

Plurality, Choice, and the Politics of Industrial Innovation

“Action, the only activity that goes on directly between men without the intermediary of things or matter, corresponds to the human condition of plurality, to the fact that men, not Man, live on earth and inhabit the World. While all aspects of the human condition are somehow related to politics, *this plurality is specifically the condition – not only the *conditio sine que none*, but the *conditio per quam* – of all political life*

Hannah Arendt – *The Human Condition* (Arendt 1958 p. 7).

Explaining Rapid-Innovation-Based Development

One of the most unexpected developments of the 1990s is that firms in a number of emerging states not known for their high-technology industries in the past, moved to the forefront in new Information Technologies (IT). Even more surprising from the point of view of comparative political economy theories, the IT industries of these countries seem to embody different business models and to carve out different positions in the global production network of the US dominated IT industry. Of these emerging economies, the Taiwanese, Israeli, and Irish indigenous IT industries, riding what seems to be one of the greatest waves of industrial innovation ever, have become hotbeds of New Technology Based Firms (NTBF). Some of these firms have become global players over the last ten years.

That very different IT industries working in the same sectors and markets have grown in emerging economies challenges two central ideas in the comparative political economy literature. First, it suggests that there is a way for less developed countries to become successful players in rapid innovation-based (RIB) industries, something that was not considered plausible in the past. Second, it suggests that there are multiple choices for industrial development. The cases of Ireland, Israel, and Taiwan demonstrate that states and societies, even under conditions of intense globalization in one of the most globalized industries, can pursue different strategies of economic growth.

Contemporary political economy literature cannot satisfactorily explain many of the changes in industrial systems in the last few decades. This is especially true in the case of RIB industries in emerging economies. First, contemporary political economy has a dismal view of the prospects for RIB industrial leapfrogging by backward societies. While each of the standard theories has a particular approach, they all unite in pessimism about the possibility of using government policies to leapfrog in RIB industries, i.e., to transform a relatively backward society to a front-rank competitor in technological innovation in a time-span of one generation.¹ Second, none of the theories can accommodate a situation in which a few different emerging countries, each employing very different industrial policies, planned and implemented by very different bureaucracies, as well as having very different labor market regulations, financial institutions, and educational/training systems, achieve success at the same time in the same R&D-intensive sectors.

Against these bleak predictions, the stories of Israel, Ireland, and Taiwan present cases of successful RIB industrial growth in the time span of one generation in countries with very different political and institutional systems. Thus, the stories of IT industrial development in Taiwan, Ireland, and Israel, offer us multiple puzzles, the answers to which are intimately linked to important debates in comparative political economy. First, comparing the three stories provides us with insights into a highly contested issue of

¹ For the purpose of this book, success in RIB industrial growth is defined as the development of an industry based around NTBFs, which contribute a significant amount of GDP growth, exports, and employment, making the industry a critical sector of the national economy. I use the common definition of NTBF from the literature: companies whose products are new technologies, are based on their own and others' R&D effort to commercialize applications of new technology, or, companies whose main revenue stream is based on R&D efforts to develop new technologies. I further elaborate on it by defining IT NTBF as a company whose main product/s are either a new technology or a new application of new technology that its main function is the gathering, transferring, processing, or presenting of information, and where the company is conducting the R&D that leads to the product itself, either with or without cooperation with other organizations.

economic growth – the role of the state in the development of high-technology industries in less developed economies. Second, comparing the three very different paths of science and technology industrial policy regimes and development, bears upon the question of whether states and societies have choices in their economic development strategies. Finally, comparing the three different positions and relationships of the local IT industry with the global IT production networks offers us an understanding of how globalization, and especially the radical transformation of production, influences development opportunities of peripheral economies.

Politics are about crafting and picking alternatives. Politics matters, therefore, only if choices can be made and if making them has real consequences. In the last three decades, students of politics have done their best to convince us that choosing between alternatives, even if choices exist, no longer truly matters. Nowhere is this more evident than in comparative political economy, particularly in the study of industrial development. Both the neo-classical economists in their belief that the only choice is to let the market rule, and the developmental statist, arguing that only specific structures of states bring forth industrial success, have marginalized the importance of picking between true alternatives.

The aim of this book is to show that choices still exist, that states and societies, through the political process of crafting and picking alternative modes of action, can follow diverse paths and still achieve industrial success. Furthermore, this book aims to prove that the outcome of each path is a different socio-industrial system with different strengths, different weaknesses, and a different distribution of the fruits of success. I argue that choices have real consequences. This book sets out to confirm that emerging

economies have different options in regard to their industrial development. Moreover, it advances a framework of thinking about how different choices lead to long-term consequences and the development of successful *and* radically different industrial systems. Hence, this book strives to give politics – the art and profession of creating alternatives and the social struggles of choosing between, and acting on, them – the importance that they seem to have lost in social science.

The goals of this book are twofold: first, to expand our understanding of the role of the state in the development of the rapid-innovation-based industries. The book aims to clarify not only what options less developed states have or do not have to spur the creation of, and sustain, IT industrial growth, but also to analyze and map the limits of state actions and the dynamics of state-industry interactions. To do so, the analysis focuses on the ways in which the three states influenced the skills and capabilities acquired and developed by the private IT industry.

The second goal of the book is to explain how the different approaches of the three states shaped the IT industries, and influenced the particular development path of, and the particular capabilities developed by, each industry. I seek to move beyond the question of whether or not the state has a role in industrial development. I propose a theory concerning the influence of particular policies on the development of RIB industries in emerging economies. Much of the literature in comparative political economy takes the existence of different industrial and capitalistic systems as given and explains their influence on the behavior of firms and economies under the same global conditions. This book seeks to understand how different industrial systems are created in the first place. It argues that state actions give rise to different high technology industries.

These industries not only utilize different business models, position themselves differently in the global production network, and acquire different skills and capabilities, but also have very different strengths and weaknesses and distribute the fruits of their success very differently within their host societies. In short, this book argues that choices are made, actions are taken, and these choices and actions have consequences.

A brief historical description of the three cases

Ireland, Israel, and Taiwan were poor, peripheral, and technologically backward societies in 1950. They all had mixed histories of success in more traditional industries. At the end of the 1960s, state-led initiatives to develop indigenous high-tech industries appeared in all three societies. At that point, all three were very similar along most of the important economic dimensions, including size and population. All three had low skill intensity in their labor force (defined as the number and percentage of scientists and engineers in the population), a relatively low percentage of high school graduates, poor communication and physical infrastructures, and a high dependence upon agriculture.

All three states followed similar infrastructure policies. Each improved its education system, leading to high rates of skill formation between 1960 and the 1980s. All three improved their physical infrastructures, and, after failed attempts at direct bureaucratic control, created public telecommunication companies that vastly improved their line subscription penetration rates. Deregulation and privatization of the telecommunication market followed, leading to high rates of wireless and Internet

penetration. Finally, unlike Japan and South Korea, all three based their growth on small and medium size enterprises rather than on big corporations.²

Despite the similarities of their macro level and infrastructure policies, however, their micro, i.e., industry and firm level, policies were distinctly different. For most of the period since the late 1960s, Ireland has focused mainly on inward investment policies. Israel has focused on inducing industrial R&D activities through government grants, with project ideas originating solely from private industry. In Taiwan, the ruling party, the KMT, mistrusted big private industry and feared the rise of competing powers. Hence, it prevented the creation of overarching conglomerates, controlled the inflows and outflows of investment, and relied on public research agencies such as ITRI and III to lead R&D efforts and diffuse the results throughout private industry.

Moreover, the structure of the state in all three countries varies significantly. Ireland is a model of an English-style Weberian bureaucracy with its separation between engineering and management, i.e., between industrial domain knowledge and high-level bureaucrats and politicians. Taiwan is a model example of a technocratic Weberian bureaucracy. All high and mid-level bureaucrats, as well as their Ministers, have graduate education in engineering, and thus, are quite versed in their industrial domain knowledge. Israel has a much more chaotically structured bureaucracy. The key principle behind its establishment was to balance bureaucratic professionalism and the ability of politicians to implement their will. The result is similar to the American bureaucracy: elected politicians bring in many of the top executives, including all the director generals of state ministries, from outside the state structure. These differences significantly influence the

² On Japan's and South Korea's conglomerate-based industrial development, see, for example (Amsden 1989; Anchordoguy 1989; Calder 1993; Evans 1995; Fields 1997; Johnson 1982; Okimoto 1987).

politics of industrial development in each country. Moreover, their existence severely weakens arguments that focus all their explanatory power on specific state structure.

It is important to underscore the critical role of the state in all three cases. For many years, the private market did not possess the necessary skills and capabilities to successfully create and manage R&D-based IT companies. Private actors, in particular investors, shied away from even attempting to do so. Moreover, even after more than a few successes, such as the spin-off of UMC from ITRI in Taiwan, or the several IPOs of Israeli firms on the New York stock exchanges by 1989, private financial institutions were unwilling to invest in the IT industry. Thus, the state was the only actor able and willing to start the process of skills and capabilities development in an attempt to spur the growth of the industry.

Today, the IT industries of all three countries are undoubtedly successful.³ But the three IT industries are markedly different in the way they work, the business models they use, and the way they relate to the global IT production network.

³ In Israel annual overall sales in the high-tech electronic industry, excluding software, more than quadrupled from 1986 to 2000 from \$2.003 billion to \$12.5 billion. Exports rose even faster from \$1.135 billion to \$11 billion. Software sales had the highest growth rates, rising from overall sales of \$380 million in 1989 to over \$3.7 billion in 2000. Software exports grew from \$5 million in 1984 to over \$2.6 billion in 1998. Ireland, a country that lost 1.1% of its total population in 1989 due to economic immigration, has seen its IT industry achieve remarkable growth. Software was the main sector where indigenous companies, and not only Irish subsidiaries of MNCs, achieved worldwide success. The number of indigenous software companies in Ireland rose from 291 in 1991 to 630 in 1998, while the total number of firms rose from 365 to 760. Revenues reached a total of \$6.6 billion, out of which exports were around \$6 billion. The total sales of Irish-owned companies were \$950 million, a marked improvement from 1991 when total revenues were \$2.7 billion, out of which only \$234 million came from the Irish-owned sector. In 1998, the IT exports of Taiwan, a country in which the first IC chip was fabricated in a demonstration fabrication facility of a public research institution only in 1977, reached more than \$40 billion, out of which over 80% were hardware, with a large and growing percentage of the world's chips being fabricated by Taiwanese companies. Sources: Israel, (CBS 2001; IAEI 2002; IASH 2003; MOTI 1998. As the SEC filing of the leading Israeli software firms were higher than the reported sale figures of the Israeli Association of Software Houses, there is a reason to believe that the figures above are underestimated); Ireland, (IDA 2000; NID 2003); Taiwan, (ITRI 2003; MoEA various years).

