences of Ireland, Taiwan, and Israel, where the involvement of industry was much deeper in the state structure (Breznitz, 2006; S. O'Riain, 2000a). Even in Andhra Pradesh, where the state interacted with the industry far more deeply with the chief minister himself taking the lead, it was not an 'embedded' or a 'networked state'. It had the same bureaucratic structure as in the other states with little domain knowledge of the industry or specific technologies. However, the bureaucracy in the state tried harder to understand the needs of the industry as the Chief Minister himself was leading the efforts to attract leading software firms to the state.

The actions of these states also differ sharply from the dominant thinking in the regional development literature. Scholars have noted that the main roles of the state in enhancing regional industrial competitiveness relate to influencing the specialized factor and demand conditions, presence of related and supporting industries, and competition among local firms (Porter, 1990, 1998). In this case, though these states influenced the factor conditions by providing industry specific infrastructure and specialized labor, there was little attempt to influence the demand conditions, except in a limited sense through e-government projects. However, the government sponsored projects had a very limited impact on attracting software firms as these firms were focused mainly on the export market. Competition among the local firms was mainly for the local skilled labor and not for the domestic market. Thus even this framework is unable to fully explain the role of the state in a hi-tech industry with global linkages in production and markets.

The policies of these states also differ from the dominant thinking in literature on national and regional innovation systems that emphasizes the importance of local linkages among firms and public and private institutions, and the role of the regional knowledge system and the knowledge creating and diffusing organizations as the major sources of competitiveness in the industry (Edquist, 1997; Freeman, 1995). The related literature on industrial districts emphasizes the role of knowledge diffusion through policy networks of private and public entities (Scott, 1996; Storper, 1995), while the literature on industrial clusters emphasizes the importance of proximity of firms and the agglomeration economies. As this research shows, while local linkages have certainly been important in the development of the software industry in these states, these linkages have played a significant role mainly for accessing the local skilled labor pool.

Knowledge creation and diffusion through linkages with the local public and private institutions have not been significant. The reasons for the relatively weak local linkages in the Indian software industry are two fold. First, the industry has been focused on the export market almost from the beginning, and second, the firms have developed most of their technology and process and project execution capabilities on their own. These two factors have contributed to the weak local linkages within this industry.

While these states did try to focus on developing local linkages for enhancing the competitiveness of this industry, it is clear from this research that their major focus was on facilitating external linkages for the industry with the global production networks and the international market. To develop a more coherent account of these policies, we need to draw on another strand of literature on the global production systems and value chains, international geography of innovations, and mobility of knowledge through vertical specialization. This literature emphasizes the importance of international linkages among firms in global production and distribution systems in industrial upgrading and improving technological competitiveness (Gereffi, 1999; Gereffi & Kaplinsky, 2001; Gereffi & Korzeniewicz, 1994). In addition, we also need to understand the role of ICT-enabled information exchange and cross-national networks of immigrant communities in transfer of knowledge across national boundaries. Scholars have pointed out the role of these two factors in knowledge transfer in the case of the Indian software firms (Saxenian, 2004; Taeube, 2004). As the case studies in this research show, the professional expatriate community from these states played a very significant role in the growth of this industry.

From the discussion above, we can now begin to see the basic building blocks for a new framework for understanding the role of the state in regional development in an

industry where the firms are at or near the technological frontier and where the markets are mainly foreign. I present this framework below.

10.3 Competitive Flexibility: A New Theoretical Framework for Regional Development in Hi-Tech Industries

As this research shows, regional governments can use multiple strategies to attract firms in a technologically advanced and export oriented industry such as software. However, the actions and strategies of the state are dependent on the stage of development (in terms of technological, financial, and organizational capabilities) of the industry at national level at the time at which they start industrializing. They are also dependent on the stage of economic development of the region, especially in terms of availability of infrastructure, skilled labor, presence of advanced academic and R&D institutions, etc. As these states began to develop their industries in the mid 1990s, they had the example of Karnataka to follow and quickly devised their own strategies to attract firms to their regions. However, their strategies were affected crucially by two critical factors: level of development of the industry and their own level of economic development. Competition to attract investments with Karnataka forced them to devise flexible state structures that could acquire industrial domain expertise quickly and respond fast to the constantly changing needs of an industry that was focused mostly on exports in a rapidly globalizing market. In short, the 'competitive flexibility' of the state in these regions was crucial in attracting software firms.

