TRANSNATIONAL PRODUCTION OF TAIWANESE INTEGRATED CIRCUIT INDUSTRY IN CHINA

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Abstract

The trajectory of the Taiwanese economy over past decades has reflected transitions in global geo-economy towards a vertical specialisation of global trade, knowledge-based competition, variation of industrialisation in the Third World, regional trisection of the world economy, *etc*. Its industry, making remarkable progress based on a long-term national assistance, is involved in the outward direct investment whereby overseas production is arranged. Such strategic actions of industrial capital slice through national boundaries and, meanwhile, incorporate state-business relationships on a broader scale at a national level. The thesis seeks to portray the transnationalisation of the Taiwanese IC sector through its specific organisational processes and spatial dynamics with an aim to understanding the way that indigenous firms are associated with the home state and the convergence of IC production systems on subnational, transnational and global scales. This work finds that the outward expansion of the IC industrial capital reflects a spatial trend converging on China, the Yangtze River Delta in particular, owing to a reshuffle of the global electronic production chain. However, flow of capital and material along the chain across the Taiwan Strait move along a circuitous route. It also finds that a persistent inter-state feud accounts for the domestic debates over the westward investment of the IC capital. There is tension between the neo-liberalist logic of business practices and national intervention in a guided capitalist stance. It underlines the conflicts of imperative territoriality. On the one hand, the firms recognise the necessity of stretching industrial territories to the Mainland in consideration of sectoral competitiveness. On the other hand, what the state is concerned with lies not only in the impacts of industrial de-territorialisation upon domestic industries but also in the result of over-dependence upon China that would incorporate national economy into economic territories of the Great China Circle.

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List of Abbreviations

A&T	assembly and test
ANT	actor-network theory
ASIC	application specific integrated circuits
BVI	British Virgin Islands
DPP	Democratic Progressive Party, Taiwan
EDA	electronics design automation
EPZs	export proceeding zones
ERSO	Electronics Research and Service Organization, Taiwan
FAE	field application engineers
GCCs	global commodity chains
HJTC	Hejian Technology Corp., China
HPF	housing provident fund
HSIP	Hsinchu Science based Industrial Park, Taiwan
IC	integrated circuits
IDMs	integrated device manufacturers
IT	information technology
JV	joint ventures
ITRI	Industrial Technology Research Institute, Taiwan
KMT	Kuomintang (*i.e.* Nationalist Party), Taiwan
M&A	Merge and acquisition
NIEs	newly industrialised economies
OBMs	brand-name manufacturers
ODMs	original design manufacturers
OEMs	original equipment manufacturers
PM	product marketing or project management
PBB	Beijing-Tianjin-Pan Bohai Bay
PRD	Pearl River Delta, China
R&D	research and development
RMB	Renminbi (the currency of China)
SEZs	special economic zones
SIP	silicon intellectual property
SMIC	Semiconductor Manufacturing International Corp., China
SoC	system-on-chip
TI	Texas Instruments, US
TNCs	transnational corporations
TSMC	Taiwan Semiconductor Manufacturing Co., Taiwan

UMC	United Manufacturing Corp., Taiwan
VLSI	very large-scale integrated circuits
VAT	value-added tax
WA	Wassenaar Arrangement
YRD	Yangzi River Delta, China

CHAPTER ONE

INTRODUCTION: AN EPITOME OF A GLOBAL SHIFT?

1.1 A highway to the world

> The Sun Yat-sen [Freeway] is … the highway of globalization … the key 70-km stretch starts in Taipei's booming new Neihu district of high-tech office buildings and ends in Hsinchu ... Along the way, the Sun Yat-sen [Freeway] leads to some of the most important but anonymous tech outfits in the world … You'll also find Taiwan Semiconductor Manufacturing Co., the biggest chip foundry on the planet, an essential partner to US companies such as Qualcomm and Nvidia. Dozens more companies dot the Neihu-Hsinchu corridor. There's AU Optronics, a big supplier of liquid-crystal display panels, and Hon Hai Precision Industry, which makes everything from PC components to Sony's PlayStation 2, and which is a fast-rising rival to Flextronics International, the world's biggest contract manufacturer. Taken together, the revenues of Taiwan's 25 key tech companies should hit $122 billion this year.
>
> (Business Week May 16th 2005)

By the late 1960s an economic recession had begun to sweep through most Western economies as a consequence of a sea change in Western capitalist accumulation (Amin 1994). The fading Fordist regime, combined with a demise of the Keynesian governance, was, however, propitious for the Asian Tiger economies – Hong Kong, Singapore, South Korea and Taiwan – as it created an opportunity for them to improve their export performance. Certainly, the Tigers had *favourable* advantages in their own right – a disposable and low-waged labour market,[1] so that they enjoyed considerable capital inflow and technological import by devoting themselves to a sub-contracting role within emerging global production systems (The World Bank 1993) (**Figure 1.1**).

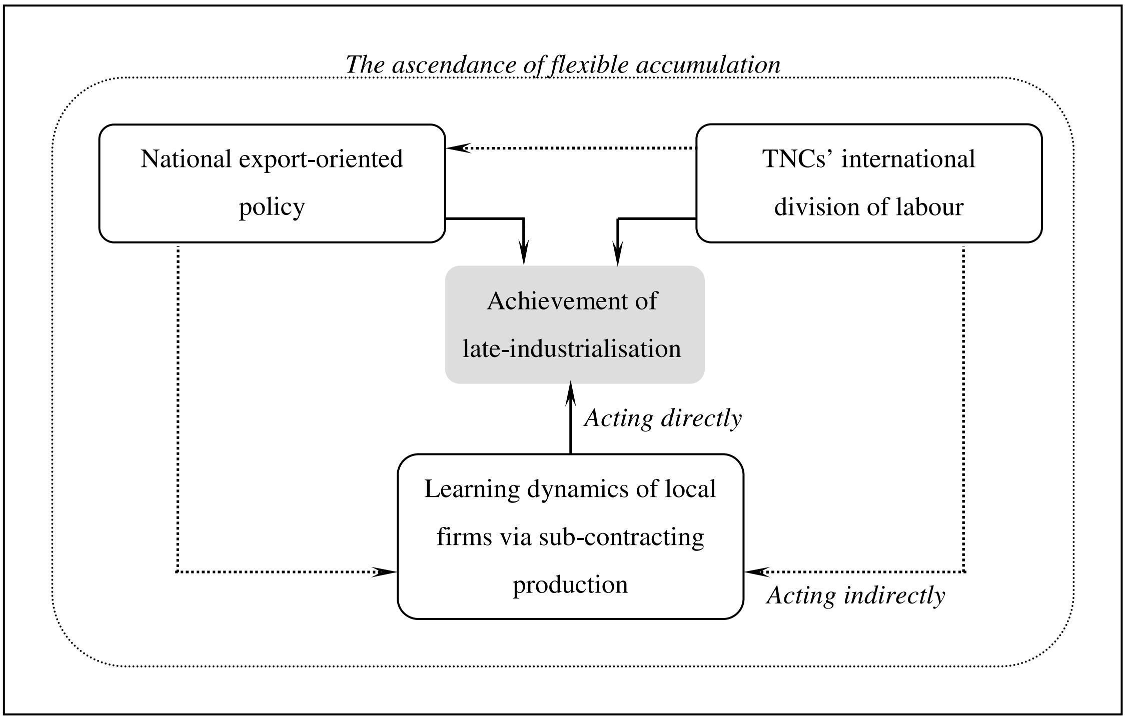

Figure 1.1 Multi-thrusts to the Tiger Economies: A prototype

Industrialisation in what was previously the Third World "is a problem of *raising productivity and creating international competitiveness*, not effective demand" (Amsden 1990: 10, emphasis original). A rapid growth of the Tiger Economies, followed by the second-tiered NIEs from Southeast Asia, recast the international division of labour (Henderson 1989). Some even went so far as to claim

[1] It was, ironically, on a basis of 'bloody Taylorization' constituted by *self-exploitation* (Lipietz 1982), so as to meet a demand of transnational corporations (TNCs) for organisational flexibility.

that the Third World had ended with the burgeoning Asian economic boom (Harris 1987). The Asian NIEs, to which China has been added of late, have now joined Japan to form a formidable Asian economic bloc. This modified the global map of economic power – the tri-polar structure is now comprised of Europe, North America *and* East and Southeast Asia (called Asia for short hereafter).

This brief review outlines a general trajectory through Taiwan, and its neighbours, have undergone a *global shift* (Dicken 2003) in their productive capacity. The clustering of high-technology activity along the Sun Yat-sen Freeway can arguably be described as an *industrial district* – a constellation of sectorally-relevant production activities and services assembled in a single locality or region. This Sun Yat-sen district is a well reputed area for it maintains a position of considerable significance in the global electronic sector (Mathews 1997; Hsu 2005). The success of the high-technology district has not occurred by chance. Rather, the area has been incubated purposively through state intervention since the mid-1970s. The government made a great effort to update industrial competence in the area by ensuring that the early labour-based global competitive advantage of the firms located there was enhanced by capital- and intellectual-intensive investments (Hsueh, Hsu et al. 2001).

However, the story of this ‘highway’ is more than a paragon of one territorially-confined industrial park manifesting attainments of industrial upgrading among choice regions in East and Southeast Asia. As the business press describes it, “[t]his stretch of road [*i.e.* the Sun Yat-sen Freeway] is how you reach the companies that connect the vast marketplaces and digital powerhouses of the US with the enormous manufacturing centers of China” (Business Week May 16th 2005). It is certain that flexibility of corporate adaptation to globalising tendencies contributes significantly to the extra-local productive connections regarding the specific market of electronics besides the active role of the state in transforming the economy from a position of underdevelopment (Amsden and Chu 2003; Berger and Lester 2005). The entrepreneurship of Taiwanese firms, if not unique among their Asian counterparts, may be particularly representative of the potential of the Asian NIEs to compete within the global *Triad* (Dicken and Yeung 2002; Higgott 2002; Yeung 2006). This thesis is concerned with a distinct trajectory that shows how the quality of a territorial ensemble evolves with industrial practices of trans-local linkages in an era of globalisation. This facet refers to the relevance of the regional economy to the *deep integration* of the contemporary global economy which “is pervasive and involves the production of goods and services in cross-border value-adding activities that refines the kind of production processes contained within national boundaries" (Gereffi 2005: 163).

Within this thesis the spatial outreach of Taiwan's regional high-technology cluster is used as a key point of departure to underline an endogenous dynamism that shows how indigenous firms[2] growing out of a late-industrialised country act on 'globalising regional development' (Coe, Hess et al. 2004; Yeung 2006). My analysis of the path of economic improvement in Taiwan is industry-specific. Industrial sectors in Taiwan have moved at different speeds, in large part because Taiwan's economic growth has been led by the *strategic industries* that are identified and fostered by national policy.

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[2] In my analysis~~,~~ I do not see those domestic firms as numerous individual establishments but, rather, as a group of collective actors acting along the IC production chain. This is to highlight their *collective power*: at a level of industrial operation, Taiwanese IC industry is run in a form of coalition on the base of vertical disintegration and, at a level of value creation, Taiwanese firms exercise a countervailing power on national agents to advance economic autonomy and business interests in a course of cross-Strait production (see Henderson, Dicken et al. 2002).

1.2 The chips: Cross-Strait production and a discontinuous territoriality

The illustration above serves as a starting point to develop my concerns with the transnational behaviours of domestic firms, which are situated in contextual specialities of one late-industrialised state, Taiwan. I attempt to shed light on the research objectives by placing emphasis on the geographies of the integrated circuit (IC) industry – ICs are products and are generally called ‘chips’. The selection of the IC industry is justified on multiple grounds, as outlined below.

(1) ICs are viewed as the key components of electronics commodities (Castells 1996) due to their capabilities of implementing the functions of electronics goods. Sophisticated IC technology is also of great consequence to the military and the aerospace industry.[3] To a certain degree, high-technology industry is politically sensitive. It signals so-called *technonationalism* “which treats technology as a commercial and strategic asset to be nurtured and kept at home” (Stevens 1990: 44). For example, in the US, the migration of the chip manufacturing sector to East Asia

[3] For example, a ‘Star-War Initiative’, announced by the US in 1983, was a technology project for wagon development applying the IC technology to weaponry.

has been highlighted as a potential strategic danger by the Senate Armed Services Committee, on the grounds that the

> DoD [Department of Defense] and [US] intelligence services will lose both first access and assured access to secure advanced chip-making capability, at the same time that these components are becoming a crucial defense technology advantage … relying on integrated circuits fabricated outside the US (e.g. in China, Taiwan and Singapore) is not an acceptable national security option.
>
> (Lieberman 2003: 2)

(2) The utilisation of IC technology is not confined to strategic purposes; not every country contains the advanced technological capacity for an armament race after all. The alternative IC significance demands attention by virtue of its economic value to consumer electronics, which is the main concern in this thesis. The IC technology was not commercialised until the middle of the twentieth century, and was once controlled by electronic monopolies, such as Fairchild, Intel, Texas Instruments (TI), etc. The international value of the industry reached US$255.6 billion in 2007 according to the World Semiconductor Trade Statistics (WSTS).

(3) The trajectory of the IC sector is towards vertical disintegration, and an uneven spatial dispersion on an international scale. Specifically, a dynamic and ever-expanding industrial promotion of the sector in the Asian NIEs has facilitated such developments. The dynamics of the macro-regional economy have been

well-documented under a theory-inflected analysis of the *(new) international division of labour* (Henderson 1986; Scott 1986; Scott and Angel 1988; Henderson 1989; Hobday 1991) The geographical experience of the IC industrialisation at the international (or, to be precise, interregional) level will be outlined in **Chapter Three**.

For Taiwan, the indigenous IC industry is outward oriented. Its development is based on the export of multitudinous electronic goods. Numerous firms have embarked upon 'strategic asset-acquiring investment' (Dunning 1998) to obtain state-of-the-art technologies and/or have sought closer access to international customers in advanced countries through foreign direct investment (FDI), strategic alliances, and merger and acquisition (M&A) (Chang, Shih et al. 1994; Saxenian and Hsu 2001; Breznitz 2005; Fuller 2005). More recently, the firms have sought to open branch offices or production lines in China, which turned into the third-largest and fastest-growing IC market during the late 1990s. The investment trend spanning the Taiwan Strait (or 'the Strait' from now on) is the central focus of substantial study in this thesis.

Taiwanese IC firms became enthusiastic about external expansion over the past 15-20 years. Such firms may be described as *developing country transnational* *corporations* (TNCs) (Yeung 1994) given that the "co-ordinat[e] production from one centre of strategic decision making … takes [them] across national boundaries" (Cowling and Sugden 1987: 60). Literature on this kind of TNCs illustrates that the firms are used to channelling investment to neighbouring developing countries. Often, spatial and cultural proximity and the benefits of regional solidarity are regarded as determining this (Heenan and Keegan 1979; O'Brien 1980; Chen 1983; Wells 1983; Yeung 1994; Gangopadhyay 1998; Miotti and Sachwald 2002; UNCTD 2002). The geographical proximity represents a unique spatial characteristic in which industrial capital from late-industrialised states is deployed. This spatial distribution is correspondent with the embodiment of (trans-border) regionalisation so that accelerating economic tie-ups organised by Taiwanese investors cross the Strait (Jou and Chen 2001).

There has been much literature dealing with the agency of foreign investment from the advanced economy on the industrialisation of the less developed countries. This work often focuses upon the TNCs of the advanced economy. The 'highly politicized nature of MNE-institution relations' (Phelps 2000) reveals that 'invested places' are often under the sway of external forces through the influence of TNCs (Cooke 1996; Braczyk, Cooke et al. 1998; MacKinnon and Phelps 2001). A very limited number of studies have focused on firm-government tensions with regard to firms from the developing countries; and even fewer have explored the institutional dynamics between 'run-away' firms and their home states.[4] Empirical research into the westward advance of Taiwan-based IC firms is concerned with matters of strategic contradiction, and the extent to which this provides a lens through which to view the cross-border activities of firms and the developmental implications of this.

The IC industrial cluster of north Taiwan reaches out to the world, and this represents one facet of globalisation that "the scale of economic activity no longer corresponds to the territory of the nation-state; [instead,] it is global and transnational" (Hirst 1997: 409). By and large, the majority of the IC productive capacity emanating from Taiwan has been located in China, which is ironic given China's hostility towards Taiwan's sovereignty (Wang 2007). What has been described as the 'go-west tendency' creates a *discontinuous territoriality* of strategic actions as indigenous capital gets involved with production systems of global reach

[4] Yeung's work on the regionalisation of Singaporean firms offers one pre-eminent exception (Yeung 1998). The case study situates the operation of outward investment in a framework of collusion-and-rivalry interaction between the firms and the state (Pitelis 1991; Pitelis 1993). Analytically, it is significant to associate specific political economy with the formation of an entrepreneurial state in Singapore and the embeddedness of the firms in the entrepreneurial nature of institutions. There is an implication that suggests the significance of recognising the characteristics of nationally differentiated and locally embedded 'business systems' (Whitley 1996) in association with the dynamics of strategic behaviours that the firms develop for transnational actions (Dicken 2000).

which slice through national boundaries (Sassen 2000; Dicken and Malmberg 2001; Henderson, Dicken et al. 2002; Sassen 2003). It is politics of economic territorialisation occurring at the conjuncture of two empirical grounds. One is an industrial dimension on a global scale, embodied by a deepening international division of labour in organisational and spatial terms; another draws upon nation-specific regulation and points to the institutional features found in developmental trajectories of late-industrialised East Asian countries. A crux of the contestation of territoriality refers to the dynamic relationships between corporate and state actors where firms take the initiative in taking "control of the production system and the relative distribution of the costs and benefits associated with its operation" (Dicken 1994: 103).

In light of geographical concerns with corporate behaviour, attention is paid to the firm-environment relationship, which is "to position business enterprises within their proper structural context; to conceptualize them as being truly *endogenous* to the capitalist production system (rather than exogenous)" (Dicken and Thrift 1992: 284, emphasis original). It is distinguished from the economic and organisational stances of conventional FDI theories[5] that lean towards viewing the firm as an

[5] Such as the market imperfections approach, the product life-cycle model or the eclectic paradigm.

individual unit of analysis, which is separated from the broader socio-economic contexts. The geographical perspective on analysing firms' locational decision-making stresses the dynamics that provoke investors to act and respond to the contexts of environments which are economically, culturally or/and institutionally constituted at multiple geographical levels.

Three environmental contexts are idiosyncratically tackled in relation to Taiwanese IC firms' westward investment, including socio-economic practices of cross-local industrial connections, politico-economic entanglements at (inter-)national levels and spatio-organisational evolution of a global production network. It is argued that

> the nature of TNCs as highly embedded interacting networks [are] involved in competitive struggles in which a diversity of competitive strategies is used. Such strategies are, themselves, the outcome of contested power relations both inside the firm and, externally, with the constellation of institutions (including the state) with which TNCs interact.
>
> (Dicken 1994: 106)

At this point, the central implication of these contexts to corporate behaviours that I stress does not lie in hierarchical division of spatial scales *per se* but in contextualities of scalar intermingling in which interactions between corporate and state actors are embedded. The main concern in the thesis centred upon the geographies of the cross-Strait investment/production entails looking into tension and negotiation generated by agencies of transnationalising and regulating economic activities. However, although attention is paid to domestic debates on industrial transplantation, the analysis focuses upon a more complex power play of *triangular* relationships between Taiwanese IC firms, the Taiwanese Government and the Chinese Government. It does so on a range of spatial scales.

The objectives are contextually situated, while I attempt to tease out complexity and structural necessity of the objectives by asking the following research questions:

1. How did Taiwanese IC firms insert themselves into the global IC production chain?
2. What mechanisms are responsible for the corporate arrangement of production operations across the Strait?
3. How are the trans-local industrial systems articulated in the face of the institutional variables at national level?

The following targets are clarified for the purpose of achieving the research objectives:

- to review the growing path of the IC industry in Taiwan;
- to probe peculiar features of the local industrial system at home base;
- to analyse mechanisms of transplanting production to China;
- to examine the state and firms' stances on the go-west investment;

- to interpret the strategic discourses constricted by the firms and the state respectively;
- to outline the presence of production reorganisation across the Strait.

1.3 Structure of the thesis

Considering that the dynamics of production systems are central to the research questions, I think it appropriate to enter the study via the idea of a production chain analysis (Walker 1988; Dicken and Thrift 1992; Gereffi 2005). The chain framework set out in **Chapter Two** primarily builds upon work on global commodity chains (GCCs). I will first lay out their characteristics and discuss the economic linkages that exist between developed and developing countries. I will then explore criticisms levelled at the analytical rigidity of this work, particularly questions about the unidirectional logic of linear chains and their geographical implications. I will draw insight from network-inspired work in recent geographical research to argue for an acknowledgment of multi-stranded connections between various sets of actors on spatial scales. In other words, the chain/network metaphor employed as a vehicle for assessing industrial reorganisation derives from the analytical framework of the GCC approach, combined with theoretical insight of new economic geographies in looking into social foundations of economic behaviours and their spatial demonstrations.

Chapter Three is a preface to the analysis of the substantial focus in the thesis, outlining the methods employed to determine how the 'go-west strategy' has evolved among Taiwanese IC firms. The chapter is a self-critical stance of my attempt to understand the perspective of corporate actors. Tensions exist between rational abstractions and the subjective reporting of motivations. Specifically, the methodological difficulty of gaining access to corporate informants during my fieldwork will be critically reflected upon given the political economic dilemma facing both domestic firms and the Taiwanese Government.

The focus in Chapters Four to Seven will shift to an examination of the substantial research conducted into the cross-Strait organisation of the Taiwanese IC industry. **Chapter Four** begins with an illustration of the IC manufacturing procedures from a division-of-labour viewpoint. It identifies how the divisible nature of production components and a technological tendency of miniaturisation lead to diversification of input-output systems. It will be argued that the global IC production network has seen a discernible reshuffle regarding organisational flexibility. In turn, I seek to capture the globalising dynamics that have incorporated Taiwan into an evolutionary international division of labour and, by doing so, to find out the industrial niche within which the Taiwanese IC industry is located.

In **Chapter Five** I sketch out the industrial path of Taiwan's IC sector. The chapter explores industrial governance within the industrial districts of the Taiwanese IC industry. I examine the economic landscape of agglomeration, and the 'sticky' nature of sectorally-specific production systems. The analysis will highlight the organisational, intellectual and virtual linkages that extend the spatial scope of the indigenous firms' reach, and ensure that production sites become nodes of global connectivity for social relations.

Two successive chapters will concentrate upon the corporate decisions to 'go west' and the material actions taken to arrange cross-Strait production. The analysis in **Chapter Six** is at a domestic level, pointing to the impact of a state-firm chasm that complicates the geographies of cross-Strait linkages and organisational arrangements: economic integration with China challenges the State's insistency on national jurisdiction over production. **Chapter Seven** examines the impacts of firm-place relationships upon the ways in which the cross-Strait IC chains are deployed. My discussion first revolves around how the firms rationalise the 'go-west' imperative of transplanting production. The ownership-specific advantages of the Taiwanese IC firms and the location-specific advantages of China (on national and subnational scales) are combined to affect a westward tendency of capital flow and organisational extension. The geographies of industrial reorganisation in light of the multi-site operation will be explained.

Chapter Eight concludes the thesis. I will first sum up general observations about the spatial process of industrial reorganisation and its concomitant tensions. Following this, I outline the implications of the transnational corporate strategies and practices that complicate the state-business equilibrium of Taiwan's developmental statist model. Finally, I go on to suggest some possible research agendas emerging from this thesis for future research.

CHAPTER TWO

ANALYSING TRANSNATIONAL PRODUCTION

2.1 Introduction: A metaphor of chains

The international division of labour in the current era of globalisation is unique in light of "the functional integration of internationally dispersed activities" (Dicken 2003: 12; Gereffi 2005), and is distinctive from the previous scenario which saw the spatial expansion of economic activities across national boundaries in a less integrative way. In other words, it is "the nature rather than the extent of trade" (Kaplinsky 2001: 124) that is in transition. Cross-border production networks for parts and components are formed in the wake of increasing exports whereby various industrial outputs produced in developing countries are shipped to developed countries (Gordon 1988; Hummels, Rapaport et al. 1990). In a sense, "access to developed country markets has become increasingly dependent on participating in global production networks led by firms based in developed countries" (Gereffi 2005: 178, Note 20). Along with this intra-industry trade is an overt tendency towards vertical disintegration of organisational patterns on a worldwide basis, which makes for tangled production chains. An understanding of economic divergence and convergence regarding organisation and geography is available via anatomising "the process [by which] production systems are ‘cut up’ and ‘put back together’” (Walker 1988: 378). This suggests that a chain metaphor is valuable in my attempts to identify an evolutionary trajectory in firms’ efforts to consolidate trans-local production territories, and will endeavour to explore its theoretical association with ‘nodes in the global networks’ (Amin and Thrift 1992).

In this chapter I will first take the approach of global commodity chains (GCCs) since it provides an accessible way of thinking about extensive and reorganised manufacturing systems. The rationale of the GCC approach is outlined in **Section 2.2**. The power dynamics and the extent to which corporate actors involve themselves in the global economy are discussed in the first part of **Section 2.3**. The second part moves on to the industrialisation of the Third World, revolving around the technology of Asian NIEs in relation to the territoriality of industrial organisations. The theoretical review will also draw attention to several conceptual drawbacks which limit the analytical capability of the commodity chain approach. Certain disjunctures will be explored and reworked in the following sections so as to make the framework more integrated. **Section 2.4** questions a rigid distinction that dichotomises industrial systems, with reference to corporate capacities to control, or adjust to, changing patterns of production externalisation. Following this, **Section 2.5** identifies the significance of chain formats and regulatory involvements by teasing out the way they are reflected in the geographical literature. This is an attempt to rework the chain framework to augment its explanatory potential.

2.2 Essentials of GCC analysis

The use of the idea of the chain in economic analysis is primarily as a heuristic metaphor to describe "a transactionally linked sequence of functions" in which each stage "adds value to the process of production" (Dicken and Thrift 1992: 284). Dicken (1994) points to the systems of the production chain at three levels (**Figure 2.1**). The first level is a primary continuation of segmented manufacturing activities. A simple procedure indicates the input-output system where economic components flow in a physical medium. The second refers to a technological level. Input of a variety of technological processes along the chain determines the functional performances of the individual tasks and their 'transactional links' as a whole. The third level draws upon a broader production environment (*e.g.* financial basis and regulatory settings) in which the production chain works. This constitutes policy-related grounds that condition how the production chain is capitalised and coordinated.

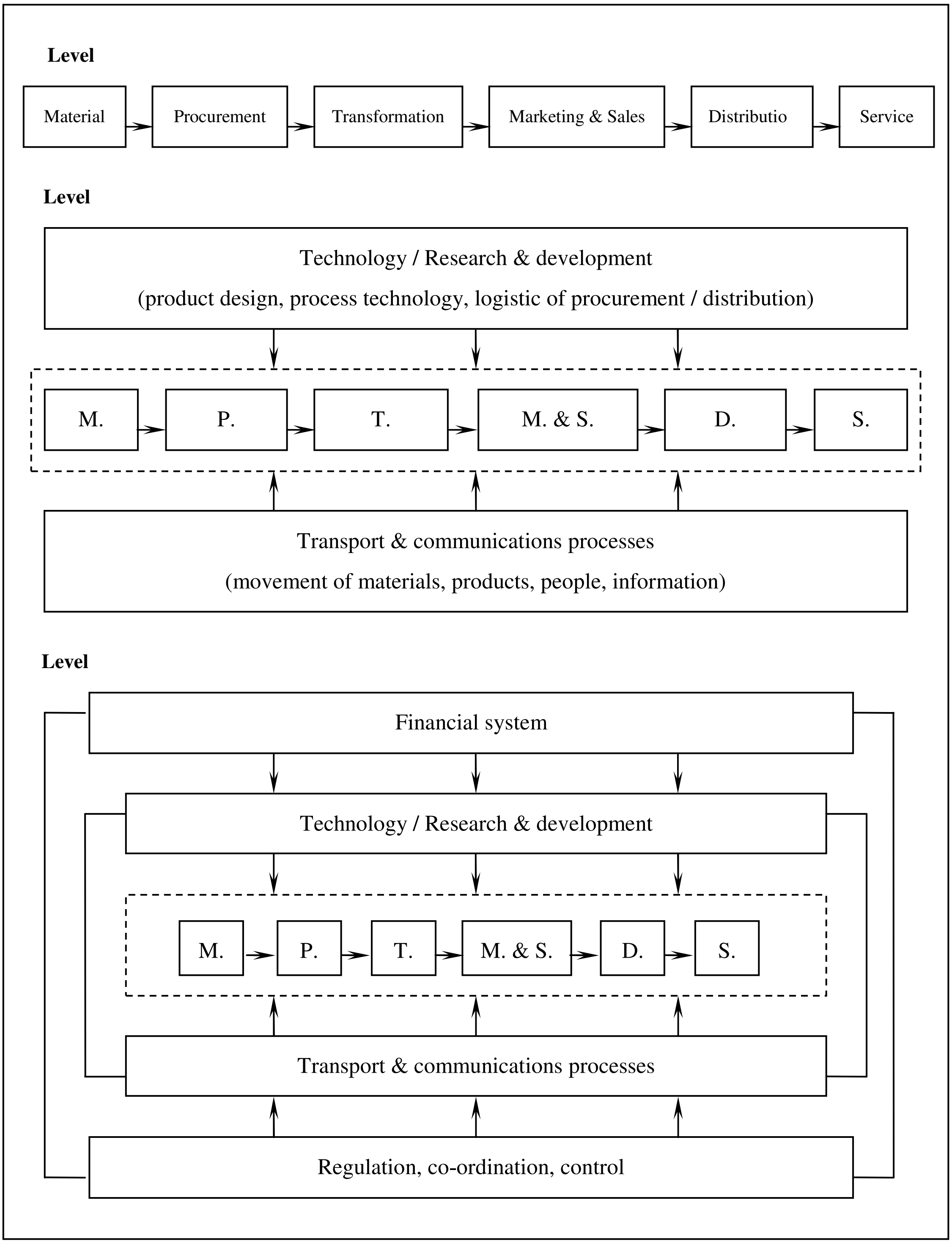

Figure 2.1 The production chain

Source: Based on (Dicken 1994: 104, Figure 1)

Three components of the production chain in nature are salient in terms of their analytical importance (Kaplinsky 2001): (1) systematic efficiency: integral elements are completed in a reasonable and efficient order; (2) rent reeking: the chain collects material and non-material sets of productive cells to produce commodities for profit-making (Storper and Harrison 1991), and (3) organisational coordination: some degree of governance acts to enable the chain to function well and to appropriate profits. The chain approach has been widely applied in economic geography, economic sociology, development studies and business management to understand the "(dis)organization of economic activity and value creation, appropriation and distribution" (Smith, Rainnie et al. 2002: 41), "around which the organisational fabric of the economy may be wrapped" (Walker 1988: 380). An analysis of global commodity chains (GCCs), which has been developed by Gereffi *et al*. since the mid-1990s, is an answer to the question, "what is the appropriate organizational field to use in studying economic globalization?" (Gereffi 1996: 436).

A working definition of a commodity chain is "a network of labour and production processes whose end results is a finished commodity" (Hopkins and Wallerstein 1986: 159). It was first proposed in Hopkins and Wallerstein's work on theorising a complex division of labour which has been developed on a world scale since the early modern era. The chain concept was developed to identify "the loci of the sources of value in the final product" (Hopkins and Wallerstein 1986: 160) by tracing production procedures of one commodity *backwards* to primary inputs. Major productive operations, involved with the output of goods or services, are designated as discrete nodes. The organisational relevance of production and its locational features are addressed by looking at an integrating process in which production nodes are functionally linked. The way to depict the constitution of chains suggests an efficient method to unfold "the functional integration and coordination of internationally dispersed activities" in a sectorally-specific sense (Gereffi 1999: 4). The commodity chain analysis thus "provides a useful antidote to the problems of overgenerality" (Mort and Thompson 1994: 109).

Commodity Chains and Global Capitalism, edited by Gereffi and Korzeniewicz (1994), extends this chain notion to a concrete *new global manufacturing system*, which is increasingly characterised by an extension across organisational and national boundaries. Founded upon the reconstituting of industrial systems, three fundamental elements are particularly identified by Gereffi. First, an input-output system, which is "a set of the products and services linked together in a sequence of value-adding economic activities" (Gereffi 1994: 97). Second, a sense of territoriality, which is concerned with "where different stages of production actually take place" (Clancy 1998: 125), and with the spatial patterns that a chain of interconnected activities, nodes and flows produce. Third, a governance structure, which is an organisational aspect that involves the exercise of authorities and power relationships in determining allocation and flow of resources and returns in the "contractual linkages of formally independent firms" (Raikes, Friis et al. 2000: 396). Theorisation of the dimension of governance has only been partially addressed to date, with more attention being paid to the power dynamics of organisational shifts within the global sourcing system (Gereffi 1994; Gereffi 1999; Gereffi 2001; Gereffi, Humphrey et al. 2005).

There are two types of governance structures formulated in Gereffi's writings. One is producer-driven GCCs, referring to the internationalisation of industrial capital, *e.g.* automobiles and semiconductors. Another is buyer-driven GCCs, related to trade-led industrialisation, with apparel, footwear and agro-food industries being particularly good examples. Entry barriers to producer-driven chains are the large-scale, high-technology manufacturing facilities required for mass production. Large, and usually transnational, manufacturers play a dominant role in driving this sort of chain. They can afford to engage in heavy investment and so capture technological access to products and processing innovation. As they increasingly focus upon core production competencies, multilayered manufacturing systems are structured by outsourcing marginal segments. The externalising process blurs "the organizational boundaries of vertically integrated corporations" (Gereffi, Korzeniewicz et al. 1994: 7) and has gone alongside an international extension of manufacturing chains. Organisational methods are another barrier to entry possessed by producer-driven chains, which are required to assure output reliability, quality control, inventory reduction, *etc.*

Buyer-driven chains are dominated by commercial capital, such as retail brands, and are distinct from the producer-driven chains in their barriers to entry in as much as they are relatively low. Manufacturing activities in buyer-driven chains are subject to being subcontracted to suppliers which are usually located in low-wage, developing countries. Such production systems are decentralised in organisation and competitive in price. In comparison, the parts of these chains with higher barriers of entry refer to design and marketing activities linked to brands, so that the extraction of value from buyer-driven chains is highest in acts of consumption as opposed to production. The key agents dominating the buyer-driven chains are international buyers, including brand owners and retailers. They act as 'producers without factories' – Nike is a typical case (Austin, Aguilar et al. 1990; Donaghu and Barff 1990) – to play a pivotal role in leveraging global sourcing to meet the mass consumption market they shape.

2.3 A concern with industrial 'upgrading'

The GCC approach is an alternative to both the development agenda and to conventional state-centric analyses – these tend to either cleave to a neo-classical perspective affirming domestic policies to "[get] relative prices right" (Amsden 1990: 6) or to a view of state intervention that sees states as manipulating the forces behind the market (Amsden 1989; Wade 1990). Gereffi's commodity-centric perspective is involved with trade-led production. Its analytical focus upon transnationally economic linkages of individual sectors offers a systematic vehicle in explanation for how some countries are able to move out of an underdeveloped status. That is, the prosperity of domestic economies is situated within international divisions of labour in relation to geographic specialisation and global sourcing (Gereffi 1997).

2.3.1 Profit and power

The intellectual aspects of the GCC paradigm stem from the political economy of the world-system approach. It belongs to the realm of development studies, broadly defined. Similar to development studies, the GCC literature has a core concern with how *lead* agents dominate international trade and industry and how *subordinate* ones are incorporated into, or excluded from, the world economy. But the GCC approach diverges from its theoretical antecedents in many aspects (Gereffi 1997; Gibbon 2001; Bair 2005).

A central interest of world-system theory is a hierarchical division of the modern world. Its primary attention to economic patterns is national in scope, which is predicated on the basis of a tripartite world-system. In comparison, Gereffi and colleagues describe GCCs as an analytical approach to understanding the global economy and endeavour to develop an organisational approach in order to "forge the macro-micro links between processes that are generally assumed to be discretely contained within global, national, and local units of analysis" (Gereffi, Korzeniewicz et al. 1994: 2). In addition, the differences are underlain by diverse experiences of sectoral and regional objects. Roughly speaking, development studies are mainly focused upon primary commodity-based industries in Latin America, while manufacturing activities in East Asia provide the GCC literature with rich evidence (Gibbon 2001). One particular question about "the opportunities and constraints presented by the forms of global integration of production and trade in specific commodities" (Gibbon 2001: 345) is posed to avoid a fatalistic attitude towards unbalanced economic processes. It considers globally organised linkages of production and distribution systems among developed and developing countries (cf. Harris 1987). Under a rubric of economic globalisation, direct attention is paid to "the possibilities (and limitations) of economic upgrading for developing countries offered by special markets" (Raikes, Friis et al. 2000: 391; and see Gereffi, Humphrey et al. 2005).

Profits condition economic power and monopoly conditions profits. The profits are associated with a concentration of productive resources wrested by lead agents from weaker competitors. The GCC literature argues that the power lead agents are able to leverage along the chains influences the profits they make. But the inclusion of power dynamics in the GCCs formulated by Gereffi *et al*. is on the basis of the manifest structural changes of economic activities which become spatially dispersed but organisationally integrated. This economic transformation corresponds to an overt tendency towards vertical disintegration. This involves: (1) an increasing degree of production fragmentation (Arndt and Kiezkowski 2001); (2) an internationalising and networking trend of inter-firm deployment (Dicken, Kelly et al. 2001; Henderson, Dicken et al. 2002) and (3) the effects of knowledge exchange and learning in decentralising business networks (Amin and Cohendet 1999; Brown and Duguid 2001). At an organisational level, "the coordination and control of global-scale production systems … can be achieved without direct ownership" (Gereffi, Humphrey et al. 2005: 81).

This includes a revised understanding of the generation of profits from the previous position – *i.e.* volume outputs are sources of profit – towards a concern about productive inputs of *scarce* assets. It incorporates a Schumpeterian view of *quality competition* regarding a primary perception of where and how economic resources and wealth are allocated. The profits are roughly divided into different levels of value creation which determine economic power. Higher value-added activities are signalled by dynamic progresses of improving efficiency, quality and reliability and diminishing risks. The lead agents can achieve these productive targets due to their advantages in "proprietary technology, product differentiation, brand reputation, customer relations and constant industrial upgrading" (Gereffi, Korzeniewicz et al. 1994: 6) and the fact that strategic alliances between leading firms have been increasing in technology-driven agreements. In short, the way to establish control and value in production chains is through technological advancement and the redefinition of organisational boundaries.

In the current economic regime, profits accrue mainly from the innovative edges of production, rather than from large manufacturing runs and labour productivity. The economic coordination of "a specialization of core tasks and capacity within lead firms and the externalization of peripheral tasks and capacity to contractors or other economic organizations and institutions" (Boggs and Rantisi 2003: 109-110) contributes to an institutional mechanism that confirms corporate status. Scarce assets create higher value, which supplies these well-run firms with the power to *define* and *police* barriers to entry (Gereffi 1999). Lead firms tend to give up what are seen to be *dead-end* aspects of the commodity chain (such as production based on unskilled-labour, for example) as lower value-added activities are left for less powerful agents to undertake. From a profit-cycle point of view, a decline in product value would emerge as productive techniques mature and the market becomes saturated or less attractive (Markusen 1987).

The way "to out-source lower value-added activities and to retain or incorporate those with higher value-added" (Raikes, Friis et al. 2000: 401-402) at an inter-firm level is associated with the lead firms' ability to handle *organisational flexibility*. The status of chain governance offers the subordinate agents "an organisational basis of chain participation" (Raikes, Friis et al. 2000: 396) – these less powerful agents are either allowed to hold a relatively unfavourable position within the chains by accepting the lead firms' flexible leverage or excluded from the chain and, in so doing, from the global economy. In one sense, this flexible account indicates that the GCC analysis does not reject the dynamic of industrial progress in the developing countries where the subordinate firms are mainly based, although there is recognition that the powerful lead firms exert strong control over commodity chains (Gereffi

1996; Gereffi 1999). As such, it embraces “the growth of industrial capabilities in a wide range of developing countries” (Gereffi, Humphrey et al. 2005: 79), which was ignored due to an ossified and conclusive tripartite divide of the economic system. In the end, the GCC approach “promote[s] a nuanced analysis of world-economic spatial inequalities” (Gereffi, Korzeniewicz et al. 1994: 2), and so may help to break up the *zero-sum* nature of power-profit circularity (Raikes, Friis et al. 2000; Gibbon 2001).

2.3.2 Link and leap

Gereffi gives a pertinent demonstration of the remarkable ascent of the first-tiered NIEs from underdevelopment by a series of studies on apparel commodity chains (Gereffi 1994; Gereffi 1999; Gereffi and Memedovic 2003), and specially emphasises “the prominent role of locally owned firms in their export-oriented industries” (Gereffi 1997: 79). However, he concedes that the mere existence of real wages, exchange rates or state policy does not sufficiently account for the geographical outcomes of production flexibility. The Asian NIEs possess enduring and promising benefits from export manufacturing/trade even though their initial cost advantages have been eroded over time.

Considering their very weak industrial bases it is not easy for developing-country firms to construct more complete local industrial linkages as theories suggest they should (Saxenian 1994; Maskell and Malmberg 1999). It is a peculiar case that "the greater the leap in upgrading, the less likely it is that knowledge acquired in existing linkages suffices" (Humphrey and Schmitz 2002: 1025). The premise on which the firms can upwardly move is that they become deeply and extensively involved with commodity chains. But this is where the problem begins. Insertion into the chains can be a risk that renders local suppliers "dependent on a small number of powerful customers" because "exclusive relationships with large buyers prevent them from diversifying their customer base" (Humphrey and Schmitz 2002: 1024). Note that it would be simplistic to conclude that the developing-country firms are only offered *passive* chances to engage in labour-intensive segments with regard to global sourcing international buyers' command – even though this *was* true in the very beginning. The way to overcome innate constraints on industrial upgrading (such as financing inadequacy, technological barriers of entry, a lack of professionals, obscure legislation) is by dynamic *learning*.

This issue is worth further comment. The growth of a national economy is not really carried out within a nationwide context. Intra-national fragmentation can occur in the wake of transnational integration. The GCC perspective also has relevance for work on cluster-based upgrading (see Schmitz and Nadvi 1999 for a special issue of World Development). Work on late-developing industrial districts is considered to be theoretically "weak on external linkages" (Schmitz 1995: 23) – notwithstanding that "physical-*cum*-economic agglomeration within a given is a necessary condition of upgrading" (Gibbon 2001: 349). The view that draws upon the exporting clusters individually is not sufficient to grasp "the manner and pace at which clusters develop" (Schmitz 1995: 24). The GCC approach embraces the "local consequences of globalization" (Bair and Gereffi 2001: 1888) and contributes a methodological complement to the cluster study (Humphrey 1995). In that regard, the economic growth of the clusters is driven by a triad composed of export manufacturing, overseas markets and industrial upgrading (Humphrey and Schmitz 2002). Having chances to play a part in transnational processes of some industry-specific system, emergent clusters that integrate within commodity chains will benefit from an increase in exports (Schmitz 1999) – but they are also likely to suffer from the occurrence of adverse results and local resistances. Take a case study from the Philippines, for example. Kelly indicates a radical resistance to land conversion from a grassroots movement that contested the capital-favoured discourse of globalisation propagated by the government (Kelly 1997).

Behind the growth (on both national and subnational scales) is the 'exogenous push' deriving from the arrival of lead firms which source materials globally, as well as institutional frameworks at national and international levels that programme corporate agents' participation in the global chains. For instance, the growth of the shoe industry in Sino Valley, Brazil is reliant upon the intermediary role of export agents that connects a cluster of local producers into a distant mass market (Schmitz 1995), and the apparel industry in Torreon, Mexico is connected to NAFTA markets through US buyers under the circumstance of a macro-institutional transition (Bair and Gereffi 2001). Firm-level learning draws upon a causal logic, expressing the extrinsic power of international buyers in bringing about the upward transition of local firms.

Although an upgrade in production and product may be achieved by a consistent transaction with global buyers, it does not automatically mean that the local suppliers will develop a new productive function or enter a new market field. There are four types of upgrading categorised by Humphrey and Schmitz (Humphrey and Schmitz 2002): (1) *processing upgrading,* where superior technologies are introduced to enhance manufacturing efficiency and speed of response; (2) *product upgrading,* referring to the ability to target more sophisticated but lucrative market segments; (3) *functional upgrading,* that extends competence to cover more productive tasks of the chain, ranging from simple assembly or production upwards to design or downwards to marketing and brand making; and (4) *inter-sectoral upgrading,* that makes a horizontal move into a new productive field regarding market diversification. The industrial transformation of corporate agents from the NIEs is not single-track but multi-dimensional.

At an empirical level, one specific strategy leading to the strong performance of the Asian NIEs is *learning by exporting*. International contract linkages with large buyers enable Asian suppliers to move up the ladder of skill-intensive activities and enhance their expertise of manufacturing, marketing, branding and their capability to co-ordinate systems (cf. Borrus 1997; Lee and Chen 2000; Ernst 2003). The local firms can initially afford to undertake assembly functions and cater for a low-end market that the international buyers order. As the sourcing linkages succeed, the buyers "[permit] manufacturers to upgrade their facilities as they [meet] buyer demands for more sophisticated products" (Gereffi 1999: 53). The Asian suppliers have made dynamic progress in transiting tasks of export-processing assembly offshore and gradually taking on skill-intensive segments in the form of original equipment manufacturing (OEM) or original brand-name manufacturing (OBM)[6]. The offshore outsourcing arranged by the suppliers has the geographical character of a *regionalising* production scheme – *triangle manufacturing*. The chain format is theoretically related to a redefined territorial division of labour (cf. Frobel, Heinrichs et al. 1980; Henderson 1989):

> The essence of triangle manufacturing is that US buyers place their orders with the NIC manufacturers they have sourced from in the past, who in turn shift some or all of the requested production to affiliated offshore factories in one or more low-wage countries. … The triangle is completed when the finished goods are shipped directly to the overseas buyer, under the import quotas issued to the exporting nation.
>
> (Gereffi 1994: 114)

As Gereffi concludes, "[t]he international competitiveness [of] East Asian firms has been spurred on by organizational learning through networks and it is anchored in conventions that are an amalgam of Western and Asian institutions, norms, and practices" (Gereffi 1996: 109). Indeed, a primary benchmark to measure to what extent economic bodies (at various spatial levels) are globally involved is associated

[6] OEM is "a form of commercial subcontracting. The supplying firm makes a product according to a design specified by the buyer; the product is sold under the buyer's brand name; the supplier and buyer are separate firms; and the buyer lacks control over distribution", while OBM is "the upgrading by manufacturers from the production expertise of OEM to first the design and then the sale of their own brand products" (Gereffi and Memedovic 2003: 1). An aggressive learning curve allows firms to evolve into OEMs or OBMs, which is underpinned by national innovation of systems (Lee 1992; Liu 1993) and efficient absorptive capacity (Hobday 1995), to which I will return in **Chapter Five**.

with a capacity to export to external markets. An extensive sourcing matrix of production and trade underlines the cumulative fortune of East Asia.

In summary, tracing *an organisational succession* of international inter-firm trade, coordination and learning enables us to grasp the late-industrialisation of the Third World. It demonstrates a peculiar approach to developmental issues by associating closely with the agenda of economic globalisation, rather than with more traditional arguments which directed analytical scope upon what happens *within* the countries. It is a feasible starting-point for looking into the spatial reconfiguration of Taiwan's IC industrial systems by situating corporate agents in industrial systems within a global context. In addition to this panoramic view on convergent and divergent mechanisms of transnational manufacturing, Asian firms are not without agency within the *structural context* of globalisation. There is an interpretive dimension within firms that shapes an agenda to encourage them to *think globally* (Jessop 2002; Thrift 2002). The action to organise the chain *in place* achieves inter-firm coordination and extends spatial scope, and this embraces a strategic attempt to link/respond to opportunities/restraints of the structurally-and globally-constituted chain. In brief, the chain can be seen both as an approach to understanding the global dynamics of production linkages and a reflexive object of global capitalist processes.

I do not object to seeing an input-output system, a sense of territoriality and a governance structure as the key constituents of the chain as Gereffi premises. However, the mechanisms of the constituents are interpreted in a static manner, whereby the formation and its dynamic (and contesting) process are illustrated in a restricted way. Besides, as an approach, the formulation of the GCC framework contains several drawbacks in explanation. Geography and the state are both implicated in my attempt to account for 'discontinuously territorial' trajectories in a later part of the thesis. Thus, I intend to explore the lacunae of the GCC literature. Attention is focused upon a failure to sufficiently account for the role of geography in the trans-local constitution of production structures (Leslie and Reimer 1999) and for the role of the state in regulating transnational connections of chain practices (Smith, Rainnie et al. 2002).

2.4 Analytical problems in the GCC literature

The framework of the GCC analysis has two methodological problems. First, there is a set of empirical investigations, drawn from a narrow sectoral range, which is used to construct a framework that is held up as being inclusive and wide-ranging (Dicken, Kelly et al. 2001; Henderson, Dicken et al. 2002). Second, some aspects of conceptual rationale and some issues which have been presupposed or formulated are dismissed in the subsequent research agenda. A case in point refers to an overemphasis on modelling inter-firm governance that leads to a persistent neglect of other elements that make up a chain. The coordination and power of the fragmented organisational structure enables flexible production at a firm-to-firm level (Humphrey and Schmitz 2001).

2.4.1 A bi-modal stylisation

It has been clearly displayed how co-ordination across global chains is central to understanding the ‘disintegration of production’ in the global economy which is a constituent of the ‘integration of trade’ (Feenstra 1998). The characterisation of the modes of governance structures is no doubt analytically remarkable. However, the differentiation of industrial sectors within the world economy is not captured appropriately. A wide range of industries, various levels of coordination and power asymmetries are *dichotomised*: producer-driven chains/ capital- and technology-intensive industries/ multilayered production systems *vs.* buyer-driven chains/ labour-intensive/ decentralised production networks. Such a stylisation formalises an oversimplified structure in light of an opaque economic reorganisation. I will now explain this in more detail by pointing to three explicit limitations which are central to the analysis of governance dynamics.

Firstly, the producer- and buyer-driven chains are taken as "contrasting (but not mutually exclusive) poles in a spectrum of industrial organization possibilities" (Gereffi 1994: 99). The two models are associated with mass production and flexible specialisation respectively (cf. Piore and Sabel 1984; Gereffi 1996). In contrast, the distinction of what drives global chains is differentiated from the structural dichotomy in the *industrial divide* according to varied scales of analytical concerns – the GCC narrative focuses organisational properties upon globally industrial processes, rather than the organisational transformation of a domestic economy (Gereffi 1996). Lying behind this stylisation is an arbitrary binary that "exclude[s] flows of any given commodity or product which are not organized and controlled according to the standard 'key-agent' pattern" (Raikes, Friis et al. 2000: 410). Moreover, other existing or newly-emerging categories that govern the chains are little concerned by such dualist rhetoric. Some researchers call for "an accurate reflection of commodity- and location-specific factors" (Clancy 1998: 345-345; Leslie and Reimer 1999). It is true that "the distinction between 'producer-driver' [*sic*] and 'buyer-driven' networks is more fluid than Gereffi's work" (Henderson, Dicken et al. 2002: 446; and see Yang and Coe 2009). Several drivers are identified as transcending dogmatic patterns, such as '*international trade*-driven chains' for primary producers (Gibbon 2001), '*contractor*-driven chains' for hospitality businesses (Clancy 1998) and 'technology-driven chains' for software industry (ÓRiain 2004).

