TECHNICAL
REPORT

Shanghaied?

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MICHAEL S. CHASE, KEVIN L. POLLPETER,
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PREFACE

The scope and scale of trade and investment flows across the Taiwan Strait have increased dramatically in recent years, driven in large part by the increasing integration of the information technology (IT) sectors of Taiwan and the People's Republic of China. This report examines the economic and political implications of cross-Strait IT and investment flows, principally in the areas of IT hardware and semiconductor fabrication and manufacturing. It is a qualitative study of the political, economic, and technology factors driving or impeding those flows and focuses primarily on policy issues. As such, it should be of interest to policymakers and analysts in the United States, China, Taiwan, and Hong Kong who are responsible for understanding the economic and political implications of increasing cross-Strait economic integration, especially in the IT industry, and other readers in industry and academia who are concerned with these evolving trends.

This research was conducted within the RAND Corporation National Security Research Division (NSRD). NSRD conducts research and analysis for the Office of the Secretary of Defense, the Joint Staff, the Unified Commands, the defense agencies, the Department of the Navy, the U.S. intelligence community, allied foreign governments, and foundations.

Comments on this report are welcome and should be directed to the project leader, Dr. James Mulvenon, at mulvenon@rand.org, or Michael Chase, at chase@rand.org.

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SUMMARY

This report examines the controversial issue of flows of information technology and investment between Taiwan and China, with a particular focus on the semiconductor industry. The goals of this report are threefold: (1) to comprehensively analyze the investment and IT transfer dynamic between Taiwan and China; (2) to assess the impact of these developments for cross-Strait relations, the global semiconductor industry, and the advancement of science and technology development in China; and (3) to evaluate the implications of the findings for U.S. government analysis and policymaking, particularly in the area of high-technology export controls.

OVERALL TRENDS IN CROSS-STRAIT FLOWS OF CAPITAL AND TECHNOLOGY

IT Production and Trade

The scope and scale of trade and investment flows across the Taiwan Strait has increased dramatically in recent years, driven in large part by the increasing integration of the information technology sectors of Taiwan and the People's Republic of China (PRC). Taiwanese IT companies began to shift production of labor-intensive products--including keyboards, mice, monitors, motherboards, and power-supply units--to offshore locations in the late 1980s and early 1990s to take advantage of lower labor costs in China and Southeast Asia.

- In 2002, more than 49 percent of Taiwan's IT hardware was made in China, and Taiwanese-invested companies produced more than 70 percent of the electronics made in China.
- The share of Taiwan's IT hardware production in mainland China reached 60 percent in 2003, while the share of Taiwan's IT hardware production remaining in Taiwan declined further, to about 26 percent, according to industry analysts.
- China's displacement of Taiwan as the world's third-largest producer of IT hardware items has touched off a debate in

Taiwan about the supposed "hollowing out" of the island's economy.

On the demand side, China now accounts for 13 percent of the world's demand for semiconductors, up from 7 percent in 2000. In addition, in the first quarter of 2003, China accounted for 11 percent of worldwide purchases of semiconductor manufacturing equipment.

- Manufacturers in China purchase $12 billion worth of semiconductors annually, of which approximately two-thirds are used in exports and one-third is used for goods sold domestically.
- Current domestic Chinese production is estimated to be able to supply a mere 10-20 percent of domestic demand.
- By 2010, China will become the world's second-largest semiconductor market, and by the end of 2003 it will have 12 percent of the production capacity of all semiconductor foundries worldwide, making it an increasingly important player in the global market for made-to-order chips.[1]
- It has been estimated that as of 2004 China will require $24 billion worth of semiconductors. China's semiconductor market is estimated to increase at an annual rate of 25 percent.

Investment

Taiwanese investment on the mainland has been growing rapidly in recent years, although widespread circumvention of Taipei's restrictions on money flows makes the actual level of investments difficult to estimate.

- In early 2003, the Taiwanese government estimated that total approved investment in China by Taiwanese firms had reached about $30 billion.

[1] Foundries are companies that produce semiconductors on order for chip designers.

- The most recent Chinese government estimate of total Taiwanese investment in the mainland is about $61.5 billion, ranking Taiwan as China's third largest source of foreign direct investment.[2]
- Some economists and Western banking analysts estimate the total Taiwanese investment in the mainland may be as high as $70-100 billion.
- Most observers expect Taiwanese businesses--especially companies in the island's IT sector--to continue to skirt regulations while at the same time pressing Taipei for further concessions.

Taiwanese companies are investing in China for several reasons: to take advantage of lower production costs, especially land, labor, and construction costs; to take advantage of the increasingly large pool of skilled Chinese engineers and technicians; to gain access to the Chinese domestic market; as part of an "investment cluster effect;"[3] and because of preferential tax policies and other incentives offered by the Chinese central government and local governments.

The most prominent change in regional investment patterns is a shift in the concentration of Taiwanese investment from the Pearl River Delta to the greater Shanghai region.

- As a result of this growing influx of investment, Jiangsu by the end of 2002 had surpassed Guangdong in terms of total approved investment from Taiwan.
- As for the impact of severe acute respiratory syndrome (SARS) on cross-Strait ties, some analysts predicted that the crisis would slow economic integration between China and Taiwan.

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[2] *Foreign direct investment* refers to investment by foreign companies in companies, facilities, and equipment. It does not include investments made in stocks or equities.

[3] *Investment clustering* refers to the concentration in some geographic area of firms that are engaged in various aspects of a given business. Investment clusters form because the concentration of firms in a given location supports the development of specialized suppliers, allows labor market pooling, cuts down on transportation, and facilitates knowledge spillovers, all of which help to reduce costs.

Rather than causing cross-Strait economic ties to unravel, however, the SARS crisis ultimately underscored their durability and resilience.

POLICY RESPONSES IN TAIPEI AND BEIJING

Taipei

For the Taiwanese government, growing trade with China raises concerns that the island's economy is becoming too dependent on the mainland. The economic relationship between China and Taiwan has thus become a sensitive issue in Taiwanese politics. Domestically, President Chen Shui-bian faces a difficult political balancing act. He faces pressure from the business community and from the opposition parties--the Kuomintang and People's First Party--to further ease restrictions on investment and to pursue the establishment of direct cross-Strait links. He also faces countervailing pressure from some of his own Democratic Progressive Party (DPP) constituents and allies in the pro-independence Taiwan Solidarity Union who fear that increasing economic integration with the mainland will increase unemployment among grassroots DPP supporters and diminish Taiwan's prospects for political independence.

- Taipei has agreed to the "mini-three links," which permit direct shipping and passenger travel between the Taiwanese-held offshore islands of Kinmen and Matsu and the mainland cities of Xiamen and Fuzhou, and some Taiwanese analysts expect Chen to cave in to pressure to establish the full "three links,"[4] which would allow direct shipping and air travel between the island and the mainland.
- In the months before Taiwan's March 2004 presidential election, however, President Chen resisted demands to permit direct cross-Strait shipping and air travel as part of an election

[4] The term "three links" (*santong*) refers to the direct transportation, trade, and postal links between Taiwan and China. These links were severed in 1949, when the Nationalist government retreated to Taiwan after losing control of the mainland to the Communists, and have not yet been reestablished.

strategy designed to solidify the support of his pro-independence constituents.

However, Taipei has relaxed other longstanding restrictions on cross-Strait economic interaction. After more than a year of acrimonious political debate and extensive lobbying efforts by major Taiwanese semiconductor companies, including industry leaders Taiwan Semiconductor Manufacturing Corporation (TSMC) and United Microelectronics Corporation (UMC), the Taiwanese government early in 2002 relaxed its ban on investment in semiconductor facilities on the mainland.

- In September 2002, TSMC became the first Taiwanese semiconductor company to apply for permission to set up a manufacturing plant in China. TSMC plans to start production at its Shanghai plant in late 2004, but its sense of urgency has diminished given the relatively slow maturation of potential Chinese competitors.

The debate over chip policy brought to the forefront longstanding concerns about loss of technology and skilled personnel to the mainland. In response, the Taiwanese government in April 2002 began drafting a National Technology Protection Law (*guojia keji baohu fa*).

- Taiwanese executives seem resigned to the eventual passage of the law, although many say it is unnecessary.
- Given concerns about the difficulties of protecting intellectual property in China, TSMC and UMC would not build semiconductor fabrication facilities (or "fabs" for short) in China to produce 12-inch semiconductor wafers (the new standard for integrated circuits [ICs]) even if they were allowed to do so, according to industry executives.
- Taipei is also facing pressure from the business community to permit Chinese nationals to work for high-technology companies in Taiwan, which is prohibited by current regulations. Taiwanese executives say that Chinese engineers are needed to

fill jobs left vacant by a shortage of qualified specialists in Taiwan.

Beijing

Chinese leaders have recognized semiconductors as a strategic high-growth industry because of the fundamental role they play in information technology and high-technology weaponry. They view the development of the semiconductor industry as being vital to economic development and national security and are unwilling to cede the growing Chinese chip market to foreign companies or to depend on foreign suppliers for the chips China needs for defense and intelligence applications. Until recently, however, semiconductors had remained the weakest link in the Chinese electronics industry, as measured by the Chinese IT industry's progress toward the global state of the art.

According to the 10th Five Year Plan, the goal for national IC production is to reach 20 billion wafers by 2005, with sales between 60-80 billion Renminbi (RMB), constituting 2-3 percent of worldwide sales of wafers. The plan also calls for meeting 30 percent of domestic demand, with IC production for national defense and national economic security being principally domestic based. The 10th Five Year Plan also calls for the following:

- Eight-inch wafers with 0.25-micron process technology will become the new standard.[5] In pursuit of this goal, China plans to build
  - Two or three 6-inch wafer fabs
  - Three to five 8-inch wafer fabs capable of manufacturing 0.18-micron to 0.35-micron process technology
  - One or two 12-inch wafer fabs capable of manufacturing 0.13-micron to 0.18-micron process technology.
- Companies investing more than 8 billion RMB to build IC fabs capable of manufacturing wafers with better than 0.25-micron process technology are taxed at a lower rate of 15 percent, along

[5] The worldwide semiconductor manufacturing industry, meanwhile, is moving toward a more advanced standard of 12-inch wafers and 0.13-micron to 0.18-micron and lower process technology, placing China's planned efforts at least one generation behind state-of-the-art levels.

with a partial refund of the 17 percent value-added tax (VAT), resulting in a net rate of 6 percent tax. The United States has charged that the higher VAT on imported semiconductors violates China's World Trade Organization commitments and gives an unfair advantage to companies that locate their manufacturing facilities on the mainland.

Other policies have been developed to promote the Chinese IC industry. For example, IC manufacturers and software enterprises are eligible to receive a two-year corporate tax exemption starting from the first profit-making year, followed by a 50 percent reduction the next three years. This benefit, known as the "2 + 3 plan," will be withdrawn if a company ceases operation within the first ten years.

Intense competition exists among Chinese cities to attract semiconductor industry investment, with the competition mainly between Shanghai and Beijing.

- Shanghai has a "5 + 5" policy of offering wafer manufacturers a five-year tax holiday and an additional five years at half the tax rate, in addition to other incentives.
- Beijing offers a mix of incentives, including a "Shanghai + 1" plan, which offers to better any financial incentive offered by Shanghai by an additional year.

Both Shanghai and Beijing have announced goals of attracting certain numbers of IC fabs that far exceed the goals announced in the 10th Five Year Plan.

- Beijing, for example, plans to build five to eight 8-inch wafer fabs capable of producing 0.25-micron technology by 2005 and plans to build another ten advanced-product lines by 2010.
- Shanghai, by comparison, plans to build approximately ten IC fabs capable of manufacturing 8-inch wafers with 0.35-micron technology by 2005.

- If both plans are realized, the total number of IC fabs in Shanghai and Beijing alone could increase the original plan for building ten fabs to as much as 15 fabs by 2005.

ASSESSMENT OF KEY ANALYTICAL QUESTIONS AND POLICY IMPLICATIONS

Is the Mainland "Hollowing Out" Taiwan's Economy?

Taiwan's economy faces serious structural problems, but these problems cannot be entirely blamed on flows of technology and investment to the mainland. Instead, government budget deficits, state dominance of the banking sector and an excess of non-performing loans, and the effects of the global economic downturn--especially given Taiwan's dependence on IT exports to the United States, which is also in the midst of a sluggish economy--are the real culprits. The cross-Strait dynamic has instead led to a new division of labor across the Strait, with the Taiwanese conducting research and development (R&D), producing key components, and taking orders on the one side, and the mainland producing and assembling products on the other side.

What Are the Implications of Increasing Economic Integration for Cross-Strait Relations?

Many commentators have argued that China's desire to attract investment and technology from Taiwan will decrease the likelihood of conflict in the Taiwan Strait by making the costs of any potentially provocative move prohibitively high for both sides. Yet increasing economic integration is far from a guarantee of peace in the Taiwan Strait. Chinese leaders might very well be willing to bear the economic costs of a conflict if they calculated that military action was necessary to prevent the permanent separation of Taiwan from the mainland. Moreover, Beijing might believe that only minimal economic disruption would result from a coercive use of force against the island designed to achieve limited political objectives.

What Are the Implications of Cross-Strait IT Flows for the Greater China Semiconductor Industry?

While the global IT market continues to be depressed, China is a notable outlier as one of the few growth markets. In semiconductors, the

greater China region will increasingly be the locus for the global IC foundry industry. Successful integration of the greater China semiconductor industry will therefore likely have a dramatic effect on the trajectory and ultimate recovery of the global semiconductor market. Yet, domestic Chinese semiconductor companies will face serious challenges as they attempt to compete with established Taiwanese foundry giants. Concerns about intellectual property security are making some chip designers reluctant to outsource production to mainland-based firms. Meanwhile, Taiwanese companies will likely rise to a higher place on the technology food chain, moving lower-end design and production to China and conducting cutting-edge R&D on the island.

In terms of technology levels on the mainland, at least one fab in China (Semiconductor Manufacturing International Corporation) is currently producing near-state-of-the-art 8-inch wafers with 0.18-micron technology, which is roughly one generation behind efforts at Intel, IBM, UMC, and TSMC, which are already producing chips with 0.13-micron technology and have plans to produce chips with 90-nanometer technology. Intel does not have any plans to move their most advanced fabs to China, and TSMC and other Taiwanese-based chipmakers are approaching China slowly. Even after they receive approval from the Taiwan government, it will take some time for Taiwanese companies to move their fabs to China.

Meanwhile, many companies are slowing down their plans for production of state-of-the-art 12-inch wafers due to sluggish global demand. The reason that companies are producing 12-inch wafers at present is largely that they are trying to position themselves in the market so that they are ready when the global IC market picks up, according to industry analysts. As a result of the high costs associated with 12-inch wafer facilities and production, few players will be successful and stay in the market. In fact, costs of production at that level are so high that they will likely prevent many aspirants from breaking into the field even if they can acquire the necessary technology.

What Are the Implications of Cross-Strait Integration for Hong Kong?

Hong Kong has been the most important conduit for cross-Strait trade for more than two decades. Yet, Hong Kong would be the single largest loser as a result of direct links between China and Taiwan. The establishment of direct transportation links between China and Taiwan would result in a loss of about 5 to 6 percent of the shipping traffic in Hong Kong and several nearby Chinese ports for the first few years. Air traffic through Hong Kong, such as Cathay Pacific's daily Hong Kong-Taipei flight, would be much more heavily affected.

Some analysts remain optimistic about Hong Kong's future role in cross-Strait economic relations and believe the city will be able to weather the potential impact on its economy from the establishment of the three links, given that there are more than 900 companies with regional headquarters in Hong Kong. Moreover, Guangdong Province is still involved in about half of all cross-Strait trade, and it is likely that many of the shipments destined for the Pearl River Delta will still be shipped via Hong Kong. In addition, Taiwanese firms exporting their products from their manufacturing bases in the Pearl River Delta will continue to rely on Hong Kong's port facilities.

Overall, the establishment of the three links would mark a political breakthrough in China-Taiwan relations and would therefore be good for trade and business, which would in turn ultimately be good for Hong Kong and would offset the loss in shipping traffic. Indeed, investment bank analysts predict that cross-Strait trade will increase by about 50 percent after the opening of direct links between Taiwan and China.

Implications for Export Controls

The rise of the information technology sector in China, combined with concerns about the modernization of the Chinese military and the possibility of U.S.-China military conflict over Taiwan, has ignited a new debate in Washington about export controls on IT-related technology to China. Our research and fieldwork strongly confirm that controls on IT would be both detrimental to the U.S. economy and impossible to enforce in a global economy. Moreover, export controls on information

technologies would not have a meaningful impact on the trajectory of the IT sector's growth or technology levels in China. American companies do not have a measurable technological lead, and European and Japanese competitors have historically shown a willingness to place less of a priority on security concerns as a determinant of export policies.

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ACRONYMS

AIT	American Institute in Taiwan
AMD	Advanced Micro Devices Inc.
ASE	Advanced Semiconductor Engineering, Inc.
ASEAN	Association of South-East Asian Nations
BoFT	Bureau of Foreign Trade
BVI	British Virgin Islands
CAAC	Civil Aviation Administration of China
CAL	China Airlines
CAS	Chinese Academy of Sciences
CDT	cathode ray display tube
CEO	chief executive officer
CISC	complex instruction set computer
CMP	Chemical Mechanical Planarization
CPU	central processing unit
CVD	Chemical Vapor Deposition
DPP	Democratic Progressive Party
DRAM	Dynamic Random Access Memory
EDAC	Economic Development Advisory Conference
EU	European Union
EY	Executive Yuan
FBIS	Foreign Broadcast Information Service
FDI	Foreign Direct Investment
FTA	Free Trade Agreement
GAO	U.S. General Accounting Office
GDP	Gross Domestic Product
GNP	gross national product
GSMC	Grace Semiconductor Manufacturing Corp.
IC	Integrated Circuit
III	Institute for Information Industry
IPO	Initial Public Offering
IPR	Intellectual Property Rights
IT	Information Technology

ITRI	Industrial Technology Research Institute
KEM	Komatsu Electronic Metals Co., Ltd.
KMT	Kuomintang
LCD	Liquid Crystal Display
LY	Legislative Yuan
MAC	Mainland Affairs Council
MIC	Market Intelligence Center
MoEA	Ministry of Economic Affairs
MoFTEC	Ministry of Foreign Trade and Economic Cooperation
n.a.	not available
nm	nanometer
NPC	National People's Congress
NSB	National Security Bureau
NSC	National Science Council
NYSE	New York Stock Exchange
ODM	original design manufacturer
OEM	original equipment manufacturer
PC	personal computer
PDA	personal digital assistant
PFP	People's First Party
PRC	People's Republic of China
PVD	Physical Vapor Deposition
R&D	research and development
RMB	Renminbi
ROC	Republic of China
RTP	Rapid Thermal Processing
SARS	severe acute respiratory syndrome
SME	Small and Medium Enterprise
SMIC	Semiconductor Manufacturing International Corporation
SMIF	Standard Mechanical Interface
SPIL	Silicon Precision Industries Ltd.
SRAM	Tokyo Electron Ltd.
S&T	Science and Technology
TEEMA	Taiwan Electrical and Electronic Manufacturers' Association
TEL	Tokyo Electron Ltd.

TFT-LCD	Thin Film Transistor-Liquid Crystal Display
TSMC	Taiwan Semiconductor Manufacturing Corporation
TSU	Taiwan Solidarity Union
UK	United Kingdom
UMC	United Microelectronics Corporation
UPS	United Parcel Service
USITC	United States International Trade Commission
VAT	Value-Added Tax
WSMC	World Semiconductor Manufacturing Company
WTO	World Trade Organization

1. INTRODUCTION

BACKGROUND

For years, Taiwan's world-leading information technology (IT) industry has exploited the relatively cheap labor pool of the Chinese mainland to produce the lower-end items in its product lines, such as keyboards and disk drives. As the Taiwanese economy stumbles, however, more companies are looking to export their production base to the mainland, threatening to "hollow out" the island's leading industrial sector in the view of some Taiwanese observers. Taiwan's leaders have attempted to stanch the flow of production to the mainland, but economic logic and political enticements from Beijing have made the move too attractive for most companies to resist. More recently, Taiwan's President Chen Shui-bian has recommended the relaxation of controls on trade, transportation, and investment, portending an even greater acceleration of Taiwanese investment in and production on the mainland. At the same time, Taiwan has become increasingly important to the success of China's science and technology development, and the combined technology, capital, and labor of the two sides could prove to be a potent force, pushing China into the top ranks of the world's IT powers.

OBJECTIVE OF THIS REPORT

The goals of this report are threefold: (1) to comprehensively analyze the investment and technology transfer dynamics between China and Taiwan; (2) to assess the impact of these developments for relations across the Taiwan Strait writ large, the global semiconductor industry, and the advancement of science and technology development in China; and (3) to evaluate the implications of the findings for U.S. government policymaking, particularly in the area of high-technology export controls.

RESEARCH APPROACH

In the course of the research, we drew information from a wide variety of sources, including Chinese and Western media, company

materials, and Internet resources. The project also built on the RAND Corporation's previous experience in gathering information from private-sector sources by incorporating interviews with researchers and industry experts, especially in the region. For this particular report, RAND researchers conducted extensive interviews with trade association representatives, company representatives, analysts, and government officials in Washington, D.C., Taipei, Hong Kong, Shanghai, and Beijing.

ORGANIZATION OF THIS REPORT

The remainder of this report is divided into three main chapters. Chapter 2 addresses the contextual environment for IT flows across the Taiwan Strait, including the overall dynamic of cross-Straits relations between Taipei and Beijing as well as Chinese and Taiwanese government policies on investment and trade. Chapter 3 analyzes the current cross-Straits IT flows, providing statistical estimates of the scope and scale of the movement of technology and capital, summaries of the integrated circuit (IC) industries in Taiwan and China, and case studies of key companies. Finally, Chapter 4 offers our conclusions on key issues, including the debates over whether the Taiwanese IT industry is being "hollowed out" by the movement of IT production to China, whether the "three links"[1] between China and Taiwan would sound a death knell for Hong Kong, and how cross-Strait economic integration is changing the overall cross-Strait political dynamic, as well as the implications of these findings for U.S. government policymaking, particularly in the area of high-technology export controls.

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[1] The term "three links" (or *santong*, in Chinese) refers to the direct transportation, trade, and postal links between Taiwan and China. These links were severed in 1949, when the Nationalist government retreated to Taiwan after losing control of the mainland to the Communists, and have not yet been reestablished.

2. GOVERNMENT POLICIES AND CROSS-STRAIT FLOWS

THE MECHANICS OF CROSS-STRAIT TRADE AND INVESTMENT

This chapter addresses the mechanics of cross-Strait trade and investment and assesses the Taiwanese government's attempts to regulate trade with and investment in China.

The Evolution of Taiwanese Government Controls on Trade and Investment

Prior to 1979, there was virtually no economic interaction between China and Taiwan. At the beginning of the 1980s, Taipei enforced a nearly complete ban on exports to the mainland and permitted only certain Chinese foods and medicines to be imported from China via Hong Kong. As China became more open, however, Taiwanese businessmen began to see opportunities on the mainland. Despite the continuing prohibitions, trade between Taiwan and the mainland reached nearly $1 billion in 1985. Perhaps recognizing the futility of enforcing the ban on trade and investment, the Taiwanese government in 1985 adopted a noninterference policy with respect to indirect exports to China,[1] with the result that Hong Kong became the main entrepôt for goods shipped to the mainland. Direct investment in China by Taiwanese companies also remained banned and had to be carried out through subsidiaries or front companies in Hong Kong. The Taiwanese government, however, generally tolerated investment in China as long as it was relatively small and involved "sunset" industries.

Yet, the economy in Taiwan was undergoing important changes that would lead to an accelerated transfer of production to the mainland. As a result of the economic "miracle" that occurred in Taiwan from the 1960s to the 1980s (with its peak in the 1970s), the standard of living in Taiwan began to increase. Between 1975 and 1985 the nominal wage rate in Taiwanese manufacturing increased at 13.7 percent annually, while nominal labor productivity was growing only half as fast, at 6.8

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[1] Clough, Ralph N., *Reaching Across the Taiwan Strait: People-to-People Diplomacy*, Boulder, Colo.: Westview Press, 1993, p. 43.

percent.[2] Nevertheless, Taiwan's current account surplus increased to 20 percent of gross national product (GNP) in 1986, and foreign exchange reserves increased from $23 billion to $77 billion between 1985 and 1987.[3] According to Barry Naughton:

> The increase in reserves meant an excessive diversion of resources into low-yielding assets and thus a significant amount of income forgone. Moreover, by preventing appreciation, the government perpetuated large trade surpluses with the United States that were not politically sustainable. Finally in 1986 the currency was revalued upward by 40 percent against the U.S. dollar in two years.[4]

Rising wages and appreciation of the Taiwanese currency reduced the competitiveness of Taiwan's labor-intensive industries and forced these industries to find low-wage markets, such as China. As a result, investment in the mainland was led by shoe manufacturers, whose labor-intensive factories in Taiwan suffered from rising wages and labor shortage, which made competition on the world market increasingly difficult.[5] The appreciation of the currency also coincided with three Taiwanese policy moves in 1987: the lifting of martial law, approval for Taiwanese to visit the mainland, and the rescinding of the need for Central bank approval for remittances of capital for amounts below $5 million.[6] In October 1989, Taiwan issued regulations sanctioning indirect trade, investment, and technical cooperation with the mainland.[7] This mix of official restrictions and tolerance allowed for steady increases in trade between Taiwan and China. In 1978, the value of Taiwanese exports to the mainland totaled a mere $51,000, but by 1991 exports exceeded $4.6 billion. The principal exports were chemical

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[2] Naughton, Barry, "Economic Policy Reform in the PRC and Taiwan," in Barry Naughton, ed., *The China Circle: Economics and Technology in the PRC, Taiwan, and Hong Kong*, Washington, D.C.: The Brookings Institution, 1997b, p. 87.

[3] Naughton, 1997b, pp. 88-89.

[4] Naughton, 1997b, pp. 89, 90.

[5] Clough, 1993, p. 44.

[6] Naughton, 1997b, p. 102.

[7] Lee-in Chen Chiu, "The Pattern and Impact of Taiwan's Investment in Mainland China," in Sumner J. La Croix, Michael Plummer, and Keun Lee, *Emerging Partners of East Asian Investment in China: From Korea, Taiwan, and Hong Kong*, Armonk, N.Y.: M.E. Sharpe, 1995, p. 148.

fibers, cloth, plastics, raw materials for the chemical industry, machinery, and electronic parts and products.[8] Indirect investment was more difficult to gauge but was reported by the People's Republic of China (PRC) government to have reached $3.4 billion by 1991.

For the Taiwanese government, the growing trade with China raised concerns that the island's economy was becoming overly dependent on economic relations with the mainland.[9] Taipei was also concerned that Taiwanese industry was losing a measure of its competitiveness to the mainland. Increasingly, labor-intensive products such as toys, footwear, and textiles as well as electronic products such as calculators, television sets, tape recorders, and other electrical appliances were being manufactured on the mainland, causing Taiwan's share of exports in these products to important markets, such as the United States and Japan, to decline.[10] This trend prompted the Ministry of Economic Affairs (MoEA) in October 1990 to issue the "Regulations on Indirect Investment or Technical Cooperation in the Mainland Area," which required firms with investments on the mainland to register the amount and nature of their investment. After April 1991, firms planning to invest more than $1 million on the mainland had to obtain advance approval of their investment, and those investing lesser amounts had to report their investment to the Ministry. Failure to report mainland investments could be punished by denying the violator permission to travel or impede remittance of funds from abroad by enforcing stricter customs inspection of the violator's goods.[11]

As a result of the new reporting regulations, the Taiwanese government learned that investments in the mainland totaled at least $750 million. While this number was considered to be far below the actual value of the investments, the new regulations did provide the government with a better means to track investment in the mainland. The regulations also allowed Taiwan firms to invest in the production of 3,353 products, mostly in labor-intensive industries such as apparel,

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[8] Clough, 1993, pp. 44-45.
[9] Clough, 1993, p. 54.
[10] Clough, 1993, p. 55.
[11] Clough, 1993, p. 54.

footwear, household electronics, and food processing. This list of permissible investments was expanded to 4,895 products in 1996.[12] In addition, in the early 1990s, Taiwanese investment began to move up the manufacturing chain. In 1992, eight Taiwanese camera manufacturers set up plants in China to compete with low-end Japanese camera manufacturers.[13]

China responded to the increase in cross-Strait trade by establishing local Taiwan Affairs Offices to assist Taiwanese investors with investment applications and recruitment of local staff. In addition to official assistance, the State Council in July 1988 also issued "Regulations Of The State Council For Encouragement Of Investment By Taiwan Compatriots," which allowed Taiwan investors to enter into joint ventures or wholly own their own companies, purchase stocks and bonds of enterprises, and purchase real estate. In addition, the regulations exempted Taiwanese enterprises from many customs duties, industrial and commercial taxes, and import license requirements. Moreover, the regulations provided tax and duty exemptions for articles and vehicles in a reasonable amount imported by Taiwan staff members for their personal use during their service period in the enterprise.[14] In addition, in May 1989, China established two investment zones for Taiwanese firms in Xiamen and Fuzhou.[15]

The Chinese government finally legalized investment in China for a certain number of personal computer (PC)-related products in 1992. According to Naughton:

> Leading producers such as Acer, First International Computer, and Mitac wasted no time in moving Foreign Direct Investment (FDI) into China. In 1993 there were already 35 Taiwanese subsidiaries in China as against 10 in Thailand, nine in Malaysia, and four in Indonesia. The number increased to 41 in 1995, constituting 70 percent of all PC firms that were running overseas subsidiaries.