It is useful to discuss how the stage of development of the industry in India affected the policies of these states. The software industry in India has been focused mainly on custom software development and software services that require considerably

less investments in R&D. The focus of these firms is much more on developing capabilities for process improvements and project execution rather than on R&D for developing advanced technologies (Athreye, 2005b). Hence, the requirement for skilled labor is mainly for software programmers with strong programming and coding skills and not for highly advanced professionals engaged in developing cutting edge technologies and products. As this research shows, this crucially affected the state policies at regional level where the emphasis was on supplying more and more engineers with undergraduate degrees rather than on advanced R&D. The finance for the industry during the early 1990s came mainly from their parent business houses as many firms were business house subsidiaries, from the promoters for the new entrepreneurial firms, and from the nationalized banks (in the form of loans for developing infrastructure and working capital). Venture capital was virtually unheard of. This again affected the policies of these states as they did not make any efforts to provide capital for the industry. Though the proportion of entrepreneurial firms has increased substantially during the 1990s and later, the pattern of financing has remained broadly similar, with little direct role being played by the state in providing capital.

It is also helpful to examine how the central government policies affected the strategies adopted by these regions. Central government had embarked upon a massive economic liberalization program in 1991 and had already liberalized the trade, exchange rate, and foreign direct investment policies by the time these regions started devising their own strategies for promoting this industry. The licensing and location controls had been abolished and entry of multinationals was made much easier. The central government had also provided several incentives for the software industry till the early 1990s which were

available to all states irrespective of location. These included establishment of dedicated software technology parks starting in 1990 and financial incentives such as a ten year tax holiday on export income. These policies constituted the overall national regulatory framework within which the different states had to compete for attracting investments to their region.

Competitive Flexibility: Regional Development Strategies for Hi-Tech Industries in a Rapidly Globalizing Market

Among the most important factors that affect the attractiveness of a region for high-technology industries such as software are the availability of specialized infrastructure and skilled labor. This includes not just the general physical infrastructure, but also industry specific infrastructure such as designated campuses, ready-built facilities, and communications infrastructure. Availability of adequate skilled labor is another extremely important factor. The regions aiming at developing high-technology industries in developing countries need to focus on these two crucial factors right from the beginning when starting to industrialize. Both Tamil Nadu and Andhra Pradesh focused on providing these two factors in a big way from the beginning. Kerala provided physical infrastructure but lagged much behind in increasing the availability of skilled labor. This in turn adversely affected the growth of the industry in that state.

It is important to note here that development of infrastructure by these states need not entail heavy financial burden on their public finances. Creation of infrastructure can be done by involving the private sector. As the firms in this industry are highly profitable, the cost of the infrastructure can be recovered easily from them when they are allotted the

space. In all the three states, it was the private sector that provided most of the capital for development. Where the governments spent the money upfront, it was mostly recouped from the private firms buying or renting the facility. Even for providing skilled labor, it was the private sector that established most of the new technical institutions in these states with little financial burden on the state.

Second, pro-employer regulatory and labor reforms are crucial for attracting investments in high-technology industries. These include quicker regulatory approvals for starting a business and flexibility in labor regulations that allows firms to adopt flexible working hours, easier compliance with statutory requirements, protection against general strikes, etc. Though the firms in this industry in India do not face labor problems internally as they have to compete for recruiting and retaining skilled labor, perception of the state as being prone to frequent labor problems and general strikes, etc. can have a significant deterrent effect on attracting private firms. This was one of the major reasons for Kerala lagging behind in attracting these firms. The states that implemented these reforms were far more successful in developing this industry.