Secondly, even though the chain approach establishes the conceptual structures of the driver logic in a rather fixed manner, it is a loose definition. Epistemologically, it fails to differentiate "whether it is more appropriate to refer to one commodity chain for a given commodity or manufactured goods, or whether each flow of produce structured by a given key agent is to be considered a separated chain" (Raikes, Friis et al. 2000: 400). The possibility that the two models converge remains unexplored; if so, how do the various types of drivers counter and balance within/across the chains? In light of an industrial trend towards production specialisation over time, it becomes more difficult to distinguish whether the inter-firm transactions belong to one chain or many. Intel is a relevant case. While possession of a technology-specific kernel often promises market superiority in industrial competition, it is hard to conclude that the advantage that Intel gains is grounded in the strength of technological rents (such as the ownership of patents and the power to bargain with international standards), a global brand with a popular slogan – *Intel Inside* – or both. On the one hand, the business approach of Intel, the leading chipmaker, which operates downstream from strategic nodes of brand-name marketing, is consistent with what international buyers would do. On the other hand, the Intel Inside propaganda wisely consolidates end customers' identification with its brand name. This enables a persistent market power from the mass to keep system integrators following standards it formulates (cf. ÓRiain 2004). Its approach to prestige-generation is not exceptional among research-intensive transnational manufacturers. To a degree, this case is pertinent in suggesting the potential that one firm might have to drive multi-forces in order to dominate (a) chain(s).

Thirdly, the bi-modal analysis appears relatively ill-equipped to capture the evolution of a supply-base. An intensified vertical disintegration of production generates many organisational and geographical connections, not only between firms that are transaction-associated but also between other segments of functional services (*e.g.* e-business solutions and venture capital), although they are not directly relevant to productive activities. However, the premise of dominant-subordinate governance at an inter-firm level, which is grounded upon the rather static categorisation of the chain, fails to recognise nuances of production externalisation.

An emergent *modular production network* of the American-centred electronics industry is specified by Sturgeon to supplement the analytical inadequacy of governance style. He points to the rise of turn-key suppliers (IC manufacturers who produce made-to-order chips are a case in point) to meet the growing demand for a total solution. In such contract manufacturing,

> suppliers have in many cases had to add entirely new competence areas, increasing their scope of activities while improving quality, delivery and cost performance … As an industry's supply-base comes to be comprised of large, highly capable turn-key suppliers, the prospects for increased outsourcing are improved. In this way, turn-key suppliers and lead firms co-evolve in a recursive cycle of outsourcing and increasing supply-base capability and scale …
>
> (Sturgeon 2002: 455)

In modularised contract manufacturing limited interdependence between lead firms and suppliers results in *low barriers to entry and exit*. A series of procurement, inventory control, logistic arrangement, process engineering, quality engineering and after-sales services are run in a *dialogic* manner, which can only be achieved by "a highly formalized link at the inter-firm boundary" (Sturgeon 2002: 455). In short, this model substantiates the highly fluid organisational relationship in which one *mutually adaptive* pattern of chain governance works out fast output and prompt delivery for bringing down costs and risks.

Regardless of comments or revisions from others, Gereffi *et al.* themselves also re-conceptualise the governance of global chains by recognising "levels of explicit coordination and power asymmetry" (Gereffi, Humphrey et al. 2005: 78) in a spectrum from market to hierarchy. In addition to the driving forces from key agents, ‘an extension of network category’ – transnational complexities, codifying abilities in transaction and capabilities of suppliers – is drawn to illustrate the way in which, and the extent to which, a chain is governed. Progressively, the identification of the variables in examining the organisational mechanism pays attention to the transactional and intellectual processes in the *supply-based* parties instead of merely enthroning the supremacy of TNCs in commanding global industries (see Hughes 2000; Sturgeon 2002 for case studies; Lee and Saxenian 2008). Taking account of information- and knowledge-involved variables in examining the complexity of supplier-buyer relations constitutes a more dynamic framework. It surpasses the previous assumption in grasping transaction diversification. Besides, organisational embeddedness of tacit knowledge is evolutionary in nature. This accentuates “spatial and social propinquity of local industrial agglomerations [that] work to buoy organizationally disaggregated, and often highly innovative, economic activities” (Gereffi, Humphrey et al. 2005: 98), providing a productive annotation correspondent with geographical literature on territorial dimensions of production (Storper and Harrison 1991).

Nonetheless, the modified typology remains dubious because too much attention is paid to how *firm-level* organisational power is coordinated with functional sites of the chains in comprehending the extensive economic processes.

The result is an incomplete construct of the analytical framework, which does not dovetail with the rationale of the original supposition outlined in **Section 2.2**. With the literature on GCCs being largely about the dominant forces driving the chains, other elements – such as the distribution of value-added across a range of relevant industries and the geographical dispersion of production and marketing networks – are conspicuous merely by their absence. Demonstration of those chain constituents is a primary step in dealing with the improper handling of analytical integrity. Rather than just dovetailing with the originally-supposed rationale of the GCC approach, I will endeavour to reflect on the limits of a linear view and spatial aggregation.

2.4.2 Linearity and global stratification of places

Recognition that "[interorganisational] networks are situationally specific, socially constructed and locally integrated, underscoring the social embeddedness of economic organisation" is stated in the GCC's narrative at the outset (Gereffi, Korzeniewicz et al. 1994: 2). At a spatial level, this recalls the point made by Storper that "[a]n activity is fully territorialized when its economic viability is rooted in assets (including practices and relations) that are not available in many other places and that cannot easily or rapidly be created or imitated in places that lack them" (Storper 1997: 21; Maskell and Malmberg 1999). In later work Gereffi has a particularly clear idea about a 'geographic logic of each node' (Rabach and Kim 1994) in an attempt to "bridge the macro-micro gap in comparative research by highlighting the local social context of global production" (Gereffi 1997: 65). The place in which transactions occur, or specific fragments of industrial processes are located, is influenced by the peculiarities of localities, such as "households, their connections to enterprises and states, and related issues of gender segmentation and racial/ethnic conflict in the workforce" (Gereffi 1997: 65).

Gereffi's interest in focusing the local contents upon 'the social embeddedness of economic organisation' is weakly expounded as a result of the exhaustive treatment of *organisational connection* (Raikes, Friis et al. 2000). A two-fold emphasis existing in conceptualising the GCCs has been questioned: one is the bias for the analysis of governance dynamics as alluded to above; another is that the buyer-driven industries are overwhelmingly accentuated among the GCC literature in a sense that trade-orientated activities increase and pervade globally (Dicken, Kelly et al. 2001). The organisational connection is specified by two aspects that clearly demonstrate (1) that a comparable array of governing categories is "posited from industry characteristics alone" (Clancy 1998: 140) and (2) that the connectedness of diverse global industries is conditioned by big firms.

The input-output system is composed of successive tasks where each link adds value to one peculiar product constituting the physical substance of the production chain. But ‘where to start and end?’ and ‘how to divide up?’ are not conceptually identified. It is more than a problem with how far along the range of commodity chains analysis should be undertaken; an important question about “how to treat convergence, divergence, and other links between separate chains” (Raikes, Friis et al. 2000: 401) is rarely asked. The system “is merely a descriptive construct at most providing a heuristic framework for the generation of data” (Kaplinsky 2001: 122).

Configurations of the input-output systems are understood by an assumption of an “essentially linear process” (Dicken, Kelly et al. 2001: 99) because the GCC narrative centres upon the global dynamics of functional linkages at the expense of the social relations involved with the constitution and transformation of chains. This logic of linearity frequently refers only to one chain in its entirety. The linear perspective gives little consideration for possibilities that separate production chains may interact with one another since it is not so effective in capturing “significant intermediary sets of decisions and processes” (Raikes, Friis et al. 2000: 418, Note 18) and it does not explore the ways in which socially contextualising processes bind agencies into a larger global industrial relationship. The production nodes are often regarded as operative sites “located within GCCs themselves” (Dicken, Kelly et al.

2001: 100) because the analysis of chain composition "passes over the particularity of individual nodes" (Leslie and Reimer 1999: 404). For that matter, the uniqueness of an individual place appears vague when analytical attention is paid to vertical connections of functional positions.

In addition, the linear-linked chain is typically imagined as a vertical system of top-down production sequences, which leads to a *deterministic* attitude towards the question of "what [are the] implications for the extraction and realisation of an economic surplus?" (Appelbaum and Gereffi 1994: 43). It is discernible that the perspective tends to stratify economic space by a structural principle "at a very high level of spatial aggregation" (Dicken, Kelly et al. 2001: 99). First, there is a politics of transactional links, demonstrated by the fact that commodities typically move from developing-country producers to developed-country consumers so that "[e]nterprises and states in the core … gain a competitive edge through innovations that transfer competitive pressures to peripheral area[s]" (Gereffi, Korzeniewicz et al. 1994: 2-3). The territoriality of the GCCs is employed descriptively to outline the spatial coverage regarding divisions of labour posited by the logic of comparative advantage. Meanwhile, connections of the nodes along the individual chains are examined in a matter of functional position, so that vertical commodity exchange relationships between local suppliers and transnational subcontractors are highlighted.

It settles the organisational arrangement of chain practice in a scalar binary (the local *vs.* the global) in addition to a horizontal division of space. For that matter, the GCC approach runs the risk of bringing about a conceptual maze that unduly imposes a homogenising influence upon understandings of economic convergence and divergence.

To sum up, vertical connections are underlined as a result of the analytical focus upon *linkages* between functional sites. The approach's attempt to interpret how "[c]ommodity chains 'touch down' in communities and industrial districts" (Gereffi 1997: 65) is never really that successful since the treatment of the "spatial dispersion or concentration of production and market networks" (Gereffi 1997: 68) flattens a diversity of multiple sites to a flat surface. With the understanding of this limit, geographical insight that highlights the multiplicity of production chains will be reviewed to assist in understanding the dynamics by which a productive site is extensively associated with certain localities to make up a chain.

2.4.3 The state as a fuzzy unit

Institutional frameworks refer to regulatory settings surrounding a chain and so influencing the processes along the chain which agents are incorporated into or excluded from (cf. Gordon 1988). Institutions that condition productive stages play an important role in shaping chain formats (although they were not specified in the early text of the GCC literature) (Gereffi, Korzeniewicz et al. 1994; cf. Clancy 1998; Bair 2005). Gereffi elaborates the dynamics of trade and investment regimes to delineate the international contexts of development in that "[t]he economic agents of supply and demand do not operate in a political vacuum" (Gereffi 1994: 99). Trade-based forms of transnational economic linkages are situated in circumstances of institutional *coupling*. Two sets of policy configurations call for special attention: that is, *development* strategies of export-oriented industrialisation adopted to promote the national economy in the first-tiered Asian NIEs; and import restrictions imposed on successful export countries in core countries for industrial *protection* (see Yoffie and Milner 1989). The policy stances of nation-states become coupled with "broader (de)regulative changes" of, specifically, a global financial market (Raikes, Friis et al. 2000: 400).

Nonetheless, a failure to incorporate the issues of state regulation into the GCC framework invites criticism (Raikes, Friis et al. 2000; Dicken, Kelly et al. 2001; Smith, Rainnie et al. 2002). Inter-firm organisation constitutes the focus of chain analyses; this implies that "internal chain relations are the only important axis of variation" (Raikes, Friis et al. 2000: 396). This stance inevitably comes to see "the state … [as] little more than a contextual backdrop colouring the particularities of national industrial orders" (Smith, Rainnie et al. 2002: 46). The position of national regulation in governing the constitutive process of a specific chain is undetermined, although Gereffi has argued that "state policy plays a major role in GCCs" (Gereffi 1994: 100). But the role referred to is "little more than trade policy" (Smith, Rainnie et al. 2002: 47) and fairly insubstantial. Gereffi (1996b: 433) explains that

> globalization … tends to diminish the influence of national origins on business systems, and to highlight the role of design, production, and marketing core competencies and strategic capabilities within and between economic sectors. The way firms do business in the global economy thus is determined to an increasing extent by their position in GCC, not their national origins.

This viewpoint envisages institutional "converge[nce] to a single efficient type through some universalising competitive process" (Whitley 1996: 411). The capacity of the state to control domestic industries is analytically underestimated and marginalised within this mode of thinking (Dicken, Kelly et al. 2001). It becomes a "false dichotomy" (Panitch 1997: 85) rendering the nation-state a fuzzy unit that has diminishing relevance to the development of international production.

2.5 Geographical reformulations

2.5.1 The morphology of non-linearity and multi-dimensionality

In contrast to the spatiality of the structural abstraction in the GCC narrative, many geographical appraisals have recently sought to expand the territorial embeddedness of commodity chains by representing the morphology of exchange relationships of production, distribution and consumption. A topological presupposition of 'network' is inspired by the concept of the nervous system in biology and electrical networks, and "is now in common usage in the social sciences as the emblem of an ambition to produce flatter, less hierarchical theories of the economy" (Thrift and Olds 1996: 322). The metaphor of network is suggested in the application of the concept to the analysis of production chains considering that

> [a commodity] chain maps the vertical sequence of events leading to the delivery, consumption and maintenance of goods and services – recognising that various value chains often share common economic actors and are dynamic in that they are reused and reconfigured on an ongoing basis – while a network highlights the nature and extent of the inter-firm relationships that bind sets of firms into larger economic groupings.
>
> (Sturgeon, 2001: 10)

The network metaphor surpasses a metaphor of chain in describing non-linear morphology of exchange relationships and multi-directionality of economic forces.

The former appropriately accentuate that the value-added processes “are organised vertically, horizontally and diagonally in complex and dynamics of configuration” (Dicken, Kelly et al. 2001: 99). This outstrips the chain metaphor which is very likely to “[restrict] our view to the linear/vertical dimension of production network” (Coe and Hess 2007: 8) in that it is extended to embrace fundamental nodes in horizontal scope (*e.g.* gender, legitimacy of various standards) which critically support exchange relationships alongside functional nodes of vertical dimension (Leslie and Reimer 1999).

Material and intangible inputs multi-directionally circuit round a network, so that “the privileging of one sphere of commodity circulation over another is ideally avoided” (Hughes and Reimer 2004: 5). Literature on commodity culture pushes a step further to engage in “more contextual understandings of the meanings attached to goods in different times, places and phases of commodity circulation” (Hughes 2000: 177). Various geographical lores of products (including a global sweep of geographical sensation, context-specific knowledges, discursive associations of impressions and aesthetic reflexivity) are identified in the course of flows and representations (Crang 1997) through a figure of displacement. There is a premise that recognises “contradictory organizations and lores available at different sites” (Leslie and Reimer 1999: 407). This position on spatial and interpretative transfers of productive inputs contributes to redeeming a failure of the chain perspective in anchoring commodity (or production) processes in places. In other words, it supersedes a tendency of GCC literature towards abstracting input-output systems from territorial specificity. At one level, the position concretes the dynamics that commodities are decoded, identified and informed are *multi-locally* demonstrative as a *travel* of commodities across sites of the chain (Jackson and Taylor 1996). It recognises that peculiarities of the places matter in “a multi-stranded and reflexive cultural process” (Weiss 1996: 104) of value creation (and allocation).

2.5.2 Actors in networks

The network-like organisations are analogous to the *webs of interdependence* (Powell and Smith-Doerr 1994) embodying “the organisation of social and cultural ties in economic linkages” (Hughes 2000: 178). The network, conceived of as an alternative interpretative concept, is conceptualised to challenge the sterile exchange forms of market and hierarchy (Powell 1990; Hamilton and Feenstra 1998). In contrast to the neo-classical view which tends to atomise economic actors, a socio-economic concern directs attention to socially exploring the formation of cooperation and collaboration. On this intellectual ground, an increasing number of geographers recognises “the importance of organizations as cognitive, cultural, social and political (spatial) framework for doing business” (Dicken and Thrift 1992: 283).

Connectivity is one distinguishing feature of organisational dynamics, by which “firms are seen as enmeshed in loosely coupled networks of reciprocity, interdependence and unequal power relations” (Taylor and Asheim 2001: 320). In terms of governance, the global economy is embodied as a set of integrated global production chains governed by increasingly decentralised corporate organisations. It reflects the fact that the organisational boundaries become blurred considering globalising impacts upon organisations of corporate governance.

Using the concept of the network as a way of referring to dynamic power relationships in industrial linkages is methodologically informed by actor-network theory (ANT) (Dicken, Kelly et al. 2001; Amin 2002; Yeung 2003; Dicken 2004; Hughes and Reimer 2004). ANT dictates that material resources (and institutions) are “functioning parts of ‘actants’” that, together with human actors, drive agency in a network (Thrift 1996: 262); simultaneously, the network “is able to redefine and transform what it is made of” (Callon 1987: 93; cited in Dicken, Kelly et al. 2001: 102). The mixing of various actants constitutes interaction which “is always bounded and circumscribed” in real *places*, and “[t]hrough the use of certain material resources, interactions can be stabilized, summarized and extended through space and time" (Murdoch 1997: 327; Hughes 2000).[7] Adoption of ANT approach leads economic geography to *relational* consideration for social practices among actors (Dicken, Kelly et al. 2001; Bathelt and Glückler 2003; Boggs and Rantisi 2003; Ettlinger 2003; Dicken 2004; Yeung 2005; Bathelt 2006).

Among others, theorisation of a global production network (GPN) framework developed by the Manchester School is more comprehensive. It is an actor-centred analysis to manifest formation of transnational production systems which is *scale-transcending* in feature. Notions of power, value and embeddedness are analytical integral. Relational attribute of power is highlighted, whereby a notion of relational geometries "refer[ing] to spatial configurations of heterogenous relations among actors and structures through which powers and identities are played out and

[7] For example, in the nineteenth century, emerging capitalists from metropolitan New York activated their *disembedding power* to alienate values of commodities from the cumbersome packages of agricultural products in a forward market through an advance of telecommunications and to incorporate a peasant economy and local credit systems in remote communities into capitalist modernity via a stretch of railroads to the Great West (Leyshon 1996; Kessner 2004). In this case, the information and communication technologies as technical objects have a significant bearing on an evolving transition of New York to a premier centre mastering nationwide (and then worldwide) financial systems.

become efficacious" (Yeung 2005: 38) is proposed.[8] Recognition of how "economic agents … operate under specific institutional and cultural conditions from which they cannot easily be separated" (Bathelt 2006: 226) is important in exploring the articulation of GPNs. This is considering that effects of cultural sedimentation, social fabric and institutional presence upon intentionality and the performance of co-exist with stabilisation of economic relations. Consequently, it requires concreting embeddedness of economic action to understand "the circumstance under which value can be enhanced" and "the possibilities that exist for value to be captured" (Henderson, Dicken et al. 2002: 449).

Hess identifies three aspects of embeddedness by demonstrating socio-institutional imprints which influence how actors behave, relational architectures reflecting stability in which actors cooperate, collaborate, compete and conflict and particular territories where actors anchor (Hess 2004). Societal, relational and territorial embeddedness are expounded in place of conventional territorially-fixed considerations. The reworking is directed at a fallacy of scalar dichotomy resulting from either a bias for solidification of territory-confined

[8] Critically, the scenario does not lead to a risk of 'anti-essentialism' overstating voluntarism and not inclining towards determinism of structural imperatives (Dicken 2004; Yeung 2005).

economic life or an overstress upon de-localising forces of globalisation. Critically, there emerges a topological view in a geographical space. The following moves to de- deterritorialise meanings of places in line with Massey's expanding upon the relational construction of spatial identity (Massey 2004).

2.5.3 A progressive sense of place

Literature on territorialised production clusters holds a common interest in the changing productive structure (*i.e.* the *specialisation* and *externalisation* of industrial operation at intra- and inter-sectoral levels) and its agglomerative concomitant. It tends to interpret the growth of industrial cluster by following the logic of *endogeneity* – to stress that an "inner momentum of falling production costs" (Scott 1988: 176) enables the pool of economic externality or to make concrete a crucial role of *untraded interdependencies* among local agents in enhancing "a local nexus of relational assets" (Amin and Cohendet 1999: 89).

An industrial cluster often refers to a certain *place* (which can mean cities, industrial districts, nations and supranational blocs *versus* a planetary integer) where production and transaction are located. The landscape of places is depicted as an outlook of social cohesion and cultural continuity. With regard to socio-economic production, the place appears as an *introverted* community in which individuals locally integrate with one another and encounter the rest of the world via a 'learning network' or 'innovative *milieu*' that they constitute jointly. These bounded territorial dynamics are from a Heideggerian perspective[9] – 'space/place as being' with a static notion *vis-à-vis* 'time as becoming' with a progressive connotation – that leads to a common recognition of place: the identity of a place is essentially single and built up via an inward-looking historical sedimentation enclosed by given boundaries. Yet, the perception is disputable considering a "spatially-varying nature of humanly-created milieux" (Johnson 1991: 137). Markusen is critical that such theses "owe their stickiness to the role of small, innovative firms, embedded within a regionally cooperative system of industrial governance which enables them to adapt and flourish *despite globalising tendencies*" (Markusen 1996: 294, emphasis added).The "coherent, settled and bounded" sense of place (Massey and Jess 1995: 218), thus, deserves a reinterpretation.

This is a world of transnational flows – transnational migrants, foreign investment, cultural imports, industrial technologies, business knowledge, super-national agreements and even financial crisis! They are mobile elements

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[9] Massey makes a trenchant comment on a reactionary idea of place/space in Harvey's 'time-space compression' (see Harvey 1989) and envisages an alternative interpretation of place with a progressive sense on a wider scale (Massey 1993; Massey 1994).

characterised by *interconnections*.[10] A global connectivity deriving benefit from an increasing advance in information and communication technologies has continuously circumvented the global with the relevant localities. As a result, it becomes less valid to delimit places with physical lines simply to underscore the specificity of the places. All the cross-border actions and phenomena that embody the presence of globalising practice and process *are* blurring boundaries:

> Definition in this sense [of place] does not have to be through simple counterposition to the outside; it can come, in part, precisely through the particularity of linkage *to* that 'outside' which is therefore itself part of what constitutes the place.
>
> (Massey 1993: 67, original emphasis)

The place is not a territorial enclosure but a porous site. The reason why the place matters is not so much in light of its territorial properties which are materially present in relative terms; rather, that it resorts to nuances of articulation: "a politics of connectivity and a politics whose relation to globalisation will vary dramatically

[10] For instance, the *maquiladoras* in the U.S.-Mexico border zone embody the formation of trans-border economic space; an emerging class of capitalist 'astronauts' (Portes 2002) takes on cosmopolitan distinctiveness to transmit soft capitalism trans-locally (Thrift 1998; Brown and Duguid 2001); a variety of 'mass actions' is carried out at the grassroots no matter whether they are politically organised or act spontaneously (Smith and Guarnizo 1998); or labour movements are trans-scale consolidated to campaign against a neo-liberalist discourse of global capitalism via virtual hyperlinks (Herod 1998; Waterman and Wills 2001).

from place to place" (Massey 2004: 17). Dynamics can render a place as "qualitative changes occurring in the nature, extent and intensity of social interaction on a worldwide scale" (Kelly 1999: 379).

In Markusen's comprehensive comparative work on the diversity of 'sticky places', she rightly substantiates the viewpoint that distinguishable configuration, transformation and prospect of industrial districts display "greater propensities for networking across district lines, rather than within, and a much greater tendency to be exogenously driven" (Markusen 1996: 294). It is true that the specificities of places progressively take on "the fact that each place is the focus of a distinct mixture of wider and more local social relations and, further again, that the juxtaposition of these relations may produce effects that would not have happened otherwise" (Massey 1993: 68). The perspective that views places "as juxtapositions of intersecting, overlapping, and unconnected global follows and historical fixities" (Amin and Thrift 1994: 10) is to put places within a wider spatial setting. Favouring Massey's reformulation of the sense of place, Amin and Thrift go on to conceptualise the global-local nexus by taking the local complexes as part of the global; in their terms, "[g]lobalisation … impl[ies] … a continuation of the significance of territorial diversity and difference" (Amin and Thrift 1994: 6) – and reversibly, "different places have very different experiences of globalization" (Massey and Jess 1995): 220).

There is an analytical shift from scalar relativisation towards process-based, relational networks involved with reinterpreting geographical implications of contemporary social organisations (Marston 2000; Dicken, Kelly et al. 2001; Amin 2002; Marston, Jones et al. 2005). Geography of global economy is referred to the spatial extension of 'associations' organised by interconnected economic *and* non-economic actors being enrolled in networks believing that localities should "be imagined as articulated movements in networks of social relations and understandings" (Massey 1991: 28; cited in Crang 1996: 51). Amin delves into spatial ontology of globalisation moves to propose a sense of *placement of practices* "to think of place in nonterritorial terms, as nodes in relational settings, and as a site of situated practices (of presence and absence)" (Amin 2002: 391).

Three intangible and micro-level natures of places are demonstrated to accentuate the power of actors to control transmission of information (Amin and Thrift 1992; Thrift 1996; Allen 1997). The elements are decisive conditions by which the place is "constructed out of a particular constellation of social existences, meeting and weaving together at a particular locus" (Massey 1994: 154): (1)

Representability: to be a meeting site for 'epistemic communities' (Haas 1992) to "generate and disseminate discourses, collective beliefs, stories about *what world production filieres are like*" (Amin and Thrift 1994: 13, emphasis original). (2) Sociability: to be a sociable context in which to exchange information, make agreements and establish trust through dense contacts and, thereby, make firm 'an expression of social knowledge', crossing organisational boundaries (Walker, Kogut et al. 1997; Brown and Duguid 2001). (3) Knowledgeability: to be a discursive mass, contributing to enriching the knowledge base and reinforcing market sensitivity for the purpose of "keep[ing] up levels of product and process innovation in a decentralised system" (Amin and Thrift 1992: 576).

At one level, this is a non-economic perspective accentuating that centred places are characterised by subtle socio-institutional exercises rather than economic entities constituted by pure input-output transactions. At another level, it suggests a de-territorialised interpretation to expound regional agglomeration of knowledge reaction (see Malmberg 1996; Malmberg 1997; Bathelt 2003; Bathelt, Malmberg et al. 2004; Bathelt 2005). As Amin and Thrift conclude,

> [t]hese centres of geographical agglomeration are, thus, centres of representation, interaction, and innovation within global production filieres … It is this unique ability to act as a pole of excellence and to offer to the wider collectivity, a well-consolidated network of contacts,

> knowledge structures, and institutions underwriting individual entrepreneurial, which makes a centre a magnet for economic activity.
>
> (Amin and Thrift 1994: 13)

That is to say, the capability for knowledge promotion is regarded as the determinant advantage for both corporate agents and local integrities in global competition. Knowledge evolution is not merely a *localised* process, nor is it generated simply by clustering effects of automatic, spontaneous circulation of knowledge and information. Instead, it necessitates combining intense exchanges of 'local buzz' with the creation of 'global pipelines' to enrich the extra-local sources of knowledge as well as to strengthen the individual firms' competence for innovation (Bathelt, Malmberg et al. 2004). In terms of centred places, their nodal positions are mainly based upon innovation ability. Their knowledge contents are not only accumulated by the spatial convergence of capital, resources, talents, information, knowledge, *etc*. but also enriched by extending the knowledge-transacting relations of places to counterparts co-located in the global webs.

The interpretative insights reveal that actors and their power are embedded in, and substantiated by, social arrangements and discourses, far more than atomic, mechanistic rationality in economically lucrative terms (Ettlinger 2003). These socio-institutional elements mean that places are "constructed out of a particular constellation of social existences, meeting and weaving together at a particular locus" (Massey 1994: 154), and the specificities of places progressively take on "the fact that each place is the focus of a distinct mixture of wider and more local social relations and, further again, that the juxtaposition of these relations may produce effects that would not have happened otherwise" (Massey 1993: 68).

In a network-informed mode of thought, places are conceived "as open and relational constructions" (Smith, Rainnie et al. 2002: 50), no longer invisible in the globalisation of a production network. This recognition helps to move beyond the conceptualisation of commodity chains as "simply structured through class divisions or the functional positions of producer and consumer" (Leslie and Reimer 1999: 403) in an unidirectional sense. It is necessary to include "the different degree and sort of power and 'powerlessness' to be found along and *external to* the length of a chain" (Raikes, Friis et al. 2000: 402 emphasis added; Henderson, Dicken et al. 2002; Smith, Rainnie et al. 2002) when thinking of the mechanisms responsible for geographical convergence through chain practices. I pay particular attention to governance mechanisms of state regulations at a national level.

2.5.4 State regulations in the chains

Increasing the amount of attention paid to an entanglement of a bureaucratic rationale with capitalist accumulation offers a distinct approach to theorising the state, and moves away from simply seeing it as a neutral institution there to correct market failures or as a political instrument that legitimises capitalist control over the labour process (see Pitelis 1991; Glassman and Samatar 1997; Yeung 1998). As Jessop argues, “the capitalist state is an essential element in the social reproduction of capital – a political force that complements the economic force of competition between individual capitals and assures the immanent necessities that cannot be secured through the latter” (Jessop 1990: 37). The state should be regarded as an actor; the force that the state exerts to govern or manoeuvre economic processes is inherent in exclusive territoriality of institutionalisation.

Smith and his colleagues comment on the limited treatment of state regulation in the GCC analysis. In the first place, they bluntly ask “why commodity chains cannot have a national or even local constitution, linking economic activities at various spatial scales?” (Smith, Rainnie et al. 2002: 50). Here the emphasis put upon national or local processes of chain arrangement does not intend to slice *global* chains into territorial sections of the chains. Rather, consideration is given to the reality that “social relations and social systems of production have important national and subnational variations which crucially can impact upon the performance of firms in place” (Smith, Rainnie et al. 2002: 50). In his comparative analysis, Whitley attaches importance to “the effectiveness of particular forms of business organisation

[that] is institutionally relative" (Whitley 1992: 5). As I will seek to show in **Chapter Five** the institutional embeddedness takes account of the fact that Taiwan's 'technology leverage strategy' influences the result of industrial decentralisation of the local IC sector.

However, it is problematic to exaggerate the stability and endurance of national business systems regardless of the transformation forces deriving from "dialectical tendencies of globalization towards homogenization and differentiation" (Yeung 2000: 399; Dicken 2003). Beyond this it is an issue of scale. Concern with the implications of national variation relates to an insight into representations of national scaling. The spatiality of globalisation is conventionally identified by a self-evident scale, under which all other scales are framed in an arbitrary power territory. The way to categorise spatial scales by a hierarchical ordering is a simplification. The continuing perception that exclusively focuses globalisation upon a scalar analysis at the global level has been challenged by geographers both theoretically and methodologically. They discern multi-scalar versions of trans-boundary networks and contest the assumption that national dynamics are replaced by super-national and/or subnational processes (Amin and Thrift 1994; Dicken 1994; Amin 2002; Henderson, Dicken et al. 2002; Sassen 2003). There is no doubt that states yield regulatory authority to the exigency of economic globalisation, as Dicken stresses that "[b]ounded political spaces matter" (Dicken 2004: 9). *But* it is *also* true that the globalising processes, in turn, "[take] place deep inside territories and institutional domains that have largely been constructed in national terms" (Sassen 2003: 1-2). For that matter, Smith *et al.*'s argument for a proper account for the national contingency of commodity chains is to take denationalisation of sovereignty seriously but not to confine the chain analysis to a certain scale of the state's territorial jurisdiction (Sassen 2000; Sassen 2002).

The second argument that Smith *et al.* propose is that "if attention is not confined to the international level, the significance of the state as an *agent* of commodity chain governance increases, as it includes industrial and other policies impinging upon the structuring of commodity chains" (Smith, Rainnie et al. 2002: 47, emphasis added). Indeed, the strategy that the nation-states regulate international economic activities is more than trade-centred policies. Regulatory barriers and incentives of FDI and industry policies which are implemented within an intra-national framework influence the spatial strategies of firms in light of market and resources' accessibility and rules of corporate operation (Dicken 1994). In addition, management of monetary policy and interest rates is also an active instrument through which states condition exchange rate fluctuations and capital flows (Gordon 1988).

2.6 An analytical framework for cross-Strait production

A variety of state regulations give prominence to a multiplicity of state-firm interactions. It produces "the complex outcome of a myriad of negotiating and bargaining processes *within* both firms and states as different interest groups and stakeholders themselves attempt to influence the larger-scale bargaining position" (Dicken 1994: 120, emphasis added). A *triangular nexus of interdependence* is argued to outline the characteristic that the firm-state interactions are intricately associated with inter-firm and inter-state relationships (Stopford and Strange 1991). Both firms and states are economic agents having capacities to exercise to various degrees within a structure – or, a network, from the ANT perspective.

For my research concern in this thesis, this nexus privileges an institutional environment at a level of political economy in which actor-specific practices work out to shape the configuration and geography of production chains/networks over time. Consequently, I argue that the spatial strategies of TNCs – if it is possible to see TNCs as a collective agent – are associated with the power play between firms and their home state, firms and their host state, and between home and host states which are entangled by economic, political and institutional determinations at multi-layered levels (**Figure 2.2**).

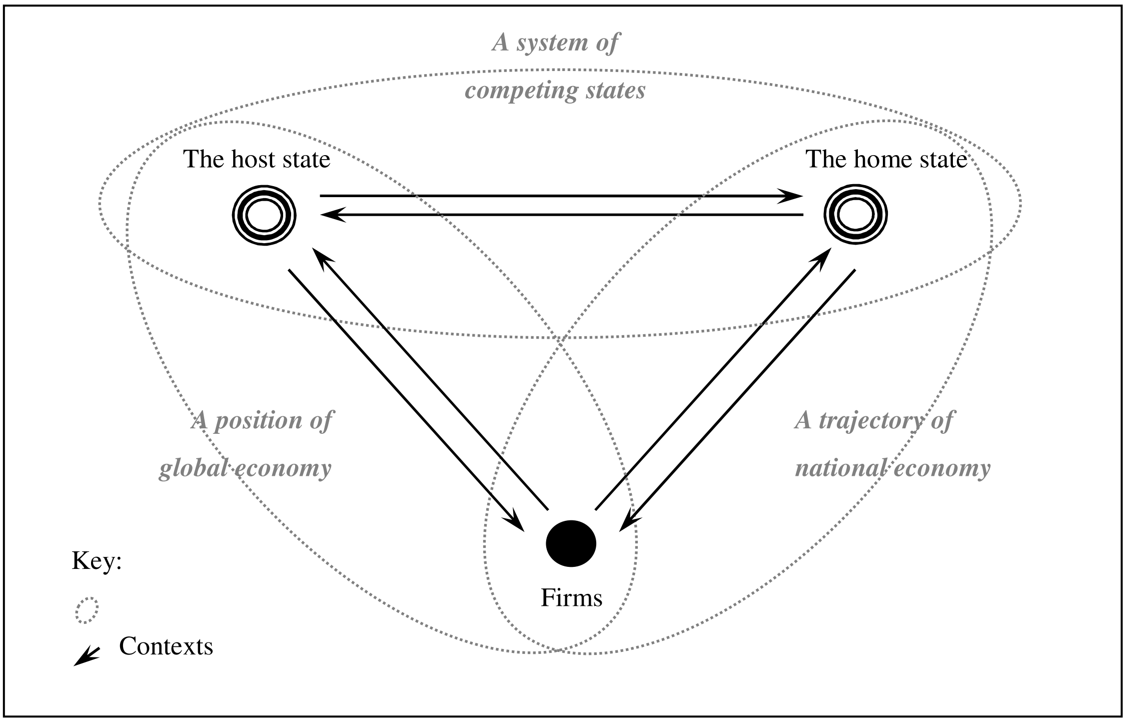

Figure 2.2 Triangular articulation of the firm-state relationships

The interactive statuses between these actors reflect differentiated recognitions, intentions and 'bargaining counters'. Pitelis identifies the power struggle between states and TNCs as a condition that might be described as 'rivalry-and-collusion', the nature of which "will depend heavily on whether the relationship refers to TNCs' own states or 'host' states, as well as whether the states in question are 'strong' or 'weak', DCs or LDCs" (Pitelis 1991: 142). It is important to recognise that this status is volatile in a *synchronic* sense, rather than a stationary matrix of firms and states.

In an Asian developmental context the guiding efficiencies of the national strategies were used to attach the growth of indigenous firms to an export-oriented policy environment and/or industrial linkages commanded by foreign investors. The status of indigenous firms appeared negligible *vis-à-vis* the governments: the firms were assisted, and dominated, by the states which had wielded their authority to provide subsidies, constitute national innovation systems, improve infrastructure *etc*. However, these firms, growing out of *a guided capitalist* context, have been making creditable progress in handling offshore production and accommodating 'triangle manufacturing' schemes.

The importance of government assistance diminishes in relative terms. For the firms, corporate capital capacity can be magnified through internationalisation, and technological improvement benefits directly from a diversity of strategic alliances with foreign TNCs. Exercise of such material economic practices is profoundly underpinned by the globalisation of business knowledge that enrols economic agents (including not only business leaders but also politicians) into international business communities (or networks) where up-to-date managerial discourses circulate (Kelly 1997; Thrift 1998; Yeung 2000; Thrift 2002). Nonetheless, in reality domestic firms are far from being independent of policy steers. The power balance evolves into a system of plurality away from one of a single model of state leadership. It is also possible that conflict and compatibility coexist in the firm-state interactions between the same pair of corporate individuals (and groups) and the public sector. As Gordon (Gordon 1988: 61) suggests, firm-state interactions become

> both cooperative and competing, both supportive and conflictual. They operate in a fully dialectical relationship, locked into unified but contradictory roles and positions, neither the one nor the other partner clearly or completely able to dominate.

Finally, I want to demonstrate a methodological argument for my empirical analysis. It is declared that "[t]he activities and strategies of firms in engaging with international production networks cannot be properly accounted for within theories of developmental state, as latecomer firm behaviour tends to be treated (usually implicitly) as an automatic response to policy and economic circumstances, rather than as a shaping influence in its own right" (Hobday 2001: 25). Attention paid to corporate action is not meant to belittle influence of the state interference, while it is significant to embrace a developmental context in general terms and distinction of state jurisdiction in specific terms. In the thesis, I seek to engage in a relational understanding by treating the nation-state as an institutional counterpart of corporate agents in economic development – rather than as a developmental structure in which the firms work.[11] There are two accounts involved with the revision. At one level,

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[11] However, the politics whereby the local matters are associated with the globalising tendencies embrace many different 'scripts' realised by agents of various natures in various scales, labour unions, international apparatuses, NGOs, *etc*. (Gibson-Graham 1996). My attention to the two agents is to

the Asian NIEs have been seeing considerable transformations in economic constitution. As such, reflection upon the empirical presence of, in particular, entrepreneurial enthusiasm for globalising business and a regulatory shift to liberalise the national economy is analytically indispensable for tackling the reconfiguration of the regional economy (Yeung 2006). At another level, and relatively, I intend to get away from an epistemological given of literature on the Asian developmental state for its theoretical position tends to structurally settle economic trajectories within institutional environments arranged by the nation-states.

2.7 Conclusion

Within this chapter I have looked at the chain metaphor employed widely to map and analyse the geographical convergence and divergence of economic activities. Building upon the organisation-based analysis of the GCC approach, the general framework for the study of global manufacturing integration was managed. But, despite acknowledging the useful conceptualisation that allows for positive prospects in developing country exporters, identifies the role of actors in governing

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make the narrative more focused, rather than meaning to confine (political) economic affairs of complexity to a dual image of visible flux of capital that drives materials and intangibles to become globalised and for nationally/regionally-tiered states to retain a commitment to their territorial turf.

economic development and problematises a state-centric analysis, I reflected upon the dualism of governance stylisation and the linear view that leads to an overview of the particularities of individual sites in constituting the chains.

The reformulations argued that the composition of production chains is multiple and persistently shifts. At an organisational level, it does not only indicate a multi-layered and multi-faceted matrix of manufacturing but also stresses that the dynamics of power relations between economic agents are associated with the reorganisation of functional activities across space. Here, the agents should include those actors out of the particular chain in addition to buyers and suppliers. I highlighted the role of the state. The nation-state is not a mere territorial entity but an actor involved with geographies of value flow. As such, the implication of the border is more than a boundary to divide territorial jurisdiction in terms of international relations; intangibly, it represents the territorial struggle between corporate agents and state agents in respect to cross-border productive capacity. At a spatial level, the geographical literature on economic globalisation was particularly drawn on to reflect upon Gereffi's chain framework of a 'self-evident global scale'. Geographical insights are invaluable in drawing attention to "locally scaled practices and conditions articulated with global dynamics, and … the multiplication of cross-border connections among various localities fed by the recurrence of certain conditions across localities" (Sassen 2003: 3). Such a position transcends a tendency towards geographical reductionism, which can consist of either a steamroller-like global assimilation on the one hand or a territorially-bounded local defence on the other.

In the next chapter I will discuss the research methodology employed in examining the strategy of Taiwanese IC firms in building trans-local productive capacity as part of global IC production networks.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter focuses upon methodological issues in the practice of doing research. The chapter will proceed in the following way. **Section 3.2** is a wider discussion of my methodological strategy which is adopted to achieve the thesis objectives. **Section 3.3** focuses on the methods of data collection, including documentary and field research. A discussion of the practicalities of the research and my positionality in relation to the subjects and objects of the research form the basis of **Section 3.3**. That section also draws attention to the dilemmas and contradictions that I faced in obtaining information, the tension that exists between the desire to conduct a rich analysis and the partiality of information generation, and how I began to resolve these issues. The practicality of doing corporate interviews makes up **Section 3.4**. It is concerned with the representation of knowledge that inhabits the contextual politics of cross-Strait business (cf. Sabot 1999; Ward and Jones 1999; Reid-Henry 2003). This section provides an account of the difficulties and challenges of carrying out qualitative research in relation to cross-Strait issues, highlighting the way that these problems are compounded by a highly politically-sensitive setting.

3.2 Methodological considerations: Explanatory power and data collection

3.2.1 A mix of research methods

Having outlined the framework of research I shall now proceed to describe the methods of data collection adopted. The selection of research methods depends upon "how they are used to ask which kinds of questions and how the results are interpreted" (Nightingale 2003: 79). That is to say, the methods flow conceptually and rationally from a series of intriguing questions that become concrete with the evolution of the research project (Valentine 2001).

The rationale for my selection of methods involved two dimensions of questions. The first dimension was concerned with factual conditions of industrial operation, including the geographical reconfigurations and governance of the global IC industry and the organisational measures and spatial strategies that individual firms have taken in accordance with the changes of industrial settings. Preparatory questions were developed to identify practical areas of product type, processing technology, market segments, production organisation, labour management and locational selection. This aimed to reveal the processes by which the Taiwanese IC industry has been successful in carving out a niche within the global IC production chains and the geographical implications of this.

Another dimension sought to understand the contexts within which agents are embedded. The contexts or settings refer to an actual presence/milieu that is geographically specific and cuts across historic contingencies. In particular, corporate agents – such as enterprises and individuals (Clark 1994; Schoenberger 1994) – and other types of organisational agents possess "multiple, path-dependent spatialities fashioned by their transactions, structures and interconnectedness within economies and societies, and the multiplicity of places (local and global) where they operate" (Taylor, Ekinsmyth et al. 1997: 59). When exploring cross-border economic activities, analytical attention is drawn both to peculiarities *and* spatial tensions that are substantial. They justify methodologically investment to ensure that the knowledge of policies and practices pursued by these firms are valuable since "the strategy adopted in any one area has implications for other choices" (Schoenberger 1991: 181). The research considers "spatialities intrinsic to actors' actions that are themselves a mirror and reflection of the information, the prejudices, and foibles and the traits of the agents that perform them" (Taylor, Ekinsmyth et al. 1997: 60).

The data were gathered by a mix of research methods, including secondary data sources and field methods of corporate interviews and on-site observations. Evidence from various sources was corroborated repeatedly in the process of data collection to avoid bias or data error (Yin 1984). In addition, the "silences and incompatibilities that become evident when data sets [are] produced by diverse methodologies" (Nightingale 2003: 80) were critically acknowledged to represent *a partial view generated in situated contexts*. For me it is not necessary to evade the variable results (gleaned by field-based methods particularly) which were likely to be full of subjectivity, although compiling the multifarious and tangled evidence was indeed a challenge. One reason is my own interest in learning stories from the 'real world'. Another reason draws upon what Clark discusses a 'close dialogue' (Clark 1998: 79), which

> "is used as the raw material for a reconceptualization of economic behaviour. It relies upon the process of codification which, according to Bourdieu (1990), provides a means of building up a general picture of the observed world, bridging local observation with broader interests and concerns, and thereby making a world rather than simply accepting as a given ready-made world composed by theorists".

He argues for *making a world*; that is, a matter of intellectual construction which is achieved via "the free association of one's imagination and intuition" (Clark 1998: 76) in the process of embracing "a fine-grained, substantive appreciation of diversity" (Clark 1998: 75). The data collected were also organised in the form of a database, which is beneficial for data composition and for further studies.

3.2.2 Appropriateness of the qualitative approach

> In intensive studies the individuals need not be typical and they may be selected one by one as the research proceeds and as an understanding of the membership of a causal group is built up. In other words, it is possible – though not mandatory – for intensive research to be exploratory in a strong sense.
>
> (Sayer 1992: 244)

The universality and neutrality of the qualitative materials bear the brunt of critiques. A precise point that positivists focus upon is the validity of empirical findings. This is in light of unquantifiable outcomes. For example, business interviews are called into question, over matters such as whether the information acquired is partially oriented by a certain group of 'sample firms' and as a result of restricted access. However, the positivist point of view is rebutted by qualitative researchers. I shall now review debates on the explanatory power of these two methodological paradigms.

A "research instrument … [is] ultimately dependent on epistemological justifications" (Hughes 1990: 11; Hoggart, Lees et al. 2002). For the positivists, the accuracy of interviews is questionable. An interviewee may have a poor memory for events, or strive to maintain a good image or have an axe to grind. Meanwhile, the 'highly subjective nature' of field materials fails to produce generalised laws for explaining and predicting empirical correlations in a rigorous sense of objectivity

(Richards 1996). Proponents of qualitative methods are opposed to those critiques and mount effective rebukes to the critiques of positivist epistemology by explicating philosophy (Harvey 1969; Sayer 1992; Hoggart, Lees et al. 2002). Firstly, the positivist approach is based upon a scientific ontology that only accepts things of direct visibility and places an emphasis upon *abstracting* empirical regularities as laws. It tends to pursue explanatory principles which are testable repeatedly and constantly predicable. Such logic may be efficient in understanding a surface appearance of realities. However, it is unable to uncover the subtlety of motivations behind the empirical exterior since it fails to "distinguish between accidental associations and causation" (Sayer 1982: 119), and the things that are not immediately accessible to the senses are obscured or excluded by an analytical inclination to cohere and unify divergence in pursuit of definitive 'truth' (Lawson 1995). Moreover, positivistic social science adopts a top-down stance, aimed at modelling empirical regularities in a neutral manner. This requires a qualification of empirical observation within preconditioned, closed systems. A manipulative methodology may be adopted in an attempt to control the bias of researcher and respondent and any other external variable so that hypotheses can be objectively confirmed. "[F]or no other purpose than to increase understanding of a particular phenomenon" (Kitchin and Tate 2000: 212), knowledge formulated by positivist deduction largely ignores the essences of specific contexts. The epistemology of objectivity and value-neutrality incurs a blunt reproach: “object and unbiased knowledge is impossible because our access to reality is never unmediated” (Hoggart, Lees et al. 2002: 4).

An academic orientation of qualitative researches, by comparison, is towards making sense of human phenomena (re)presented in social structures which “are open systems and subject to constant change” (Hoggart, Lees et al. 2002: 17). It is well known that knowledge of “people’s elusive sense of place” (Limb and Dwyer 2001: 3) is context-dependent and socially constructed. In particular, qualitative field methods sensitive to processes and people are efficient tools that can capture and illustrate the truth that the informant tells “about themselves and their industry” (Clark 1998: 79) and are able to dig into indefinable information – which either has not been surveyed statistically (*i.e.* a definite number of the Taiwanese IC firms in China) or could not be made public (*i.e.* the under-the-table transfer of capital, technology and human resources) (Schoenberger 1991). What makes more sense is to “produce a coherent and illuminating description of and perspective on a situation that is based on and consistent with detailed study of the situation” (Ward-Schofield 1993: 202; cited in Bailey, White et al. 1999: 172).

One thing that is critical here is to ponder whether the acquisition of messy and creative realities is open to the charge of producing "debilitating effects of fragmented identities and separate loyalties" (Clark 1998: 83). This puzzle of practice is tied to the methodological substance of validity. The procedures to acquire field-based information are not necessarily linear, but proceed "in a series of iterations with modifications of understanding occurring throughout the interviewing state as well as during the formal analysis and writing up stages" (Sykes 1991: 4). It is 'a permanent self-critical stance' on which an intellectual rigour of qualitative researches relies – an imperative to striking a balance between rational reflecting and subjective reporting (Schoenberger 1992; Baxter and Eyles 1997; Wainwright 1997; Clark 1998; Bailey, White et al. 1999).

3.3 The practice of research

3.3.1 Secondary sources

Documentary evidence contributes to contextual material that "embeds the research questions in broader empirical traditions" (Valentine 2001: 42). Compared to field materials, one distinguishing point of secondary analysis is that "it forces the researcher to think more closely about theoretical aims and substantive issues of the study rather than the practical and methodological problems of collating new data"

(Hakim 1982:16). Hence, these sorts of data – whether in number or in text – were as vital as the field materials before, during and after the empirical stages of research.

The secondary data were multiply sourced, and grouped into four categories: first, numerous forms of statistical materials from government censuses and international market surveys (*e.g.* the IC Insight); second, existing academic and commercial studies in the form of journal papers, books, and consultation reports; third, other texts including on-line archives of corporate annual reports and releases of government communiqués and archives of newspapers. There are disparate stances among the newspapers so that it is a risk to presume neutrality and integrity of news coverage, press comments or editorials. For example, the *China Times* and the *Liberty Times* – which constituted materials for a textual analysis of state-business interplays – are 'barons' of the Taiwanese press, standing for two sides of the political spectrum and having different opinions on Taiwanese outward FDI to China. These sources covered a wide range of general informant and critical analyses regarding industrial intelligence and programmes of public policies. The fourth aspect was industrially-focused with reference to known industrial press sources, *e.g.* the Electronics Business, the Silicon Strategies, the EE Times and the DigiTimes in English, and the Business NEXT, the Computex and the Micro-Electronic Magazine in Chinese. These sources produced such a prodigious volume of written evidence that I had a long process of extracting and evaluating materials to develop an industrial profile at the incipient stage of research and for cross-referencing with field materials.