Israeli firms have succeeded in both the software and the hardware subsectors. The industry's role in the global IT production networks is one of a supplier of high-end new technologies (or of new products based on new technologies). Thus, Israel's success is almost solely based on intensive R&D. In Taiwan, the software industry development has stagnated, and the IT hardware industry is embedded within the global IT production network in a very different way than Israel's. Taiwan's industry bases its success on innovation in product design and manufacturing, and focuses on second-generation innovation R&D. In Ireland, even after more than forty years of industrial policies that brought MNCs to open manufacturing facilities in Ireland, the indigenous IT hardware sector growth has not been significant, and it is the local software industry that rose to prominence.

Politics play a very important role in these stories. In a similar way to Japan in the late 19th century and Germany before it, these three young societies faced a harsh reality, in which the result of a failure to build successful national industries would have meant destruction of their societies as independent social units. Israel, Ireland, and Taiwan were all societies that had only recently gained their right to independent existence after long, bitter, and bloody struggles. The leaders who directed the three societies to their current success – politicians, civil servants, and businessmen and entrepreneurs – were all of a generation keenly aware of the price of failure.

Thus, the ways in which Ireland, Israel, and Taiwan have been building their national IT industries, and shaping the relations of these with the global markets, can only be understood as part of national efforts. These have been endeavors in which Ireland, Israel, and Taiwan strived not only to stay independent, but also to continuously win

legitimacy as a coherent national unit, both internally and externally. Economic and industrial growth has been an important part of the national and international process with which these societies have been defining and redefining themselves. Analyzing the roles of the state in the growth of the IT industry, therefore, gives us another mirror in which to see how national socio-political identity is shaped both inwardly and outwardly in a globalizing world – a continuation of the constant socio-political struggle to define what it is to be Irish, Israeli, and Taiwanese.

The bulk of the book aims to show that politics – creating, picking between, and acting on, different alternatives – have consequences. Accordingly, it analyzes how different policies are structured and shape different national industrial systems in turn. However, throughout this book I will also analyze how specific critical decisions were shaped, in part, as an element in this nation-building political process. I will briefly explore how Ireland’s economic policy was shaped within the context of its long dependency on Britain and its struggle to shape itself anew; how science and technology policies were formed by both the Israeli-Arab conflict and the ongoing quest for a national Jewish identity; and how the Taiwanese IT industry has been shaped by its formal international political isolation and the need to craft and present a new and better model of “a China.”

The book utilizes the comparative case-study method in an inductive-iterative theory building effort (Eisenhardt 1989; King et al. 1994; Lin 1987; Ragin 1987; Ragin 1994; Van Evera 1997; Yin 1994). Hence, the theoretical and research traditions that this book arises from, firmly believe that only intimate connection with empirical reality allows the researcher to develop a relevant and valid theory (Glaser and Strauss 1967).

The data analyzed in this book comes from a database of 482 interviews conducted between December 1999 and December 2003, as well as from official and industrial statistical sources.⁴ The interviews were conducted with founders and executives of IT companies, top civil servants in all the developmental and science and technology industrial agencies, academics, and venture capitalists. All developmental agencies were visited at least once and their top officials interviewed. In addition, interviews with the specific labs and departments within each agency were conducted. For both the hardware and software sectors, a list of companies was compiled from public and official records. All the major Irish, Israeli, and Taiwanese companies in the two sectors were interviewed, together with a large sample of smaller companies chosen from companies that were not doing only bespoke development or consultancy.⁵ Lastly, a snowball technique was used to tease out companies that were not included in the original lists but were deemed innovative by their peers. Thus, our sample was intentionally biased toward the more successful and R&D-based companies, giving us, if anything, an overly optimistic view. In all company visits we tried to interview the top management, preferably the CEO/President and/or the firm's founders.⁶

⁴ Of the 482 interviews (not counting repeats), 137 were conducted in Ireland or with Irish companies and officials in the US, 110 were conducted in Israel or with Israeli companies and official in the US, and 235 were conducted in Taiwan or with Taiwanese companies and officials in the US. Unless otherwise stated data on company profiles and information was gathered through interviews, SEC filings, Hoover on-line database, and companies' websites.

⁵ Because many interviewees from private companies have not only asked to stay anonymous but asked that no mention be made that their firm was interviewed, unless I needed to refer directly to an interview, a decision was made that when possible not to specify which of the companies described in this chapter were interviewed. This was done in order to better mask the identity of the interviewees who wished to stay anonymous.

⁶ While the interviews were open-ended, an interview theme was adhered to consisting of forty questions organized around eight sub-themes, with all questions touched upon during the 1-2 hour long interview. The interviews' transcripts were then uploaded onto a server running custom-made software that allows access to the extended database through a web portal with enhanced research engine capabilities.

The State of the Literature

No single strand of political economy literature offers a comprehensive answer to the puzzles that motivate this book. The first puzzle is to understand the role of the state in the development of high-technology industries in less developed economies, under the conditions of intensified globalization and fragmented production. The second puzzle is to understand how such different development paths of the high technology industry appeared, and whether they suggest that multiple developmental choices are available to emerging economies.

It is therefore necessary to develop a theoretical approach using the arguments of several theories. For each question our puzzles present we will need to borrow insights from a different body of literature. The developmental state and late development theories give us an understanding of the role of the state in economic growth in emerging economies. Globalization theories, specifically global production network and industrial fragmentation, offer us a way to understand development in the radical new conditions caused by the rise of global production networks. Finally, systems of innovation theories, which seek to explain how different institutional systems affect the innovative capacity of industrial systems, offer some explanations of how different decisions about resources, industrial R&D, and industrial relations affect the dynamic creation of firms' capabilities. Systems of innovation theories also present a theory of how the co-evolution of state-industry interactions influences different development paths. The following section explores these theories and the answers they provide to the two puzzles of R&D-based industrial development of emerging economies. I then use elements of these theories in my approach, which is presented in the concluding part of this chapter.

Late Development and Developmental State Theories

One prominent school of thought that aims to explain the role of the state in emerging countries' economic growth is late development. This paradigm originates in the work of Alexander Gerschenkron on the industrialization of the “late developing” European countries, e.g., France, Germany, and Italy (Gerschenkron 1962). In *Economic Backwardness in Historical Perspective*, Gerschenkron presents an institution-based view of how a backward state's leadership can use the advantages of relative backwardness to attain rapid economic growth. He argues that the more economically backward a nation, the more state intervention is needed if it is to grow. An economic historian of Europe, Gerschenkron acknowledges that the task of economic growth should be positioned within the process of modern nation-state building. Late developing states needed a more rapid industrialization than the pioneering nations, as economic backwardness equals political and military weakness.

One of Gerschenkron's main arguments is that states have different paths of industrial development, built around different institutions, depending on the *timing* of industrialization. Gerschenkron points to the appearance of a new model of industrial banks in France and Germany and the transfer of this model to Italy and Russia as they reached their rapid industrializing phase.

Advancing a linear theory of economic development that sees it as a process with specific stages, Gerschenkron contends that among the advantages of backward countries is the fact that product markets are already developed and defined by the pioneering countries, which have already invested in the R&D to develop the manufacturing

technologies.⁷ A backward country, unlike a pioneering country, has the double advantages of knowing the market, and accordingly being able to predict needs fairly accurately, as well as of having a clean slate in regards to manufacturing infrastructure so that its industry can invest in the latest technologies. This allows backward countries to reach a scale and scope that the pioneering countries cannot match, as they have already invested in an array of smaller and older manufacturing facilities.

To use these advantages, backward economies need two institutional capabilities: planning capability (i.e., a professional and capable bureaucracy) and access to large amounts of patient investment capital, i.e., financiers willing to invest large sums for long periods of time. If it manages to put these two together, a relatively backward economy can invest in large-scale factories with the latest manufacturing technology. It can achieve economies of scale and outdo the leader in manufacturing capacity and global market share. Gerschenkron stipulates the development of specific and new institutional systems, different from the institutional system of early developing countries.

The idea that backward economies have a specific path of development that depends on the *timing* of their industrialization, is still very prominent in the literature.

For example, Alice Amsden argues that

“If industrialization first occurred in England on the basis of invention, and if it occurred in Germany and the United States on the basis of innovation, then it occurs now among ‘backward’ countries on the basis of learning. The paradigm of late industrialization through learning generalizes to a diverse assortment of countries... but in all cases industrialization has come about as a process of learning rather than of generation of inventions or innovations. *Learning*

⁷ Together with Rostow, Gerschenkron gave a paradigmatic all-powerful stature in economic development studies to the notion that economic development should be seen almost as an organic process that must pass through certain specific stages before achieving full blossom, and with it the ability to innovate on the scientific edge (Rostow 1960). A more recent proponent of the linear model in regards to innovation and the IT industry in Asia was Linsu Kim with his influential model of innovational catch-up progression (Kim 1997). For an argument that changes in the 1990s made this linear model of sequential innovational progression less compelling in Asia, see (Ernst 2004).

moreover, has been based on a similar set of institutions” (Amsden 1989. P. 4. Italics added.)

Even the most recent proponents of the developmental state theories bow to the notion that common timing necessarily means a common model of development.⁸

Gerschenkron’s model provides the basis for a more recent version of the late development theories, the developmental state theory. Most writers in this tradition focus on the rapid growth of Japan after WWII and on the rise of the Asian Newly Industrialized Countries (NIC), also known as the Tigers or the Dragons. The latter group of states has been described as late-late-developers. One of the pioneers of this approach was Chalmers Johnson (Johnson 1982). Johnson situated the industrial and economic growth of Japan as a part its national-political struggle and development process.⁹ In *MITI and the Japanese Miracle*, Johnson uses Gerschenkronian logic to argue that what enabled Japan to attain such rapid growth after its devastation in the Second World War was a unique developmental agency called the Ministry of International Trade and Industry (MITI). MITI, argues Johnson, acted as a pilot agency. It not only strategically planned the development of Japan, relying on the fact that both the technologies and the major markets for its final products were already well developed, but also used control over foreign exchange to encourage the entrance and growth of a few large conglomerates to compete in each of the strategic industries chosen.