Third, developing regions need to acquire industry-specific domain knowledge and encourage closer interaction and networking between the state and the industry. This helps the state in formulating appropriate policies for the industry and in responding quickly to the changing needs of the industry in a rapidly changing international market. There are multiple ways to achieve this objective. While at the basic level, this requires flexibility in the state bureaucratic structure that allows for closer interaction and networking with the industry, entrepreneurial leadership of the state in pro-actively projecting the state and attracting the leading firms is also very important. While both

Tamil Nadu and Andhra Pradesh devised similar state structures for interaction and networking with the industry, the Chief Minister of Andhra Pradesh displayed exceptional personal commitment and entrepreneurial leadership in attracting the big MNCs to his state.

The experiences of these states also show that it is possible to make even traditional Weberian-style bureaucracies flexible and responsive without changing its fundamental structure. All the three states formed a separate department headed by a civil servant but under the overall control of a political executive to deal exclusively with the IT industry. However, they all established separate public agencies that interacted and networked with the industry more closely and on a regular and sustained basis. They also formed separate advisory bodies not under the regular bureaucratic structure of the state to involve the industry experts and academicians in the policy-making process. However, the role of these outside experts was mainly advisory. Implementation of the policies was still in the hands of the permanent civil service. This sharply differs from the experiences in countries like Israel, Taiwan, and Ireland, where the state structures were far more flexible in terms of much deeper involvement of outside experts in both policy formulation and implementation (Breznitz, 2006; O'Riain, 2000b). For example, in Ireland, the nodal development agency, the Industrial Development Agency (IDA), is headed by an industry expert and not by a permanent civil servant (O'Riain, 2000a).

Fourth, developing regions attract leading firms to their regions in a bid to attract other firms and highly talented labor. Scholars have noted that these leading firms act as 'gatekeepers of knowledge' (Allen, 1977) and as magnets for attracting other firms and highly talented and skilled labor (Lazerson M.H., 1999; Lissoni, 2003). Regions have

multiple choices in devising strategies in this regard. At a broader level, policies can focus explicitly on attracting large multinationals and/or large national firms. As this research shows, while Tamil Nadu did not explicitly focus on attracting MNCs, Andhra Pradesh focused specifically on attracting large MNCs. As noted before, successful policies for attracting these firms focused on providing specialized infrastructure and skilled labor and pro-employer regulatory and labor reforms. These states also successfully exploited cross-national networks of expatriates from their regions to attract them to invest in the state. It must be noted here that one time financial incentives, such as investment and tax subsidies, seem to have little impact on the location decisions of relatively large firms. As this research shows, the firms are guided more by prospects of long-term growth and profitability in a region rather than by these incentives. The major location specific factors that seem to affect the long-term growth and profitability in this industry are availability of infrastructure and highly skilled labor, and pro-employer regulatory and labor reforms.

Fifth, in an export oriented and rapidly globalizing industry, developing regions promote production and marketing linkages between the local industry and the international market. The states again have multiple choices in adopting strategies to achieve this objective depending upon their unique strengths and weaknesses. The states with sizable and professionally qualified expatriate communities are in a unique advantageous position in this industry as they can promote networking with the expatriates to attract them to start new firms or establish subsidiaries in their regions and also use them to promote marketing and outsourcing deals between foreign and local firms. The second strategy to promote these linkages is to encourage firms to network

with foreign firms and the market through participating in international trade shows and exhibitions and showcasing their capabilities. The state can play an active role in this by organizing such exhibitions within the state and inviting leading firms and industry leaders to interact with the local industry. The sate can also actively participate in such events abroad to promote the state as an investment destination. Another strategy for the state is to actively involve the industry associations in promoting these linkages. As this research shows, both Tamil Nadu and Andhra Pradesh adopted these strategies and also actively involved the national association, NASSCOM, in all such events.

Key Differences between the Earlier and the New Model

Discussion in the preceding sections indicates several key differences in the regional development strategies pursued by the earlier traditional bureaucratic states and those pursued by these states for developing this industry. I present these key differences on certain key parameters in the Table 10.1.