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[12] Sutter, Karen M., "Business Dynamism Across the Taiwan Strait: The Implications for Cross-Strait Relations," *Asian Survey*, Vol. 42, No. 3, May/June 2002b, p. 525.

[13] Clough, 1993, p. 56.

[14] PRC State Council, "Regulations of the State Council for Encouragement Of Investment By Taiwan Compatriots," July 3, 1988 (see http://Novexcn.com).

[15] Sutter, 2002b, p. 524.

> China accounted for almost half of Taiwanese offshore production of motherboards in 1993, one of the latest items to go abroad, with the rest being supplied by subsidiaries based in Thailand and Malaysia.[16]

Although the Taiwanese government continued to ease restrictions on trade and investment in the mainland, there were still lingering suspicions about the political leverage that increased trade and investment would give to Beijing. This prompted former president Lee Teng-hui (1988-2000) to urge Taiwanese investors to divert their investments from China to Southeast Asia. The "Go South" policy, which was initiated by Lee Teng-hui in 1994, aimed to prevent the island from becoming overly dependent on its economic relationship with the mainland by encouraging Taiwanese companies to invest in Southeast Asian countries. The policy has produced relatively modest results: Taiwanese foreign direct investment (FDI)[17] in the Association of South-East Asian Nations (ASEAN) in 1998 totaled $842 million, making Taiwan the seventh-largest investor in the ASEAN nations that year. Taiwan fell out of the top ten in 1999, but in 2000 ranked as the fourth-largest source of FDI for ASEAN countries, with $802 million in FDI. From 1995-2000, Taiwan was the seventh-largest investor in the region with total of $4.45 billion in FDI.

Having concluded that the "Go South" policy was not reducing the movement of Taiwanese capital to the mainland, the Lee government promulgated the "No Haste, Be Patient" (*jieji yongren*) policy in September 1996, requiring case-by-case approvals for Taiwanese investments in high-technology and infrastructure projects in China. The policy also placed limits on investments by companies listed on the Taiwanese stock exchange and imposed a ceiling of $50 million on individual Taiwanese investments in the mainland. Supporters of the policy argued that it was needed to prevent Taiwan from becoming overly dependent on its economic relationship with China. Some even asserted that Taiwanese investment on the mainland would leave the island

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[16] Naughton, 1997b, p. 186.

[17] *Foreign direct investment* refers to investment by foreign companies in companies, facilities, and equipment. It does not include investments made in stocks or equities.

vulnerable to economic coercion and enable China to develop military capabilities that would threaten Taiwan's security.

But Taipei's policies were beginning to lag badly behind the economic reality of cross-Strait trade. By 1999, only half of Taiwan's $40 billion worth of PCs, peripherals, and semiconductors were made at home,[18] and by 2000, China displaced Taiwan to become the world's third-largest producer of information technology hardware, after the United States and Japan.[19] In addition, the Taiwanese government in 2000 lifted restrictions on manufacturing notebook PCs on the mainland, prompting manufacturers to shift their production to China. By 2000, four of the five most important Taiwanese notebook PC makers--Inventec, Acer, Compal Electronics, and Arima Computer--had plants producing computer components in China.[20] According to PRC statistics, by the end of 2000 Taiwan had invested $28.46 billion in China[21] with two-thirds of approved new investment projects in 2000 in the electronics sector.[22] But this figure reveals only part of the story, because much of Taiwan's investments are allegedly funneled through third countries, such as Hong Kong, the British Virgin Islands, and the Cayman Islands, to avoid government restrictions. This has led U.S.-China Business Council's Karen Sutter to estimate that contracted investment by Taiwanese firms could be as high as $70-$100 billion.[23]

The go-go economy in Taiwan that continued throughout most of the 1990s came to a grinding halt in September 2000 with the global "dot com" crash. Gross domestic product (GDP) growth slowed from 6.73 percent to 3.82 percent during the fourth quarter of 2000 and contracted for the first time in Taiwan's history, by 2.18 percent in 2001.[24] These

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[18] Einhorn, Bruce, and Macabe Keliher, "Minds Over Matter," *Business Week*, November 27, 2000, p. 142.

[19] Lardy, Nicholas, *Integrating China into the Global Economy*, Washington, D.C.: Brookings Institution, 2002b, p. 52.

[20] Lardy, 2002b, p. 53.

[21] Sutter, 2002b, p. 528.

[22] Clark, Cal, "The China-Taiwan Relationship: Growing Cross-Strait Economic Integration," *Orbis*, Fall 2002, p. 757.

[23] Sutter, 2002b, p. 528.

[24] Republic of China (ROC) Ministry of Economic Affairs, Statistics Department, "Economic Indicators," http://www.moea.gov.tw/~meco/stat/four/english/english4.htm, last accessed August 26, 2003.

announcements precipitated a fallout in the high-technology sector that seriously affected Taiwan's economy. Predictably, the high-technology bust also encouraged movement to the mainland as Taiwanese companies looked to the mainland for cheaper real estate and labor to improve their competitiveness.[25] It was reported in 2001, for example, that notebook manufacturer Arima Computer Corporation was investing $100 million and planned to employ 650 research engineers in several Chinese projects.[26] The continued flow of investment to the mainland led to charges by some, including many independence supporters, that trade with the mainland was "hollowing out" Taiwan's economy and that restrictions on mainland investment should be maintained.

Yet, the incoming Democratic Progressive Party (DPP) government, whose presidential candidate, Chen Shui-bian, had won the election in March 2000, had a different view. The election of Chen, who during his candidacy had supported opening the "three links," which would permit direct cross-Strait trade and transportation, raised hopes that restrictions on trade and investment in the mainland would be eased. On January 1, 2001, Chen partially delivered on his pledge by establishing the "mini-three links,"[27] which allowed residents of the Taiwanese-held offshore islands of Kinmen and Matsu to travel directly to the mainland and permitted some direct shipping between the offshore islands and China. The mini-three links were later expanded in June 2002 to enable Taiwanese businessmen working in Fujian to travel between Taiwan and the mainland through Kinmen and Matsu.[28]

The "Mini-Three Links"

Covering both passenger and cargo ships, the mini-three links allow residents of the offshore islands of Kinmen and Matsu to travel

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[25] Clark, 2002, p. 757

[26] Einhorn, Bruce, "Facing A Shakeout, PC Makers Aren't Shrinking," *Business Week*, April 16, 2000, p. 29.

[27] The term "mini-three links" (or *xiao santong*, in Chinese) refers to the direct links between the Taiwan-controlled offshore islands of Kinmen and Matsu and the cities of Xiamen and Fuzhou in Fujian Province, China.

[28] Hsieh Kuo-lien, "'Mini Three Links' Policy Expanded Further: Cabinet," *China Post*, June 20, 2002.

directly to the mainland and to import a limited number of items from Fujian Province. The policy was expanded modestly in June and July 2002, when Taipei began permitting some Taiwanese who are not residents of Kinmen and Matsu--including family members of Kinmen and Matsu residents, Chinese spouses of Taiwanese citizens, and Taiwanese businessmen working in Fujian Province and their dependents--to travel directly between the two offshore islands and the mainland. As part of that expansion of the mini-three links, the Taiwanese government also expanded the list of products that the offshore islands can import directly from China.[29] As of February 29, 2004, under the mini-three links policy, more than 2,550 trips have been made by ship between the offshore islands and the mainland. Some 1,540 trips have been made carrying passengers from Kinmen and Matsu to the port cities of Xiamen and Fuzhou in Fujian Province, and about 1,000 trips carrying passengers and goods such as gravel have been made from the mainland to the offshore islands (see Table 2.1).

Although the total number of direct crossings made between Taiwan and the mainland under the mini-three links is not particularly large, the relaxation of the ban on direct travel has allowed a total of 152,438 passenger trips between the offshore islands and Fujian Province, including 144,234 from the offshore islands to the mainland, and 8,200 from the mainland to the offshore islands as of February 29, 2004 (see Table 2.2).

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[29] "Cabinet Expands 'Mini' Links with China," *Taiwan News*, August 1, 2002; and Hsieh Kuo-lien, 2002. The expansion of the list of commodities that can be imported directly from the mainland was intended to cut down on smuggling and to boost economic development on the offshore islands.

Table 2.1

Number of Ships Traveling Between Taiwan and the Mainland Under the "Mini-Three Links," January 1, 2001, through February 29, 2004

	Ships from Taiwan (number of trips)		Ships from PRC (number of trips)	
	Kinmen to Xiamen	Matsu to Fuzhou	Xiamen to Kinmen	Fuzhou to Matsu
2001 (total)	83	54	34	11
2002 (total)	288	147	116	42
2003 (total)	467	309	531	36
January 2004	65	41	90	18
February 2004	68	26	110	15
Subtotal	971	577	881	122
Total	1,548 Taiwan to PRC		1,003 PRC to Taiwan	

SOURCE: "Mini-Three Links: Ships," in "Mini-Three Links Between Kinmen/Matsu and the Mainland," Department of Economic Affairs, Mainland Affairs Council, the Executive Yuan, Taipei, February 2004 (available at http://www.mac.gov.tw/english/english/csexchan/3link9302.htm as of March 2004).

Table 2.2

Number of Passengers Traveling Between the Offshore Islands and Mainland via the "Mini-Three Links," January 1, 2001, through February 29, 2004

	From Taiwan to China (number of passenger trips)		From China to Taiwan (number of passenger trips)	
	Kinmen to Xiamen	Matsu to Fuzhou	Xiamen to Kinmen	Fuzhou to Matsu
2001 (total)	9,770	1,998	951	86
2002 (total)	26,151	1,936	1,039	319
2003 (total)	78,782	2,977	2,936	824
January 2004	11,515	802	361	98
February 2004	9,981	322	1,304	282
Subtotal	136,199	8,035	6,591	1,609
Total	144,234		8,200	

SOURCE: "Mini-Three Links: Ships," 2004.

Local government officials on Kinmen and Matsu have expressed enthusiasm about the potential of the mini-three links to draw travelers to the offshore islands, but the Control Yuan[30] in early September 2002 issued a report blasting the government and asserting that it had failed to achieve the goals it established for the policy: enhancing economic development on the offshore islands, reducing smuggling between the islands and the mainland, improving relations with Beijing, and gaining experience that would be valuable if the two sides agree to move toward establishment of the full version of the three links in the future.[31] More recently, the severe acute respiratory syndrome (SARS) crisis at least temporarily resulted in a dramatic reduction of the number of passengers traveling between Taiwan and the PRC via the mini-three links. Taipei suspended passenger service on April 1 and halted cargo shipments on May 16, 2003. Cargo and passenger services were resumed after the SARS crisis abated (the economic impact of SARS is discussed further in Chapter 3).

The Full Three Links

Since 1949, there have been no direct transportation links between China and Taiwan. In the absence of direct links, most cross-Strait trade is composed of goods shipped indirectly through Hong Kong or third country ports. In all, however, there are five different channels for cross-Strait trade: re-exports via Hong Kong; transshipment through Hong Kong; transshipment through Korea and Japan; the mini-three links (which accounted for little more than $1 million in trade in 2001); and illegal or semi-legal transit shipment and direct trade.[32] About 80 percent of cross-Strait trade is re-exported or transshipped through Hong Kong, while about 20 percent is accounted for by transshipment via Japan and

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[30] The Control Yuan is one of the five branches of the government in Taiwan. It is responsible primarily for monitoring, oversight, and auditing of government policies and the activities of government officials.

[31] "Control Yuan Demands 'Mini Links' Correction," *China Post*, September 4, 2002.

[32] For a full explanation of the different mechanisms by which cross-Strait trade is conducted, see Ma Jun, Zhu Wenhui, and Alan Kwok, *China-Taiwan Economic Integration: Trends and Implications*, Hong Kong: Deutsche Bank, Asia-Pacific Equity Research, September 2002, pp. 29-30.

Korea, mini-direct links, and various types of semi-legal and illegal shipments.[33]

The government's policy on the "three links" has become a highly charged political issue in Taipei. President Chen faces a difficult balancing act. On the one hand, he faces pressure from the business community and the major opposition parties--the Kuomintang (KMT), the main opposition party, and the People's First Party (PFP), another opposition party that was cooperating with the KMT to field a joint ticket against Chen in the 2004 presidential election--to further ease restrictions on investment and to pursue the establishment of direct links. On the other hand, he must manage the demands of some of his own DPP constituents and allies in the Taiwan Solidarity Union (TSU), who fear that increasing economic integration with the mainland will increase unemployment among grassroots DPP supporters and diminish Taiwan's prospects for political independence. Indeed, many political analysts, and even some DPP politicians, say Chen Shui-bian's chances of reelection in 2004 may depend in large part on progress toward establishing direct links.[34]

Pressure from the Taiwanese business community is an important political consideration for Chen, especially given the state of the economy. The view from the business community is that the government has not given sufficient weight to economic concerns,[35] and this leaves Chen vulnerable to charges from the opposition that he is placing too much emphasis on politics instead of dealing with the economic downturn. Meanwhile, Taiwanese IT companies have become more influential as their contribution to Taiwan GDP has increased. The chief executive officers (CEOs) of Taiwan IT companies regularly get involved in lobbying senior government officials, according to industry analysts.[36] The TSU and some

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[33] Ma Jun et al., p. 27.

[34] Dean, Jason, "Strait Signals," *Far Eastern Economic Review*, June 20, 2002.

[35] The assertion that "politics shouldn't dominate economic issues" was repeated again and again in interviews RAND conducted with Taiwanese high-technology sector executives in Taipei in April and October 2002.

[36] Interviews with IT industry analysts, Hong Kong, October, 2002.

of President Chen's own supporters in the DPP are trying to counteract the influence of the business community.

Business community pressure appears to be increasing as a result of the economic downturn in Taiwan.[37] For example, Y. C. Wang, chairman of Formosa Plastics, has called for the early establishment of direct links on several occasions.[38] Wang warned recently that the competitiveness of Taiwanese companies operating in China would decline if China and Taiwan do not move quickly to establish the three links. "If they are not open, all our businesses in China will lose their competitiveness in three years," Wang said. Wang added that Taipei should allow private businesses to enter into negotiations with their Chinese counterparts over the establishment of direct trade, transportation, and communications links.[39] Other leading Taiwanese executives, including Acer CEO Stan Shih, have warned that the lack of direct cross-Strait links diminishes Taiwan's attractiveness to foreign multinational companies.[40]

In part because of the political sensitivity of the issue in Taipei, the Taiwan government has on occasion put pressure on the island's leading executives to refrain from actions or statements that might intensify the controversy surrounding the debate on cross-Strait economic policy. In one case, for example, two well-known executives from Taiwanese high-tech companies were invited to address a technology forum in Shanghai, but the Taiwan government intervened and told the executives not to travel to Shanghai for fear that it would "send the wrong message." As a result, the executives gave their address via videoconference from Taiwan.[41]

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[37] Indirect travel and shipping increases costs, and this is becoming a serious issue for Taiwanese companies because margins are "razor thin," as one source put it.

[38] See, for example, "Industry Leader Calls Again for Direct Links with China," *Taiwan Economic News*, April 16, 2002.

[39] "Businesses to Lose Edge for Lack of Three Links," *China Post*, October 25, 2002.

[40] See, for example, Culpan, Tim, "Acer Laments Taiwan Links Ban," *South China Morning Post*, July 11, 2002c.

[41] Interviews with industry leaders, Taipei, October 2002.

President Chen also faces pressure from opposition legislators who are urging an accelerated approach to opening direct links. In October 2002, for example, opposition legislators called on the Taiwan government to allow charter flights between Taipei and Shanghai during the Chinese New Year holiday, when as many as 300,000 Taiwanese working on the mainland were expected to return to the island to visit friends and relatives. In a petition organized by KMT legislator John Chang and signed by 122 legislators, advocates of the measure said the charter flights would give the government an opportunity "to test the feasibility of full-scale direct air links."[42] The government resisted the lawmakers' entreaties, however, and said it was willing to only grant permission for indirect charter flights routed through Hong Kong or Macau. Much to the disappointment of the Legislative Yuan (LY, the Taiwanese legislature) members who backed the proposal, Taiwanese Premier Yu Shyi-kun stated that direct cross-Strait flights of any sort would require the completion of negotiations between the governments of China and Taiwan.[43]

Nevertheless, an agreement was reached that allowed charter flights in late January and early February 2003. The charter service carried more than 1,300 Taiwan businesspeople from Shanghai's Pudong International Airport to Taipei. Although a stopover in Hong Kong was required, the passengers did not have to change planes.

Finally, the government must also contend with public opinion, as reflected by surveys that show a high level of popular support for the establishment of the three links. For example, several recent surveys conducted by the National Chengchi University indicated that more than 70 percent of Taiwanese favor the resumption of direct links across the

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[42] "Taipei's Lawmakers Seek Charter Flights to China," *Associated Press*, October 28, 2002; and Lin Miao-jung, "Charter Flight Issue Gains Steam," *Taipei Times*, October 28, 2002f.

[43] See Hsu, Crystal, "John Chang Wishes Government Would Be More Responsive on Charter Flights," *Taipei Times*, November 13, 2002b; and "Yu Sticks to His Guns on China Flights," *Taipei Times*, November 13, 2002.

Taiwan Strait.[44] Similarly, in a recent poll commissioned by Taiwan's Mainland Affairs Council (MAC), the government body charged with formulating the island's policies toward China, more than 70 percent of respondents indicated that they support the establishment of direct links.[45]

At the same time, however, President Chen is also facing pressure from independence advocates who are wary that increasing economic integration will narrow the range of political options for the island in the future. Opponents of further opening charge that the establishment of the three links would increase Taiwan's dependence on the mainland and enable China to exert greater political, economic, and military leverage against the island. An August 2001 editorial, for example, asserted that the three links would "totally undermine Taiwan's national security . . . leaving it fewer and fewer cards to play in its attempt to resist China's ever-mounting pressure and blackmail."[46]

TSU legislators say neither the party nor its "spiritual mentor," former President Lee Teng-hui, are categorically opposed to the three links,[47] but recent statements suggest the party is hardly enthusiastic about the possibility of Taiwan entering into negotiations with the mainland. For example, TSU politicians argue that the links should be characterized as "state-to-state,"[48] and a TSU spokesman has stated that as long as China refuses to renounce the use of force to settle its dispute with Taiwan, establishing the direct links would be equivalent to "relinquishing Taiwan's sovereignty and bringing humiliation to the

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[44] The survey results are available at "Public Opinion on Cross-Strait Relations in the Republic of China," Mainland Affairs Council website, http://www.mac.gov.tw (last accessed March 2004).

[45] Lin Miao-jung, "China Links Viewed with Caution," *Taipei Times*, October 26, 2002e. Although most respondents favor opening direct links, roughly two-thirds also said they were concerned that the links might result in increased capital outflow and unemployment, as well as more movement of high-technology personnel to the mainland.

[46] "Dangers of Embracing China," *Taiwan News*, August 28, 2001.

[47] See, for example, "TSU Not Against PRC Links: Lawmaker," *Central News Agency*, June 16, 2002.

[48] Hsu, Crystal, "Direct Talks for Direct Links, Government Told," *Taipei Times*, November 2, 2002a.

country."[49] Former MAC chief Su Chi, now an analyst at a KMT-affiliated think tank, says a lack of consensus within the DPP on the establishment of the three links is complicating Taipei's approach to negotiations with the mainland.[50] Nonetheless, many Taiwanese researchers and journalists expect Chen Shui-bian to cave in to pressure to establish the three links in the months leading up to Taiwan's 2004 presidential election.[51] The domestic political pressure may be intensified by recent overtures from the mainland concerning negotiations on direct links.

President Chen's most recent statements on the three links, however, indicate that he will resist demands to permit direct cross-Strait shipping and air travel as part of an election strategy designed to solidify the support of his pro-independence constituents. In a July 2003 interview with foreign journalists, President Chen pledged that Taiwan would not establish "direct links for the sake of direct links," and said cross-Strait economic ties are "already close enough."[52]

What Would the Full Three Links Look Like? The establishment of the three links would make cross-Straits travel easier and reduce the inconvenience and extra costs associated with moving cargo across the Taiwan Strait. Senior executives at high-technology companies in Taiwan say they would like to see the establishment of the three links because it would allow costs savings and a reduction in travel time for trips to the mainland; several senior executives noted that with direct flights to the mainland, Taiwan businessmen could fly to Shanghai, attend a meeting, and return to the island in the same day.

If an agreement were reached, the three links would likely be implemented gradually, beginning with marine shipping, then progressing to air cargo services, and finally to direct cross-Strait passenger

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[49] Low, Stephanie, "Taiwan's NSB Says Direct Flights Endanger Security," *Taipei Times*, October 30, 2002.

[50] Chu, Monique, "DPP Lacks Consensus on Links: Analyst," *Taipei Times*, November 6, 2002.

[51] Interviews with Taiwanese researchers and journalists, Washington, D.C., January and February 2003.

[52] For Chen's comments, see Dean, Jason, and Michael Vatikiotis, "Chen Shui-bian: Political Pugilist," *Far Eastern Economic Review*, July 31, 2003a; and Dean, Jason, and Michael Vatikiotis, "Taiwan: Politics First, the Economy Second," *Far Eastern Economic Review*, July 31, 2003b.

flights. The gradual phasing in of direct links would take approximately two to three years.[53] "Bilateral trade will surge by about 50 percent due to direct links," according to a recent Deutsche Bank report.[54] Direct links would reduce costs of communications and financial services by about 30 percent and cut costs of cross-Strait transport by about 50 percent, although it must be noted that direct links would have a minimal effect in the high end of the Taiwanese IT industry because shipping expenses are a small percentage of its overall costs.[55]

Taiwan would stand the most to gain from the establishment of direct cross-Strait links. According to the Deutsche Bank report, Taiwan would gain 2.5 percent in GDP growth over the five years following the establishment of the three links (see Figure 2.1).

The island's real exports would rise by a total of 5.4 percent, largely as a result of cross-Strait trade creation, but also owing to diversion of trade from other economies (see Figure 2.2).[56]

Among the major beneficiaries would be the island's petrochemical, textile, and transportation sectors. China would gain a more modest amount--about 0.9 percentage points in GDP growth--in the same five-year period following the establishment of direct links. The Deutsche Bank general equilibrium model confirmed that Hong Kong stands to lose the most from direct links.[57] Yet, there may be a potential silver lining for Hong Kong if the territory can position itself to take advantage of the expected increase in cross-Strait economic interaction that would accompany the three links.[58]

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[53] Ma Jun et al., 2002, p. 1.

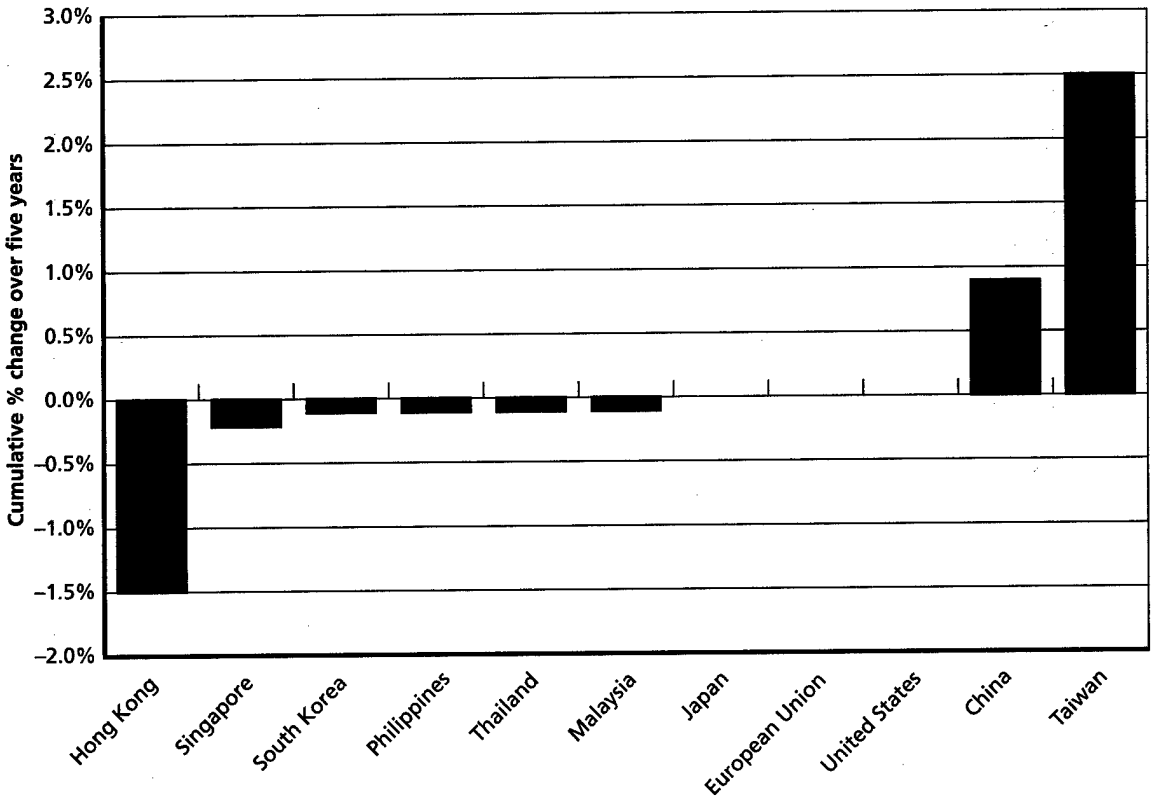
[54] Ma Jun et al., 2002, p. 24.

[55] Ma Jun et al., 2002, pp. 23-26.

[56] Ma Jun et al., 2002. For a complete description of the computable general equilibrium model employed by the Deutsche Bank analysts, see Ma Jun et al., 2002, pp. 22-23.

[57] Ma Jun et al., 2002, p. 24. According to the Deutsche Bank report, Singapore, Korea, Malaysia, Thailand, and the Philippines would also be adversely affected, but to a far lesser extent than Hong Kong.

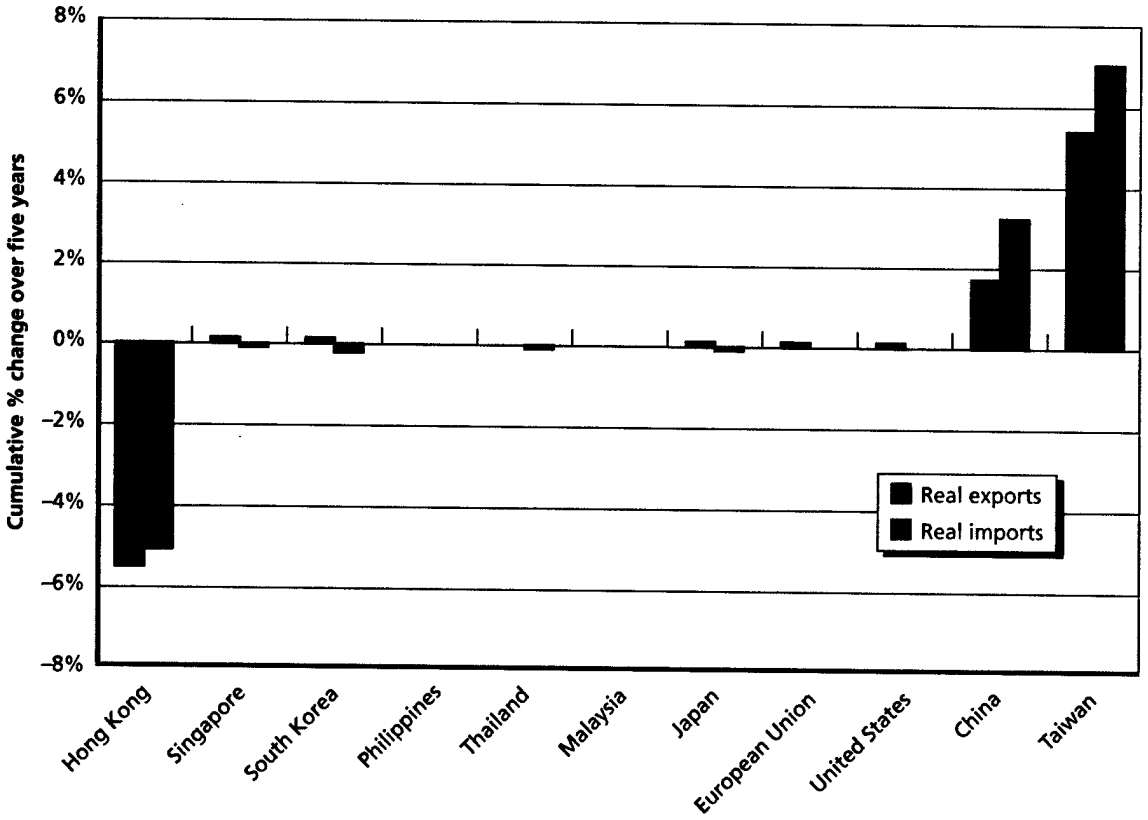
[58] The predicament Hong Kong would face is treated in greater detail in Chapter 4, in a discussion on the implications for Hong Kong and the Pearl River Delta of increasing cross-Strait integration and the emergence of Shanghai as a trade and high-tech manufacturing center.