Hence, Johnson argues, the fact that the Japanese state had internal cohesiveness, a capable bureaucracy, and *a specific structure* with a pilot developmental agency, allowed Japan to become a plan-rational-economy, enabling it to generate an export-

⁸ See, for example, (O’Riain 2004. Pp. 6-8), or Amsden proposing the same theoretical argument in her recent works (Amsden 2001. P 2.)

⁹ Woo-Cumings elaborates to great lengths on the intimate connection between the developmental state and its growth as part of the socio-political efforts of nationalism and state building (Woo-Cumings 1999).

oriented catch-up industrialization that has been the basis for its “economic miracle” after World War II.¹⁰ Some writers have applied Johnson’s arguments to South Korea. Others claim that Taiwan also used a similar strategy even if in a less state-controlled way (Amsden 1989; Amsden 2001; Amsden and Chu 2003; Cheng 1990; Cheng 1993; Fields 1997; Kohli 1994; Park 2000; Wade 1990; Woo-Cumings 1991).

In sum, the developmental state theories have built on Gerschenkron’s theory of relative backwardness to present a model of development that emphasizes the role of the state in a national effort of creating an export-based industrial system and facilitating industries that excel in technology transfer-based catching-up. Thus, they advance an argument about the need for *specific state structure* that enables emerging economies to utilize *a particular strategy* of development. This is a strategy of state-led development based on long-term industrial planning, and the nurturing of a few big industrial conglomerates operating across a broad array of industries with some managed competition. This creates a system that tends toward large investment in the latest manufacturing technologies to reach scope and scale. Its underlying assumption is that industrial development is achieved by the growth of a few big vertically integrated firms that manufacture complete products and are not only competing among themselves, but are also able to directly compete with foreign companies in the world markets.¹¹

The industrial systems that are built as a result of these policies are systems that foster industrial research that focuses on: (1) improvement in process and manufacturing technologies; and (2) incremental changes to products and technologies originally

¹⁰ For a recent article that also argues that the development agency needs to be a “pilot” agency, contending that in order for developmental policy to succeed there is a need for a “nodal” development agency with power over other agencies, see (Chibber 2002).

¹¹ Parts of this version of this economic growth theory have been sanctified by the World Bank (WB 1993).

innovated and designed elsewhere. Moreover, this model of development is based on the assumption that advanced economies are willing to grant the emerging economies access to their market and to their technologies, even when their trade balances with the same emerging economies are deteriorating. In addition, a key element in all these theories is a particular model of professional elite bureaucracy, as was idealized by Weber (Weber 1952; Weber 1958; Weber 1999).¹²

None of the assumptions of this model hold in the case of R&D intensive and RIB industries. First, looking at the industrial landscape, the market is not already well developed. Therefore, strategic planning by the state, based on the fact that both the products and their markets are defined, is not as useful. Second, the rate of technological innovation is so fast that industrial systems based on incremental innovations on technologies and products developed elsewhere find it difficult to compete and develop comparable products quickly enough. Third, products are no longer being manufactured by vertically integrated firms. Many of the leading MNCs in all industries, American as well as European, are shedding most of their manufacturing capacities and moving to manage a global production network where products are manufactured by stages in geographically distant locations. Finally, when the industry itself becomes the creation and rapid application of new technologies, a strategy that is based on catching-up and massive long-term investment in large-scale manufacturing facilities does not grant such a big advantage. Chalmers Johnson noted this in *MITI and the Japanese Miracle*:

¹² Among Japanese specialists a disagreement with Johnson's assessment of the state's extreme power and importance evolved. For examples of studies that strongly disagree with Johnson, see (Calder 1993; Freeman 1987; Samuels 1994; Samuels 1988); for examples of studies that only slightly disagree, or even agree with Johnson, see (Anchordoguy 1989; Chinworth 1992). Nonetheless, all these studies agree with the basic Gerschenkronian model of industrial growth and all agree that the state was highly important in the development of the industry in Japan.

“When there is confusion or conflict over the overarching goal in a plan-rational economy <developmental state>, it will appear quite adrift, incapable of coming to grips with basic problems and unable to place responsibility for failures... Generally speaking the great strength of the plan-rational system lies in its effectiveness in dealing with routine problems” (Ibid. pp. 22).

The relative economic stagnation of many of the Asian NICs and Japan toward the end of the 1990s, their difficulties to succeed in more innovative industries, and even more importantly the realization that under the new international conditions and the rise of China it would be difficult for other nations to emulate their growth strategies, brought a new version of the development state theories to the fore. Proponents of the neo-developmental state theories, building on earlier research by critics of the strong developmental state theory like Richard Samuels, or on the revised theories offered by some of the developmental statist themselves like Peter Evans, proposed a restructured theory of state-industry interaction in industrial development (Amsden and Chu 2003; Ansell 2000; Calder 1993; Chibber 2002; Chibber 2003; Evans 1995; O’Riain 2004; Samuels 1994; Samuels 1988). The adjectives describing this newly found category of developmental state proliferated. However, be it “the flexible developmental state,” “the neo-developmental state,” “the developmental networked state,” or “the embedded autonomy industrial bureaucracy,” the same broad model is advanced.

This model suggests that for a state to initiate successful industrial development, especially in a technologically intensive industry, it must cultivate interaction and a dynamic division of labor with the local industry. The state needs to: (a) have and retain ability to make and implement decisions in the national interest; (b) be informed about the needs, abilities, and difficulties of the industry so it can tailor its policies accordingly and refrain from policy initiatives that limit the ability of the industry to develop

capabilities on which it can base long-term growth; and (c) change its policies in tandem with the changing needs of the industry. Rather than long-term planning, the state needs a flexible structure that enables it to quickly change and implement different policies as quickly as possible when industrial conditions change.¹³ In addition, the neo-development argument implicitly calls for the state to manage a process in which its let the industry gain more and more power to decide its own future as it finds its feet and grows. Hence, the state needs to be able to change its role from that of initiator and leader to that of a supporting actor.¹⁴

However, neo-developmental arguments are all structural, contending that if a state manages to have the *specific necessary state structure* economic development will follow. The main difference between the various neo-developmental statist lies in the specification of the necessary structure, not in the theoretical argument or causal mechanisms.

The neo-developmental statist argue that in order to succeed in the developmental efforts in high technology industries, the bureaucracy needs, first, to have multiple ties with, and embeddedness within, industry and finance.¹⁵ Indeed, recent

¹³ There are some differences among the neo-developmental state theorists, in particular between those who argue that the state should continue to advance national champions, and those who argue for a strategy based around SMEs. It is unclear whether these differences arise because of the different context of location, timing, and industries that the different writers researched. However, in the critical part of theorizing about the optimal role and behavior of the state in its attempt to spur the growth of high-technology industries and in their treatment of the state for all practical purposes as a unitary actor, the authors are similar enough to be treated as advancing one model.

¹⁴ The reason why I argue that this point is implicit and not explicit in the neo-developmental state theories is that while some writers, for example Peter Evans, present a typology of the different roles of the state, none of the neo-development statist pay enough attention to the political process of the state initiating the creation of the industry and then managing its own retreat from a commanding and planning position to a more supporting and less controlling role. Nonetheless, these exact political processes determine both whether sustained success is achieved, and how different models of industrial systems are shaped.

¹⁵ As such the neo-developmental state theorists are different from the earlier critics of the strong developmental state argument, such as Samuels' model of the politics of reciprocal consent. These earlier critics' main aim was to re-inquire into the exact roles of the state and the nature of state-business relations

writers in this line argue that the main attribute of a successful developmental-state in the 1990s was its network structure. They argue that the ability of the state to successfully motivate industrial development stems from a structure where different agencies are embedded into different social-industrial-capital networks (Ansell 2000; O'Riain 2004). Second, the bureaucracy needs skills that enable it to understand the complex and changing needs of a highly technological industry. These two requirements means that we can no longer view the developmental bureaucracy as an ideal-type Weberian bureaucracy with long stable career patterns and skills and capabilities that are taught solely within the organization. In addition, if the arguments are that: (a) the developmental agencies need to be able act independently from other state agencies; and (b) that the developmental agencies need to be flexible and dynamic, constantly changing their policies in step with the needs of the *specific and different industries* each agency aims to nurture, we must also change our view of the state.

No longer can we view the state as a unitary actor. The neo-developmental theories lead us to focus on specific parts within the organization of the state and analyze each one in line with the specific policy domains and industrial sectors we study. If we are to follow the neo-development arguments to their ultimate conclusion, the state itself is to be viewed as multiple groups of development bureaucracies each with unique capabilities, structures, powers, and embeddedness within society. Indeed, even a cursory

in the development of industries that are not based on rapid innovation, at a period before the advent of globalized fragmented production, not to propose a new model of the developmental state suitable for RIB industries (Samuels 1988).

look at Ireland, Israel, and Taiwan reveals three very different bureaucratic structure and cultures, therefore, very different politics of industrial development.¹⁶

Nonetheless, the new developmental state theorists, in much the same way as the old development statist, still portray the state as a unitary and under-defined variable: the state is portrayed either as a success, and therefore a flexible/networked/embedded developmental state, or as a failure, and hence not a neo-developmental state. An example is Sean O’Riain’s recent study of the Irish software industry, where he defines a flexible development state:

“The flexible developmental state (FDS) *is defined by its ability* to nurture 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 2000, my italics)

The tendency toward a success or failure definition of states is the result of two common traits of recent studies. The first is the use of either a macro level of analysis of industrial development, or the use of partial sectoral analysis looking at one specific industry or region and generalizing to the national level. The second trait is the tendency to focus on either successes or failures without an attempt to analyze these at the micro level. This tendency can be attributed to the under-defined nature of the neo-developmental state concept and the need to classify the cases studied using the dependent variable. This is true even in studies that urge us to look at the different bureaucratic constellations of agencies and power.

¹⁶ Just using the simple Evans-Ruach measurement of “Weberianism” in the structure of the bureaucracy in regards to meritocratic recruitment and career patterns reveals some surprises. While Taiwan and Ireland score very high (12 and 12.5 respectively on a 14 point scale), Israel’s score is relatively low 7 (Evans and Rauch 1999; O’Riain 2004. Pp. 145-146). Israel’s score equals that of Morocco and Turkey, and is below that of Mexico, Brazil, Sri-Lanka, and Egypt (Ireland’s score was evaluated by a different study using the Evans-Ruach measurement, an evaluation which is strengthened by our own analysis, see Chapter Four of this book). This result suggests that the strong coherent Weberian bureaucracy hypothesis does not hold a lot of generalizable explanatory power over the three cases. This is before we even noted the fact that bureaucracies are very different in their tradition and social role, as well as the social origin, educational background, and influence on the political decision making process of their members.