Table 10.1: Comparative analysis of regional development strategies by the traditional bureaucratic states and the new "competitive flexible" states

Area	**Traditional Bureaucratic States**	**"Competitive Flexible" States**
State structure	Classic "Weberian", little interaction with industry	Flexible institutions, more interaction with industry
Planning	Centralized planning	Flexible and dynamic
Development Institutions	Provide subsidies and monitor performance	Facilitate linkages with global production networks and international market
Finance	Subsidized finance	Market finance
R&D	State support through public R&D institutions	R&D mainly by the industry
Control over Industries	Centralized control and targeted development	Autonomous and flexible development

Domain expertise	Little efforts to acquire domain expertise	Actively acquire domain expertise
Involvement of industry in policy making	Little involvement	Deeper and more direct involvement
Style of Functioning	Bureaucratic control	Entrepreneurial leadership

Source: Author's compilation based on literature review and this research

Conclusion

This research shows that regional development strategies retain their relevance even in modern knowledge-based economies where national boundaries have increasingly become irrelevant due to increasingly global flows of capital and information, and where production is organized in highly globalized production and commercial networks. These global networks are marked by cross-national flows of capital, information, technologies, and people. Globalization of the economy has been marked by a new spatial organization of innovation, production, and consumption that are not necessarily linked by geographical proximity. This new spatial organization is characterized by virtual and real transport and communication links mediated by the new information and communication technologies. These new technologies facilitate communication at great distances forging new links between distant communities, consumers, and producers.

In high technology and knowledge-based industries such as software, firms increasingly operate across national boundaries and aim at the global market for their products and services. However, even with increasing globalization of capital, information, and flows of people, firms do not spread out their operations homogeneously across the world. Developing regions still have their relevance in these global networks, where, as this research shows, appropriate development strategies can attract firms to

locate to take advantage of local resources and capabilities. These local and regional clusters utilize these capabilities and forge links with the wider international networks to gain access to knowledge, technologies, and foreign markets. Successful regions aim at developing these capabilities and facilitating the insertion of the local and regional clusters into the wider international networks of production and innovation.

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12 Appendix A

Table 12.1: Total Software Exports from India
(At constant 1993-94 prices)

Year	Software Exports (Rs. million)	Per Capita Income (Rs.)	Secondary Sector Production (Rs. m.)	Tertiary Sector Production (Rs. m.)	Number of Engineering Graduates
1990	3422.0	7345.0	1740968	3735246	42022
1991	6124.9	7251.0	1690108	3874257	44281
1992	8174.0	7424.0	1796882	4078163	46762
1993	10200	7690.0	1850700	3342160	48281
1994	13447.5	8080.4	2060717	3555727	52905
1995	22238.6	8516.9	2320499	3930770	56181
1996	31993.1	8995.1	2438137	4198818	57193
1997	49526.9	9254.9	2513440	4549338	61353
1998	82916.2	9549.3	2572862	4856147	67548
1999	111148.2	10038.7	2661774	5424262	75030
2000	168274.3	10187.0	2820216	5679901	79343
2001	217802.7	10621.6	2918073	6159061	97942
2002	259474.9	10545.8	2995708	6367165	107720
2003	313159.2	11303.9	3255053	6901808	128432

Source: Software exports data is from ESC (2006). Data on per capita income and secondary and tertiary sector production come from www.indiastat.com and the data on number of engineering graduates in the country is from (Arora & Bagde, 2006).

Table 12.2: Software Exports at Constant 1993-94 prices (Rs. m.)

Year	KA	TN	MH	AP	DL	HA	UP	WB	OA	KL	MP	GJ	PN	RJ
1990	626	374	1571	127	301	0	129	80	0	2	0	0	0	0
1991	1189	489	1774	158	430	0	188	94	0	6	0	0	0	0
1992	1595	654	2521	242	387	119	248	143	0	13	0	0	0	0
1993	2235	1124	3836	277	986	170	385	251	3	17	0	2	0	0
1994	3079	1800	4771	511	2849	248	541	319	4	19	0	10	0	0
1995	4386	2725	6321	857	3459	458	770	410	9	29	0	12	0	0
1996	7609	4563	9764	1813	5493	745	1288	465	15	62	0	30	0	0
1997	12630	7502	12751	2127	9458	1442	1644	743	28	196	0	40	0	0
1998	24347	9174	14114	4587	17643	7763	7057	1411	565	374	106	93	56	26
1999	29158	13171	18703	7037	26027	6448	8255	2434	726	442	239	183	99	99
2000	48681	24435	26853	12103	23869	9108	21935	2946	1256	706	314	641	314	188
2001	71786	36465	37866	18052	14215	17923	15451	4363	1545	909	544	754	433	278
2002	81834	43529	40754	22001	17121	20377	17992	7545	1741	958	604	609	406	269
2003	107598	44925	54921	28152	19412	27732	19689	8874	1803	1212	693	782	1009	277