One important caveat is necessary when using official censuses. As warned, "[t]he official status of much secondary data [has] given them an authoritative air which can be both reassuring and beguiling" (Clark 1997: 57). This requires researchers to have a reasonable scepticism and not to be blinded by an authoritative rubric. For example, consider data on Taiwanese investment to the Mainland in 1993 (**Table 3.1**) which draws out several problematic issues.

Table 3.1 Comparison of statistics: The approved investment to China in 1993

	MoEA, Taiwan	MoC, China	Ratio (MoC/MoEA)	TW.Modif.
Item	1,262 cases	10,948 cases	8.7	9,329 cases
Amount	1.14 billion US$	3.139 billion US$	2.8	3.168 billion US$

Source: Industrial Development & Investment Centre, MoE (http://www.idic.gov.tw/html/c3409.htm)
Notes: (1) MoEA is short for the Ministry of Economic Affairs, Taiwan, and MoC is short for the Ministry of Commerce, China. (2) TW.Modif. means the data that were *officially* updated by Taiwanese authority.

Firstly, as shown, in 1993 there were 1,262 cases of investment from Taiwan to China which amounted to US$1.14 billion according to Taiwan's Investment Commission, Ministry of Economic Affairs. However, the numbers claimed by Chinese authority was as high as 6,247 cases and amounted to US$53.95 billion respectively. There is a big difference here – 8.7 times for cases and 2.8 times in amount – despite both being official sources. Secondly, figures in the final column of **Table 3.1** are much closer to the Chinese statistics. In March 1993, a regulation issued to supervise the westward investment, by which the firms having done business in China but not yet registered were required to do so officially within three months. The data revision is associated little with techniques of statistics *per se* but much more with *political implications*. It certainly implies that the data released prior to 1993 were far from genuine numbers. But, paradoxically, the Taiwanese Government was fully aware of this quantitative gap between statistical results and reality.

It is argued that "facts of strategic manoeuvrings, conflicts, and tradeoffs, or historical contingencies ... may be rendered opaque by aggregate statistical manipulations" (Schoenberger 1991: 181). At least two reasons for the gap can be identified. The first is a technical issue in relation to statistical sampling. For example, data of proceeding trades were compiled as an investment category in China but as a trade category in Taiwan. In other words, the divergence in numbers resulted from the discrepancy in defining taxonomic groups. In addition, the fact that Taiwanese firms failed to fully report their overseas operations is the second reason obscuring the accuracy of statistic figures (Yang and Tu 2004): on the one hand, a tedious reporting process was an administrative burden that made the firms reluctant to register with the Investment Commission; on the other hand, a desire to evade paying taxes or to keep their flow of funds confidential was an important factor leading the firms to conceal their foreign investment from the government.[12]

It is not my purpose to judge which authoritative resource is more authentic here. Instead, I intend to suggest the necessity of deliberation in applying the sort of 'official' data directly to studying cross-Strait exchanges. I was aware of 'statistical manipulations' more discreetly, which led me to rethink the nature of the data *per se* – the data were expedient figures referring to implicit messages of political temporality. For me, the summary statistics in the methodological stance of *situating knowledge* serves not simply as an extensively descriptive role but also shows that the material itself is a problematic object within the research (Sayer 1992). On the one hand, the authoritative status of quantitative methodologies entails being situated in a broader context formed by causality and politics of temporal depth (Nightingale 2003). On the other hand, such numerous materials are also artificially produced by those priorities highlighted by administrators (Clark 1997) and in specific

[12] For enterprises, all income from overseas operations needs to be accounted for in relation to their liability for tax, whereas personal income tax is calculated only on domestic income.

(regulatory) circumstances. For that matter, I made use of the data with quantitative reference to "set[ting] the topic in context" (Markusen 1999: 872) and checked diachronic changes at a primary level.

3.3.2 Corporate interviews

Corporate interviews are commonly adopted in obtaining first-hand data from firms. I conducted interviews during 2004 and 2005 (from December 1st, 2004 to May 5th, 2005 and from October 14th, 2005 to December 9th, 2005) in five cities: Taipei and Hsinchu in Taiwan, and; Shanghai, Suzhou and Nanjing in China. The fieldtrips to China were held twice in 2005 (one was from March 21st to April 8th and the other was from October 18th to November 3rd) as the amount of time I could realistically spend there was financially constrained.

Qualitative interviewing design takes shape by degree, which is an iterative process to repeat information gathering, analysing and testing (Rubin and Rubin 1995). By doing so, the research topic can be narrowed down and the core point can emerge gradually. I did not ask the interviewees to complete questionnaires. Providing informants with a range of possible answers was unlikely to cover the diversity and complexity of industrial practice, pre-coded answers might have restricted the attitudinal and motivational responses of informants (Schoenberger

1991). *Semi-structured* interviews were seen as a more appropriate strategy to determine how the IC industry as a whole has undergone change. In the fieldwork, the questions were continually refined/reorganised to explore the relevant themes which emerged as the preliminary results came out.

Semi-structured interview has a number of strengths, of which three are particularly important. The first is flexibility. The questions used in a semi-structured questionnaire are open-ended. The interview is not simply question-and-answers, as it is more appropriate to undertake conversational-based interaction with managers. The phrasing of questions need not be fixed but can be adapted in line with "how the interview develops, the knowledge of the respondent and the level of understanding of the interviewer at the time of the interview" (Healey and Rawlinson 1993: 344). As such, I was allowed to "go back over the same ground, asking the same questions in different ways in order to explore issues thoroughly; and interviewees c[ould] explain the complexities and contradictions of their experiences" (Valentine 1997: 111). Secondly, rich narratives are displayed unintentionally via detailed examples in open conversation, particularly if questions are tailored to individual interviews. By doing so, I was able to stimulate debates with respondents to pick apart agents' strategies for real-world predicaments and to explore their analysis of specific issues as the interview progressed. Information yielded could thus be mutually validated by way of cross-checking with the analysis of statistical materials. Thirdly, initial suspicions between the researcher and informant are mitigated in a face-to-face encounter, and as discussions proceeds a rapport can be developed. Potentially useful information can not only be obtained from what informants say; tones and gestures often unwittingly reveal attitudes towards business environments (Butler 2001; Jackson 2001). Reading the rich detailed and multi-layered (con)texts helped in piecing together a more inclusive picture of the cross-Strait investment and perceiving discourses of the firms' de/re-territorialising.

Practicalities

The corporate interviews were conducted with reference to general guidelines, while every interview differed according to the background and context of the interviewed company, the field in which the informant specialised, the rapport developed with the informant, my own performance as an interviewer, and time constraints of the interview. I now provide more detail of my in-depth interviews with IC professionals.

(1) Who to talk to?

It is impracticable to conduct interviews with all the relevant corporations due to time and cost considerations. Originally, I intended to take representative firms on the strength of the companies' market niche/share, technological competence and profitability.[13] However, recruitment of potential informants in targeted corporations did not go as well as wished considering the narrow point of entry. Finally, the selection of the corporation samples was made at random by means of snowballing.

I carried out 52 semi-structured interviews with 37 companies (**Appendix A**), including firms located in the IC production chain, two administrative institutions of industrial parks, one press agency and one industrial association. The interviews covered most parts of the IC production chain although I did not (and could not) pursue informants following an exhaustive inventory of companies. An elite group of electronics experts was identified as my potential informants. They were insiders, clear about constraints and opportunities open to the IC industry as a whole and the firm's investment business. Those in managerial positions had the power to decide and execute corporate policy. The major group was composed of senior managers (from department-level directors to VPs and CEOs) and senior engineers

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[13] Common Wealth, a business report published annually by a noted and reliable business journal publisher, provides an authoritative index of corporate performance. The samples of the companies investing in the YRD are chosen from those that remain in the list of the top 1000 during 2000- 2003. This annual survey, considering manufacturing enterprises in Taiwan, is conducted on the basis of five indicators (revenues, revenue growth, return on equity, total and profit). Basically, the methods for survey are similar to other business journals, such as Business Week.

(specialising in various professions) in selected top IC firms. It is worth remarking that most of the managerial respondents held important posts directly concerned with engineering-related tasks in their firms.

As well as the respondents from Taiwanese-based companies, I also contacted several senior managers from start-ups operated by 'returnees' (that is, Taiwanese and Chinese nationals who had been either educated or worked overseas, often in Silicon Valley, California) and in Chinese companies with government backgrounds. Extending the range of ownership categories was considered to be helpful to triangulate the reports offered by the Taiwanese companies since information (including rumours) often circulated rapidly throughout the industrial circle, and since interpersonal exchanges were common even if they might specialise in various professional segments, work in differentiated establishments, and even stay in discrete locations. Many people were friendly with one another because they were alumni of the same university or worked in the same lab or firm in the US (cf. Angel 1989; Hsu 1999; Oinas 1999). Consider one of many examples that I learned about in the field: a Taiwanese expert running a foundry in Hsinchu was a major shareholder of a design start-up in Shanghai whose Chinese founder had made the acquaintance of the semiconductor 'veteran' when engaging in venture capital in Silicon Valley.

In addition to corporate workers, I also interviewed two people working in the Taiwanese industrial press, and three director-level administrators of industrial parks and industrial associations in Shanghai and Suzhou. An additional remark is necessary here. Although the agency of the states is one of the main concerns in the research, governmental officials were not included among my interviewees simply owing to impossibility of access. I made a compromise by gleaning officials' speeches or interviews released by the press. Citation of their statements was perceived to be a feasible method to find out adoptable information about governmental attitudes towards certain agendas –what the officials might have said in an interview was very likely the same as that which they declared publicly in authoritative terms.

(2) The procedure

All of the interviews were pre-arranged by phone and conducted in person at the respondent's place of work wherever possible. Having obtained prior permission before a visit, I was generally welcomed by the respondents. To maximise the quality of the interviews, I allocated specific question areas to different respondents in each firm according to their job role (**Appendix B**). Consistency was addressed by means of an interview checklist, a list of topics to be covered with all respondents, whilst allowing them freedom to describe their own experiences in their own terms. I usually interviewed a single respondent, but in several cases more than two people were interviewed. Generally speaking, most respondents appeared keen to conduct the interviews and they lasted about one hour on average. Two interviews lasted about two-and-a-half hours but, at the other extreme, one informant wound up the interview after only 15 minutes.

I tape-recorded the interviews, except for two respondents who turned down my request to do so. Unfortunately, three interviews came out blank because the recorder was faulty and an additional three had poor sound quality because of background noise. The notes I took during and directly after the interviews were analysed to provide information. In addition to the pre-arranged interviews, I had follow-up interviews with several respondents via a direct visit or web phone. Some opportunistic – and so unrecorded – interviews were also conducted with individuals at a trade fair and on a staff outing. The former was a B2B exposition, eMEX, having been held since 2002 in Suzhou. The exposition was held with the aim of promoting the electronics sector in the Suzhou area and its sponsor was a quasi-public agency constituted jointly by a government-appointed board of Suzhou City and an affiliated office of the Taipei Computer Association (TCA). The staff outing opportunity emerged when one respondent invited me to attend a two-day trip with his department colleague. The transcription was done on my return to the UK.

(3) Confidentiality

"Confidentiality is a particular[ly] thorny issue" (Valentine 2001: 49). When asking the informants to talk me about matters that might include professional, commercial, political or potentially sensitive information, I endeavoured to keep all interviewees anonymous. They were given pseudonyms which were coded with a serial number (of interviewing sequence). I avoided displaying trademarks, abbreviations or acronyms, considering that many IC firms that I visited were easily identifiable. But I did not disguise corporate locations in case the data and interpretation were confused. As a result, some details had to be suppressed in order not to provide a set of clues that, taken together, would lead someone else to be able to identify the firms. However, this was not the case if specific business news or corporate affairs had been released or were well-known.

Hurdles and tactics

The intensive, flexible format of the open-ended interviews was of use to probe the process of cross-border investment/production and potential contradictions and to generate in-depth geographical accounts. However, "[f]ieldwork is permeated with the conflict between what is theoretically desirable on the one hand and what is practically possible on the other" and "[i]n the conflict between the desirable and the possible, *the possible always wins*" (Buchanan, Boddy et al. 1988: 54, emphasis added). Many expected and unanticipated dilemmas and issues came to light during the interview period. They were complexly bound up with each other and played an important role in shaping the interviewing processes and the acquisition of information.

Obtaining primary knowledge of the semiconductor field was the first obstacle to overcome. In particular, the issues I needed to master covered four major segmentations and a bifurcation of auxiliary sections (*e.g.* equipment vendors and distributors) owing to a fine division of labour. I had to be able to identify technical jargon commonly used in the IC industry and to learn about the process of chipmaking, the applications of IC components and trends of technological advances. It was a difficult job for me, a computer illiterate, to figure out the cryptic electronic world! It was for the purpose of being able to make sense, and make knowledgeable assessments, of what respondents might say lest I got lost in a maze of technology-laden vocabularies and so failed to grasp the contexts and more intimate insights which were useful for my data collection. To accomplish the task, the best policy was preparation. Learning the 'working vocabularies' began when I decided to select the industrial sector as my research object, and this ultimately worked out.

Challenges in the field were even trickier than those I faced at my desk. Interviewing is a social encounter fraught with reflexive ideas manifested by axes of social identities. It is described as "a game in which participants often are playing with a different set of rules" (McDowell 1992: 214). The rules consist of a power matrix: elites are talking with less powerful groups (England 1994; Richards 1996; Desmond 2004). In such encounters the elites tend to "have the upper hand by controlling access to knowledge, information and informants" (Valentine 1997: 114) and by "impos[ing] his or her power agenda in the interview" (Schoenberger 1991: 182). As a result "the interviewer is more often in the position of a supplicant, requesting time and expertise from the powerful [corporate informants], with little to offer in return" (McDowell 1992: 213). The problem was quite true in my experience. Respondents' narrative accounts were prone to go adrift and strayed around the latest products, unintelligible engineering, anecdotes, and personal experiences of living in Chinese cities or encountering verbose bureaucracy. Sometimes I wondered if they received my request for an interview in expectation of disseminating new smart devices or expressing their appeal (to policy-makers) by having their business affairs prioritised through me who would make their narratives public, or if they (the resident engineers peculiarly) simply liked to help with enthusiasm and have a chat (with someone from their home town). For fear that an interview went too far adrift, I struggled to keep the discussion focused upon the issues – and struggled to do this while maintaining conversational fluency at the same time.

Reflected by methodological rationality, the term ‘elites’ is an arbitrary one “without any substantive conceptual depth” (Woods 1998: 2101; cited in Smith 2006: 646). In light of my interviewing process, those managers and engineers I met did not exactly intend to exert their authority of a peculiar profession upon our relationship when talking. As alluded to, my unfamiliarity with specific expertise in a particular field could be offset to some extent by prior desk-based study. What challenged me more lay in unfamiliarity with how to conducts a visit to and interact with the respondents in an office suite who had professional knowledge – and presumably owned social power by mobilising ‘divergent sources of social capitals’ (Schoenberger 1994). I knew well that the sort of self-conscious feeling was reflected by my own preoccupation with differences of occupations, social status and living experiences. Concretely speaking, my working-class background and teaching experience caused me to be more hesitant and less assured of handling technology-laden interviews with predominantly male experts than if I were doing so with high school students and parents.

My attempt to be perceived as “one of them” (Schoenberger 1992: 218) put me under considerable pressure, and sought to over come this problem through a number of strategies. First, I sought to mask the obvious visual signifiers of position by giving off the appearance of an academic. Dressing in smart and sensible attire was helpful in creating a good impression on the respondents, and which was a good way to raise my own self assurance. An ability to display my professionalism and a sound knowledge of the subject under discussion was actually of more importance. Asking questions succinctly and to the point substantially demonstrated my professional attributes that led me to win the confidence of the respondents. A second tactic was to deal with my gender. Being a female researcher doing a study in an industrial realm of *masculinity* was another challenge. One young male geographer, who was conducting similar fieldwork in Shanghai and smaller cities in the vicinity, told me that ‘smoking’ was his vehicle for digging out stories behind the scenes since “a smoky room is particularly a space [in which] we fellows’ talk”. On some occasions, this did seem like a strategy that would work. But I did not perceive this to be a particularly strong or failsafe strategy – not all the bosses had the time to befriend him in the ‘smoke’ after all. I found that my female status could be helpful, as I was seen as being “less threatening, more intriguing, or presumed to be a better audience for the recounting of exploits” (Schoenberger 1992: 217). Drawing upon my experience, I agree that ‘acting dumb’ (O'Connell Davidson and Layder 1994: 146; cited in Valentine 1997: 121) is a smart tactic to encourage the senior, male respondents to tell more details and give a clearer explanation. This tactic was also useful – and necessary – when their reports were totally beyond my comprehension.

Compilation and analysis

The transcription was done on my return to the UK. Those well taped-recorded conversations were transcribed verbatim in Chinese. On average, transcription required about one hour for every ten-minute. There were several stages of my building analysis from the transcription. Time slots for each stage were not distinct; rather, the analysis “involve[d] going through material, then going back to check or change in the light of later ideas” (Crang 1997: 188).

Firstly, I read through the transcripts to mark up changes of tones (such as emphases, pauses, or hesitations), while the conversations were still fresh in my memory. This was for fear that actual opinions an interviewee intended to express could be hidden or misunderstood by literal meanings. Secondly, I marked key words of the text that interviewees used. Then, each response to one specific question/issue was labeled by interpretive words abstracted from the data in the margins. All the passages were summarised subsequently. In many cases, I returned to the tapes to grasp “the ‘flow’ of a particular conversation, to locate the context in which a particular view was expressed” (Jackson 2001: 203-204). This coding process was undertaken manually, so that I could become aware of how interviewees made sense of their dispositions. Thirdly, a further phrase of analysis was a second reading across the interviews. I noted down common/various discourses by linking the materials, and drew out ‘silences’ in the contents.

3.3.3 On-site observations

An on-site (*non*-participant) observation was an additional tool in the fieldwork. If the intensive interview is a method executed for the “understanding of an interviewee’s ‘mental set’” (Hoggart, Lees et al. 2002: 209), then I see observation as reading the landscape as text as a short-cut to making sense of substantive conditions of space-time experience in order to look through “communication of meaning about places and the political manipulation of space” (Aitken 1997: 204).

Observation acquainted me with unfamiliar spheres in relation to potentially necessary materials and gave me greater understanding of the situation. It is, as Sayer argues, “precisely because causal groups are selected, [that] the ‘logic of the situation’ is often relatively easy to discover” (Sayer 1992: 248). In many cases, the potential materials were more intangible – *e.g.* the business culture of the industrial circle in the IC sector (and electronics industry as a whole). It is an experiential-oriented sort of knowledge, which eluded me as an outsider. Even if I had learned some explanations and descriptions from written information, direct observation in person revealed the subtleties of characters and the contextually relevant circumstances became more lucid.

The pertinence of making an observation goes with an intellectual sense that ‘geography is everywhere’ (Cosgrove 1989). Visual discovery of spatial formats adequately incorporated a substantiality of place into the fieldwork within which the corporate agents were the focal objects with whom I talked. Experiences of the fieldtrip in China were examples of this. I had some reservations about visiting China before going. It was without doubt a prejudice within my own sense of place. When I arrived, I nearly ‘drowned’ in culture shock – there was a mismatch between my internal image of ‘socialist China’ and the *adapting to* an updated impression. For example, many commercial advertisements were displayed on the reverse side of ‘official’ traffic signs on the streets (in urban areas), looking like cornucopias embodying the ‘enormous potential of popular consumption’ that has been largely reported *empirically*. This was a sensory experience. They were so dazzling that they persuaded me that there *is* a socialist Republic of capitalist vigour.

In addition, the non-verbal knowledge I gleaned enriched and constructed my spatial perception when I walked into a respondent's office or stayed in fully-equipped accommodation for company personnel. The procedure was not a one-way flow of information but "a creative, evolving and contingent process" (Cook 1997: 128). One case that impressed me was a rediscovery of spatial scales. I was told about efficiency in the workplace by one manager in the Suzhou Industrial Park. He pointed out a material condition as an explanation of why his local colleagues were not so engaged themselves in work performance:

> … first of all, it is much more flexible [to arrange working schedules] in Taiwan. One may ride a motorcycle to the office; it doesn't matter [if he gets] off duty at ten o'clock. [But] you have to leave by five-thirty here. [If not,] the office is so far away from the city centre. He gets no transport home. As such, this [situation] certainly drives him [out of the office].

I had been oblivious to the problems of transport and communications, and simply deemed it as managerial comment on subordinates until I jumped on a jam-packed local bus and went around Suzhou City. In geographical terms, there was simply not a short commute for local employees (*cf.* the Taiwanese companies often fixed up the posted staff with accommodation around the Park) between the residential, populous and hectic urban area and the newly-built area interspersed with smart office blocks and shop floors of increasing number (but which remained spacious and monotonous at least during the period I visited). Of more annoyance was an ill-equipped transport system that made the physical distance seem longer than it really was. This physical condition also constituted one reason why the local staff *fled* so soon when being released from duty – to catch the free bus provided by their companies. Obviously, the time–space experience in the locale was distinguished from that in Taiwan's HSIP where the engineers can simply "ride across the back yard of the Park (the HSIP)" to have further education after work, as reported by another posted engineer in Suzhou. Spatial-temporal properties in reference to actualities of work setting are, to a degree, implicitly shaped by urban formation. Being forced to experience the material realities of location and context, I learned at first hand the different possibilities for collective learning between technical communities (Brown and Duguid 2001) in diverse circumstances; this was materially associated with employees' everyday routes.[14]

My perception of those material landscapes and the like was more than an auxiliary proof of material landscape. On the one hand, it was also a concern that

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[14] Although *beyond* the scope of the central issues in this thesis, additional questions can be posed by thinking over the working spaces experienced and created by the local (technological) staff: along which path does knowledge spill over in the functionally-estranged enclave that the workforce perceives? And, does the time–space restraint fall into a pattern, working on industrial agglomeration of innovation and knowledge fluidity?

avoids having a prejudice in favour of “analyses of spatial clusters or development within regions” but situates “the focus on the firm as the unit of analysis” in “the development of the region as a whole” (Sayer 1982; cited in Perrons 2001: 210). On the other hand, the fieldwork experience exposed me to ‘reflexive management’, creating an openness to “re-presenting messy, creative, fragmented and complex modes of reality” (Bailey, White et al. 1999: 172). Despite this, one thing became problematic during my early stage in the field. There was a plurality of empirical observation since I was like a sponge, although it was problematic to absorb anything bizarre that arose. Side issues cropping up unexpectedly led me astray. Opportunistic on-site observations were eventually positioned as an intermediate method, balancing and making sense of printed information and informants’ responses at each stage of data collection and then communicating empirical narratives with theoretically-informed accounts. Pieces of information or images inserted into field notes were conceived of as helpful in understanding the industrial circumstances in which Taiwanese firms were engaged. But when bringing the materials into economic-focused geographical research within a cross-cultural context, I was aware of a latent danger of creating illusions or new biases (Clark 1998).

3.4 Accessing and reporting 'situatedness'

> Access to a research setting is never a given. What is open at one juncture can be closed at another time or in different circumstances.
>
> (Lee 1995: 16)

The business of actually initiating interviews was a frustrating experience. I try to illustrate the complicated situation of recruiting informants in **Appendix C** with indications of location and timeframe. There was often no reply after mailing named individuals at an early stage of the research. I was also directly rejected, mainly by secretaries, when making a direct enquiry to relevant companies on the list. Having received a series of rejections, I decided that I would need to make the reason for the request of an interview less specific. The wording of the objective was slightly altered: "I'd like to ask you some questions about corporate strategies and disposition for *outward* investment" – in place of *westward* investment. Changing the tone appeared a bit deceptive but was necessary in order to pass through several gatekeepers. However, in comparison, drawing on personal networks (*i.e.* calling or mailing friends and relatives to ask if they knew any potential informants) bore an immediate result. It seemed to me that seeking out a potential respondent directly was less easy than getting through by *guanxi*, at least in the first round of fieldwork in Taiwan. In general terms, the experience of recruitment might be a result of coincidence or luck, or just that business people are reluctant to answer student queries. But it would dangerous to dismiss out of hand "the *deeper structures* that generate events and discourses" (McDowell 1992: 213, emphasis added).

According to Cook, "the reasons for why a community and/or situation … is not open to you may reveal vital clues to its character [of the research objectives]" (Cook 1997: 132). I intended to unravel the 'why' of a series of rejections. The means of accessing the field were not intentional but were compelled by the *circumstances* at the time. Making manufacturing investments in the Mainland is always an open secret even though it has long been forbidden legislatively by the Taiwan Government. What one senior manager said was both explicit and pertinent:

> [we are all] afraid to talk. All are proceeding [in the Mainland] on tiptoe; [but] just cannot [talk].

The initial cases in which I was refused access were conveyed with a gentle wording under thin excuses (such as a coincidence of a manager's tight schedule, an impression of intrusion or corporate confidentiality). The situation *worsened* later. Many corporations I contacted made no excuses but simply gave a flat denial. This was particularly problematic during an episode of legal action in February 2005. The UMC was raided by the public prosecutor, accused of having illegal connections with another start-up foundry, HJTC, in Suzhou. More than 20 key employees of HJTC (who were UMC's ex-employees) had travel restrictions imposed upon them at that time. This event, albeit surprising, threw the whole industrial circle *and* me into a panic and discloses the true reason why the interviewing access was so problematic. At one time in Suzhou one interviewee introduced me to his colleague by making a joke that “I’m sure she is okay; she won’t spy on us”. For the managers/engineers, it would undoubtedly be running a risk to talk to someone unknown who might disclose information to create trouble or even ruin them (cf. Mullings 1999; Sabot 1999).

I do not mean to define the incident as a watershed, marking out a degree of difficulty concerning corporate responses found in Taiwan, but to point out the tip of an iceberg that indicates a suspicion of research enquiry in the industry. The problem of permission and access is pertinent in explaining the ‘sticky’ moments at which objects, events and considerations are contextualised. According to regulation, once an investment project has applied for a grant, the result of the official decision should be given in three months. A domestic chipmaker proposed to apply for permission to open a fab[15] in China in August of 2004, but the project was asked not to make an application until January 2005 (some six months later). One respondent in charge of opening a branch plant complained about the administrative delays on qualification.

[15] The word ‘fab’ is short for wafer-fabricating plant.

The words that an official of Taiwan's Investment Commission suggested he quoted make sense: "you['d better] come [to apply for a grant] after an election". The reason is that once the outcome was declared in December (of 2004) when the presidential campaign was in full swing, the public voice must make a noise no matter whether this project would be approved or not. The challenge of having corporate interviews was actually a matter of timing, seeking access in precarious circumstances, and a fear of political reprisal or rejection often resulted in ambiguity, obfuscation and cryptic comments. The accessibility is involved with the methodological nuance of *reflexive ontology* demonstrating that free-floating access is hardly a case in concrete studies. The timing is concerned with a sensitivity to "the politics of time as a research moment" (Ward and Jones 1999: 301).

So far, I have made a brief explanation of the corporate interviews in Taiwan by drawing upon the informants' response after receiving an academic enquiry. I now turn to the interviews in China. I contacted potential informants in China via three interviewed respondents. I was obliged to reconcile myself to the possibility of failure in data collection and made a decision to take the plunge. Only three interviews were arranged before my setting out and an additional four respondents were recruited through a snowball method in the locality. The first fieldtrip to China was of some help, despite starting with a small number of interviews. I seemed to have more positive replies when making a call to ask if there would be any possibility of conducting an academic interview *during* the sensitive period I was there.

The Taiwanese staff in China were friendly towards me, which was in sharp contrast to the experience in Taiwan. Those who were assigned to China appeared more relaxed, although some of them might have felt ill at ease at the outset. As they made sure that my purpose in coming would not be threatening and perilous to them, a rapport was developed, to a degree. They talked about the organisational structure, the (outline of the) strategies for marketing and manpower, and their personal experiences in a light-hearted manner. Many of them even voluntarily made an apologetic statement concerning the 'meanings' of companies' outward expansion (to China), and made sarcastic remarks on the policy contractions of 'go-west' affairs (in Taiwan) and the generous tariffs (in China). The same issues would be evaded by their Taiwanese colleagues who were circumspect and tended to dodge my queries about the business in the Mainland.

The reporting was given in a distinct manner but its qualities were not mutually exclusive in general terms. I do not espouse the either/or stances of interviewees' statements in a neutral sense of *data accuracy*, but I tried to figure out why the field location made “a story [that] was told ‘that’ way” (Riessman 1993: 2). It is proper (and easier) to think of the question by drawing upon the assigned cadres because they were directly involved with the investment in China. Many managers and engineers have been keen to work abroad (on the Mainland *they meant*). Such resident cadres had a clear stance: “if you [like to] keep doing semiconductor things, then just stay in the Mainland”; “[y]our view would be widened, [in spite of] no idea of ups or downs”. Certainly, no matter what they aimed at (such as ‘getting on’ or broadening scope), a possible risk of career had been stressed: “my boss told me, ‘never calculate upon a withdrawal [if you fail]; your place won’t be [reserved] here’”.

I found *a status of distance* to be a key issue. This distance was as a result of capital flight and in turn became a measure for business purposes. It refers to a transfer of personnel under circumstances that a certain group of elites have ‘expatriated’ themselves to an alternative position in relation to the home country’s domain (of geography and governance). Being a foreign national was instrumental. As one Taiwanese CEO (having run a start-up in Suzhou financed by a Taiwanese firm) spoke bluntly, “I don’t care [about investment limitations]. I’m of American nationality. I won’t be fined 50 million [NT] dollars [by the Taiwanese Government] like Richard Chang (the chair of SMIC) [due to his direct investment here]”.

Distance gives an artificial impression: *being* far from the territory of the domestic regulation tool effectively allowed the posted staff a 'buffer space'. Deliberately or not, they themselves owned a relatively sheltered status of security to represent their own knowledge.

From the above, it is possible to conclude that "the political time-specific mode of entry by the researcher into the research field shapes the contexts, forms of response and kinds of 'knowledge' obtained" (Ward and Jones 1999: 307). The qualitative nuance of reporting is discerned by associating the time–space contingency (of the political economic structure) with the respondents (*i.e.* the corporate agents). The way and intent that the Taiwanese respondents articulated corporate information, creative insights and/or arbitrary attitudes reflected the narrowed entry, which was led by the politically-relative dilemma (*e.g.* the election campaign and the indictment against UMC). In the meantime, the respondents resident in the branch offices took a position distant from the arguments in Taiwan; they acted in an effective regulatory void which is relatively divorced and detached from the debates in Taiwan, and felt able to pass me, a researcher, information of strategic trade-offs and 'buzzes' and their own interpretations of business perspectives from technological, managerial and locational points of view, in often subtle ways. In the matter that a certain knowledge is (re)produced through a respondent's (intentional) choice of (physical) positions, representation of the knowledge is actually the text discourse *authorised*, in Rose's terms, by the respondent in response to the moment when the research is undertaken (Amin and Thrift 1997; Rose 1997; Ward and Jones 1999; Reid-Henry 2003). In summary, as Schoeberger states, "the knowledge generated is unavoidably filtered through the processes by which people make sense of their experiences" (Schoenberger 1991: 183). The *processes* consist of research *situatedness,* of "what those actions mean in context" (Hoggart, Lees et al. 2002: 16), and which is *constrained/enabled* by political concerns mobilised at the scale of the state.

3.5 Conclusion

A clear justification for the selection of the research methods employed in this study has been discussed in this chapter. The rationale, strategies and processes behind the research were framed by the qualitative approach. With recognition that social phenomena are tangled but contextualised, this approach is flexible in that it allows for the generation of modest, situated knowledge. My efforts to collect data were made by incorporating the techniques of documentary sources, in-depth interviews and observations.

I underline two arguments emerging from the chapter. First, the practice of research was not a linear process; instead, I kept reorganising and interrogating the questions to explore the relevant themes which emerged as the preliminary results came out. The data-collection tools played complementary roles by building incremental knowledge. The documentary review contributed to primary materials from the industrial statistics to the profiles of my targeted interviewees, while the field-based methods helped to anchor tangled information by contextualising the interpretation of non-verbal interview nuances and landscape texts. Second, the issue of political temporality is crucial to my study. On the one hand, it was a methodological question reflected by the hurdle of gaining fieldwork access and respondents' sometimes awkward attitudes towards my academic visit. On the other hand, it was an empirical background contextualising the practical actions and intangible discourses through which Taiwanese IC firms engage in cross-Strait business. The ensuing discussion of a domestic debate on 'go-west investment' has been significantly informed by the political-temporal contingency. The following chapters provide empirical narratives of the subject matter. The geographical shift of the global IC production chain, in tandem with organisational changes and technological evolution, will be examined first in the next chapter.

CHAPTER FOUR

THE INTEGRATED CIRCUIT INDUSTRY: DIVISION OF LABOUR

4.1 Introduction

This chapter examines the empirical background of the thesis with regard to the industrial tendencies of the IC sector. Organisational evidence of the temporal trajectories of the industrial systems is provided. The narrative considers the theoretical implications of the research for understanding the international division of labour, national innovation systems, and clustering dynamics. But, before getting into the main issue, it is appropriate to give a general description of the IC industry within a global context. In **Section 4.2**, an elementary background is given to aid understanding of the industrial trajectory. The IC production process is first described. Following an analysis of the features of electronic components, the spatio-organisational structure of IC industrial production on a broad geographical scale is interpreted. **Section 4.3** and **Section 4.4** reveal the evolving process of the international division of labour by focusing attention on a migration of the US IC manufacturing to East Asia. Implicitly, but essentially, the chapter examines the (Taiwanese) IC industry within the context of developmental agenda.

4.2 The procedure of IC manufacturing and its components

An IC (generally called a chip) is a piece of semiconductor material with a set of electric connections etched on it to perform tasks of digital data storage or amplification. Semiconductor devices were originally built as discrete components, such as diodes and transistors, but the incorporation of these functions on one silicon chip in the 1950s created considerable potential for miniaturisation. The commercial production of IC began in 1958, with TI and Fairchild leading the way (Tilton 1971). Chip production for consumer markets became significant during the 1970s when the application of ICs to consumer commodities accounted for nearly 25% of all chip sales (Saxenian 1983).

Chip manufacture goes through a set of complicated and precise processing segments. There are three main stages of IC production involving related support industries: (1) IC design and 'mask marking'; (2) wafer fabrication; and (3) chip assembly and testing (**Figure 4.1**).

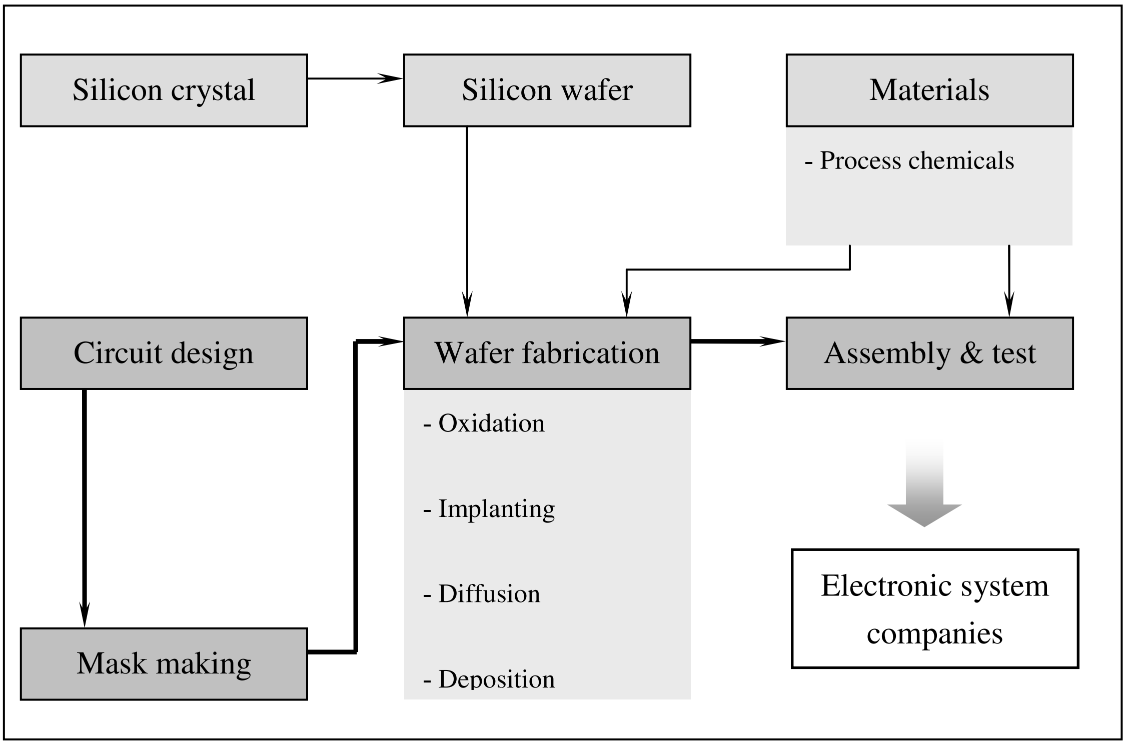

Figure 4.1 The processing flow of IC production

The purpose of IC design is to create a product which is marketable or which meets a customer's specific requirement. Many sophisticated engineering problems must be worked out in the design process, which is related to the particular function to be performed, the specification to be defined, and the consideration of process technology for fabrication. The completed circuit layout is stored on a tape using the database format. In electronics, 'tape' refers to the writing of the magnetic tape with the final data file describing the circuit layout and other details, although magnetic tapes are now rarely used for this process. The final stage of the design of a chip is called 'tape-out': that is, the point at which the description of a circuit is sent for mask marking. Mask marking copies the designed circuits onto a glass plate as the mask for fabrication (**Figure 4.2**).

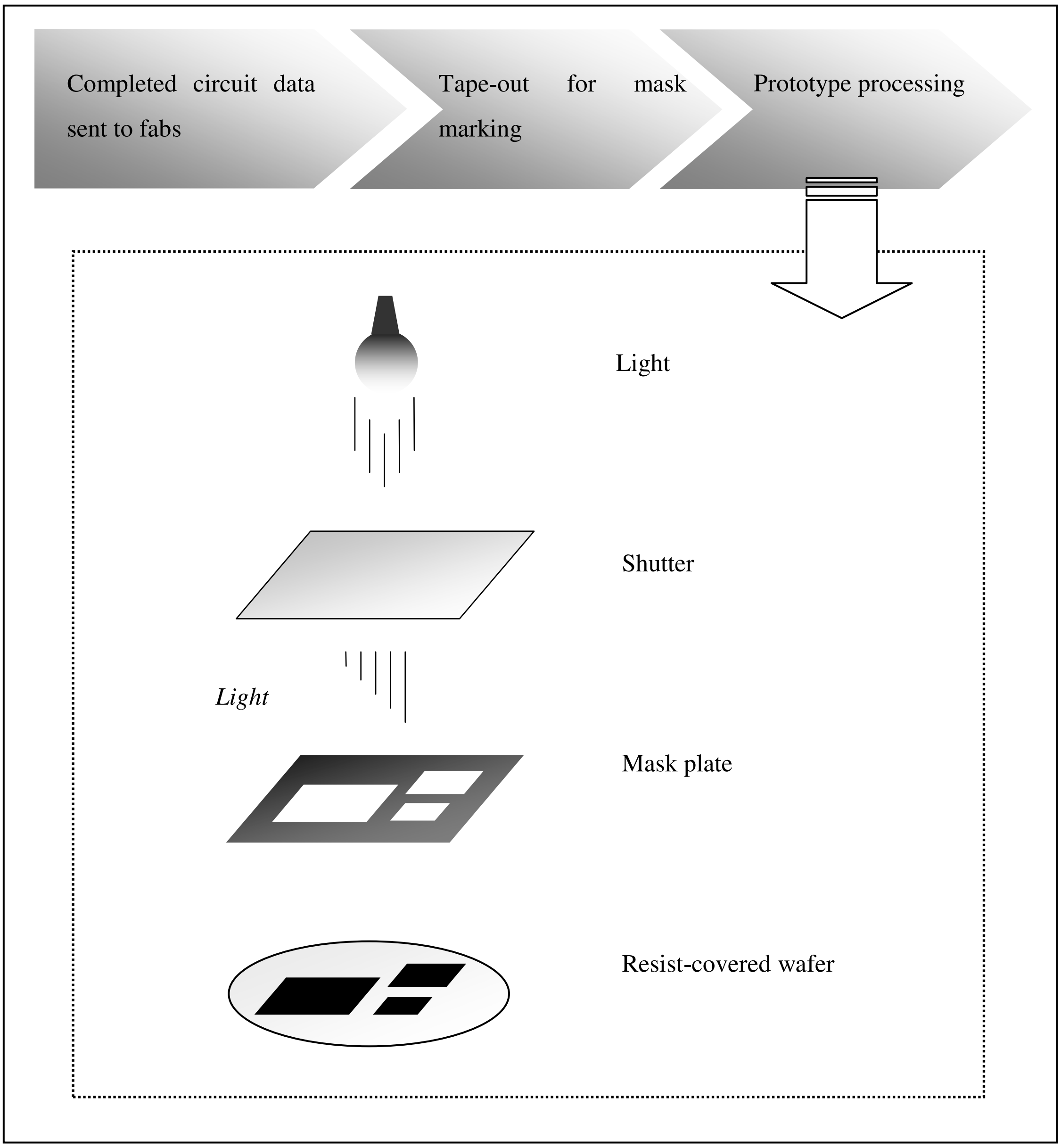

Figure 4.2 Illustration of mask marking

In the fabricating process, each wafer is run repeatedly through various procedures using masks that fabricate the circuits upon the wafers. Every wafer will possess hundreds of identical chips on completion, with each of them containing millions of submicron circuits, photo-etched on its surface. The complexity of fabrication is related to the numbers of masks used. For example, one DRAM has over 20 masks to run; that is, to complete one piece of DRAM it is necessary to repeat the processes of oxidation, implantation, diffusion, and photo and etching more than 20 times. Thus, the fabrication can take several weeks, even months, to complete.[16] Chipmaking is an extremely intricate process carried out in very expensive 'clean rooms' which are rigorously controlled under management schedules designed to reduce yield loss (*i.e.* the rejecting rate of wafer output which is associated with the production cost of wafer output). In the final assembly stage, which involves less technical competence, the completed wafers are cut for packaging as individual chips so as to make electrical connections[17] and to protect them against moisture and contaminants. After testing, the chips can be applied to diverse electronic commodities.

Two distinctive features of the IC production procedure are significant for economic geography. First, all the procedures are "relatively disarticulatable from

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[16] The wafers are sliced from silicon crystals, so the size of each wafer depends on the diameter of the crystal; normally, wafers are 6-inches, 8-inches or 12-inches. The size of the wafer determines the power of the chip: the larger the wafer diameter the greater the capacity of the chip.

[17] The chips are mounted on a piece of plastic or ceramic, and connected to metal pins, so that they can be connected to printed circuit boards (PCB).

one another" (Scott 1986: 144; see Henderson and Scott 1987) and therefore potentially flexible. Second, every step in the processing flow is "an important and complex labour in its own right" (Scott and Angel 1987: 880). Thus, IC production is characterised by technical divisibility owing to its finely detailed division of labour with special knowledge involved in individual stages. This divisibility is further reinforced by a tendency towards miniaturisation within chip manufacture. The pursuit of miniaturising[18] the circuit line-width of chips has been ever-present since IC first came into existence, and is inherent in an innovative process which seeks to encompass more and more functions on one piece of chip.

A twofold commercial logic of electronic components enables electronic goods to be versatile and/or portable to fit in with market demand. Driven by an ethos of miniaturisation, all the input elements, including labour skills, managerial procedures, production facilities, *etc.*, are constantly upgraded and revised in chip design. Similarly, the trend of miniaturising chips raises the entry barrier to chipmaking, because it requires a great deal of investment to upgrade technology and facilities.

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[18] The substitution of chips for previous components, such as, for example, vacuum tubes and transistors, is based upon the continuous reduction in the size of chips yet their capacity to bear more functions. The cutting-edge technology in 1984 was 1.0-μm line-width. Some leading chipmakers, Taiwanese firms included, have put the 65-nm process technology into mass production since 2007.

For instance, to build one cutting-edge 12-inch wafer line would cost nearly US$3 billion, coupled with the R&D expenditure of US$1.5 billion to develop up-to-date processing technologies. This large and continuous investment in technologies and fixed capital perpetually raises the cost of production. The difficulty of internalising production, meanwhile, is reinforced by the pressure of time economies as a result of a shortened life-cycle of the product. In this sense, the production process tends towards vertical disintegration (Scott 1988; Walker 1988; Storper and Harrison 1991).

Vertical disintegration is driven by more than simple cost considerations. While IC production is technology-intensive and market-driven to a certain degree, the direction of IC industry development is not confined to self-explanatory technological logic following the ‘science-technology-production’ process. Rather, the developmental trajectory of the industry calls for dense, subtle interactions, both organisational and spatial, along its input-output structure. It is the technological trajectory that Dosi suggests in order to stress the complexity of the relationship between technological change and economic growth; he draws attention to *non*-technological variables as an explanation for innovative process (Dosi 1982).

From the next section on, particular attention is paid to the sectors of design and fabrication considering that, empirically, they are the axis of IC production with high technology involvement and that, technically, industrial and spatial presence are important considerations.

4.3 The dispersion of assembly operations

The restructuring of the IC industry can be dated from the 1970s in its birthplace, Silicon Valley. This process of industrial realignment, as Saxenian (1983) documents, was due both to changes in the local labour force and the shifting nature of competition in the IC industry. The former refers to the spatial dispersion of manufacturing activities because of wage increases and local labour shortages after a couple of decades' growth in the IC industry. The assembly sector *vis-à-vis* other IC sectors is characterised by labour intensive but routinised processes; thus, these 'back-end' manufacturing functions were first relocated from the Silicon Valley to locations with cheaper labour costs, both within the US and to developing countries, during the late 1960s and early 1970s (Saxenian 1983; Henderson and Scott 1987; Scott and Angel 1987; Scott and Angel 1988).

The operation of offshore assembly in some selected locations of the global *periphery* was originally explained through the theoretical framework of the new international division of labour (NIDL). International assembly managed by US-based companies[19] was undertaken to take advantage of favourable labour costs in Asia. However, researchers did not conclude that the US companies merely aimed to make use of the "ownership advantages to exploit the location-specific advantages of the host economy" (Chen 1983: 209). Rather, a core-periphery pattern of industrial structure emerged at a *regional* level from the mid-1970s onwards (Scott 1986; Henderson and Scott 1987; Coffey 1996). Research on offshore assembly in Southeast Asia has certainly provided emphatic evidence to explain that the spatial realignment of the industrial system was underpinned by technology spillovers from US-based assembly branches, together with the intervention of developmental states and a socio-economic presence in the selected localities.

It is undeniable that the operation of offshore assembly reflected 'a rather static picture of the way foreign direct investments function in peripheral areas' (Scott 1986: 156) and its industrial linkages remained hierarchical, both organisationally and geographically. Most assembly branches were operated by US-based integrated

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[19] I do not suggest that the US firms were superior to European or Japanese firms regarding contribution of direct overseas investments to internationalisation of the IC industry (Sayer 1986; Scott 1986). But this narrative presents the empirical specificity that reorganisation of the US IC industry was dynamically associated with IC industrialisation in the Asian Tigers, although lower in technological capacity, through an internationalisation of spatial processes.

device manufacturers (IDMs), while the locally-owned plants were inferior to their international counterparts in both scale and capability. That is, there was an uneven geography of technological competence between the core on the one hand (*i.e.* Silicon Valley), and the periphery/semi-periphery (*i.e.* production sites in Asia) on the other hand. During this period, industrial restructuring was more geographically dispersive than organisationally transformative.

4.4 An extensive division of labour

There was a profound reshaping of the geography of IC production as the nature of competitive advantage changed in this market. A demand for chips in fast-changing consumer markets, combined with the *miniaturisation* of devices, escalated from the 1960s onwards. Product life-cycles began to be shortened. In terms of international competition, US firms suffered from the formidable competition of Japanese companies in the world market during the first half of the 1980s (Angel 1994). US firms turned their product emphasis away from commodity products, such as DRAM,[20] to differentiated, design-intensive, high value-added custom components (Schoenberger 1988; Hobday 1989; Angel 1990) in addition to

[20] The memory chips are output in large, standard lines, requiring less design flexibility but heavy fixed assets.

appealing for a legal aid against Japanese ‘dumping’ (Yoffie and Milner 1989).[21] Technically, the growth of advanced customised chips in small-volume output was encouraged during the 1980s because the upgrade of design technology, such as electronics design automation (EDA) tools, and process technologies, such as low-volume flexible management, reduced production costs. Thanks to the widespread use of application-specific IC (ASIC), downstream electronic manufacturers have experienced a considerable growth by reducing time and money spent on system-technology R&D (Angel 1994). Consequentially, the exploitation of the production systems in the US shifted to economies of scope from economies of scale. The requirement for diversification and speed of product output has made IC production more market-driven, which in turn intensified the innovation of chip design (Saxenian 1983; Saxenian 1991).

Electronics manufacturers require novel components and diverse sources of component supply to meet the market volatility. IC design start-ups – also known as *fablesses* – gained more opportunities to develop proprietary technologies for small-volume market niches in the second half of the 1980s (Angel 1990; Hobday

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[21] That is the claim that Japanese firms were deliberately selling goods at artificially low prices to this market to drive competitors out of the market.

1991; Angel 1994). Without fabricating facilities, the IC design houses needed to contract their designs to IC producers, *i.e.* the-IDMs, which meant that firms such as Intel and TI took on full-range processing. A significant specialisation of the IC production system, therefore, began to develop. A vertically disintegrated production system emerged among the fablesses and the IDMs, while the two corporate parties competed against each other in technological innovation and for market share. Consequently, the fablesses suffered from the reluctance of IDMs to lease fab capacity for chipmaking (Economist May 19th 2001) particularly during boom periods for IC. The IC design houses, meanwhile, remained subordinated to IDMs because the latter dominated the manufacturing process and capital-intensive facilities.

As vertical disintegration proceeded, the geographies of IC production in East Asia were transformed. Mathews and Cho (Mathews and Cho 2000) propose a conceptual explanation for the dynamics behind the East Asian experience, teasing out various 'technology leverage strategies' used by South Korea, Taiwan, Singapore and, to some extent, Malaysia in rapidly catching up – and in some cases overtaking – the rest of the world. From an institutional point of view, one distinct developmental model – a 'national system of economic learning' – attributes the success of the East Asian experience in promoting knowledge-intensive industry, including the IC sector, through a learning path of technology acquisition rather than original innovation. Industrial 'latecomers' made remarkable progress in upgrading their microelectronic technologies over the last two decades. For example, the rise of the Japanese microelectronic industry took much of the market share away from US firms in the first half of the 1980s, while South Korea has "built up strong in-house capabilities" (Hobday 1995) and is currently ranked at the top in the DRAM world market.