Thus, for example, Vivek Chibber, comparing the development efforts of India and South Korea, argues that the Korean state was successful and that the Indian state was a failure. He does so even when arguing that the Korean development efforts were successful because the Korean state had a “nodal” development agency with power not only over the industry but also over other agencies. Thus, even with an argument locating the reason for success at the level of industrial agencies and constellation of power within the state, Chibber still treats the state as a unitary actor and industrial success as a binary success or failure variable (Chibber 2002).

This is surprising because the neo-developmental statist arguments strongly suggest that the same state, having a structure where different agencies are embedded into different social-industrial-capital networks during their attempts to nurture different industries, can both succeed and fail in different sectors. It is quite possible that it is no longer the “state” that is neo-developmental or not, but different parts of it. If indeed there are many ways to organize the ties between the state and the industry, many ways in which to organize R&D efforts, and no way in which to fully and strategically plan the industrialization process, then industrial systems that grow out of these diverse efforts will be different. The neo-developmental statist, however, still propose one “best” model of development and focus their explanations around specific state structures. Therefore, their argument marginalizes the importance of politics. They do so even when their own arguments, suggesting the possibility of many different ways of organizing and managing the industrial development effort, undermine the one best practice argument in the case of R&D intensive industrialization.¹⁷

¹⁷ For example, Sean O’Riain, a neo-developmental statist who specifically looks at the growth of SMEs in the software industry of Ireland, still argues for one specific model of development and state behavior that

Another way in which the neo-developmental statisticians diminish the role of politics in their theories is by not accounting for the dynamic process of co-evolution within which the state builds its “networked structure” and embeddedness. Even if the argument is that there is only “one” best way to be embedded, then it is important to explain how this embeddedness is taking place. It becomes crucial to explain this once the assumption is that there is more than one way to be “networked” and that the different ways in which the state get embedded with industry have long-term consequences. Ignoring the politics of state-industry co-evolution is a significant oversight in the case of emerging economies. Since private industry lacks the skills, the capital, and sometimes the will to enter new high-technology industries, many times the first and foremost role of the state is to directly intervene and create the industry. Hence, it is imperative for sustained industrial growth that the state manages the dynamic political process of moving from a position of hierarchical power into a position where it acts more as the supporting actor. These processes are critical in molding the final shape of each particular industrial system, and as such they need to be accounted for.

Since the old and neo-developmental state theories are not focused on explaining the various outcomes of diverse industrial policy regimes, they do not supply tools to understand and predict these differences and to gauge their influence and importance. Instead, their main efforts are devoted to showing the importance of the state in industrial development and to distinguishing their model of state-industry interactions from that of the old development state theories. Indeed, “The State” might have been brought back “in,” but only at the price of throwing politics “out” (Evans et al. 1985).

he terms either as Flexible Developmental State or as Developmental Networked State, which is different than the old developmental state model that he terms Bureaucratic Developmental State (O’Riain 2000; O’Riain 2004).

Finally, the neo-developmental state argument proceeds without attention to the radical ways in which industrial production has changed since WWII, although these writers claim to explain growth in post-Fordist industries. Recall that the old developmental school was built around the coherent Gerschenkronian institutional theory of industrial development in relatively backward societies, and was built on an understanding of industrial technology and production management. Thus, the old developmental-state school not only explained but also predicted a whole set of complementary institutions seen in many successful NICs, such as high saving rates and the strategy of industrial conglomerates-based growth. In contrast, the neo-developmental statisticians do not propose or integrate a theory of economic and industrial development. This explains why writers in the developmental state tradition can not account for a particular set of institutions arising in a specific society or industry, nor for how certain institutions influence economic growth trajectories and behavior in global markets.¹⁸

This is a major lapse in the neo-developmental state arguments as it also denies them one of the mainstays of the developmental state theories - the intricate explanation of the specific ways in which developmental states' control over finance allowed them to influence industrial development (Zysman 1983). Many developmental state writers have gone as far as to call control over finance the “nerves” of the developmental state; others have argued that answers to questions about financial resources and policies provide the best indicators for states' ability to realize industrial goals (Evans et al. 1985; Woo-Cumings 1991; Woo-Cumings 1999). It is a glaring omission that the neo-developmental

¹⁸ For example, high saving ratios, industrial banks, conglomerates-based industrial development, and employment regimes.

school does not have a coherent theory of how states' different financial initiatives shape the growth of different high technology industries.

As a tradition of research that grows from an institutional theory of national industrial and economic growth, the neo-developmental-state theorists lack a systematic understanding of how recent and radical changes in industrial production change industrial growth. Without such a theory, it is not possible to explain how policies interact with the markets and with private industry to produce specific institutional systems that foster the growth of technological industries with specific capabilities.

Globalization as Fragmentation – Global Production Network Theory

The intensified movement of capital, trade, services, and, to some degree, people across national borders, starting in the 1970s, gave rise to a multitude of studies. Of these, a specific line of research that tries to understand the international reconfiguration of industrial activities is of particular interest. Pioneered by economic geographers, these studies highlight two interlinked novel features of the latest globalization: the growth of worldwide production networks, and the growing fragmentation or 'deverticalization' of the production process. Interestingly, this process is accompanied by a new pattern of geographical industrial clustering, that of similar activities of the production process (Arndt and Kierzkowski 2001a; Feenstra 1998; Gereffi 1994; Gereffi 1996; Sturgeon 2000; Sturgeon 2002).

Today we see rising spatial specialization in particular stages of the product manufacturing chain and a rising international inter-firm (not just intra-firm) trade in components (not only in final products). Within the electronics industry, for example,

there has been a major transformation in the way final products are manufactured and sold. In the US, new leading companies such as Dell, Sun, Cisco, or Microsoft's Xbox division do not even have their own manufacturing facilities but concentrate on R&D, high-level product design, sales, marketing, and, at most, final assembly. Old companies such as HP (and Compaq before their merger), 3Com, and IBM have been shedding a large percentage of manufacturing capabilities and opting for manufacturing outsourcing. Even components such as hard-drives are now manufactured in discrete stages in different locations globally (Gourevitch 2000; Kenney and Florida 2004; McKendrick et al. 2000; Sturgeon 2000; Sturgeon 2003). In addition, a whole new class of high-technology companies – the fabless IC design houses – rose to prominence without ever having a manufacturing facility for their own chips.

Many writers use the term product chain to describe this growing 'de-verticalization'. However, product chain may imply linear manufacturing processes of specific products from basic inputs to final assembly. The reality, however, is of manufacturing processes built from multiple relationships between suppliers, each with different power structures between actors involved in the production of numerous products. These products may be the final products and/or components for other products. For these reasons I prefer to use the term production networks which implies many suppliers with different relationships producing multiple products. Especially in the case of the IT industry, the term global production networks describes reality much better than product(s) chain with its linear implications.¹⁹

¹⁹ For papers outlining the different terminology used in the literature, see (Henderson et al. 2002; Sturgeon 2001).

There are many causes of the growing fragmentation of production: lower transportation costs, lower telecommunication and information costs that in turn decrease the cost of off-site coordination and control, technological advances that enable the codification of component manufacturing and allow off-site manufacturing, and the de- and re-regulation of trade. This fragmentation process has also been the cause, and in turn is further expanded by, the de-linking of the innovation, design, and marketing and sales processes from the production process. The de-linking of production stages is now evident in almost every industry in the world, from textile to auto manufacturing, and from tool making to electronics (Fuller et al. 2003; Gereffi 1999; Gereffi and Korzeniewicz 1994; Herrigel and Wittke 2004; Sturgeon 2000; Sturgeon 2003; Sturgeon and Lester 2004; Yeats 2001).

The growth of the global production network raises questions about its effects on developmental strategies of nations and regions (Arndt and Kierzkowski 2001b; Bathlet et al. 2002; Gereffi 1999; Gereffi et al. 2004; Henderson et al. 2002; Ruane and Gorg 2001; Sturgeon and Lester 2004). It is becoming more and more apparent that what is moving from country to country are specific phases of production, rather than the production of complete products, but of. Thus, product-cycle theories, which predict that as products and industries become old and commoditized they will move from the more advanced economies to the less developed, are becoming less relevant (Akamatsu 1962; Cumings 1984; Vernon 1966).

This fragmentation not only occurs in production, but also in R&D (Dunning 1994; Gassmann and von Zedtwitz 1999; Gerybadze and Reger 1999; Pearce 1999; Reddy 2000). A study by the MIT Industrial Performance Center analyzing the results of

two surveys conducted in 1991 and 1999 on all the companies in Western Europe, Japan, and the US, with R&D expenditures topping \$100 Million in 1991 current dollars (totaling 244), found a remarkable growth in the tendency of big companies to rely on external sources of R&D. While in 1991 less than 10% of American firms, 20% of European, and 40% of Japanese reported a high reliance on external sources for R&D, by 1999 the figure was above 80% for *all surveyed firms*. Moreover, the geographical range and distance of firms' sources of R&D had also grown tremendously. If the average of the percentage of total R&D activity outside the home region was 26.8% for European companies, 24.3% for American, and 4.6% for Japanese, in 1999 European and American companies reported estimates of over 33% of total R&D done outside the home region and Japanese companies reported over 10% (Roberts 1999).

There has been no study that systematically examines how product fragmentation shapes the development of emerging industrial countries. Such an account would need to explain why some activities occur in specific locations, as well as to clarify whether particular development strategies resonate better with specific stages in the global product chain. There are many calls for research on the effects of global production networks on economic development. Nevertheless, what the literature offers are only suggestions for research frameworks on the governance and power relations in different types of product chains, or case studies about particular industries in specific locations.

A promising point of departure is to look at the two dynamic processes that reinforce fragmentation: production stage specialization and capability building, and production stage economies of scope and scale. These are the main reasons for the rapid diffusion of fragmentation and the growth of global production networks. If we can

analyze them to gain understanding of how different emerging countries' industrial policies give these countries advantage in specific stages of production, we will have the beginning of an answer.