SOURCE: Ma Jun et al., 2002.

Figure 2.1--Estimated Impact of Direct Links on Real GDP

Recent Progress? By fall 2002 there were signs that China was willing to soften its position on negotiations to establish direct links. In an October 2002 interview with the Taiwanese newspaper *United Daily News*, Chinese Vice Premier Qian Qichen said China views the three links as an economic, not a political, matter and indicated Beijing's willingness to characterize the links as "cross-Strait" rather than "domestic." The comments were seen by many analysts as indicative of Beijing's willingness to adopt a more flexible approach toward Taiwan. The official PRC media have been remarkably reticent about the apparent change in policy, but the official English-language newspaper *China Daily* on October 18, 2002, carried an article that repeated Qian's remarks. The article said the comments were a "goodwill gesture, aimed at de-politicizing the definition of direct transport links between



SOURCE: Ma Jun et al., 2002.

Figure 2.2--Estimated Impact of Direct Links on Trade

Taiwan and the mainland" and represented "a major effort by Beijing" to promote the establishment of the three links.[59] More recently, Beijing reiterated its willingness to hold discussions on the three links despite President Chen's refusal to accept the "one China" principle. In a document issued in 2003 by the State Council's Taiwan Affairs Office, China once again proposed shelving political disputes and suggested authorizing non-governmental trade organizations to negotiate the establishment of the three links.[60] As the document indicates, however, Beijing has not dropped its insistence that the participants in the

[59] "Mainland Offers Taiwan Goodwill Gesture," *China Daily*, October 18, 2002.

[60] The document is excerpted in "Mainland Reiterates Policy on 'Three Direct Links' Across Taiwan Straits," *Xinhua*, December 17, 2003.

discussions must be private groups representing the two sides, rather than government officials.

The Taiwan government welcomed the apparent softening of Beijing's position, but has reacted somewhat cautiously to Qian's comments and more recent overtures. President Chen has cautioned that the establishment of direct cross-Strait links "is not a cure-all medicine" for Taiwan's economic problems, and Premier Yu Shyi-kun has warned that it would be incorrect for people to view the links as "a panacea to all of our problems."[61] More important, Taipei has rejected Beijing's suggestion that nongovernmental groups meet to discuss a resumption of direct links, continuing to hold that official government representatives should handle the negotiations. Chen said in early November 2002 that Beijing had "misjudged the situation and wasted time" by insisting that civil groups handle the negotiations. "This issue cannot be entirely handed down to nongovernmental groups. The government must eventually get involved," Chen said in a meeting with visiting U.S. scholars.[62] Taiwan media reports suggest, however, that the government's position is somewhat more flexible and that it might consider allowing a nongovernmental organization to represent Taiwan in the negotiations, as it did in the talks on flights between the island and Hong Kong.[63] In a possible sign that the Hong Kong talks might be a model for negotiations on the three links, a delegation of officials from the Civil Aviation Administration of China (CAAC) visited Taiwan for meetings with executives from China Airlines (CAL) in early November 2002. According to Taiwan press reports, a Taiwanese nongovernmental group arranged the visit on behalf of Taiwan's MAC.[64]

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[61] "Chen Alerts 'Three Links' Not a Cure-All Medicine," *Taiwan News*, October 24, 2002.

[62] "Chen Says Beijing 'Misjudged' Situation on Three Links," *Taiwan News*, November 5, 2002; and Lin Chieh-Yu, "Chen Insists Links Need Official Talks," *Taipei Times*, November 1, 2002b.

[63] See, for example, Wu Tien-jung, "Government Assessment: Mainland is Sincere in Pushing Forward Three Links," *China Times*, November 11, 2002 (also in Foreign Broadcast Information Service [FBIS]).

[64] "Mainland Chinese Aviation Officials in Taiwan for Visit," *China Post*, November 3, 2002.

The possibility that the two sides of the Taiwan Strait might enter into negotiations on direct links has sparked some debate about the potential implications of the links for Taiwan's security. In anticipation of the eventual establishment of direct links, Taiwan's military is preparing to cope with possible security threats that might be posed by direct flights from the mainland. Deputy Defense Minister Kang Ning-hsiang said at a joint meeting of the LY's defense and budget committees in November 2002 that the Ministry of National Defense prefers that Hsiaokang International Airport in Kaohsiung be the first to operate direct flights between Taiwan and the mainland, followed by CKS International Airport in Taoyuan, outside Taipei. Kang said Sungshan Airport in Taipei should not be used for cross-Strait flights, and that flights between Taiwan and China should not be allowed to go directly across the Taiwan Strait.[65] The Taiwan Air Force has also told legislators it prefers that flights between the island and the mainland take somewhat circuitous routes rather than flying directly across the Taiwan Strait,[66] and National Security Bureau (NSB) officials reportedly also have stated that Sungshan Airport, located just a few kilometers from key government offices and military facilities, should not be used for cross-Strait flights.[67] Nonetheless, it seems likely that the three links would be established in phases, beginning with shipping links and moving to air links later. Indeed, Chiou I-jen, the secretary general of Taiwan's National Security Council, said in early November 2002 that it might take as long as three to five years to complete negotiations on direct flights between China and Taiwan.[68]

Despite some apparent progress toward discussions on the establishment of direct links, however, it appears that the prospects for a resumption of broader cross-Strait political negotiations remain limited. Beijing continues to insist that Taipei recognize the "One

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[65] Hsu, Brian, "MND Airs Direct Links Provisions," *Taipei Times*, November 8, 2002.

[66] "Intelligence: Taiwan's Top Guns Ready for Air Link," *Far Eastern Economic Review*, November 14, 2002.

[67] Low, 2002.

[68] "Direct Flight Links Still Three to Five Years Away," *China Post*, November 10, 2002.

China" principle before political discussions can proceed, while Taipei counters that it should be considered a possible topic of discussion rather than a precondition for the talks themselves. In his address to the 16th Party Congress, Chinese President Jiang Zemin made China's most recent high-level overture to the island when he said, "On the basis of the One China principle, let us shelve for now certain political disputes and resume the cross-Strait dialogue and negotiations as soon as possible." Taiwanese Premier Yu Shyi-kun quickly rejected the offer and reiterated Taipei's position that "Talks between both sides can start any time if there are no preconditions."[69]

Chen Shui-bian, Mainland Investment, and the Economic Development Advisory Conference

On investment policy, the Chen administration continues to support the "Go South" initiative launched under former President Lee. In August 2002, Lin Chia-lung, a senior advisor to the Taiwanese NSB, said, "From a strategic perspective, Taiwan should diversify its investments by going to countries other than China to prevent a situation of over-concentration."[70] Huang Chih-peng, director general of the Taiwan MoEA's Board of Foreign Trade, said in November 2002 that he would continue to promote the Go South policy in an effort to diversify the flows of Taiwanese FDI and spread the investments beyond the mainland. Southeast Asian leaders are responding enthusiastically to Taipei's renewed efforts to stimulate investment in the ASEAN countries,[71] but Chinese leaders have criticized the Go South policy, alleging that it is "damaging" to cross-Strait economic ties.[72]

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[69] Wo-Lap Lam, Willy, "Taiwan Rebuffs Jiang's Overture," *CNN.com*, November 9, 2002.

[70] Lin Miao-jung, "Taiwan NSC Advisor Says 'Go South' Good for Security," *Taipei Times*, August 28, 2002c.

[71] "Southeast Asian Nations Welcome Taiwan's 'Go South' Policy," *Taiwan Economic News*, October 27, 2002. Brunei and the Philippines are among the countries that Taiwan officials are targeting as part of the policy. Minister of Economic Affairs Lin Yi-fu visited the Philippines in 2002 and was scheduled to visit Brunei in November 2002 as part of the effort to promote Taiwanese investment in Southeast Asia.

[72] Fong Tak-ho, "Zhu Hits Out at Taipei for Damaging Trade," *South China Morning Post*, November 4, 2002.

At the same time, however, the Chen government has sought to manage the increasing flow of money across the Strait. In May 2001, President Chen announced the formation of the Economic Development Advisory Conference (EDAC) to make recommendations on major economic policy issues.[73] Preparatory meetings were held in June 2001 to discuss the EDAC's membership, themes, and agenda. Charged with proposing measures to deal with an economic slump that resulted in negative growth rates and record unemployment in Taiwan, the EDAC was composed of prominent businessmen, academics, think tank researchers, and representatives from all of the island's major political parties. Among the 125 members of the EDAC were many of Taiwan's most influential business executives, including Morris Chang, chairman of Taiwan Semiconductor Manufacturing Corporation (TSMC); Robert Tsao, chairman of United Microelectronics Corporation (UMC); Barry Lam, chairman of Quanta; Stan Shih, chairman and CEO of Acer; Frank Huang, chairman and CEO of Powerchip Semiconductor; and Wang Yung-ching, chairman of Formosa Plastics.[74] The EDAC was divided into five panels focusing on economic competitiveness, investment, the financial sector, unemployment, and cross-Strait economic and trade relations. The co-conveners of the latter panel were Wu Rong-I, director of the Taiwan Institute of Economic Research, Stan Shih of Acer, and MAC Chairperson Tsai Ing-wen.

The EDAC announced its 322 consensus recommendations in late August 2001, which President Chen pledged to implement in a speech at the closing meeting of the conference.[75] Among its key recommendations, the EDAC's mainland affairs panel urged the government to replace the "No Haste, Be Patient" policy with one of "Active Opening, Effective

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[73] "Background for Convening the Economic Development Advisory Conference," Taipei, Taiwan: The Office of the President of the Republic of China, 2001.

[74] For a complete list of EDAC members, see "The List of the EDAC's Members," Taipei, Taiwan: The Office of the President of the Republic of China, July 19, 2001.

[75] For an overview of the EDAC's recommendations in the areas of economic competitiveness, investment, the financial sector, unemployment, and cross-Strait economic and trade relations, see "President Chen Shui-bian's Address at the Closing Ceremony of EDAC," Taipei: Government Information Office, Republic of China, August 26, 2001.

Management" and to "actively promote" the establishment of direct cross-Straits trade, transportation, and communications links. In its final summary report, the EDAC also recommended that the government allow businesses that had already invested in the mainland without obtaining official permission to "make the appropriate adjustments retroactively."[76]

In terms of specifics, the "active opening, effective management" policy eliminates the $50 million cap on individual investment projects in China and institutes a simplified review process for mainland-bound investments of less than $20 million.[77] Moreover, the EDAC recommended that "sectors that have no further room for development in Taiwan or which can only survive by investing on the mainland should not be restricted" and those "sectors whose investment on the Chinese mainland may result in a transfer or loss of Taiwan's core technologies should be carefully evaluated."[78] Also, as part of the "active opening, effective management" policy, the Taiwan MoEA in August 2002 implemented new measures that require Taiwanese companies with total investments of $20 million or more on the mainland to submit quarterly reports and annual financial statements detailing their activities on the mainland to the government. The MoEA's Investment Commission also announced plans to further liberalize investment regulations by permitting direct investment in China and reducing the number of items that it is prohibited for Taiwanese companies to invest in on the mainland.[79]

The government also announced that Taiwanese companies would be permitted to invest directly in China rather than routing their investments through other countries. Additional relaxations implemented earlier in 2002 allowed Taiwanese insurance companies to establish

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[76] Mainland Affairs Division, Economic Development Advisory Conference, *Final Summary Report*, Taipei: Government Information Office, Republic of China, August 26, 2001.

[77] For more on the relaxation of restrictions under the policy, see "Economic Ties with the Chinese Mainland," *Republic of China Yearbook--Taiwan 2002*, Taipei: Government Information Office, Republic of China, 2002.

[78] Mainland Affairs Division, 2001.

[79] "MoEA Implementing New Measures on Investments in Mainland," *Taiwan Economic News*, July 31, 2002; "Government to Lift Investment Ban on More Items in Mainland China," *Taiwan Economic News*, August 7, 2002.

branches in China and permitted Taiwanese banks to make loans to Taiwanese-invested companies operating on the mainland.

Although many executives continue to press the government to enter into negotiations to establish the three links, Taiwan's business leaders are, for the most part, satisfied with the government's implementation of the EDAC's recommendations.[80] In a September 2001 survey of Taiwanese companies with operations on the mainland, for example, about 75 percent of respondents indicated that they support the "active opening, effective management" policy.[81] Some executives also say they are pleased with the Chen administration's efforts to incorporate independent views into government policy deliberations. They say the government frequently seeks input from the business community and from independent scholars and experts.[82] Indeed, the Chen administration may have learned some valuable political lessons as a result of the EDAC process. Before the establishment of the EDAC, Chen "lacked lines of communication" into the business community, according to Terry Cooke, former chief of the commercial section of the American Institute in Taiwan (AIT) in Taipei. Moreover, according to Cooke, when President Chen came into office, "He didn't understand the role of economics in supporting his political agenda, the DPP's prospects, and his own political career." In that sense, the EDAC has helped Chen deal with what was a major political blind spot. At the same time, however, many in the business community are continuing to press the government to pursue further liberalization of regulations and the opening of direct cross-Strait links. Moreover, President Chen's tough stance toward China has apparently alienated some of Taiwan's most influential businessmen. Although many of the executives were already firmly allied with the opposition KMT, even some of Chen's former backers in the business community, concerned about deteriorating cross-Strait relations and

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[80] "Taiwan Businesses Approve Government Performance on EDAC," *Yahoo! News,* August 26, 2002. Taipei Computer Association Chairman Huang Chung-jen and Acer CEO Stan Shih were among those commending the government for its efforts to implement the EDAC's recommendations.

[81] "75% Back 'Active Opening, Effective Management' Policy," *Taiwan.com.au,* http://www.taiwan.com.au/Polieco/Trade/Policy/200109/29.html (last accessed November 2002).

[82] Interviews with Taiwanese businessmen, Taipei, April 2002.

frustrated with the lack of progress on direct links under the DPP, appeared poised to throw their support behind the opposition ticket in the tightly contested 2004 presidential election.[83] In another development that reflects the business community's dissatisfaction with Chen, tens of thousands of Taiwanese businessmen residing in China were expected to return to the island to vote in the 2004 presidential election. Many members of the expatriate business community, which is emerging as an important force in Taiwanese politics, were expected to vote for KMT candidate Lien Chan in hopes that his election would improve the climate for cross-Strait economic interaction.[84]

Taiwan's Push for Free Trade Agreements

Taipei has recently expressed interest in establishing free trade agreements (FTAs) with several countries, including the United States, Japan, Panama, and several members of ASEAN. President Chen raised the idea of a U.S.-Taiwan free trade agreement in a meeting with a visiting official from the U.S. Department of Commerce in April 2001, saying an agreement would slow the rapid flow of investment into the mainland and prevent the economies of the United States and Taiwan from being excessively drawn toward China.[85] Yet, the economic impact of a free trade agreement between Taiwan and the United States would be relatively modest. The U.S. International Trade Commission estimates that U.S. exports to Taiwan would rise by 16 percent, and U.S. imports from Taiwan would increase by 18 percent. The elimination of trade barriers would not have a significant impact on U.S. GDP, and it would result in only a

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[83] See, for example, Jason Dean, "Losing Business," *Far Eastern Economic Review*, February 19, 2004.

[84] See, for example, "Taiwanese Expats Exert Their Clout," *South China Morning Post*, February 23, 2004. Though this report was completed before the March 20, 2004, presidential election, it appeared that the expatriate businessmen's ballots might prove very important in a tight race that most commentators were describing as too close to call.

[85] "President Chen Meets with U.S. Under Secretary of Commerce for International Trade Grant D. Aldonas," press release, Taipei: Office of the President of the Republic of China, April 11, 2001. According to some economists, pursuing free trade agreements with Latin American countries that might eventually sign FTAs with the United States would allow Taiwanese companies to enjoy some of the same economic benefits they would get from a U.S-Taiwan FTA.

modest 0.3 percent increase in Taiwan's GDP.[86] According to some observers, however, of greater importance to Taiwan is that an FTA with the United States would symbolize a closer political relationship between Taipei and Washington. Taipei is also pursuing bilateral free trade agreements with Japan, Panama, and the ASEAN members in part as a way of cementing its political relationships with each of those countries as well.

China's recent agreement to establish an FTA with the ASEAN countries by 2004 has intensified concerns in Taiwan that the island could be "marginalized" as the mainland's economic pull continues to grow. For political reasons, countering the Chinese agreement by signing one of its own with ASEAN is not a realistic option for Taiwan, according to Minister of Economic Affairs Lin Yi-fu. "Given the current political environment, it would be difficult for us to pursue a similar agreement with ASEAN as a block," Lin said.[87] Instead, according to Lin, Taiwan's strategy is to attempt to negotiate bilateral free trade pacts with individual countries. Yet, Taipei is finding it difficult to woo any of the countries it has targeted for FTAs. Singapore, New Zealand, Malaysia, Thailand, and Japan reportedly have all reacted coolly to Taiwan's recent overtures.[88]

WTO and Beyond

In order to gain entry into the World Trade Organization (WTO), the Mainland Affairs Council in November 2001 announced that the Taiwan government would abandon the $50 million investment cap on individual investments, automatically approve projects of less than $20 million, allow Taiwanese banks to transfer money directly to and from Chinese banks, and allow direct investment, but it did not allow investment in

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[86] United States International Trade Commission (USITC), *U.S.-Taiwan FTA: Likely Economic Impact of a Free Trade Agreement Between the United States and Taiwan*, Investigation No. 332-438, Washington, D.C.: USITC, Publication 3548, October 2002.

[87] "Taiwan Fears Being Isolated as ASEAN, PRC Pursue FTA," *China Post*, November 6, 2002.

[88] "China May be Blocking FTA Efforts," *Taipei Times*, November 13, 2002.

projects to manufacture semiconductors.[89] Eventually, in April 2002, the government decided to allow semiconductor companies to apply for mainland investment projects that involved the production of six- or eight-inch semiconductor wafers[90] on the mainland.

As the Chinese market became more attractive, trade and investment began to increase. In October 2002, it was reported that between January and August of that year more than 30 percent of Taiwan's production value of semiconductors were exported to China. In addition, two-way trade in 2002 increased 36.9 percent over the 2001 trade figure. Taiwanese exports to China reached $41 billion, while imports from China totaled $7.95 billion.[91] Even though trade and investment continue to increase, Taiwan's economy is predicted to have moderate growth. One Taiwanese think tank forecasted the economy to grow by 3.02 percent in 2003.[92]

Viewed from a macro perspective, therefore, economic relations between Taiwan and China have indeed been steadily increasing since China opened up in 1979. Since 1979, to encourage its own development and to gradually integrate Taiwan into its economy in order to facilitate unification, China has established its own open-door policy to Taiwan trade, investment, and travel. Taiwan, on the other hand, has tried to resist China's overtures lest it lose its de facto independence. However, the combination of similar cultures, language, and familial bonds and attractive markets have made China a nearly irresistible destination for Taiwanese businesses, industries, and citizens. Consequently, the past 20-some years have seen Taipei's cross-Strait political agenda undermined by the will of the Taiwan people. In this respect, Taipei's China policy has been reactive, as it has tried to stem the flow of people and money to China instead of being a

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[89] Yu-shan Wu, "Taiwan in 2001: Stalemated on All Fronts," *Asian Survey*, January/February 2002, p. 33; and Landler, Mark, "Taiwan Lifts Restrictions on Investment in China," *New York Times*, November 8, 2001b.

[90] The thin, round slices of silicon from which semiconductor chips are cut.

[91] "Mainland China Becomes Taiwan's No. 1 Export Outlet," *Asia Pulse*, March 24, 2003.

[92] Huang, Joyce, "Gov't Think Tank Lowers Taiwan's 2003 GDP Growth To 3.02%," *Taiwan Economic News*, October 26, 2002.

proactive effort to recognize trends and prepare for their consequences. Taiwan's efforts to remain economically independent from China have also been hampered by the type of industry Taiwan has developed. Instead of moving up the manufacturing chain, it has instead moved from labor-intensive industry to labor-intensive industry, all of which are always vulnerable to being undercut by lower-cost markets. These factors pose hard policy questions for the Taiwanese government as it tries to prepare to compete in the global economy and remain politically independent.

GOVERNMENT INFORMATION TECHNOLOGY POLICIES IN TAIPEI AND BEIJING

Western economists and analysts characterize the role of government policy in the process of cross-Strait economic integration as "secondary" and "reactive." In Barry Naughton's words, "Individuals, driven by their own self-interest, acting without government sanction and sometimes in defiance of government controls and restrictions, have created impressive cross-border networks of firms and of production and trade. Economics is clearly the engine that is driving these three entities [China, Taiwan, and Hong Kong] into an increasingly intimate relationship."[93] Even though decisionmakers on both sides of the Taiwan Strait have often been slow in reacting to economic developments, however, modifications of long-standing policies have been crucial in accommodating the emergence of economic ties.[94]

Taiwan Government Cross-Strait IT Policies

The Taiwan government has been playing catch-up in terms of its policies on cross-Strait economic relations. For the most part, Taiwan's policies have lagged behind economic trends, often by several years or more.[95] Nowhere has this tendency to fall behind the business curve been

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[93] Naughton, Barry, "The Emergence of the China Circle," in Barry Naughton, ed., *The China Circle: Economics and Technology in the PRC, Taiwan, and Hong Kong*, Washington, D.C.: The Brookings Institution, 1997c, p. 3.

[94] Naughton, 1997c.

[95] Two examples illustrate the reactive nature of Taipei's approach to economic integration with the mainland. First, Taipei did not lift its ban on private sector cross-Strait exchanges until 1987. Second, the

more evident than in Taipei's attempts to regulate the flow of investment from the island's companies into the emerging information technology sector on the mainland.

Taiwan companies have found innumerable ways over the years to circumvent the restrictions imposed by the Taiwan government, such as incorporating overseas or channeling funds through Hong Kong, the Cayman Islands, and the British Virgin Islands. In recent years, the pattern has continued, with Taiwan modifying regulations to accommodate--and to attempt to shape to the greatest extent possible--emerging trends in the increasingly dynamic China-Taiwan economic relationship. In September 2002, for instance, the Taiwan cabinet proposed an extensive series of revisions to the "Statute Governing the Relations Between the People of the Taiwan Area and the People of the Mainland Area." The Legislative Yuan was originally expected to review and vote on the proposed changes in November 2002, but the vote has been repeatedly delayed. Explaining the need for the revision of the statute, MAC Chairwoman Tsai Ing-wen said the changes were necessitated by the rapid expansion of cross-Strait exchanges since the inception of the law in 1992. MAC Vice-Chairman Jonathan Liu added that the revision of the statute reflects a change in principle from "prohibition as a rule, opening as an exception" to "opening as a rule, prohibition as an exception."[96]

Even with this apparent change in the Taiwanese government's attitude toward regulating cross-Strait economic interaction, most observers expect Taiwanese businesses--especially companies in the island's IT sector--to continue to search for ways to skirt regulations while at the same time pressing Taipei for further concessions. In Karen Sutter's words, "To remain globally competitive and to capitalize on commercial opportunities in the PRC, Taiwan businesses will likely continue to pull government policy along while testing and skirting existing restrictions."[97] For its part, the Taiwanese government appears

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Taiwanese government waited until the early 1990s to legalize investment in the mainland by Taiwanese businesses.

[96] Lin Miao-jung, "Cross-Strait Legal Changes to Usher in Whole New Era," *Taipei Times*, September 30, 2002d.

[97] Sutter, Karen M., "WTO and the Taiwan Strait: New Considerations for Business," *China Business Review*, January-February 2002a.

to be "recognizing the role of government and moving in the right direction," according to a former U.S. government official, but its progress remains "halting and fitful."[98] Indeed, the Taiwanese government's decision in March 2002 to permit Taiwanese firms to invest in semiconductor fabrication facilities (or "fabs" for short) on the mainland, provided they fulfill certain conditions, appears to indicate that policy is still largely reactive to unfolding commercial developments.

Technology Transfer Restrictions and Personnel Controls. In April 2002, the Taiwanese government began drafting a National Technology Protection Law (*guojia keji baohu fa*). The bill was intended to address concerns surrounding the government's decision in late March to permit Taiwanese semiconductor companies to establish eight-inch semiconductor wafer fabrication facilities on the mainland. Indeed, when Premier Yu announced the lifting of the ban on mainland semiconductor investment, he also pledged that among the government's key objectives was "ensuring that no core technologies, personnel, and capital will be drained off, and Taiwan's current advantages in high-technology industries will be maintained."[99]

Even before the March 2002 decision relaxing restrictions on high-technology investment in China, however, the leaking of sensitive technology to the mainland had become a hot issue in Taiwan politics, in large part as a result of reports concerning the alleged illegal transfer by a TSMC employee of proprietary information to Shanghai-based Semiconductor Manufacturing International Corporation (SMIC).[100] In response to the controversy generated by the alleged illegal transfer of TSMC's proprietary information, Taipei established an interagency task

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[98] Sutter, 2002a.

[99] "Premier Yu Shyi-kun's Policy Statement on the Liberalization of Mainland-Bound Investment in Silicon Wafer Plants," Taipei: Government Information Office, Republic of China, March 29, 2000.

[100] The TSMC employee allegedly e-mailed proprietary information about TSMC's cutting-edge 12-inch wafer manufacturing processes to SMIC on several occasions from November 2000 to January 2001, and in February 2001 left TSMC to work for SMIC as a consultant. The prosecutor's office in Hsin-chu has been investigating the case since March 2002.

force charged with preventing industrial espionage and leaks of sensitive technology to the mainland.[101]

Taiwan's National Science Council (NSC) and Ministry of Economic Affairs asked the Science and Technology Law Center (*Keji falu zhongxin*) of the Institute for Information Industry (III) to help prepare the draft of the proposed science and technology protection law. While preparing to draft the law, researchers studied similar laws in the United States, Japan, and Europe.[102] Indeed, when the Science and Technology Law Center of Taiwan's III conducted research in support of the drafting of the law, it studied the U.S. Economic Espionage Act and the Wassenaar Arrangement.[103] The draft version of the law categorizes technologies related to national security or that give the island a competitive technological edge as "sensitive technologies." The National Science Council would have responsibility for determining which technologies are designated as "sensitive" and supervising the enforcement of the law.[104]

Taiwanese businesses seem resigned to the eventual passage of the law even though many executives say it is unnecessary.[105] They argue that technology transfer restrictions are not needed because Taiwanese companies already have strong incentives to ensure that their employees do not give away advanced technology to the mainland. The executives say that Taiwanese companies are well aware of the intellectual property rights (IPR) problems multinational companies have encountered in China

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[101] "Task Force Formed to Check Leaks of High-Technology Secrets: Official," *Central News Agency*, March 13, 2002. The task force is composed of representatives from the National Security Bureau and other government agencies.

[102] Parts of the law are modeled after the U.S. Economic Espionage Act, according to National Science Council officials. See Chiu Yu-tzu, "Technology Law to Guard Valued Assets," *Taipei Times*, April 17, 2002a.

[103] The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies is an agreement among various nations regarding common standards for export control.

[104] The National Technology Protection Law is intended to supplement existing laws, including the National Security Law, National Secrets Protection Law, Copyright Law, and Statute Governing Relations between the People of the Taiwan Area and the Mainland Area.

[105] Interviews with Taiwanese IT industry executives, Taipei, April and October 2002.

and that Taiwanese firms will keep higher-end production in Taiwan. Given concerns about the difficulties of protecting intellectual property in China, TSMC and UMC would not immediately build 12-inch wafer fabs in China even if they were allowed to do so, according to one knowledgeable observer.[106] Moreover, the observer said, Taiwan IT companies will avoid setting up high-end research and development (R&D) centers in China, although they may establish centers that will engage in less-sensitive development activities. In this regard, the observer said, there is an additional reason to be concerned about the R&D centers being established in China by U.S. high-technology companies, including Microsoft and IBM.

The Taiwanese government is taking the concerns of the business community into account, but is moving forward with the law, according to Taipei-based analysts. "The regulations should not be too restrictive, but they are still necessary," a Taiwanese senior official said.[107] The official said that technologies created by research institutes that receive government funding, defense and national security related technologies, and other technologies designated as "sensitive" need to be protected. The senior official acknowledged, however, that the range of technologies that require protection is difficult to define and will need to be revised from time to time. For this reason, a committee under the Taiwanese National Science Council will be charged with drafting and periodically updating the list of protected technologies.