A striking transformation may be seen in the case of 'pure-play' foundry services, which were first created by the Taiwan Semiconductor Manufacturing Corp. (TSMC) in 1987. This was an innovative production model that "specialise[d] in capital-intensive manufacture and [did] none of the design" (Economist May 19th 2001: 62), distinguishing itself from the original IC producers, IDMs, in several respects:

> A foundry would specialise in capital-intensive manufacture and do none of the design. It would then sell capacity to many customers – not only chip designers that had no plants but also IDMs[22] whenever they hit production bottlenecks – and consequently achieved economies of scale

[22] Actually, the outsourcing from IDMs was some 30% of pure-play chipmakers' output value in 2003, according to the IC insights. For example, Motorola closed down 10 of its 18 factories (about 25% of its chipmaking) and outsourced by the end of 2002; meanwhile, TI farmed out 10% of its total manufacturing in 2002, and the proportion kept climbing (Business Week June 24th 2002).

> and better returns on big capital investments. For designers, foundries would lower barriers to entry by offering them a factory for hire, while keeping their intellectual property secret.
>
> (Economist May 19th 2001: 62)

A foundry provides a supporting service, and the specialised, small IC design houses were allowed to focus upon “innovative muscle and marketing clout to drive and define the market for new products” (Sturgeon 2000: 13) and so became numerous worldwide. In the mid-1980s, there were only about 20 IC designers, indicating a dependence on the IDMs to produce their chips, although the number has increased to over 1,000 worldwide (http://www.fsa.com/). This structural breakthrough encourages a transformation in the spatial division of labour in this sector. Taiwan, for instance, “dominate[s] what has become a $16 billion global industry” (Business Week May 16th 2005) by means of providing highly technology-intensive services to global customers, mainly in the US. As shown in **Figure 4.3**, the industrial structure has been divided into an intricate hybrid with an increase in the degree to which production specialisation increases. The juxtaposition of the original IDMs and finely separated fractions shows that the division of labour in the IC industry becomes multipartite and closely interdependent. The sectoral relationship is, therefore, dynamically redefined: foundries might not only take advantage of running in full capacity but also regulate market fluctuations owing to various sources of specialised orders; while design houses are able to embark on the introduction of novel products by continual design innovation but need not make the large investments necessary to set up an expensive fab operation. In combination with the processes of multiplying vertical disintegration, the spatial tendency of the IC industry represents an extensive connection that enables production complexes in East Asia to coordinate/compete with the sustainable ‘technology districts’ in advanced economies.

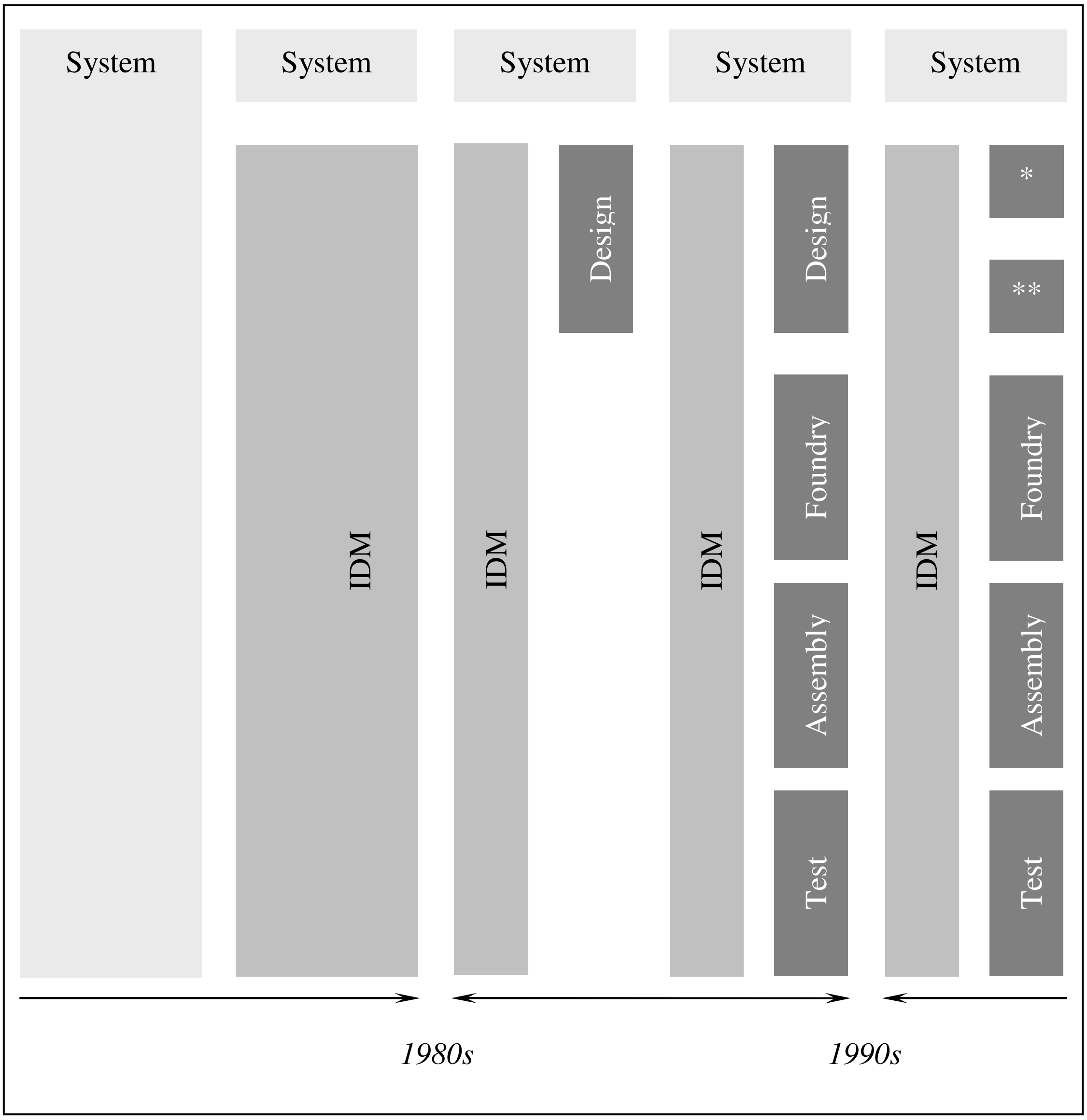

Figure 4.3 Illustration of vertical disintegration in IC industry

Notes: * refers to silicon intellectual property (SIP or IP) vendor; ** refers to design house.

4.5 Conclusion

The process of IC industrialisation has seen a geographical transformation over time in both technological and organisational dimensions. Globally extensive manufacturing is organised in a contractual form, where multi-layered technologies are scattered across multiple sites, so that lower-ended processing lines are geographically separated from highly capitalised and knowledge-intensive units, such as R&D or design. The IC industry is representative of the hierarchical world system, but its international division of labour is not fixed in a rigid manner. The Asian NIEs are found to have considerable advantages in a process of long-term learning and, thus, in technological promotion. They are able to involve themselves more widely and deeply with the progression of the industry – although their terms and conditions remain dominated by the multinationals from the developed countries. In the following chapters, central attention is paid to analysing Taiwan's industrial trajectory and its geographies of industrialisation with special reference to the organisational fabric of the (trans/)local IC production chain. It is necessary to understand the qualities of the IC industrial system evolving in Taiwan before I look at production transplants in China and the political issues related to production de-territorialisation. As a result, the next chapter will concentrate upon the rise of the Taiwanese IC industry and its properties of industrial systems.

CHAPTER FIVE

GEOGRAPHIES OF THE IC INDUSTRY IN TAIWAN

5.1 Introduction

This chapter begins to develop the empirical study contained in the thesis. It serves as an introduction to the geographical industrialisation of the IC sector in Taiwan. The spectacular growth of the Taiwanese economy, in line with the other Tiger economies, is attributed to the efficiency of official guidance (although the policy instruments differ between the Asian NIEs as a whole).[23] The fundamental stance of the thesis accepts the idea that "state intervention is a given" (Evans 1995: 10) and crucial in driving the industrialisation of East Asia. However, it is important not to underplay other mechanisms related to the top-down nature of economic growth. Two points deserve to be mentioned among these. One refers to the entrepreneurial momentum of the private sector which complements the 'bureaucratic economy'. The business enterprises were outward-looking and encouraged to be so by national export programmes. Taiwan's firms were engaged in

[23] It has been emphasised that the Far East experience is distinguished from the Western model (a critical theoretical reflection in Yeung and Lin 2003). Although the Tiger economies are used to being grouped into one group, the common results were archived by various historical backgrounds and institutional contexts (Whitley 1992; Preston 1998).

flexible manufacturing. It is certain that there was a "sustain[ed] entrepreneurial vitality and commercial adaptability of [a] decentralized industrial system that is preserved by the state" (Chan and Clark 1994: 137; cf. Buck 2000). The ethos of such a system is 'small-is-beautiful', which has been described as *guerrilla capitalism* (Lam 1990). A second point is beyond the scope of substance in the state and/or enterprises. It is contingencies of the space-time variable that persistently impinge upon the industrialisation and globalisation of East Asian economies (see Preston 1998; Olds, Dicken et al. 1999).

The space-time dynamics that exist and evolve in industrial situations of the local firms – as well as the changing postures of the state-business nexus – should not be underplayed in the context of late-industrialisation. Attention is drawn to the properties of the Taiwanese IC industry and the dynamics of geographical (re/)formation. It is an attempt to identify the process by which indigenous corporations become more receptive to the world market and reject the productive limits of national borders. The *global chain* approach is of merit in understanding the industrial evolution owing to its useful framework which frees the late-industrialised economies from a *pre-designated* geographical scale of boundary-confinement.

The evidence revolving around the geographical trajectories of Taiwan's IC industrial sector is outlined in the rest of the chapter. **Section 5.2** reviews the industrialisation of the IC sector in Taiwan in a nationally-guided dimension. However, this perspective suffers from questions of geographical substance with reference to a territorialised industrial system. The issue is complemented by spatial experiences of entrepreneurial activities in **Section 5.3**. Case studies are developed with reference to issues of network, proximity and extension. I will explore these by associating the relationship between clustering and connotations of place and boundary. In the final section, I argue that the industrial complex area of Taiwan is a crucial link within global IC production networks.

5.2 An institutional trajectory of industrialisation

Over the course of the last three decades, Taiwan's IC industry has come to the forefront with significant industrial chains and output value. Currently, both pure-play foundries and outsourcing assembly are dominant, taking the lion's share of production worldwide, as much as 72.9% and 30.4% respectively in 2001, according to the Industry and Technology Intelligence Service (ITIS). Meanwhile, the IC design sector in Taiwan accounted for almost 26% of global production in the same year, ranked second only to the US. This developmental trajectory was given significant impetus by the Taiwanese state (Wade 1990; Castells and Hall 1994; Mathews 1997; Fuller 2002).

5.2.1 Guided by the government

I shall focus upon two dimensions of national strategies for promoting the highly technology-involved industry of the IC sector: technology diffusion and creation of industrial parks. Before going further, it is necessary to give a brief introduction to industrial transition in Taiwan. The success of Taiwan's long-term economic growth was mainly ascribed to an export-oriented strategy that made good use of industrious but low-cost labour. Nevertheless, the labour-intensive industrial structure exposed the national economy to latent problems rooted in the scarcity of natural resources and export-led manufacturing possessing. Two energy crises in the 1970s drove Taiwan to confront its inadequate energy sources and triggered the decision to upgrade the domestic economy towards energy-efficient, high-tech and high value-added sectors. In the late 1970s, the government undertook several measures to promote a technology upgrade.[24] The developing trend was imperative

[24] The earliest national technological policy, the Guidelines for National Long-term Science Development, was promulgated in 1959. However, the procedure was not formalised until the late 1970s (Li 1995).

in the 1980s. This was because the main source of competitive advantage in Taiwan – its ample and cheap labour pool – had diminished due to a long-term low unemployment rate and steep wage rises. According to official statistics, the average unemployment rate in Taiwan was 2% between 1978 and 1988. The real wages in 1980 were nearly four times as much as those in 1960 (Hsueh, Hsu et al. 2001: 52). This changing climate burdened the labour-intensive manufacturing sector with higher labour costs, which revealed Taiwan's weak position within the international division of labour, and its dependence upon labour-intensive output.[25]

The domestic electronics industry has been made up overwhelmingly of small- and medium-sized enterprises (SMEs) due to the government's support of state-owned enterprises since the 1970s (Hsueh, Hsu et al. 2001), which limited the ability of the private sector to invest in manufacturing innovation and to absorb state-of-the-art technologies. In this sense, Taiwan has a significant technology lag in respect to advanced countries. For example, compared to R&D expenditures of 2.3% in the US and 2.35% in Japan, research expenditure in Taiwan accounted for merely 0.71% of GDP in 1980 (Hsueh, Hsu et al. 2001: 65, Table 3.2). For purposes of

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[25] The main export products were textile products, and electrical machinery and apparatus, making up over 40% of the total export turnover aggregately since the 1970s (Jou and Wu 1993).

industrial promotion, the government took responsibility for piloting the development of the IC industry from the mid 1980s onwards (Chen and Sewell 1996; Hsu 2000).

The government sourced advanced technology from abroad through international licensing and this typified the national learning strategy. The indigenous IC industry in Taiwan started with an initial technology contract with an American company, RCA, in the mid-1970s, when the Electronics Research and Service Organization (ERSO) was set up under ITRI, which took charge of IC technology acquisition (Liu 1993). This may be described as an *accommodative* approach, by which the state sought to connect the development of domestic industry with the tendencies of the global technology market (Wang 1994). Under the agreement, ESRO sent 37 engineers to RCA for one-year's technical training in 1976. Following training in the US, the engineers brought back not only IC technology but also managerial skills, including knowledge of design and testing processes, fabricating management, and accounting (Chang, Shih et al. 1994).

The trainees became the pivotal media for the transfer of comprehensive IC manufacturing know-how to Taiwan's IC industry as a whole (Hsu 2000). In 1977, the first prototype plant was set up for a pilot run of IC manufacturing in Taiwan with RCA's assistance (Chang, Shih et al. 1994). From then on, any technology acquired has been assimilated successfully within the national system of innovation. It fosters local talent in collaboration with domestic universities in order to disseminate advanced technology from abroad and to build up in-house technological know-how. For instance, there was the Multi Project Chip (MPC) programme initiated to improve students' and professors' practical ability in IC design through computer-aided design training at ITRI (Chang, Shih et al. 1994). The primary reason that ITRI devoted resources to sourcing IC technology from abroad was to promote the industry, by transferring new technology to *commercial* operations (Li 1995). To achieve this task, ITRI began to focus its research efforts upon business firms by setting up spin-off companies as well as financial assistance in various R&D stages (Liu 1993; Chang, Shih et al. 1994) (**Table 5.1**).

Table 5.1 Government-funded projects for IC industry promotion

Project/exp.	Objectives	Tech. capability	Main spin-offs
EIDP-I	To acquire IC design & manuf. technology	7.0µm CMOS	N/A
(1976-1979)	To establish pilot operation		
NT$489 mil.			
EIPD-II	To improve CMOS facilities	3.5µm CMOS	UMC
(1979-1983)	To promote mask technology		Syntek
NT$796 mil.	To promote IC applications in industry		
VLSI	To establish VLSI process technology	1.0µm CMOS	TSMC
(1983-1988)	To acquire CAD for VLSI ICs		TMC
NT$2,921 mil.	To promote VLSI IC application		
ULSI	To acquire submicron process technology	0.5µm CMOS	VIS
(1990-1994)	To establish ULSI pilot plant		
NT$5,500 mil.	To promote ULSI IC application		

Source: (Liu 1993: 303, Table 2; Mathews 1997: 43, Table 2).
Notes: EIPD is short for the Electronic Industry Development Project, VLSI is for Very Large Scale Integration Project, and ULSI is for Ultra Large Scale Integration Project.

Since the first spin-off was funded in 1979, the entire structure of Taiwan's IC production, ranging from design, masking, fabricating, packaging and testing, had been completed continuously until the late 1980s (Liu 1993). The United Manufacturing Corp (UMC)[26] was the first spin-off company from ERSO founded in 1979. To ensure that the process of technology transfer was smooth and efficient, ERSO started with a transfer project team to cooperate with the preparatory office of UMC. This involved establishing an IC fabrication plant with 4-inch wafer capability,

[26] There was 40% of UMC equity capital from the government, and the remainder was from the private sector (Hsueh, Hsu et al. 2001).

providing the latest information on equipment selection and so forth. ERSO also offered almost all the executives to UMC. The support personnel covered all the sectors of a business firm, including design, manufacturing, quality control, and marketing sectors (Chang, Shih et al. 1994). In addition, UMC had its IC design masked in ERSO at that time, so that it did not need to send its IC design abroad for the masking procedure (Chang, Shih et al. 1994).

Following the setting up of UMC, a number of staff members from ERSO initiated enterprises in the design sector. As the number of domestic IC design companies increased, the requirement for the development of the very large-scale integrated circuits (VLSI) became urgent. The VLSI project was achieved, and carried out IC fabricating procedures for IC design houses, which led to an increasing demand for IC mask manufacturing. Thus, ERSO initiated the sourcing of masking technology from overseas in the early 1980s and opened the Taiwan Mask Corp. (TMC) in 1988. The creation of TMC completed Taiwan’s IC industry, as it now had facilities that ranged from design, masking, foundry and packaging to testing (Liu 1993). Among numerous spin-off companies, the foundation of the

Taiwanese Semiconductor Manufacturing Corp. (TSMC)[27] was a distinct landmark in the global IC industry (Electronic Business November 1st 2005) due to its taking the lead in developing a made-to-order model service revealed in **Chapter Three**. Taiwan's IC manufacturing sector has seen an astonishing growth for the last three decades. For example, two major foundries (TSMC and UMC) have pioneered cutting-edge process technologies to produce 12-inch wafers of line-width level at 90nm and less since 2003.

In addition to transferring technologies to private firms, the government developed a strategy to encourage investment that would promote the overall development of the IC industry. To archive this, the Hsinchu Science-based Industrial Park (HSIP) was opened in north Taiwan in 1980 in an attempt to create a specific industrial district (**Figure 5.1**).

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[27] The founder of TSMC is Dr Morris Chang whose previous career was as a top manager at TI (1958-1983) and General Instruments (1984-1985). Owing to his familiarity with the semiconductor business, Chang foresaw a tendency for the division between the IC design sector and the IC fabrication sector to increase. Chang is typical of Chinese expatriates who were recruited by the Taiwanese Government to engage with the promotion of the domestic IC industry.

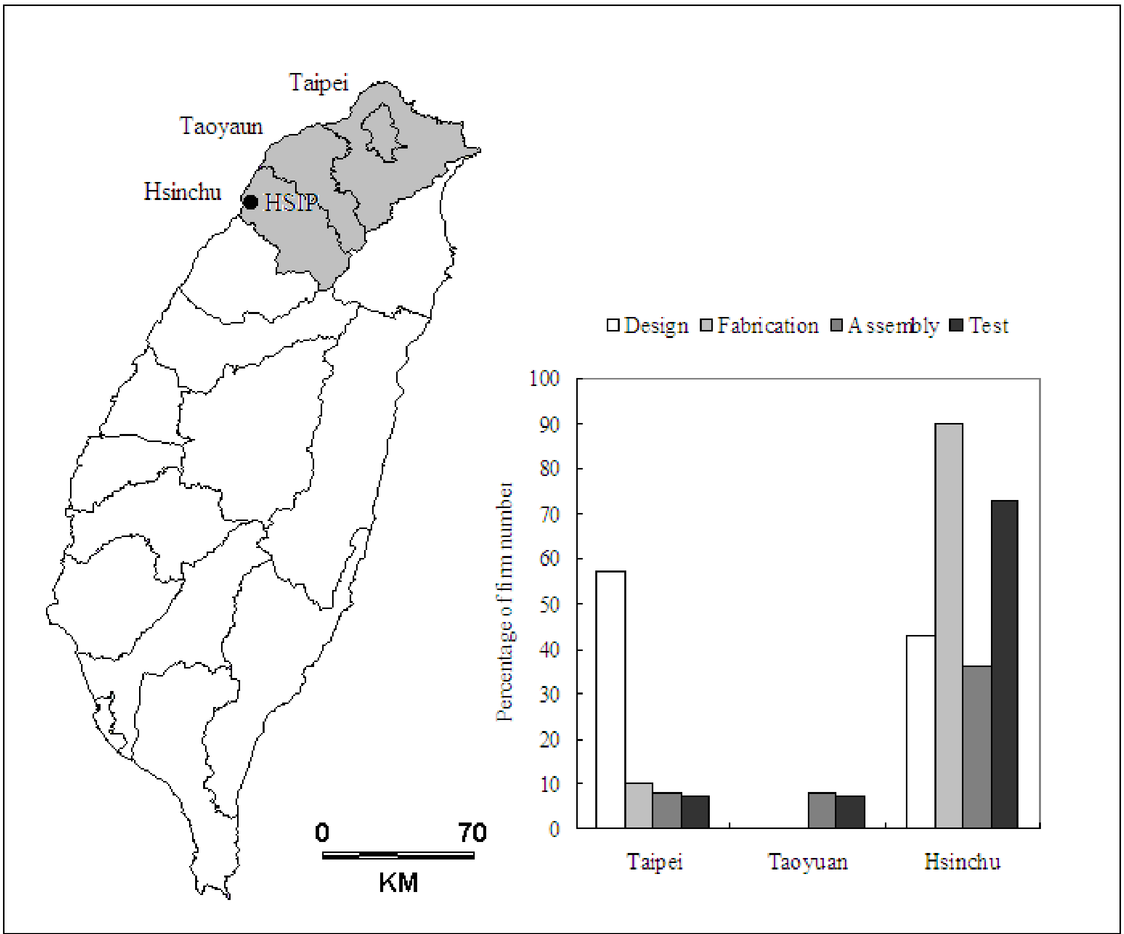

Figure 5.1 Spatial distribution of Taiwanese IC companies by sector: 1998

Source: Adapted from the Year Book of the Semiconductor Industry 1998.

Note: The data of HSIP is incorporated into Hsinchu.

The Park was modelled on the export processing zones (EPZs) seen elsewhere in East Asia to be 'a high-tech version of an export processing zone' (Hsueh, Hsu et al. 2001: 61). From the outset it was expected to attract foreign investment from high-tech firms to bring advanced technologies and to employ local labour (Li 1995). In 1983, there were 37 companies with a combined capitalisation of NT$3 billion; by 2003, 369 firms were established in the HSIP which, between them, generated NT$857.8 billion in annual turnover. In contrast to the original intention, however, most firms in the Park were actually operated by Taiwanese experts from overseas, instead of foreign firms *per se* (Mathews 1997). Actually, foreign investment played a negligible role in the development of the domestic IC industry (Amsden and Chu 2003), while those emergent start-ups there flourished since they enjoyed lots of incentives, including convenient transportation networks, preferential tax and duty measures, the simplification of administrative procedure, a good infrastructure and back-up services[28] and so on (Chang, Shih et al. 1994; Li 1995; Chen and Sewell 1996)

It is shown clearly in **Figure 5.2** that there is a lasting growth of IC output value. Together with the increase in profits, the contribution of the IC value to the total value in HSIP has a steady growth. Its share exceeded one-third of HSIP's annual revenue in 1991 and has been more than half of that since 1997. The development of high-technology firms was not geographically confined to the Park, but spread out in north Taiwan, which has captured an increasing share of the market with a significant niche in a wide range of electronics manufacturing. In summary, the rise of the Taiwanese IC industry benefits from a range of institutional provision

[28] For instant, there is an experimental bilingual school built to accommodate those English-speaking children who come with their parents (who are staff in HSIP) from abroad.

covering good quality and subsidised premises, infrastructure and business services. The industrial agglomeration in north Taiwan embodies the sustainability of Taiwan's IC industry territorially.

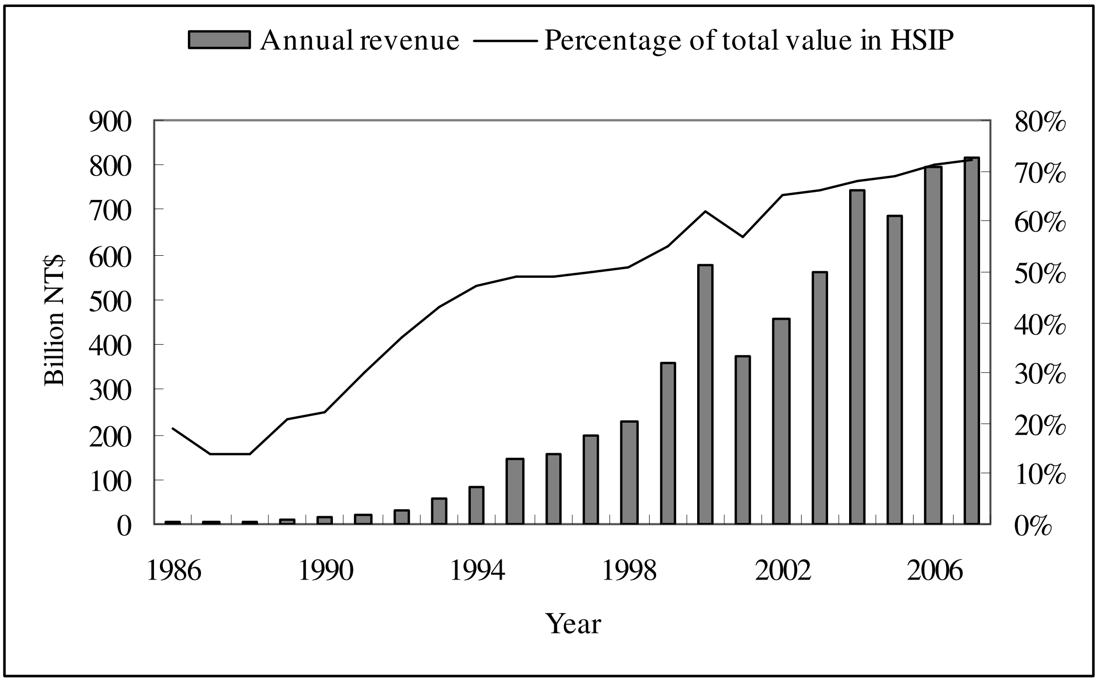

Figure 5.2 Revenue of the IC sector and its percentage in HSIP: 1986-2007 (billion NT$)

Source: Adapted from the database of the Science Park Administration (www.sipa.gov.tw).

5.2.2 The analytical limits of institutionalism

The government was instrumental in leveraging the growth of the IC sector in Taiwan. The IC industry, and its territorial complex in north Taiwan, "was not a development so much as a *creation*" (Mathews 1997: 27, emphasis in original); the state enabled institutions to take technoglobalist measures to achieve a 'techno-nationalist' goal (Fuller 2005). As Mathews concludes, the achievement of the Taiwanese IC industry has been made possible by a unique technological trajectory by which "the *institutional framework* [was] created and the *dynamic interactions* [were] triggered between firms and public agencies" (Mathews 1997: 48, emphasis in original). The idea that local corporations are cast as subservient to national development policy is an epistemological concept of the 'hard state'. As Whitley puts it, "where the executive can enforce its economic policies and ensure that leading economic actors follow its commands" (Whitley 1992: 27; see various national contexts of the IC industry in Mathews and Cho 2000).

The governmental support has framed the IC sector as an important industry; in particular, a full range of infrastructural provision and administrative aids have facilitated geographical consolidation of industrial activities. The nationally-guided trajectory tells an interesting story about how Taiwan came to the front in an industrial sense, while some caveats must be observed. Firstly, an overstress on the policy narrative of institutions is an unsatisfactory explanation for the reason why Taiwan was able to catch up with its more advanced counterparts over a short period and to overtake them in the long-term. On empirical grounds, the guiding role of the public sector as an incubator for industrial start-ups and technological promotion has yielded ground to the firms with an increasing vibrancy in the private sector.

Entrepreneurship within firms has stood out as technology sources were diversified. Indeed, based upon the institutional framework of industrial development mapped out by the government,[29] the firms had an initiative to collaborate with one another domestically and increasingly reached out to worldwide counterparts with regard to market transactions and non-price connections. The state became more of a supporter of the industry in the late 1980s; from then on, there was a steady flow of indigenous and expatriate start-ups (Mathews 1997; Hsu 2000).

Secondly, the explanation fails to associate local performance and improvement with the global setting. The review of institutional matters draws upon a domestic arrangement and explains that the 'national system of economic learning' (Mathews and Cho 2000) coordinates with the progressive trajectory. It seems to display a one-way flow of technological knowledge and to downplay international factors, such as strategic alliances, global demand, talent flows, *etc.*, which might affect the industrial outcomes. In a word, the practical reality whereby the domestic industrial integrity has climbed up the value-added chains is ignored, for the forming of an industrial system is enclosed at a national(ly-led) level.

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[29] This national innovation system represents a strategic intent of geographical industrialisation involving the *regional context* of the national system (Hsu and Cheng 2002; and see Bathelt 2003).

The third point refers to an assumption that industrial policy acts on a spatial isotropic plain. Geographically, the national learning system is prone to *even out* the geographies of industrialisation. The agglomeration of the IC industrial system is treated simply as a spatial outcome deployed by the public programmes of industrial promotion. It is difficult to expand upon the industrial territorialisation of the Taiwanese experience due to a spatial vacuum at both international and subnational levels. To sum up, the top-down statist account tends to "assume that capitalism is acting on or spreading over an isotropic plain and therefore neglects the range of socio-political constellations with which economic forces engage and by which varied outcomes develop" (Boggs and Rantisi 2003: 110).

Other than the explanation that highlights state-driven and incentive-based provision, insights from research in new economic geographies offer theoretical advances to think about why the Taiwanese IC cluster is able to outrun the difficulties of economic adjustments compared to others. Literature on the industrial district, in particular, points out the significance of inter-firm synergies in the context of territorial development (see Storper 1997). The extent to which a regional trajectory is technologically dynamic and innovation-rich relies upon an efficiency of *socially* regularised institutions. *Untraded interdependencies* play a profound role in economic coordination, because they are crucial for "constitut[ing] region-specific assets in production" (Storper 1997: 5). The processes of knowledge spillover and information flow are achieved in "a field of forces" (Perroux 1950: 95) where firms and others agents (such as public institutes and labour markets) interrelate with one another.

This perspective draws upon "a site of important stock of relational assets" (Storper 1997: 44) with an emphasis upon a sense of local 'institutional thickness' which broadly includes provision of enterprise support systems and the endogenous force that firms use to strengthen networks of association (Amin 1994; Amin and Thrift 1995; Amin 1999). According to this view, the convergence of the IC firms and related agents within north Taiwan has been labelled as an 'industrial district' (Hsu 1997), a 'learning region' (Hsu 1998), a 'technopole' (Castells and Hall 1994), and a 'new industrial space' (Yang 1999). Such an array of terms specifies the industrial district of IC production as a typical economic agglomeration which represents "critical masse in one place of unusual competitive success in a particular field" (Porter 1998: 78). However, it is not my purpose to stylise the Taiwanese IC industrial complex as a particular 'brand' of clustering here (Gordon and McCann 2000; Benneworth and Henry 2004). Instead, what follows are endeavours to draw upon self-reinforcing dynamics performed by corporate and individual agents (indigenous and foreign) jointly in the state-framed industrial setting and externally-connected features of the industrial cluster.

5.3 Clustering dynamics and beyond

An industrial cluster is an *ensemble* of firms, "a large assemblage of producers tied into an interdependent whole by means of their external transactional relations" (Scott 1988: 28). Some specific regions working out this externalisation of the production system found themselves to be surviving or even prospering during the Western economic crisis of the 1970s. This unusual phenomenon triggered numerous investigations of industrial districts (in the Third Italy *ad hoc* and other cases in places such as Germany) where small- and medium-sized firms were gathered and produced an extensive social division of labour as early as the mid-1970s. Following this, theoretical argument developed over the possibilities of shifting paradigms in capitalism in the 1980s.[30] Since the 1990s there has been an account of regional advantage connecting the literature on territorial specification with the research of techno-economic paradigm (Malmberg 1997; Audretsch 1998; MacKinnon, Cumbers

[30] Piore and Sabel, in particular, see the *endogeneity* of local productive systems constituting regional development to be a more general tendency of industrial success (Piore and Sabel 1984; Sabel 2000). It is from a macro perspective beyond the interpretation of "regional individuality" (Lipietz 1993).

et al. 2002; Malmberg and Maskell 2002). Literature on geographies of knowledge has been carried out to explain and understand the phenomenon of economic cluster*ing* in a territory. The notions of network and proximity are two relative and overlapping elements in some aspects. They are abstracted from the localisation literature although with different approaches and changing concerns.

5.3.1 The arrangement of corporate networks

The networking practices of economic agents are fundamental to the production of agglomerations. Material, intellectual, or social articulation of vertical disintegration often works out in (and is illustrated by) the form of a network. The network metaphor as the prescription for business success is considered a key to regional development (Cooke and Morgan 1993; Castells 1996; and see Dicken, Kelly et al. 2001). In light of an instrument for economic growth, Cooke and Morgan propose the network paradigm to underline the coordination of intra- and inter-organisations in clustering configuration (Cooke and Morgan 1993). In focusing upon external networking practices, three distinctions may be identified: (1) "close and long-lasting ties between producers and users to capture learning-by-using"; (2) "networking and joint ventures as a method for reaping both specialisation and coordination gains"; and (3) "long-run and cooperative subcontracting as far as possible in order to promote joint technological innovations" (Cooke and Morgan 1993).

I intend to take an 'UMC clan' as an example to illustrate that individual firms are more than contractual entities and corporate relationships are not simply legally-based. UMC was transformed from an IDM into a made-to-order foundry by spinning various design divisions off in the middle 1990s. The UMC clan is known as a group of IC companies composed of UMC and those design houses separated from UMC. Before I go further, the sectoral trajectory where the vertical disintegration of the Taiwanese IC industry has been formed should be added.

The prosperity of numerous small Taiwanese design houses that make up some one quarter of worldwide fabless value can, to a certain extent, be attributed to an exclusive relationship with strong indigenous foundries. The first domestic design house, Syntek, was spun off from ERSO, in 1982 (Liu 1993; Chang, Shih et al. 1994). Up to 1986, there were only four design houses in Taiwan, but the numbers rose to more than 40 by the end of 1987 (Chen and Sewell 1996). The interaction between domestic fablesses and foundries was initially limited. The percentage of work contracted out to foundries at home, though, increased from 34% in 1990 to 94.9% in 1994 according to the Yearbook of IC Industry (ESRO 1996). Taiwan's chipmakers had insufficient capacity with outdated processing technology prior to 1990, so that the design houses used to contract out to IDMs in the US or Japan at that time (Chen 1997). With a 'manufacturing-only' pattern being adopted, a chipmaker becomes concentrated upon advancing process technologies more efficiently. Manufacturing procedures are modularised to meet a variety of customer demands. Because foundries remove design competition with fablesses, they strengthen a deeper trust from design customers. In this sense, foundries can establish a long-term relationship with customers on the basis of a tailored service and trust; meanwhile, it also speeds up the learning curve by co-working with foreign professional design houses (Chen and Sewell 1996). The beneficial results of vertical disintegration have come into full play as the technological level of the foundry sector has evolved by cooperating with foreign customers. In turn, vertically disintegrated cooperation, together with the advantages of spatial proximity, facilitated the boom of domestic design houses.

I will now move on to the case study of the 'UMC clan'. As has already been said, the UMC was originally founded as an IDM. Because customers have to reveal proprietary design details to their foundry partners, they may be unwilling to contract with chipmakers in possession of in-house design departments for fear that their firm-specific design may be shared. In order to focus its business upon foundry activities, and to obtain more orders from design customers, UMC decided to transform itself into a pure-play foundry. As a result, UMC separated its IC design divisions into independent companies in 1995. By doing so, it became easier for UMC to win trust from customers, because this helped to reduce customers' doubts about the spillover of proprietary technologies. There were five design houses spun off with different market niches: they are MediaTek (optical storage IC), Novatek (LCD driver IC), ITE (PC I/O IC) and Faraday (IC design service) in Hsinchu, along with ITeE (ADSL IC) in Silicon Valley. Sequentially, two more IC companies, Holtek (MCU) and SiS (chipset), joined the UMC clan by M&A in 1998 and 2004 respectively. The design members embody a total commitment to unique market niches and perform well in individually professional spheres. In **Table 5.2**, five design members were listed in the top ten design houses in 2005.

Table 5.2 The top ten designers in Taiwan: 2005 (million NT$)

Rank	Company	Annual revenue	Main output	UMC partner
1	MediaTek	46.49	Optic storage ICs	√
2	Novatek	25.98	LCD driver ICs	√
3	VIA	19.13	Chipset	
4	Sunplus	18.78	Consumer ICs	
5	Himax	17.78	LCD driver ICs	
6	SiS	11.53	Chipset	√
7	Realtek	10.64	Communication ICs	
8	Etron	6.71	Power management ICs	
9	Holtek	6.31	MCU	√
10	Faraday	5.75	IC design service	√

Source: Adapted from ITRI/IEK Project (March 2006)

New firms spun off from the original members were also subsumed into the UMC clan. For instance, XGI was spun off from SiS in 2003, when SiS was acquired by UMC, to commit resources and personnel to the design of professional graphic chips in an independent company. Both SiS and UMC hold XGI's stocks (30% and 27.59% respectively) and license in-house IPs to XGI. The spin-offs not only obtain financial support by an equity arrangement with UMC but also have access to technological resources with UMC and other design members. A senior manager (***Des.16-1***) makes clear that

> [we] separated them off, [because] those colleagues expect [it]: 'I'd like to start up [a] company. I have an endless dream and wish to become MediaTek [the biggest Taiwanese IC design house specialising in optical

> storage chips] someday.'[31] What SiS or UMC can do is to stake them or license IPs to them. Now, IP licensing is very important [for advanced design] … so the very thing that SiS or UMC group handles [is to license IPs] including UMC's in-house IPs, say, the patent library sale (implying the IP library), or the [technological] contracts signed with foreign companies. By doing so, [the design members] may share [IPs]. This enables many new, small start-ups to employ the IPs, rather than to develop all alone or to purchase [IPs]. Thus, we can find that UMC group is quite unique among the design houses in Taiwan or worldwide.

In addition, a periodic fluctuation in chipmaking was related to "ordinary cyclical mismatches between capacity and market growth" (Schoenberger 1988: 323) in the macro-economy. Therefore, the design members may have more commitments on their manufacturing capacity from their foundry partner during IC boom periods owing to a tight partnership with UMC. During boom periods, the production capability of a foundry cannot match designers' demands; in turn, foundries struggle for orders during a downturn. The design members of a network benefit from close technological collaboration and the cheap and speedy output of newly designed chips with an assured quality. The way that the members of the UMC clan collaborate with one another is not rigidly bound but is a flexible and complementary cooperative partnership to accommodate technological and financial resources and to moderate the uncertainty of manufacturing cycles.

[31] Certainly, the action of spinning off corporate divides is partly under consideration of business strategies and partly based upon a sense of entrepreneurship.

There are two common and interrelated points in association with the formation of corporate networks in the agglomeration. One is the sense of reciprocity among interactive agents, and the other is the involvement of knowledge/information during interaction. The constitution of networks is the practical operation of 'support infrastructure', including reciprocity, trust, learning, partnership and empowerment, facilitating the regional economy by activating the technological dynamics. In short, the reciprocal relationships evolve into a pattern of *pseudo*-IDMs, which means flexible link-ups of production coordination or business alliances at an inter-firm level, in the IC complex of northern Taiwan.

5.3.2 In the 'proximities'?

Spatial proximity is an explicit starting point in analysing economic agglomeration. The advantage of physical proximity is related to 'pecuniary externalities' by which individual companies can benefit from "pools of common factors of production" (Harrison 1992: 472). The potential of territorial propinquity is associated with externalities generated by the local economy that reduce costs. The California School, among others, focuses on an "inner momentum of falling production costs" (Scott 1988: 176) as the source of the success of 'new industrial spaces' (NISs). However, the transaction-intensive position tends to simplify a firm's responses to uncertainty[32]. Any possibility of corporate behaviours is seen as market-oriented. As a result, the explanation for economic agglomeration revolves around cost-based externalities at the expense of "the political economy of a specific society" (Lovering 1990: 163) and the socio-spatial dimension acting to incubate local industrial *atmosphere* (Henry 1992).

The nature of competition between many companies has shifted towards quality improvement rather than price competition (OECD 1996); the price-signals of local supply alone are insufficient to explain local sources of competition in the context of the knowledge-based economy. The impasse of technological *lock-in* will not be resolved through contractual exchange (Storper 1992; Storper 1995) in the sense that "firms are islands of planned coordination in a sea of market mechanisms" (Taylor and Asheim 2001: 318). In order to explore the beneficial effects of spatial proximity upon technological development, the research concern turns towards an examination of how local ties of sociality facilitate the learning process and innovation performance (Saxenian 1994; Morgan 1997). Storper argues that the favourable condition that sustains regional advantages in prosperous places is the

[32] External transaction is a key mechanism in reducing risks of overcapacity, transferring the tension of dispatching labours (Brusco 1982) and enabling returns of an "interrelated whole" increase (Young 1928: 539).

“interdependencies which are *untraded*, including labour markets, and conventions, or common languages and rules for developing, communicating and interpreting knowledge” (Storper 1995: 206, emphasis in original).

The nature and quality of the cluster’s “local nexus of relational assets” (Amin and Cohendet 1999: 89) determine how existing knowledge and new ideas are fused to generate superior products and services (Storper 1997; Amin and Cohendet 1999). The social analysis of economic behaviour is strongly influenced by the concept of ‘embeddedness’ proposed by Granovetter (Granovetter 1985). The cluster is, accordingly, seen as an entire society. To use Gordon and McCann’s (Gordon and McCann 2000: 520) words,

> all economic relations (even the ‘pure’ market relations of the agglomeration model) are socially embedded in the sense that these depend upon norms, institutions and sets of assumptions shared among a group of actors and are not, in themselves, simply the outcome of economic decisions … industrial clusters differ from the agglomeration model in that there is a belief that such clusters reflect not simply economic responses to the pattern of available opportunities and complementarities, but also an unusual level of embeddedness and social integration.

In this matter, the region is a source of knowledge creation because corporate interactions in the proximity facilitate to localise the learning process (Malmberg 1996; Amin and Cohendet 1999).

It is true that "[e]ven the world's largest and most international firms can no longer 'bet the company' on the next generation of semiconductors or jumbo jets; in many industries the cost of a competitive R&D budget has risen to the point where it is no longer possible to 'go it alone'" (Kobrin 1997: 151). With an increase in technological complexity of IC output, the specialty among different sectors becomes intensive. Collaboration arrangements between design houses, foundries and equipment vendors in the IC industrial district of Taiwan are exemplary. The inter-firm governance of technologically-sophisticated inputs along the process of chipmaking reveals a multi-lateral collaboration of closeness and extension.

I shall state the situation of a pilot run in the wafer production first. The pilot run is a tentative stage to verify the function of chips in small volumes before batch production. During the initial run, engineers from both design houses (*i.e.* customers) and foundries (*i.e.* manufacturers) have to check out every bottleneck occurring in the production process, and then sort out related problems (such as an engineering parameter or a design error). This is an iterative and time-consuming process of trial and error required to work through a refined run of production; it can take up to six months for product engineers from both sides to engage with modification via continuous discussion and communication.

In practical terms, customers and manufacturers need to reach a common cognition surrounding the designing targets and the processing so that the expertise from the two sides can be exchanged and understood to the full. Each firm specialises in its own form of complicated expertise, so it can only work by complementing each other to reach "some kind of coordination" (Malmberg and Maskell 2002: 438). The design details are often associated with the customers' intellectual novelty with a highly commercial value, which must not be leaked out. Therefore, a basis of high-level trust accumulated by repeated personal contact over a long period of time is fundamental so that the design customer would be agreeable to reveal proprietary knowledge to their production partners (Zucker 1986; Leyshon, Thrift et al. 1998). The foundries and the equipment vendor necessitate a series of mutual adjustments in an interpersonal sense during the transacting processes, as foundries and design houses do. Because the wafer-related equipment becomes more and more complicated as a result of a growing requirement to meet evolving designs and process technologies, many machinery hitches or mechanical malfunctions are beyond product engineers' knowledge (von Hippel 1977). A machinery engineer is the engineer assigned to a station in customers' fabs from vendors.[33] He should

[33] Making prompt responses is imperative for the sponsor. As ***Vnd.1*** reports, he "must respond in two hours and turn up in four hours if customers (*i.e.* chipmakers) call up … [on] an occasion during

understand the principles of machinery architectures so that he can deal with any machinery hitch or mechanical malfunctions on the lines.

But proximity is more than a spatial term. Various senses of proximit*ies* are identified to expand upon the coordinating process (Gertler 1995; Gertler 1997; Gertler 1997). Coordination of information delivery across organisational divisions is illustrative. As mentioned above, the technical assistance of the machinery supplier in chipmaking is carried out through a *compromising solution* according to the degree of difficulty. The *in-situ* services or ordinary demands for techniques or components are mainly conducted by the local branches or distributors, otherwise special technical personnel and key components demanded would be transferred from parent companies exclusively. The sponsors, as listening posts, are conducive to machinery amelioration by delivering customer feedback *vertically* to parent companies abroad in an *organisational proximity/distance*.

Furthermore, a sense of *cultural proximity/affinity*[34] can be employed to account for information delivery and knowledge transfer in a wider organisational

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off-duty; in office hours, [sponsors] basically must be on call".

[34] The point here is to reveal the learning milieu generated by interpersonal, informal communications among engineers in a place, so I draw a *techno*-cultural dimension, rather than a *national*-cultural one (Gertler 1997), in relation to a smaller spatial scale (Malmberg and Maskell 2002).

scope. A cultural commonality is shared by firms and engineers from different backgrounds. There is a common language surrounding technical expertise and training experience and a shared attitude and commitment to one goal in a productive environment (cf. Brown and Duguid 2001). Unscheduled meetings and quick progress checks are not only crucial to fulfilling the productive process *per se*; far beyond the costs of transaction and lead time, the dynamics of complementarity contribute a lot to cumulative improvement and even critical technological breakthroughs (Angel 1994; Benner 2003):

> Q: When you put the 90-nm process into production, is it … that your customers verify their design function and you test your process technology at the same time?
>
> A: That's right. [But] basically, this sort of case requires three parties [to be involved], added [to] by one party; namely, [the] equipment vendor. … It is because everyone is learning actually. … Machinery vendors don't even have the experience [to produce facilities for the 90-nm process]. It is just the case that [IC] design capability may work out. However, they are not sure if it (*i.e.* designed circuits) can be produced. So, it often requires three parties to work together. Because it is a sense of [strategic] alliance, everyone goes for development together and shares the cost.
>
> – ***Fdy.3-1*** reports

There is a deepening process of technical specialisation in relation to the mutual adjustment for problem-solving and innovation. One famous example around the industrial circle is the 'immersion lithography programme', a critical bottleneck for chipmakers to mask an extremely-minimised circuit. This programme was an innovative technique first proposed by a senior engineer from TSMC in 2006. With an intensive co-developing process, a new set of equipment for the programme was materialised by an R&D team of Applied Materials Inc. (AMI) to cross the technical threshold. Such joint technical innovations are associated with *inter*- and *intra*-organisational feedbacks from the equipment vendors' point of view – externalised information exchanges and internalised information transfers respectively.

To sum up, the multi-literal collaboration can be regarded as a collective learning process, echoing Bathelt's statement that "innovations must be viewed as a result of social relations and reflexive behaviour and not of individualistic endeavours" (Bathelt 2002: 587). This process is a 'learning-by-*co-working*' pattern achieved by intensive contact via proximity-based transaction/interaction. As the proximity benefits getting through material input-output linkages efficiently and catalyses a non-hierarchical and substance-filled communication to cultivate a relational mutuality and cognitive commonality between participants, it is relational in nature – surpassing a territorial sense of proximity (Gertler 2003). On the basis of Gertler's insight, it is appropriate to refer boundaries of organisations *and* localities to a porous attribute considering extensionality of relational processes. It suggests that a force of *extra*-local dynamics is an important dimension to the growth of industrial agglomeration besides the logic of *endogeneity* localisation literature stresses.

5.3.3 Issues of technological lock-in

With understanding as to how the proximity-based ties of technical community actually work and their effects on the local production system, it should be possible to take a further step to reflect upon the geographical scope of *networking* that underlines the extension of multi-layered collaboration. The requirement for redefining the scale of a network depends on the strength of a company's response to the limits of 'lock-in'. Technological lock-in results from a habitually technological trajectory; in other words, "it is more difficult to change from one path to another as external economies in production or use increase, and it may even become difficult to move further along a given, narrowly defined product path if production technologies become specific" (Storper 1992: 78). The contemporary economy is characterised by the far-reaching permeation of economic activities through boundaries and the accelerating pace of technological evolution. But, under what circumstances are some specific industrial districts able to sustain their competitive advantages rather than succumb to the widespread internationalisation of economic and technological contexts? Guerrieri and Pietrobelli provide a useful approach to examining the possibility of cluster evolution by citing the conception of 'technological regimes' from evolutionary economics (Guerrieri and Pietrobelli 2004). This framework surrounds a central point, that localised clusters' condition of 'opportunity, appropriability and cumulativeness' is crucial to their technological capability of accumulation and innovation; that is, regional competitiveness.

The dense interactions among local companies make material the crucial exchange of tacit knowledge through informal personal contacts or face-to-face communications in the vicinity. The creation of lasting knowledge in the locality requires enlarged technological bases sourcing relevant knowledge and information to overcome the problem of lock-in. From this techno-economic point of view, the spatial implications of the network metaphor are twofold: the first is the web of interdependence linked among agents within the clusters, and, extensively, the second is to take each relevant cluster as a node which interacts with other clusters via networking (cf. Amin and Thrift 1992; Leyshon and Thrift 1994). The latter suggests that some sustaining clusters are driven by the evolving forces of local and global knowledge networks.

The course of technical community is a case in point. Hu and his colleague (Hu, Lin et al. 2005; Hu, Lin et al. 2005) refer to a local innovation network constituted by the cooperative interactions among organisational agents, including firms and R&D institutes in north Taiwan, in several ways: formation of spin-off companies, establishment of supply production coalitions, and flow of technology professionals. It is argued that professional expatriates play a mediating role in leveraging the exchange of industrial technology and business information between north Taiwan and Silicon Valley (Hsu 1998; Hsu and Saxenian 2000; Saxenian and Hsu 2001). This bridging process, based upon a practice of professional community socialisation, enlarges the sources of technology and, in a spatial sense, connects the industrial districts with global production networks. The production system localised in north Taiwan is endowed with knowledge-intensive networks at various geographical levels by the socialising practices of knowledgeable agents. In that regard, an industrial cluster may gain "the chance to reach out much further, breaking through geographical borders without losing its identity and preserving its specificity and uniqueness" (Guerrieri and Pietrobelli 2004: 903). The consolidation of the cross-Pacific technical community embodying communities of practice is a strategic strength "for the firm as a whole to compete effectively at the global and local levels" relying on "a process of spatial integration (intra-firm networks) and local embedding (inter-firm networks)" (Yeung 2005: 315).