“Production stage economies of scale and scope” is the term I use to describe the process by which, once a specific production chain fragments into discrete stages, suppliers in each stage, by pooling the demand of many customers, create economies of scope and scale that in-house manufacturing divisions cannot. These economies of scope and scale enable suppliers to become more efficient and allow them to operate on levels of profit margins that are significantly lower than those achieved by in-house manufacturing divisions.²⁰ This in turn allows them to further lower their prices while offering the same or even higher quality, further speeding the trend toward outsourcing of this stage's manufacturing activities (Sturgeon 2000; Sturgeon 2002).

“Production stage specialization” is the term I use to describe the process by which product fragmentation leads companies to develop superior capabilities in particular stages or components of the product network. A recent example of this in the IT industry are the pureplay foundries. Pureplay foundries, such as the Taiwanese TSMC and UMC, are semiconductor companies that specialize solely in chip fabrication, and whose revenues come from fabricating chips according to the designs of their customers. Such specialization enables companies to become better and more efficient in this narrow set of activities.²¹ It also helps them to acquire specialized capabilities and knowledge

²⁰ One should differentiate between higher overall profits and profits margins. As these specialized suppliers sell vastly large quantities, they can lower the margin of their profits per item sold, while still having overall profits that are higher in-house manufacturing divisions. The best scenario from the point of view of the specialized supplier is becoming so efficient that they can continuously lower their prices per item and still have a profit margin that is as high, or higher, in-house manufacturing divisions.

²¹ In effect this process takes Adam Smith's argument about the division of labor, specialization, efficiency, and the size of the market one step further (Smith 1937, in particular book I chapters 1 and 3).

that more vertically integrated firms could not. These capabilities, once acquired, enable these firms to excel in innovation around the particular production stages and set of components they focus on, using their superior skills and unique knowledge. Over time these two related advantages, in skills and innovation capabilities, grant these companies even more advantages vis-à-vis in-house division of vertically integrated companies. We observe this process both in high-technology areas, for example in the manufacturing of specialized cards or chips for the PC, such as graphic cards or memory chips, and in more traditional industries such as the bicycle where the product chain fragmentation allowed one company, Shimano, to become the innovator and market leader in drive-train components (Galvin and Morkel 2001).

The fragmentation of production and the growth of global product chains suggest that there are multiple entry points and ways to succeed, even in the same industry and even during the same time period. Global production networks allow emerging economies as many different innovation-based entry points to the global IT industry as there are stages in the global IT industry production network. The decisive factors that influence the entry point of each national industry are: (a) the relationship of the industry with global markets, specifically with the MNCs that build, manage, and to a large degree control these product chains; and, (b) the development of capabilities that enable the industry to excel in specific activities that are more or less suitable to specific stages of production. Thus, focusing on the development and growth of global production networks, theories of product fragmentation enable us to formulate arguments as to how different states' science and technology policies build national industries that do better in different production stages. However, we still need to account for how state-business

interaction and the implementation of specific policy regimes translate into institutional systems that, through time, facilitate the development of particular capabilities and skills by private firms and motivate them to employ specific business models. We need to understand how different industrial innovational capabilities are created, maintained, and employed.

Systems of Innovation Theories

From the point of view of the comparative political economy literature, the systems of innovation theories are seen as part of the varieties of capitalism theories. Those theories assume many different models of national economies, each with distinct institutional systems. These systems confer different economic and industrial advantages and disadvantages on companies operating within them. As a result, these companies, in turn, behave differently even when operating in the same product markets and under the same international conditions.

Systems of innovation (SI) theories aim to explain how systematic differences in industrial as well as science and technology institutional systems give rise to industries with specific industrial technological innovation capabilities. SI theories were first developed in the 1980s by evolutionary economists (Carlsson et al. 2002; Edquist 1997; Freeman 1987; Lundvall 1992; Nelson 1993). The writers in this tradition build on Schumpeterian economics and on institutional economic theories. They argue that not only is innovation the main source of long term economic growth, but also that there is a major role for policy in R&D and science. Government has such a major role, they argue, for two reasons: first, the innovation process itself is iterative and cooperative in nature; hence, there is a significant role for public actors (Braczyk et al. 1998; Cooke and

Morgan 1998; Lester and Piore 2004; Morgan 1997; Piore et al. 1994; Piore and Sabel 1984; Teubal 1996; Teubal 2002). Second, scientific research, especially industrial R&D, represents a clear case of market failure. The indivisibility, inappropriability, and high uncertainties of R&D lead private investors to allocate sub-optimal amounts of finance to research under conditions of perfect free competitive market – a clear case of market failure (Arrow 1962; Schumpeter 1961 (1934)).²²

Starting from the national system and later moving to the sectoral, regional, and industrial systems, researchers in this tradition have argued that the different relationships between government, firms, research institutions, suppliers, and customers influence the ways in which new technologies are created and/or diffused throughout the industrial system. The relationships also affect the rates at which new generations of products using the latest technology are produced (Braczyk et al. 1998; Breschi and Malerba 1997; Lundvall et al. 2002).

The main mechanisms by which these constellations influence firm behaviors are, first, by shaping firm capabilities, especially their dynamic economic capabilities and innovation production/absorption capacities, i.e. capabilities to produce new products and technologies or to infuse new technologies into their existing products and manufacturing systems (Carlsson and Eliason 1994; Carlsson et al. 2002; Cohen and Levinthal 1989; Cohen and Levinthal 1990). Second, institutional structures influence firm behavior by offering different opportunity structures and different resources which influence the profitability of certain activities (Carlsson 1995; Carlsson and Eliason 1994; Giuliani 2002; Morgan 1997; Teubal 2002; Teubal et al. 1991). Thirdly, institutional structures

²² Market failure is defined as a case where due to lack of information or the specific characteristics of the industry/activity, we should expect the private market to allocate a sub-optimal amount of resources.

influence firms' R&D behavior by infusing the system with specific research paradigms and business models that move certain R&D activities and procedures to the forefront and others to the background (Dosi 1982; Samuels 1994).

There are two main strands of SI theories. The American strand of SI focuses more on the influences emanating from the different ways in which R&D is organized and financed (Nelson 1993). The European school, originated at Aalborg, has been more focused on explanations based on backward links between producers, and on the flows of information from users (or user sectors) to producers, and has a stronger emphasis on the role of the quality of demand on the development of capabilities (Lundvall 1992; Lundvall et al. 2002).²³

SI theories argue that three main variables explain the amount and sophistication level of industrial R&D of each system, all intimately connected to the fact that industrial R&D is a semi-public good. The first variable is the location of industrial R&D activities within the industrial system. The levels of industrial R&D sophistication and capabilities are different if most of the industrial R&D is conducted by the firms themselves, or by public and semi-public organizations like research institutions and universities. SI theories contend that there are major differences between systems depending on the location (public or private) and the identity of the agents that typically conduct most of the R&D. While most SI writers do not deal with these issues in detail, SI theories suggest that the more R&D is conducted by private firms, the more private industry develops sophisticated R&D capabilities.

²³ For an excellent example of a theoretical model for the importance of the creation of a users-innovators community to the successful implementation and continuous improvement of new technology, see (Teubal et al. 1991).

The second variable is financing. Different financing modes affect not only the location of R&D activities, but also the focus (time horizons and product versus process innovation) and amount of industrial R&D. SI theories, again, do not fully elaborate their arguments on the subject but suggest that differences between public and private financing, the financial gains that investors are looking for, and the origin of the financiers directly influence the R&D capabilities and business models employed in each industrial system. The more resources for innovative product R&D are available, the argument goes, the more R&D is conducted and the more sophisticated capabilities are developed. Similarly, the more there are sectoral limits on R&D activities, which inhibit the development of broader or multidisciplinary capabilities and knowledge, the more the scope of R&D capabilities will be limited. Finally, the more financing is linked with global capital and exchange markets, the more investors will seek financial exits that allow them to channel the profits back home. Accordingly, foreign, or foreign-financed VCs will push firms into business models that aim at either going public on the leading stock exchanges or being bought by an MNC. As these tend to utilize a business model emphasizing new product innovation, SI theories imply that the more the local industry is dependent on global VC financing, the more the industry will focus on product innovation and follow a business strategy aimed at foreign IPOs or merger and acquisition deals.²⁴

The third explanatory variable highlighted by SI theories is the industrial opportunity structure. By industrial opportunity structure I mean the composition of the

²⁴ SI theories usually do not pertain to the important national difference between the regulation of venture capital and stock exchanges. Thus, while they argue for a more general observation, claiming that VC financing leads to the rapid diffusion and use of American-like start-up businesses models, I prefer to refine their argument. Thus, I claim that only VC funds whose source of finance is the global capital markets and are linked to the leading global stock exchanges.

local industry, including the links between producers, between producers and customers, and the links of the local industry with the global production networks, in particular with the MNCs that control them. Different opportunity structures affect the capabilities and business models employed by firms by giving different industrial systems access to different information and skills, as well as by giving each local industry different sets of customer focus, business prospects, and market niche openings. A critical factor in this configuration is the local leading companies. In addition, as the main market for IT has always been the US, and as American MNCs (with some exceptions) also control the global markets, a key to understanding the different opportunity structure is to look at the different relationship that the local IT industry has with these MNCs, both inside and outside national borders. This has become especially true with the growing fragmentation of production.

MNCs (and leading local firms) are critical for the overall skills and capabilities composition of each national IT industry for a few reasons. First, MNCs and local leading companies are the main customers of new local IT companies. Secondly, MNCs are important for the local IT industry as key actors in the transfer and development of two critical spheres of skills and capabilities. First, the R&D labs of MNCs develop products and components on the technological cutting edge. Consequently, they are a major source of cutting edge technological information and knowledge, and, even more importantly, world-level R&D-conducting capabilities into the industrial system in which they operate. Second, MNCs are the best organizations in the world in designing and developing new products. Therefore, their R&D divisions diffuse into the industrial

systems within which they are located the skills and capabilities needed to design new products as well as better knowledge of the customers in the final market.

For these reasons, major differences in industrial development patterns are to be found in IT industries that have different leading companies and different relationships and links with the leading MNCs. If the MNCs' subsidiaries and leading companies within a specific country are conducting manufacturing activities and focus on process and manufacturing innovation, then their outputs into and inputs from the industrial systems are significantly different than if most of the MNCs' subsidiaries and leading local companies conduct critical R&D activities. Thus, the outputs MNCs and leading local companies seek from local firms, the inputs they put into the local industrial systems, as well as the ability of local firms to sell their own products and services to these MNCs globally, are different depending on the activities MNCs perform locally.