Source: Arora and Bagde (2006)

KA: Karnataka, TN: Tamil Nadu, MH: Maharashtra, AP: Andhra Pradesh, DL: Delhi, HA: Haryana, UP: Uttar Pradesh. WB: West Bengal, OA: Orissa, KL: Kerala, MP: Madhya Pradesh, GJ: Gujarat, PN: Punjab, RJ: Rajasthan

Table 12.3: Annual Number of Fresh Engineering Graduates in Different States

Year	KA	TN	MH	AP	DL	HA	UP	WB	OA	KL	MP	GJ	PN	RJ
1990	9015	5861	9575	3927	630	235	2412	1857	723	2325	1940	2137	331	1054
1991	8663	6147	10900	4368	846	465	2412	1959	824	2319	1798	2164	307	1109
1992	9169	6349	12339	4385	900	547	2412	1587	805	2161	2268	2372	337	1131
1993	7665	6595	14323	4367	994	533	2502	2106	845	2246	1823	2742	429	1111
1994	11494	6669	14742	4405	847	625	2502	2304	870	2157	1651	2852	522	1265
1995	11611	6660	15283	5610	940	621	2610	2301	851	2547	2123	3132	554	1338
1996	12182	7835	13772	6298	910	683	2886	2241	901	2441	1849	3087	679	1429
1997	11977	9111	16812	5900	1160	662	2749	2439	913	2795	1647	3158	813	1217
1998	12036	11941	19516	5390	1097	657	3294	2432	994	3001	1763	3168	816	1443
1999	12259	13452	20534	7817	1085	1004	3323	2518	1181	3571	2287	3851	679	1469
2000	12526	15524	19706	8102	1103	1120	3552	2644	1498	3877	2158	4723	1365	1445
2001	14173	16670	26341	12171	974	1788	4822	2754	2950	4126	2727	4762	1991	1693
2002	14195	20550	26791	14680	1160	2225	6703	3459	3259	3764	2050	4902	2081	1901
2003	14550	28107	27157	20099	1089	1950	8083	3834	4316	3944	3439	6944	2944	1976

Source: Arora and Bagde (2006)

KA: Karnataka, TN: Tamil Nadu, MH: Maharashtra, AP: Andhra Pradesh, DL: Delhi, HA: Haryana, UP: Uttar Pradesh. WB: West Bengal, OA: Orissa, KL: Kerala, MP: Madhya Pradesh, GJ: Gujarat, PN: Punjab, RJ: Rajasthan

Table 12.4: Secondary Sector Production in Different States (at constant 1993-94 prices, Rs. m.)