The disposition of the networking process has been altered by the extensive application of telecommunication technology. It is true that "telecommunications now play a crucial role in corporate repertoire of product, process and organisational innovation" (Morgan 1992: 325). I shall reveal an alternative process of linkage with reference to impersonal interface/information flow rather than technological community/know-how learning. Virtual communications work as a supplement to, not a substitute for, the localised practice of proximities and networks and acts, by extension, to reshuffle the spatial organisation of the IC industry (Graham 1998).

5.3.4 The e-foundry: Communication, reintegration and extension

There is an e-commerce portal – the so-called *virtual foundry* or *e-foundry* – that redefines the disposition of vertical disintegration at an instrumental level (Business Week June 18th 2001; TechVantage May 2003; http://www.tsmc.com). This is a generic term referring to a set of Internet-enabled software a foundry develops to enhance efficient coordination between the foundry and design customers at arms' length.

Technically, there are “parameters and constraints within which the design engineers and design architecture must work” (Macher, Mowery et al. 2002: 162) established by the foundry. Correspondence of design layout with the rules is requisite for completion of chip output. Website-based tools are launched by the foundry to link the designers with accurate design rules and up-to-date process technologies through the Internet. Take UMC’s i-design for example; software products of layout reviewers enable engineers from the design houses and the foundry located in multiple sites to coordinate with one another immediately, simplify design rule check, and even estimate costs of various feature sets (Macher, Mowery et al. 2002).

One other device – a ‘silicon intellectual property (SIP) library’ – also improves the efficiency of design lay out. IP refers to a set of *modularised* circuits with specific functions. It is reusable in a variety of chip designs and is saleable in the market. The design houses are used to outsource SIPs from an IP mall of virtualisation where the SIPs are traded or mutually licensed in that each module requires a time-consuming verification. Applicable SIPs are alternatively available by accessing the portal of the e-foundry where the free IP library is elaborated by the foundries. For stabilising partnerships, the foundries have a tendency to offer contracted designers with an eligibility to pick up applicable SIPs, as well as engineering knowledge of processing technologies in reference to designing and the EDA tools. The database pools the coded knowledge explored in-house and those deriving from other allied designers (*e.g.* the reciprocity of the UMC Clan) or SIP vendors.

Design houses share the achievement that foundries have made to improve process technology, minimising yield loss[35] and producing reliable volumes of wafer output in time. The telematics system accelerates the designers to hand design specifications to the foundries quickly, and *vice versa*. Formerly it took a couple of days for foundries to confirm one design client's orders, while the orders can now be confirmed immediately via open business-to-business systems on line. Parallel to the merit of time-saving in contacting or order checking, the system is associated with reformulation of industrial governance. To give some sense of this, I shall make particular reference to an instrument for communication – a real-time monitoring apparatus.

Previously, when an IC was put into batch production, its wafer would be set on schedule and run all the way automatically by programming. Production information,

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[35] It is the failure proportion of output: produced wafer that is disqualified. The higher the yield loss the higher the production cost.

e.g. the bugs occurring beyond expectations or the rate of yield, was unavailable until all the wafers were output once the wafer was put in the processing lines. This was an information block unfavourable to the advance of production efficiency. Nowadays, each piece of wafer on the processing line is read automatically through the use of RFID (*i.e.* radio frequency identification) and computers. It is a system that pools, transmits and receives reports and feedback, so that design clients will learn about the digitalised data without any delay or error and even halt the running lines if necessary, provided that they log on to the portal site.[36] The data updated for the client are not merely drawn upon the course of wafer fabrication but may embrace the whole range of manufacturing procedures. This is a turnkey service that authorises the foundry to manage a continuation of assembly and testing tasks (and logistics and final shipping as well).[37] In turn, the production data offered by those partner companies are converged to fabs' real-time monitoring apparatus for customers' reference. That is, the expedient arrangement of design, engineering and logistics surrounding the foundry-fabless collaboration is virtually materialised.

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[36] Surely, the flexibility to intervene in running lines is at the expense of a rise of manufacturing cost and lead-time risks resulting from process re-programming needs to be taken by customers themselves.

[37] Where the assembly and test chips may be assigned by the designers themselves or entirely decided by the foundry.

The remote reviewers and the SIP circulation are more than a matter of transaction carried out by electronic devices in cyberspace, and the case of monitoring systems does not simply refer to a tool of more direct oversight by which the design houses have an immediate control over fabricating. Those virtual devices (and ideas) above come down to one demonstration of functional reformulation. The sectoral functions of specialisation become mutually immersible to a deeper degree, while the administrative fiats of individual firms remain *independent* (Markusen 1999). The verticAlly disintegrated format of tHe IC industry may not alter much in shape but its articULation is evolved in a 'soft' manner – the productive fragmentation Is *virtually reintegrAted*, while this sort of governance "allow[s] buyers easily to connect to and disConnect from a set of merchant service providers with a wide variety of technical and geographically-specific attributes" (Sturgeon 2000: 14).

One caveat is required when taking virtualisation into Account. Coded knowledge, reports, feedback and commands are passed in no time via telematics systems. The cybernetic immediacy that constitutes 'mirror worlds' reflecting digitalised data in a screen (Gelerntner 1991). The status is said to do away with "the formal qualities of geographical spaces"; alternatively, it is found that the mechanism of impersonal *and* off-site communications gives rise to an anxiety about the 'managerial dilemma of virtuality' – an expiry of trust (Handy 1995). Those views have different concerns but come to a presupposition that "an independent dynamic of mechanical invention, modification and perfection imposes itself onto a social field transforming it from outside" (Crary 1994: 8; cited in Thrift 1996: 263). It is a fallacy of technological determinism of which one should be aware. First of all, the data fluidity may be extensible but not footloose in *spaces*. The access control represents the power of *exclusive* use in light of cyber-segmentations (cf. Sassen 1997). It is only available to individual units (various firms of different sectors) working correspondingly within the legally-contracted scopes. For example, one design house is entitled to use the database served by its chipmaker to do much of the design work and to learn the current progression of manufacturing from the system of reporting-monitoring if it were to log in to an individual account. The exclusivity at a corporate level is functionally indicated by the sectoral articulations of differentiated but integral engineering tasks in the industrial repertoire.

The practical evidence reminds us that communications are subtle in terms of the ways in which they can be modularised, codified and digitalised. It is feasible to explain the status of a portal site by analogy with an information node through which data is threaded or is cut off. The latter does not mean that the data flows come to a standstill but that the data can and need to be represented at a specific point. This point in cyberspace is involved with *spaces* at industrial, technological, organisational and associational levels. The electronic exchanges of all sorts make a type of managerial solution to spatial barriers, “which in turn, necessitates the construction of new (relatively) fixed and confining structures” (Swyngedouw 1993: 306; cited in Graham 1998: 176). Furthermore, Graham makes clear that “the use of faster and faster telematics systems actually increases the demands for face-to-face contact so that the interpretative loads surrounding information glut can be dealt with rapidly and competitively” (Graham 1998: 180). In this regard, the e-foundry is more than a technological mechanism to reconfirm a spatial division of labour; it symbolises (and functions as) a site of ‘situated practices’ in a nodal sense where professional communications and communities consolidate (Amin 2002). The IC cluster in north Taiwan represents a cohesive feature due to a “collectivity of dense linkages between individual actors” (Amin and Thrift 1992: 20), which share similar characteristics regarding the spatial practice of production system with other industrial districts. The way to diverge/converge information and technology-specific knowledge is well handled owing to a position of *communication nodality*, which is beyond a territorially-defined closeness. The growth of Taiwan’s IC industry within an economic agglomeration embodies an industrial node of specialisation inserting itself into a broad, large-scale production network.

5.4 Conclusion

The preceding discussion reveals the evolutionary trajectory of the Taiwanese IC industry. The input of governance infrastructure and public resources supported the IC industry in its embryonic period. But the construction of intense inter-organisational networks was conducive to rapid industrial growth. Furthermore, my analysis of industrial governance in organisational, geographical and instrumental dimensions indicated that the high-technology industrial district in Taiwan was not territorially-contained. The territoriality of industrial behaviour is refined since the cross-border actions and phenomena that embody the presence of globalising practice and process *are* blurring boundaries. Particularly, as "information has become central to the practice of modern economic theory and practice" (Thrift and Olds 1996: 316), the substantial proximity and networks in place are reinforced and strengthened across *spaces* with the help of virtualisation – such as, the instantaneous nature of data delivery and the exclusive access to the computer-mediated devices of specialisation. This instrumental manner that acted with an emerging time-space reconstitution of industrial activities is a supplement to, not a substitution for, the agglomerative embeddedness.

In summary, the local cluster is extensively connected to the outside world and demonstrates the global connectivity of social organisations. Such local-global articulation is associated with, and significantly impacts upon, the growth and development of the global IC production network. This chapter has represented *transnationality* in terms of organisational governance. These Taiwanese firms have also transformed themselves into TNCs. My focus in the following chapters will be upon the outflow of IC capital and geographical deployment of industrial operations, so as to understand the capabilities, pressures and discursive strategies that developing-country TNCs deploy in justifying their overseas investment.

CHAPTER SIX

THE POLITICS OF CROSS-STRAIT PRODUCTION

6.1 Introduction

> A businessman is stateless.
>
> – A Chinese proverb

The formation of the IC industrial system and its agglomerative manifestation in Taiwan is a product of a planned industrial strategy. The development literature on Taiwan (and its East Asian counterparts) has pointed to the dominant role of the state in fulfilling industrialisation since "[its developmental] achievement has lain in [the state's] "ability to *both* implement national planning priorities *and* expose their economies to market disciplines, especially international" (White and Wade 1984: 2, emphasis original). The state's attempt to *internationalisation* domestic productive capital is represented by the governmental involvement in the formulation of export-oriented industrialisation. Such state effort is effective, and promotes change. Closer relationships with the world market make the indigenous IC firms more accommodating to a capitalist logic.

The aim of this chapter is to explore the dynamics at play when firms endeavour to take the initiative in governing spatially-extensive production chains. I shall present this argument in the following manner. **Section 6.2** outlines Taiwan's regulatory framework which is imposed upon the cross-Strait economic activities at an inter-state level. It will point out that a long-term political conflict between Taiwan and China has made a considerable impact upon Taiwan's attempt to regulate economic exchange with China. **Section 6.3** reveals the corporate point of view on the westward investment which is diametrically opposed to the state's attempt. **Section 6.4** draws upon the domestic debate upon the repeal a legislation which banned the transplantation of 8-inch wafer lines (with process technologies up to 0.18μm) to China during 2002 and 2003.

6.2 Policy formulation

6.2.1 An overview

Relations between Taiwan and China were almost suspended during the Cold War owing to their political opposition to one another. Since then, Taiwan has become embedded in the world system by engaging in the international division of labour compared to the policy of national self-sufficiency pursued by China until 1978. For over half a century, the Communist threat across the Taiwan Strait provided Taiwan's Kuomintang (KMT, the Nationalist Party) government a rationale for maintaining a strong state in the name of national security (Snyder, Gregor et al.

1980). The cross-Strait linkages were restricted according to the 'Three-Nos Policy' – no contact, no negotiation and no compromise – which launched by Taiwan's President Chiang Ching-Kuo in 1979. Under the legislative imperative, all interactions with China, including economic exchange, postal communication and transportation, were forbidden.

However, there was a *pragmatic* turn in policy marking a significant breakthrough in 1987 when 29 products and raw materials were permitted for indirect import from China, while Taiwanese citizens were permitted to make family visits to the Mainland. Conditional relaxation in the prohibition of trade and investment was made by enacting the 'Act Governing Relations between Peoples of the Taiwan Area and the Mainland Area' in 1992. Since then the cross-Strait trade and investment of granted items *going through third parties* have been allowed.[38]

The regulatory ban on the cross-Strait economic exchange was lifted to gradually take account of economic reality. The trade exchange between Taiwan and China has become more frequent and intensified. As shown in **Figure 6.1**, the total value of the share of cross-Strait trade of Taiwanese foreign trade nearly tripled

[38] The sanction on Taiwan's *direct* investment in China was proposed by the resolution of the Economic Development Advisory Conference held by Taiwan's Office of President in 2001.

between 1992 (7.4%) and 2007 (21.9%). This indicates a rapid growth of market dependency upon China. The figure also displays an excess of Taiwanese exports to China. Machinery and parts took the lion's share of the export items which were mainly supplied by Taiwanese investors who ran proceeding trade in China to take advantage of the vertical division of labour across the Strait (Lin ; Chen 2003). In other words, the trade surplus was associated with Taiwan's westward investment. Despite this, the fast growing and high dependency upon the Chinese market worried the Taiwanese Government. Political uncertainty (such as the Tiananmen incident), changeable regulations and local bureaucracy were negative factors which increased the risk costs in doing business there. A further concern was the nature of export-oriented industrialisation which has been fundamental to Taiwan's economic growth. The national development strategy necessitates an extensive involvement with the international economy, while market dependency on just one geographical region was a potential weakness of a trade-based economy.

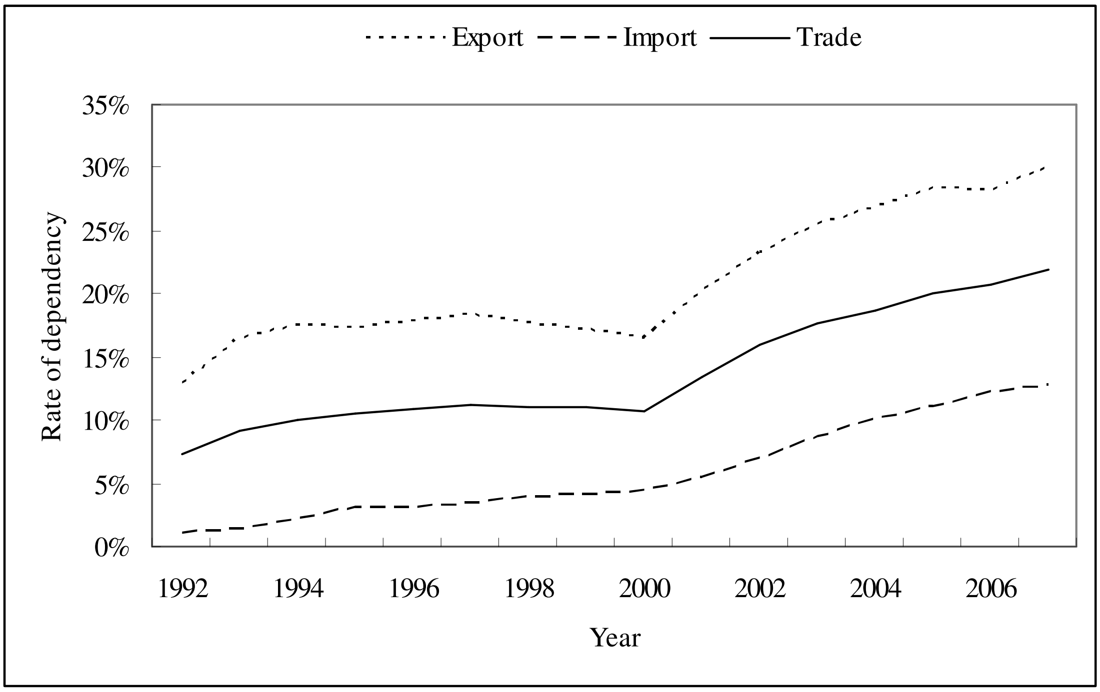

Figure 6.1 An increase in trade dependency on China: 1992-2007

Source: Adopted from the statistics of the Mainland Affairs Council, Taiwan (www.mac.gov.tw).
Note: Dependency rate is the share of cross-Strait trade related to the total value of Taiwanese foreign trade.

6.2.2 Preventing over-dependency

For Taiwan as a whole, however, the risk of doing business with China is not merely the rate of return on investment. State sovereignty is at the crux of the matter that explains why the government was so reluctant to welcome closer economic ties with China. An ideological divide between Nationalist Taiwan and Communist China has became peaceful since the mid-1980s when Taiwan progressed to economic liberalisation and political democratisation and China became more involved with the world economy. Nonetheless, the cross-Strait conflict has by no means been settled. Taiwan diametrically opposes the 'One-China Policy' that is held by China on the strength of Chinese nationalism.

'No haste, be patient'

The political tension between the two countries is frequently inflamed by constant political and military manoeuvres performed by China. There was an array of missile drills that China held during the period between the visit of President Lee Tung-Hui to the US in June of 1995 and the first general election held in Taiwan in March of 1996. The intensive military menaces and diplomatic means to isolate Taiwan's international status worsened the political dialogue and reconciliation hopes between both sides of the Strait. The way that China has repeatedly claimed territorial rights over Taiwan and has kept threatening to use force if Taiwan ever moved to declare independence[39] had exactly the opposite effect. The provocative actions prompted President Lee to promulgate a guideline of 'No-Haste-Be-Patient' (NHBP) that urged domestic enterprises to refrain from making excessive investments in China (Lee 1999). This was for fear that Taiwanese investors might be held as *economic hostages* by Beijing; that is, those who invested a massive

[39] The political discourse of independency is constructed by historical legacies of Japanese colonialisation and Nationalist autocracy. However, it is beyond the scope of the thesis to discuss this in any detail.

amount of fixed costs there could be politically forced to express views in opposition to the home state.

The Taiwanese state was conscious that the cross-Strait economic integration had nothing to do with any reduction in anxiety about China's troop disposition in the southeast coastal areas of the Mainland. In 1999, 'Special State-to-State Relations' were proposed to define relations between Taiwan and China so as to comment on the idea of 'One Country, Two Systems'[40] that China unilaterally insisted upon. In a word, westward investment is more than a business matter: it is deeply entangled with the relative economic competitiveness and national strength of Taiwan and China. The NHBP policy establishes the guiding principle of cross-Strait economic affairs which was formally proclaimed after the relaxation of national restrictions against exchange with China. Nonetheless, the evidence displayed in the later part of the chapter demonstrates that the government has failed to fully work out its economic guidelines.

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[40] In the early 1980s, Deng Xiaoping formally put forward this principle regarding the future of Hong Kong and Macao when the two places were reunified with mainland China. Its intention is to retain their established systems under a high degree of autonomy for at least fifty years. China also proposes to apply this principle to Taiwan, which is highly unpopular in Taiwan and has been adamantly refused by the Taiwanese Government.

Such inter-state rivalry led to a pessimistic view of Taiwan's economic autonomy. In a sense, over-dependency on the Mainland has made trade and investment vulnerable to China's economic sanctions and military threats. For that matter, economic activities were highly politically sensitive since inter-state tension was a critical element in provoking anti-China feeling *within* Taiwan. An underlying crisis of autonomy triggered ardent Taiwan *nationalism*, and consolidated domestic opposition to the Mainland, with the Democratic Progressive Party (DPP)[41] as the leader, asserting Taiwan's sovereign independence from China. Such opposition was triggered in part by signs of Taiwan's increasing economic entanglement with China; the rate of export dependency upon China exceeded 20% since 2001 (20.3%), and continued to rise to 30.1% in 2007. This indicates an undue concentration upon one single country's market which increases the vulnerability of Taiwan's export-oriented economy. It was envisaged as a serious risk to the sovereign rights behind an accelerating integration of cross-Strait economy which would provide China with further leverage against Taiwan. Those opposition groups warned that increasing market dependency and de-industrialisation render~~s~~ the Taiwanese economy vulnerable to China and jeopardises state sovereignty.

[41] Before coming into power in 2000, the DPP was the counterforce standing against an autocratic regime ruled by the KMT.

A 'go-south' scheme

The state has long perceived that Taiwan's resource-poor and export-oriented economy is vulnerable. Various types and levels of global forces, including foreign interventions (*i.e.* pressure by the US Super 301) and institutional imperatives (*i.e.* pursuit of GATT/WTO accession) determine the schedule of trade liberalisation in view of sustaining prosperity. Take tariff cuts, for example: the average nominal tariff rate was reduced from 26.46% in 1985 to 10.74% in 1989, and then to below 10% in 1995, and the ratio of total customs revenue to total imports continued to fall after 1974 (28.03%) to 8.75% in 1996 (Liu 2002: 978, Table 1). The removal of restraints on trade had been achieved by 1996 primarily in order to support a bid for entry into GATT. Together with the trade liberalisation, the policy reform contains deregulation of financial control, privatisation of publicly-operated enterprises, the opening-up of access to licensed monopolist industries, *etc*. despite difference in the speed of implementation.

In addition, a macro economic programme to develop Taiwan into an 'Asia-Pacific Regional Operation Center' (APROC) was devised to internationalise the national economy in 1995. One of the major objectives was to target Mainland China as an economic hinterland and to incorporate it with the operation centre. However, the unstable relation with China, as was mentioned earlier, was an obstacle to this approach. In other words, the Taiwanese Government considered whether national security would be exposed to risk once an embargo on cross-Strait transportation was lifted. Such considerations reflect policy constriction in line with the NHBP principle. Nonetheless, in contrast to the suspension of political dialogue between the two states, non-governmental communication and exchange gradually increased. For that matter, a strategic policy of 'go-south' was constructed to cool 'China fever'. The go-south strategy advocated transplanting less profitable production lines to Southeast Asian countries. This strategic thrust was formally inaugurated as a 'Southward Policy' by the Ministry of Economic Affairs in 1994; one year after the ASEAN countries passed a resolution to sign the Common Effective Preferential Tariff (CEPT) for the advance of economic regionalisation. In a word, an expected boom reinforced the official determination to take part in this trade liberalisation on a regional scale.

Substantial measures were adopted by the KMT-dominated government to try to achieve "advantage of a certain complementarity … across national boundaries" (Yeung and Lo 1996: 37). Firstly, the state worked hard to secure a number of bilateral agreements to protect investment with these countries through conferences at a ministerial level. The policy was certainly politically wise in facilitating multi-dimensional connections to these countries considering the absence of diplomatic relations between Taiwan and ASEAN countries. Next, financial assistance was offered to the Philippines (in Subic Bay), to Indonesia (in Batam Island and Medan) and to Vietnam (in Haiphong) to set up industrial parks in which Taiwanese enterprises could base manufacturing-based ventures to reduce labour costs and land rents. Take Subic Bay, for example (Chen 1996). There, a 300-acre industrial park was specially developed as a JV by a Taiwanese consortium and the local authority. Taiwan was the largest single-country investor in Subic Bay; 105 acres of land was occupied by the end of 1995. One Taiwanese firm employed some 4,000 workers and turned out 180,000 sport shoes each month. Furthermore, the state even took a lead in making investment that it then directly channelled southward into funds of public enterprises and KMT-owned enterprises[42] in the neighbouring countries.

The policy was originally a three-year programme from 1994 to 1996, but has subsequently been implemented twice more (Wang 2003). The second time was during the Asian Crisis of 1997. Concrete measures mainly consisted of offers of financial aid. In 2002, the DPP-ruled government (which was in office between 2000

[42] When taking over Taiwan after World War II, KMT received a great deal of properties and lands from Japan as party-owned assets (Hsueh, Hsu et al. 2001).

and 2008) proposed the third Southward Policy. In an international conference on the US-Japan-Taiwan Trilateral Strategic Dialogue in 2002, President Chen Shui-Bian stressed the importance of intra-regional integration and asserted that

> Taiwan needs to get along its own way … it is to seek for cooperation with democratic states within the [Asian-Pacific] regional market in order to promote security in the Asian-Pacific region and to strengthen democracy and prosperity.

There are consequences concerning the governmental understanding of overseas investment. The economic guide to capital flow provides an explicit contrast to the restraint on cross-Strait exchanges, although the achievement of the Southward Policy appeared rather limited. In a sense, participation in the emergent economic bloc of ASEAN (as opposed to the China Economic Circle) was envisaged as a beneficial measure to *redirect* the approach to the world economy for the sake of averting "a catastrophic 'siphoning' effect into mainland China" (Chen 2003: 92).[43] As well as promoting the exploitation of local markets and reducing production costs, the Southward Policy has a noticeable characteristic of *directionality* that points to governmental guidance for industrial relocation to destinations out of China. Modification of excessive westward investment was based on the presumption that

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[43] In reality, Taiwanese foreign investment was channelled mainly towards Southeast Asia before the 1990s when China emerged as a major attraction for Taiwanese capital (Kung 2001).

economic marginalisation from the world market would ensue after economic incorporation into – *rather than integration with* – (a rise of Greater) China.

To sum up, from a macro-historical perspective, the geopolitics of a West-East divide has been reversed since socialist China turned to the world economy, and this has reshuffled the global geo-economy. Such radical changes put Taiwan into a predicament: should the Taiwanese economy go with the flown of the global market or become marginalised considering that political threats from China persist. In a word, the governmental effort to orient capital outflows discloses that Taiwan's economic situation is strongly influenced by geopolitics, although, as do business enterprises, the state recognises the necessity and reality of "internationalisation of national economic spaces through growing penetration (inward flow) and extraversion (outward flow)" (Jessop 2002: 22). The rhetoric of 'go-south' underlines that the state's concern with the outflow of domestic capital does not refer to outward investment in general, but to westward investment in particular.

6.3 Going ahead, not running away?

Issues about investment in China were regulated by 'Regulations Governing Investments and Technical Cooperation with Mainland China'.[44] Any investment project, either in the name of individuals or of firms, must have approval given by an Investment Commission, under the Ministry of Economic Affairs (MoEA). Projects that amounted to more than US$50 million or that were involved in strategic technologies and construction of infrastructure (*e.g.* establishment of power stations) were subject to stringent regulations in accordance with the NHBP principle. Investment items were divided into three types (ordinary, forbidden and special categories) under considerations of 'national security' and 'industry development' – the two were specifically declared in writing.[45]

The classification was simplified to 'ordinary' and 'forbidden' categories in 2002. Most IC-related investing activities belonged to the forbidden category. The production of silicon wafers and lead frames, fabricating, testing and packaging chips and engaging with IC design were banned by formal decree. The penalty for

[44] It was legitimised in 1993 in accordance with Article 35 of the 'Act Governing Relations between Peoples of the Taiwan Area and the Mainland Area'.

[45] It was legitimised in accordance with Article 86 of the 'Act Governing Relations between Peoples of the Taiwan Area and the Mainland Area'.

violating the prohibition was 4% of the investment amount; a repeated offender would be fined up to five times this. In comparison, a fine for illegal investment in the ordinary category was 0.5%- 2% of the investment amount.

It is argued that “different actors and agents bring equally different, idiosyncratic and dynamic spatialities to the unequal relationships that are central to their survival and reproduction and their differential integration into a globalising world economy” (Taylor, Ekinsmyth et al. 1997: 59). Most semiconductor magnates and industrial associations (such as the Taipei Computer Association) appealed for the liberalisation of westward investment on many public occasions, imposing a counter-discourse of ‘go-ahead’ that contested the de-industrialisation discourse. They made efforts to convince the government that the aim of promoting indigenous industry to a global level necessitated doing business with and in China. Some managers expressed a low opinion of the industrial prospects in Taiwan, arguing that “[staying] in Taiwan has slim hope [to compete]”, as ***Des.8*** said pessimistically (see also Business Week June 11th 2001). The intention to ‘find a way out’ through China refers to a material strategy “to create its own conditions of existence” (Yeung 2000: 403). The firms recognised China an as exploitable market and, of greater importance, an emerging link in the global production chain in terms of competitiveness. To be competitive, there was fundamental consensus recognising collaboration with China as an imperative for domestic firms to maintain industrial niches (or to survive) in a global economy.

The business community presents further opinions which are rooted in a liberalist conviction at diverse levels (cf. Thrift 2002). Laying stress on *a global horizon of action* (cf. Jessop 2002), Morris Chang, the CEO of TSMC, argued for thinking globally and gave advice on the removal of investment restrictions:

> There has already been an evident shift of the semiconductor industry towards China. Instead of leaving China to fumble its way and ruin the rule of game, [we should] make [an] effort to assist China in engaging with a[n] [industrial] structure of globalisation so as to promote a positive development of the entire industry.
>
> (Business NEXT September 15th 2002)

In a more constructive sense, Taiwan's industrial capability of tackling trans-local governance was construed as an advantage. The Monte Jade Science and Technology Association of Taiwan is representative of the business community, and a central objective of the association refers to advance cooperation among *ethnic Chinese* on an international scale. It was conceived so that Taiwan could be an industrial interface to link up with Silicon Valley and the Mainland to consolidate ethnic Chinese high-technology business. For example, the idea of an 'ethnic Chinese IT belt' was proposed in a business workshop, substantiating this mission (China Times July 21st 2005).

Chipmaking, for example, has hitherto been taken as Taiwan's 'economic lifeblood' in view of its extremely heavy capital investment, highly advanced technology content and exceptional output values every year. Therefore, the government kept an eye on any move that the IC manufacturers made towards Chinese investment. As early as the mid-1990s, Taiwanese chipmakers embarked upon the deployment of their production abroad in order to have closer access to customers. In 1996 TSMC established a foundry in the US to serve a growing number of local design companies (Puget Sound Business Journal December 6th 1996). UMC acquired an ailing Japanese DRAM manufacturer in 1998, and turned losses into profits by making chips for Japanese companies, such as Sony and Sharp (TechVantage March 2001). However, in comparison with a more tolerant attitude towards (or even active support of) foreign investment conducted elsewhere, the state always felt hesitant about ventures in China. An investment embargo was imposed on account of the supposition that locating IC manufacturing there might produce technology spillovers which would enable China to overcome its technological–lag with Taiwan. However, instead, Taiwanese firms invested heavily in China for fear of lagging behind Japanese, Korean and American firms which were taking *beachheads* in the newly-opened, promising Chinese market. The business strategy that the firms employed to take advantage of China competed for dominance with deploying the production system against the national regulation.

I intend to highlight the dissension between the state and business firms by focusing on the domestic controversies about the investment ban on chipmaking. One caveat is required before I proceed any further. It is not to be supposed that there was a rupture of cooperative relations between the state and IC firms in light of industrial promotion. Actually, the state kept investing a great deal of public resources to upgrade the industrial environment with the purpose of *internationalising* the IC industry. For example, MoEA invested public resources in support of an e-commerce programme initiated by TSMC, UMC, ASE and SPIL during 2001 and 2003. The programme successfully formulated the worldwide standards of B2B Partner Interface Processes (PIP) by which up to 50% of the time and cost spent in delivering complicated transnational 'work orders' from design houses through fabs to assembly plants can be saved. Its achievement is to confirm Taiwan's leading position in made-to-order IC production at a national level and to contribute further consolidation of the vertically disintegrated system at an industrial level. The complex triangular relationship between firms (*i.e.* Taiwanese IC firms), the home state (*i.e.* Taiwan) and the host state (*i.e.* China) is outlined in **Figure 6.2**.

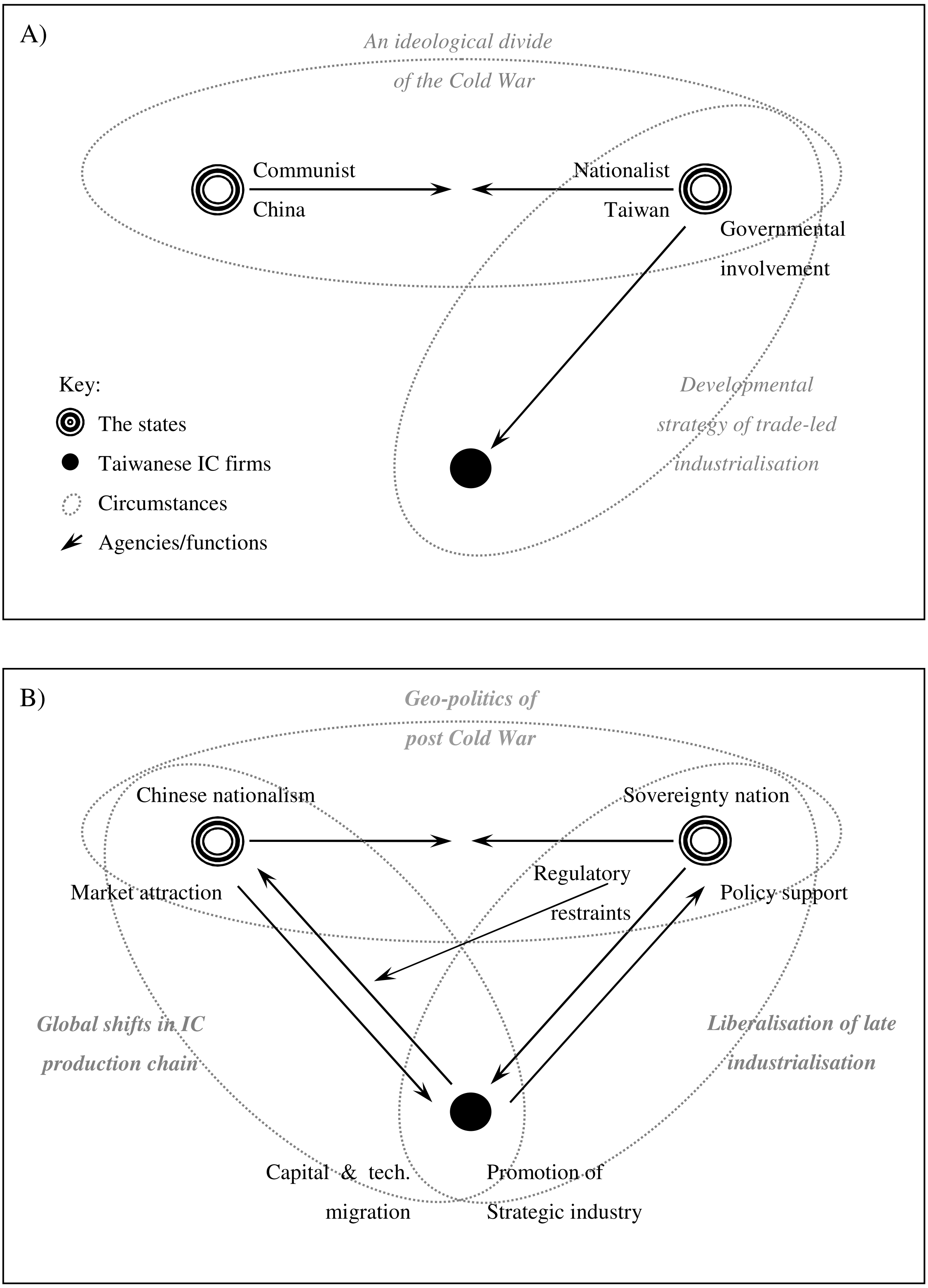

Figure 6.2 Illustration of the evolutionary state-business nexus

Notes: A) implies the period when all cross-Strait exchange was severed; B) implies the political economic status after mid-1990s.

6.4 Fab external investment in dispute

6.4.1 Contesting policy revision

Chipmakers (including made-to-order foundries and DRAM producers) have long been encouraging the state to ease restrictions on building 8-inch wafer plants and use technologies up to 0.18μm in China. It is for the purpose of deploying wafer lines for carving out business. The state persisted in its negative opinion, in opposition to the corporate perspective which sought to consolidate a niche for the global IC industrial chain by moving straight into China. The quarrel about the investment policy was fierce. It was a continuation of the dispute over loosening restrictions on exporting 8-inch lines and related technologies into China at the turn of the century.

The uproar during 2002 is an illustration of the antithesis between the political objections of the national government and corporations' ambition to expand industrial territory. The appeal for a more open policy became pressing because three IC manufacturers – Semiconductor Manufacturing International Corp. (SMIC, in Shanghai), Grace Semiconductor Manufacturing Corp. (GSMC, in Shanghai) and Hejian Technology Corp. (HJTC, in Suzhou) – were successively launched in China during 2000 and 2001. The new chipmakers had some characteristics in common, three of which significantly came to the notice of Taiwanese chipmakers. (1) A VLSI technology was applied to production lines, which made a considerable leap from the previous generation in technology (**Appendix D**). (2) They were run on a foundry model, instead of IDM. (3) The China-based fabs were JV in ownership but were operated by Taiwanese managers. For example, the establishment of GSMC was note-worthy because its founders Wenyang Wang and

Mianheng Jiang – came from impressive backgrounds. Wang is the son of Yongqing Wang, the chairman of Formosa Group which is the biggest Taiwanese manufacturing enterprise. Jiang is son of Zemin Jiang, the former prime minister of China.

It is certain that the emergent Chinese foundries have been unable to match TSMC and UMC, the top foundries in the world, concerning the processing technology and the yield rate to date. Nonetheless, their participation in a made-to-order market ignited a fierce price war. The Taiwanese chipmakers suffered very much. After a chip boom of 1999 and 2000, the global IC industry saw a periodic slump in 2001 and 2002 when the international market for chips was seriously ruined by cut-throat competition (Economist August 11th 2001). For instance, the market price for one piece of 8-inch wafer was about US$1,600 in 2002, but the Chinese foundries cut the price by half to win the market. A case in point is the performance of SMIC, when it leapt into fourth place in global foundry sales in 2004 from its launch in 2002 (IC Insight August 10th 2004) (**Figure 6.3**).

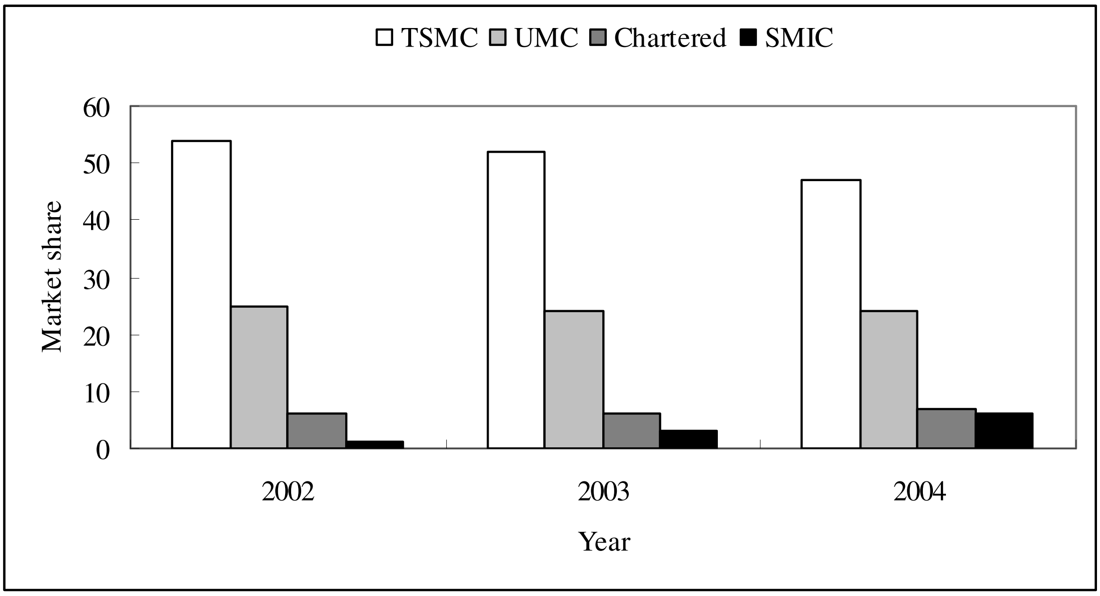

Figure 6.3 From the foundry Big Three to Big Four: 2002-2004 (%)

Source: Adapted from IC Insights (August 10th 2005: Figure 1).
Note: Chartered is a Singaporean-based IC foundry.

In the face of that competitive dilemma, the indigenous firms lobbied the government to permit them to process wafers with technologies down to 0.25μm/8-inch in China. They planned to remove the lagging-edged lines, namely the wafer lines for circuit line-width over 0.25μm, to China. The technological level for 0.25μm or lower in 8-inch processing lines has matured in Taiwan but remained advanced for the market demand in China at that time. Additionally, the domestic fabs had 30% of their capacity idle during the period. For that matter, their argument for transferring these outdated lines was on the strength of three prospective devices regarding the organisational flexibility of industrial operation: (1) to increase utilisation rate of lower-end wafer lines to minimise a heavy sunk cost deriving from facility depreciation; (2) to seize China's market where the technology demand was still low, and; (3) to upgrade the fabs to 12-inch lines at home by vacating the dated ones. Simply put, it was a formulation to upgrade-by-transplantation.

In addition to these enterprises, the concerned authorities in Taiwan were under pressure from the rapid line construction in China. Specifically, the knowledge that Taiwanese veterans went to start an enterprise in China came to the notice of the DPP government which was deeply anxious about investment in and trade with China. It indicated that a potential chain reaction of head-hunting in Taiwan would follow, and this has proved true. Knowledge spillovers were reinforced by a brain-drain when successive numerous managers and engineers (particularly those who specialise in the IC manufacturing segment) left for China. The loss of precious manpower was expected to lead to the collapse of the domestic IC industry. Because of this, the government remained suspicious that any relocation of wafer lines to China might help to reduce the technological lag by promoting local productivity and so blunting Taiwan's technological edge. Vice President Annette Lu pointed out that "go-west does not necessarily arrive at [an economic aim for] globalisation; China is merely one of numerous countries in the world" and indicated the high risk in "put[ting] all eggs in a single basket" (Liberty Times February 25th 2003).

A Debate on Westbound Investments of 8-inch Fab Policy held in early March 2002 demonstrated a fundamental chasm between the two parties. The groups in favour of lifting the barriers stressed the significance of spatial deployment to upgrade (or to retain) an industrial niche in global competition, while the arguments against a removal of the investment ban focused attention on risk management with regard to national security. The argument of those in favour was resolutely refuted by the indigenous political communities which had an anti-China slant because, as the Taiwan Solidarity Union (TSU) pointed out, "China is Taiwan's rival, rather than a complementary partner". That is, loss of technological and economic advantages to China would no doubt enable Beijing to obtain political leverage over Taipei with all the dangers that entailed. At that time, there was a demonstration led by the Taiwan Association of University Professors, one of the pro-independence associations, together with other related organisations. The rally protested against any relaxation of the ban on relocating the domestic fabs on the basis of a nationalist-conscious discourse. **Table 6.1** summarises key contentions that both sides proposed.

Table 6.1 Comparison of opposing opinions on the fab removal issue

Dissidents' views	Proponents' views
The kernel technologies would be spilt along with transplantation of wafer lines.	The dated lines which lay idle could be fully utilised if they are moved to China.
An advantage of agglomeration would be lost since a whole range of IC industrial systems would follow the move-out of fabs.	The transfer of overage facilities would spare domestic plants, which assist in promoting technological levels of lines in full.
Unlike labour-intensive industries, the IC fabrication has a high margin so that it does not need to be relocated overseas.	The price competition from Chinese counterparts is eroding Taiwan's market share.
Brain-drain effects would occur in line with relocating lines.	A serious shortage of engineering manpower has become a bottleneck for industrial development.
Once the wafer lines are shut down, the domestic unemployment rate would be raised.	Transplantation would not cause unemployment; instead, the indigenous labour force could be advanced because the lines are upgraded.

Source: According to fieldwork results and the record of the Debate on Westbound Investment of 8-inch Fab Policy (held by the Public Television Service on March 9th 2002) in http://www.taiwanthinktank.org/ttt/servlet/n.

6.4.2 Temporary expedients

In fact, that this formal debate over transplantation issues was *allowed* to be held is attributed to a distinct political consciousness. A new economic and trade policy towards China was taken by the DPP government. Under pressure from the stagnant economy and the serious chip slump, President Chen decided on a policy, a

New Middle Line[46], to replace the NHBP policy for 'Proactive Liberalisation with Effective Management'. A Public Statement of Proactive Liberalisation with Effective Management declared (November 17th 2001):

> Current circumstances of national and international economies are drastically in comparison with that in the period when the No-Haste-Be-Patient policy was formulated. Particularly, in the face of new positions referring to an advance of globalisation and Taiwan and China's accession to WTO, it is necessary to deliberate upon the imperative to upgrade enterprise global competitiveness by means of incorporating the cross-Strait economic and trade affairs into the global market. The passive action of No-Haste-Be-Patient made to resist the investment in the Mainland is not appropriate to last.

On these grounds, the controversy subsided slightly owing to a compromise so as to "strategically extend the flexibility of corporate governance in the globe and across the Strait and to establish a safety net for the investment in the Mainland by the effective regulation of transparency and institutionalisation at the same time", according to the policy announcement (http://www.mac.gov.tw/index1.htm). In late March 2002 the government developed a policy to allow Taiwan chipmakers to relocate their idle 8-inch wafer plants in mainland China, and proclaimed 'Measures

[46] President Chen stressed that this policy was inspired by the 'Third Way' ideology of Anthony Giddens.

of Investment in an IC Foundry Plant in the Mainland' to reconcile competing stands on the fab removal.

Even though the fabs were able to make the move, the tight restrictions were not eased indiscriminately. The measures were an interim procedure bound with a series of examining devices stipulated by 'Guidelines Governing the Review and Supervision of Investment in an IC Foundry Plant in Mainland China' which were issued four months later. Corporate applicants were only permitted to make 0.25μm chips at their directly-owned plants in China. The restraint was in accordance with the Wassenaar Arrangement (WA) regime of export restrictions[47] and one US embargo on exporting equipment capable of processing 0.25μm wafers. Key points are abstracted below.

- The applicant had to have already set up at least one 12-inch wafer plant at home, and the wafer plant was required to be in operation with orders for over six months.
- The investor had to be in major control in its business in China.
- The process technology was restricted to 0.25μm and below.

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[47] Since 1996 it has come to replace the NATO Coordinating Committee for Multilateral Export Controls (CoCom) export restrictions which was phased out at the beginning of the 1990s. It is the first global multilateral agreement on export controls for conventional weapons and sensitive dual-use goods and technologies by 33 co-founders in 1996 (http://www.wassenaar.org/).

- The maximum of total approvable cases in Taiwan was limited to three 8-inch wafer plants prior to the end of 2005.

The guidelines were formulated in a sense of finite relaxation under governmental supervision. The approved projects required *direct* investment, so that the flow of corporate capital could be properly regulated by the concerned authorities (Strait Business Monthly August 2002). The measure of accommodation, from the authoritarian point of view, was expedient to restrain the indigenous chipmakers from exporting cutting-edged technologies to China and, meanwhile, to encourage companies to rapidly upgrade their foundry lines at home.

Applying for the approval

TSMC was the first foundry, and still the only one, to gain approval from the governmental authorities. As early as when the government decided to lift the investment ban, TSMC had come to terms with the Shanghai Municipal Government. According to the agreement, the local authority would put up capital to establish infrastructure and factory buildings in advance; TSMC would then either buy out or rent the plants from the municipality once it had received official approval from Taiwan. TSMC avoided transgressing Taiwan's law but saved time by not needing to wait for plant construction in Shanghai. In addition, the firm registered around 3,000 semiconductor-related patents before investing in China in a bid to fully protect the intellectual property right (Computex May 24th 2002). Its operation of 12-inch fabs fulfilled all the requirements that the home government had asked for prior to June 2002. A branch plant, TSMC (Shanghai), was opened and succeeded in batch production in September 2003, one year after the submission of a formal application. This fab-removal project was expected to be completed in four years with an investment of US$898 million.

TSMC was a unique case that went thorough the bureaucratic procedure before going west. Two leading DRAM companies, ProMOS and Powerchip, intended to follow the same approach. They competed for the remaining slots, but political collisions soon stirred economic activities. Their application collided with a presidential campaign for Taiwan's second general election during 2004. Affairs in relation to China became embroiled in electioneering disputes. Such large-scale investments – every project might amount to some US$900 million – were so sensitive at the time that they were delayed, as in the status I illustrated in **Chapter Four**. The situation did not improve after the election. Taiwan was in an uproar over an 'Anti-Secession Law' that China passed in March of 2005. The Law provoked much agitation because it formalised China's use of *non-peaceful means* against the Taiwanese independency movement. Due to this aggressive Law, the promise already made to make available the remaining vacancies was suspended for the time being.[48] ProMOS, for example, recruited a team of senior managers to deal with the preparatory tasks in 2003 and met the regulatory requirement for application by the deadline of 2005. The official sanction was not given until the end of 2006 when the concerned authorities, MoEA and the Mainland Affair Council, granted permission for the chipmakers to relocate the 0.18μm/8-inch lines to China.

Illegal moves

The government seemingly retained the capacity to regulate the economy, but the reality is that the productive capital found an alternative way to exit. Having been impatient at the government's hesitation in easing barriers to investment, several investors were bold enough to find alternative ways out. As mentioned above, the start-up of SMIC in 2001 was a shock not only to the IC industry worldwide but also to both governments across the Strait. SMIC, the first 8-inch *foundry* in China, was opened by an offshore holding company registering in the Cayman Islands. The founder of SMIC is Dr Richard Chang[49] who returned from Silicon Valley to take on

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[48] KMT re-held the reins of government in the third general election of 2008. The party has veered sharply from its original stand of anti-communism toward focusing on improving relations with mainland China. It stands for the go-west investment and regards it as a panacea for solving domestic economic problems.

[49] Chang (no relation to TSMC's Morris Chang) was born in China, grew up in Taiwan and served some two decades in TI.

the presidency of the Worldwide Semiconductor Manufacturing Corp. (WSMC) in 1997.[50] After WSMC was merged with TSMC in 1999 without notifying Chang, he turned to China and set up the new foundry company. The semiconductor expert received a big welcome from Chinese authorities. SMIC was started with capital of some US$1.48 billion raised from local capital, such as the Shanghai Industrial Investment Corp. (fully owned by the Shanghai Municipal Government), and international venture capital, such as Goldman Sachs. In fact, some Taiwanese electronics firms also became involved with the investing projects of SMIC through their overseas holding companies (Business NEXT April 1st 2004).

With full support from national policies and local municipalities the first fab of SMIC was built up in only 13 months and began batch production in 2001. In addition to a favourable policy environment, its rapid growth was attributed to a team of senior staff recruited from abroad to run the fabs in China where was a lack of experienced engineers. According to SMIC's report in 2006, foreign staff made up over 10% of the total employment – of whom some 55% were Taiwanese-based (559 engineers) and came mainly from TSMC. Indeed, at the time, the establishment of

[50] WSMC was founded in 1994 on the privatisation of the Sub-Micron Project sponsored by ITRI in Taiwan.

SMIC became a landmark in China's IC industry by importing higher process technologies ($\leq 0.18\mu m$). Soon after, it opened two other 8-inch fabs in Shanghai and acquired one 8-inch fab from Motorola in Tianjin in 2004. This case was controversial at the time because WA restrictions and the US embargo on exporting equipment capable of processing 0.35µm were not been released until 2004. One 12-inch fab was launched in Beijing, which had been in production since 2004. Its technological capacity made great progress - up to 90nm, 65nm and 45nm in 2005, 2006 and 2007 respectively – by licensing cutting-edged technologies from the top IC manufacturers, such as IBM (EE Times January 26th 2007).

The expansion of SMIC was so impressive that its market share increased from only 1% in 2002 to 6% in 2004, jumping to become the third largest foundry in the world (IC Insight August 10th 2004). Although SMIC was still far behind TSMC (47%) and UMC (24%), its contribution to the promotion of China's IC industry has come to the notice of the Taiwanese Government. Chang, as a Taiwanese citizen, was accused of opening chipmaking facilities in the Mainland that broke bans intending to foster China's IC industry. The government penalised him with NT$5 million and requested him to repay the investment within six months (EE Times March 30th 2005). Stalemate resulted. Chang "[denied] any wrong doing" (Business Week June 5th 2004) but made a declaration of alienage in August 2005, while the government turned down his petition and imposed a further two penalties on his new investing projects in Tianjin (in 2003) and Beijing (in 2004) (EE Times March 11th 2005). Despite his lack of fear of the prosecution, the government has threatened to seize his property.