In the case of MNCs' manufacturing, subsidiaries, local firms might find it easier to sell manufacturing services or become components suppliers to MNCs, than to become suppliers of new technologies and innovations. In addition, the inputs of the leading domestic companies and MNCs into the local industrial system would be focused around manufacturing and process information and skills, including critical innovational capabilities around these activities. For the same reasons, local firms will find it harder to sell the same MNCs new technologies and the MNCs will diffuse less R&D and fewer product design skills and capabilities into the local industrial system.

In short, the global production network and the system of innovation theories give us a better understanding of the institutional underpinning of industrial development and innovation in a world of geographically fragmented industrial production. Using

these insights, together with the lessons we have learned from late development and development-state theories, we can now develop a more comprehensive argument about the role of the state in the development of RIB industries in emerging economies.

Building the Theory

This book develops an approach to understanding the role of the state in industrial development in a world of globalized fragmented production. It does so by presenting arguments about the roles and structure of the state in the development of high technology industries in emerging economies. Hence, we first need to explain how states can organize and interact with private industry to promote the growth of innovative high-technology industry, and to explain the political process of this interaction. Second, we need to explain how specific policies and state-business interactions produce different national industrial systems within the same industrial sector.

A New Model of RIB Industrialization Politics

Analyzing late development and developmental state theories, we noted that, in the development of high technology industries, the state should act as the flexible facilitating agent, and not as an overall commander. The state should no longer methodically plan the development of strategic industries by choosing specific products and product niches, forcing private companies to enter them and supplying some of the necessary finance and technologies. Instead, the state should concentrate on creating more broadly defined technological capabilities, and focus on motivating private agents to work in these areas and collaborate with each other and with the state. The state role is no longer seen as one where it makes the decisions and compels private companies to

follow them, but rather motivates private companies to make long-term commitments to operate in RIB industries and activities. This argument is an opposite one to the strong developmental-state argument that gave the state the job of long-term planning and control over the industry. The neo-developmental statist argue that, in the case of RIB industrialization, the state needs not only to spur the creation of the industry, but also to quickly grant the industry control if not full jurisdiction as it develops. At the same time, the state still needs to retain enough knowledge and skills to devise and implement policies that help the industry to grow and maintain its competitiveness in the world of constant technological change.

The state is pictured as the national management consultant and central arbitrator and promoter of the industry, with the distinction between public and private roles and power becoming more ambiguous. State-industry relations are described as a division of labor of the tasks each side takes to reach the same national goal of economic growth. In this way the state is seen as embedded, i.e., as an important agent, but not the overall leader, in a network of private and public agents that together makes the industrial system.

However, the neo-developmental arguments are still: i) structural in claiming that one specific structure of the state (differently named by different authors) has all the explanatory power; and, ii) aggregate in treating the whole state as either developmental or not. However, often success in one sector does not implies success in others, a point that the neo-developmental statist tend to neglect. Moreover, they still hold to the old timing logic of the Gerschenkronian argument – that the timing of the beginning of the rapid industrialization efforts inherently imposes only one successful model. For

example, Alice Amsden argues for one specific mode in which “the rest” can industrialize, and Sean O’Riain sees Israel, India, Ireland, and Taiwan as representatives of the same model of a developmental state (Amsden 2001; O’Riain 2004).

In so doing the developmental statist marginalize politics in several ways. First, by maintaining that the explanation lies in a particular state structure, the neo-developmental statist repudiate the importance of specific policies, as it is no longer the policies that make the difference but the overall bureaucratic structure. At the same time, structural explanations also negate the importance of selecting between alternatives, as the only choice left is of either selecting the “correct” alternative or dooming oneself to economic backwardness.

Thirdly, the neo-developmental arguments disregard the importance of sectoral politics. By looking at the aggregate level and describing whole states as either successful or not, the neo-developmental state theorists cannot explain how embeddedness develops in the first place. Consequently, neo-developmental statist disregard the importance of politics in determining the success or failure of the sectoral state-industry co-evolutionary process. Moreover, looking at the aggregate level and advancing one form of state-structure, the neo-development statist evade confronting the realization that their own arguments suggest that there are multiple forms of embeddedness, each leading to a different industrial system. Accordingly, failing to notice that what determines both sectoral success and failure and the mode of success, are the politics of state-industry co-evolution that leads to each form of embeddedness. For example, there is nothing in the neo-developmental argument that would help explain why the Taiwanese hardware industry flourished while the software industry languished, although the two sectors had

the exact same formal bureaucratic structures of state-industry embeddedness and rules of conduct.

Fourthly, the neo-developmental statisticians suggest that there are many differences between the developmental bureaucracies of different states, their policies, and the ways these policies are implemented. Nevertheless, they do not explain these different modes of state-industry embeddedness and bureaucratic structures and cultures bring about different trajectories of industrial development. *This book aims to propose explanations of this phenomenon.*

Lastly, although these writers claim to explain growth in post-Fordist industries, the neo-developmental state argument proceeds without attention to the radical ways in which industrial production has changed since WWII. The neo-developmental statisticians cannot account for a particular set of institutions developing in a specific society or industry, nor for how certain institutions shape economic growth trajectories and behavior in global markets. *Our framework aims at rectifying this gap by utilizing insights from the systems of innovation and global production networks theories.*

Therefore, there is a need for a new model that delineates the role of the state in the politics of industrialization. This theoretical framework should build on the neo-developmental state arguments, taking into account the multiple ways in which successful development can simultaneously take place within the same industries; accordingly there are alternatives, with different consequences, to create and from which to choose.

The idea of network development can serve as our basis. My framework proposes that, in successful cases of RIB industrial development, state agencies will first aim at creating a set of firms and industrial actors, and then seek to develop a thoroughly

multiplexed network among these actors, and between these actors and the international financial and production markets and networks (Ansell 2000; Locke 1995; O'Riain 2004; Teubal et al. 1991). What I expect to find in successful cases of RIB industrial development are, *different political processes*, in which the state's first role is as a key actor in the creation of a network. First, a more hierarchical network, and then in the course of co-evolution, I expect to find the network becoming denser and more heterarchical/polycentric and international, with the state moving from a position of controlling the network to a position of centrality, i.e., an important node within a bigger and much more multiplexed, larger, and diffused network. Consequently, the state's main role becomes more that of a facilitator-organizer, rather than of an overall commander. Further, I predict that the different ways local and sectoral *politics* shape the development of these networks will vastly influence the industrial structure and capabilities.

In cases of RIB industrial development failure, I expect to identify two different kinds of failure. The first occurs because of the inability or unwillingness of the state to facilitate and participate in the growth of this industrial sector. An example for that kind of a failure would be the state ignoring the industry, largely refusing to participate in its growth, or to channel the resources necessary to that effect.

A second kind of failure is anticipated when the state actively participates in the creation of the network, but then resist the relinquishing of its own power, trying instead to retain its position of power and control, aiming to maintain hierarchical relationships with private industry.

To successfully manage the dual staged process above, the state needs to acquire two assets: (1) sufficient technological and scientific skills, knowledge, and information

to make informed decisions in the case of ever more complex industrial technologies development; (2) multiple relationships with the industry that enable the development agencies to be constantly informed about the shape and needs of the industry, as well as to implement its decision without resorting to coercion. Moreover, it needs to have and preserve its ability to make decisions independently. As I noted earlier, acquiring these two assets, managing these transitions, and developing the needed industry-state co-evolution processes suggest a model of the state that is incompatible with the Weberian model of the ideal-type bureaucracy. In addition, as there are many ways to acquire the needed skills and create embeddedness within the industry, as well as many ways to manage the relationship with the industry, even within the same state, it follows that there are many different models of the new development state.

We can now propose a new model of successful state efforts for RIB industrialization. The new model suggests a bureaucracy that is less Weberian and isolated, but much more fragmented. However, it is also more technologically and scientifically knowledgeable and skillful, and closer to industry. The state's structure should allow the developmental agencies to react quickly to the needs of the industry, allowing the state to be the facilitator, but not overall commander, of industrial development. Thus, while the old model conceptualized the state as a unitary actor with personnel recruited, trained, and indoctrinated within the bureaucracy, the new views the state less as a monolith and shifts attention to its different agencies. It follows that differences in the ways the bureaucracy is constructed, the social origin and educational background of its personnel, and its ability to shape the decision making process must be analyzed.

There are many ways in which the developmental bureaucracy can acquire the needed skills and embeddedness within industry. One approach is for the state to be involved as deeply as possible into the industrial R&D process bringing the technology creating agents into its own structure. Of the three cases, Taiwan’s strategy of utilizing two state-controlled public research institutions – the Industrial Technology Research Institution (ITRI), and the Institute for Information Industry (III) – as the main impetus for IT industrial growth, is an example of such strategy. A second approach is to create a development bureaucracy with porous borders and employ a “revolving door” recruitment and training strategy, enabling scientists and industry leaders to move back and forth from state to private industry. Of our cases, the way in which Israel’s main developmental agency – the Office of the Chief Scientist in the Ministry of Trade and Industry (OCS) – has been structured, is an example of such a strategy.²⁵ The third approach is a variant of the second, in which the state attempts to preserve the cohesiveness and Weberian principles guiding the developmental agency by creating specific subunits, usually with more limited or advisory role, in which regular recruitment and training procedures do not apply and into which industry insiders are recruited on a temporary basis. Of our cases, Ireland’s utilization of such subunits, of which the National Software Directorate has been the most influential, within a larger development agencies – the Industrial Development Agency (IDA) and Enterprise Ireland (EI) – that embodies Weberian ideals, is an example for the use of that strategy.²⁶

The new framework differs from the old in the ways in which the developmental agencies create, conduct, and maintain their relationships with industry. In the old model,

²⁵ Since 2003, the Ministry is called the Ministry of Trade Industry and Employment.

²⁶ Since 2003, the National Software Directorate has been renamed the National Informatics Directorate.

the development-state was portrayed as having strong relations with the leading big firms. While dialogue was maintained, the state had the authority and responsibility of guiding and controlling the industry's development. In the new model, the state aim is to become embedded within the industry, industry-state dialogues are to be between equals, and the state's role is more of a facilitator than a planner and overall leader. However, unlike the old theories, which described a fairly straightforward relationship and power structure, there are many ways in which the state can accomplish its roles and create the relationships that the new framework emphasizes. The shaping of these choices is done through a constant political process.

