CHAPTER-I
INTRODUCTION

1.1 INTRODUCTION

During the first half of the nineteenth century Great Britain lead the world in industrial technology. Leadership had passed to the United States (US) by the early decades of the twentieth century\(^1\). During the last half of the twentieth century US leadership has been challenged by Japan and Germany. The world was amidst the World War II and to curb the powers of Japan and Germany, US President Franklin Roosevelt was persuaded by the then president of the Carnegie Institution in Washington, Vannevar Bush to mobilize funds in support of the development of the new military technologies and thus prepared a report called *Science: The Endless Frontier (1945)*. This report became the charter for US post war science and technology policy. Thus, the report was the first initiative in formulating the separate science and technology policy for the developmental tasks. The report insisted that basic research not only contributes to national security but also help in generating new processes, new products, new industries, and new jobs (Ruttan, 2001).

The role of science and technology policies in accelerating the growth process of advanced countries has been widely acknowledged in economic literature (Rodrik, 2007; Maio, 2009; Akyuz, 2009; Cimoli et al., 2009). Two historical examples that are particularly instructive of this trend are of Germany and Japan. These countries successfully followed the policies for acquiring new technologies, learning how to use them, and improving upon them to acquire comparative advantage in dynamic sectors during the process of their catching-up (Maio, 2009). Specifically, in June 1947, US Secretary of State, George Marshall announced the policy of ‘industrialization’ for war-torn Europe. The Marshall Plan, as commonly known, recommended heavy-handed economic interventions such as high duties, quotas, and import-prohibitions. Further, the Marshall Plan recommended that free trade is viable only after reconstruction and international competitiveness has been achieved (Reinert, 2009).

\(^1\) The industrial prominence achieved by the United States during this period was associated with the exploitation of natural resources and the result of incremental advances in knowledge and technology associated with improvement in practice (Ruttan, 2001).
On the other hand, the culmination of World War II also resulted in decolonization of several Asian and Latin American countries. The biggest challenge for these economies was to become self-reliant and to initiate and sustain the process of development. During the mid-twentieth century, governments of many developing countries started extensively to intervene in their respective economies with different packages of industrial policies (Maio, 2009). By the time, technology gained the status of *de-facto* source of growth as was acclaimed widely in the theoretical and empirical literature. But the generation and acquisition of technology was found to be risky and costly affair. So, being nascent in technological competence and being scarce of financial resources for undertaking research, the countries from the ‘South’ relied on developed countries in ‘North’\(^2\) for acquiring technologies (Amsden, 2001) to begin with.

On the other hand, the process of industrialization has a complex relationship with trade. This relationship is convoluted to comprehend and it has remained an issue of debate since centuries amongst the trade theorist and its applicants in policy arena. The doctrine of ‘free trade’ has been repeatedly and widely emphasized in the theoretical models but the issue of its implication surrounds strategic compulsions. Thus, different countries adopted different degrees of openness from time to time to accomplish the process of growth.

To comprehend the divergences precisely, the culmination of World War II could be hypothetically regarded to bifurcate the world - economically, demographically but also in formulating the government policies.

Regarding the issue of free trade, while the countries in the ‘South’ resorted to inward-looking, import pessimist, protectionist policies; the countries in the North were building ties amongst themselves to boost trade and technology transfer amongst themselves (Sodersten, 1980) as is evident in the steeping rise of intra-industry trade

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\(^2\) According to Nayyar (2008), this distinction is due to the difference in the levels of income and development and although such distinction are neither mutually exclusive nor exhaustive. But such distinction is preferable from the point of view of analysis and comparison. Further, according to International Monetary Fund (IMF) country classification, out of 183 countries only 33 belong to the advanced countries (World Economic Outlook Database, 2010).

These, although, distinguished policies regarding ‘technology’ and ‘trade’ adopted by the countries in ‘North’ and ‘South’ resulted the quarter century that followed the World War II to be the period of unprecedented prosperity for the world economy (Rodrik, 2007; Ocampo, 2008; Nayyar, 2008). But the last decades of the twentieth century witnessed deceleration of growth in many countries of South Asia and Latin America except for four East Asian Countries, with their private-sector led, export oriented industrialization. These divergences in growth raised the issue of ‘impact of openness’ on growth and the ‘means of acquisition of technology’ for industrialization as a topic of debate amongst the intelligentsia.