Year	KA	TN	MH	AP	DL	HA	UP	WB	OA	KL	MP	GJ	PN	RJ
1990	92610.0	182220.0	342620.0	119280.0	42876.1	51730.0	158631.8	116180.0	41578.8	41960.0	83304.3	151010.0	54270.0	78030.0
1991	101970.0	170210.0	344330.0	128370.0	45644.3	52050.0	165104.4	123240.0	42745.5	43510.0	76357.4	139530.0	55250.0	77260.0
1992	102960.0	182600.0	371010.0	123940.0	50924.6	50830.0	167001.4	127500.0	44465.7	47510.0	84844.9	185570.0	60890.0	85970.0
1993	104354.6	193896.7	371333.8	126839.9	52885.9	58062.0	172593.9	122977.1	36663.6	54271.6	80295.9	175951.3	65830.6	82292.3
1994	113431.9	224355.0	380032.1	158328.5	62900.6	63345.0	197107.7	128459.0	41029.5	60022.2	91944.0	202175.7	68983.1	99867.7
1995	121067.3	244186.7	438658.5	182087.8	53396.9	68620.8	208311.5	143074.6	42348.1	63951.5	99430.7	232549.1	75084.7	107846.4
1996	132436.8	248965.7	458797.9	201409.2	55458.4	73316.0	239017.5	150522.6	37730.0	63774.3	103344.7	259540.9	77369.2	108870.2
1997	151102.4	253771.7	513177.6	227383.0	65454.2	78015.5	239695.3	160989.2	40370.6	65833.1	112358.5	259619.9	85533.4	131520.8
1998	178933.3	255345.7	491994.3	256239.2	68212.0	83495.9	244521.8	170111.6	43926.0	71999.3	123167.8	281185.2	94639.5	135952.5
1999	170800.5	282943.7	521799.0	277858.2	65233.4	88206.6	244786.4	184280.3	50713.0	73230.4	153011.9	309390.0	93919.2	159755.4
2000	177493.4	305421.1	455668.5	294001.8	90102.2	93247.7	246974.8	189369.1	46340.2	79908.1	144937.2	300110.0	97983.5	145787.6
2001	196227.3	276107.2	460516.1	320400.0	87945.9	98519.8	252378.6	198007.0	43298.7	79237.9	145284.7	304010.0	98607.2	149461.4
2002	209807.8	301756.9	499103.9	367870.0	88182.9	102540.6	270112.6	209440.7	45093.3	86302.7	135267.2	355580.0	104216.3	156163.1
2003	228917.5	294624.9	553857.2	403490.0	91936.5	110427.7	285212.4	217788.8	54683.9	97270.3	145385.7	382640.0	108969.2	168536.8

Source: www.indiastat.com (retrieved May 2007) and Ministry of Statistics and Program Implementation, Govt. of India

KA: Karnataka, TN: Tamil Nadu, MH: Maharashtra, AP: Andhra Pradesh, DL: Delhi, HA: Haryana, UP: Uttar Pradesh. WB: West Bengal, OA: Orissa, KL: Kerala, MP: Madhya Pradesh, GJ: Gujarat, PN: Punjab, RJ: Rajasthan

Table 12.5: Tertiary Sector Production in Different States (at constant 1993-94 prices, Rs. m.)

Year	KA	TN	MH	AP	DL	HA	UP	WB	OA	KL	MP	GJ	PN	RJ
1990	131690.0	193300.0	420560.0	210130.0	105016.5	60700.0	253081.1	192440.0	51699.2	110980.0	91511.0	158510.0	86260.0	118040.0
1991	143120.0	207500.0	457690.0	226910.0	120778.4	65920.0	256198.7	202210.0	60553.4	108890.0	92316.9	160750.0	88480.0	116930.0
1992	147960.0	219080.0	511180.0	223970.0	135312.8	65280.0	262860.2	211960.0	61019.2	120200.0	89615.5	182350.0	92800.0	129180.0
1993	157221.3	238946.0	533375.8	245074.1	148941.9	69315.3	311751.8	230461.0	65376.5	128473.1	135417.3	190739.9	97101.1	127809.2
1994	171683.6	264791.3	556726.9	263028.5	167663.9	73078.5	323953.0	247255.1	70351.7	136790.2	138169.1	207933.5	100023.8	139179.1
1995	188520.3	287266.3	620799.1	279228.6	184109.5	78361.4	337723.1	270476.5	75836.5	146488.8	149962.0	228010.1	106788.3	150137.2
1996	211093.5	316802.9	629692.0	299907.6	213907.3	91437.0	370136.2	294312.0	78491.2	155557.9	164040.1	242223.1	118343.9	166538.9
1997	230808.0	357956.4	686470.8	314238.3	245368.1	98920.5	386343.5	320948.0	86669.7	166860.9	174197.3	272308.4	127504.7	186251.4
1998	254448.7	378936.0	742142.3	340580.9	256849.0	105391.5	396713.4	362350.9	88817.4	180859.3	187860.5	292248.1	134001.0	201825.2
1999	279033.2	407809.8	837675.5	370807.7	276206.8	118278.0	419359.3	394147.7	98874.2	203012.0	199515.9	322040.0	145134.4	208871.8
2000	3097856	4426552	8528765	4022362	2989404	1317066	4306011	4340491	1057678	2277313	1986665	3324100	1503034	2276310
2001	3339008	4518348	9107894	4319500	3168363	1439664	4477387	4607843	1102718	2380059	2108282	3562700	1568982	2374404
2002	3641824	4871384	10136262	4658300	3357890	1584014	4820616	5291168	1192301	2623434	2151900	3843000	1673608	2469112
2003	4036077	5289214	11150105	5045500	3742870	1725772	5102937	5814670	1295972	2936783	2364606	4183500	1797979	2816914