Another investment involved with litigation is even more dramatic. UMC was called into question about its intricate relationship with the establishment of HJTC in Suzhou. When Taiwanese IC investors called urgently for an easing of investment control, UMC announced it had little interest in China. Instead, its geographical placement was arranged in Japan and Singapore by means of M&A and JV (TechVantage March 2001). Paradoxically, UMC was, in fact, one of the pioneers, among the Taiwanese IC firms, to set up branch sites in China. As early as the mid-1990s, SinoWealth was opened to conduct back-end design (rather than chip fabrication) in Shanghai. The investment was conducted by passing through Hong Kong in 1994.[51] In addition, UMC planned to get involved in a programme of fab upgrading in collaboration with a Chinese IDM, Shanghai Belling, even though this cooperation broke down in 2002 after a long negotiation (Commercial Times June

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[51] The ownership of SinoWealth was then shifted to Novatek, one of the UMC-clan member, after UMC reshuffled the organisation by spinning off its design sections in 1995.

19th 2001). A team of technical staff who had originally been posted to portage technologies in Shanghai Belling then transferred to work in HJTC.

HJTC was *nominally* founded by an ex-employee of UMC, Chien-Hwa Hsu, with an investment of over US$1.5 billion in 2001. This investment project passed through British Virgin Islands (BVI). The performance of HJTC was promising in that it was ranked in the top ten chipmakers in China in 2005 according to the China Semiconductor Committee. The emergence of HJTC was ascribed to its extraordinary association with UMC. Some 200 senior staff in HJTC were ex-employees of UMC. The processing systems in the two foundries were reportedly compatible. This harmony between the two foundries was considered irrational. It is in conflict with conventional concerns relating to a strict attitude towards intellectual protection in the IC industrial circle. In comparison, for example, TSMC initiated a lawsuit accusing SMIC of patent infringement and the theft of trade secrets through ex-employees of TSMC jumping ship to SMIC (Financial Times December 22nd 2003). According to Morgan Stanley's market survey, UMC referred parts of orders with lower technology requirement (≥ 0.18μm line-width) to HJTC (China Times January 12th 2005). The way in which UMC took HJTC as its *backdoor* solution for participating in China appeared to be an open secret within the sphere of the IC industry.

For the Taiwanese Government, however, the situation was undoubtedly that of a flight of technology to China by cultivating a Chinese foundry without secured permission. In 2005, a raid was made on UMC to gather evidence of alleged investments and other industrial aids that might prove UMC's illegal link to HJTC. At the same time, more than 20 employees of HJTC were detained for further illegal investigation when they returned to Taiwan for home leave. In face of the sudden raid by the prosecution, the executive of UMC, Robert Tsao, made public statements to clarify that the relationship between UMC and HJTC was on the basis of a business strategy (EE Times February 18th 2005). He explained that he had *personally* arranged to foster a Chinese start-up, *i.e.* HJTC, and would subsequently acquire this partner foundry once the investing bans were lifted. Tsao admitted redirecting orders to HJTC and providing administrative assistance to help the latter make profits in the short term, while denying that UMC had ownership of the 'friendly partner'. The second open letter was published later to call for the ending of probes. The letter refuted any capital involvement or patent transfer, but revealed that a *verbal* agreement had previously been made between the two foundries. The letter revealed that HJTC had been willing to transfer 15% of the stake, valued at over US$110 million at current prices, to UMC in return for the latter's aid in management (EE Times March 21st 2005). This announcement sharply turned an alleged charge of illegal investment into a public indictment. While the defendants, including HJTC's Hsu, were not indicted due to insufficient evidence of a crime, Tsao and two other executives were charged with committing a breach of trust because the undisclosed assistance of personnel and technology in HJTC had damaged the benefits of UMC's shareholders.

6.5 Conclusion

This chapter has shown the political economic tension occurring in the transplantation of domestic IC industry to China. It has found that the state steps up the pace of liberation and that the firms become deeply inserted into global production networks in concert. However, the Strait separates their respective orientations towards economic globalisation. Inter-state rivalry accounts for the strict restraints on the connection to China, while the statutory barriers to the cross-Strait exchange have been worn away. The government sees it as a *cul-de-sac* that blocks up the path of national development. For the enterprises, doing cross-border manufacturing in China is deemed the requisite access to connecting with the global IC production chain. In other words, the tendency that the domestic IC firms show in turning to embrace the Chinese market drives the authorities in Taiwan to worry about the possible political aftermath of the economic hollow-out.

It is argued that "explanation itself has become a political force, helping to create the institutional realities it purportedly merely describes" (Piven 1995: 108). The firms construct their own discourses and strategies in response to the state involvement in channelling Taiwanese foreign capital to places outside China and in blocking the flight of capital and technology across the Strait. The *mode* of the cross-Strait economic linkage is kept indirect. It is somehow because of the regulatory structure that the firms made a detour to avoid the national domain by controlling the industrial organisation. The preceding narrative concerning policy revision and unsettled lawsuits does not imply that spatial permeability of economic activity is a counter force to territorial impedimenta to global flows, but underlines such conflicting spatialities "involve[ing] the stabilization of power relations across the organizational field of action" (Clegg 1989: 188; cited in Taylor, Ekinsmyth et al. 1997: 59). Production transplantation is not a simple business matter. Transnationalisation of domestic capital actually uncovers the existence of discontinuous territoriality lying between the state and the outward-looking firms, while such discontinuity was varnished by the national objective in the promotion of economic development. The next chapter discusses the mechanism underlying the intention (and/or imperative) that Taiwanese IC firms move their industrial organisation across the Strait to pursue global IC production.

CHAPTER SEVEN

IN THE DIRECTION OF CHINA

7.1 Introduction

In this chapter an attempt is made at unpacking the motives for firms deciding to carry out international production in China and their spatial practice. The foreign investment that the Taiwanese firms have undertaken in China has seen a change in its type, volume and distribution. There has emerged a surge of the IC-related investments to the Mainland since the later 1990s. China is a Greenfield site for IC business with explosive growth potential. My discussion mainly revolves round the relationship between Taiwanese firms and the Chinese economy. The rest of this chapter is divided into four sections. An outline of Taiwanese investment in the Mainland is provided through statistics in the first part of **Section 7.2**. The second part of the chapter reveals some conceptual implications of the Taiwanese FDI experience. Taiwanese firms conduct cross-border activities by associating their ownership-specific advantages with China's location-specific advantages. It is helpful to situate the firms within a changing international division of labour. **Section 7.3** points out a structural transition within the Chinese economy at a macro level. It provides a background against which it is possible to understand the increasing scope of China's IC market which international firms favour. **Section 7.4** explores the reasons that drive Taiwanese investors to China. It addresses how the firms, located within the global IC chain, are industrially, organisationally and territorially related to the locales in which they decide to situate. The dynamics whereby firms' industrial status is associated with corporate behaviours are dissected in depth. The chapter attempts to reveal how the firms investing in China perform and are reorganised in line with shifts in the global IC production network. **Section 7.5** illustrates the practical conditions of collective transplantation. Three aspects are highlighted: (1) a geographical shift of the industrial system; (2) impacts of the shift on the firms and on the interaction between the firms and the territory where they locate; and (3) the connections between the transplant and the IC production chain.

7.2 Go-west: An overview

7.2.1 Investment trends

A geographical inclination towards China has become conspicuous in reviewing Taiwanese foreign investment. Taiwan has been separated from the rest of China since 1949. Little trade and investment, if any, was undertaken between the two regimes for about 40 years owing to political hostility. Economic exchange between Taiwan and China restarted at the end of the 1980s. After the prohibition of trade and investment with China was officially lifted in 1992, China became the major destination for Taiwanese capital. By 1993, about US$ 3.17 billion of FDI (over 65% of Taiwanese total) flowed into China, while China has accounted for more than 60% of Taiwanese outward investment since 2002 with the highest figure reaching US$ 7.7 billion in 2003 (**Figure 7.1**). Correspondingly, Taiwanese investment was ranked in third place among foreign investment in China by 2000 (Kao 2001). This implies that the economic connection across the Strait has become significant in a relatively short period of time (Borrus 1997).

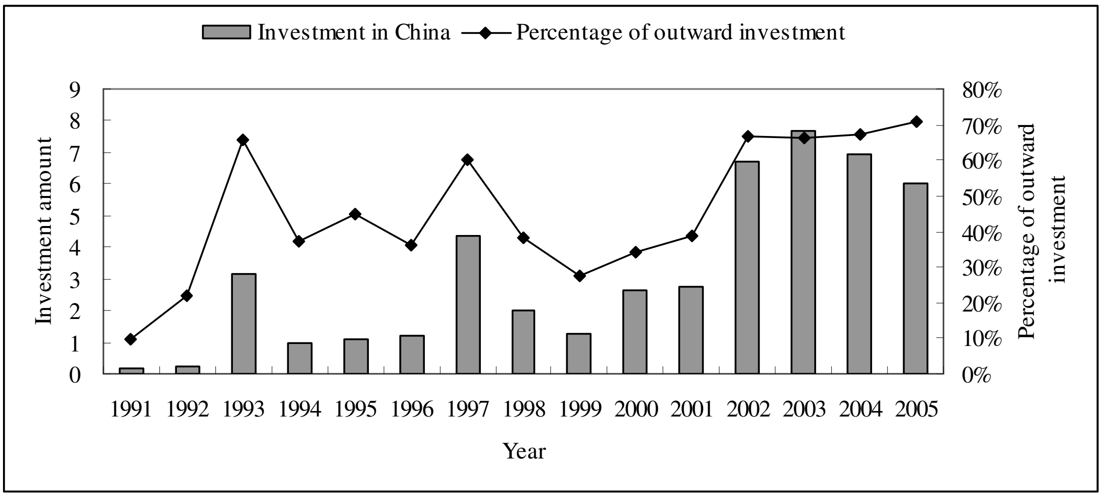

Figure 7.1 Approved investment in China: 1991-2005 (billion US$)

Source: Adapted from Investment Commission, various years.

As investment has grown, so the kinds of activities undertaken by Taiwanese firms in China have changed. The first change is the sectoral composition of investment; the second is its geography. The World Investment Report (UNCTD

2002) reveals that the production activities operated by the Taiwanese-funded firms in China changed from labour-intensive industries, such as toy- and shoe-making, in the 1980s to more capital-intensive and more technology-intensive activities in the late 1990s. An important sector is electronic and electrical appliances. The sector is not only the leader in invested items among all sectors but also continues to enlarge its share of Taiwan's westbound investment. **Figure 7.2** displays that this sector accounted for 48% of Taiwanese investment in China during 1998 and 2004, compared to 18% in the period from 1991 to 1997.

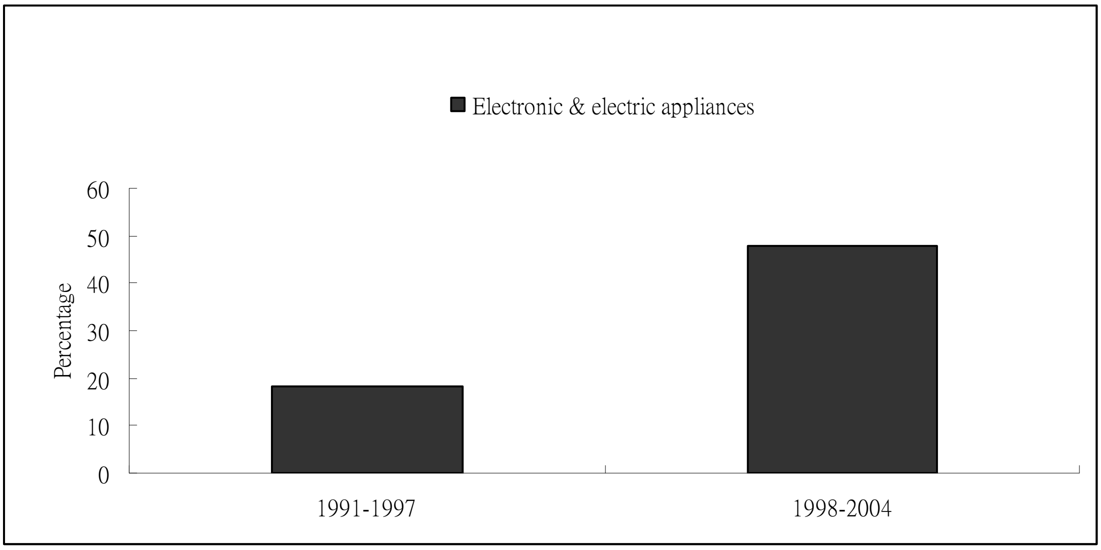

Figure 7.2 Taiwanese investment of an electronic sector: Comparison of 1991-1997 and 1998-2004

Source: Adapted from Investment Commission, various years.

In addition, a spatial shift of investment can be identified. Jiangsu was the only Province to capture more than 50% of Taiwanese investment in China from 1998 to

2004 (**Figure 7.3**). To give a concrete example: the transplantation of the assembly Taiwanese notebook production to China began in 1996, and the last production line to run in Taiwan was closed down in 2005 (China Times November 4th 2004; Xinhua September 19th 2005). All the major laptop producers, and their component suppliers too, had relocated to the Suzhou Municipality by 2003 (Yang and Hsia 2004; MIC 2005).

Such rapid transplantation is characterised by a highly geographical concentration. The process of *converging* towards some specific territories is known as a *collective* action, led by a couple of top system firms (Chang 2001; Yang and Hsia 2004; Yang 2006). For example, there were 14 IT component suppliers rooted in branch plants in Suzhou in 1993, propelled by the BenQ Group, a Taiwanese brand-name. Organisationally, in other words, there is a hub-spoke structure whereby component suppliers (*i.e.* the spoke firms) offer system firms (*i.e.* the hub firms) parts for assembly activity. The hub-spoke model was first seen not in 'go-west' investment but in 'go-south' investment, as in the case of the Inventec Group (an electronic ODM) that organised over 50 satellite companies (part suppliers) to invest together in Penang, Malaysia in 1989. This has been known as the 'industrial transplantation' of *Inventec Commons* (Jou and Chen 2001). The phenomena of collective transplantation demonstrate the intensive networks of vertical disintegration regarding the Taiwanese industrial systems and their geographical capability of extension.

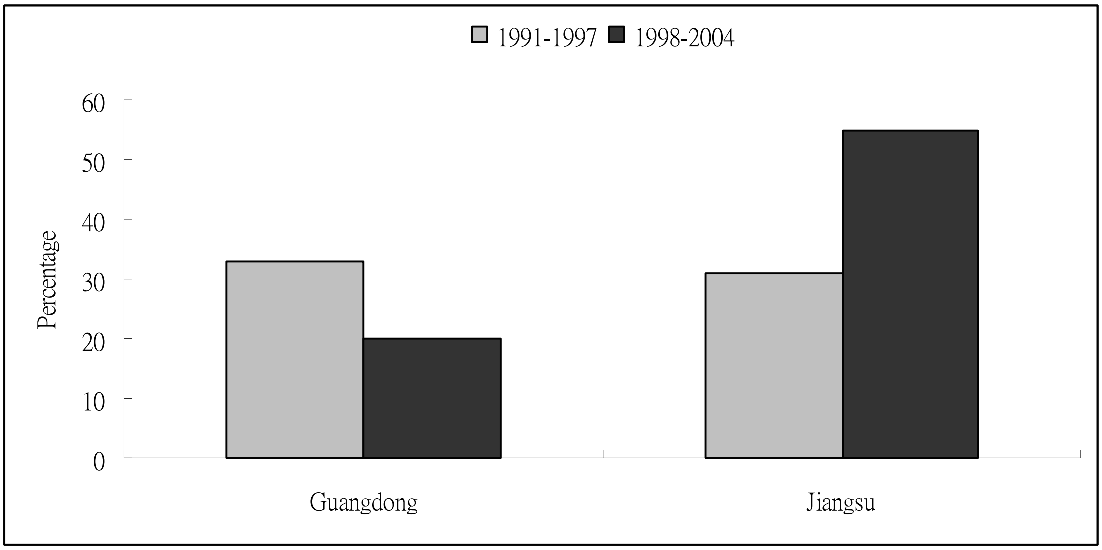

Figure 7.3 Comparison of Taiwanese investment in Guangdong and Jiangsu: 1991-1997 and 1998-2004

Source: Adapted from Investment Commission, various years.
Note: The data of Guangdong and Jiangsu on behalf of PRD and YRD respectively. The former contains three out of four Special Economic Zones (SEZs); the scope of the latter covers most productive parts of the YRD (including the data of Shanghai).

7.2.2 The implications of investing in China

Taiwan had accumulated considerable technological capability and capital potential because of its insertion into the new international division of labour after the 1960s. A further momentum for exporting capital was macroeconomic changes in the 1980s. Taiwanese-based firms began to explore offshore production from then on, as four problems emerged which threatened the international competitiveness of the domestic firms: (1) rising wages and land rents in the home economy; (2) a shortage of domestic labour; (3) an appreciation of the Taiwanese currency against the US dollar, and (4) competition from neighbouring countries (in Southeast Asia and China), which became more market-oriented (Chen 1996; Hsueh, Hsu et al. 2001).

The places where the firms do business are “most frequently in the region where they belong” (Chen 1983: 168). Geographical proximity represents simply a spatial description, which requires theoretically convincing explanations for the *why*. A review of work on the ways in which Taiwanese firms arrange cross-border production of, say, apparel, footwear and electronic industries in China (Hsing 1998; Cheng 1999; Gereffi 1999; Hsing 1999; Chang 2001; Jou and Chen 2001; Yang and Hsia 2005; Chang 2006; Wang and Lee 2007; Yang and Coe 2009) reveals the locational selection at two correlative levels on multiple spatial scales.

The first is a supply dimension in relation to the functional status of Taiwanese firms in a framework of global production chains. Similar to counterparts from other Asian NIEs, Taiwanese firms, following considerable technological improvement, have been capable of exporting technologies to lower cost neighbouring countries (Heenan and Keegan 1979; Chen 1983; Yeung 1994). As a result, the role they play has shifted from being the ‘primary production contractor’ to one of an intermediary which carries on contracting from overseas buyers on the one hand and engages in offshore production operations on the other.

The way that Taiwan's investors take part in the restructuring of the international division of labour is in line with the changing strategies of international buyers and host economies. There are processes of negotiation between international buyers, who possess considerable purchasing power, and Taiwanese OEMs who supply the manufactured goods: the buyers press the OEMs to set up production sites in China to reduce costs.[52] To put it another way, Taiwan's foreign investment was forced by stringent requirements from buyers. Taiwanese manufacturers played a role of OEM in 'a defensive sense of globalisation' (Jou and Chen 2001); however, it may after all be accepted as an efficient way for those OEMs to "[construct] the entry barriers obstructing the latecomers' catch-up and replacement desire" (Kung 2005: 61) in terms of organisational governance. Despite the business pressure, they were able to stabilise output quality and balance production costs by operating in the difficult environment of China's transition economy. This is largely attributed to an

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[52] A piece of informant report cited in Yang and Hsia (2004: 31) clearly substantiates the pressing force from international buyers typically: "… it's simple, cost. [I] hear of going to mainland can reduce 25 dollars [of production cost], [so] I want to cut 25 dollars [off the price]. Go or stay; it's up to you".

inherent advantage in socio-cultural terms. Taiwanese manufacturers managed to regain their international orders, confirming the advantages of the interface role they played in adjusting the production chain geographically and organisationally.

The position in which the OEMs can rapidly adapt themselves to the environment and then assist in improving linkages between brand names and Chinese factories refers to the second level of offshore manufacturing. It draws upon the interconnectedness of firms and places in institutional terms. Cultural affinity and institutional familiarity are firm-specific features that Taiwanese investors inherited from their "cultural and administrative heritage" (Dicken 1998: 202). These corporeal properties enabled firms to deal with cross-border production when encountering geographical difference. Literature on the socio-cultural subtlety of informal public-private alliances offers several examples. Mutual benefits of Taiwanese enterprises and local authorities are grounded upon a transition of Chinese political economy. Local states in China seized more administrative autonomy following a series of devolutions in the mid-1980s (Li 1999). As a result, they have been able to act *flexibly* as entrepreneurs in their own right helping to improve the local economy. These regulatory changes in China became an opportunity for Taiwanese firms.

The practice of ‘gift exchange’ embodies a relationship of reciprocal trust – a sense of *guanxi* – shared among ethnic-Chinese society, and plays a key role is communicating with local officials (Hsing 1996; Hsing 1998). Another model of public-private alliances in line with the culture of gift exchange is concerned with the regulatory flexibility of local states that alter ownership patterns of business establishments: Taiwanese-founded branch plants are opened in the name of JV with rural enterprises in the locale, yet the production operation is actually handled by the investors themselves (Wu 1997; Cheng 1999). Their intra-firm trades are *nominally* externalised to coordinate with the locally export-oriented policy and to “reduce the risk of being exposed to a corrupt environment and thereby alleviate the problems of rent-seeking under fuzzy property relations” (Wu 1997: 321). The corporate strategies consolidate the corporations’ *non*-material linkages, regarding social conventions and political manoeuvre, with local institutions. Such a shared foundation represents an ownership-specific advantage that Taiwanese companies hold, compared to other foreign counterparts, in gaining access to location-specific resources in China.

In general terms, China’s cheap wages, rents and a huge market are the factors that drive inward investment. Particularly, investors from Taiwan have various *patronages* (namely, preferential treatments) created by local officials (and the central government as well) within an administrative domain (Wu 1997).

Put simply, the situation means that the generation of locational-specific resources contingently corresponds with the firm-specific properties. As Dunning argues, “the locational configuration of a firm’s activities may itself be an O[wnership]-specific advantage, as well as [having an impact on] the modality by which it augments, or exploits, its existing O advantages” (Dunning 1998: 60). To understand the phenomenon of Taiwanese IC capital investment in China, its geographical outcomes should not be “separate[d] from the broader structures of which they are a part” (Dicken and Malmberg 2001: 347). In this regard, a ‘firm-territory nexus’ is a key point of departure. I will now move onto China – the destination for the investment – to display how its industrial environment is changing within the context of national economic reform and of global economic transformation.

7.3 The growing IC market in China

7.3.1 Rejoining the world economy

Having developed regional self-sufficiency through central planning in the Maoist era (1949-1978), China's economic strategy was turned towards the outside world in pursuit of 'modernisation' (Wong, Lau et al. 1988: 1) in the late 1970s. The Economic Reform Programme and the Open-Door Policy launched by Deng Xiaoping in 1978 embodied China's determination to develop a market economy. Thereafter, China began to approach the world economy by developing a 'Socialist market economy with Chinese characteristics'.

Following China's economic reform and openness programmes, an increasing volume of FDI has gone to China in search of its large reservoir of cheap labour. China received US$40.8 billion of FDI inflows in 2000, a ten-fold increase over a decade (US$3.5 billion in 1990) (UNCTD 2003). Despite the global downturn in 2002, China's FDI inflows continued to increase and accounted for over 55% of all capital inflows to Asia (UNCTD 2003). Note that FDI in China moved from labour-intensive sectors during the 1980s towards more capital- and technology-intensive sectors during the 1990s (UNCTD 2001). China underwent a "rapid diversification of manufactured exports", which is "directly linked to its integration in the international segmentation of production processes" (Lemoine and Unal-Kesenci 2002: 829). The industrial expansion in China seems almost hard to believe. Generally speaking, the outwardly-oriented, highly-competitive industries there are mainly dominated by foreign-owned branch plants. These affiliates commanded an 81% share of all high-technology exports in 2000 (**Table 7.1**).

Table 7.1 Exports of high-tech products from China by ownership of production: 1996-2000

	Total (billion US$)	State-owned enterprises	Foreign affiliates
1996	12.6	39%	59%
1998	20.3	25%	74%
2000	37.0	18%	81%

Source: (UNCTAD 2001: 26, Box table)

TNCs are responsible for a growing export share of high-technology sectors even if their branch plants focus upon processing tasks. Such manufacturing activities, as in China, are greatly conducive to drawing capabilities of importing higher quality intermediates, better production and management techniques and a tighter association with the international market (Lemoine and Unal-Kesenci 2002). Among the high-technology sectors, the IT industry is the largest destination for foreign investment in China, and the country's biggest exporter. Foreign investment groups set up in China accounted for over 23% of the IT sector in 2003. Regarding the trade of high-technology products, the share of the IT industry has increased continuously (**Figure 7.4**). Obviously, the TNCs make a great contribution to China's high-technology production, the IT sector in particular.

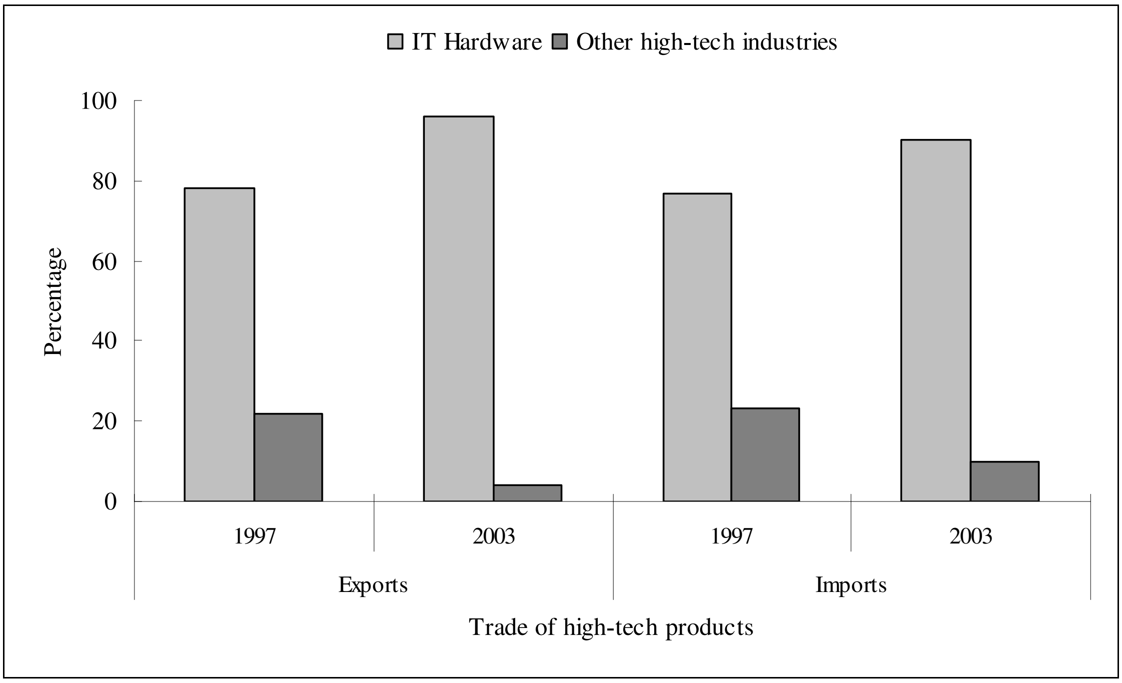

Figure 7.4 Trade in high-tech products to/from China: 1997 and 2003

Source: Adapted from the database of China Science and Technology Statistics (http://www.sts.org.cn)

Note that more and more large IT companies, firms such as Intel, IBM and Microsoft, have begun to establish R&D teams or distribution centres in China, in addition to production activities. For example, the number of R&D centres in Jiangsu increased from 14 in 2000 to 58 in 2003, so that the installation of TNCs is expected to benefit the improvement of China's industrial standards over a long period of time. China is now not merely the source of traditional products (such as textiles, toys and shoes), but it is also viewed as the electronics-equipment manufacturing hub of the world.

7.3.2 An IC supply lag

China's immense population acts as the magnet for FDI. With large supplies of low-cost labour,[53] China's initial entry into the electronics industry was through the assembly of appliances. Later, the range of electronics goods produced in China expanded to computer-related commodities, with Taiwanese IT hardware makers making a significant contribution in this upgrading process (Simon 1998; Fuller 2005; Yang and Hsia 2005; Yang 2006). Followed by other Taiwanese IT peripherals manufacturers, the leading Taiwanese computer manufacturers have started to expand their business into China (mostly in Shanghai and Suzhou) since the mid-1990s. Take the sector of computer notebooks, for example (China Times November 4th 2004; Business NEXT September 1st 2002). Taiwanese-based manufacturers supplied 80% of global output in 2004. Nonetheless, over 70% of the output was produced in the Mainland, and the last two processing lines in Taiwan were moved to China in 2005, due to a deep fall of profit margins (from 18% in 1998

[53] The average salary of an employee in China was 10% of that in Taiwan or 3% of that in Japan around the outset of the 2000s (Computex April 23rd 2004).

to less than 6% in 2004) in the global computer manufacturing sector. More than 55% of Taiwan's IT products were made in China in 2002 (Computex August 16th 2002):

> In terms of consumer electronics, the largest [market] still lies in the developed countries. … This is the case of terminal [consumer] market. The production [of electronics goods], I mean the end commodities, is produced in the Mainland. No matter what kinds of processing lines, [they] are set up in the Mainland. Previously, there were some [production] in Southeast Asia, South America, and so on. But, currently, [production] is almost attracted [to China].
>
> – reported by ***Des.15-2***

According to the annual survey of Reed Electronics Research, an international market intelligence company, China had become the third largest producer of global electronics in 2004 (**Figure 7.5**). Associated with sustained economic development, the rapid expansion of the domestic consumer market emerged as another competitive advantage. Economic growth in China reached 7% *per annum*.[54] The largest domestic population, combined with cumulative purchasing power, means that China represents a huge and fast-growing domestic market, so that both local and foreign owned brands/producers are seeking to capture market share in China.

[54] The GDP in China has grown from US$388 million in 1990 to US$1,080 million in 2000 (UNCTAD 2003). Some estimates are that the economic growth in China in the last few years may be double-digit, even if there was an *official* growth rate of 8.5% in 2003.

China will continue to gain a share of global electronics production with reference to the scale of its domestic market and the size of its manufacturing sector.

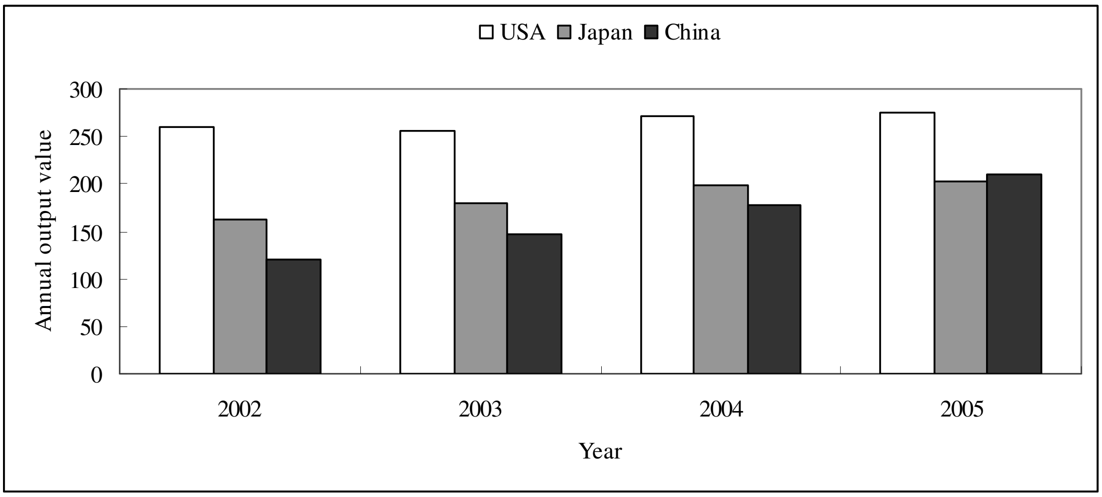

Figure 7.5 World electronics production: 2000-2005 (billions US$)

Source: Adapted from Yearbook of World Electronics Data, Reed Electronics Research (http://www.rer.co.uk)

In spite of a boom in electronics manufacturing, the capacity of chipmaking in China has long failed to match the output of finished commodities in either quality or quantity (Simon 1988; Simon 1992). China was responsible for 21% of $192.4 billion IC consumption globally in 2005, up from only 6% in 2000 when the IC market in the US was more than five times the size of China (IC Insights January 9th 2006) (**Figure 7.6**). However, the domestic capability of IC supply was far behind the vast demand that electronics producers required in China.[55] Around 80% of IC consumption in China relied upon imports, according to a survey conducted by the China Semiconductor Industry Association (CSIA) in 2004 (IT Time August 6th 2005).

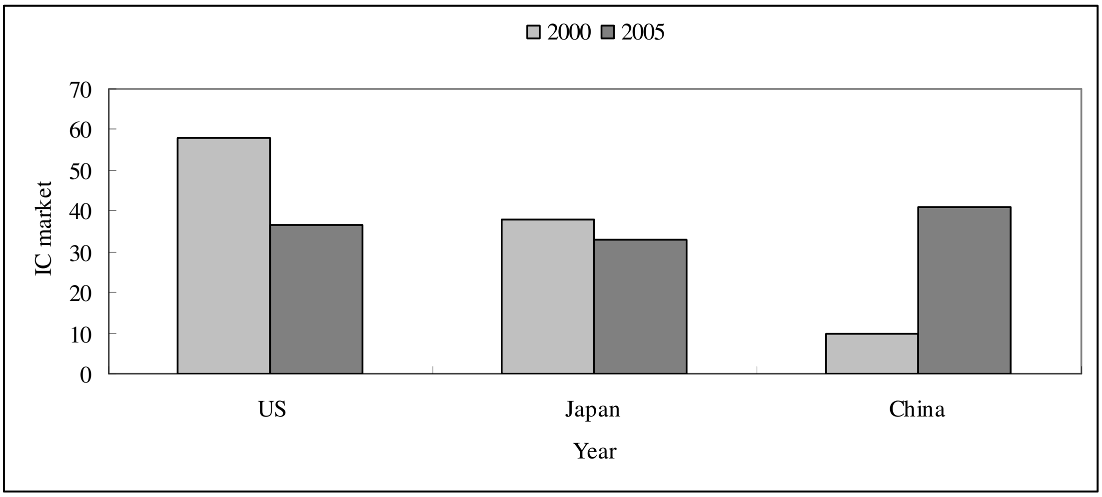

Figure 7.6 The global top three IC consumption markets: 2000 and 2005

Source: (IC Insights January 9th 2006: Figure 1)

In reality, the IC supply lag was worse than the statistics suggest for at least three reasons: (1) a large amount of smuggled chips were not counted in the import statistics; (2) the estimation of domestic IC output capacity contains wafer fabrication and chip packing, so that the same batches of chips were double counted, and (3) about 80% of domestic IC output was contracted from foreign customers,

[55] By 2004, 50% of cameras, 30% of TVs, 30% of air conditioners, 25% of washing machines, and 20% of refrigerators were produced or assembled in China.

which was not available to satisfy the domestic demand (IT Time August 6th 2005). That is to say, the actual gap between supply and demand was probably even wider than the published statistics. Chipmaking in China, though strongly policy-supported, retains a capacity for further development, which becomes a big lure for international IC manufacturers.

7.3.3 Relocating to the Yangtze River Delta

As shown in **Figure 7.7**, three IC industrial clusters – Beijing-Tianjin-Pan Bohai Bay (PBB), the Yangtze River Delta (YRD) and the Pearl River Delta (PRD) – have emerged in China's coastal area. Among these, the YRD appears to lead its counterparts (Hu 2006). More than the direct effects of national economic policy, institutional benefits of economic devolution in the early 1980s from the central government (Wong 1992) and the coordination among local authorities, have assisted in the economic growth of the YRD since the 1990s (Hsing 1998). According to the National Bureau of Statistics of China, the YRD accounted for 18.7% and 28.4% of GDP and export nationwide respectively in 2002 (http://www.stats.gov.cn).

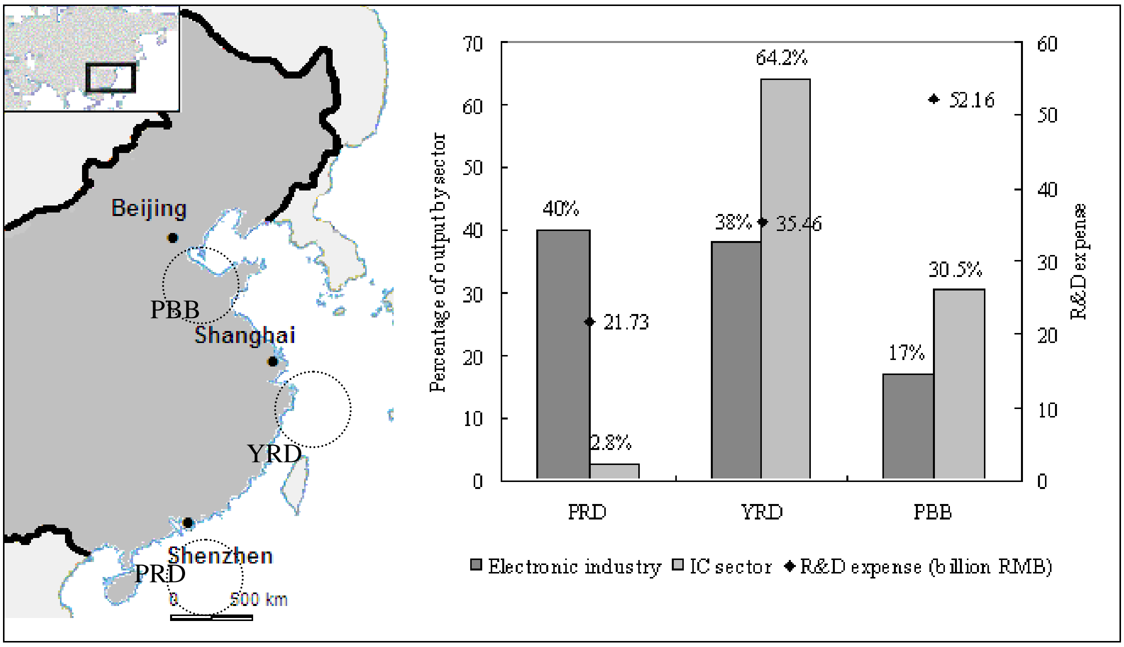

Figure 7.7 Output value and R&D expense in China's IC clusters: 2003

Source: Adapted from (Chen, Xiao et al. 2004: 2-6, 2-9, 2-12, 2-18, 2-21)

Note: This data added the costal area of Fujian Province to the scope of the PRD.

As the Shanghai Integrated Circuit Association (SICA) reported, the YRD commanded a two-thirds share of total output in China in 2004, of which over 70% of IC investment came in the form of FDI and JV. It is noteworthy that Shanghai is an IC hub of the YRD, which accounted for 42% of the national output value in 2004. Historically, the IC industry has been incubated in Shanghai since the mid-1950s, even though the progress of commercialisation was so sluggish until the late 1970s. A favourable period began with a series of IC industrial promotion projects in the 1990s – Projects 908 and 909. They were mapped out mainly by the central government in pursuit of commercialisation. The national programmes of IC industrialisation came at an opportune moment when Shanghai was turned into a new economic pivot of China in the 1990s in place of Shenzhen which was the chief locus of economic reform during the Open-Door Policy of the 1980s (She, Xu et al. 1997). The programmes and industrial outcomes are detailed in **Appendix D.**

As for Taiwanese investors, the YRD is seen as appropriate habitat for transplantation. This intention has been recognised in an annual survey on corporate options undertaken by the Taiwan Electric and Electronic Manufacturing Association (TEEMA) since 2000. There is great diversity in accounts of locational choice, while numerous Taiwanese IC firms (as well as several Chinese returnees' start-ups and foreign affiliates) approve of the investment-friendly environment of the YRD. According to interviewed managers (many of whom have been assigned to different places around China) administration and environment are two of the qualities of the regions.

The authorities in the YRD are reported to be more efficient and have policy tailored to foreign investors' needs (cf. Lee and Saxenian 2008). Financial support, good quality infrastructure and land preparation are basic conditions that meet investors' requirements. One more point of attraction is efficient customs that speeds speed up procedures to simplify the movement of goods and shorten shipping times. It is worthy of remark that the relocation of the Taiwanese IT industry contributes a lot to the improvement of outmoded customs practices (Chen 2003; Wang and Lee 2007). In the past, for example, goods were required to sit in customs bays for a minimum of 24 hours before clearing. Such customs delay was unsatisfactory to the Taiwanese PC manufacturers since computers need to be shipped within three days of the order confirmation. With an understanding that rapid delivery is an imperative for industrial competitiveness, the government soon expedited the customs procedures so as to accommodate the Taiwanese investors (Commercial Times May 22nd 2002).

Newly-built industrial parks also embody the efforts that the concerned authorities make. The China-Singapore Suzhou Industrial Park (SIP) is a case in point. This Park was co-developed by the Chinese Government and the Singaporean Government in 1994. The level of international cooperation facilitates the introduction of advanced and up to date *managerial* ideas/know-how, embodied in the infrastructure planning and park governance, according to the SIP Administrative Committee. The exchange of knowledge via the joint administration of the park by Suzhou and Singapore has continued so far, although the Chinese Government has become a controlling stockholder in place of the Singaporean Government since

2000. Second, the park is run by the local state,[56] but the administrative committee is *nationally* authorised to approve firms intending to relocate, to issue official passports and to have an independent system of customs.

The environmental dimension is another consideration, including physical conditions, living surroundings and business milieu. Chipmaking requires a large volume of water in their manufacturing and a strict requirement for air quality. It requires nearly one ton of clear water every day to run one 6-inch fab with a monthly capacity of 20 thousand wafers, for example. Constrained by a water shortage and the dust storms of north China, the establishment of fabs in the PBB suffer from inherent barriers to production. Second, knowledgeable manpower is always a key index of industrial competitiveness.[57] Amenity is acknowledged as a significant

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[56] The local authorities in the Suchou Municipality had performed a distinguished 'Sounan model' since the mid-1980s of which 'collectively owned Township and Village enterprises' (TVEs) were anchors of local industrialisation (Walder 1995; Jacobs 1999; Marton 2000). But, its bureaucrats were not so notorious for playing around foreign investors for 'rent-seeking' unlike the counterparts in the south, as shown in **Section 7.2**. Such a local state corporatism was reconstructed approvingly as service depots in 'tugging foreign capital' and technologies in the 1990s considering an updated strategy of 'outward-looking economic development' (Chang and Chiu 2002; Chang 2006).

[57] A Chinese expatriate (***Des.4***), who runs China's first RFIC design houses in Shanghai with a certain proportion of Taiwanese capital involved, shows his favour to Zhangjiang, Shanghai, "there are over two thousand doctors, six thousand post-graduates, [and] totally 60 thousand operators in such a tiny Zhangjiang … [compared to Taiwan's HSIP,] the scale and industrial [technology] will remain five-year lagged I'm afraid. But [look,] there is potential. Two thousand doctors stay here. So we believe Shanghai has superiority".

factor to gaining human resources (Florida 2002). The living standard in the YRD is said to be much better than its clusters elsewhere in China:

> If you compare here with Shenzhen, you would feel here is much better. … From the talent [recruitment] point of view … the living standard here is more favourable. The environmental well-being here is conducive to attract human resources.
>
> – reported by ***Des.11***

It is worth also commenting upon what can be described as *urban fetishism* (Chang 2006). The generation of fetishism is highly law-driven. On the one hand, under the central planning, China used to implement the residential registration system to govern internal migration, and this led to a dualistic socio-economic space: industry/urban (well-off) and agriculture/rural (badly-off) (Chan and Zhang 1999; Cai, Wang et al. 2002; Fleisher and Yang 2003). On the other hand, the citizens holding the right of abode (*hukou*, *e.g.* Shanghai's blue card) are entitled to enjoy social welfare, educational and medical resources, etc. Those staying in a city without city *hukou* are excluded from the public welfare the municipal government provides. Third, and perhaps most importantly, the market mechanism in the YRD is considered to be most mature and active within the 'Socialist market economy of Chinese characteristics':

> Actually, Shanghai is more internationalised and thus easy to attract human resources. … Well, Beijing is somehow red-taped. Of course, the

> governmental support is indispensable. But when I just came back [to China], I preferred the free-market style [in Shanghai].
>
> – reported by ***Des.4***

It suggests that a market-friendly milieu in the YRD is evident. The financial market in Shanghai, for instance, is getting stronger and internationalising. Supplemented by a range of industrial services, it enables companies to manipulate their capital and to have the specialised production services accessible (cf. Sassen 2000).

The YRD is an attractive location, on a subnational scale, which Taiwan's IC firms favour for locating their outward-bound capital. However, its strong points, presented by piecing numerous 'objective' conditions together, fail to furnish a properly substantive account. The locational merits can only be confirmed when coupled with corporate conditions (Saxenian 1994). What follows is concerned with how requirements and conditions of the Taiwanese IC industry *per se* are interconnected with the host economy, China in general and the YRD in particular, by virtue of clarifying the considerations under which Taiwan's firms are inclined to, or *are forced* to, move westward.

7.4 Investment motivations

> Of course, the aim [for] you [to] set up a fab in China is for access [to] China's market. [So, the fab] here would give a higher priority to local customers in China. … The reason [we] come to China, just like other factories from worldwide, is for the same purpose. We can say that the biggest attraction of China is nothing but China's market, [and] the second [attraction] is China's talent.
>
> – reported by ***Fry.3-2***

> We are a typical design house, [and] focus upon R&D [activities]. … There [are] two main considerations to build up the bases in [the] mainland. The first is that we find a limitation of Taiwan's talent. [Namely, it's] insufficient. Particularly the quantity; the quantity is not enough. … The second concerns that there is a market. So, we hope to set up some sites to enter, to approach [the] market.
>
> – reported by ***Des.2-1***

The motion for Taiwanese IC companies to move production facilities across the Taiwan Strait is crystal-clear: to enlarge their market share and to acquire human resources. One is an external force, as the rest of the supply chain within Taiwanese IC-related investment moves westwards, while the other is the internal pressure of labour demand that pushes IC companies out of Taiwan to search for knowledge workers in China. It is not enough to deem the two facets simply as business logic though. There are some variables, including the resources and restraints of the host economy, the status of a firm itself within the IC chain, and industrial conditions at home where the firm is based (cf. Dicken 2000; Dicken 2002). The practical actions of cross-Strait investment worked out are entangled with the diverse possibilities of geographies.

7.4.1 Heading for a growing market

Production chains

China, unquestionably, has been in the spotlight owing to its position as the 'world's factory'. Electronics manufacturing there grows by leaps and bounds, which triggers an urgent demand for chips:

> Where are our customers? [They're] all around the world. Where is their manufacturing centre? [They're] either in Taiwan or in the Mainland. Actually, those firms that cooperate with us set up their [branch] plants in the Mainland.
>
> – reported by ***Des.22***

Indeed, no fabless would pass up this huge market opportunity. The Taiwanese IC firms are keen on getting involved with chip sales in China. Seven out of the Taiwanese top-ten fablesses had made over 60% annual profits from the market in Hong Kong/China by 2000 (EE Times May 31st 2002). Having been the main destination to which Taiwanese-designed ICs were shipped, the percentage of the Chinese market increased from 30.8% of the export market in 2002 to 50.9% in 2004 according to the ITRI/IEK Project (June 2005) (**Figure 7.8**).

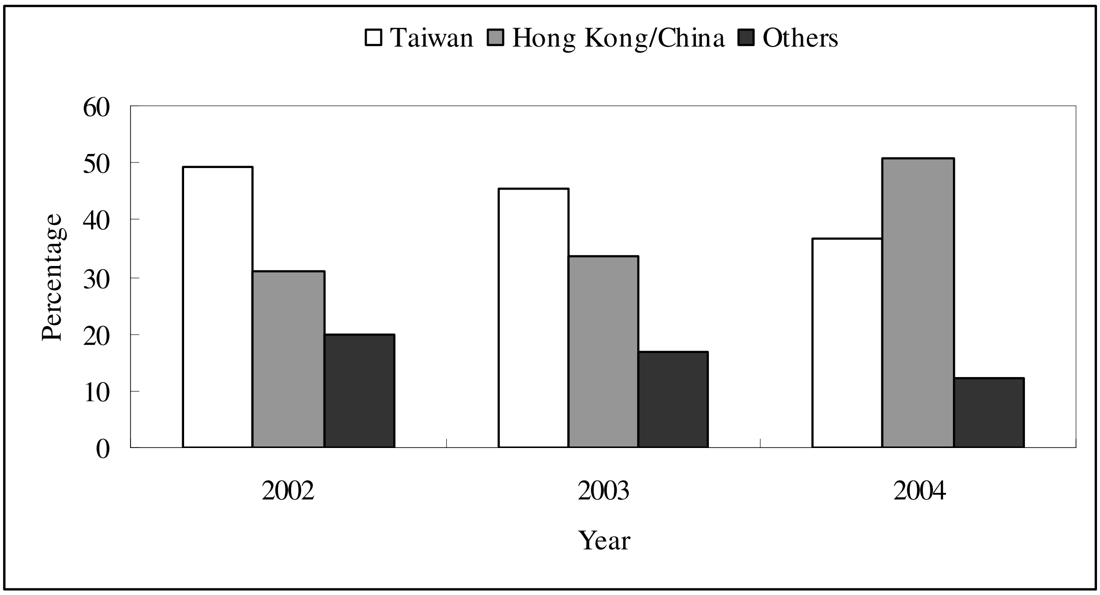

Figure 7.8 The shipping distribution of Taiwanese-designed ICs: 2002-2004

Source: Adapted from ITRI/IEK Project (June 2005).
Note: Most components, including chips, shipped to Hong Kong are transferred to south China for 'supplied/imported materials processing trade' in order to avoid duty.

In comparison with their counterparts in Silicon Valley, the firm-specific advantages that Taiwanese design houses hold to win orders from electronics customers is not cutting-edged chips but their capability to supply "more speedily, cheaply and reliably" (Breznitz 2005: 205). They are adept at 'technology fusion' (Kodima 1992) to integrate diverse technologies effectively,[58] albeit not the most advanced technologies. This 'second-mover' advantage is greatly reinforced by cost

[58] MediaTek is illustrative in terms of a customer-based innovation. It made a successful adaptation of CD-ROM chipsets, DVD dual chipsets and the like, which were soon put into mass production at the end of the 1990s. Volume output of fabrication enabled a quick cost-cut. Such a price edge led to a speedy expansion of the market share. Consequently, the firm made a great profit – but also facilitated a spread of DVD players worldwide. It is currently one of the top ten fablesses in the world.

superiority and ‘time economy’ (Stalk 1988) as a result of the solid foundation laid by the industrial efficiency of vertical disintegration. That is, the highly proficient domestic foundry services in support of lowering costs and time-to-market enable the design houses to provide customers with value-added ‘total solutions’ to assist customers in cutting production cost (EE Times May 31st 2003). In addition, the total solutions the designers offer are almost inclusive: to introduce new products and the latest technological developments, to analyse demands of the current market for customers to tailor powerful products. And once the chips are designed, the post-sale support (such as de-bugging or testing services) would be provided in customers’ plants to tune the products up. Such an extended series of services requires frequent and close communication with customers, most of which *have* been transplanted to China:

> My customers’ plants are located in the south [of China], such as the areas of Shenzhen and Dongguan, so that I have to offer post-sale services nearby. This is the primary imperative. So, we must set up a technical support [team], [namely] FAE, around the areas of Shenzhen and Dongguan. … It’s no way out, because customers are there. Customers call [you] up in the morning, and you’d better turn up by midday. [You] must not arrive three days later, but [you] have to straighten out [problems] right away.
>
> – reported by ***Des.15-2***

In reality, the model of vertical disintegration has been successfully practised not merely by the IC industry but also among all electronics-related industries in the high-technology complex area of north Taiwan (Hsu 2000; Hsu and Cheng 2002). As global electronics manufacturing activities move into China, the IC design sector soon follows after the electronics manufacturing companies to engage in customer services. The investment vehicles open affiliates to provide field application engineer (FAE) services for customers (typically OEMs or system firms and have been mostly relocated in China) in the neighbourhood.