From the early 1960s, South Korean government supported domestic technological upgrading in several ways, like subsidizing the import of technology, tax deductable technology import fee and technological consultation, and income tax exemptions for foreign engineers etc. In Taiwan, government acted as venture capitalist in high technology sectors and launched comprehensive Technology Plans (Maio, 2009). Hong Kong practiced a laissez faire trade and industry policy and developed a light industrial structure specialized in assembly and manufacture of consumer goods especially in small and medium enterprises (SMEs). Singapore, relied more on multinational corporations for the transfer of technology and the government policies concentrates in developing the skill-base, technical support and subsidies to promote high technology activities (Lall, 2001). Specifically, in the East Asian Tigers, import substitution policies were usually coupled with export promotion policies. Subsidies were given by the government and the right to sell in the protected domestic markets under the commitment to export (Maio, 2009).

Regarding the overall expenditure in R&D in a number of Asian and Latin American countries, Amsden (2001) found that during the mid 1980s, Korea and

³ Under the ambit of GATT, the member countries could meet and negotiate jointly on the matter of trade policy.
Taiwan used to spend around 1.5 percent in R&D as a percentage of GDP. The R&D expenditures of Brazil, Turkey and China were modest at around 0.7 percent. The lowest spenders in R&D were Argentina and Mexico.

Conclusively, it could be stated that East Asian countries invested heavily and strategically in indigenous technologies which helped them to sustain national ownership in relatively high-technology intensive industries. In contrast, Argentina and Mexico, and to a lesser extent Brazil and Turkey, increased their dependence for future growth on foreign know-how and the extent of indigenous investment in science and technology remained virtually nil (Amsden, 2001).

Apart from divergence in strategies adopted for building technological capabilities in East Asian countries, other Asian countries and Latin American countries, these countries adopted the policies of opening their economies during the late 1980s. As, during the time an intellectual rationale was generated regarding the policies of globalization following the success of East Asian countries, which were largely acclaimed to trigger the growth. The policies went under the name of ‘Washington Consensus’ for the developing countries. These neo-classical policies of ‘less intervention’ and ‘more market oriented strategies’ were optimistically perceived to boost industrialization. But unlike East Asian countries, these policies were failed to produce any growth in Latin America (Stiglitz, 2006) and many other Asian countries. These divergent results made it apparent to understand the relationship between greater openness and industrialization, more so in the world of fast changing technologies. The present study is an attempt towards this direction.

The structure of the chapter is as follows. The present section presents the overview of the various technological and trade policies adopted by the different countries during the process of their industrialization. The second section 1.2 presents an overview about the Indian manufacturing industries- the case study for the present study. Section 1.3 presents the objectives of the study and the last section infer some general elements undertaken in the following Chapters two to eight.
1.2 INDIA’S QUEST FOR INDUSTRIAL DEVELOPMENT

The biggest challenge for the newly independent India, who has inherited a large, starving and predominantly agrarian population\(^4\) from a century old tyranny of the Britishers, is to find the way for self-reliance and sustainable development. Greatly influenced by the Fabian Socialism\(^5\) and Soviet style planning for Industrialization, the Indian policy-makers endorsed for the state-directed industrialization model (Singh, 2009) and India earmarked on the planned developmental path. Based on the Mahalanobis model\(^6\), the Second Five-Year Plan beginning in 1956, primarily aimed at developing the industrial sector with assigning the State ‘crucial and strategic task’ of its development\(^7\). The private sector was also regulated by the State for channeling the investments in the ‘socially desired directions’. It controlled not only entry into an industry and expansion of capacity, but also technology, output mix and import content (Ahluwalia, 1991). Thus, there was an attempt to force the pace of structural transformation by the government with emphasis on heavy industry, import substitution and State led investments in the industrial sector (Mookherjee, 1997). This ambitious public investment programme in heavy industry showed a rapid growth until mid sixties (Ahluwalia, 1985; 1991; Nayyar, 1994).