The choices available to the state can be conceptualized along two related continua. On one end of the first continuum, measuring control, are attempts by the state to get maximum control over development and direct industrial R&D efforts almost from basic research all the way to specific products. On the other end of this continuum we have a state formulating high technology industry-specific policies only after a few companies have already proved the growth potential of specific sub-sectors, with the state direct assistance limited only to more mature firms. State decisions as to the degree of sectors and technologies targeting, can be conceptualized on a second continuum. On one end are states that formulate policies down to the level of defining specific generic products and technologies. On the other are states that see their role mainly as assisting in the realization of decisions made by private firms, employing horizontal technological policies that are neutral in regard to technologies and sectors (Teubal 1997). In between there are states that target specific sectors, for example software, but do not attempt to target specific technologies or define future products.

In our cases we have an example for the three main positions on these two continuums, both extremes and the middle. On the one hand we have Taiwan, where the state has been targeting specific technologies and products, authorizing and financing its public research institutions to develop them to the stage of working product prototypes and then either deliver the result to the industry, or, spin off the research teams as companies to commercialize the results. On the other hand we have Israel, with a development agency that defined its role as fixing the market failures associated with industrial R&D and maximizing product R&D activities. The Israeli state followed almost ideal-type neutral horizontal technological policies (Teubal 1983). It implemented a policy of giving R&D grants for product ideas developed by private companies and entrepreneurs in every industrial branch, helping companies in all stages of development. In the middle is Ireland, which did not have a specific industrial policy for rapid-innovation-based industries until after the indigenous software industry achieved some success globally. Ireland then restructured its development agencies and policies to focus on specific industries and tailored its financial instruments to companies that, while still young, have already moved beyond the seed stage.²⁷

The last dimension along which the new model of the state is significantly different than the old model is in its role in relation to the global industry and financial markets. In the old model the state had three main roles. The first was to organize and facilitate technology transfer deals from the leading MNCs to local industry. The second was to use its control over foreign currency to shape industrial development, granting it

²⁷ That is not to say that the state was not important in the early development of the industry in Ireland, indeed the then mainly FDI focused industrial agency – IDA – was critical in the industry’s development in the 1980s through its Enterprise Development Plan. However, as the name suggest, the aim of that policy initiative was to develop business in all sectors of the economy, without regard to R&D, and with its main goal still that of job creation.

to chosen firms who were exporting successfully, and denying it to others. The third role of the state was to prevent MNCs from gaining control of too large a percentage of the domestic market, crowding out local infant industries.

In our framework, the state's roles are much more complex. In a world of fragmented industrial production, vertical integration is no longer the sole option, not necessarily the best one. Instead, there are many ways in which the local industry can become a part of the global production networks. In each of these, the local industry needs to develop specific relationships with the MNCs and with the global financial markets, and for each kind of relationship different technological and managerial skills are necessary. In addition, as the local industry is based more and more on indigenous R&D activities, the role of the state in strategically managing technology transfer, while might still prove important in the early stages, is diminishing. These decisions relate to the heart of national politics: questions about national ownership, identity, foreign relations, as well as financial security and independence.

Again it is useful to think about state choices in enhancing the local industry's specific linkage with, and embeddedness within, the global industry and financial markets as two continua. The first continuum looks at the state's behavior toward foreign technology-based firms, in particular the MNCs that develop and control the global production networks. On one extreme, we have states that look at foreign firms as the main mode for industrial upgrading and focus on convincing foreign firms and MNCs to locate manufacturing facilities within their borders. They hope that these firms' subsidiaries, once established, will become embedded within the domestic industry. On the other extreme we have state that focus most of their efforts on convincing MNCs to

locate their R&D labs in their borders, and pay a close attention to the development of specific relationships of local companies with their foreign partners.

On one extreme we have Ireland, which until the early 1990s focused its industrial policy almost solely on bringing MNCs to open manufacturing facilities in Ireland, without paying much attention to creating strong relationships between them and the local industry, either within or outside Ireland. On the other extreme lies Israel. By generating collaborative projects between Israeli IT firms and American companies, the Israeli state has established relationships in which Israeli firms focus on product R&D and their American partners focus on sales and marketing. Israel's developmental agencies have also been attempting to lure foreign firms to open R&D centers in Israel. Taiwan has chosen a middle course, first urging MNCs to open manufacturing facilities in Taiwan, but then goading them into buying a growing percent of their components from, and outsource their manufacturing activities to, Taiwanese companies.²⁸ At the same time, Taiwanese developmental agencies have tried to help local companies produce more components and improve their manufacturing and design services capabilities.

Relationships with global financial markets are better conceptualized along a second continuum. On one extreme we have states that try to link their local industry with global financial markets. They court foreign investors not only to back local firms but also be the financiers of the local VC industry, and encourage local companies to get

²⁸ In 2001, the Taiwanese Department of Industrial Technology (DOIT) embarked on a initiative to specifically lure MNCs to open R&D centers in Taiwan. This initiative has been quite successful with thirteen MNCs opening facilities in Taiwan within two years, and ten more MNCs on the waiting list. Indeed, if this new trend is sustained, and these MNCs would consistently conduct high-level R&D activities in Taiwan, a very interesting future research project would be to gauge their influence on the Taiwanese IT industry after a decade or so of operations.

publicly listed on foreign stock exchanges. On the other extreme we have states that try to limit, as much as possible, the financing of their high technology industry to local investors, and try to limit, if not outright prevent, the public listing of local companies on foreign stock exchanges. In between, we have states that are either less active or aim to strike a balance between the two.

Of our three cases, Israel has done the most to lure foreign VC investors and urge public listing on foreign exchanges. State efforts have been a main cause behind the current situation: the vast majority Israeli start-ups financing, either directly or through local VC funds, is foreign. In addition, Israeli companies all aim to be listed on foreign exchanges, making Israel, with only six million people the state with the largest number of companies listed on NASDAQ other than the US and Canada. On the other extreme is Taiwan, focusing all its technology financing initiatives on the local investment community, and strongly advancing the Taiwanese Stock Exchange. Ireland has chosen the middle road: channeling EU money to the local VC industry, but creating the new funds mostly through local financial institutions.

Different Choices – the Varied Paths of Industrial Growth

Conceptualizing the new model of state-industry relationships helps us to analyze the different ways in which emerging states can structure themselves and their relationship with the local industry in order to nurture and support the growth of high technology industry. We can now consider how the different choices taken by states influence their high technology industrial development path by utilizing our analysis of

the systems of innovation and product fragmentation arguments. Using these insights to explain how in the cases of Taiwan, Ireland, and Israel, specific state policies and behavior has helped to spur the development of different IT industries, as well as the relative success and failure of each subsector within each of the three cases.

Our reading of production network theories highlighted the spatial clustering of similar production activities and the underlying linked dynamics of production stage specialization and production stage economies of scale and scope. These point us to several domains of interest. First, specific industrial R&D, dynamic economic capabilities, and business models are more suitable for certain stages of the production process. Secondly, the analysis of the dynamics of production stage specialization and economies of scale and scope indicates that industrial systems that specialized in specific stage of production tend if successful, with time and effort, to become ever more competitive and innovative in these specific stages. Consequently, if we want to understand the different evolutionary processes of high technology industrial growth we need to: (a) understand how industrial R&D and dynamic economic capabilities are created, improved, and maintained in each of our cases; (b) the growing utilization of certain business models in each of our cases; and (c) understand the development of specific relationships that the local industry has with the global industrial and financial markets.

In the words of the systems of innovations theories we need to analyze the development of industrial R&D capabilities, capacities, and opportunity structures in each of our cases. In order to understand the growth of industrial R&D capabilities SI theories urged us to compare the different location of the R&D conducting agents, the

R&D resources available and the way in which firms are financed, the scope and limits of R&D, and the industries customers and relationships.

As to opportunity structures, with infrastructural variables being more or less equal, two main variables, the industry's customers and markets and the ways in which the industry is financed, strongly affect the business models and strategies firms and entrepreneurs employ. This leads industrial agents to focus on the building of specific innovative and manufacturing capabilities. In a world in which most of the trade in IT is done through global production networks, the relationships that local IT firms have with local leading firms and with foreign companies, especially leading MNC, are one key factor in determining their opportunity structure. The second factor is the sources and forms of finance. For example, in a system in which the main source of financing available to technology entrepreneurs is product-development R&D grants, entrepreneurs and firms would devote much more attention into developing R&D capabilities, than in a system in which the main source of financing is not focused on the R&D stage. In addition, systems of innovation theories argue that the more financing is linked with the global capital and exchange markets, the more investors will seek foreign financial exits. Consequently, foreign-financed VCs will push firms into business models that aim at either going public on the leading stock exchanges or being bought by a MNC.

We can now analyze how different behavior and structure of the state influences the development of the IT industry's R&D capabilities in each of our cases. First, decision by the state on how to acquire the necessary R&D skills are influencing the identity of the agents conducting industrial R&D. The more the state bureaucracy encompassed R&D conducting agents within its structure, the less industrial R&D

activities private firms are encouraged to take. Second, decisions by the state over the level it attempts to control the technological development path of the industry, including decision of how, and who, to finance bear on both the R&D resources available to the industry and the scope of R&D activities taken. Thirdly, state efforts developing the first local leading companies have long-term consequence for the industry's opportunity structure. Similarly decisions that the state is taking concerning the involvement of foreign firms and investors within its national borders, as well as decisions taken whether to enhance specific relationships between local and foreign companies outside the state's national borders affect the resources, the particular feedbacks and information the industry gets from its main customers, and the diffusion and development of specific innovative capabilities.

Following the arguments of the systems of innovation theories, we expect that private firms in the high technology industry of emerging economies will have more limited R&D capabilities where the state tried to control the industrial R&D development path, encompassed the R&D conducting agents within its structure, supplied only limited resources, refrained from urging foreign companies to conduct R&D activities within its borders, and limited the involvement of foreigners as financiers. Diagram II, presents a flowchart of our theoretical industrial evolution framework so far.

However, neither Taiwan, nor Ireland, nor Israel followed these idealized paths. In each case a particular mix of policies and initiatives across these different dimensions has been played out. Therefore, to have the full answer we will have to go into a more refined level of comparison, fully elaborated in chapters three to five. Nonetheless, even a brief analysis along the lines described in our arguments can demonstrate our case.