Source: www.indiastat.com (retrieved May 2007) and Ministry of Statistics and Program Implementation, Govt. of India

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Table 12.6: Population in Different States ('000)

Year	KA	TN	MH	AP	DL	HA	UP	WB	OA	KL	MP	GJ	PN	RJ
1990	44696.9	55536.0	78152.0	65912.0	9263.8	16300.5	130482.0	67411.9	31408.0	28987.0	46891.0	41043.8	20123.0	43621.0
1991	45405.7	56196.0	79843.0	67218.0	9615.1	16682.9	133185.0	68766.0	32006.0	29378.0	48387.0	41757.1	20507.0	44573.0
1992	46132.5	56767.0	81425.0	68433.0	9958.0	17058.5	135735.0	69963.0	32606.0	29775.0	49772.0	42522.5	20898.0	45550.0
1993	47183.0	57670.0	83531.0	69652.0	10441.0	17530.0	140030.0	71637.0	33055.0	29879.0	51547.0	43447.6	21296.9	46874.0
1994	48065.6	58340.0	85326.0	70763.0	10856.0	17964.0	143274.0	72964.0	33584.0	30132.0	52720.0	44304.6	21703.2	48039.0
1995	48964.7	58992.0	87128.0	71805.0	11283.0	18410.0	146597.0	74255.0	34105.0	30388.0	53904.0	45178.5	22117.4	49238.0
1996	49760.7	59624.0	88930.0	72767.0	11722.0	18870.0	150001.0	75502.0	34618.0	30646.0	55095.0	45926.5	22539.4	50474.0
1997	50465.9	60235.0	90729.0	73639.0	12172.0	19344.0	153487.0	76697.0	35118.0	30906.0	56293.0	46588.4	22969.5	51751.0
1998	51152.1	60821.0	92519.0	74409.0	12632.0	19833.0	157057.0	77831.0	35606.0	31168.0	57494.0	47267.0	23407.8	53072.0
1999	51817.6	61381.0	94296.0	75067.0	13103.0	20337.0	160715.0	78895.0	36079.0	31432.0	58696.0	49003.0	23854.4	54439.0
2000	52414.1	61913.0	96053.0	75604.0	13584.0	20859.0	164463.0	79881.0	36534.0	31699.0	59898.0	50104.0	24309.6	55858.0
2001	53191.3	62416.0	97786.0	76008.0	14074.0	21398.0	168289.0	80778.0	36971.0	31968.0	61102.0	51267.0	24359.0	57331.0
2002	53854.2	63104.0	99201.0	77152.0	14494.0	21745.0	171703.0	81989.0	37463.0	32357.0	62395.0	51892.0	24621.3	58430.0
2003	54541.5	63749.0	100670.0	78118.0	14940.0	22136.0	175271.0	83079.0	37940.0	32711.0	63692.0	52840.0	25076.5	59629.0

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Table 12.7: Per Capita Income in Different States (at constant 1993-94 prices, Rs.)