\(^4\) At the time of Independence, more than 70 percent of population derives its livelihood from agriculture (Krueger and Chinoy, 2002).

\(^5\) Fabians believes in gradually moving towards socialism by adhering to the notion of social control of property administrated through State – the government.

\(^6\) This model of economic growth is developed by Indian statistician P.C. Mahalanobis in 1953. His model ignored foreign trade and push heavily to “make machines to make machines” (Krueger and Chinoy, 2002).

\(^7\) Key sectors include iron and steel, coal, power, mineral oils, atomic energy, arms and ammunition and allied items for defence equipment. In other areas such as machine tools, non-ferrous metals, fertilizers, etc., also the State was the leading entrepreneur (Ahluwalia, 1991).
But thereafter, the stagnation\textsuperscript{8} loomed in the industrial sector and this aroused a debate in the intelligentsia regarding the role of the government in either accelerating or hampering industrial growth\textsuperscript{9}. The interventionist policies of the government were largely blamed for sluggish growth of the sector which does not permit competition and provides little if any, incentive for reducing costs or improving quality (Ahluwalia, 1985). This debate regarding the role of industrial and trade policies in India\textsuperscript{10} started mounting up for the change. The 1980s witnessed some changes with regard to import of intermediate inputs and capital goods, especially in context of giving a thrust to technological upgradation (Ahluwalia 1991; Das, 2004). But these reforms were regarded as too hesitant (Rodrik and Subramanian, 2004), reluctant, intermittent and patchy (Lall, 2001) to call them the real reforms until 1991 reforms for macroeconomic stabilization following the adoption of Structural Adjustment Programme, wherein the State was dragged to the back seat. ‘Globalization’\textsuperscript{11} a ‘new game’ emerges in which ‘market’ is the biggest player driven by technological race. Thus, after adopting the protectionist policies for about three decades India adopted economic reforms\textsuperscript{12} and embarked on dismantling controls specifically in the industrial and trade sectors with the aim of entrusting the

\begin{itemize}
  \item \textsuperscript{8} The realised rate of growth of industrial output were 7, 10.5, and 10.75 percent per annum for the First, Second and Third Five Year Plans, respectively which fell to 3.33 and 2.75 percent per annum in the period 1965-70 and 1970-74, respectively (Raj, 1994).
  \item \textsuperscript{9} There were some (Ahluwalia, 1985; 1991) who blamed the interventionist policies of the government for the lacklustre industrialization in the country while others found various other reasons for the sluggish industrial growth like poor infrastructure, frequent power cuts, poor transport facilities, lack of credit, paucity of technology (Sheety, 1978) while some found demand side constraints in boosting growth (Raj, 1994).
  \item \textsuperscript{10} Various committees were formed towards the end of the eighties like Alexander (1978), Dagli (1979) etc. (Ahluwalia, 1991).
  \item \textsuperscript{11} With its complex characterisation, globalization means different things to different people and is a source of some confusion. In positive sense, it describes a process of increasing integration into the world economy. There are three economic manifestations of the phenomenon- international trade, international investment and international finance (Nayyar, 2008). But the asymmetry in framing the rules of the game are the distorting the level playing field (Stiglitz, 2006; Nayyar, 2008).
  \item \textsuperscript{12} To meet the economic crisis of early 90s India adopted the IMF conditionality and World Bank’s Structural Adjustment policy. The licensing system was done away with; tariffs were brought down sharply; conditions were made conducive for private players. The optimism of adopting the reforms was the belief in the invisible hands of the markets.
\end{itemize}
long term growth. Thus, the present study aims to find out whether the Indian manufacturing industries actually survived by the ‘initial optimism’ for adopting the reforms (Pack, 1988).

In other words, the aim of the study is to ascertain whether ‘international trade’ acts as a source of technological spillover in case of the Indian manufacturing industries as has been perceived while adopting the reforms.