Israel, Ireland, and Taiwan – the Argument in Brief

Taiwan is the case where the state attempted to firmly direct and control the technological development path of the IT industry. In Taiwan the bureaucracy recruitment is styled on the Japanese model where exams screen the candidates into different management and career pattern (Kim et al. 1995). However, unlike both Israel and Ireland, almost all of the top persons of the development agencies and ministries have Ph.D. in various engineering disciplines. In addition, all the Ministers responsible for industrial development, telecommunications, and Science and Technology policies, have had doctoral degrees in engineering, before and after democratization. The state, already relatively well equipped with scientific experts in its decision-making apparatus, opted to acquire the necessary skills and knowledge for IT industrial development by encompassing the industrial technology creating agents within its bureaucratic structure by establishing two public research institutes, ITRI and III. Nevertheless, Taiwan has also supplied funds for industrial R&D and the state encouraged, even if within its structure, R&D activities on a wide spectrum of technologies. However, where throughout the development of the hardware industry ITRI saw as its ultimate goal the creation of a thriving private industry and has successfully managed its own diminishing role as the industry grew, the situation in software has been different. From its inception, III tried to maximize its control and financial resources, directly competing with private industry. In contrast to ITRI, III has been reluctant to see its power diminish and has continuously competed with the industry. In addition, III focused its strategies and policy initiatives around its own, and not around private industry's, growth. Thus, the case of the

Taiwanese software industry is a case of stage II failure – inability of the state to relinquish its own power over the sectoral industrial system and move from hierarchical to networked mode of governance.

On the local-global relationship front, Taiwan has aimed to help the local industry to excel in supplying components, and manufacturing and design services, to the IT industry's global production networks. Until recently Taiwan steered a middle course in regard to the activities it encouraged foreign companies to conduct in Taiwan. Unlike South Korea, Taiwan encouraged foreign companies to establish manufacturing facilities in Taiwan. But unlike Ireland, Taiwan then pushed these companies to acquire more and more components locally and to transfer the necessary skills and know-how to local suppliers. In addition, Taiwan has been encouraging local companies to be publicly listed on the Taiwan Stock Exchange and not on foreign stock exchanges. It has been targeting almost solely the local financial community as the source for the IT industry's venture capital.

This partial analysis already helps us to understand why Taiwan's IT industry developed in the way it did. Taiwan has an enormously successful hardware industry in which the first leading firms have been focusing on supplying components and OEM manufacturing services to foreign companies. This gave rise to an industrial system, which focuses on 2nd generation, process, and manufacturing innovation, with a division of labor between the state and private firms. The state conducts most of the early technology screening and R&D, and the private companies focus more on final product development. It is an industrial system in which most of the firms are supplying

components and design and manufacturing services to the IT industry's global production networks.

Israel has also been very active in the development of its local high technology industry, but with an almost opposite strategy. The state defined as its main goal the development of an industry with sophisticated, new product-oriented export-focused industrial R&D capabilities. The Israeli state devised and implemented its policies around this notion. The state supplied financial backing to R&D projects developed and executed by private firms and entrepreneurs across the industrial range, without any attempt to direct the industry's technological development path. Israel's bureaucracy never strictly followed the Weberian model. Throughout the years there have been attempts to both professionalize the bureaucracy, and follow the American model of "government of strangers" allowing politician to have more control over their Ministries by bringing with them many of their own people (Bowsher 1991; Deri 1993; Heclo 1977; Pfiffner 1992). The result has been a mixed structure civil service with relative low status and workforce continuity. The OCS is also the best example, within the three national cases, of a development agency following the porous borders and revolving door structure strategy to acquire skills and knowledge. Thus, the chief scientists (the heads of the OCS) have been traditionally recruited outside the agency, with a particularly large number of executives and employees brought on either as consultants or recruited directly from other organizations outside the bureaucracy.

On the local-global front, the Israeli state pushed Israeli and foreign, especially American, companies to form partnerships in which the Israeli firms focused on R&D and the foreign firms on marketing and sales. Until recently uniquely in the less

developed world, Israel focused on trying to convince first and foremost MNCs to open R&D centers within its borders not manufacturing facilities. The state was also actively linking both its companies and its VC industry to the foreign financial markets. We can now begin to understand why in Israel both the hardware industry, and the software following its footsteps in a second stage of growth became equally successful with almost all firms following a similar strategy – industrial R&D leading to either the development of new technologies or new products based on cutting edge technology. Israeli companies positioned themselves as suppliers of new R&D inputs to the IT industry’s global production networks. Israel has become one of, if not the most, prominent locations in which foreign companies and MNCs open large-scale R&D centers.

Ireland concentrated for many years on job creation. The state has also been following a much less active strategy in regards to the indigenous IT industry. While vastly improving the educational, physical, and communication infrastructures, Ireland’s industrial policy focused mainly on bringing foreign companies to open manufacturing facilities within its borders. Some thought was given to the ultimate goal of embedding these firms within the Irish industrial system, but there has not been, until very recently, coherent attempts to do so. As a result, many of these companies eventually left Ireland. For many years the Irish bureaucracy development agencies followed the ideal-type Weberian structure with internal recruiting, training, and career development procedures. However, with an English flavor, including a strong distinction between the social-science-humanity-law “general-educated” employees who are being groomed to management, and the technical-engineering “expert-educated” personnel whose career does not lead them to high management positions (Rose 1981; Rose 1986). Since the

1960s there has been only one Secretary General of a Ministry who joined the civil service technical personnel career track with an engineering background.²⁹ Accordingly, Ireland opted to follow the third strategy of acquiring technology and industry specific skills – creating domain specific subunits stuffed with industry insiders – when these skills were deemed necessary.

There were very limited resources devoted to R&D in Ireland. Even when the IDA established a program to promote local industry in the late 1980s, its focus was on job creation and not R&D. This especially hurt the hardware sector, which needs more financing than software to successfully conduct R&D or commence operations. Local Irish hardware companies also had less opportunities to profitably employ service or consultancy business models. In addition, during the 1980s the hardware industry had to compete fiercely for the limited amount of skilled engineers against MNCs who were recruiting for both their Irish and global facilities. With meager financial resources and unable to offer secure long-term employment the Irish hardware industry was at a severe disadvantage. This failure of the state to engage with the specific needs of the Irish hardware industry and to embed itself within it, even with the first successes of the indigenous industry – Mentec and Lake Electronic – both being hardware company is a case of stage I failure. The Irish state focused as much as it was on FDI strategy was unable to allocate enough resources and attention to devise specific policy initiatives and embed itself within the industry to spur its growth. It was only a decade later, after a few software companies achieved some commercial success in foreign markets, with the software industry using all its political muscle, and with the IDA already changing its

²⁹ Similarly to Taiwan, and unlike Israel, the top civil servants in each ministry (including the Secretary General, or the General-Manager) are chosen from within the ranks of the civil service.

focus of attention, that Ireland developed a coherent IT industry focused industrial policy. Even then, the industrial policy was geared toward the indigenous software and not hardware sector. Moreover, the policy was focused mostly on companies that have passed their early development phases, again putting at a disadvantage hardware firms that need larger amount of pre-revenue R&D financing and find it more difficult to use consultancy or service model.

Only in the late 1990s, did Ireland start to pay close attention to the assistance its local companies might need abroad, and even then the state limited its role to that of a promoter of companies in various foreign markets and did not attempt to structure specific relationships between local and foreign firms. In regard to foreign financial markets, the state, while happy that some IT firms publicly listed on foreign stock exchange, has also encouraged them to list locally. In addition, while employing and channeling EU grants, the state focused on local financial institutions as the main loci for its various initiatives to create a local venture capital industry.

Again we see that even a cursory analysis of Ireland along the dimensions suggested above helps us to understand why the Irish IT industry developed the way it did. Even with the IDA's long history of bringing foreign hardware firms to open large manufacturing facilities in Ireland, it is the indigenous software industry that has become the more successful sector, while the hardware sector has struggled. The Irish IT industry focuses on developing products of mid-level sophistication, most of which are innovative mainly in applying existing IT technologies to new domains. The more successful companies prefer to either double list on both the local (now also EU) stock exchange and a foreign one. The level of acquisition of Irish firms, while still higher than Taiwan's,

is a lot lower than in Israel, in both total numbers and in the average size of the financial transaction. The IT industry is still dominated by foreign firms concentrating on activities of relatively low sophistication, and the overall level of innovation in Ireland is the lowest of our three cases.

In sum, even with a brief analysis built on comparison of the behavior and structure of the state in our three cases we can distinguish strong national patterns. These patterns greatly help us to understand the different development path of each industry, as well as the relative success of the software and hardware sector in each case. This empirical analysis lends strength to our theoretical arguments. The full analysis laid out in chapter three to five looks at each of these cases in detail, giving us a much more refined understanding, and supplying us with lessons that can then be generalized

Plan of the Book

This book has three targets. The first is to expand our understanding of the role, and the limits, of the state in the development of rapid-innovation-based industries in less developed economies. The second is to explain how the different approaches taken by Israel, Ireland, and Taiwan shaped the IT industries, influenced the particular development path of, and the particular capabilities developed by, each industry, and moved each industry into a different position in the IT industry's global production network. Lastly, by showing that emerging countries have real alternatives in regard to RIB industrial growth, the book argues that politics and the political struggles of crafting and choosing between these alternatives, as well as the politics of state-industry co-evolution are important not only to explain the difference between success and failure, but are also the reasons behind the diverse paths to success chose. Hence, by moving

away our explanations from solely timing and structure reasoning, this book aims to show that both “state” and “politics” needs to be explained if we want to understand both policy formulation and its outcomes.

The chapters are divided as follows. This chapter is followed by the empirical part of the book – three chapters each describing one national case. Each of these chapters presents the politics and evolution of the IT industry in Ireland, Israel, and Taiwan. All the chapters utilize the model in the analysis of the history of state actions and interactions with the two subsectors of the IT industry, the national and sub sectoral innovation systems, business models used, and the industry’s position in and interaction with the IT industry’s global production network. Chapter six returns to the theoretical approach in a comparative way, reflecting on what can be generalized from this study to the more general question of innovation-based industrial growth in other emerging countries. It concludes the book by briefly exploring the strengths and weaknesses of each of the three national models, looks at the ways in which the fruits of the success are distributed to the wider society in each country, and considers the sustainability of the IT industry in each case.

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