Year	KA	TN	MH	AP	DL	HA	UP	WB	OA	KL	MP	GJ	PN	RJ
1990	7739	8785	12356	7600	12229	12343	6333	6645	5019	7696	10097	10346	13022	7573
1991	8535	8938	12130	7880	15483	12366	6285	7014	5503	7775	9245	9510	13415	6963
1992	8631	9321	13598	7630	17076	12114	6271	7113	5351	8190	9634	11990	13785	7750
1993	8706	9979	13566	8308	20105	12625	5745	7458	5608	8811	7366	11323	14203	7034
1994	9027	11105	13620	8636	21650	13189	5940	7820	5815	9459	7411	13104	14348	8045
1995	9429	11361	14871	9015	21368	13186	6019	8254	6022	9803	7692	13556	14664	8169
1996	10109	11797	15310	9456	23263	14359	6515	8683	5652	10080	8017	15234	15448	8867
1997	10656	12635	15841	9216	25878	14207	6361	9253	6303	10284	8239	15335	15614	9627
1998	11851	13105	16056	10229	26141	14627	6388	9698	6369	10917	8596	16200	16178	9765
1999	12322	13779	17288	10604	26410	15356	6585	10226	6611	11642	9305	15785	16770	9721
2000	13326	14700	16306	11443	29037	15997	6499	10745	6506	12009	8230	15157	17031	9268
2001	13371	14261	16811	11935	29137	16441	6539	11369	6788	12207	8773	16047	17367	9879
2002	13779	14532	17954	12207	29612	16987	6777	12044	6742	13064	8048	17040	17596	9027
2003	14259	14896	19091	13138	31549	18129	6944	12729	7675	14306	9158	19265	18364	11142

Source: www.indiastat.com (retrieved May 2007) and Ministry of Statistics and Program Implementation, Govt. of India
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Table 12.8 Primary School Plan* Expenditures in Different States (Rs. '00,000)

Year	KA	TN	MH	AP	DL	HA	UP	WB	OA	KL	MP	GJ	PN	RJ
1979	198.0	23.8	168.3	201.2	286.1	112.4	375.6	1591.0	226.1	364.6	112.4	155.0	18.2	348.0
1980	277.3	777.3	98.6	340.1	378.7	197.2	570.8	1668.9	269.7	267.2	151.4	252.4	20.9	437.7
1981	373.2	968.0	181.3	394.7	504.1	336.9	825.3	1931.7	300.4	375.4	260.2	307.1	9.1	728.4
1982	684.6	1569.8	489.7	3024.2	560.4	394.6	1047.5	137.5	343.5	435.5	656.9	689.6	10.2	860.0
1983	1116.1	362.3	670.5	4791.7	685.6	718.2	1267.7	2644.3	418.4	593.2	667.8	826.7	11.0	1436.4
1984	1588.6	1133.3	1235.5	3221.4	947.3	1108.1	2616.9	2493.0	598.3	898.9	1381.8	939.7	34.6	2257.8
1985	889.6	3642.1	617.5	1655.2	193.8	529.3	2470.3	968.6	684.3	259.8	1592.2	5127.1	35.8	1571.8
1986	701.4	3712.7	1804.8	2463.5	2300.9	875.4	3120.3	3359.2	863.5	1149.2	756.0	440.2	68.8	1960.6
1987	1686.2	4277.3	961.3	2621.1	1213.3	1356.3	3423.8	3015.9	1236.7	1423.7	1661.2	1447.5	314.6	3086.2
1988	1326.8	3967.8	1190.1	3864.8	278.8	1451.5	7291.2	3517.9	2365.5	2736.8	2689.3	1463.3	117.6	4850.5
1989	1893.4	4807.3	2443.4	8979.2	1693.8	2310.0	13223.0	3405.7	3778.2	2043.2	5506.7	1954.8	568.7	6287.7
1990	3335.8	4121.1	964.8	3390.4	2120.9	1185.0	10093.4	1419.8	4212.8	166.8	5799.0	1273.0	51.5	4152.6
1991	5787.8	4107.6	2641.8	4872.9	3033.3	1499.2	8586.6	1096.0	3901.3	146.5	5586.5	1614.9	42.2	6488.5
1992	13515.2	3223.8	5323.2	8696.9	3446.0	2492.4	10035.3	1476.1	6501.6	301.0	5524.1	1464.2	1349.0	6301.6

* Plan expenditures refer to expenditures on new facilities or expansion of existing facilities

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