Having said this, the majority of Taiwan's design houses that participate in the Chinese market do so primarily because of China's position in the world production base. But, undeniably, the rise of local electronics-related industries is considered as a developing market. Take TFT-LCD panels, for instance. The 17-inch TFT-LCD panel is the key competence applied to the screens of monitors and notebooks. Each panel requires about 11 pieces of chips to run. In other words, volume production of the panels would increase orders for chips, implying an opportunity for the IC manufacturers to make profit. Currently, there are two local panel plants in operation and another two are under construction in China. A surge of investment in 17-inch TFT-LCD panel plants in China has encouraged a number of Taiwanese LCD driver IC designers (such as Novatek, Himax, Mayson Century, Cheertek, *etc.*) to locate production facilities there.

Market opportunity is one thing but profitability is quite another. The current situation shows that the full exploitation of the Chinese market remains a long way from being achieved. The technology level of most local electronics manufacturers is still weak, requiring an *entire* complement of technical support from design houses. This increases design firms' costs and burdens concerning chip supply and the task of technological support. As a result, the orders from international customers and Taiwanese manufacturers – which locate production lines in China – make up the major business that the Taiwanese design firms have engaged with in China so far. That the firms embark on enlarging the range of Chinese customers is an on-going process and one that must be placed in the context of the potential growth of the local electronics industry. For instance, Huaya, specialising in the TV ICs design, accounted for some 10% of China's domestic CRT TV market in 2005, and aims for one-third of the market share in the future.

Tax and local growth

The condition in the foundry sector is more evident in terms of market expectancy. As DigiTimes (September 12th 2005) comments, "as the migration of manufacturing bases for IT, communication, and consumer electronics production to China continues, international chipmakers all have their eyes on big pieces of this cake". The chip market is large in China and amounted to some US$30 billion in

2004. But, this market is mostly consumed by the TNCs which operated export facilities in China. One ponderable issue is the technological competence that is much lower among local start-ups. Despite an increasing number of local design houses, the majority are small, with less than a dozen personnel. They have limited capability to commercialise in-house designs, compounded by limited capital resources as well as small IP pools. A marketing manager (***Fry.1-2***) comments that

> [a] basic ability that general design houses own is to carry out testing after chips are outputted. Who provides the testing programmes? [The design houses] themselves need to provide [this]. … [But] some of them (local design houses) cannot even do that. They are unable to write the programme; software and firmware, neither. … All right, when we cooperate with downstream customers, we will offer a team [to] co-ordinate. … I'll tell you some concepts. [If] you'd like to play these, you need certain concepts. You must sort out your spec, so that I'm able to support you. If you cannot even develop spec, how should I work with you? After the spec is done, I need to ask the back-end assembly and test plants to help, to integrate with front-end … It's quite tough.

Concerning the current situation, the local firms apparently fail to fill up the production capacity of any 8-inch foundries. An illustration of the *status quo* with statistics may offer a clear outline of limited demand from indigenous firms for foundry services. The annual revenue of China's design sector was about US$1 billion in 2004, which could be converted into some US$400 million of revenue in chipmaking regarding the 8-inch lines. However, a considerable part of chip output was actually made by outdated process technologies with line-width of more than

0.35µm, so that the 8-inch fabs in China made up half the foundry revenue in total, *i.e.* some US$200 million *per annum*. Simply put, an output value of US$200 million is negligible, compared to the annual profit of the foundry giants, TSMC, which gained US$7.7 billion in the same year.

The sector is still relatively underdeveloped, and can not support *pure-play foundries*.[59] The low level of local customers for the foundry market implies the newly-opened 8-inch fabs in China are currently run by the orders from worldwide customers, including Taiwanese firms. It begs the following question: why are Taiwan's chipmakers so anxious to locate plants there? Clearly, market *potentiality* is the point that the foundries highlight:

> Q: Is your fab founded here for China's design houses?
>
> A: [If we run only] for them, we would be starving. It is because the proportion of imports remains very low at the moment … merely 10% or so. [Actually] that is pretty good, acceptable [so far]. …We hope to increase [proportion of local firms] up to 20% [of our customer scale]. … Look, since 2002 when we came; … it has grown up extremely fast year by year almost in 40%, 50%. … Currently, all the top ten [design houses in China] together may not match up to one Taiwanese design house [in revenue], [but] they will move up in a couple of years. It is because there is a continuous movement toward here, [I mean] global production …

[59] International chipmakers posited there are IDMs (such as Infineon, Intel and Motorola). Even local manufacturers of scope (such as ASMC, Belling and SHHIC) do not run a made-to-order model service with very few exceptions.

> and [manufacturing] won't move out; it seldom moves out. … I often term here is a black hole; [industries] move in but never move out.
>
> – reported by ***Fry.1-2***

On second thoughts, though, the application of cyber-links to foundry services impacted upon communication and collaboration in the processing function. The electronic communication, having been discussed previously, helps to transform the spatial organisations and practical patterns of the vertical disintegration in the IC industry – IC design and chipmaking, hence, need not be tied up spatially. Take TSMC for example; it has customers worldwide, of which 75% are in the US. In this regard, the Taiwanese chipmakers should be able to serve China's rising market, regardless of distance. However, why did the chipmakers feel compelled to open production lines in China rather than fulfil orders at home?

The Chinese Government was keen on attracting chipmakers, whether indigenous or foreign funded, to produce chips domestically. It aimed to slow down an increasing reliance on imports, and to improve the standard of the indigenous IC industry. Tax incentives were a key tool in this strategy. The Encouragement Policies on Software and IC Industry Development (*i.e.* 'State Circular 18') initiated in 2000 were critical. The Circular had incentives of tax exemption and 'drawback facilities' to actualise industrial targets (**Appendix D**). A rebate in excess of 6% for chips made in China was deducted from the 17% value-added tax (VAT) charged for all chips sold there. The tax rebate rate was decreased to 3% in 2001, which further enlarged the cost gap between local output and import chips.[60] Given the tight price competition of chips and the growing importance of the Chinese chip market, front- and back-end chip manufacturers were willing to build up production sites in China.

This policy discriminated against ICs produced overseas, with an impact upon competitiveness. It affected the logic of sourcing chips – and also manufacturing governance: the point was that Taiwanese foundries opened wafer lines in China aimed at establishing business footholds that might eventually target the Chinese market. To put it bluntly, China's market power was institutionally manipulated – it was a market bounded by taxation.[61]

7.4.2 Manpower, cost and industrial status

The demand for knowledgeable labour

The IC industry requires a high proportion of its workers to be highly skilled. With the miniaturisation of chips, the difficulty and complexity of design tasks and

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[60] However, China called off this trade-related investment measure in 2004, submitting to the WTO regulation.

[61] However, the taxation flowed over continuous superiority of those fabs located in Taiwan as a result of quality instead of price.

production processes are increased. For example, the system-on-chip (SoC), where one piece of the chip is in possession of comprehensive functions, is developed to reduce the size of ICs for use in portable devices, such as mobile phones, digital cameras, *etc.* More elaborate design skills and onerous manufacturing proceedings are involved with combining various components upon a single chip. Seeing that the technical division of labour along processing segments is extremely complicated (**Figure 7.9**), I will not illustrate the manpower requirements of each section in detail but draw upon the specialty of chip design as a concrete example of companies' demand for high level human resources.

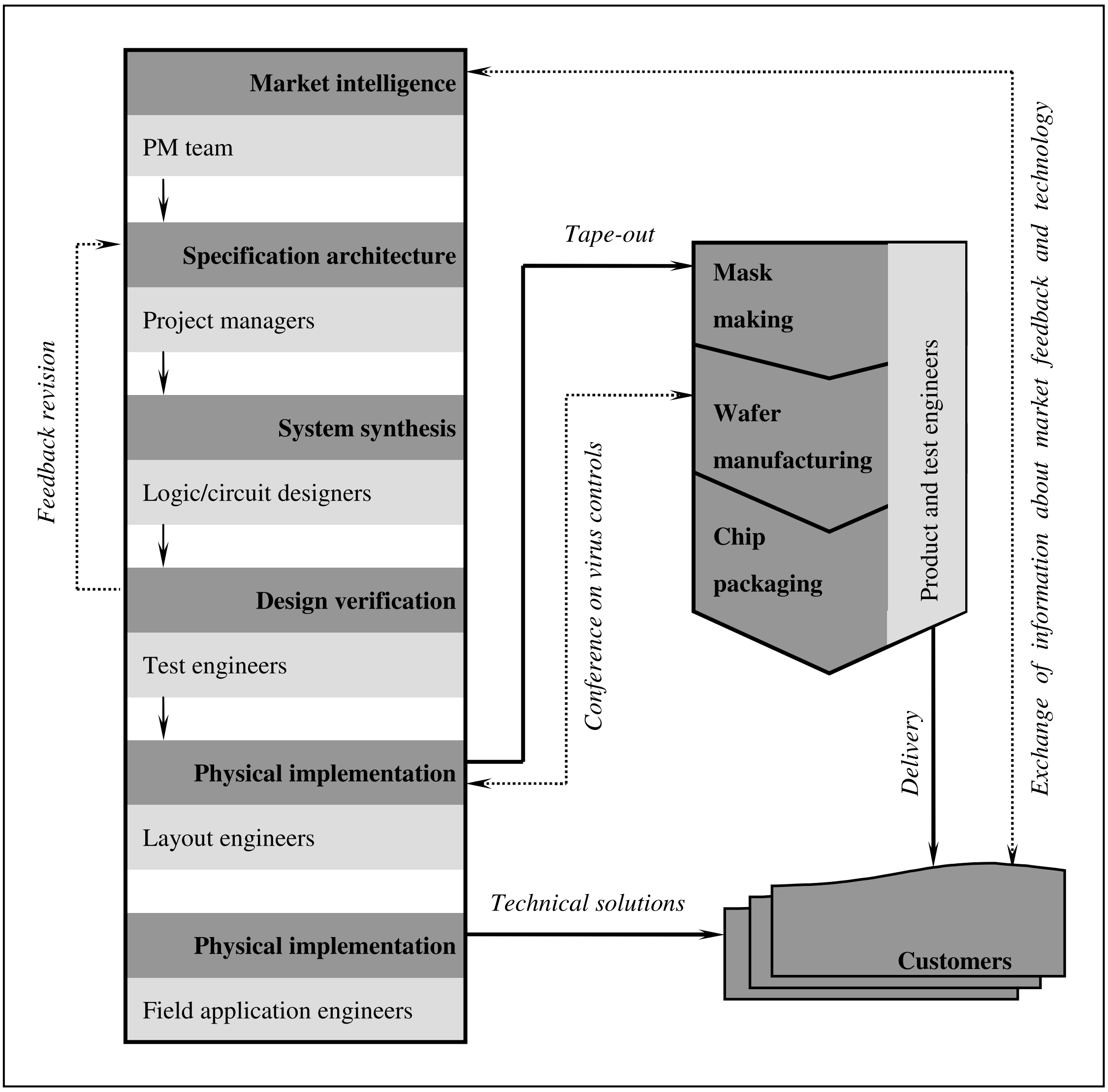

Figure 7.9 A variety of engineering manpower of the IC industry

Source: According to fieldwork results.

Chip design, coinciding with component miniaturisation, is highly market-driven. Marketability is the top priority for companies to map out developing strategies and are associated with two related competitive features. First, a process of market diversification has facilitated large numbers of specialised but low-volume market segments. Concentrating upon specific market segments is acknowledged to be a best practice for design houses to "stay at the forefront of each of these diverse and fast changing technologies" (Saxenian 1991: 425). As such, there would be a PM (*i.e.* product marketing or project management) team[62] that takes responsibility for the definition of products – to select *marketable* and *feasible* products by means of information collection. There are two dimensions of this. One ~~the first~~ implies a market survey to collect customer feedback and demands for the purpose of mastering up-to-date product features. Another dimension is technology analysis, including knowledge of current standards and the review of in-house capability, which measures corporate technological ability, leading to a decision on what kinds of IPs should be sourced externally for targeted products. All the information is taken into account in order to set up a production specification to follow R&D activities. Second, considering the shrinking life-cycle of various electronics products, the capability for time-to-market is one crucial competitive edge (Stalk 1988). The speed of putting new products on the market is closely related to the profit margin:

> Sometimes the consumer IC products change quite fast. Say, Elan, Sunplus, Sonix and so on, they are consumer IC [design houses]. What they stress is TAT, [namely] turn-around-time. [Even if] one product is put on the market just a couple of days [later], lots of similar types [of chips] are coming out. You know, price is very 'bloody'.
>
> – reported by ***Drm.1***

[62] The detailed function of the PM team in firms can vary but, generally, they are engaged in product marketing and project management prior to project launch.

There is a very fine division of labour within design houses. From a project launch, through the chip design process, to design tape-out for outsourcing fabrication, an assortment of engineers are involved. In addition to in-house R&D activities or manufacturing process, there would be FAE teams appointed to work with customers in pre-sale services (including technical presentations, demonstrations and benchmarking) and post-sales technical solutions (such as tuning-up and debugging). By doing so, the application of chips to electronics goods has to be well-formulated as soon as possible. It is essential to strengthen corporate capabilities for product creativity, technological innovation and technical support in the face of the market volatility and the economics of time; this requires companies to capture sufficient human resources to carry on continuous innovation.

Talent shortage at home

The high-technology industry in Taiwan has been facing a serious shortage of labour because the annual supply of graduates is insufficient for the labour market. The technical personnel that domestic IC firms require is mainly focused upon the professional fields from electronics engineering or information engineering backgrounds with a preference for those who are awarded a Masters degree. There is a high overlap with respect to the talent requirement among various electronics industrial sectors (**Table 7.2**). A fast-expanding LCD-TFT industry, in particular, attracting manpower straight out of school has shrunk the supply of the talent pool for the IC sector in the last five years (Taishang Newsletter April 26th 2004). The S&T Advisory Group, under Taiwan's Executive Yuan, had estimated the demand for IC-related engineers was up to 9,700 in 2005, but the number of available workers was as low as 6,200.

Table 7.2 The background requirement for labour force of selected industries in Taiwan: 2005 (%)

	Educational background			Professional background			
	BS	MSc	PhD	Electronics Eng.	Computer Sc. & Info. Eng.	Mech. Eng.	Others
IC Design	33	65	2	53	23	9	15
IC Manuf.	33	60	7	25	20	10	45
IC Ass. & Test	90	9	1	20	2	30	48
LCD-TFT	35	55	10	43	3	9	45
Telecomm.	35	60	55	45	30	0	25

Source: Adapted from ITRI/IEK Project (December 2004).

The IC design industry in Taiwan, as in other electronics sectors and in other states, finds itself without enough engineers (novices or veterans) to fill the available positions. Sourcing overseas manpower becomes an alternative option to make up the gap in light of the skilled labour. A potential stock of well-educated labour in China drives Taiwan's IC design houses to enlarge their corporate talent pool for fear that the talent shortage may threaten to run down their innovation capacity. However, Taiwanese regulations forbid the Taiwanese design houses to carry out circuit design of chips in China on the one hand, and restrict the firms in recruiting Chinese engineers to work in Taiwan on the other hand. It is because the government regards the technology of hardware design as a leading edge of national competitiveness that the prohibitive edicts are proclaimed in order to preserve this advantage, by preventing a loss of expertise (to China in particular). In this regard, two segments of the labour force are currently the main concerns – *i.e.* FAEs and software engineers – even though quite a few Taiwanese design houses have built up an R&D team to engage in hardware design in China in a manner that is effectively 'under the table'.

In addition to the concerns over the legal position of such activities, the disposition of companies prowling for certain segments of Chinese manpower is associated with the problems of labour costs and the specificity of Taiwan's labour market. The employment of local FAE staff is directly related to cost reduction. As mentioned earlier, the FAE functions as a customer service, so they are not core R&D personnel responsible for decisive technologies but perform a customer relations' role by supporting customers and delivering market feedback to head office. The implementation of technical support requires instant communication and inspection on customers' shop-floors. The local hire of an FAE team is for the convenience of access to nearby customers and to save the costs of undertaking long distance but intensive business trips.

The situation is more complicated with regard to R&D personnel. Generally speaking, the IC design industry requires R&D staff, consisting of circuit designers (for hardware design) and system designers (for software application) to engage in project development. The hardware design involves setting up the specification of the chip, while the software application acts to create different versions on the basis of the defined specification. A single piece of chip must be developed to have two essential qualities: first, so that the product life of the chip can be extended, and second, the chip can be tailor-made to meet specific demands that customers require. In other words, the chip has to have a standard version from which more specialised versions can be developed.

In general terms, an ideal ratio of hardware design to software development is 1: 2 or 1: 3 for the product development. However, the ratio is merely about 1:1 in Taiwan; the current structure of domestic manpower is unsatisfactory. The reason for the large gap of software talent within the design sector is in relation to an aspect of engineering: a failure in chip design can be wasteful in production; such problems can cost as much as US$1 billion in regard to one mask making a 12-inch wafer, while the development of software is revisable and issued repeatedly for successive versions. The design task within the hardware section is fundamentally responsible for the success of products. It explains why design houses tend to lay much more emphasis on hardware design, and why hardware design offers a strong competitive advantage to Taiwanese engineers in comparison with software development. On the supply side, many qualified software engineers (with professional backgrounds from the field of computer science and information engineering) prefer to find a place in software companies rather than design houses. In a sense, they consider the position of software engineers to be *slightly* inferior to that of hardware engineers within the IC design sector:

> If I were a software talent, I would choose software companies, such as Cyberlink or Ulead (two Taiwanese leading software companies which specialise in imaging products). It is because what they are engaged with is genuine systematic software. But the role of software [engineers] in design house[s] is subordinate, so that an excellent software talent won't come to a design house to be in a minor role.
>
> – reported by ***Des.16-2***

A certain portion of the software application and field application can be externalised both organisationally and geographically considering that these tasks are not the core of design houses' competitive edge. Design houses thus tend to search for manpower in China to make up for the deficiency of software engineers in Taiwan and, incidentally, to reduce their labour costs.

The cost mechanism

The *lower* wage levels of Chinese electronic engineers do indeed draw in foreign investment. Take the design of RF (radio frequency) ICs for example. Every generation of chip requires an R&D team of 20-30 engineers to work out for about three years until tape-out. It costs at least US$25 million to implement if the team is located in Silicon Valley. However, the cost can be reduced to about one-third or one-fourth of ordinary expenditure by locating in China thanks to the low labour costs there. From a defensive point of view, the need by TNCs to open branch sites in China in pursuit of labour-cost minimisation is a means of "defend[ing] a 'quasi-monopoly' of knowledge" (Pitelis 1993: 529, quotes original). That is one crucial reason why a number of foreign design houses, and the US-based ones in particular, with worldwide capital resources are particularly attracted to the prospect of saving a great deal of money by exploiting locational advantages in China to develop up-to-date products, as it provides access to low paid but suitably qualified engineers.

Despite popular belief, it is a mistake to view the level of labour wage as a primary factor in attracting Taiwanese capital to China. The issue of labour costs that Taiwan's firms take into account when appointing some engineering tasks to branches in China is more complicated than the point of wage level. First of all, regulatory differences should be factored into the cost accounting of personnel expense, of which social security is particularly germane. Employees' social benefits (*i.e.* the four premiums (*sijin*), which employers are required to fund in China, are higher than those in Taiwan. Take companies in Shanghai and Suzhou~~,~~ for example; the *sijin* that employers should pay is up to 44% of salary according to a local management centre of a housing provident fund (HPF, *zhufang gongjijin*).[63] Comparatively, the social security of employees that enterprises in Taiwan have to pay is some 20% on average. In other words, the burden of personnel expense *per capita* is nearly 1.5 times the actual pay in China, compared to about 1.2 times in Taiwan. Hence, the combined labour costs are not as low as one might suspect from the Taiwanese companies' perspective.

The second factor regarding the labour cost is concerned with the rate of wage drift. During my research a rapid hike in the wages of technical personnel in China was in progress as a result of a scarcity of IC labour. The rapid rise of the Chinese IC industry means that the engineering workforce has not been able to make up the labour requirement. The data shown in **Table 7.3**, conducted by the electronic industry press in 2002, revealed that the average pay of IC-specific engineers

[63] It is a non-profitmaking unit subordinated to a local authority.

increased fastest among electronic engineers and experienced the highest annual growth rate. It reflects that an increasing demand for IC-specific engineers in China picked up strongly as the IC industry expanded. The wage gap between Taiwan and China has narrowed over time. This implies that Taiwan's firms have declining labour cost advantages by locating production in China.

Table 7.3 The salary level of selected engineers in China (US$)

	IC	Telecomm	Consumer electronics
2001	7,022	7,802	6,056
2002	10,618	9,426	8,707
Growth rate (%)	51.2%	20.8%	43.8%

Source: (EE Time September 28th 2002)

The main reason that the Taiwanese firms are keen on exploiting the talent reservoir in China is not the value of wages *per se*. A variety of contexts (*e.g.* capital sources, technological bases, industrial positions or functional requirements) upon which the various transnational capitals are founded require a subtle understanding. As Smith and others (Smith, Rainnie et al. 2002: 47) conclude,

> [r]eferences to labour processes are almost entirely concerned with the issue of labour cost as a factor in determining the international patterning of production, assembly, distribution and retailing activities within a chain. Little, if any, attention is given to the organisation of work and employment at the intra-firm level, clearly limiting an assessment of the impact of a place's location within a commodity chain.

Here a comparison can make the location decision clearer. The US affiliates, for example, are assigned more R&D tasks to carry out, thereby undertaking processes as constitutive roles in circulating, codifying and loading information and knowledge. Taiwanese investment is currently not focused on advanced R&D tasks. Taiwanese firms aim to enhance the servicing of clients located in China, so that they pay more attention to reducing the overheads of cadre deployment, although the wage gap between Taiwan and China has *narrowed* over time.

7.5 Straddling the Strait

7.5.1 Shifts in the industrial system

Most of Taiwan's leading firms in the sectors of design, fabrication and assembly sectors have sought to spread out their business/production activities in China according to the ITRI/IEK (Chen, Xiao et al. 2004), although it is clearly difficult to offer precise quantitative estimates of the IC company numbers investing there. **Table 7.4** reveals 20 Taiwan-funded design houses, of which the firms ranked as the Taiwanese top ten design houses of 2005 are included. The information I compiled is based upon various corporate annual reports, formal statements published by the Taiwan Stock Exchange Corporation and fieldwork results. The table illustrates that Taiwanese IC capital is spatially concentrated in Shanghai and adjacent cities (such as Suzhou, for example) around the YRD. The spatial distribution corresponds to the locational considerations that have been outlined in **Section 7.4**.

Table 7.4 The investment of leading Taiwanese design houses in China

Parent company	Affiliates	Est. year	Location (√ in the YRD)		Notes
MediaTek*	MediaTek Software	2002	Shenzhen		# Cayman and Samoa
	MediaTek	2003	Hebei, Anhui Prov.		# Cayman and Samoa
Novatek*	SinoWealth	2001	Shanghai	√	In the name of individual shareholders
	Novatek	2002	Suzhou	√	# BVI and Samoa
VIA*	VIA	2000	Shenzhen		# BVI and Hong Kong
	VIA Software	2000	Hangzhou		# Cayman and Samoa
	VIA	2001	Beijing		# Cayman and Samoa
	S3 Graphics	2001	Shanghai	√	In the form of JV with S3 # Cayman and Samoa
	GAPT	2003	Shanghai	√	In the name of individual shareholders Run for assembly task
	VIA Telecomm	2003	Hangzhou, Zhejiang Prov.	√	# Cayman and Samoa
Sunplus*	Sunplus	1999	Beijing		In the name of individual shareholders
	Sunplus	2001	Shanghai	√	# Belize, Mauritius and Cayman
Himax*	Himax	2004	Suzhou	√	# Samoa
SiS*	SiS	2005	Suzhou	√	# Samoa
Realtek*	Realsil	2001	Suzhou	√	# BVI and Mauritius
Etron*	GTBF	2001	Dongguan, Guangdong Prov.		In the form of JV # BVI Run for assembly task
Phison*	N/A	N/A	N/A		N/A
Faraday*	Faraday	2002	Shanghai	√	# BVI and Mauritius

continued over page

Table 7.4 continued

Parent company	Affiliates	Est. year	Location (√ in the YRD)		Notes
Elan	Elan	2002	Shanghai	√	# Hong Kong and Mauritius
	Elan	2003	Shenzhen		# Hong Kong and Mauritius
Holtek	Holtek	2001	Shanghai	√	# BVI
Ali	Ali	2000	Shanghai	√	# BVI
ULi	ULi	2004	Shanghai	√	# BVI
Winbond	Winbond	2001	Shanghai	√	# BVI
Cheertek	Cheertek	2002	Shanghai	√	# Samoa
SmartASIC	Huaya	2001	Shanghai	√	# BVI and Cayman
Princeton	Princeton	2002	Shenzhen		N/A
Macronix	InnoSiS	1999	Suzhou	√	InnoSiS was restructured as Macronix in
	Macronix	2005	Suzhou	√	2005
Myson Century	Chiplinks	2003	Shanghai	√	In the form of JV with Shanghai Belling. # Malaysia

Sources: According to fieldwork results, financial statements of various firms and Market Observation Post System of Taiwan Stock Exchange Corporation (http://newmops.tse.com.tw/).
Notes: (1) * means Taiwanese top ten design houses in 2005; (2) √ refers to the location of affiliates in the YRD; and (3) # means the third parties through which investment projects pass.

In addition, dimensions of timing and ownership can be identified. (1) The firms began to locate within China at the turn of the last century. (2) The flow of capital is indirect, most of which goes by a circuitous route via offshore companies , such as BVI, Cayman and Samoa. Although their investment items may not be prohibited, the firms set up the offshore companies for '*cash parking*' for financial reasons. The capital deposited in these tax havens can be transferred to China (and then back again, if necessary) more freely because the *raison d'etre* of offshore financial centres makes it more difficult for the Investment Commission or other agencies to supervise the flow of funds. In addition, many investment projects are conducted in their capacity as individuals which qualify for tax relief. Enterprises were required to include all income gained from overseas business when calculating their tax liability, while personal income tax was levied only upon income earned within Taiwan. For that reason, the firms were apt to evade paying tax by an expedient of conducting offshore investment in the name of individual shareholders.

Attention now is paid to interpreting the input-output system and organisational governance in relation to implications of territorialisation. A consideration of the temporal dimension of IC design house investment in China demonstrates that the IC sector was the second-round investment by the Taiwanese electronics industry going west. The IC business is run in the form of project-based coalitions following the evolution of vertical disintegration. The tight interlinked segments of the IC industry, embracing design, fabrication, assembly and other associated supporting industries, are geographically transplantable. Foundry activities serve as the locomotive engine within the IC industrial sector in driving investment in China. A group of the UMC-clan design members (such as Novatek and Holtek) and some other design houses (such as Realtek), which have long developed a good rapport with UMC, started to build production capacity in the YRD in 2001 and 2002. This investment was actually encouraged by UMC, who wanted its design partners to support the establishment of HJTC in Suzhou in 2001.

In addition to the case of the UMC-clan, there is a strong pull by foundries to bring back-end assembly houses together. Both TSMC and UMC have their own assembly partners in Taiwan. As **Table 7.5** reveals, ASE and SPIL followed TSMC and HJTC respectively to open branch plants in China even if the two world leading assembly plants[64] have dealt with lower-end packaging tasks there to date. The branch plant of SPIL is located next to HJTC's fab in the Suzhou Industrial Park. Besides the assembly partners, design service providers, such as Faraday (a member of UMC-clan) and FameG (a partner of TSMC's design centre alliance) also moved along with the rest of the industrial chain by opening branch offices in Shanghai.

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[64] ASE and SPIL, solely, accounted for about 45% of the output value among assembly contractors in 2003 (China Times June 24th 2004; http://www.chipscalereview.com/). The two firms have seen the market share enlarged in line with continuous advance of processing technologies.

Table 7.5 Comparison of TSMC and HTJC

	HJTC	TSMC, Shanghai
Est. year	2001	2003
Location	Suzhou	Shanghai
Investment	Founded by UMC ex-employee	Directly invested by TSMC
Tech. capacity	0.18μm/8-inch wafer line *licensed* from amity firm, UMC.	0.25μm/8-inch wafer line ported from parent company.
Facilities	Purchasing used equipments from worldwide.	Moving equipments of Fab7 from Hsinchu.
Staff in total	1,600 persons	1,000 persons
Taiwanese staff	Some 200 staff recruited from Taiwan (UMC mainly).	Some 100 staff assigned by Headquarters.
Assembly partners	SPIL set up plants in Suzhou in 2002.	ASE set up branch plants in 2003 in Shanghai and Kunshan (in Jiangsu Prov.) in 2004 and had strategic alliance with GAPT*.
IP vendors partners	Faraday set up a branch office in Shanghai in 2002.	FameG set up a branch office in Shanghai in 2003.

Source: According to fieldwork results in 2005.
Note: * GAPT, a packaging and testing plant in Shanghai, founded by MS Cher Wang, the chairman of VIA.

7.5.2 System, assemblage and territorial reflexivity

That the firms undertake transplantation collectively produces a geographical shift of the entire industrial system. It generates a *territorial manifestation* of the industrial sector (Dicken and Malmberg 2001). Three further dimensions can therefore be determined in order to understand that "the particularities of a firm enmesh the particularities of a firm with the particularities of that territory" (Dicken and Malmberg 2001: 347). First, considering the scale and structural nature of

Taiwanese IC firms, it can be profitable to carry out offshore production by concentrating just a part of the industrial system within a new geographical territory. An immediate gain is made by reducing transaction costs. For example:

> TSMC is located in Songjiang (in western Shanghai), HJTC is in Suzhou and GSMC and SMIC are in Pudong (in eastern Shanghai). All are confined within a couple of hours drive. Once I got one piece of a part broken, [the equipment vendors] should dispatch the components [to me] in no time. … [But] if I set up [branch plants] in the inland, a flight would take half of a day, added by passing through customs or the like. The cost of time would reflect on [production costs]. I should run [the equipment] 22 hours a day. If waiting for a piece of a part takes me six hours, the productivity would be low and the cost would be lifted.
>
> – reported by ***Drm.1***

The achievement of time economy in component supply or malfunction reparation underlines the necessity for the firms to re-agglomerate activities in certain locales (**Figure 7.10**). As Scott has argued, "a large assemblage of producers [is] tied into an interdependent whole by means of their external transactional relations" (Scott 1988: 28). Further matters relating to the re-situated industrial system, and its interaction with places to which they are transplanted are discussed in more detail below.

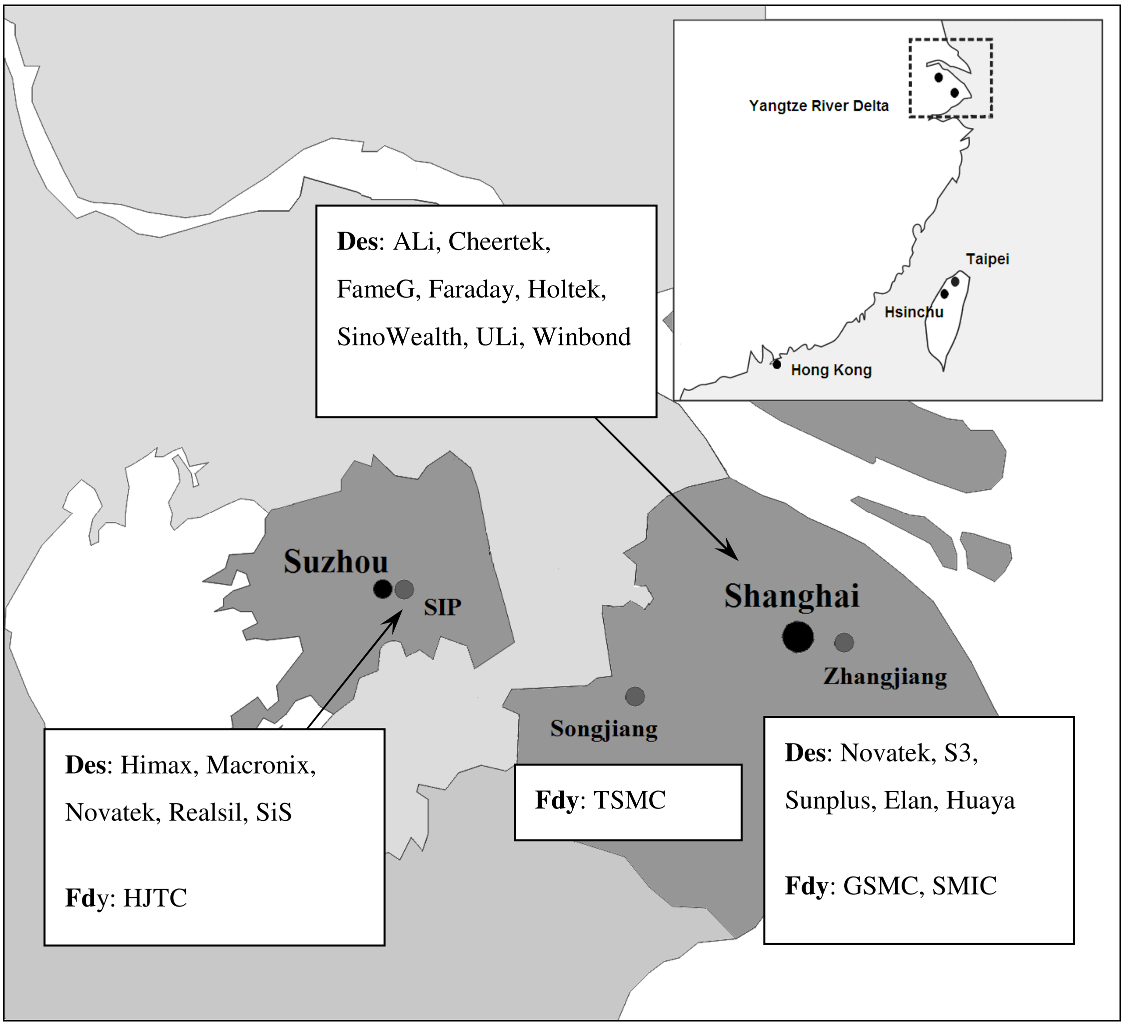

Figure 7.10 The agglomeration of Taiwanese IC firms in Shanghai and Suzhou

Notes: (1) This map displays some of the Taiwanese design houses listed in **Table 7.4** and several chipmakers; (2) SIP is short for Suzhou Industrial Park; and (3) Des is design house, Fdy is foundry and Ass is assembly house.

Taiwan's inter-firm networks of 'social embeddedness, flexibility, efficiency' (Xie 1991; Buck 2000) are adjusted in the locales. The industrial system moving abroad does not, and should not, represent a hermetic business circle. It is peculiarly specifically important to combine with other co-located counterparts to produce efficiencies. While the dimension of creating innovation or learning milieu has not materialised in the YRD so far, the assemblage of production facilities here is crucial for investors to share the expense of information collection and to enhance the exchange of knowledge. The power of coherence is an "inner momentum of falling production costs" (Scott 1988: 176) that generates great interest within corporations. A geographical concentration assists in agreeing appropriate policies and expediency in the face of China's regulations that are notorious for their complexity and capriciousness. Solidarity between producers makes for bargaining counters when negotiating with local authorities, and even lobbying the State Council on policies. For instance, a preferential clawback made on export duties was reduced from 17% to 13% in January 2004. Once a diminution of 4% in tax refund is put into practice, cost superiority of Chinese fabs over Taiwanese ones would have been barely 1%, compared to 5% previously. All voices converged as one and the same opinion to argue against the cancellation of favourable policy. Unity was indeed strength. The foundries located in Shanghai particularly took a lead to excuse the IC industry from this tax reform.[65] Their common appeal was submitted to the central government by way of the SICA. This effort had a positive response from the State Council in

[65] At that time, the majority of foundries were concentrated in Shanghai and most of them were Taiwanese-based. They rushed out their dissentient view against the revocation of preferential export treatment. The policy revision eventually took effect on April 1st, 2005.

November 2004; that is, the IC industry was, finally, allowed to retain the tax rebate of 17%.

For Taiwan's IC firms, the re-agglomerative dynamics additionally facilitate to *reproduce* the positive effects of the Taiwanese industrial system in the territory where the transplanted firms are situated. Following the arrival of the Taiwanese IC investment in the YRD, the IC production chain in the YRD has moved forwards to great capacity in both breadth and depth. Of more importance, the local base of industrial knowledge and know-how was upgraded to a certain degree owing to the introduction of experienced engineers or managers to the YRD. The establishment of site offices and branch plants were usually managed by senior staff assigned or recruited from Taiwan or Silicon Valley.[66] Equally significant is the fact that the newly-open fabs required a great deal of proficient personnel to steer manufacturing procedures – fine-tuning equipments and transporting technologies from parent companies – *at least* in the initial stage. Hence, teams of engineering staff were often

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[66] Those 'top' managers recruited or assigned from Silicon Valley are not necessarily Taiwanese; Chinese are also included. Quite a few of them had fellowship, for example as alumni or colleagues, with Taiwanese investors in the US. Besides the talent, there was one technical reason why several of the Taiwan-based design houses engaged Chinese returnees as an executive. It was a concern with even more tax relief that the Chinese Government has provided to them for the purpose of withdrawing stopping the brain-drain.

recruited or assigned from Taiwan for assistance. The managerial and technical expertise they brought help to get fabs or offices up to speed ready to run. More critically, local engineers and other staff could shorten their learning curve by means of co-working with assigned staff in the workplace. In short, the Taiwanese firms investing in China have not only internationalised their production/business activities but also helped to improve the 'location capacity' given the positive effects they have upon industrial territorialisation (Storper and Walker 1989; Yang and Hsia 2004). These location-specific advantages are produced by the investors collectively and have geographical outcomes. This, in turn, reinforces the locational attraction to followers.

7.5.3 Industrial 'roundabouts'

Divisions of labour between branches/subsidiaries and home bases vary from case to case. In the design sector, for instance, a conventional pattern is that head offices take charge of R&D and marketing and allot FAE tasks to site offices. More and more site offices are enlarged in scope to constitute a talent pool so as to undertake a portion of design tasks. In some cases, the scope of business in subsidiaries is totally separated from headquarters in terms of market targets or product segments. However, it can make more sense to take the production chain as a whole into account as an explanation for the spatiality of trans-local manufacturing than to sort out various ownership models that individuals govern. At this point, the following illustration (**Figure 7.11**) portrays a simplified form of 'design-manufacturing-assembly' chain for reference.

The figure outlines the input-output system and organisational governance in relation to multiple sites. Firms chosen for the figure are actual, not fictitious, cases. The situation with which the chain proceedings are associated with the division of labour is explained by revolving around one foundry and its business-related firms.

(1) The *dotted-line* frames indicate three types of ownership concerning cross-Strait governance, even though the patterns are much more complex in reality:

- Des.S vs. Des.H:
  Des.H was 100% owned by Des.S via a Cayman company in 2000 and received technological and managerial assistance from the head office. It aims at the Chinese market. It has transformed into a joint-stock company since 2003, independent from the Des.S in equity.
- Fab(SH) vs. Fdy:
  Fdy is an exceptional case, having opened a branch plant in China by means of foreign direction investment among Taiwanese chipmakers.
- Ass vs. Ass(SH):
  Ass(SH) is a wholly-owned subsidiary of a BVI company, while the BVI

company is a wholly-owned subsidiary of one Taiwanese firm in which Ass holds over 50% equity stake.

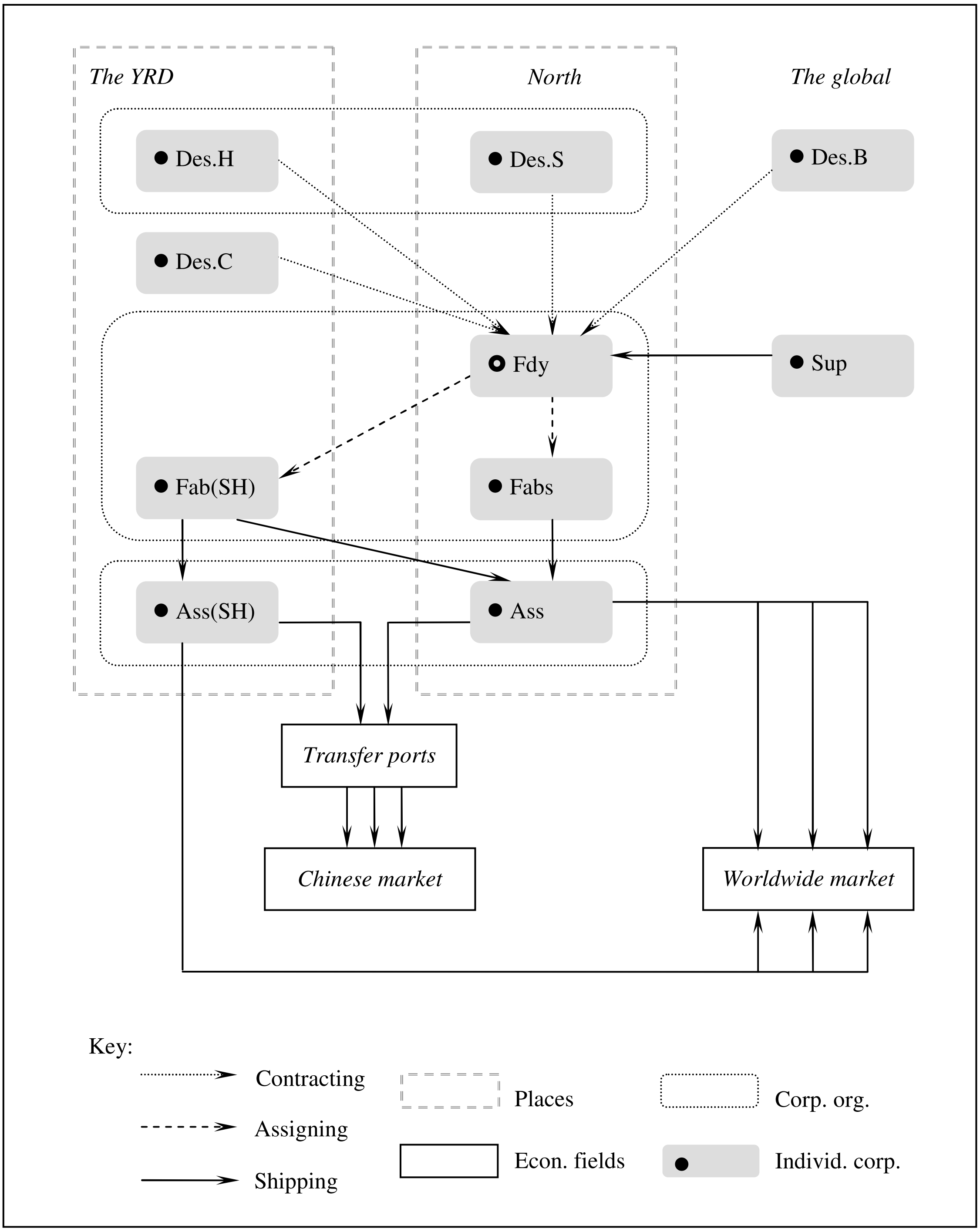

Figure 7.11 Illustration of the cross-Strait production within a global chain

Note: Firms are coded anonymously for confidentiality.

(2) The *dash-line* frames indicate certain places of industrial territories (*i.e.* the north of Taiwan and the YRD).

(3) The *solid-line* frames indicate functional fields of economic activities, including trans-shipping sites and 'marketplaces'.

(4) The *lines with arrows* mean industrially-functional connections that one firm to another. Fdy is a Taiwanese chipmaker which runs several fabs in Taiwan and China. Sup signifies suppliers of various materials and equipment in long-term concert with Fdy. Four design customers of Fdy are enumerated as *representatives* of distinction in location, ownership and targeted market:

- Des.B is a top US design house which is located in Silicon Valley. It aims at the worldwide market.
- Des.C is a design house which is managed by a Chinese returnee in Shanghai. Taiwanese capital and venture capital were involved in the start-up. It aims at the worldwide market.
- Des.H is invested by a Taiwan-based design house (i.e. Des.S) but run by a Chinese returnee in Shanghai. It aims at the Chinese market.

Des.S is a Taiwanese design house in Taipei. It aims at the worldwide market. Production schedules in Fdy are arranged in a centralised way regarding organisational governance. The Headquarters receives differentiated orders from individual design houses around the world. The allotment of the orders, no matter where they come from, is made to fabs in Taiwan or China according to comprehensive estimates concerning fabs' capacity, results of consultations with customers, programmes of strategic alliances and other technological and managerial considerations. Ass, in association with Fdy, carries on back-end manufacturing by operating its packaging facilities in either Taiwan or China. In a geographical sense, the assembly tasks are not necessarily tied up with fabs where the wafers are fabricated owing to the existence of technological differences. Ass(SH) has lower technological capacities and so fails to cater for higher-level outputs. As to superior designers, their fabricated wafers are often transferred from any fabs of Fdy to Ass's plant in Taiwan to accomplish assembly and testing at cutting-edge levels by contract.

Made-up chips are then delivered to the final market. As far as the Taiwanese IC industry is concerned, the so-called 'end market' is divided roughly into two geographical spheres: one is the worldwide market and another is China's market. In logistical terms, the procedure for shipping finished-ICs (and other types of components as well) to the Chinese market is complex because the chips are products for export *from* China but, meanwhile, components for import *to* China. The logistics are highly policy-related in the economic context of China and render shipping routes tortuous. ‘A day-trip to Hong-Kong’ was a notorious practice undertaken in the light of custom procedures. First, the movement of chips – produced in the YRD – out of China’s territorial space can have VAT refunded. Next, the chips that were moved from distributors to agents/channels or offshore centres of system firms *within* Hong Kong were duty-free. Finally, the chips – now as components – were shipped to factories in China and were exempted from import duty because of government-approved transactions. This is preferential treatment of the ‘export processing trade’ (*Sanlaiyibu*): a foreign party purchases Chinese manufactured goods or has raw materials and components processed on a consignment basis in China, in both cases with the inputs imported free of duties and VAT. In short, transfer points are of significance concerning delivery because they are key loci for both suppliers (*i.e.* design houses) and buyers (*e.g.* system firms and distributors) to avoid export and import duties respectively.

A short summary can be made on empirical grounds as shown above. The simplified figure here is expected to make clear the condition that the internationally-operated IC production chain crosscuts the spatial reorganisation of the Taiwanese industry system taking place trans-locally. Therefore, there stress is laid on the spatiality of the cross-Strait manufacturing which is not only deposited by the assemblage of individual Taiwanese firms but also by a reconstitution of industrial geography led by an intersection of transverse corporate reorganisations and lengthwise industrial linkages. Outsourcing from designers to chipmakers has geographical outcomes. In light of manufacturing proceedings, wafer fabrication is assigned to fabs or chip assembly is limited to packaging plants that are in appropriate locales. Moreover, the final delivery of chips to markets extends the IC production chain to the downstream sector of the electronics manufacturing in a circuitous way. In a geographical sense, it is intriguing that the niche of Taiwanese electronics firms is of vital importance internationally, and their achievement is reached by making good use of the world's factory – China. The manufacturing arrangement displays clear spatial phenomena of convergence and divergence.

7.6 Conclusion

Within the chapter I have endeavoured to trace out the dynamic practices of the cross-Strait production operated by the Taiwanese IC firms. In analytical terms, such corporate conduct was referred to the ownership- and location-specific properties. Instead of atomising the firms as individuals, the transnational behaviours of developing country TNCs were understood by situating the firm-place relevance in the context of capitalist production systems. I think it useful to give an in-depth account to look into the mechanisms behind the locational selection of geographical proximity and to avoid over-socialising the dynamics of the discernible sociality concerning the Chinese-ethnic similarities.

Firms establishing operations in Taiwan start to attempt to segment production facilities both functionally and spatially by trans-local production. A coupling of corporate strategies and local conditions is not merely a premium set by the sociality of the Chinese-ethnic characteristics presented in previous layers of 'go-west' investment. The rapid emergence of electronics manufacturing in China has led to the country assuming a new status in the global market and has brought about a great spatial shift in the IC chain. There are three elements that substantiate how industrial relocation is critical to the dynamics of the global IC production chain, which has seen investment flow in the direction of China. First, the governance of vertical disintegration as conventionally implemented in Taiwan plays an important role in extending the domestic industrial systems overseas. Second, market momentum is artificially augmented by the Chinese Government; the effect of taxation enables the Chinese market to tie chip making to the locale to draw the complete set of productive activities from overseas. Third, an urgent lack of engineering talent in Taiwan encourages firms there to carry out recruitment in China to exploit human resources for sustaining the corporate advantages with knowledge-intensive development.

Finally, I illustrated that the routes by which commodities physically flow along the input-output system are tortuous. The capital flows and the transit of chips from and back to the Mainland represents an adroit strategy of tax avoidance. It indicates *a strategic dimension* of chain organisation in response to the regulatory interference which is the sort of governance in force outside the chain. A considerable part of the global IC production chain is vertically associated with the trans-local industrial operation constituted by the Taiwanese firms. Corporations (based in Taiwan, China or elsewhere and ranging over design, manufacturing, supporting services, logistics, etc.) are geographically discontinuous.

CHAPTER EIGHT

CONCLUSION

8.1 Summary

Transnational production is a crucial element of globalisation, which is characterised by an increasing degree of production fragmentation owing to geographical dispersion and the organisational de-centralisation of business. This thesis has depicted industrial re-territorialisation as the experience of outward foreign investment from a late-industrialised state by an analysis of the cross-Strait production networks of the Taiwanese IC industry. I have sought to contribute to an understanding of contested territoriality of economic transnationalisation produced by the dynamics of economic globalisation. In the first section of this final chapter I shall summarise briefly the argument of this thesis, underlining the evolution of the Taiwanese IC sector and the spatial dynamics of cross-Strait production.

I have argued that there are finely detailed divisions of labour with special knowledge related to individual stages of IC production, and the tendency towards miniaturisation within chip manufacture strengthens this technical divisibility. Those sectoral features mean that the industry system is particularly conducive to organisational de-centralisation. The vertical disintegration of production organisation is bound up with shifts of industrial geography. The offshore migration of US semiconductor manufacturing to East Asia is the mechanism mainly responsible for the reshuffle of the industrial landscape. Made-to-order fabrication has been an important development which has promoted the division of labour, not only in functional terms but also in geographical terms. Specifically, such an organisational innovation has significantly acted to the benefit of Taiwan, where the new production model has been created, by occupying a niche in the global IC production chain.