Along with the technology transfer restrictions, the Taiwanese government drafted regulations that would require Taiwanese scientists and engineers working in certain high-technology industries to apply for government permission before seeking a job in China. The regulations, which have proven more controversial than the other aspects of the technology protection law, were seen by some analysts as part of an effort to reduce criticism of the relaxation of the policy governing investment in semiconductor facilities on the mainland. Others say the drafting of the regulations on the movement to China of personnel from

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[106] Interview with industry analyst, Taipei, October 2002.

[107] Interview with Taiwanese government official, Taipei, October 2002.

high-technology companies was also a response to the uproar sparked by media reports indicating that more than 300 engineers fled from TSMC, the world's leading contract manufacturer of semiconductors and the flagship company of Taiwan's high-tech sector, to SMIC. Industry sources in Taipei and Shanghai say the true number of TSMC employees that went to SMIC was actually closer to 100, but the outflow of Taiwanese semiconductor engineers to potential rivals on the mainland is seen by many as a worrisome symbol of the migration of the island's high-technology talent to China.[108]

Taiwanese government officials say the proposed regulations are designed to prevent Taiwanese high-technology specialists from unlawfully transferring proprietary or otherwise sensitive technological information to the mainland. They note that the restrictions would apply only to engineers working on a relatively small number of "core technologies" in the private sector, sensitive military programs, and government-sponsored research projects.

Some major companies would in principle like the government to implement some form of restrictions on engineers going to China. Many Taiwanese companies and multinational corporations with business interests in Taiwan and China, however, are firmly opposed to the regulations that the government has proposed.[109] Executives at foreign high-technology firms with operations on both sides of the Taiwan Strait say the regulations would make it difficult to transfer experienced employees to company facilities on the mainland. Executives from TSMC and UMC also expressed skepticism about the proposed restrictions on high-technology personnel movements. Executives at the semiconductor

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[108] Sources say most were young engineers who left the company seeking opportunities for rapid career advancement. Similarly, some of them left for stock options and possible riches from an anticipated initial public offering (IPOs). Only one TSMC employee that went over to SMIC was a senior manager.

[109] Interview with Taiwanese IT industry executive, Taipei, April 2002. "I deeply believe the personnel restrictions are wrong," said one executive at a multinational high-technology firm. The most likely result is that China will obtain the same technological knowledge from other sources--China will simply invite engineers from Malaysia, Thailand, or Singapore if Taiwan places restrictions on personnel movements, the executive said.

companies told Legislative Yuan (LY) members that the government should focus on preventing the unauthorized transfer of sensitive technologies rather than attempting to place restrictions on scientists and engineers interested in working on the mainland. TSMC executives said the proposed regulations would make it difficult for the company to attract highly skilled employees.[110] The president of the American Chamber of Commerce in Taipei, Richard L. Henson, has warned that multinational companies will be reluctant to invest in Taiwan if they cannot freely transfer Taiwanese employees to the mainland. Several leading technology industry groups--including the Taipei Computer Association, Taiwan Science-based Industrial Park Companies Association, Taiwan Thin Film Transistor-Liquid Crystal Display (TFT-LCD) Industry Association, and Taiwan Semiconductor Industry Association--have urged the government to work with industry executives to modify the proposed policy.

For the Taiwan government, another problem is that restricting the movement of Taiwan citizens is inconsistent with the free and democratic image Taiwan wants to project to the world. Some opponents of the proposed restrictions say that they would constitute an unacceptable infringement of individual liberties and could harm Taiwan's international image.[111] Academica Sinica president and Nobel laureate Lee Yuan-tseh is perhaps the most prominent of the many scholars and businessmen to speak out against the proposed regulations. Testifying before the Science, Technology, and Information Affairs Committee of the LY, Lee said that although it was reasonable to regulate the movement of scientists engaged in research on classified defense projects, placing restrictions on other high-technology engineers would tarnish Taiwan's image and damage its economy. Similarly, Frank Huang, chairman of Power Chip Semiconductor and head of the Taipei Computer Association, said the regulations are "like thinking someone is going to commit a crime before

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[110] "TSMC, UMC Skeptical About Government Plan of High-Technology Personnel Control," *Central News Agency*, April 15, 2002.

[111] See Bradsher, Keith, "Taiwan Is Trying to Limit Its Engineers' Work in China," *New York Times*, April 26, 2002; and Chiu Yu-tzu, "NSC to Regulate High-technology Labor Across the Strait," *Taipei Times*, April 18, 2002b.

they do so—it's taking away democratic freedoms."[112] One opposition politician has even criticized the proposed regulations as a form of "technological martial law,"[113] recalling the human rights abuses that occurred under the authoritarian rule of the Kuomintang before Taiwan's democratic reforms.

Many critics of the plan also say it will likely prove impossible to enforce the restrictions. For example, Lee Yuan-tseh also argued in his testimony before the LY that it would be impossible to enforce the regulations because high-technology specialists could easily travel to the United States or another third country first before continuing on to the mainland.[114] Taiwanese businessmen also say Taiwanese technology personnel who want to go to China will still find ways to get there. "Money gets to China via third countries, Hong Kong, the U.S., the Cayman Islands," one senior executive said. "It doesn't matter, some people will get there, too."[115] The government seems to have recognized that attempts to prevent people from taking jobs in China will likely prove quixotic. One senior Taiwanese official said managing restrictions on personnel and investment is much more difficult than trying to control technology transfer. Taipei-based analysts agree that the rules would be ineffective.[116] "The government has to come up with some kind of policy to at least symbolically send a warning signal. Whether it is effective or not is not a major issue," Andrew Yang of the Center for

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[112] Bradsher, 2002.

[113] The politician was quoted in "Taiwan to Stem Tech Expert Exodus to China," *South China Morning Post*, April 10, 2002.

[114] "Talent Control Would Tarnish Democratic Taiwan: Nobel Laureate," *Central News Agency*, April 22, 2002; and "Top Scientist Speaks Against Regulations Limiting Cross-Strait Employment," *Taipei Times*, April 23, 2002.

[115] Interview with Taiwanese IT industry executive, Taipei, Taiwan, April 2002. The executive opined that protecting technology and IPR is a better way to address the concerns that prompted the government to draft the personnel restrictions.

[116] A government researcher predicted that the Taiwan government would be unsuccessful in attempting to restrict the flow of Taiwanese personnel to China. They can always travel to China via third countries, after all, including the United States. The motivation for Taiwanese companies is that while there are many good universities in China, there is still not enough IT talent, creating a need for Taiwanese IT professionals to move to China.

Advanced Policy Studies said in April.[117] Indeed, some commentators suggested the regulations were intended primarily to counter criticism of the relaxation of restrictions on high-technology investments in China.

In response to widespread criticism from the business community, officials from Taiwan's National Science Council said the government would take the business community's concerns into account and the proposed regulations have apparently been revised. The government reportedly has narrowed the regulations so that they cover only a relatively small number of high-technology engineers.[118] The ultimate fate of the law has yet to be decided. The Executive Yuan (EY)[119] failed to pass the draft version of the National Technology Protection Law when it first reviewed the proposal on September 25, 2002, and reviewed the draft bill again a few days later after revising the language to clarify the definition of "sensitive technologies" in response to concerns raised by critics of the proposal.[120] In addition to the business community's anxiety, the approval of the regulations reportedly has also been delayed by disagreements among Taiwan government agencies.

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[117] Nystedt, Dan, "Restrictions on Workers Seem Futile," *Taipei Times*, April 19, 2002.

[118] "High-Technology Personnel Control Narrowed Down to One Category: Official," *Central News Agency*, April 29, 2002. The draft regulations as initially proposed would have covered engineers working in the semiconductor production, semiconductor design, aviation, shipbuilding, and anesthetics industries, and possibly the biotechnology, opto-electronics, and TFT-LCD industries. Government officials subsequently indicated, however, that the rules would be narrowed so that they would apply only to engineers working on photolithography at semiconductor wafer fabrication plants.

[119] The Executive Yuan is the equivalent of a cabinet. The premier of the ROC is appointed by the president and serves as head of the EY. The eight ministries subordinate to the EY are the Ministry of Interior, Ministry of Foreign Affairs, Ministry of National Defense, Ministry of Finance, Ministry of Education, Ministry of Justice, Ministry of Economic Affairs, and Ministry of Transportation and Communications. Among the several commissions and other organizations that fall under the purview of the EY are the Mongolian and Tibetan Affairs Commission, Overseas Chinese Affairs Commission, Directorate General of Budget, Accounting and Statistics, Council of Economic Planning and Development, National Science Council, and Government Information Office.

[120] Ko Shu-ling, "Cabinet to Mull Tech Law--Again," *Taipei Times*, September 30, 2002.

The draft has since been approved by the EY and submitted to the Legislative Yuan for review. That review has been a contentious process. President Chen and Premier Yu instructed DPP legislators to make passage of the law in the LY a priority early in 2003, hoping to defuse opposition to the approval of investments in 8-inch wafer fabs on the mainland from the TSU, which has insisted that the investments should not be allowed to proceed until the technology protection law is in place.[121] The LY failed to pass the bill before the end of the session in June 2003, however, and although it is scheduled to be reviewed in the LY session beginning in September 2003, Executive Yuan officials have expressed concerns that few important bills are likely to be passed during that LY session because the major parties will be gearing up for the March 2004 presidential election.[122]

The Chen administration is also facing pressure from the business community to permit Chinese nationals to work for high-technology companies in Taiwan. Current regulations prohibit Chinese high-technology specialists from working in Taiwan, though the rules allow them to apply for permission to conduct academic research on the island.[123] Taiwan executives say that Chinese engineers are needed to fill jobs left vacant by a shortage of qualified high-technology specialists in Taiwan. The shortage of skilled engineers and high-technology personnel in Taiwan has persisted even through an economic downturn that witnessed record unemployment rates. Last year, the National Science Council estimated that Taiwan's high-technology companies would face a shortfall of 52,000 trained engineers and other

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[121] See "Excerpts from Q&A Session of Premier Yu Shyi-kun's Anniversary Press Conference," Taipei: Government Information Office, Republic of China, January 27, 2003; "Chen Instructs DPP Lawmakers to Push Through Technology Bill," *China Post*, January 29, 2003; and Crystal Hsu, "DPP Promises to Prevent Outflow of Technology to China," *Taipei Times*, February 23, 2003.

[122] "Cabinet Fears Legislature Will Stall," *Taipei Times*, June 9, 2003.

[123] Lin Miao-jung, "Taiwan's MAC Reviewing Regulations for High-Technology Workers Going to China," *Taipei Times*, May 8, 2002a.

skilled personnel by 2005.[124] Semiconductor giants TSMC and UMC together employ more than 15 percent of the island's engineers. "Taiwan only has so many engineers, and they can't all work in the semiconductor industry," a government researcher said.[125] The government plans to boost its investments in training, but for now many IT companies have little choice but to train their own recruits or seek talent from abroad.

Chinese Government IT Policies

The Chinese government has realized the important role information technology plays in promoting economic growth and in making advanced weaponry. According to the Chinese Communist Party's 10th Five-Year Plan, which covers the time period from 2001 to 2005, China made the promotion of high technology its top priority and has established four goals to be realized by 2005:

1. The percentage of GDP produced by the high-technology industry will be raised from 4 percent to approximately 6 percent. The percentage of high technology in industrial production will be raised from 9 percent to 16 percent, and the percentage of high-technology exports will be raised from 15 percent to 25 percent of total exports.
2. China's development and production of software, communication equipment, electronic products, bio-pharmaceuticals, and bio-chips will reach international levels. In addition, high technology will be used to raise the international competitiveness of the machine, textile, petroleum, metallurgy, and natural resource industries. Moreover, the Internet will be used to form a high-technology service industry.
3. China will form large high-technology industries that will be able to influence international markets with strong R&D capabilities and

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[124] Keliher, Macabe, "Where High-Technology Talent Is Scarce . . . and Help May Be a While Coming," *Business Week International*, June 18, 2001.

[125] Interview with Taiwanese government official, Taipei, October 2002.

competitiveness. China will also form new and vibrant small and medium enterprises (SMEs).

4. China will form several specialized sectors, each with its own characteristics and market base in order to create a high-technology industry resembling that of a moderately developed country.

To meet these goals, China plans to develop 12 large high-technology projects, including broadband information networks, integrated circuits, high-definition television, and broadcast and satellite broadcast systems. In addition, it will speed up the development of 20 strategic industries, including the software, digital electronics, and satellite industries, in order to develop e-commerce, distance learning and medicine, banking and finance, tax collection, trade, and transportation.

More specifically, the government has vowed to improve market conditions by establishing an intellectual property rights protection system and a system to assess and exchange IPR, and improve high-technology standards to form a fair, rationale, and effective system to promote high technology. China will also adjust its present policies from giving preferential tax treatment to certain regions to giving preferential tax treatment to certain sectors or products. It will also offer preferential tax treatment to investments in R&D and to high-technology enterprise initiatives. China will also encourage governmental reform to promote organizational cooperation and streamline resource allocation. In addition, it will develop better investment mechanisms in new industries and attract and nurture human resources and vital industries.

CONCLUSIONS

The analysis in this chapter illustrates the intense political and diplomatic tensions surrounding the growing economic integration of China and Taiwan, particularly in the information technology sector. Yet, the governments in Beijing and Taipei may no longer hold all of the levers to control this trade and investment, and they appear in many cases to be reacting to events rather than anticipating them. As the

next chapter reveals, the real sources of the impetus behind the cross-Strait economic dynamic are the companies themselves, driven by the increasing attractiveness of the Chinese market and global changes in the information industry.

3. THE CURRENT CROSS-STRAIT INFORMATION TECHNOLOGY DYNAMIC: STATISTICS AND CASE STUDIES

This chapter assesses the dramatic increases in cross-Strait trade and Taiwanese investment in mainland China, driven in recent years by the dynamics of the global IT industry. These cross-Strait flows are drawing the two sides of the Taiwan Strait closer together economically even as they are seemingly drifting further apart politically. This chapter also examines the semiconductor industries of Taiwan and China and provides profiles of several of the major Taiwanese and Chinese semiconductor companies.

RECENT TRENDS IN CROSS-STRAIT TRADE AND INVESTMENT

Despite the absence of direct links between Taiwan and mainland China, the scope and scale of trade and investment flows across the Taiwan Strait have increased dramatically in recent years, driven in large part by the increasing integration of the Taiwan and PRC information technology sectors.[1] China's displacement of the United States in late 2001 as the largest market for the island's exports, the surge in cross-Strait trade that in 2003 made China Taiwan's largest trading partner, and recent increases in Taiwanese investment in the mainland all reflect this important trend. Another factor closely tied to the expansion of cross-Strait trade is the growth in the number of U.S. firms entering the Chinese market. Taiwanese companies that once shipped their products to U.S. computer firms in the United States are now shipping them to those same companies in the PRC.[2]

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[1] The decisions of many Taiwanese high-technology companies to relocate manufacturing operations to the mainland are discussed later in this chapter.

[2] The authors would like to thank Denis Fred Simon of the Rensselaer Polytechnic Institute Lally School of Management and Technology for raising this important point, and for his comments on several other issues related to the cross-Strait IT dynamic.

Foreign Direct Investment in China

To put increases in Taiwanese investment in China in a broader context, it is necessary to review China's remarkable performance in attracting FDI in recent years. In 2001, China received $46.87 billion in actual FDI, an increase of about 15 percent over the previous year. Contracted investment in China in 2001 increased more than 10 percent, reaching an impressive total of $69.19 billion.[3] According to China's Ministry of Commerce, actual FDI in 2002 reached $52.74 billion, an increase of 12.5 percent from the previous year. Contracted FDI in 2002 increased by 19.6 percent to a total of $82.77 billion.[4] Moreover, in 2002, China surpassed the United States as the largest recipient of FDI worldwide. In early 2003, China's magnetism appeared to be growing even stronger. In the first four months of 2003, actual FDI in China rose 51 percent from the same period in 2002, reaching $17.8 billion, while contractual FDI reached $30.5 billion, an increase of slightly more than 50 percent over the same period in 2002.[5]

As underscored by these statistics, Taiwanese investors are following a global trend. Besides Taiwan, some of the other major investors in China are the United States, Japan, Hong Kong, South Korea, Singapore, France, Germany, Canada, the United Kingdom, and the Netherlands. South Korean companies, for instance, have poured more than $30 billion in FDI into China since the two countries established diplomatic relations in 1992, making South Korea the sixth-largest source of overseas investment in China. The South Korean conglomerate Samsung alone has invested nearly $3 billion in China, establishing 26 factories that produce a wide variety of electronics including notebook computers, flat-panel displays, and cellular phones.

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[3] National Bureau of Statistics, *China Statistical Yearbook 2002*, Beijing: China Statistics Press, 2002, p. 629.

[4] *Actual FDI* refers to the amount of investment actually utilized in a country during a given period of time, whereas *contractual FDI* refers to the total value of investment contracts signed during a given period of time.

[5] Ministry of Commerce, People's Republic of China, "Statistics About Utilization of Foreign Investment in 2003," http://www.english.mofcom.gov.cn/article/200305/20030500090069_1.xml (last accessed May 2003). See also "FDI Likely to Hit US$60 Billion," *China Daily*, May 12, 2003.

Indeed, China is increasingly viewed by businesses worldwide as perhaps the most attractive destination for FDI. While investor confidence in other markets falters, China's attractiveness continues to increase. In a recent survey conducted by A.T. Kearney's Global Business Policy Council, top executives from the world's 1,000 largest companies ranked China as the most attractive destination for foreign direct investment. In claiming the top spot, China surpassed the United States for the first time in the five-year history of the survey, which is a predictor of future flows of foreign direct investment.[6] While their expectations for other emerging markets have declined, roughly half of investors surveyed said their outlook toward China has become more optimistic during the past year. Economic growth, China's WTO accession, and the emergence of a rapidly increasing middle-income population are all boosting investor confidence, according to the survey.[7] For their part, U.S. executives ranked China as the most attractive destination for FDI, and a comparison with previous surveys indicates that U.S. companies, like many of their foreign counterparts, have an increasingly optimistic outlook concerning the prospects for the Chinese market.[8] Intel's venture capital arm has made China its highest priority for investment in the Asia-Pacific region.[9] China is also the preferred market for Asian investors, and almost three-quarters of the Asian executives surveyed by A.T. Kearney said that their view of the Chinese economy is more positive now than it was in 2002.[10]

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[6] A.T. Kearney Global Business Policy Council, *FDI Confidence Index*, September 2002, Volume 5, pp. 11-12.

[7] A.T. Kearney Global Business Policy Council, 2002, pp. 24-25.

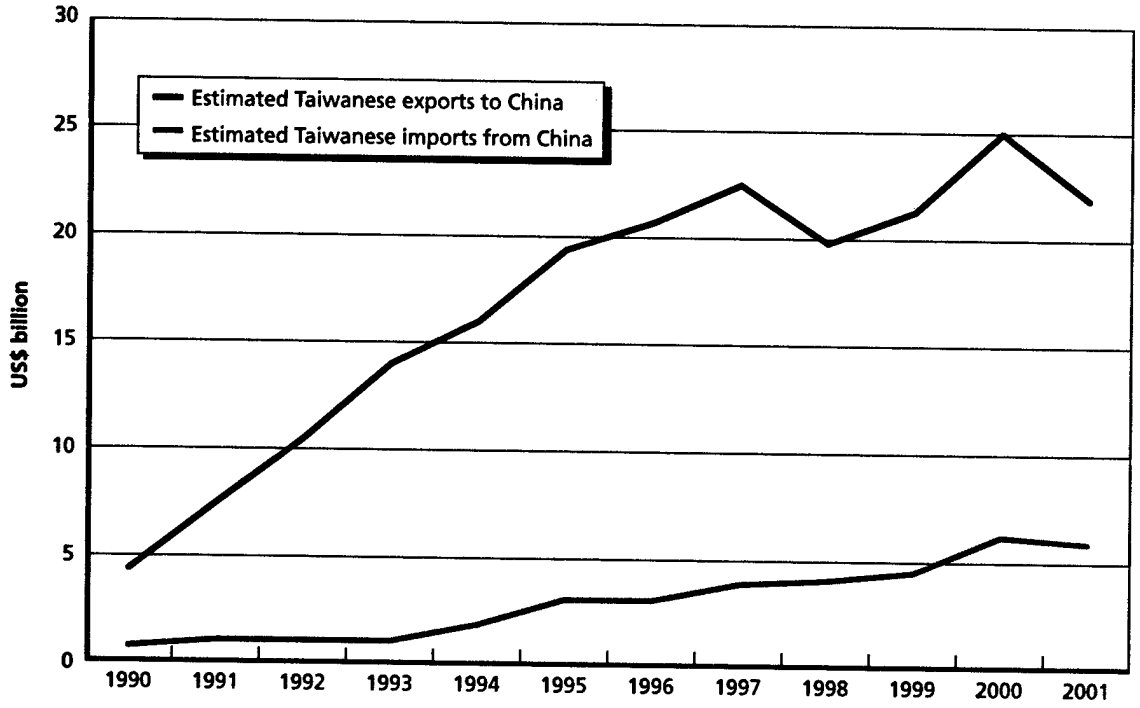
[8] A.T. Kearney Global Business Policy Council, 2002, p. 12.

[9] Savadove, Bill, "Intel Makes China Top Priority for Funding," *South China Morning Post*, September 27, 2002.

[10] A.T. Kearney Global Business Policy Council, 2002, pp. 25-28. The outlook for Taiwan is mixed, according to the survey. Expected growth in Taiwan's GDP notwithstanding, confidence is undercut by weak private consumption and the island's reliance on exports to the United States. According to the A.T. Kearney report, ASEAN countries "continue to face lackluster prospects," as reflected by the declining attractiveness to investors of Indonesia, Malaysia, Singapore, Thailand, and the Philippines recently. Concerns about the war on terrorism and rising security costs in Southeast Asia are among the factors cited by investors.

Cross-Strait Trade

Cross-Strait trade has ballooned over the past decade. According to Deutsche Bank estimates,[11] Taiwan's exports to China increased from $4 billion in 1990 to well over $20 billion in 2001, growing at an average annual rate of 16 percent. Taiwan's imports from the mainland also grew at an impressive rate during the same period, increasing from $800 million in 1990 to $5.9 billion in 2001, an average annual growth rate of 20 percent. In all, China-Taiwan trade has grown over the decade from 1991 to 2001 from about $10 billion to about $30 billion (see Figure 3.1). Moreover, since 1991, China has been the largest source of Taiwan's trade surplus (see Figure 3.2).

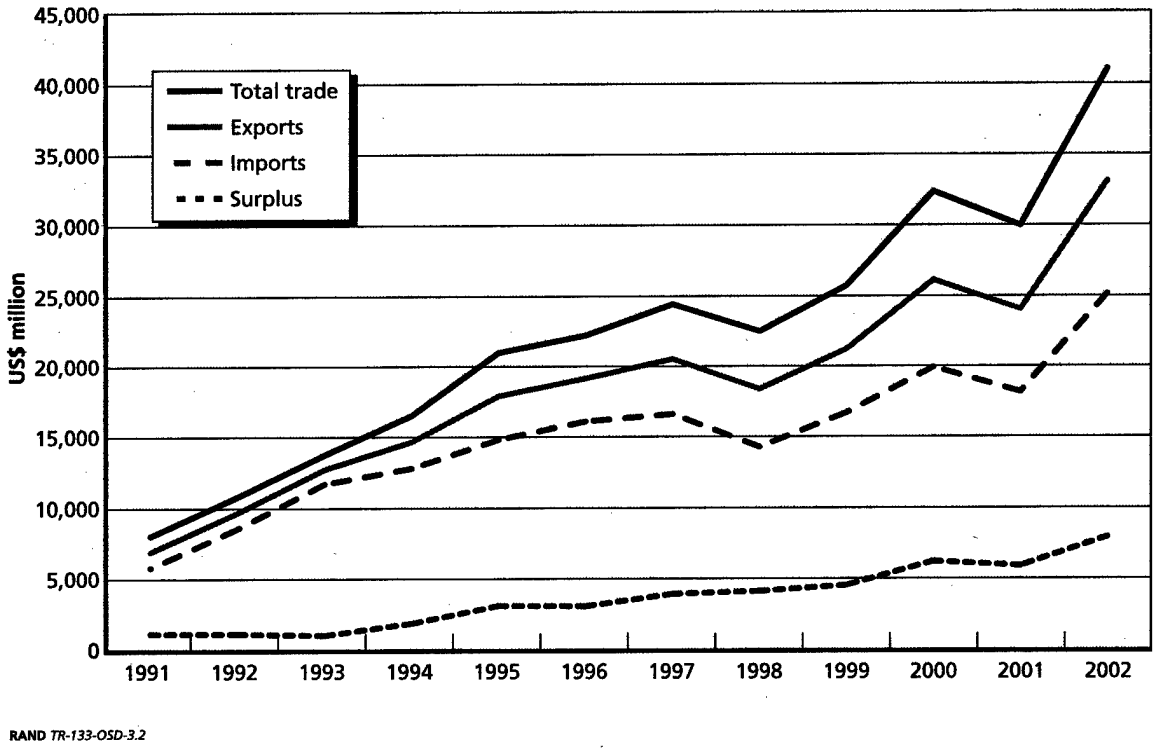


SOURCE: Ma Jun et al., 2002.

Figure 3.1--Deutsche Bank Estimates of Cross-Strait Trade, 1990-2001

[11] Ma Jun et al., 2002.

As we noted earlier, in late 2001, China replaced the United States as Taiwan's largest export market. According to the Taiwan MoEA's Bureau of Foreign Trade (BoFT), Taiwan's exports to China in 2001 totaled $24 billion, accounting for 23 percent of the island's total exports, while exports to the United States slipped to 21 percent of the total. In 2002, Taiwan's exports to China reached $33.1 billion, an increase of 37.4 percent from the previous year.[12] Economists predict that the growth of Chinese demand for Taiwanese imports "will almost certainly continue to outpace that from other major economies."[13] This growth is



SOURCE: MoEA Bureau of Foreign Trade website, http://www.trade.gov.tw/bofteng/index.asp.

Figure 3.2--Taiwanese Official Statistics on Cross-Strait Trade, 1990-2001

[12] "Taiwan Relies More on Rival China for Exports: Official Figures," *Taiwan Economic News*, March 17, 2003.

[13] Ma Jun et al., 2002, p. 4. The growth of Taiwanese exports to China is a result of two factors: the demand from Taiwanese-invested companies on the mainland for intermediate goods produced on the island and Chinese demand for Taiwanese final products.

in large part attributable to demand from Taiwanese-invested firms on the mainland.

Now that both China and Taiwan have joined the WTO, the flow of trade across the Taiwan Strait is likely to grow even more. Indeed, cross-Strait trade rose dramatically during 2002, reaching a total of $41 billion, according to the Taiwan MoEA's BoFT. Taiwan's exports to the mainland increased 37.4 percent, reaching $33.1 billion and accounting for more than 25 percent of Taiwan's total exports in 2002, while the island's imports from China rose 34.7 percent to $7.95 billion.[14] In 2003, the surge continued, with indirect trade between China and Taiwan reaching more than $46.3 billion, an increase of 23.8 percent year-on-year, according to Taiwan's BoFT.[15] Taiwan's exports to China in 2003 grew 20 percent to more than $35 billion, while its imports from the mainland increased nearly 38 percent, reaching almost $11 billion. The shipments to the mainland once again accounted for almost a quarter of Taiwan's total exports, and trade with the PRC represented more than 17 percent of Taiwan's total external trade. As a result of this surge in cross-Strait trade, China became Taiwan's largest trading partner, surpassing the United States and Japan.

Cross-Strait Investment

The dramatic increase in cross-Strait trade described above has been driven in large part by the expansion of Taiwanese investments in China.[16] Taiwanese firms began investing in China in the 1980s and Taiwan investment in China took off in 1987 after the government lifted martial law and began permitting visits to the mainland. After the Taiwan government legalized indirect investment on the mainland in the early 1990s, China quickly surpassed other Southeast Asian countries as the destination of choice for Taiwanese investors (see Table 3.1). As Chin Chung observed, several changes in the scale and nature of Taiwan investment on the mainland occurred during the first half of the 1990s:

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[14] "Taiwan Relies More . . . ," 2003.

[15] Chinese statistics placed the total value of cross-Strait trade slightly higher, according to officials from the PRC's Ministry of Commerce.

[16] Ma Jun et al., 2002, p. 3.

The average Taiwan investment project in China was valued at $735,000 in 1991, but by 1995 it had increased to $2.78 million. At first, investments in the PRC were made mainly by small and medium-size enterprises, but by the mid-1990s many large, publicly listed companies were active on the mainland. While the motivation of these companies at the beginning was primarily to establish a low-cost manufacturing base to produce items for export, it increasingly shifted toward positioning for exploitation of the Chinese market. Initial investments were mainly in labor-intensive industries, but later began moving into capital and technology-intensive industries.[17]

Table 3.1

Taiwanese-Approved Foreign Direct Investment in China and Selected ASEAN Countries, 1986-1994 (in millions of U.S. dollars)

	China	Indonesia	Malaysia	Thailand
1986	0	18	4	20
1987	100	8	96	160
1988	421	914	317	455
1989	523	157	797	517
1990	984	618	2,345	420
1991	1,358	1,056	1,312	317
1992	5,543	563	589	130
1993	9,450	131	346	215
1994	5,395	2,480	1,150	83

SOURCE: Chin Chung, 1997, pp. 166-167.