1.3 OBJECTIVES

In compliance with the neo-classical endogenous growth models, it was assumed that ‘technology’ possessing the ‘public good’ character, would spillover into the Indian manufacturing industries following the adoption of economic reforms in 1991. It was assumed that the technology spillover through imports would lead to greater total factor productivity growth (TFPG) in the sectors with implicitly enhancing the ‘efficiency’ in resource use. It was further assumed that greater technology spillovers would have led to structural shift towards relatively high income elastic industries paving the way for industrial sustainability.

Precisely, the following objectives are undertaken in the present study:

- To analyze the patterns of industrial growth in India from 1980-81 to 2005-06.
- To examine the relationship between openness and productivity growth in manufacturing industries.
- To examine the impact of trade and technology on manufacturing sector.
- To explore the role of technology policy on capability building for innovations in Indian manufacturing industries.

1.4 CHAPTER SCHEME AND OUTLINE OF THE CONTENTS

The introductory chapter was aimed to provide the basic gist of the issue at hand followed by the outlining the various objectives undertaken by the thesis.

In Chapter 2, selective survey of the literature on the relationship between technology, trade and industrial growth is presented. It begins with providing the coherence mix of theory and policy implemented from the domain of international economics. In doing so, the chapter traces the evolution of free trade doctrine since
the advent in the field by Adam Smith; that explicitly assumes that free trade is efficient (Nayyar, 2008). But the contemporary reality since then provides rationale for undertaking various routes for industrial development which has been explored in the chapter simultaneously. The chapter followed by presenting the gaps in the literature that surfaced after presenting the literature covering the scope of the study.

In Chapter 3, rationale of the basic data sources used in the study is presented. The chapter presents the methodology used in the study - the period of study, the techniques of analysis and the construction of various variables.

In Chapter 4, an attempt is made in presenting an economic analysis of structural transformation within the manufacturing industries in terms of theory, policies and empirics. It explores the process of industrialization and develops a conceptual understanding of the patterns of industrial growth through the mechanism of structural transformation. The first part seeks to analyze the patterns of industrial growth using the descriptive analysis. The second part endeavours to identify the factors that accounts for the growth experience in the manufacturing industries in India. The analysis is based on panel regression model in which an attempt was made to encompass the changes in the economic structure that lead to, and caused by various proximate causes.

In Chapter 5, we analyze the impact of economic reforms on TFPG in the organized manufacturing industries. It explores the evolution of ‘technological change’ as a source of output growth. The chapter followed with the estimation of TFPG through two methods: Translog Index and Stochastic Frontier Production approach.

Chapter 6 is devoted to understand the factors that could trigger the sustainable industrial growth. For the purpose, the empirics of the chapter undertakes the issue that whether investment in indigenous research and development (R&D) or technology spillover through imports could be the determining factor in generating the industrial productivity. The chapter situates ‘technology’ in a wider context of sustainability by regarding it as a means for enhancing productivity growth. It begins
with the proposition that trade leads to technology spillover that spur productivity growth in the host country; which got refuted by the panel regression model attempted for the purpose. For understanding the peculiarities of technology spillover the chapter further analyze that whether the extent of technology spillover varies with respect to (i) technology gap; (ii) productivity gap; and (iii) absorptive capacity.

The subject matter of Chapter 7 is to understand the contours of various policies and institutions that would lead to technological capability building in the country - a pre-requisite for sustainable industrialization. It is now more than sixty years since Independence and India’s endeavour on the planned development strategy to begin with. Several attempts were being made during the past decades to enhance the technology capability of the country either by importing technology from abroad or relying on building the indigenous science and technology structure. The first part of the chapter considers the existing attempts underlying the various Plans focusing on building the science and technology structure in the country so as to build the technological capability. The chapter evaluates the experience, analyzes the problems, recognizes the limitations and identifies the gaps to sketch some changes in the existing system. The chapter, then provides some recommendations that emerge significant from the study.

Chapter 8 pulls together the discussion in the preceding chapters and offers a few broad conclusions for public policy and institutional change that may help to pave the way for industrial sustainability.