The trajectory of the Taiwanese IC industry was also discussed and analysed. I illustrated how Taiwan's IC industry has grown rapidly to world leading levels of productivity and innovation through state support. It was revealed that the national innovation system responsible for knowledge acquisition, assimilation and diffusion systematically promoted technological progress within the domestic IC industry. Technology transfer to local firms offered efficient latecomer advantages as the firms are firmly integrated within an intensively networked production system in the industrial district. The local production system shows strong evidence of clustering, but also contains strong evidence of *transnationality*. That is, the extension of extra-local connections indicated that the territoriality of industrial linkages, organisational governance and corporate strategy evolved in line with the transformation of the global IC industry along dimensions of technology, structure and space. The outward investment of Taiwan's IC capital was made manifest by the development of production capacities within Mainland China. **Figure 8.1** gives a general timeframe to outline spatial characteristics of the industrial progress. Note that previous features are not replaced but retained and related to the sequential ones.

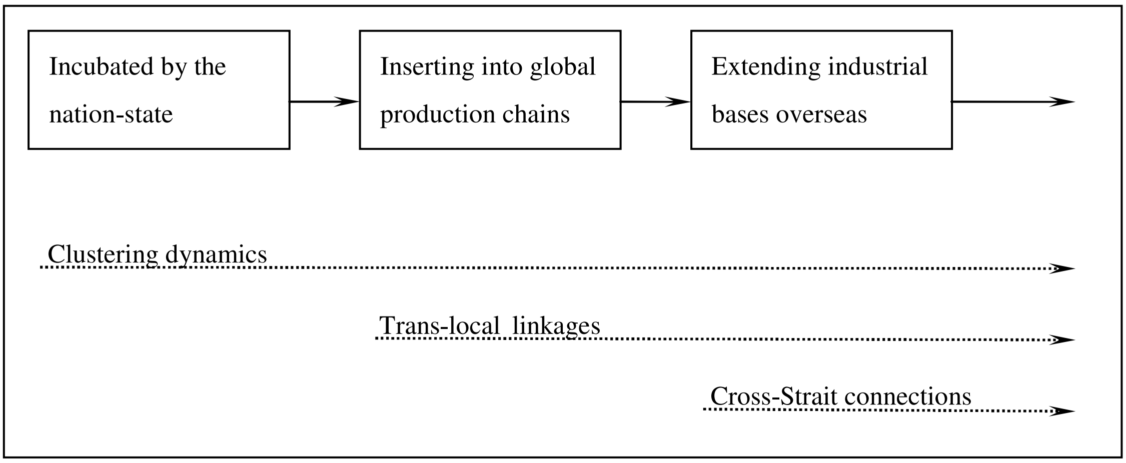

Figure 8.1 Spatial progress of IC industrial practice in Taiwan

There are three points of note indicating features of the cross-Strait production which will be illustrated, together with extensive interpretations drawn from my examination of the empirical evidence. First, firms began transplanting production facilities to the Mainland in the mid-1990s. There are many conjectures as to why this took place. (1) With regard to the industrial trajectory at a global level, there has been a tendency for the electronics market and chip fabrication to move to East Asian countries, and to China in particular. (2) The growing importance of China's IC market was reinforced because the trade-based taxation that China imposed produced favourable price advantages for Chinese-made chips compared to imported chips. (3) IC firms in Taiwan suffered from a shortage of skilled labour which led to a high demand for engineers. In short, from the mid-1990s onwards, despite China's expensive commodity and labour markets, it has become a very attractive location for export-oriented and knowledge-intensive IC industries in Taiwan.

Second, on a subnational scale, the transplantation of Taiwanese IC production represents a functional convergence with the YRD. This geographical relocation has brought about the creation of local production systems which are based on, and associated with, the primary industrial organisations in Taiwan. To a degree, the locational qualities of the YRD are enhanced because a geographical shift of the entire industrial system contributes a *territorial manifestation* of the industrial sector to the region. It is a case of territorial reflexivity: these location-specific advantages are produced collectively by the investors and have geographical outcomes and this, in turn, reinforces the locational attraction to other interested parties.

The governance of cross-Strait IC production is based upon conventional features of vertical disintegration that are efficiently practiced in Taiwan. Spatially, the Taiwanese industrial system is reproduced in both the home base (*i.e.* the industrial district in north Taiwan) and the destination (concentrated upon the YRD) *at the same time* – to cite one of the topological presuppositions of economic practices suggested by Thrift and Olds (Thrift and Olds 1996: 321-322). For Taiwanese IC firms, the reshuffling of industrial systems at trans-*local* levels is a dynamic strategy to couple with the global-scale IC production chain by stretching a certain link of the chain to other locations.

Third, capital migrates and commodities and resources materially flow in unclear and contested ways. This can be demonstrated along two strategic dimensions. One is that investment funds are channelled in a circuitous way owing to the constraints imposed upon them by the Taiwanese state. Capital moves through offshore companies registered in tax havens, which enables it to avoid official supervision. To a degree, the corporate responses implicate that government action has certain influence upon the way that chains are formed, although the government action is "constituted *outside* a production chain" (Smith, Rainnie et al. 2002: 47, emphasis in original). A second dimension is the existence of logistical 'industrial roundabouts'. That is to say, chips produced in China-based fabs are shipped away from Chinese territory before being delivered to the places assigned by the clients. Actually, most of the destinations are somewhere in the Mainland. This movement of materials takes advantage of tax abatement in China.

For that matter, the territorial extent of cross-Strait production is wider and more intangible than the bounded and physical localities – that is, north Taiwan and YRD – where the enterprises are located. “[T]hink[ing] of scale in relational terms” (Amin 2002), helps us to understand the way by which the firms set up offshore companies and/or make use of overseas staff to run the businesses in the Mainland, and confirms the power of transnationality through which the firms are able to ‘jump scales’, in Smith’s terms (Smith 1993). The case of China-based Taiwanese IC production shows that the arrangement of cross-border production chains challenges the state’s institutional domain. The way in which the firms carry out transnational production is more than merely conducting business across borders; it is a spatial tactic which manipulates and obscures judicio-territorial borders.

8.2 Some reflections

Some reworking of the GCC approach has been made in analysing extensive evidence of the cross-Strait industrial practice. Firstly, I have taken a network metaphor to emphasise complexity of economic interconnections. This is to avoid an impression of top-down determinist linearity of economic activities while recognising that a chain is imaged as a system of productive sequences. Secondly, it has been found that the GCC approach to development studies is analytically insufficient with regard to its stress on relevance of firm-level organisational power in the constitution of transnational production linkages. Taiwanese firms' efforts to coordinate with lead firms in response to pressure of the international market, to exploit local resources to tackle problems of talent shortage and to create opportunities by engaging enhancement of regional assets have evidenced evolution of power balance. That is, the way in which lead firms impose influence upon subordinate ones has increasingly shifted towards multiple directions of organisational forces. This reveals that a bi-modal stylisation of inter-firm governance in the GCC approach is analytical ossification since it fails to reflect multiplicity and variability of governance mechanisms. Thirdly, the evidence has also demonstrated that corporate actors are not exclusive as regards organisation governance. It requires embracing other types of economic actors to see what roles different actors play in governing value creation and its flow across production networks and how interaction among those actors affects the configuration of production activity. In particular, I have attached importance to a dynamic role of state actors in intervening in transnational business behaviours in order to reveal "broader political economic environments in which chains operate, including the institutional and systemic factors that shape the commodity chains and condition the outcomes associated with them" (Bair 2005: 154).

On the basis of this analysis, some general conclusions can be made which return us to the theoretical discussions presented earlier. I focus upon two central concerns in light of the spatial dynamics of collective corporate behaviours and discontinuous territoriality of strategic actions.

8.2.1 Going beyond clustering

> Definition in this sense [of place] does not have to be through simple counterposition to the outside; it can come, in part, precisely through the particularity of linkage *to* that 'outside' which is therefore itself part of what constitutes the place.
>
> (Massey 1993: 67, original emphasis)

I have argued that spatial convergence of production activities in north Taiwan is predicated upon the entrepreneurial momentum of the private sector working in tandem with the bureaucratic state. The business enterprises are of an outward-looking nature, encouraged by national export programmes. Taiwan's firms tend to be engaged in flexible manufacturing. The characteristic of such a system is the belief that 'small-is-beautiful'. Socio-cultural cohesion in the locale reinforces the (re)production of locally-based assets, underlining the sense of 'embedding': the local socio-economic embeddedness serves as the industrial basis where individuals coordinate/compete with each other. An implicit role of joint social life and common cultural context in intensifying economic exchange underlines the advantages of clustering, so that the firms and related agents consolidate as an *ensemble* in the local complexes. This, in turn, produces advantages of collectivity through business and learning opportunities.

However, rather than producing a restricted spatiality of connections, socio-economic relations embedded within a regionally cooperative system of industrial governance extend out of the local complexes on a global scale. Along with technological promotion, local firms are largely furnished by intellectual communications as vital sources of knowledge. Consequently, the firms are embedded in an open innovative milieu, showing that production and its social mixes in contemporary capitalism are place-based but *not necessarily* place-bound. For example, a technological coupling between Silicon Valley and Hsinchu is strengthened by a group of technical communities enhancing a frequent, vital industrial exchange between the two 'technopoles' across the Pacific (Saxenian and Hsu 2001).

A distinctive configuration, transformation and prospect of the Taiwanese IC industrial district displays "greater propensities for networking across district lines, rather than within, and a much greater tendency to be exogenously driven" (Markusen 1996: 294). The enthusiastic participation of the Taiwanese IC firms demonstrates that the domestic industry and its production systems are dynamically connected to other productive sites along the global chains. Empirically, there exist variations of organisational governance in the IC production chain. For example, cooperation between the UMC-clan members indicates the emergence of a pseudo-IDM model, and the utilisation of telematic systems along the input-output processes promotes the virtually reintegrating tendency of the IC industry. The evidence strongly confirms the importance of "[t]hese webs of intra- and inter-organizational relationships [woven] across geographical space in ways which not only connect organizations, and parts of organizations, together but which also connect highly dispersed *places* together through the networked flows coordinated" (Dicken 2002: 26, emphasis original).

In summary, the advance of domestic industry moving together with global production underlines the status of the Taiwanese IC complex as an aggregation of extensive and intensive networks. As such, the conventional idea of a geographically-defined industrial district is challenged by *a nodal sense of place* with the characteristics of porosity and connectivity. The territoriality of industrial behaviour is redefined because all the cross-border actions and phenomena that embody the presence of globalising practice and process *are* blurring boundaries.

8.2.2 The state-business nexus in transit

> [W]e are witnessing a proliferation of spatial scales (whether terrestrial, territorial or telematic), their relative dissociation in complex tangled hierarchies (rather than a simple nesting of scales), and an increasingly convoluted mix of interscalar strategies as various economic and political forces seek the most favourable conditions for their insertion into the changing international order.
>
> (Jessop 2002: 24)

Together with the geographical processes of production reorganisation is another set of issues relating to the discord between corporate spatial strategy and national jurisdiction. The interaction between the Taiwanese 'run-away' IC capital and its home state is dynamic, taking into consideration that "[l]ocal companies that have emerged from particular social and institutional contexts *evolve over time* on the basis of trajectories that are in part a reflection of these contexts" (Henderson, Dicken et al. 2002: 451-452, emphasis added). Taiwan's IC industry has grown out of *a model of guided capitalism* in the Asian developmental context. In this vein, the status of the Taiwanese firms appears negligible (and even invisible) *vis-à-vis* the dominant role of the state in steering economic affairs in analysing the economic performance. However, it is inappropriate to underplay other mechanisms related to, and associated with, the top-down nature of economic growth. For example, Taiwanese firms are engaged in more flexible manufacturing. Their "sustain[ed] entrepreneurial vitality and commercial adaptability of [a] decentralized industrial system" (Chan and Clark 1994: 137; cf. Buck 2000) is complementary to the bureaucratic autonomy that governs industrial promotion.

To a degree, reinforcement of corporate potentialities for dealing with transnational activities enables the domestic firms to conduct lucrative strategies which are *not necessarily* under a political rubric of national development, as used to be the case. The result is a transition in the state-business nexus. Nowadays, although the state apparatus remains relevant to the internationalisation of domestic firms, governmental command in the past has proved inferior. Evidently, the IC firms are to collaborate with the state in formulating industrial strategies to compete for advantages of standardisation while still keeping an opposing stance against the state in capital movement and transnational production. The complex, competitive and bargaining relationships imply that the conventional dominant-subordinate model constituted by the strong state becomes diversified in a context of global capitalism.

The scene in which firms move in and out of the Mainland is in conjunction with the prolonged dissension deriving from opposing polities and contradictory national identities between Taiwan and China. This represents an intriguing case that displays discrepancies – an unceasing wave of production transplantation to China against the state functionaries' hostility towards China's professing threat *pari passu*.

The opening of production sites by Taiwanese firms in China is associated with inter-state rivalry. As **Figure 6.2** illustrated, triangular articulation of the state-business relationships is entangled with contingent spatio-temporal matrices, including economic liberalisation in Taiwan, an opening-up of the Chinese market to global IC industry and the cross-Strait geo-politics during the post- Cold War era. Structurally, the domestic debates over transplantation presented a "nexus of multiple and asymmetric interdependencies involving local and wider fields of influence" (Amin 1997: 153).

To sum up, as the IC firms have augmented an astute capacity for spatial elasticity in "taking advantage of the territorial fragmentation of the international economy" (Cox 1996: 23), there has been a lifting of conflicts of *imperative territoriality* – the corporate perspective in favour of neo-liberalist globalisation *vis-à-vis* the national scale as 'taken-for-granted primacy' (Jessop 2002) for official governance. Such conflicts embodying politics of economic territoriality are a result of the cognitive gap which exists between making profit and securing sovereignty rights. However, it may be too simplistic to view the power balance between the state and firms as the zero-sum game that Reich envisages (Reich 1990; Reich 1991). Analytically, instead of a comparison of power levels, what matters is to look into the implicit vectors of strategic discourses that the agents formulate to reflect their own geo-economic images and positions in a broader (political) economic context.

8.3 Areas for further study

The final section of this concluding chapter will briefly discuss possible avenues along which the research may be extended. I wish to highlight three dimensions. Firstly, as was stressed above, migration of Taiwanese engineering experts and senior managerial staff is fundamental to technology spillover and knowledge reproduction. Consequently, one area of further study would involve exploring the dynamics of labour market(s) to understand the time-space mechanisms responsible for communications in the technical community composed of Taiwanese, Chinese and expatriate staff in workplaces, or trans-space cyber-space offices.

Secondly, too little attention has been paid in this thesis to the analysis of how the Taiwan-based IC firms compete, bargain and/or coordinate with local organisations (business enterprises and public institutions) in China. A closer investigation into their industrial linkages to local firms is required. One purpose in doing this will be to understand the way in which they adjust to local business systems from a supply perspective. Furthermore, it also highlights the need to involve the supplier-customer connections and production governance with the shift of the Chinese IC market in geography and organisation, in particular considering the increasing *internationalisation* of some Chinese brand-names, such as Lenovo.

Thirdly, there have been limits in understanding dynamic interactions between a liberalising tendency of Taiwan's developmental capitalism and China's post-socialist transition, although the analysis of the territoriality of the cross-strait industrial organisation was associated with the changing roles of Taiwan and China in the world economy. Such research would look into the natures of the economic systems embedded in the two countries respectively and internal and/or external dynamics that evolve their regulatory institutions. With such understanding in this thesis, it became clear that the sectorally- and geographically-specific transnational production system allows to evolve a certain Chinese-ethnic institution of accumulation, and that there has been a coupling process of the distinct capitalisms together with power wrestling between the firms and the states.

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APPENDIX A LIST OF INTERVIEWEES

No	Code of informant	Type of firm	Location of firm	Title of informant	Date and place
1	Adm.CHJ	Park admin. Com.	Shanghai –Caohejing (CHJ)	Research Dept. Director	Oct-28-2005 in Shanghai
2	Adm.SIP	"	Suzhou –Suzhou Ind. Park (SIP)	Deputy Director of Investor Service Div.	Nov-02-2005 in Suzhou
3	Ass.S	Assembly house	Suzhou -SIP	Deputy Manager of Management Info. Sys.	Apr-03-2005 in Suzhou
4	Assoc.S	Indus. assoc.	Shanghai –Zangjiang (ZJ)	Deputy-Secretary General	Oct-26-2005 in Shanghai
5	Con.Y	Consultancy	Shanghai –ZJ	General Manager (G.M.)	Apr-07-2005 in Shanghai
6	Des.1 [F]	Design house	Shanghai –ZJ	Tech. Mktg. Specialist	Oct-26-2005 in Shanghai
7	Des.2-1	"	Taipei –Neihu Tech. Park (NTP)	Vice President (V.P.) of Human Resources (H.R.) & Admin. Dept.	Jan-21-2005 in Taipei
8	Des.2-2	"	Shanghai –CHJ	Director of H.R. & Admin. Dept.	Apr-05-2005 in Shanghai
9	Des.3	"	Shanghai –ZJ	Director of G.M. & Admin.	Oct-25-2005 in Shanghai
10	Des.4	"	Shanghai –ZJ	President & Chief Executive Officer (C.E.O.)	Oct-25-2005 in Shanghai
11	Des.5	"	Suzhou –Suzhou New Park (SNP)	Site Manager of Suzhou Design Cebter	Oct-18-2005 in Suzhou
12	Des.6-1	"	Nanjing	V.P. of Sys. Group	Apr-04-2005 in Nanjing
13	Des.6-2	"	Shanghai –ZJ	C.E.O.	Oct-27-2005 in Shanghai

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Appendix A continued

No	Code of informant	Type of firm	Location of firm	Title of informant	Date and place
14	Des.7	"	Suzhou –SIP	C.E.O.	Apr-08-2005 in Suzhou
15	Des.8	"	Suzhou –SIP	G.M.	Oct-19-2005 in Suzhou
16	Des.9-1	"	Hsinchu –HSIP	Sr. Hardware Engineer (Eng.)	Mar-10-2005 in Hsinchu
					Dec-22-2005 by telephone
17	Des.9-2	"	Hsinchu –HSIP	Technical Manager of Digital Consumer Bu.	Mar-14-2005 in Hsinchu
18	Des.10	"	Suzhou –SIP	G.M.	Oct-20-2005 in Suzhou
19	Des.11	"	Suzhou –SIP	G.M.	Oct-19-2005 in Suzhou
20	Des.12	"	Hsinchu –HSIP	Product (Prod.) Manager	Oct-14-2005 in Hsinchu
21	Des.13	"	Taipei –NTP	Chief Finance Officer	Jan-18-2005 in Taipei
22	Des.14	"	Shanghai –ZJ	Vice Chief Eng.	Oct-26-2005 in Shanghai
23	Des.15-1	"	Shanghai –ZJ	President	Oct-27-2005 in Shanghai
24	Des.15-2	"	Hsinchu –HSIP	Special Assist. & Spokesperson of President Office	Nov-23-2005 in Hsinchu
25	Des.16-1	"	Taipei –Xindian	V.P. of Worldwide Sales & FAE Div.	May-05-2005 in Taipei
26	Des.16-2	"	Hsinchu	Acting Section Manager of H.R. Dept.	Dec-09-2005 in Hsinchu
27	Des.17	"	Shanghai –CHJ	Director of C.E.O. Office	Oct-26-2005 in Shanghai
28	Des.18	"	Shanghai	Director of VCT Div.	Oct-21-2005 in Shanghai

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Appendix A continued

No	Code of informant	Type of firm	Location of firm	Title of informant	Date and place
29	Des.19	"	Shanghai –CHJ	Director of R&D	Nov-03-2005 in Shanghai
30	Des.20-1	"	Taipei –Xindian	Sspecial Assist. to President.	May-03-2005 in Taipei
31	Des.20-2 [F]	"	Taipei- Xindian	Sr. Specialist of H.R. Div.	Nov-15-2005 in Taipei
32	Des.21	"	Shanghai	Director of China Admin. Div.	Apr-08-2005 in Shanghai
33	Des.22	"	Taipei –NTP	Sr. Detp. Manager of Prod. Marketing (Mktg.)	Jan-06-2005 in Taipei
34	Dis.1	Distributor	Taipei	Sales Supervisor	Jan-24-2005 in Taipei
35	Dis.2-1	"	Taipei	V.P. of MarCom	Jan-27-2005 in Taipei
36	Dis.2-2 [F]	"	Taipei	MarCom Specialist	Feb-23-2005 in Taipei
37	Drm.1	DRAM maker	Hsinchu –HSIP	Director of Manuf. Operation Div.	Jan-24-2005 in Hsinchu
38	Drm.2	"	Shanghai –ZJ	G.M.	Oct-27-2005 in Shanghai
39	Fdy.1-1	Foundry	Suzhou –SIP	Sales Manager of Domestic Sales Dept.	Mar-31-2005 in Suzhou Apr-03-2005 in Suzhou
40	Fdy.1-2	"	Suzhou –SIP	Manager of Mktg. Dept.	Oct-18-2005 in Suzhou
41	Fdy.2-1	"	Shanghai –ZJ	Deputy Director of Mktg. & Joint Development (Dev.) Coordination	Oct-21-2005 in Shanghai
42	Fdy.2-2	"	Shanghai –ZJ	Director of Mktg.	Oct-21-2005 in Shanghai

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Appendix A continued

No	Code of informant	Type of firm	Location of firm	Title of informant	Date and place
43	Fdy.3-1	"	Hsinchu – HSIP	Sr. Planning Eng. of Supply Chain Integration Dept.	Jan-18-2005 in Hsinchu Mar-22-2006 by webphone
44	Fdy.3-2	"	Shanghai	Director of Business Dev.	Oct-24-2005 in Shanghai
45	IDM.1	IDM	Shanghai –CHJ	Sales Manager	Oct-24-2005 in Shanghai
46	IDM.2	"	Suzhou –SIP	Project Manager of Mktg. Dept.	Oct-20-2005 in Suzhou
47	IDM.3 [F]	"	Shanghai –ZJ	Commercial Assist.	Oct-24-2005 in Shanghai
48	IDM.4		Shanghai –ZJ	Vice Chief Eng.	Oct-26-2005 in Shanghai
49	IDM.5	"	Shanghai –CHJ	V.P. of Foundry & Discrete	Oct-25-2005 in Shanghai
50	Med.D-1	Indus. press	Taipei –NTP	Deputy G.M. of Sales Dept.	Dec-23-2004 in Taipei
51	Med.D-2	"	Taipei –NTP	Lead Reporter of News Center	Nov-17-2005 in Taipei
52	Vnd.1	Equip. vendor	Hsinchu –HSIP	Sr. Eng. of TSMC Account Div.	Feb-23-2005 in Hsinchu Mar-03-2005 by telephone
53	Vnd.2	"	Hsinchu	Manager of Agent Sales Dept.	Jan-10-2005 in Hsinchu

Sources: Adapted from fieldwork results.

Notes: (2) Informants is kept anonymous and their companies or institutions are given pseudonyms as well. However, organizational locations are not disguised for indicating geographical distribution. (2) Those informants marked [F] are female.

APPENDIX B PROPOSED QUESTIONS FOR INTERVIEW

i. General questions for all informants

- Name
- Present employer and current job title
- Brief career history

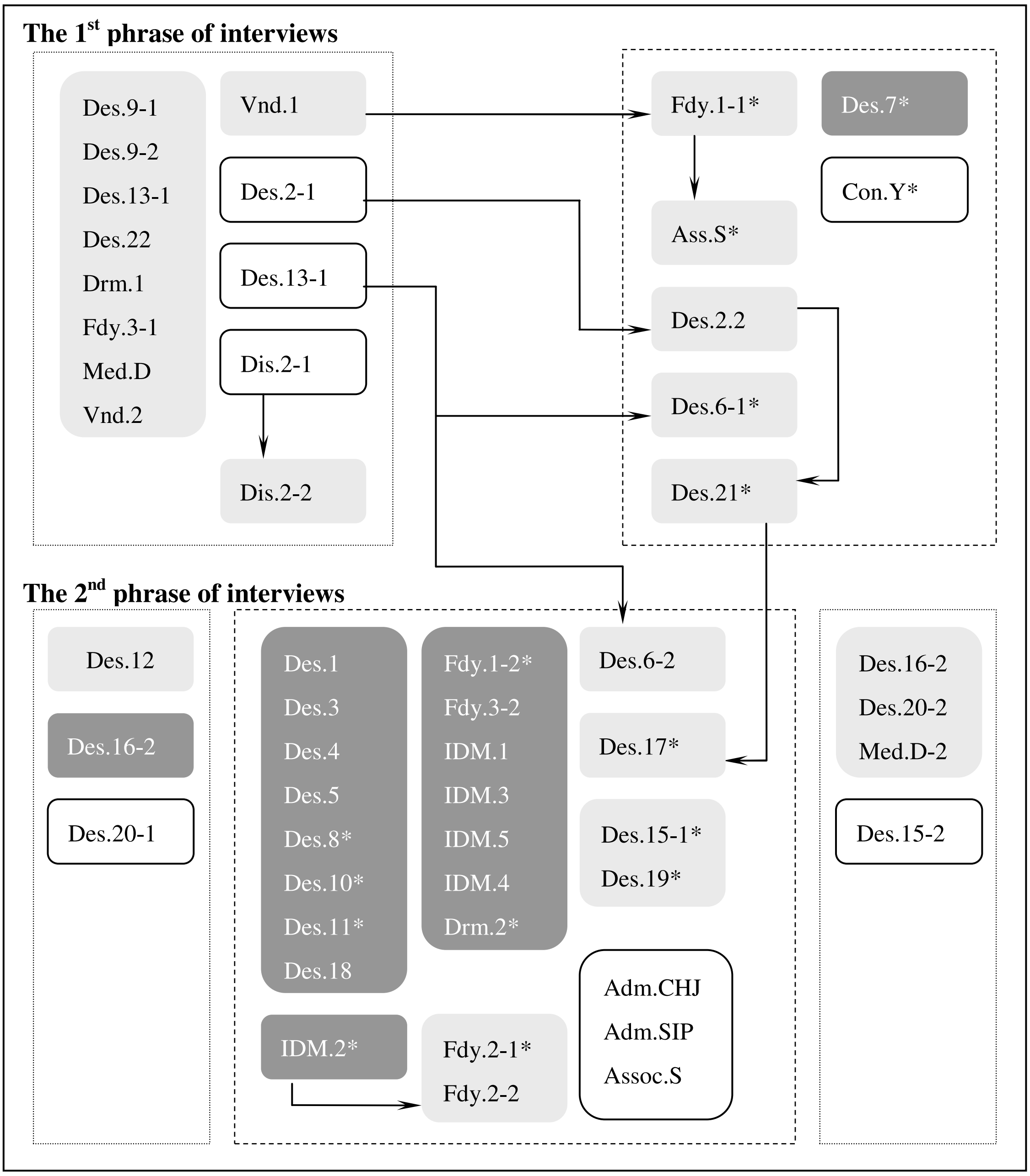
ii. Questions for corporate managers

- What are the reasons for your company's decision to invest in China?
- When/how did you start your investment projects?
- Where/how do you source supply chains when doing business in China?
- Where are your main customers located? And, how do you exercise your business/services with those customers?
- What are potential/existing difficulties to do business/production locally? If any, how do you deal with those issues?

iii. Questions for engineering staff

- What is your speciality?
- How is a process of product development in general terms?
- How do engineers from different firms and from various divisions within your firms work together during the R&D course?
- Have you posted to branches? If any, what was your task there?
- How does division of labour operate between a head office and branches?
- How do you handle the technology transfer in the locales (considering China is notorious for its poor intellectual property right protection)?

APPENDIX C INFORMANT RECRUITMENT



Key

Ways to recruiting individual respondents

Interviews in Taiwan

Interviews in China

By personal networks or snowballing

Via a 3rd party

By cold calling

Informants directed the researcher to a third party who was then interviewed.

* Taiwanese staff posted to or recruited in China

APPENDIX D THE RISE OF IC INDUSTRY IN CHINA

Governmental promotion in the 1990s

As early as the mid-1950s, China put a high priority on the development of IC technology (OTA 1987); in particular, when China recognised the fundamental potential of chips both for business and military capability.[67] However, the effort made to foster indigenous IC technology was not as effective as anticipated owing to China's centrally planned economy. This was because an overemphasis of the military sector and a bureaucratic obstacle[68] attributed to a long-term ignorance of the *commercial* benefits of IC technologies before the Economic Reform (Simon and Rehn 1986; OTA 1987; di Capua 1998). This situation began to shift thanks to the domestic electronics boom. Both central and local administration strove to draw on foreign technology and capital for the purpose of *industrialising* IC technology. However, the result achieved little due to a lack of comprehensive programmes, as

[67] The microelectronics thrust in China was further reinforced by the success of American 'smart weapons' in the first Gulf War (Simon 1992).

[68] The innovation climate in China was hindered by inefficient resource allocation and dual jurisdiction due to overlapping multilevel governance, including numerous ministerial-level organisations and provincial or municipal authorities, on industrial support.

well as the restriction of the Coordinating Committee for Multilateral Export Controls (CoCom)[69] (Simon and Rehn 1986; Chen 1998).

With an expanding chip demand for downstream industries, China has been suffering seriously from a lasting lag of chip output. The extending unbalance between IC consumption and production in China has called the authority's attention to implement incentive policies for industrial advancement. Considering the drawback resulted from repeated investments and overlapping governance, China undertook the industrial promotion programmes by central planning. The first programme was Project 908, implemented during 1991 and 1995 (**Table D.1**).

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[69] This was an international arrangement that was established to block the Communist bloc during the Cold War. The CoCom aimed to deal with the risks of regional and international security and stability related to the spread of conventional weapons and dual-use goods and technologies. The CoCom was terminated in 1993 due to the removal of the political rampart between the East and the West. Later, it was reshuffled as Wassenaar Arrangement (WA) in 1996.

Table D.1 Comparison of Project 908 and Project 909

Project 908	Project 909
Setting up: ● One 0.9µm/6-inch wafer line:* Huajing (technology licensed from US-based Lucent) ● One mask firm: Toppan (JV with US-based Dupont) ● One assembly plant (JV with Thai-based Millennicum Microtech and US-based Micro Chip) ● 18 IC design houses (spun off from research institutes)	Setting up: ● One 0.35-0.5µm/8-inch wafer line:* Huahong-NEC (JV with Japanese-based NEC) ● One silicon crystal line: GRINM Semiconductor Material Co. Ltd. (spun off from research institute) ● IC design houses (spun off from system firms and IDMs' design divisions)

Source: Adapted from ITRI/IEK Project (July 1998)

Note: * Huajing and Huahong were the focal points in the two Projects, respectively.

The 6-inch line set up in a domestic company, Huajing, was viewed as the key objective to promoting IC production in the Project. However, limited by managerial techniques, the operation of this upgraded line suffered from a great loss aggregated up to RMB 360 million by the end of 1997. This 6-inch line was then contracted to CSMC[70] in 1997 and became the first 6-inch pure-play foundry in China. In addition to Huajing, another four companies, containing three JV and one local firm, were

[70] CSMC, one affiliate of a Hong Kong-based group, Chinese Resource Co. Ltd., was run by a Taiwanese excusive team. In 2002, CSMC merged with the 6-inch line of Huajing.

chosen as the 'backbones' to upgrade[71] the production lines to 5- and 6-inch process technologies by concentrating resources upon the selected companies (**Table D.2**). It is obvious that China had to source the advanced technologies (including industrial and managerial know-how) and facilitates from abroad because of its suffering from outmoded infrastructure and poor industrial organisation. Regarding the IC design sector, 18 IC design houses were separated from public research institutes under a governmental sponsor. Yet the effect was less valid because those IC spin-offs had little market sensitivity (ITRI/IEK Project Jul 1998).

[71] Over 20 IC companies were founded before Project 908 held 3- and 4-inch wafer lines.

Table D.2 Five backbones of Chinese IC companies

Firms (Est. year)	Ownership types	Technology capability	Notes
Shanghai Belling (1988)	A JV of Shanghai Instrument & Telecomm. Bu. (60%) with Shanghai Bell (another JV) (40%) in Shanghai.	1.2μm CMOS/4 inch 0.5μm CMOS/6 inch	● China's first IC JV.
SAMC (1989)	A JV of Shanghai 7th Radio Factory with Philips (36.86%) in Shanghai.	2μm bipolar/6 inch 2μm CMOS/6 inch 0.8μm CMOS/6 inch	● Nortel (Canadian-based) joined as partner in 1995 with a 34% share (but sold to Shanghai Belling in 2000). ● Pure-play foundry model.
SGNEC (1991)	A JV of Shougang (60%) with NEC (Japanese-based, 40%) in Beijing	0.5-1.2μm CMOS/6 inch	
CHMC (1980)	A domestic firm in Zhenjiang Prov.	2.5μm bipolar/3-4 inch	● Acquiring technologies from Japan (Fujitsu).
Huajing (1982)	A domestic firm in Zhenjiang Prov.	2-3μm bipolar/4-5 inch 2-3μm CMOS/5 inch 0.9μm CMOS/6 inch	● Acquiring technologies from Japan (Toshiba), German (Siemens) and US (Lucent).

Source: Adapted from ITRI/IEK Project (July 1998).

With an anxiety to promote industrial capability, a new programme was announced in the Fourth Eighth National People's Congress in 1996 with the main goals being as follows (Semiconductor International 2000):

- Reach volume production levels for 0.8μm and 6-inch process technology.
- Enter industrial production for 0.5μm and 8-inch wafer technology.

- Increase IC design capability to meet market demands.
- Pursue R&D in 0.3 to 0.4μm and advanced packaging technology.
- Develop 8-inch single-crystal wafer technology.

Project 909 was mapped out to be implemented between 1996 and 2000 (**Table D.1**). In pursuit of an import substitution, China, by following the Taiwanese foundry model, inclined to gearing up the foundry service in support of the domestic IC design sector. China's first fab with VLSI technology was launched. In terms of capital- and technology-intensive wafer fabs, JV remained the way to carry out the establishment of higher-level fabs. By 1999, one 0.35-μm/8-inch wafer line founded by the Shanghai Huahong Group (71.4%) in JV[72] with NEC of Japan (18.6%) began batch production with full capacity at 20 thousand units. China, by definition, intends to import up-to-date technologies and equipment from foreign enterprises through a promise of market access[73] in return.

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[72] Huahong expected to obtain the technologies and facilities from NEC, while NEC benefited from technology licensing and facility vending and stood to earn a huge price difference through selling low-cost DRAM made in China to the international market (Nanfang Daily December 20th 2003; ChinaByte June 14th 2004).

[73] There are dual political implications for opening a market. On the one hand, China's market opened to specific partners is not bound to products *per se*, but expensive equipment instead, in order to protect the domestic market from foreign dominance. On the other hand, the U.S. imposes serious restrictions on the export of advanced semiconductor technologies and equipment to China under a

With an attempt to complete the vertical disintegration of the IC supply chain, China poured RBM 286 million into fostering domestic design houses. In Project 909, China turned to spinning off design divisions from system firms or IDMs,[74] instead of research institutes, under the consideration that the new start-ups may design *commercial* chips to meet market demand. Yet, the effort that was made to open the up-to-date fab and IC design houses failed to work out in the industrial evolution. On the one hand, the technological competence of the seven IC design partners was too weak to reach the line-width level at 0.35- 0.5-μm, at which the fab was in operation; on the other hand, this 8-inch was run as the exclusive line of NEC for DRAM output and struck by a sudden DRAM slump[75] in 2001 that caused a serious sacrifice of up to RMB 700 million (Micro-Electronics Magazine December 16th 2003).

In summary, the insufficient commercialisation of domestic IC technology in China was attributed by three limits: (1) its inability to transfer S&T results market demand; (2) poor infrastructure/equipment and bureaucratic systems; and (3)

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military consideration, so that China has to obtain the facilities from other sources, such as Europe or Japan.

[74] For example, SHHIC spun off from Huahong.

[75] After that, Huahong-NEC has turned to focus upon foundry business since 2002.

restriction of technologies and facilitates import because of developed countries' export control (*e.g.* the Coordinating Committee for Multilateral Export Controls). China, thus, was keen on utilising the inducement of 'market access' to attract foreign companies to transfer technologies and import facilitates in need. Despite this, the results achieved little. Two crucial cruces were related. First, the IC production system was uncompleted. Particularly, the technology level of the domestic IC design sector was far behind the development of process technology. Both the quality and quantity of designed chips were unable to match the production capacity that new fabs provided so that the industrial activities failed to achieve the synthesis of a complete IC supply chain. Second, combined with a lack of sufficient orders, fabs, the JVs' *ad hoc*, served as foreign companies' 'branch plants'. Huahong-NEC was not singular of its kind. ASMC had provided 100% capacity for Philips before Canadian Nortel joined as the shareholder. Obviously, the operation of new fabs set up on the basis of national programmes in the 1990s owned insufficient independence of both technology and management.

A fever of inward investment

Even though the path on which China upgrades its domestic industry is thorny, global companies, in light of the electronics boom in China, come in groups to fill up the production vacancies in the locality. By 1997, the global top 20 IC companies, except for TI, have deployed their investment in China. **Table D.3** displays that the assembly sector dominated over foreign investment items in the late 1990s. Compared to wafer fabrication, chip assembly requires less fixed cost and technology but more intensive labour involvement, so that international companies took the assembly operation as the starting point to invest.

Table D.3 The global top 20 IC companies in China prior to 1997

Rank	Company	Ownership type	Chinese partner (plant location)	Des.	Fab.	Ass.
1	Intel (US)	Wholly owned				√
2	NEC (Japan)	JV*	Shougan (Beijing)	√	√	√
2	NEC (Japan)	JV*	Huahong (Shanghai)	√	√	
4	Motorola (US)	Wholly owned			√	√
4	Motorola (US)	JV	Leshan Radio (Sichuan Prov.)			√
5	Samsung (S. Korea)	Wholly owned				√
6	Toshiba (Japan)	Tech. transfer*	Huajing (Zhejiang Prov.)		√	
6	Toshiba (Japan)	JV*	Huajing (Zhejiang Prov.)			√
7	Hitachi (Japan)	JV	(Singaporean Government)			√
8	Fujitsu (Japan)	Tech. transfer*	Huayue (Zhejiang Prov.)		√	
8	Fujitsu (Japan)	JV	Huada (Jiangsu Prov.)			√
9	SGS-Thomson (France)	JV	Seg (Shenzhen)	√		√
10	Philips (Netherlands)	JV*	Shanghai 7th Radio (Shanghai)		√	
10	Philips (Netherlands)	JV	Changjiang (Jiangsu Prov.)	√		√
11	IBM (US)	Wholly owned				√
12	Mitsubishi (Japan)	JV	Stone (Beijing)			√
13	National Semiconductor (US)	JV	Sunrise (Suzhou)			√
14	Siemens (German)	Tech. transfer*	Huajing (Zhejiang Prov.)		√	
15	Lucent (US)	Tech. transfer*	Huajing (Zhejiang Prov.)		√	
16	AMD (US)	Wholly owned				√
17	Hyundai (S. Korea)	Wholly owned				√
18	Matsushita (Japan)	JV	Huaxe (Shanghai)			√
19	Sanyo (Japan)	Wholly owned				√
20	LG Semicon (Korea)	Wholly owned				√

Source: Adapted from ITRI/IEK Project (July 1998).

Note: * The projects of JV or technology transfer were supported by governmental programmes.

The foreign companies, mainly IDMs producing own-branded ICs, attempted to utilise the lower level of labour wage and land rent in China to reduce production costs. However, cost cutting was not the only inducement to foreign investment. In particular, many IDMs were keen on participating in the growing electronic system market in China. For example, the Belgian-based Alcatel set up China's first JV IC fab, Shanghai Belling, in 1988, to manufacture IC components in support of its JV affiliate, Shanghai Bell, for the output of telecomm devices. By means of arranging IC manufacturing, back-end and/or front-end, in China, the foreign companies could save tax expense in importing ICs and, meanwhile, make use of cheap land to manage stock. Besides, the enlarging size of the domestic end-market has contributed to attracting foreign investment inward. The case of Motorola is exemplary; it opened a wholly-owned assembly plant in Tianjin to package IC and MPU for its telecommunication commodities production in China in 1992 to make cost savings in its production facilities. With the expansion of the handset market[76] in China, Motorola *promised*[77] to build up one 8-inch line operated as an IDM in Tianjin in

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[76] China has become the largest market for handsets in the world over the last decade due to its huge population and increasing purchase power.

[77] Actually, Motorola had begun to reduce its IC production since 1997 and it shut down five fabs worldwide in four years (21st Century Economic Report September 18th 2003). Motorola's 8-inch fab,

2000 in light of market pre-emption. It then became the only foreign company among 49 licensed companies[78] allowed to produce and sell handset-related products locally in 2003. Certainly, China's potential market has contributed itself as a magnet for the IC industry since the late 1990s.

A remarkable turn in foreign investment in the IC industry in China has occurred since 2000 owing to the encouragement of a series of preferential polices, among which the 'State Circular 18' launched in 2000 was most striking. First, chipmakers were required to pay a standard 17% VAT, while a rebate on any net tax rate paid that exceeds 6% was granted. An incidental remark was that the amount of refund should be used in R&D or reinvestment. Second, IC corporations, investing over RMB 8 billions or engaged in 0.25µm line-width or more advanced process technologies, were eligible to enjoy an enterprise income tax holiday with the first two years having 100% exception and another three years having 50% exception.

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i.e. MOS-17, was merged with SMIC in 2004 when the line only output less than 4,000 units per week according to fieldwork results.

[78] In 1999, China announced the State '5 Circular' to restrict the production of handsets in China and to control the import of handset-related devices, such as mobile switchers or terminal equipment. China's Ministry of Information Industry (MII) has ceased to approve licence to foreign companies and ordered foreign companies to export at least 60% of locally produced handsets since 1999 (ITRI/IEK Project December 2004).

Third, the corporations were also immune from tariffs for imported raw materials, expendables, processing technologies and equipment. Moreover, there was a series of sequential supplementary regulations, covering governmental grants for enterprise R&Ds and protection of intellectual property, and various incentives initiated by local authorities.

The investment of the IC design industry was fuelled by not only indigenous enterprises but also, and more significantly, attracted international design houses to come in great numbers. As shown in **Figure D.1**, the IC industrial sectors, including design, fabrication and assembly, have seen a dramatic growth since 2001. The total revenue increased from US$1.5 billion in 2001 to US$6.7 billion in 2004. In addition to the rise of output value, there have been three fundamental features emerging since 2000 with regard to the industrial promotion and geographical distribution of China's IC industry.

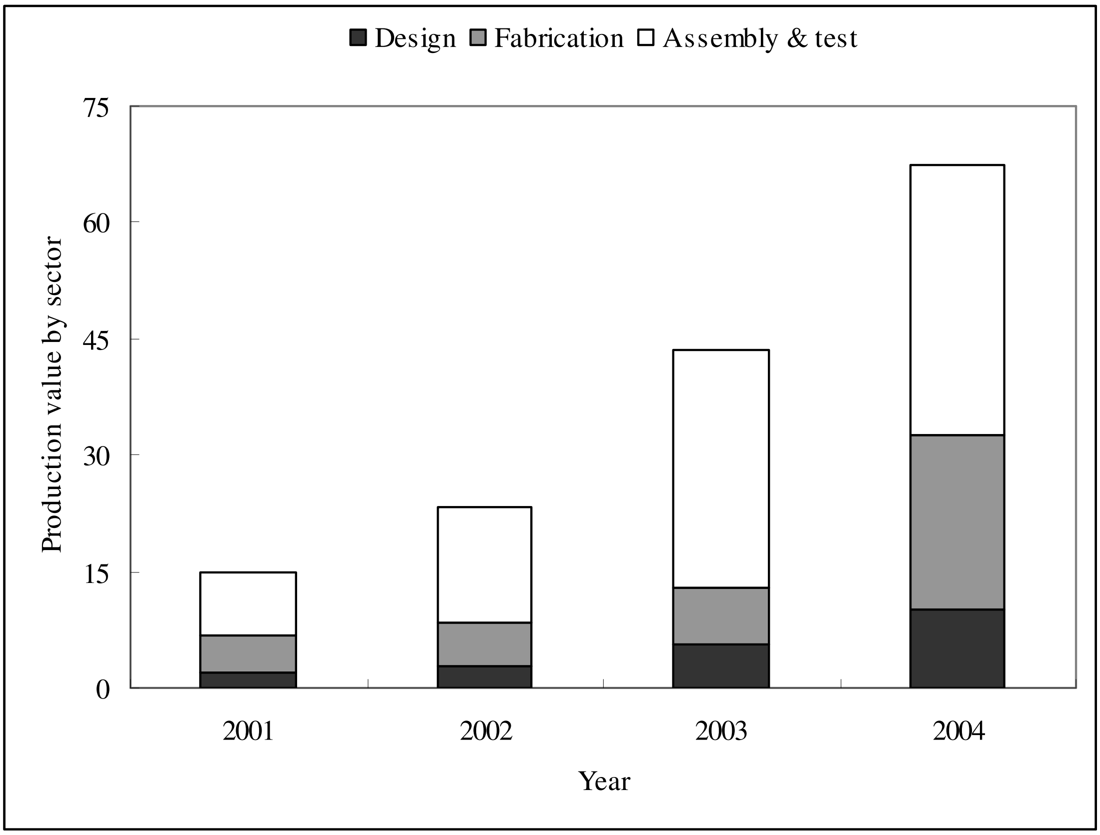

Figure D.1 Value of China's IC production value: 2001- 2004 (100 million US$)

Source: Adapted from DigiTimes (September 12th 2005).

The growth of fab establishment

There has been new growth of fab establishments in China, emerging with three distinctions from the earlier plants. First, the technological level has been upgraded. Four 8-inch fabs were launched and 0.25μm or above processes were imported to apply to the new wafer lines. Second, except for Motorola's wholly-owned IDM in Tianjin, other new fabs – SMIC (in Shanghai), GSMC (in Shanghai), Huaxia

Semiconductor Manufacturing Corp. (HSMC, in Beijing)[79] and HJTC (in Suzhou) – are operated in the form of a made-to-order foundry rather than IDM model. Third, Taiwanese IC professionals [80] have expressed increasing enthusiasm about participating in China's IC production. In addition to SMIC, GSMC and HJTC which I have mentioned in the narrative, one of the co-founder of HSMC is also a Taiwanese expatiate – Dr Mike Chang (no relation to TSMC's Morris Chang and SMIC's Richard Chang) ran an IC design house, Alpha & Omega, in Silicon Valley.

China's gravity of IC output, as Taiwan-based chipmakers flock into China, has been increasing in the global market by degree, even though its quantity and quality still fails to meet the market demand. It is noticeable that the prospect of the foundry business also encourages other Chinese companies to shift strategy from IDM to foundries. ASMC, the former leader in China's semiconductor industry, has garnered 1% of the global foundry market. The rise of foundry operation in China has promoted the participation of international assembly plants, equipment vendors and IP suppliers and, particularly, the inspiration for the design sector boom. In this sense,

[79] The investing project of HSMC failed due to the withdrawal of the main investor.

[80] The first Taiwanese-based IC firm in China is Nanker, located in Zhuhai, Guangdong Province, and set up in 1989, followed by CSMC which took on Huajing's 6-inch fab as the first foundry in China.

the foundry sector serves as the engine to drive on the completeness of the IC production chain in China.

The rise of IC design houses

In the design sector, a surge in design start-ups represents the second feature of China's IC industrial development. The number of IC design houses in China has leapt from 57 in 1999 to 421 in 2004 since the first specialising fabless was set up in 1986; further, there was 106% annual average revenue growth during 2000 and 2004 (CSIA June 8th 2005). Comparatively, local design houses are inferior to foreign/Taiwanese companies in China in respect of technology level. An industrial survey conducted by an electronic industry newspaper, EE Times (May 1st 2004), in 2004 reveals the technology lag of local companies: the proportion of Taiwan-based firms engaging with 0.13μm was double that of local design houses and nearly 30% of local firms focused upon the dated technologies (≥ 0.35μm line-width) (**Figure D.2**). Despite China's boast of numerous IC design start-ups, only a few hold distinct market niches and most of them struggle for survival by engaging with lower-end products, such as toys and consumer goods (Silicon Strategies May 20th 2004).

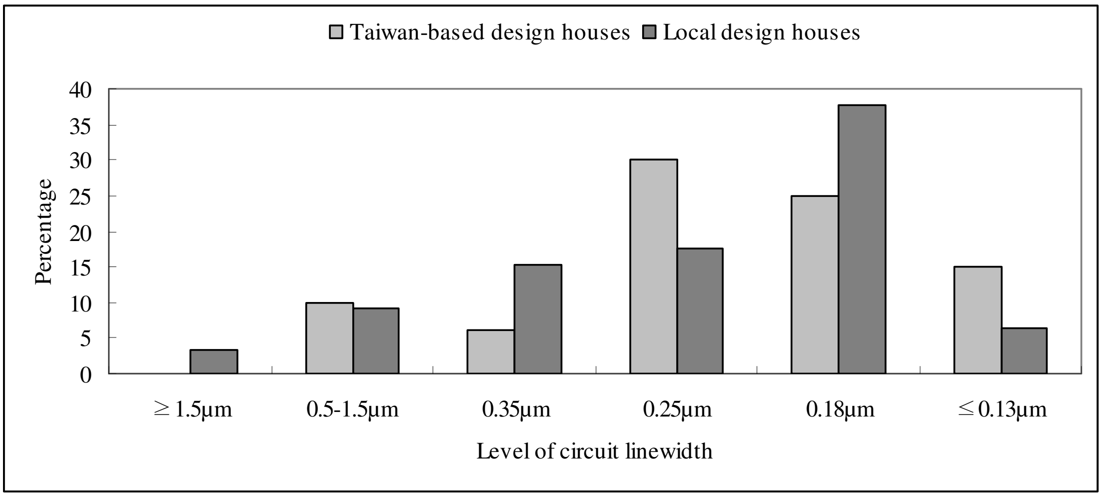

Figure D.2 Difference of design level between Taiwanese and local firms: 2004

Source: Adapted from EE Times (May 1st 2004: Figure 2, Figure 6).

Focusing upon the foreign capital, its participation in China's design sector is particularly significant. Many international IDMs or design companies opened R&D centres in the form of design divisions or branch offices, such as Intel's division in Shanghai and Freescale's branch in Suzhou, to engage design activities by exploiting local human resources. The locational factors that foreign companies take into account have been local talent pool rather than the material conditions (such as land rent or labour wage). Correspondingly, local employees are able to improve their technological competencies and their managerial know-how to a certain degree by engaging in higher level projects or attending in-house training programmes. For example, Trident, a US-based design house specialising in digital TV-related ICs, announced a novel chip (USB2.0 TV Tuner Box) in 2004 developed by its local R&D team in Shanghai. This team, composed of local engineers and led by a local director, was engaged with this project from specification definition through tape-out to marketing.