As a result, China has become the largest recipient of Taiwanese FDI. Many analysts are calling the current influx of Taiwanese investment in China the "third wave" of investment from the island, and at least one has quipped that "a Tsunami might be a better description"

[17] Chin Chung, "Division of Labor Across the Taiwan Strait: Macro Overview and Analysis of the Electronics Industry," in Barry Naughton, ed., *The China Circle: Economics and Technology in the PRC, Taiwan, and Hong Kong*, Washington, D.C.: The Brookings Institution, 1997, p. 173.

for the current wave of investment flowing across the Taiwan Strait.[18] As another business community source puts it, "FDI is going great guns from Taiwan into China, both legal and illegal."[19]

While the trends in cross-Strait trade and investment are relatively clear, finding solid quantitative data is much more difficult.[20] Much of the money that flows across the Strait does so illegally. Going offshore to circumvent restrictions is an art form that Taiwanese investors have developed over the course of 20 years. Yet, the information available from official Taiwanese government sources captures only approved deals, so it only represents "a fraction of the overall picture," according to a business community source.[21]

Although it is widely believed that the statistics compiled by the MoEA Investment Commission understate greatly the actual amount of Taiwanese investment in China, the official numbers provide a basis of comparison with other estimates and an indication of the increases in approved investment in recent years. From 1991 to early 2003, according to MoEA Investment Commission statistics, approved investment by Taiwanese companies in the mainland totaled more than $29.17 billion, accounting for about 45 percent of approved overseas investment by Taiwanese firms and making the Chinese mainland the number-one recipient of Taiwanese FDI during that period.[22]

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[18] Lawrence, Anthony, "Hi-tech's Promised Land," *Topics Online Magazine*, American Chamber of Commerce, Taipei, November 1, 2002. The "first wave" was composed largely of small and medium-size enterprises that migrated to Guangdong and Fujian in the 1980s to produce toys, textiles, and shoes. Petrochemical companies and lower-end IT hardware manufacturers dominated the "second wave" of Taiwanese investment in the mainland, which took place in the early 1990s.

[19] Interview with U.S. business community representative, Washington, D.C., May 2002.

[20] Analysts at Taiwan's Market Intelligence Center (MIC), which is widely regarded as one of the best sources of data on IT in the Greater China region, said it is difficult to gather accurate data on Taiwanese investment in the PRC, especially because a significant percentage of it is still illegal and Taiwanese companies frequently channel investments through the British Virgin Islands and other countries to circumvent government regulations.

[21] Interview with U.S. business community representative, Washington, D.C., April 2002.

[22] Investment Commission, Ministry of Economic Affairs, and Department of Economic Affairs, Mainland Affairs Council, "Taiwan's

The percentage of Taiwanese investment flowing to the mainland has increased substantially in recent years. According to the Chung-Hua Institute for Economic Research, more than 64 percent of Taiwan's outbound FDI went to China in 2000, up from around 43 percent in 1999.[23] The MoEA estimates that Taiwan was the fourth-largest investor in China in 2001, following Hong Kong, the United States, and Japan. It is important to note that these statistics fail to account for investment that is channeled into China through tax havens in British Central America, which have received more than $12.7 billion in investment from Taiwan since the late 1980s, accounting for 20 percent of the island's total approved outward investment.

The most recent Chinese government estimate of total Taiwanese contractual investment in projects on the mainland is about $61.5 billion, ranking Taiwan as the third-largest source of foreign investment in China (see Figures 3.3, 3.4, and 3.5).

In 2002, actual Taiwanese investment in the mainland was $3.97 billion (see Figure 3.5), an increase of 33 percent over the previous year, according to Chinese government statistics. Taiwanese contractual FDI in 2002 reached $6.74 billion.[24] Preliminary statistics indicate that Taiwanese investment continued to flow into China at a rapid pace in 2003.

According to the Taiwan, Hong Kong, and Macao Department of the Chinese Ministry of Commerce, Beijing in the first ten months of 2003 approved 3,664 Taiwanese investment projects with a contractual value of $6.6 billion, up almost 22 percent from the same period the previous

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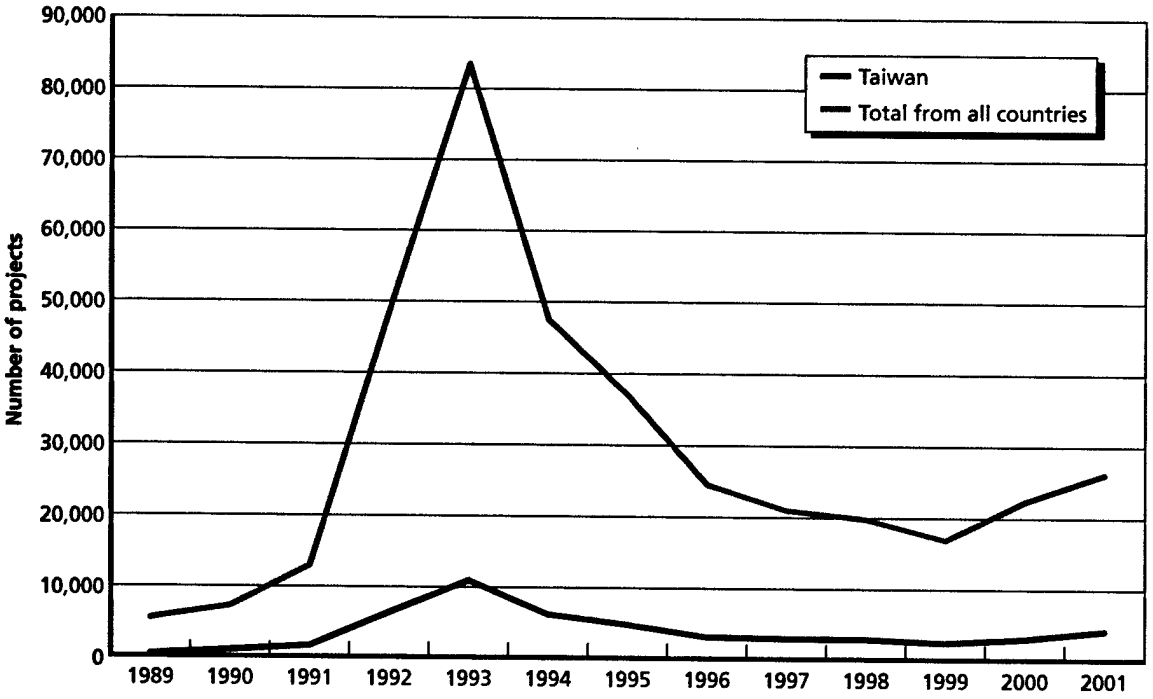
Approved Outward Investment," Taipei, February 2003, http://www.mac.gov.tw/english/english/foreign/18.gif. See also, "Economic Ties . . . ," 2002.

[23] Lawrence, 2002.

[24] People's Republic of China, Ministry of Foreign Trade and Economic Cooperation (MoFTEC), cited in "Preliminary Statistics of Cross-Strait Economic Relations, February 2003," Taiwan, Mainland Affairs Council, Executive Yuan, May 12 2003, http://www.mac.gov.tw/english/english/csexchan/economic/9202e.gif. See also, "China Says Taiwan's Investment in Mainland Rose 47% in 1st Half," *Dow Jones*, September 16, 2002. Chinese officials indicated that while Taiwanese investors on the mainland in the past were typically smaller enterprises, more investments are now flowing in from large, publicly traded firms.

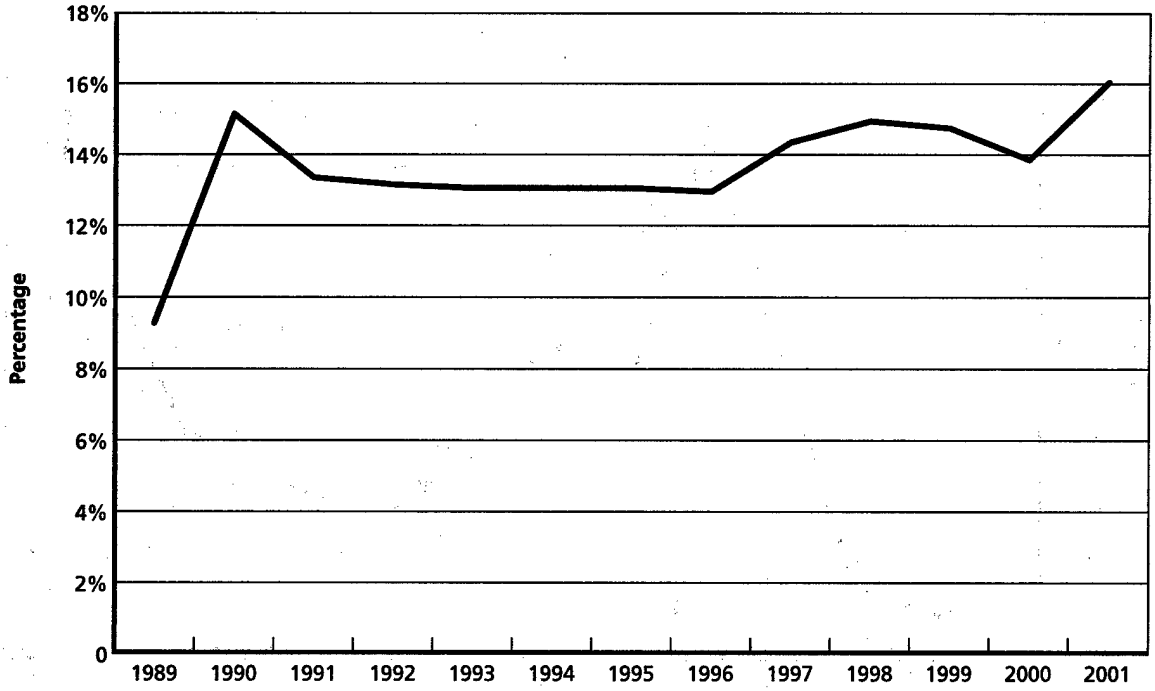
year. In addition, Chinese statistics show that actual investment during the first ten months of 2003 amounted to $2.7 billion. Yet, China's statistics also almost certainly undercount Taiwanese investment, as much of that investment flows through holding companies in the Caribbean.

According to Taiwanese statistics, in 1995 investment by Taiwan firms in the British Virgin Islands (BVI) accounted for 15 percent of the island's total outgoing investment. The official number nearly doubled in just five years, reaching almost 30 percent in 2000 and making BVI the second-largest recipient of Taiwanese FDI after the mainland (see Figure 3.6).



SOURCE: Ministry of Foreign Trade and Economic Cooperation, PRC.

Figure 3.3--Taiwanese Investment in China, 1989-2001

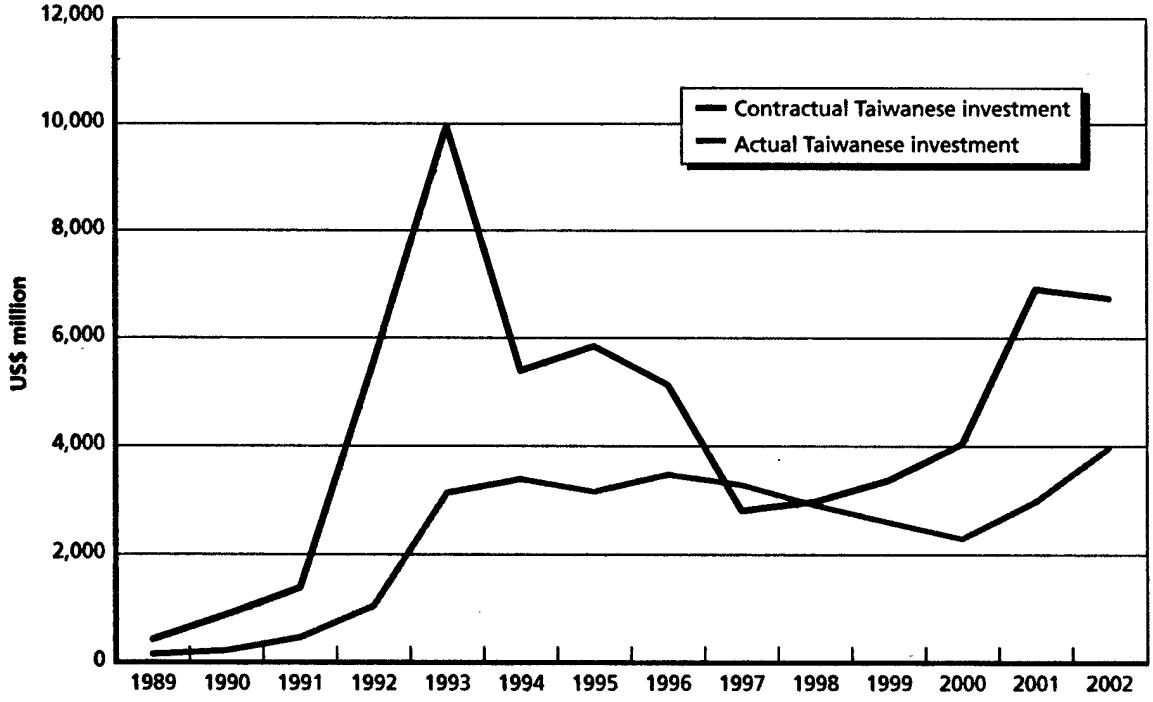


SOURCE: Ministry of Foreign Trade and Economic Cooperation, PRC.

Figure 3.4--Taiwanese Investment in China, Percentage of All Projects by Taiwanese Companies, 1989-2001

There is ample reason to believe that much of the Taiwanese investment in BVI ultimately finds its way to the mainland. Indeed, along with the rapid expansion of Taiwanese FDI in BVI, the percentage of investment from BVI as a share of total FDI in China rose from less than 1 percent in 1995 to nearly 10 percent in 2000. Another reason Chinese statistics likely undercount Taiwanese investment is that a large percentage of Hong Kong investment in China actually comes from Taiwanese companies. One Taiwanese executive said his best guess is that 50-70 percent of Taiwan's investments in Hong Kong are really destined for the PRC.[25] Thus, according to investment bank economists, available official statistics on cross-Strait economic interaction are "seriously distorted" and "none of the official data sources--whether from mainland

[25] Interview with Taiwanese business executive, Taipei, April 2002.



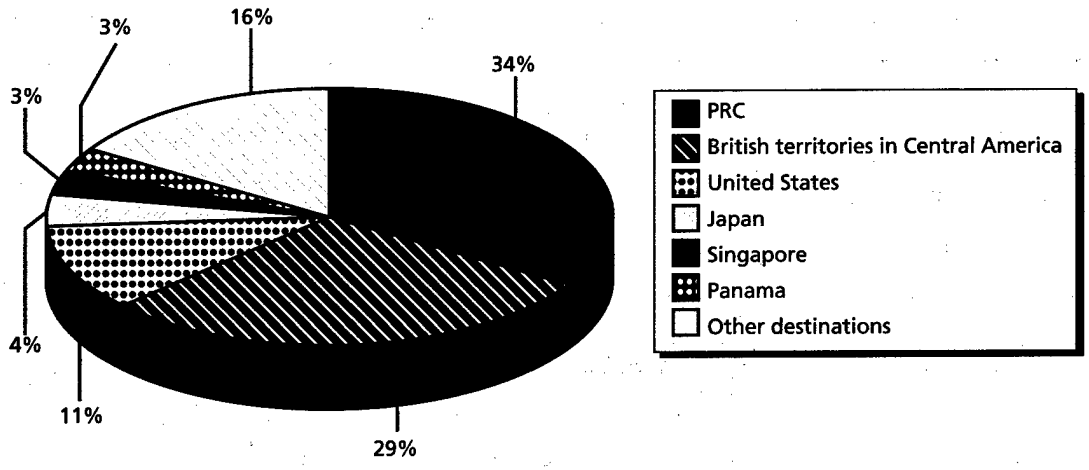
SOURCE: Ministry of Foreign Trade and Economic Cooperation, PRC.

Figure 3.5--PRC Statistics on Taiwanese Investment in China, 1989-2002

China, Taiwan, or Hong Kong--provides a complete description" of cross-Strait economic flows.[26] In short, all of the official statistics are widely viewed as underestimating Taiwanese investment in the mainland, even by some Taiwan government officials. For example, Perng Fai-nan, governor of Taiwan's central bank, estimated that by the end of 2001 cumulative Taiwan investment on the mainland probably reached $60 billion, more than twice the official Taiwan estimate. Some economists have even estimated that cumulative Taiwanese investment in the mainland may actually exceed $100 billion.[27] Somewhat more conservatively, independent economic analysts estimate that from the early 1990s to the

[26] Ma Jun et al, 2002, pp. 2-3.

[27] See, for example, Hwan C. Lin, "Taiwan Has Overinvested in China," *Taipei Times*, October 31, 2002.



SOURCE: "Taiwan's Approved Outward Investment," Mainland Affairs Council, MoEA, http://www.mac.gov.tw/english/index1-e.htm (last accessed March 2002).

Figure 3.6--Taiwan-Approved Outbound Foreign Direct Investment, 2000

present Taiwanese companies have invested approximately $65-$75 billion in China.[28] Although we were unable to independently verify the accuracy of these different estimates (which are listed in Table 3.2), based on our interviews with government officials, industry analysts, and corporate executives, we assess that the middle-range figures (estimates of around $65-$75 billion U.S.$) probably most closely reflect the true scale of Taiwanese investment in the mainland.

Two of the most important trends underway in Taiwanese investment in the mainland are the increasing concentration of investment in the electronics sector, which is discussed further later in this chapter, and accelerating changes in regional investment patterns. The most prominent change in these patterns is a shift in the concentration of Taiwanese investment from the Pearl River Delta to the greater Shanghai region. When Taiwan businessmen first began investing in the mainland,

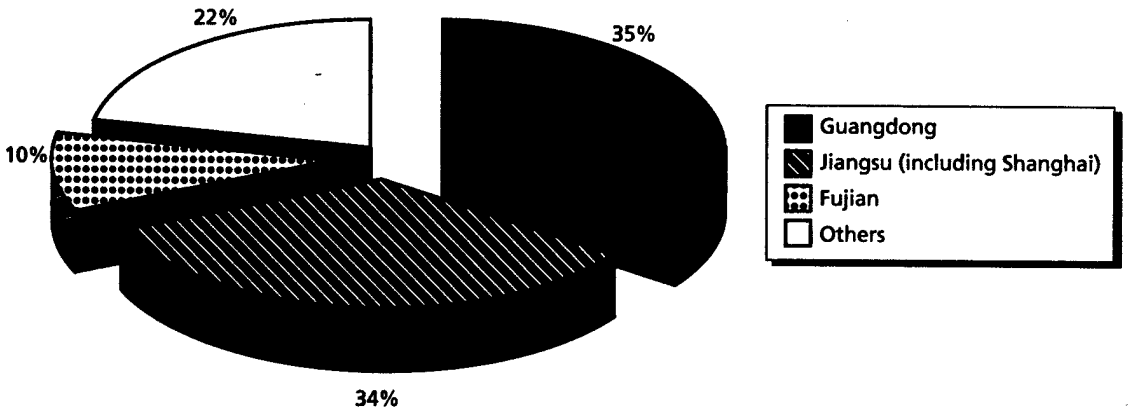
[28] Interviews with economists and industry analysts, Washington, D.C., June 2003.

Table 3.2

Comparison of Estimates of Taiwanese Investment in the PRC

Source of Estimate	Amount
Taiwan-approved investment in China (MoEA Investment Commission)	$29 billion
Taiwan central bank governor's estimate of investment in China	$60 billion
China's official estimate of Taiwan investment on the mainland	$61 billion
Taiwan economists' unofficial estimates	$70-$100 billion
U.S. observers' unofficial estimates	$65-$75 billion

the factories they established were concentrated heavily in the provinces close to Hong Kong. Initially, the primary targets of Taiwanese FDI were Shenzhen, Guangdong, and Fujian. Indeed, as of 2000, Guangdong Province had received approximately 35 percent of cumulative Taiwanese investment in the mainland, ranking it as the first choice of Taiwanese investors, according to official Taiwanese statistics. In second place was Jiangsu Province, including Shanghai, which accounted for 34 percent of total Taiwanese FDI in China, and in third place was Fujian Province, with 10 percent of the total (see Figure 3.7).



SOURCE: Ministry of Foreign Trade and Economic Cooperation, PRC.

NOTE: Numbers do not add to 100% due to rounding.

Figure 3.7--Taiwanese Investment in China by Region, Cumulative to July 2000

Over the past several years, however, the interest of Taiwan investors has shifted markedly toward Shanghai, Jiangsu Province, and Zhejiang Province. In 2001, Shanghai and Jiangsu displaced Guangdong as the primary destination for Taiwanese investment on the mainland, accounting for more than 50 percent of actual Taiwanese FDI in China that year, while Guangdong's share fell to about 25 percent.[29] Shanghai has become the new center of gravity for value-added manufacturing. Almost 1,100 Taiwanese-invested enterprises were established in Shanghai and Jiangsu Province in 2001, and there are now more than 10,000 Taiwanese companies operating in the area. Jiangsu Province has approved investments in more than 11,700 Taiwanese-funded companies.[30] Despite these gains, Shanghai is still second to Guangdong, where there are more than 14,000 Taiwanese-invested firms.[31]

The trend toward investments being made in Shanghai and the Yangtze River Delta continued in 2002, as reflected by Taiwan MoEA Investment Commission statistics, which show that Shanghai and Jiangsu Province received around 53 percent of approved Taiwanese FDI in the mainland in the first eight months of the year.[32] Guangdong Province was the second most popular destination, accounting for about 23 percent of mainland-bound investment approved in the first eight months of 2002, and Zhejiang Province was third with slightly more than 9 percent of approved investment (see Figure 3.8).

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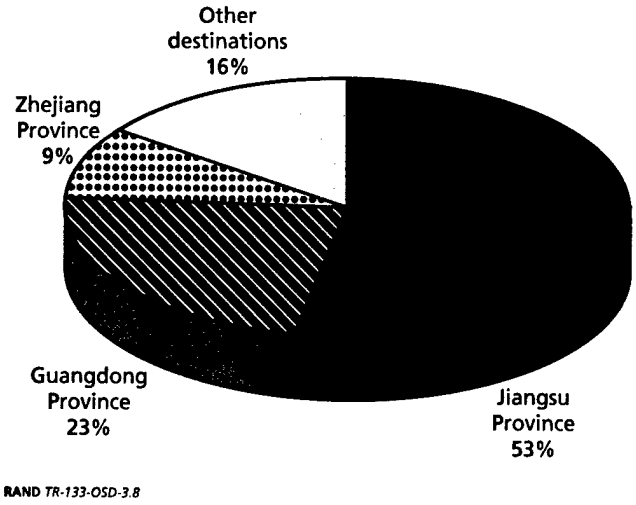
[29] In 2001, Zhejiang Province was third, with roughly 10 percent of the total Taiwanese investment on the mainland.

[30] See "More Taiwan Investment Flowing into Jiangsu," *Xinhua*, June 2, 2003.

[31] Ma Jun et al., 2002, pp. 9-11.

[32] In all, Jiangsu Province has received about $20 billion in contracted Taiwanese investment, according to official statistics, about $5.4 billion of which has been directed to Kunshan, a city about an hour west of Shanghai that some call "Taiwan town" or "Little Taipei." Suzhou, for its part, has drawn about $1.4 billion in contracted investment from Taiwan, according to Jiangsu provincial government statistics. For more on Taiwanese investments in the Yangtze River Delta, see Lawrence, 2002.



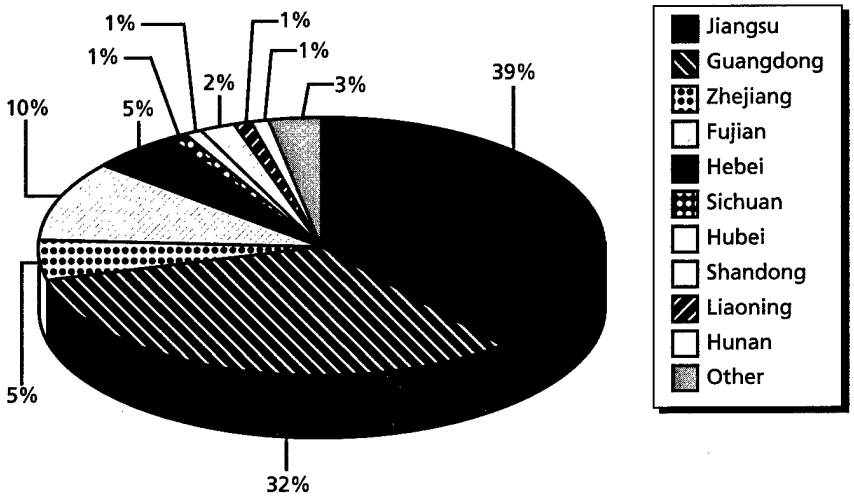
SOURCE: Investment Commission, MoEA.
NOTE: Fractions do not add to 100% due to rounding.

Figure 3.8--MoEA-Approved Taiwanese Investment in China, January-May 2002

As a result of this growing influx of investment, by the end of 2002 Jiangsu Province (with a 39 percent share) had also surpassed Guangdong Province (with a 32 percent share) in total approved investment from Taiwan, while the Zheijiang Province's share was 5 percent, and the Fujian Province's share was 10 percent, according to the Taiwan MoEA Investment Commission (see Figure 3.9).

Moreover, the torrent of investment in Jiangsu Province accelerated even more dramatically in early 2003. During the first four months of 2003, Jiangsu Province registered more than US$2.2 billion in contractual investment from Taiwan, according to Chinese government statistics.[33] The prime target for Taiwan investors was the city of Suzhou, which attracted more than US$1.3 billion in contracted FDI from Taiwan, mainly in the electronics industry. As of June 2003, according to Chinese government statistics, the total amount of contractual Taiwanese FDI in Jiangsu Province was about US$31 billion, and the total amount of actual FDI from Taiwan was more than US$15.5 billion.[34]

[33] See "More Taiwan Investment . . . ," 2003.
[34] See "More Taiwan Investment . . .," 2003.



SOURCE: Investment Commission, MoEA.

Figure 3.9--Cumulative Taiwan-Approved Investment in China by Province, 1991-2002

Underscoring this ongoing shift to the east, from 2000 through 2002, Shanghai and the Yangtze River Delta region topped the list as the areas with the most favorable environments for Taiwanese investment, according to the 2002 Mainland China Investment Environment and Risk Survey, conducted by the Taiwan Electrical and Electronic Manufacturers' Association (TEEMA).[35] The Shanghai municipality, the greater Suzhou area (including Kunshan, Wuxian, and Wujiang), the rest of Jiangsu Province, and Zhejiang Province have achieved consistently high scores in the categories of natural environment, infrastructure, public facilities, social environment, and legal and political environment. Among the cities highlighted as being the most favorable destinations for Taiwanese investment, most are in Jiangsu and Zhejiang Provinces. The top ten cities in investment environment in the 2001 survey, for example, were all in the Shanghai and Yangtze River Delta region,[36] and

[35] Taiwan Electrical and Electronic Manufacturers' Association, *2001 Mainland China Investment Environment and Risk Survey,* Taipei: TEEMA, 2001.

[36] TEEMA, 2001, pp. 12-14. The top ten cities were Fenghua, Hangzhou, Kunshan, Ningbo, Shanghai, Suzhou, and Wenzhou, Wujiang, Wuxi, and Zhenjiang.

of the top ten destinations for Taiwanese investment identified in TEEMA's 2002 survey, eight are in Jiangsu and Zhejiang Provinces.[37] Suzhou, Kunshan, Wujiang, Yangzhou, Wuxi, and Xiaoshan were all among the 21 cities listed as "Grade A" cities for Taiwanese investment in the 2002 survey. Indeed, the only city outside of Jiangsu and Zhejiang that was "highly recommended" for investment in the 2002 survey was Qingdao.[38]

At the same time that Taiwanese businessmen's optimism about the investment environment in East China, particularly Shanghai and the Yangtze River Delta region, is increasing, their enthusiasm for the Pearl River Delta region is noticeably waning. Despite its early establishment as a hub of Taiwanese investment on the mainland, the Pearl River Delta area--including Guangzhou, Shenzhen, Dongguan (see the related discussion in the boxed text),[39] and Shantou--has received relatively low scores in the TEEMA surveys in recent years, in large part as a result of numerous investment and trade disputes involving Taiwanese businessmen. Threats to personal safety, widespread official corruption, rampant counterfeiting, an unresponsive legal system, and capricious local officials were also cited as serious problems degrading the attractiveness of the Pearl River Delta.[40]

For example, Dongguan ranked 44th in investment environment in 2001, registering below-average scores in infrastructure, public facilities, social environment, and legal and political environment.

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[37] Taiwan Electrical and Electronic Manufacturers' Association, *2002 Mainland China Investment Environment and Risk Survey*, Taipei: TEEMA, 2002. See also Bao Xinyan, "Taiwan Favors Eastern Cities," *China Daily*, August 23, 2002.

[38] The "highly recommended" cities are Hangzhou, Kunshan, Ningbo, Qingdao, Suzhou, Wuxi, Xiaoshan, and Yangzhou. Those listed as "recommended" are Changsha, Chengdu, Dalian, Fenghua of Ningbo, Gueilin, Hueizou, Nanjing, Pudong, Shanghai suburban district, Shanghai urban district, Shantou, Shenyang, Shijiazhuang, Tianjin, Wujiang of Suzhou, Xiamen, Zhangzhou, Zhengzhou, Zhongshan, and Zhuhai.

[39] For an intriguing portrait of Dongguan, see Kroeber, Arthur, "The Hot Zone," *Wired Magazine*, Issue 10.11, November 2002.

[40] TEEMA, 2001, pp. 17-20, 25.

In Dongguan, Taiwanese companies are involved in "a little bit of everything" and have established several powerful business associations. Manufacturing is the core business in the Pearl River Delta, but regional officials aspire to turn it into a software hub.

Dongguan began emerging as a destination for overseas investment in the early 1980s, when local government officials started offering tax incentives and cheap land to entice foreign companies to build manufacturing facilities in the city. Investors from Taiwan rushed into the city, establishing "suitcase companies"--enterprises founded by Taiwanese businessmen who arrived on the mainland carrying bags of cash--even though Taiwanese government regulations still prohibited direct investments in China. Following the relaxation of government regulations, investment from Taiwanese companies seeking reduced land and labor costs poured into the city in the early 1990s. In the mid-1990s, many of the Taiwanese companies producing peripherals and related items moved across the Taiwan Strait in search of lower production costs, and many of them ended up in Dongguan. Before long, Dongguan began to replicate the pattern of clustering of customers and suppliers that had formed earlier in Taiwan.

By 2001, Taiwanese companies had invested more than $3.3 billion in Dongguan. The city is currently home to more than 1,000 Taiwanese-invested electronics manufacturing facilities. The interests of Taiwanese-invested companies and Taiwanese businessmen in Dongguan are represented by the city's Taiwan Business Association, which in the absence of diplomatic representation combines the functions of chamber of commerce and de facto consulate. The association maintains offices in each of Dongguan's 32 townships. It also operates a school for the children of the tens of thousands of Taiwanese businessmen who live in the city.

In the 2002 TEEMA survey, Dongguan was one of several cities that received a "Grade D" ranking for its investment environment, in large part because of problems with the legal and regulatory environment in the city. In the 2001 and 2002 surveys, the city was listed as "temporarily not recommended" to Taiwanese high-technology companies considering investments in the mainland. "Even if Dongguan claims itself as the 'World's Factory,'" according to the 2002 TEMA survey, "It is only barely satisfactory in terms of its investment environment and investment risk."

An early 2002 survey by the Taiwan MoEA[41] of 2,000 companies with overseas investments showed no signs that the pace of Taiwanese investment in the mainland will slow down anytime soon. According to the survey, some 75 percent of Taiwanese companies with an overseas presence have investments in China, up from 69 percent three years ago, and 77 percent of Taiwanese firms with plans to invest overseas are considering the mainland, up from 55 percent two years ago. Painting a similar picture is a Taiwanese *Economic Daily News* survey from 2002,[42] which found that more than 43 percent of companies without existing overseas investments plan to invest in the mainland within the next year, while only 2 percent are planning to invest in Southeast Asia, and even fewer expect to invest in the United States and Europe. In addition, more than 80 percent of Taiwanese high-technology companies are planning to expand their investments in China.

SCOPE AND SCALE OF INFORMATION TECHNOLOGY FLOWS OVER TIME

Despite Taiwan's economic malaise, the island's IT industry is showing some signs of recovery. From 2001 to 2002, Taiwan's total IT hardware production value rose 12 percent to $47.8 billion.[43] Propelled by strong growth in the production of notebook computers, desktop PCs,

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[41] The survey is cited in Ma Jun et al., 2002, p. 15.

[42] "Survey of Investment Climate and Outlook for the Second Half of 2002," *Economic Daily News*, July 1, 2002, cited in Ma Jun et al., 2002, p. 16.

[43] "Taiwan the World's No. 4 Computer Hardware Producer in 2002," *Deutsche Presse-Agentur*, March 12, 2003.

servers, LCDs, and optical storage devices, the total value of Taiwan's IT hardware production reached $57.1 billion in 2003.

Indeed, it is difficult to overstate Taiwan's significance in global IT production. The MIC estimates that Taiwanese companies produce approximately 60 percent of the world's notebook computers, 90 percent of its motherboards, 60 percent of its liquid crystal displays (LCDs), 50 percent of its cathode ray display tubes (CDTs), 30 percent of its optical disk drives, and 25 percent of its servers. Until recently, Taiwan was third in the world in IT hardware production value, trailing the United States and Japan. In 2001, according to MIC analysts, China accounted for about 30 percent of world IT hardware production, and Taiwan accounted for 50 percent or so, but the numbers are changing very quickly and China is taking the lead. As of 2003, the numbers will probably be reversed, with 50 percent in China and 30 percent in Taiwan. Even though 2002 was an especially difficult one for the IT industry and margins are still shrinking, Taiwan's flexibility, responsiveness, and close ties with the United States and Japan are helping the island to hold its position as one of the world's top IT powers.

In 2002, more than 49 percent of Taiwan's IT hardware was made in China, up from a total of about 37 percent in 2001, according to MIC. The total production value of Taiwan's IT hardware produced in China reached $22.5 billion in 2002, an increase of 42 percent over the previous year.[44] The share of IT hardware produced on the island, meanwhile, declined from slightly more than 47 percent in 2001 to about 38 percent in 2002.[45] According to MIC analysts, the share of Taiwan's IT hardware production in mainland China is likely to reach 60 percent in 2003, while the portion produced in Taiwan will likely decline to about 26 percent.[46] Taiwanese-invested companies account for the majority of electronic goods exported by China. Indeed, highlighting the extent of Taiwanese investment in the Chinese IT sector, MIC industry

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[44] "Taiwan: Productive Years Ahead for Hardware," *Asia Computer Weekly*, January 13, 2003.

[45] Culpan, Tim, "Taiwan IT Storms into Mainland," *South China Morning Post*, April 30, 2002a.

[46] "Taiwan to Move 60% IT Hardware Production to Mainland China In 2003," *Taiwan Economic News*, November 28, 2002.

analysts estimate that Taiwanese-invested companies produce more than 70 percent of the electronics products made in China.[47] Deutsche Bank statistical analysis showing a strong correlation between increases in Taiwanese exports to China and the growth of Chinese electronics exports supports these estimates.[48]

Migration of IT hardware manufacturing capacity across the Taiwan Strait was propelled in large part by the requirement to lower production costs (other factors are considered later in this chapter). In 1993, Taiwanese companies producing PC-related products on the mainland were already benefiting from significant savings over the cost of production on the island, exceeding the savings available in Southeast Asian countries such as Malaysia. For example, producing a motherboard in Southeast Asia cost 4 percent less than producing it in Taiwan, but costs 10 percent less in China (see Table 3.3). Because Taiwanese companies producing for export needed to offer competitive prices by world market standards, these differences in manufacturing cost were sufficient to motivate Taiwanese companies to invest in China instead of the ASEAN countries.[49] Thus, the percentage of offshore manufacturing in mainland China increased rapidly from 1990, when Taiwanese firms started heading across the Strait in significant

Table 3.3

Percentage Cost Savings for Taiwanese Companies Producing PC-Related Goods in China and Southeast Asia, 1993

	China	ASEAN
Monitors	8%	5%
Motherboards	10%	4%
Switch power supplies	16%	8%
Keyboards	21%	16%
Mice	22%	n.a.

SOURCE: Chin Chung, 1997, p. 188.
n.a. = not available.

[47] Interview, Taipei, October 2002.
[48] Ma Jun et al., 2002, pp. 5-6.
[49] Chin Chung, 1997, pp. 187-188.

numbers, to 1993, when it reached almost 35 percent, surpassing the percentages in Malaysia and Thailand.

Offshore production of PC hardware by Taiwanese companies rose from 10 percent in 1992 to 27 percent by 1995,[50] when more than 75 percent of switch power supplies and keyboards, about 50 percent of monitors and graphics cards, almost 40 percent of motherboards, and approximately 25 percent of CD-ROM drives and computer mice were made overseas, primarily in China and the ASEAN countries (see Table 3.4).

By the mid-1990s, Taiwanese companies were producing more of these items offshore than in Taiwan and were increasingly relocating offshore production to China. By 1996, according to MIC, Taiwan companies with major PC-related projects on the mainland included Acer Peripherals (monitors, keyboards, motherboards), First International Computer (motherboards, monitors), Copam Electronics (monitors), Mitac International (monitors, PC assembly), Datatech Enterprises (motherboards), Logitech (PC mice), Primax Electronics (PC mice), Chung Hua Picture Tubes (cathode-ray tubes [CRTs]), and Picvue Electronics (small-size LCDs).[51] By 1999, about one-third of Taiwan's IT products were manufactured in China, according to MIC estimates. Taiwan's role in the growth of the mainland's IT sector was already so great that one Merrill Lynch analyst quipped, "It should be called the 'Greater Taiwan Economy' instead of the 'Greater China' one."[52] Taiwanese companies such as Acer began shifting production of desktop computers to China in the late 1990s, and by 2000 nearly half of the PCs produced by Taiwanese computer companies were made on the mainland.

The migration of productive capacity has continued, with companies pushing the Taiwanese government to lift remaining restrictions on high-technology investment in the mainland. For example, the Taiwanese government in November 2001 lifted its restrictions on the production of

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[50] Chin Chung, 1997, p. 185.

[51] Chin Chung, 1997, p. 185.

[52] Azab Powell, Bonnie, "Taiwan Unleashed: Taiwan's High-Technology Economy Rushes in Where Its New Government Fears to Tread," *Red Herring*, October 2000.

Table 3.4

World Market Share and Domestic and Overseas Production of Taiwanese PC Products, 1995

	World Market Share (%)	Domestic Production (1,000s of Units)	Annual Growth Rate, Domestic Production (%)	Overseas Production (1,000s of Units)	Annual Growth Rate, Overseas Production (%)	Overseas Production as % of Total Production
Displays	57	16,085	12	15,244	58	49
PCs	12	6,758	39	400	n.a.	n.a.
Desktops	10	4,167	48	400	n.a.	9
Laptops	27	2,592	26	n.a.	n.a.	n.a.
Motherboards	65	13,133	14	7,751	29	37
Switch Power Supplies	35	7,756	261	26,564	12	77
Image Scanners	64	2,481	49	n.a.	n.a.	n.a.
Graphics Cards	32	4,920	-2	4,380	17	47
Keyboards	65	4,589	-35	28,191	79	86
CD-Rom drives	11	2,825	1,519	927	927	25
Network Interfaces	38	9,946	63	318	1,490	3
Terminals	27	956	-8	n.a.	n.a.	n.a.
Audio Cards	35	1,663	-16	n.a.	n.a.	n.a.
Mice	72	31,087	41	9,817	27	24

SOURCE: Institute for Information Industry, Market Intelligence Center, quoted in Chin Chung, 1997, p. 182.

high-end notebook computers in China.[53] Facing pressure from customers including Hewlett-Packard, Compaq, and Dell to cut costs, leading laptop

[53] Taiwan is the world's leading producer of notebook PCs. In 2001, companies from the island manufactured more than 13 million notebook PCs, accounting for more than 50 percent of the world market.

manufacturers such as Quanta Computer Inc. started shifting production to the mainland, where notebook PC production costs are about 5 percent lower than in Taiwan.[54] Taiwanese notebook computer manufacturers currently produce about 30-40 percent of their units in China, up from just over 5 percent in 2001. Industry analysts predict the percentage will climb to 60 percent in 2003. Also increasing rapidly is the number of TFT-LCD monitors produced by Taiwanese companies in China. By late 2002, according to the Market Intelligence Center, more than 60 percent of Taiwan's LCD monitor production had moved to China, more than double the 28 percent that was produced there in 2001. MIC industry analysts forecasted that most of Taiwan's high-end LCD monitor manufacturers will have moved their production facilities to the mainland by the end of 2003. Analysts say the move will allow Taiwanese manufacturers to take advantage of lower production costs and boost their global market share.[55]

THE IMPACT OF SARS ON CROSS-STRAIT ECONOMIC ACTIVITY

When the SARS crisis hit China, many retail businesses were closed and tourist arrivals were nearly eliminated. Analysts painted a worrying picture of the impact the disease would have on the Chinese economy, including China's dynamic IT industry. Indeed, with the SARS crisis forcing many shoppers to stay home, mobile phone sales plummeted, especially in the cities that were hardest hit by SARS, Beijing and Guangzhou.[56] Consumer demand for desktop computers also declined sharply in major Chinese cities in the second quarter of 2003, falling 40 to 50 percent below expectations.[57] In Beijing, consumer demand for desktop PCs was 75 to 85 percent below original forecasts. Corporate sales were less severely influenced by SARS, however, falling only 10 to 15 percent

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[54] Nystedt, Dan, "Quanta to Boost China Investments," *Taipei Times*, November 27, 2001.

[55] Market Intelligence Center, "Promotional Strategies and Movement to China to Boost Taiwanese LCD Monitor Production in 2H 2002," Taipei: MIC, September 12, 2002.

[56] Market Intelligence Center, "SARS Trammels Chinese Mobile Phone Market by Close to 30% in 2Q 2003," Taipei: MIC, May 27, 2003i.

[57] Market Intelligence Center, "SARS Sparks Double Digit Downward Adjustment of Chinese Desktop PC Market for 2Q 2003," Taipei: MIC, May 20, 2003b.

below original forecasts. In addition, notebook PC sales in China were less severely influenced as most notebooks are sold to businesses. Industry analysts expect improvements in the third quarter as the SARS crisis abates.[58] Increasing demand for distance education and home offices should also help invigorate the desktop PC market.

In all, SARS caused only a temporary cooling of the Chinese economy. Indeed, China posted an impressive 9.9 percent growth rate in the first quarter of 2003. In the first five months of 2003, Chinese exports rose by 34 percent (the growth in exports to the European Union and to the United States, where China may soon replace Mexico as the second-largest source of imports, was especially strong), investment in fixed assets increased 32 percent, and demand for electricity climbed 15 percent.[59]

Across the Taiwan Strait, the disruption brought about by SARS threatened to decrease Taiwan's economic growth, which had been recovering slowly from a slump that hit the island hard in 2001. Economists revised their forecasts for GDP growth downward to less than 3 percent and predicted increased unemployment. President Chen proposed a massive economic stimulus program. Shops and restaurants were closed and the Computex electronics exhibition was cancelled.[60] In May 2003, Taiwan's export orders increased by only 4.3 percent from a year earlier, the smallest increase in more than a year, while the island's industrial production declined 2.8 percent, the biggest decrease in 15 months.[61] At the height of the SARS outbreak in Taiwan, the stock market suffered its sharpest decline in nine months.

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[58] Market Intelligence Center, 2003b.

[59] Lynch, David J., "Economy in Post-SARS China Taking Off 'Like a Rocket,'" *USA Today*, June 23, 2003; Hille, Kathrin, and James Kynge, "Chinese Economy Escapes Worst Effects of SARS," *Financial Times*, June 12, 2003.

[60] See, for example, Hsu, George, and Koh Chin Ling, "Taiwan Economy Struggles with Disease," *International Herald Tribune*, April 24, 2003; Einhorn, Bruce, "Taiwan's SARS Luck Runs Out," *Business Week*, May 26, 2003.

[61] "SARS Helps Slow Export-Order Growth to 14-Month Low," *Bloomberg*, June 25, 2003.

Industry analysts expected SARS to have a negative impact on Taiwan's IT industry in terms of both supply and demand.[62] The SARS outbreak threatened to disrupt manufacturing, curtail business travel, reduce attendance at trade shows and exhibitions, and cut sales at retail outlets. Analysts feared that Taiwanese desktop PC makers, with production centered in southern China, faced particularly serious risks of factory closures. At the same time, however, the software and service sectors were expected to benefit from the crisis, as consumers wary of venturing out to stores turned to on-line shopping, and corporations sought to establish "virtual offices" in response to quarantines and travel bans. Government agencies and educational institutions were also expected to increase their IT investments.

As predicted, the impact of SARS on high-tech sectors was uneven. For Taiwan's optical disk drive industry, for instance, which is heavily dependent on the Chinese market, SARS combined with seasonal factors resulted in downward revisions of expected shipment volume and value in the second quarter (still, analysts had relatively optimistic expectations for recovery in the third quarter).[63] Many of Taiwan's key high-tech industries, however, were largely unaffected by SARS. For example, the island's TFT-LCD panel makers largely avoided any impact from SARS. Instead, the volume and value of Taiwan's TFT-LCD panel shipments in the second quarter of 2003 increased 8.8 percent and 11 percent, respectively.[64] The impact of SARS on Taiwanese data communications, server, notebook, and desktop PC makers also was limited.[65]

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[62] Market Intelligence Center, "Double-Edged Sword: The Impact of SARS on the Taiwanese IT Industry," Taipei: MIC, April 24, 2003a.

[63] Within the sector, the results of SARS were expected to be mixed, with makers that rely on branded business in China hit much harder than those that engage primarily in original equipment manufacturer/original design manufacturer businesses and are less reliant on shipments to China. See Market Intelligence Center, "Chinese Market Reliance Magnifies SARS Effect for Taiwanese Optical Disk Drive Industry in 2Q 2003," Taipei: MIC, May 26, 2003e.

[64] Market Intelligence Center, "Global LCD Panel Scarcities in 2Q 2003 Shield Taiwanese Makers from SARS Impact," Taipei: MIC, May 21, 2003c.

[65] See Market Intelligence Center, "SARS Delivers Soft Blow to Taiwanese Data Communications Industry in 2Q 2003," Taipei: MIC, May 21,

As for the impact of SARS on cross-Strait ties, some analysts predicted that the crisis would slow economic integration between China and Taiwan. Many companies, including TSMC, Quanta Computer, and Compal Electronics, temporarily put cross-Strait travel on hold. Some high-tech companies, such as BenQ Corporation and Quanta, considered diversifying their manufacturing bases to reduce their reliance on production in China. Many executives in Taiwan, however, acknowledged that none of the alternatives was a suitable replacement for China.[66] In Taiwan, commentators warned that SARS "looms as the biggest single uncertainty for economic and trade exchanges across the Taiwan Strait."[67] Compared with the same period last year, cross-Strait travel dropped more than 80 percent in the second quarter of 2003. Many flights from Taipei to Hong Kong and Macau were suspended. The lifting in early July 2003 of Taiwan's mandatory home quarantine for travelers returning from China, however, promised to help begin the process of returning cross-Strait tourism and business travel to normal levels.[68]

In all, rather than causing cross-Strait economic ties to unravel, the SARS crisis ultimately underscored the durability and resilience of those ties. Taiwanese investment in China was more than US$1.7 billion in the first five months of 2003, up more than 43 percent from the same period the previous year. Even in April 2003, Taiwanese investment on the mainland was up more than 22 percent from April 2002. In May 2003, contractual investment in the mainland reached US$318 million, an increase of 4 percent from April of that year. Cross-Strait trade

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2003d; Market Intelligence Center, "SARS Maelstrom an Easy Breeze for the Taiwanese Server Industry in 2Q 2003," Taipei: MIC, May 26, 2003f; Market Intelligence Center, "Taiwanese Notebook PC Shipments Undeterred in 2Q 2003 as SARS Treads Lightly on Corporate Demand," Taipei: MIC, May 26, 2003h; and Market Intelligence Center, "Taiwanese Desktop PC Industry Afflicted by Swelling Inventories Rather than SARS in 2Q 2003," Taipei: MIC, May 26, 2003g.

[66] See, for example, Tsai Ting-I, "SARS to Slow Investment Capital Headed for China, Experts Say," *Taiwan News*, April 26, 2003.

[67] "SARS Emerging as Top Uncertainty for Cross-Strait Economy," *Taiwan Economic News*, April 21, 2003.

[68] Ho, Jessie, "Travel Agents, Businessmen Glad for End to Quarantine," *Taipei Times*, July 1, 2001.

increased 39 percent in the first quarter of 2003, reaching more than US$12 billion.

TAIWANESE FOREIGN DIRECT INVESTMENT IN CHINA

This section discusses the factors driving Taiwanese companies to invest in China and the shift in investments over time from lower-end, labor-intensive items, such as textiles, to higher-end, technology-intensive items, primarily electronics and information technology products.

Why China?

Taiwanese companies are investing in China for several reasons: to take advantage of lower production costs, especially land, labor, and construction costs; to take advantage of the availability of an increasingly large number of skilled Chinese engineers and technicians; to gain access to the Chinese domestic market; as part of an "investment cluster effect"; and because of preferential tax policies and other incentives offered by the Chinese central government and local governments. Although there is general agreement that these are the primary reasons why Taiwanese IT firms are investing on the mainland, there is a wide array of opinions on the relative weight of these factors. For example, according to Deutsche Bank economic analysts, "cost advantage is the primary reason for Taiwanese investments in China."[69] Some Taiwanese high-technology executives assert, however, that while lower costs are part of the allure of China for some companies, for many firms, access to the Chinese market and the opportunity to sell products in China are much more important.[70] Our assessment is that the latter view most accurately reflects the reasoning of many Taiwanese IT companies seeking to expand their investments in China. While lower costs, PRC government incentives, and increasing availability of skilled engineers and technicians all are important factors, the desire to gain greater access to the rapidly expanding Chinese market and the perceived benefits of investment

[69] Ma Jun et al., 2002.

[70] Interviews, Taipei, April 2002 and October 2002.

clustering[71] are the primary motivations for many Taiwanese firms investing in high-tech projects on the mainland.

Reduced Costs. Pressure to reduce production costs is one of the chief reasons why Taiwanese high-technology firms invest in China. As a result of the slumping global demand for IT products, Taiwanese companies are facing pressures from their customers to move production to the mainland. Indeed, pressure from outsourcing partners to move manufacturing to China is one of the key driving forces behind the move across the Taiwan Strait for many Taiwanese IT companies. For example, Dell is requesting that Taiwanese companies produce notebook computers in the PRC. In addition, companies such as Hewlett-Packard are dealing with fewer suppliers. Consequently, Quanta Computer and other Taiwanese manufacturers are under enormous pressure to reduce costs and enhance their competitiveness. Minimizing costs is their top priority at the moment, as Deutsche Bank economists point out, and in China, average wages are one-sixth as much as the average wages in Taiwan, land is one-tenth as expensive, and construction costs are about one-third the level that they are on the island. "For many Taiwanese firms," according to a Deutsche Bank report, "investing in the mainland may well be the most practical and effective means of cost reduction."[72] Cost savings on the mainland are a major factor for manufacturing operations that are labor intensive. In some industries, one Taiwanese executive said, the average labor cost in Taiwan is as much as ten times higher than in the PRC.

Land Availability. Another factor closely related to the production cost issue that is driving companies to move to the mainland is the lack of available land in Taiwan. As one researcher at a government-supported institute points out, "Hsinchu and the other

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[71] *Investment clustering* refers to the concentration in some geographic area of firms that are engaged in various aspects of a given business. Investment clusters form because the concentration of firms in a given location supports the development of specialized suppliers, allows labor market pooling, cuts down on transportation, and facilitates knowledge spillovers, all of which help to reduce costs. The concentration of the U.S. semiconductor industry in Silicon Valley and the Taiwanese semiconductor industry in the Hsinchu Science-Based Industrial Park are examples of such clusters in the IT world.

[72] Ma Jun et al., 2002, pp. 15-16.

science-based industrial parks only have so much space."[73] The Hsinchu park, for example, is already home to more than 330 companies, including 133 IC companies, 60 telecommunications companies, 57 opto-electronics firms, and more than 50 makers of computers and peripherals. The Hsinchu park probably already has the world's highest density of production facilities. Problems with water and electrical supplies are also influencing the decisions of Taiwanese companies to move to the mainland.

Clustering. Another important reason for increasing Taiwanese investment in the mainland's high-technology sector is investment clustering. In a recent survey of high-technology companies,[74] some 40 percent of companies with mainland investments said the move by upstream suppliers and downstream clients to the mainland was the primary reason for their investments in China. As Deutsche Bank economic analysts Ma Jun, Zhu Wenhui, and Alan Kwok put it:

> Taiwanese firms tend to cluster together, a trait that is typically shared by IT firms. The tendency is also strong among Taiwanese-invested firms in the mainland. Once the core manufacturers have made the move, down-stream firms and related services providers tend to follow suit voluntarily or involuntarily, or risk seeing their costs rising. The congregation of Taiwanese-funded firms in the Guangdong and Jiangsu areas of the mainland was, to a large extent, a manifestation of the cluster effect.[75]

The first cluster of Taiwanese high-technology firms to take shape on the mainland includes firms in Shenzhen, Dongguan, Guangzhou, and Shunde and comprises a desktop computer supply chain that is almost an exact replica of the high-technology supply chain that stretches from Taipei to Hsinchu.[76] The second cluster of Taiwanese IT companies on the mainland that is now forming around Shanghai, Suzhou, Wuxi, and Hangzhou is likely to become even larger. Some Taiwanese businessmen explicitly

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[73] Interview, Taipei, October 2002.

[74] Nystedt, Dan, "High-Tech Investment Surges 73 Percent," *Taipei Times*, March 5, 2002a; and Wang, Flor, "Mainland Investment Fever Dwindling: Poll," *Central News Agency*, March 4, 2002.

[75] Ma Jun et al., 2002, p. 14.

[76] Ma Jun et al., 2002, p. 14.

draw a parallel between the proximity of Taipei, Hsinchu, and Kaohsiung and the comparable distances in the Shanghai, Suzhou, and Nanjing area in the PRC.[77]

Market Access. Gaining access to the potentially lucrative Chinese market for high-technology goods is another increasingly important motivation for many Taiwanese firms investing on the mainland. According to the survey of high-technology companies by the Taipei Computer Association and *E-Business Weekly,* as many as 80 percent of Taiwanese IT companies are planning to expand production on the mainland in order to increase sales to the domestic Chinese market. At the same time, however, for many firms, the mainland will continue to be primarily an export platform in the immediate future, while exploiting the potential of the domestic market will remain a long-term goal.[78] Nonetheless, among the key reasons Taiwanese companies are moving to the mainland is the fear that their competitors will move in before them and capture the market. This was a factor in the debate on semiconductor regulations (see the section later in this chapter titled "Case Study: Semiconductors").

Electronics Sector Has Become the Main Target for FDI

Taiwanese investment in the mainland is increasingly flowing into high-technology projects. From 1991 to 2000, Taiwanese companies invested $4.796 billion in the Chinese electronics and electrical appliances industry, accounting for about 28 percent of all mainland-bound investments approved by the Taiwanese government (see Figures 3.10 and 3.11).[79]

In the first five months of 2002, more than 49 percent of Taiwanese FDI in the mainland went to the electronics sector, according to MoEA Investment Commission data. The increasing concentration of investment in the electronics sector is reshaping the composition of Taiwanese exports to the mainland, as firms producing IT products in facilities on the mainland require more and more inputs from the island. MoEA Board of

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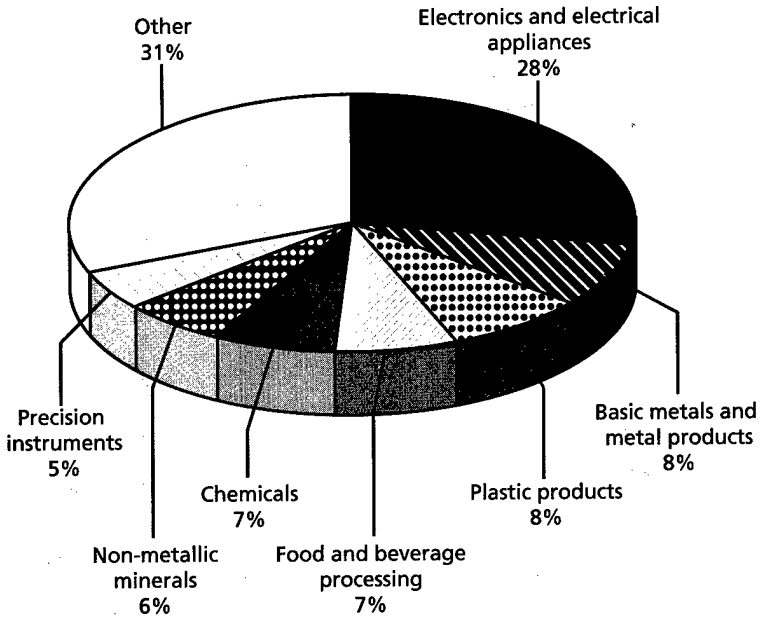
[77] Interview, Washington, DC, September 2002.

[78] Ma Jun et al., 2002, pp. 13-15.

[79] Cheng, Allen T., "The United States of China: How Business is Moving Taipei and Beijing Together," *Asiaweek*, July 6, 2001b.



SOURCE: Investment Commission, MoEA.

Figure 3.10--MoEA-Approved Taiwanese Investment in China by Sector, 1991-2000

Foreign Trade statistics show that electrical machinery and equipment in the first half of 2002 accounted for 31.4 percent of Taiwanese exports to China, up from 22.5 percent in the first half of 2001.

Indeed, the total value of electrical machinery and equipment exported to the mainland rose from $2.587 billion in the first half of 2001 to $4.665 billion in the first six months of 2002, posting an impressive growth rate of more than 80 percent.[80] Statistics on the changing composition of re-exports from Taiwan to China via Hong Kong also reflect the shift of Taiwanese investment in the mainland from textiles to information technology products (see Figure 3.12).[81]

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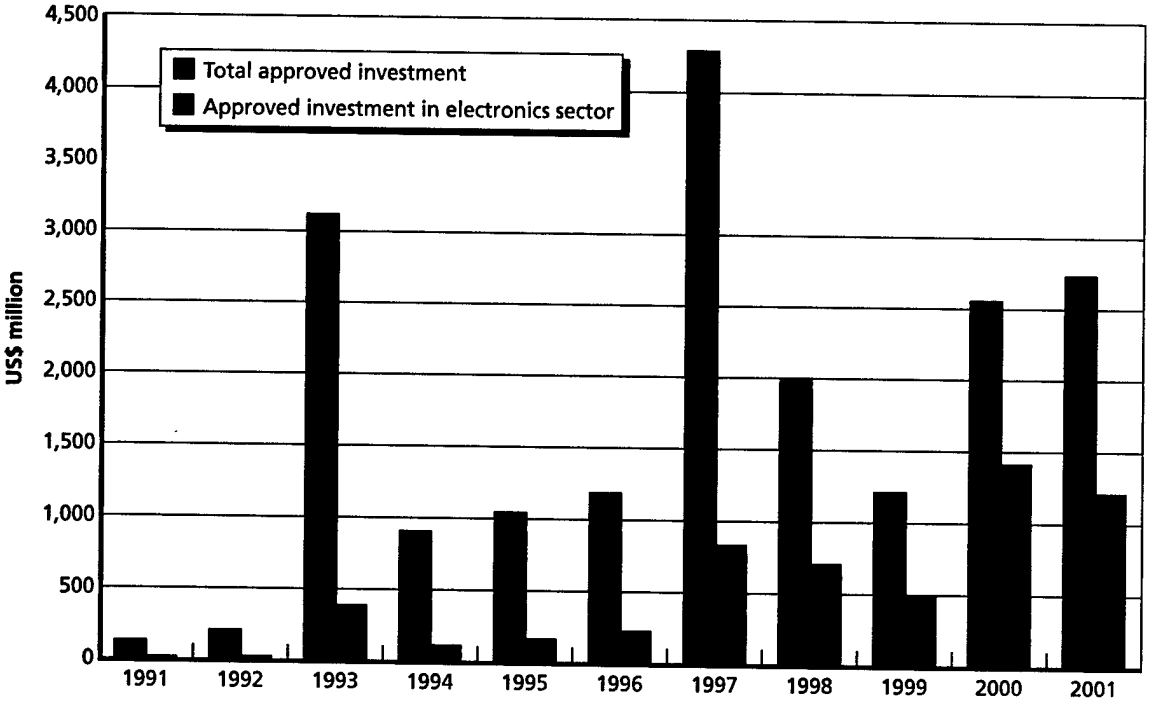
[80] Republic of China, Ministry of Economic Affairs, Board of Foreign Trade, "ROC-China Trade Statistics," June 2002, http://www.trade.gov.tw/eng2002/type_sub_list.asp?sub_code=1041&Rnd=0.6998529.

[81] See Ma Jun et al., 2002, p. 6.

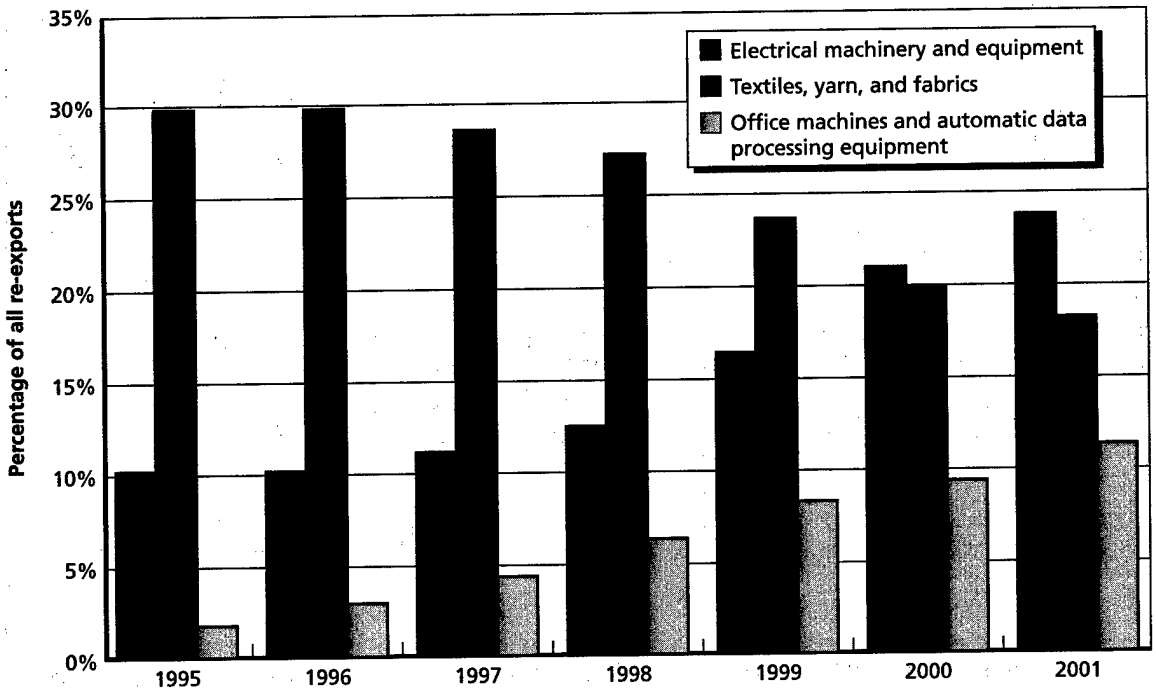


SOURCE: Investment Commission, MoEA.

Figure 3.11--MoEA-Approved Taiwanese Investment in the Chinese Electronics Sector, 1991-2000

Shanghai Fever

Over the past few years, Shanghai has become increasingly alluring to foreign investors from many countries, not the least of which are those from Taiwan, prompting some commentators to proclaim that the island's business community has been afflicted with a case of "Shanghai fever." While that may be an overstatement, to be sure, the global economic downturn, Taiwan's economic slump, and the growing domestic Chinese market are making Shanghai an increasingly attractive destination for Taiwanese companies. At the same time, however, it is important to view the influx of Taiwanese companies in the broader context. As a rough indicator of the speed with which U.S. companies are moving into



SOURCE: Ma Jun et al., 2002.

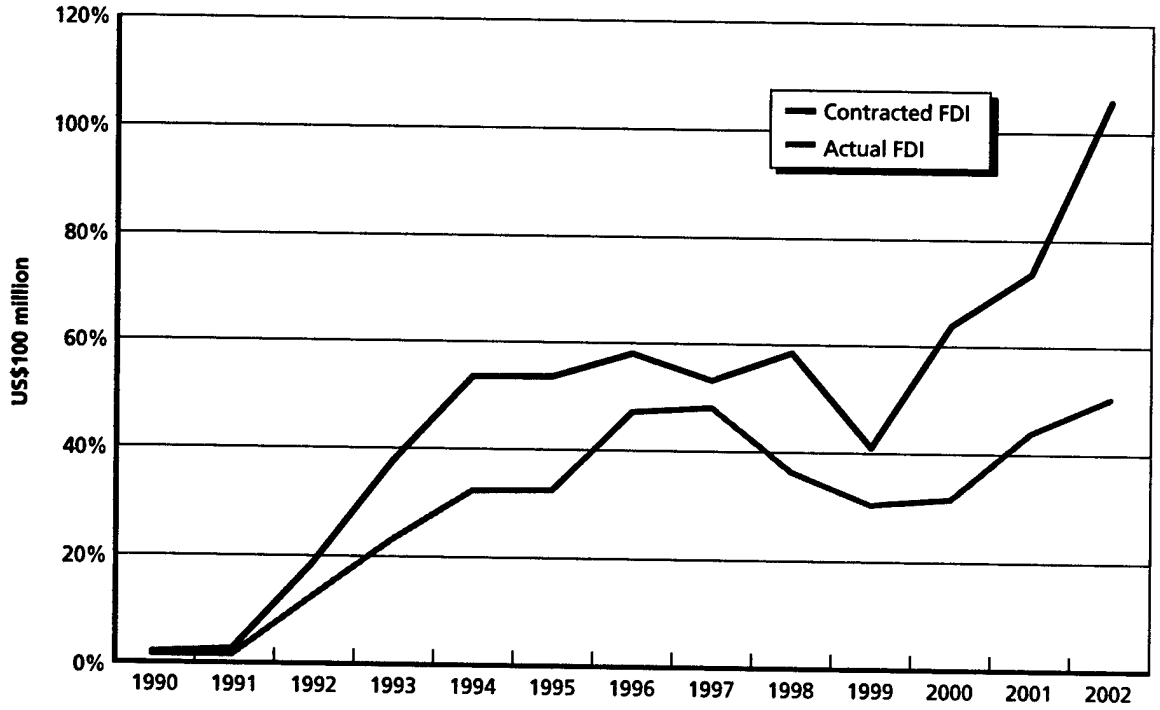
Figure 3.12--Composition of Re-exports from Taiwan to China via Hong Kong, 1995-2001

Shanghai, for example, membership in the American Chamber of Commerce in Shanghai has more than doubled in the past several years.[82]

According to Shanghai officials, the city "has a magnetic attraction" that makes it easy to draw investments from leading foreign corporations, and more than 150 Fortune 500 companies have investments in Shanghai.[83] From 1996 through 2000, the period of the Ninth Five-Year Plan, Shanghai attracted $25 billion in contracted FDI, an increase of about 150 percent over the amount of contracted FDI during the previous five-year period. In 2001, the total amount of actual FDI absorbed by Shanghai was $4.39 billion, up from $3.16 billion the previous year, and

[82] Lawrence, 2001.

[83] "Total of 153 Fortune 500 Enterprises Invest in Shanghai Projects," Shanghai Foreign Investment Service Center, August 7, 2002.



SOURCE: Shanghai Municipal Statistics Bureau, 2002.

Figure 3.13--Foreign Direct Investment in Shanghai, 1990-2002

the total value of contracted FDI was $7.37 billion, up from $6.39 billion the year before (see Figure 3.13).[84]

The Shanghai municipal authorities, for their part, are working to increase the amount of FDI flowing into Shanghai and to entice major multinational corporations to establish their regional headquarters in the city. Shanghai Executive Vice Mayor Jiang Yiren said at a September 2002 conference on foreign investment that Shanghai was moving toward achieving its ambitious targets of $8 billion in contracted FDI and $4.5 billion in actual FDI for the year. In fact, Shanghai exceeded both targets. In 2002, contracted foreign investment in Shanghai reached $10.6 billion, an increase of 43.4 percent over 2001, and actual FDI was just over $5 billion, an increase of 14.6 percent over the previous year

[84] Shanghai Municipal Statistics Bureau, *Shanghai Statistical Yearbook 2002*, Shanghai: China Statistics Press, 2002, p. 129.

(see Figure 3.13).[85] Contracted foreign investment in the service sector increased even more dramatically, rising by more than 75 percent year-on-year, according to the Shanghai Foreign Investment Service Center.[86] One of the biggest sources of investment in Shanghai during 2002 was the British Virgin Islands, with $1.53 billion during the first nine months of the year.[87]

As overseas investment in Shanghai increases, foreign-invested companies, especially those in the IT sector, are playing a larger role in the city's economy. Foreign-invested enterprises in Shanghai accounted for 60 percent of the city's exports in the first five months of 2002. The fastest growth rate is in the IT products sector, and Philips, Siemens, and Intel are among the city's top overseas-funded exporters, according to the Shanghai Municipal Foreign Trade and Economic Cooperation Commission.[88]

The city authorities are also making progress toward their goal of enticing 200 major multinational corporations to move their Asia-Pacific headquarters to Shanghai by 2005. Although some companies prefer to remain in Hong Kong or other cities in the region, some 78 companies have already established regional or Chinese headquarters in Shanghai, including eight companies that shifted their regional headquarters to Shanghai during the first eight months of 2002. In 2003, both Honeywell International[89] and United Parcel Service (UPS) [90] announced that they would move their regional headquarters to Shanghai. Several other

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[85] Shanghai Municipal Statistics Bureau, 2003, http://www.stats-sh.gov.cn/2003shtj/2003shtj.htm (last accessed March 2004).

[86] "Foreigners Invest More in City, Open Headquarters," Shanghai Foreign Investment Service Center, September 3, 2002. The amount of actualized foreign investment received during the first eight months of 2002 was $2.74 billion, a much more modest increase of 1.1 percent over the same period in 2001.

[87] Although firms from many countries use offshore investment vehicles, analysts say a significant proportion of the money that flows into Shanghai via the British Virgin Islands is investment from Taiwan companies.

[88] "Overseas-Funded Firms Dominate Exports," *Xinhua*, July 20, 2002.

[89] "Honeywell to Move Regional Headquarters from Singapore to Shanghai," *People's Daily*, June 19, 2003.

[90] "UPS to Move Its Regional Headquarters to Shanghai," *People's Daily* (online), July 4, 2003.

companies--including major high-tech companies such as Advanced Micro Devices Inc. (AMD)--reportedly are planning to move their regional headquarters to Shanghai in the near future. Indeed, the shift toward Shanghai appears to be well underway, and it may accelerate further as Hong Kong's allure diminishes relative to that of Shanghai, and Shanghai becomes an increasingly attractive place to live for expatriates, Chinese professionals, and Chinese students returned from overseas.

The Pudong New Area, with its futuristic skyscrapers, is in many respects emblematic of Shanghai's accelerating economic growth. Established in 1990, Pudong was once derided as a major economic disappointment, but has become increasingly attractive to foreign investors over the past several years, particularly in the wake of China's accession to the World Trade Organization. The district is now home to the regional headquarters of 22 major multinational corporations, and nearly $40 billion in FDI has poured into the Pudong area in the past 12 years, accounting for approximately 33 percent of all FDI in Shanghai during the period. Among the major foreign investors in Pudong are General Motors and Kodak, each of which has invested more than $1 billion in the district. In addition, several foreign high-technology companies, including IBM and Intel, have opened R&D centers in Pudong. Foreign-invested enterprises in Pudong now account for about 50 percent of the district's fiscal revenue, roughly 50 percent of its exports, and almost 80 percent of its high-technology output.[91] Over the past decade, exports by foreign-invested enterprises in Pudong have grown at an average annual rate of 53 percent. Although Shanghai has proven to be an effective platform for exports, many foreign IT companies are increasingly focusing on building a presence in the city that will allow them to tap China's growing domestic market.

The region surrounding Shanghai has also become an extremely attractive destination for foreign investors. In particular, cities in Jiangsu Province including Suzhou, Kunshan, and Nanjing are benefiting from the surge of investment. Jiangsu provincial government statistics

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[91] "Booming Pudong Attracts 39 Billion US Dollars in Overseas Investment," Shanghai Foreign Investment Service Center, August 20, 2002.

show that contracted investment in the province for the first half of 2001 was $3 billion, up more than 40 percent from the same period in 2000.[92] Foreign direct investment in Suzhou is growing rapidly. Suzhou has a variety of benefits for foreign investors. It is close to Shanghai, but is less expensive. Perhaps more important, the city is managed well, and it is possible for investors who would not even be noticed in Shanghai to get a high level of attention from local government officials. "It's a small pond, so someone who could never even get a meeting with a vice mayor in Shanghai can easily call and get a meeting with the mayor of Suzhou," according to a representative of a U.S. business association.[93]

Why Taiwanese Firms Are Attracted to the Greater Shanghai Region

The allure of Shanghai and the Yangtze River Delta is equally as strong for many Taiwanese firms as it is for foreign companies.[94] By the end of 2001, Taiwanese firms had invested in slightly more than 3,000 projects in Shanghai, ranking second to Hong Kong companies, which accounted for nearly 8,000 investment projects; companies based in the British Virgin Islands, many likely channeling funds from Taiwanese investors, had invested in nearly 400 projects (see Figure 3.14).

In 2001, Taiwan was Shanghai's fourth-largest source of contracted FDI, with 4.5 percent of the total, and actual FDI, with 4.8 percent, ranking behind Hong Kong, Japan, the United States, and Singapore.[95] More than half of Taiwanese investment in the mainland went to the

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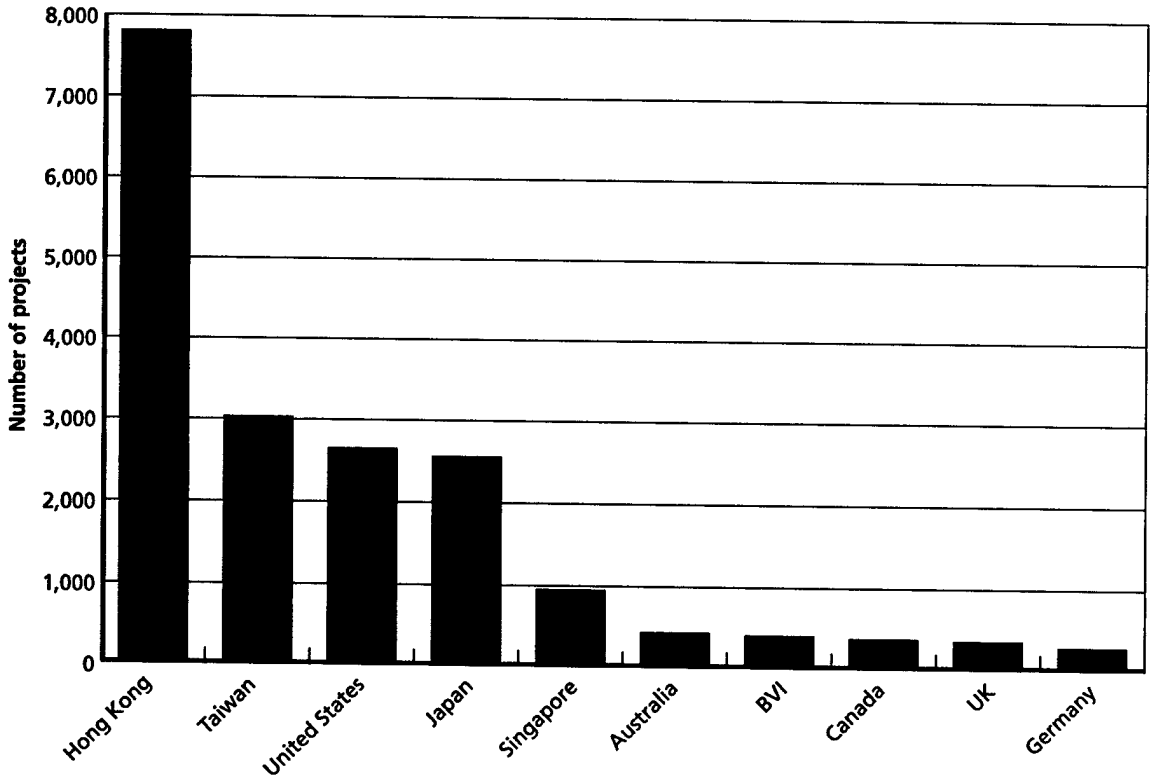
[92] Another beneficiary is Zhejiang Province, which received $2.2 billion in actual FDI in 2001.

[93] Interview, Shanghai, October 2002. The only potential problem in Suzhou is that it is not as easy to find highly educated employees as it is in Shanghai.

[94] The fascination with Shanghai is also reflected in the popularity among Taiwanese of television shows, music, and movies that evoke romantic images of the city, and in the proliferation of Shanghainese restaurants and nightclubs in Taipei. The phenomenon, however, is by no means universal: Some observers say that the majority of Taiwanese who are drawn to Shanghai come from mainlander backgrounds. See, for example, Huang, Andrew, "Looking for Shangri-La," *Topics Online Magazine*, American Chamber of Commerce, Taipei, November 1, 2002.

[95] Shanghai Municipal Statistics Bureau, 2002, p. 130.



SOURCE: Shanghai Foreign Investment Service Center website, http://www.sfisc.com/.

Figure 3.14--Foreign Direct Investment Projects in Shanghai, as of December 2001

Shanghai region that year, and it has become the destination of choice for Taiwanese high-technology companies.[96] As with other foreign companies, Taiwanese firms are also moving into other cities in the region, such as Kunshan and Suzhou. For example, AU Optronics opened a $150 million flat-panel display factory in Suzhou in early 2003.[97]

[96] Interest in Shanghai is so strong now that it seems like "every Taiwan venture cap and its dog are moving to Shanghai," one industry analyst quipped.

[97] Unlike many companies, AU Optronics envisions that its design, marketing, and management teams will move to the mainland over the next five years, eventually making its operations in China look exactly the same as those in Taiwan.

Along with the surge of Taiwanese investment in the Greater Shanghai region has come the development of a community of Taiwanese businessmen and their families in the area. The Taiwanese influence is apparent in several cities around Shanghai, most notably Kunshan, where Taiwanese teahouses and restaurants abound along with factories backed by companies from the island.

Professionals in Taiwan who are moving to Shanghai are attracted by the possibility of rapid career advancement and the opportunity to enjoy a lifestyle that would be beyond their means in Taiwan. In the words of one observer, "No doubt, Shanghai holds great appeal to Taiwanese and much of it can be summed up in one word: opportunity."[98] Estimates of the number of Taiwanese living in Shanghai run as high as one million, but most commentators put the size of the Taiwanese community in the city and surrounding areas at between 300,000 and 400,000.[99] The sources for recently published estimates appearing in Western and regional media reports of the number of Taiwanese citizens living in and around Shanghai are frequently uncertain, however, and sources in Shanghai say that the numbers given in Western media reports may be too high. Indeed, the MAC reportedly estimates that there are 300,000 to 500,000 Taiwanese citizens working on the mainland, which would suggest that the numbers in Shanghai are lower than what is frequently reported. If the estimates are accurate, the number of Taiwanese in Shanghai would probably exceed the combined total of Americans and Europeans living in the city.[100] One source of the discrepancy in these estimates may be that the estimates are based on different definitions of what constitutes residence in China. The estimate that 500,000 Taiwanese citizens live in Shanghai apparently includes anyone who spends at least several months per year in the area, and other estimates that place nearly one million Taiwanese citizens on the mainland apparently also include businessmen who reside in China for only part of the year. In addition, the ethnic distribution of Taiwanese citizens on the mainland is unclear, although many

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[98] Boyce, Jim, "Shanghai Surprise," *Topics Online Magazine*, American Chamber of Commerce, Taipei, November 1, 2002b.

[99] See, for example, Meredith, Robyn, "Taiwanese 'Invade' China with Investments," *The Star Online*, October 18, 2002.

[100] Boyce, 2002b.

observers believe that it reflects the demographics of the island in that among Taiwanese citizens living in China there are more Taiwanese than there are mainlanders.

Whatever the exact number of Taiwanese citizens living in the region, fears that Taiwan's best and brightest will desert the island in droves for the allure of Shanghai are likely exaggerated. One reason is the tightening employment market in the city. According to managers at executive search firms in Taiwan, the job market in Shanghai is becoming much more competitive for Taiwanese and expatriates from other countries, as companies operating in the city increasingly are turning to local talent or Chinese students returning from overseas to fill many vacancies.[101] Indeed, recent surveys confirm that Taiwanese firms with investments in China are increasingly willing to hire mainland Chinese workers to fill lower and middle-management positions.[102] At the same time, many Taiwanese professionals are returning to the island after spending a few years in Shanghai. Some analysts expect the trend to accelerate along with improvements in the U.S. and Taiwanese economies.

Despite fears that closer economic integration with the mainland will spark an outflow of Taiwan's most talented professionals to the greater Shanghai region, it is possible that the establishment of direct links would actually have the opposite effect. Eliminating the stopover in Hong Kong would shorten flight times between Taipei and Shanghai, making it more convenient and less expensive for the island's high-tech specialists and managers at IT companies to live in Taiwan and to travel to the mainland more frequently on business. Indeed, some observers in Taipei say that the establishment of direct air transportation between Taipei and Shanghai would reduce one of the major incentives that Taiwanese businessmen have for living on the mainland.

For Taiwanese companies, the allure of Shanghai includes the city's cosmopolitan reputation and lifestyle, its strategic location and solid infrastructure, attractive government incentives, the advantages

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[101] Boyce, 2002b.

[102] "Big Taiwan Firms Look Across Strait," *CNA*, April 18, 2002. The poll indicated that more than 60 percent of Taiwan's largest companies expect Taiwanese middle managers to be replaced by mainland Chinese.

of investment clustering, a strong regional human resources base, and the need to respond to customer pressure for lower prices and for the convenience of proximity to customers who have opened or who plan to open facilities in and around Shanghai.

Lifestyle. As the most cosmopolitan city in China and a traditional center of trade and finance, Shanghai offers an attractive lifestyle to employees of Taiwanese companies.

Location. Shanghai, Nanjing, Suzhou, Kunshan, Wuxi, and other cities in the region are all within a few hours driving distance of each other, so investing in the area provides ready access to domestic and overseas markets. The area is a particularly attractive base for companies interested in making inroads into the domestic market because many potential Chinese customers are in the East China region. In addition, much land is available around Shanghai.

Infrastructure. The region has a strong industrial base and is rapidly emerging as a business and transportation center. The Greater Shanghai area features two international airports--Hongqiao and the new Pudong Airport--a major rail hub, China's biggest port, a developing regional highway system, an expanding subway system, and excellent information technology and telecommunications resources. In an effort to make the city more attractive to foreign investors, the Shanghai municipal government invested more than $18 billion in public transportation, communications, electrical power, gas, and the water supply over the past several years.

Government Incentives. Local governments throughout the region are very cooperative with Taiwanese investors. The Shanghai municipal government is offering attractive incentives, and the local government offers preferential tax policies that are especially favorable to foreign companies investing in the Pudong New Area. In addition, foreign investors report that dealing with the government bureaucracy in Shanghai and cities in the Yangtze River Delta region is less problematic than in other regions in China. Some say corruption is not as endemic there as it is in many other parts of the country. One Taiwanese manager told us that the problems he encounters with Chinese

officials are less frustrating in Shanghai than they are in Guangdong.[103]

Clustering. Industry analysts say initial tax breaks and incentives generated a "snowball effect" that has led Taiwanese IT companies to cluster in the region. One analyst said this "network effect" in Shanghai is "gaining critical mass" and that Taiwanese companies are "replicating the Taiwanese model" in Shanghai.[104] The greater Shanghai area has been emerging as *the* prominent center of activity, especially over the past few years, the analyst continued, and "as more Taiwanese suppliers go in and economies of scale rise, so they draw the rest of their upstream and downstream partners with them."

Human Resources. Shanghai, Jiangsu, and Zhejiang have a high concentration of highly educated people, and the growing pool of technical talent in Shanghai and surrounding areas is another resource that is attracting foreign companies to the region. According to the Shanghai Foreign Investment Service Center, there are 1.41 million technical personnel in Shanghai.[105] Shanghai and nearby cities such as Suzhou and Nanjing are home to several of China's best universities. In all, Shanghai, Jiangsu, and Zhejiang have ten major universities and 38 science and engineering schools.[106] Moreover, many graduates from Beijing's most prestigious universities, as well as Chinese students returning from overseas, are also drawn to job opportunities in Shanghai.

Customer Pressure. In addition to pressure to cut costs, according to Anthony Lawrence, "Multinational partners . . . are pushing Taiwanese suppliers into Shanghai to set up links in their global supply chain which are closer to the burgeoning Chinese market."[107]

Climate. The supply of water needed in manufacturing can play a significant role in determining where to locate a plant. As such, climate can influence the semiconductor industry in terms of the choice

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[103] Interview, Taipei, October 2002.

[104] Lawrence, 2002.

[105] Shanghai Foreign Investment Service Center, "Shanghai Overview" website, http://www.sfisc.com/over.htm (last accessed March 2004).

[106] National Bureau of Statistics, 2002, pp. 682-683.

[107] Lawrence, 2002.

of manufacturing locations. Some wafer manufacturers have declined offers from Beijing to move their facilities to the city because of Beijing's arid conditions and sand storms.

Risks of Investing in China

Despite Shanghai's allure to Taiwanese investors and businessmen, operating in the region still means dealing with many of the same problems that confront foreign firms doing business throughout China. Taiwanese companies confront at least three major problems in China, according to a manager working for a Taiwanese high-technology company. The first is political sensitivity. Taiwanese managers working on the mainland are aware that they "can't say anything political." The second problem concerns the rampant violations of intellectual property rights. Another problem is the unpredictability of the Chinese government. One Taiwanese high-technology manager said that given China's insistence on upholding the "one China" principle, he finds it particularly frustrating that China treats Taiwanese firms as "foreign" companies. "If they say there is only 'one China' and Taiwan is part of it," the manager pointed out, "then we should be treated as a local company, but we're not!"[108]

For Taiwanese semiconductor companies preparing to establish IC wafer fabrication plants, called "fabs" for short, on the mainland, the risks of investing in China include unpredictable and arbitrary changes in policy and the widespread lack of protection for intellectual property. However, IPR issues may pose bigger risks for design companies than they do for foundries. Semiconductor industry executives note that the high costs of building a fab would prohibit most companies from copying from their Taiwanese competitors even if they had all the information.[109]

CASE STUDY: ACER

Acer, which was established in 1976, has become Taiwan's largest computer company and one of the top-ten branded PC vendors in the world.

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[108] Interview, Taipei, October 2002.

[109] Interviews with industry executives, Taipei, October 2002.

Acer entered the PC business in 1984 as Multitech, became Acer in 1987, and the divided into several groups--including Acer, Wistron, and BenQ Corporation--in late 2000. In company parlance, the groups are referred to collectively as the Pan Acer Group, while Acer itself is referred to as New Acer. Within the new organizational framework, New Acer is concentrating on marketing and services, Wistron is responsible for design and manufacturing of IT products for original equipment manufacturer (OEM) customers, and BenQ focuses on cross-media digital devices and computer peripherals. Acer is also one of the major manufacturers of TFT-LCD panels in the world. The chairman and CEO of Acer is Stan Shih, one of Taiwan's most famous high-technology executives. To cope with a chronic shortage of trained high-technology workers, Acer maintains a training academy near the Hsinchu science-based industrial park, licenses its training courses to several universities, and offers an online study program.

Acer, like other Taiwan IT companies, is moving production facilities to China to take advantage of lower labor costs. Acer established facilities in Malaysia (Penang) and the Philippines (Subic Bay) approximately ten years ago because there were no opportunities to invest legally in China at that time, but for the past few years, the company has been moving its manufacturing capacity to Shanghai and Guangdong. The largest Taiwanese investment in China is Acer's motherboard plant in Chungshan, which will have an annual production capacity of more than six million motherboards when production is ramped up.

Wistron has sites in several cities on the mainland. It manufactures notebooks in Kunshan and desktops in Zhongshan at its Zhongshan subsidiary A-Open. Wistron also operates an R&D center in the Shanghai area. The R&D center employs approximately 70 engineers and focuses on servers and software. BenQ assembles peripherals in Suzhou, where it plans to expand its operations as it downsizes its Penang, Malaysia, facility. Acer is primarily focusing on branding, sales, and marketing in China. It has two "final configuration centers" (final assembly and shipping centers, like the one that Dell operates in Xiamen)--one in Beijing and one in Zhongshan, Guangdong Province--and

seven branch offices that handle sales and services on the mainland, where they provide a two-hour service guarantee to Acer's customers.

The Acer facilities in China concentrate mainly on exports, which is encouraged by the Chinese government.

In 2001, about 44 percent of Acer's annual revenues came from the European market, around 24 percent came from the Greater China market, and 19 percent came from the rest of the Asia-Pacific region; only 13 percent of Acer's annual revenues in 2001 came from the United States, where the company is downsizing. More than three-quarters of Acer's 2001 annual revenues was generated by sales of notebooks, which accounted for 43 percent of revenues, and desktops, which accounted for 33 percent.

Rising PC sales in Europe and China helped Acer post impressive profits in late 2002.[110] The company forecasts that its annual revenues will rise 20 to 30 percent in 2003, driven in large part by an expected 100 percent increase in sales in China, the Asia-Pacific region's fastest growing PC market.[111]

Currently around 40 percent of Acer's sales come from Europe and about 20 percent come from China, but the company expected that the percentage of sales from China will increase to 30 percent by the end of 2003, boosted mainly by rising demand for home PCs in China.[112] Acer's current share of the home PC market in China is about 2 to 3 percent, but CEO Stan Shih said he expects the share to rise to 5 percent by 2005. Acer is fifth in notebook PC production on the mainland. According to Acer's projections, the annual demand for PCs in China will increase by 33 percent by 2005 or 2006.[113]

Acer plans to expand its Greater China operations. In July 2003, it decided to open two new offices--in Urumqi, Xinjiang Province, and Zhengzhou, Henan Province--bringing the total to 18.[114] Shih has said

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[110] "Acer Returns to Profit as PC Sales Rise," *South China Morning Post*, October 30, 2002.

[111] Tzeng, David, "Acer Expects to Lift 2003 Revenues to NT$120 Billion," *DigiTimes.com*, October 21, 2002.

[112] "Acer Returns to Profit . . .," 2002.

[113] Hung, Faith, "Acer Takes Aim at China's PC Market," *EBN*, May 31, 2002b.

[114] "Acer to Set Up Two New Branches in Mainland China," *Taiwan Economic News*, July 17, 2003.

his goal is to make Greater China account for 40 percent of Acer's annual revenue by 2006. At the same time, Acer will increase its investment in research conducted in Taiwan. The company's plan for investment in Taiwan includes the establishment of an integrated circuit design house and company-affiliated institutes and colleges.

Acer executives noted that Shanghai was an obvious choice for Acer for several reasons: It is "the most convenient" city on the mainland; it is easy to get labor (labor costs are about the same as in Zhongshan); it has a central location, making it suitable to support South Korea, Japan, and the rest of the Asia Pacific; and it is a "very commercially oriented city." Other cities along the Yangzi River, such as Changzhou and Wuxi, are also convenient locations for Taiwanese IT companies because it is easy for businesses there to make shipments through Shanghai.

Local governments provide companies such as Acer with a variety of incentives, including facilities, construction assistance, transportation infrastructure, and tax breaks. Local government incentives were important factors in Acer's decision to choose Shanghai and were ranked the number-two priority for Acer, following access to the pools of labor and high-technology talent in the Shanghai area, which was the number-one priority for Acer. Companies like Acer require both basic and more highly educated labor. What makes Shanghai and its surrounding areas particularly appealing is that they have ample supplies of both. Nevertheless, Acer sources said that it is still difficult to find "good R&D people." Another problem for Acer is that even Chinese employees who are highly competent technically lack commercial training and business savvy. They also tend to switch jobs frequently, leading one Acer manager to lament that Chinese employees "aren't loyal." He also said that while the individual capabilities of Chinese staff are generally good, group productivity and teamwork skills on the mainland are not as good as they are in Taiwan.

There are about 300 people in Acer's two final configuration centers and seven sales and service centers on the mainland; only 19 of the 300 are from Taiwan. Acer is starting to promote Chinese employees to the middle-management level on the mainland. Few Acer employees on

the mainland have studied in the United States, but Acer hopes to send two or three Chinese employees to the United States for further study in the near future.

CASE STUDY: SEMICONDUCTORS

This section focuses on the semiconductor industries of Taiwan and China. It provides a brief introduction to semiconductor technology, assesses the industrial policies of the Chinese and Taiwanese governments, and discusses the key semiconductor manufacturers on both sides of the Taiwan Strait.

Technology

An *integrated circuit,* sometimes also called a *chip* or *microchip,* is a semiconductor wafer on which thousands or millions of tiny resistors, capacitors, and transistors are fabricated. Integrated circuits are used in an increasing variety of consumer products, including personal computers, digital cameras, and cell phones, and in military applications ranging from high-performance computers to cruise missiles.

The two main features of an IC that require explanation are its wafer size and the width of the circuits on a chip. The larger the wafer, the more chips it can hold. A grown silicon crystal is cylindrical in shape, causing each cross-sectional wafer cut from it to be circular. Rectangular chip dies cannot fit into the curved edge of the circular wafer, but the number of chips a wafer can hold grows geometrically with the diameter of the wafer because a smaller proportion of the wafer's area borders its perimeter. Thus, the larger the wafer, the less of its silicon "real estate" is wasted. For example, a 12-inch wafer (the new standard for chipmaking) can yield 2.4 times more chips than an 8-inch wafer (the current standard), thereby boosting a fab's output while cutting its cost per chip.[115]

A second, and more important, factor in chip design is miniaturization. Over time, the miniaturizing of IC technology has been

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[115] Brown, Stuart F., "Building for the Next Chip Boom," *Fortune* (online), August 12, 2002.

governed by Moore's law, a 1965 empirical observation by Intel co-founder, Gordon Moore, that the density of transistors on a semiconductor microchip doubles every 18 to 24 months.[116] The number of transistors that can fit onto a chip is determined by the width of the circuits (in microns) that connect them. Narrower circuits allow more transistors to be put onto a chip, enabling the chip to work faster. Intel's original 4004 chip, introduced in 1971 with 10-micron technology, had 2,300 transistors. Intel's newest chip, the Xeon Processor MP, has 0.13-micron (about one-thousandth the width of a human hair) technology and crams 108 million transistors onto a chip.[117] Improvements continue to be made. Samsung Electronics announced in September 2002 that it was the first company in the world to produce memory chips with 90-nanometer (nm) (0.09-micron) technology.[118] The economic effect of Moore's Law over the past 40 years has been a rapidly decreasing price-to-performance ratio of between 36 and 56 percent as technology improves and prices for electronics remain nearly constant or drop. But the drive for finer circuit width will not last forever. The effect of Moore's Law is expected to end around the second half of the next decade as the task of making chips runs up against the laws of physics.

Other technology enhancements, however, can also make microchips more productive. IBM announced in November 2002 that it had built a transistor that can run at speeds of 350 Gigahertz, which is three times faster than current technology.[119] There is also a shift from using aluminum wiring to copper wiring to connect the millions of transistors on a chip.[120] Copper has less electrical resistance than aluminum, so electricity flows through it more quickly and without generating as much heat. Such a feature is popular with laptop and cell phone manufacturers who are trying to increase performance and battery life while lowering

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[116] For a discussion of Moore's Law, see Intel's "Silicon" web page (http://www.intel.com/research/silicon/mooreslaw.htm).

[117] Intel website (www.intel.com).

[118] Intel website.

[119] "IBM Builds Fastest Silicon Transistor," *South China Morning Post* (online), November 5, 2002.

[120] Brown, 2002.

operating temperatures.[121] Intel is also developing a semiconductor chip with all the functions of a cell phone, dubbed a "system on a chip," which could eventually be applied to digital cameras, MP3 players, and personal computers.[122]

These continual advances in technology have forced chip manufacturers to continue improving their product or else fall behind their competitors. According to Andy Bryant, chief financial officer of Intel, "The pace of technology doesn't change, even during recessions, and if you want to be in the business, you have to continue on through the downturns."[123] These competitive pressures have important implications for the industry as the technology becomes more complicated. Developing a new product can now cost between $500 million and $1.5 billion.[124] Better technology has also required advances in equipment to manufacture new chips, which raises costs. Consequently, retooling to make the new 12-inch chips is becoming so expensive that it may be out of reach for companies with annual sales of less than $5 billion.[125] The cost of building new 12-inch wafer fabs is also increasing and is now estimated to be around $3 billion as compared to the roughly $1.8 billion need to manufacture 8-inch wafers.[126] The combination of larger wafer sizes with smaller and improved circuitry and more complex semiconductors may make it increasingly difficult for smaller fabs to continue in the market and for new companies to enter into the market. Intel, for example, boasts that its "system on a chip" design will render existing modem chipmakers obsolete. Such technology may also increase profits in another way by making chip packaging operations and other steps in the manufacturing chain redundant.[127]

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[121] Brown, 2002.

[122] Park, Andrew, Cliff Edwards, Andy Reinhardt, and Irene M. Kunii, "Dawn Of The Superchip," *Business Week*, November 4, 2002, p. 128A.

[123] Park et al., 2002, p. 128A.

[124] Swanson, K. C., "Demand for Leading-Edge Chips Could Catch Some Unawares," *thestreet.com*, July 2, 2002.

[125] Brown, 2002.

[126] Richter, Allan, "Size Matters," *Semiconductor Magazine* (online), July 2002.

[127] Park et al., 2002.

Taiwan's IC Industry

Semiconductors began to be assembled in Taiwan in 1963 when Philco-Ford set up an assembly operation, which was soon followed by a dozen U.S.-owned assembly plants. As more Taiwanese employees began to form their own semiconductor companies, the Taiwanese government searched for ways to promote the industry, and attention focused on starting a wafer fab industry. A government-owned think tank called the Industrial Technology Research Institute (ITRI) began preparations by offering courses at the Jiaotong University on wafer fabrication and setting up a test line for experimental manufacturing. In 1978, after about one year of operation, ITRI decided to take the production line commercial and founded UMC. UMC's success was rapid. In 1987, by cashing in on the deregulated phone market in the United States, the company was able to increase sales to more than $100 million.

The success of UMC prompted Taiwanese government officials to consider supporting a more advanced fab while keeping in line with the government philosophy of encouraging private investment rather than attempting to create a nationalized industry. The government turned to Morris Chang, who had been a senior executive at Texas Instruments for 23 years before returning to Taiwan, to run a new company. In 1987, after Chang assembled a top management team and attracted investment funding from Philips, the company--TSMC--was founded.[128]

Since then, Taiwan's semiconductor industry has thrived, rapidly narrowing the technological gap that once separated it from world leaders. In 1986, Taiwan process technology trailed world leaders by six years, but by 1991 Taiwan was only one year behind, and by 2000 it had reached state-of-the-art levels.[129] The island has also become the fourth-largest market for semiconductors in the world and dominates wafer manufacturing. TSMC alone was estimated to have more than a 50 percent share of the foundry[130] market in the first half of 2003 (see Figure 3.15).

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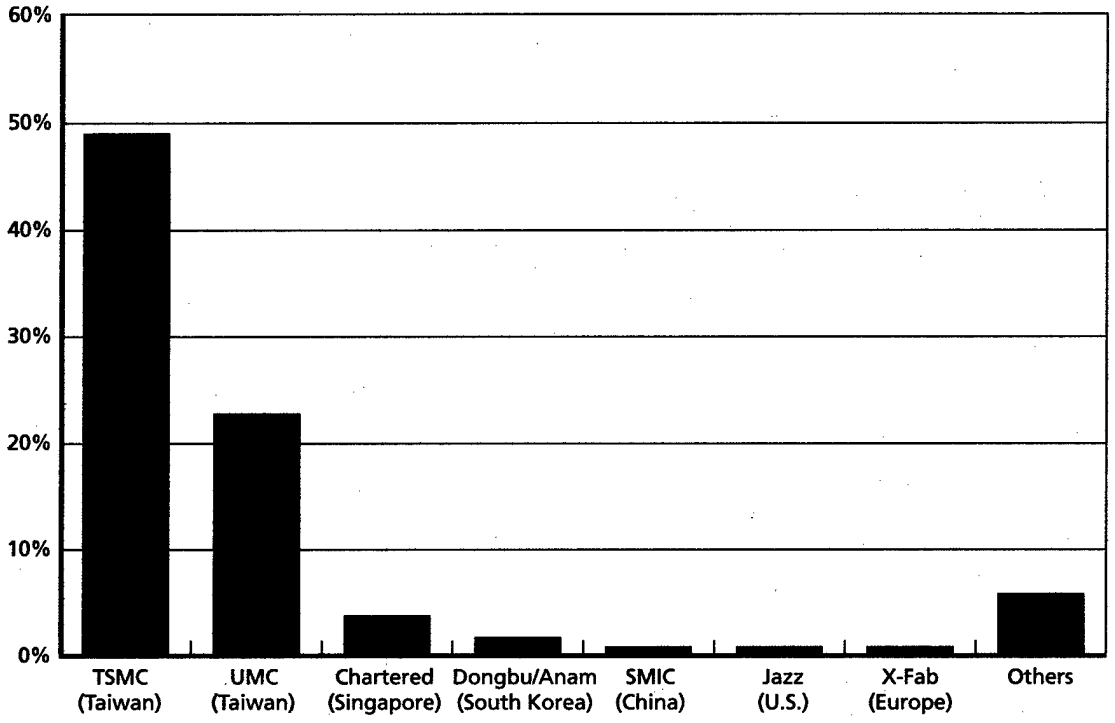
[128] Warshofsky, Fred, *The Chip War,* New York: Charles Scribner's Sons, 1989, pp. 194-210.

[129] Chin Chung, 1997, p. 195.

[130] Foundries are companies that produce semiconductors on order for chip designers.



SOURCE: LaPedus, Mark, "IC Insights' Pure-Play Foundry Rankings for 1H03," *Silicon Strategies*, August 20, 2003.

Figure 3.15--Market Share of Major Foundry Companies, as of First Half of 2003

Taiwan's chip production increased by 226.2 percent from 1995 to 2000, and in 2001, the dollar amount of Taiwan shipments of semiconductors reached $15.6 billion. The island is also the world leader in semiconductor assembly.[131] While Taiwan's semiconductor industry has experienced a downturn with the burst of the high-technology bubble, it still continues to play an important role in the world economy. Nevertheless, it is facing increasing pressure to locate facilities on the mainland in order to exploit the Chinese market and to better service mainland exporters by offering quicker turnaround times. The manufacturing of chips in China also allows firms to pay a lower value-added tax (VAT). The recent slowdown in the development of several

[131] United States International Trade Commission, 2002, pp. 5-20.

potential Chinese competitors, however, has reduced TSMC's and UMC's concerns about losing market share and lessened their sense of urgency about opening production facilities on the mainland.[132]

Taiwanese Government's IC Policy

After more than a year of acrimonious political debate and extensive lobbying efforts by major Taiwanese semiconductor companies, including industry leaders TSMC and UMC, the Taiwanese government early in 2002 relaxed its ban on investment in semiconductor facilities on the mainland. On March 29, 2002, Premier Yu Shyi-kun announced the government's decision to allow Taiwanese chipmakers to build 8-inch wafer fabrication plants in China. In the announcement, the ROC government offered the following explanation:

> In view of the future competition for the mainland semiconductor market, the ROC government now allows its businesses to invest and develop an early presence there. This is to ensure that Taiwan's businesses can compete effectively with other nations and the Chinese mainland in the future as well as maintain Taiwan's leading international position in the wafer manufacturing industry. However, lifting the ban on investment in the Chinese mainland must follow commitments by Taiwan manufacturers to continuously upgrade the development of the local semiconductor industry and prevent Taiwan's core technologies from flowing into the Chinese mainland.[133]

Taipei-based analysts assert domestic politics was the driving force on the issue of permitting Taiwan companies to open chip foundries on the mainland. The issue became "almost as politicized as the nuclear power plant controversy," according to a former U.S. government official, with the Chen administration facing intense lobbying by the business community on the one side and heavy pressure from pro-independence politicians on the other. The island's semiconductor companies, led by TSMC and UMC, argued that moving some of their older production equipment to the mainland while they moved ahead with

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[132] "China's CSMC Gets $67 Million For Foundry Expansion But Other Mainland Projects Are Slowing, Say Analysts," *The Semiconductor Reporter*, August 5, 2003.

[133] "Premier Yu Shui-kun's Policy Statement on the Liberalization . . . ," 2002.

investments in more advanced 12-inch wafer production facilities in Taiwan made good business sense and would contribute to Taiwan's economic recovery. The industry leaders made a concerted effort to persuade the government to relax the restrictions. According to a senior TSMC official, getting the restrictions on investments in 8-inch wafer fabs lifted required intensive lobbying at the highest levels.[134]

On the other side of the debate was the TSU, which strongly opposed the decision to allow Taiwanese semiconductor companies to invest in fabs on the mainland, arguing that the transfer of manufacturing capacity to China would result in increased unemployment and a "hollowing-out" of Taiwan's high-technology industry. Chen Chu, chairwoman of Taiwan's Council of Labor Affairs, charged that allowing manufacturers to move 8-inch wafer fabs to the mainland would result in the loss of 18,000 jobs in Taiwan by 2005.[135] Other opponents of the measure argued that it would allow China to steal advanced Taiwanese technology and that "hollowing out" would be accelerated if the relaxation sparked a migration of Taiwanese design and packaging and testing companies to the mainland.[136] Former president Lee Teng-hui suggested that Taipei should wait for China to renounce the use of force before permitting Taiwanese semiconductor companies to establish 8-inch wafer fabs on the mainland.[137] Following the announcement of the new policy, Lee publicly criticized the government's decision, warning that China's rapid economic development and Taiwan's increasing dependence on the mainland would threaten the island's sovereignty and national identity.[138] Some TSU politicians even suggested that relaxing the ban

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[134] Interview, October 2002.

[135] Lin Mei-chun, "Moving Wafer Fabs Would Cost 18,000 Jobs," *Taipei Times*, March 20, 2002.

[136] See, for example, "Plans for Moving Wafer Fabs Brings 'Security Versus Business' Debate," *Taipei Journal*, March 15, 2002.

[137] "No Rush to Allow Wafer Investment in Mainland China: Ex-President," *Central News Agency*, March 10, 2002.

[138] "Choose Between Taiwan and Mainland: Lee," *China Post*, June 8, 2002. Speaking on the question of Taiwan's identity at a TSU conference in June, Lee asked, "How can you love the wife and the concubine at the same time?" During the speech Lee also confirmed reports that he had told Premier Yu Shi-kun he would rally 100,000 of his supporters and lead a demonstration to protest the lifting of the investment ban.

would play into a Chinese scheme to absorb Taiwan through economic integration. "They don't want to use weapons to retake Taiwan," a TSU legislator said. "They now want to use economics and money."[139]

As a result of the contentious debate on the island, the long-anticipated liberalization measure was accompanied by the announcement of several conditions that went along with it.[140] Premier Yu's March 29, 2002, policy announcement stated that:

- Taiwanese chipmakers will be permitted to manufacture only 8-inch or smaller wafers and must use mature technologies (0.25-micron and higher process technology) in their mainland fabs.
- Taiwanese chipmakers will be permitted to build an 8-inch wafer fab in China only after they are operating at least one 12-inch wafer fab in Taiwan at full production levels for six months.
- The government will permit the construction of a maximum of three 8-inch wafer fabs on the mainland by 2005.
- The government will allow only Taiwanese companies to transfer used wafer manufacturing equipment to facilities on the mainland (investment in new equipment will be discussed in two years).

The policy change did not apply to downstream companies in Taiwan's semiconductor industry. Consequently, semiconductor testing and packaging firms such as Advanced Semiconductor Engineering, Inc. (ASE) and Silicon Precision Industries Ltd. (SPIL) are still forbidden from investing in facilities in China.

Premier Yu also stated that the government would conduct an investigation to determine whether any Taiwanese companies made illegal investments in semiconductor foundries on the mainland prior to the lifting of the ban. This will be no easy task for the authorities in

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[139] Shu Shin-luh, "Strait Just Wafer-Thin," *South China Morning Post*, March 27, 2002.

[140] Some of the smaller semiconductor manufacturing companies in Taiwan have complained that the conditions provide an unfair advantage to TSMC, UMC, ProMOS Technology, and Powerchip Semiconductor. Those four are the only Taiwanese companies that are starting production of 12-inch wafers and will thus be the only companies eligible to build an 8-inch plant on the mainland under the guidelines announced by Premier Yu.

Taiwan. Indeed, MAC Vice Chairman Liu Te-shun recently acknowledged that "Capital outflows through a third country are not easy to trace." Nevertheless, he vowed that the government's investigations into alleged illegal investments in Chinese chipmakers "will continue very aggressively all the way."[141] The main target of the investigation is SMIC. Taiwanese officials found evidence that firms from the island made illegal investments in the newly established Shanghai-based semiconductor manufacturing company, and several Taiwanese firms have already agreed to withdraw their investments in the company. The MAC asked others to sign documents declaring that they made no investments in SMIC. The government's investigation is also targeting Grace Semiconductor Manufacturing Corp. (GSMC) and He Jian Technology Company, a semiconductor producer in Suzhou,[142] although officials have yet to uncover evidence of direct investments from Taiwan in either company.[143] The investigation quickly became a hot political issue in Taipei, with the TSU aggressively publicizing allegations that UMC made an investment in He Jian Technology before the ban was relaxed (see the "United Microelectronics Corporation (UMC)" subsection below).[144] In addition,

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[141] Hung, Faith, "Taiwan's Tech Companies Flout China Investment Restrictions," *Electronic Buyer's News*, August 5, 2002c; Cheng, Allen T., "Making China Less Fab-ulous," *Fortune*, September 30, 2002a.

[142] Huang, Joyce, "MOEA Levies Fines on Four Companies for Investing in China," *Taipei Times*, January 19, 2003.

[143] Taiwanese companies found to have violated the rules will face sanctions, and executives who make false statements will face fines of up to $70,000 and possible imprisonment for as long as five years. Despite the government's efforts, analysts say firms that wanted to make forbidden investments in the Chinese semiconductor industry probably found it easy to circumvent the regulations, as demonstrated by the success with which Taiwanese companies invested in notebook PC production on the mainland in defiance of a government ban. Most of the major Taiwanese players were already producing notebooks in China before the ban was eased in 2002.

[144] Tsai Ting-I, "TSU Lawmakers Disrupt UMC's Board Meeting," *Taipei Times*, June 4, 2002. In June 2002, two TSU legislators, Lo Chih-ming and Lin Chih-lung, disrupted a UMC board meeting, arguing with UMC Chairman Robert Tsao and waving a copy of the *Asian Wall Street Journal* that carried an article about UMC's reported investment on the mainland. For its part, TSMC stated publicly in 2002 that it has adhered to government regulations on investment in the mainland, and senior company executives called on the government to strictly enforce its policies to prevent less scrupulous competitors from gaining an unfair advantage.

Premier Yu's announcement stipulated that "in order to ensure that the investment in 8-inch wafer foundries on the Chinese mainland will not have a negative impact on the semiconductor industry and our domestic economy, the government will establish sound and effective management mechanisms." These management mechanisms include regulations on technology transfer and the movement of high-technology personnel to the mainland.

The drafting of these regulations and any required amendments to existing laws was supposed to be completed by May 10, 2002. Although the committee that formulated these regulations reportedly submitted its final report ahead of schedule in early April 2002, political bickering delayed the formal publication of the rules governing investment in fabs on the mainland by several months and the government missed the initial deadline for putting in place a management plan for investment in mainland wafer fabs.[145] In August 2002, the Ministry of Economic Affairs finally announced that it was ready to begin accepting applications from Taiwanese chipmakers interested in building fabs on the mainland, and in September 2002, TSMC became the first Taiwan semiconductor company to apply to the government for permission to set up a manufacturing plant in China. Taiwanese companies said that they expected to begin construction on plants and start moving equipment to China by the end of 2003.

Industry observers say that, although the political debate has quieted down, it is likely to heat up again as more companies follow TSMC's example by filing applications to invest in China and starting construction of their mainland facilities. Pro-independence politicians in particular remain wary of increasing cross-Strait economic integration. Some observers predict that when TSMC and UMC receive government permission to begin building plants in China and transferring equipment to the mainland it will spark a political fight in Taiwan. The issue is "too emotionally charged" to be ignored by politicians in Taipei and "appears to be pent up and ready to explode," according to industry sources.[146]

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[145] Interviews with industry analysts, Washington, D.C., July 2002.
[146] Interviews with industry analysts, Washington, D.C., July 2002.

Another round of political combat would also likely ensue if Taiwanese semiconductor companies push for further relaxation of the regulations to allow the transfer of more advanced process technology to facilities on the mainland. If Taiwan firms want to use 0.18-micron process technology in China they will need to lobby the Taiwanese and U.S. governments to lift existing export control restrictions. According to a senior industry executive, after spending a year pressing the Taiwanese government to allow investment in the Chinese semiconductor industry, the island's semiconductor companies do not want to devote such an enormous effort to lobbying the government again for at least another year or so. The executive predicted, however, that the U.S. and Taiwanese governments would ultimately relax the restrictions and allow 0.18-micron process technology to be transferred to China, perhaps as early as 2004.[147]

China's IC Policies and Market

Chinese leaders view the development of the semiconductor industry as being vital to China's economic development and national security. On the economic side of the ledger, Beijing is determined to make sure that Chinese companies reap the rewards of the growing domestic market for chips. As one Chinese observer put it in a recent commentary, "If we do not develop our own chip industry, then this vast market will be handed over to others on a platter."[148] China is equally determined to avoid depending on foreign companies to supply the semiconductors that are required for its military modernization program. This determination stems from a concern that reliance on imported chips would be detrimental to national security, as it would allow foreign governments to tamper with chips supplied to the Chinese military. Chinese observers argue that, to avoid falling into this trap, "Key technologies such as chips that concern national defense must be held in one's own hands."[149]

The Chinese (PRC) government has long regarded the semiconductor industry as being strategically important, listing microelectronics as a

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[147] Interview, October 2002.

[148] "China Must Accelerate Construction of the Important Chip Industry," *People's Daily*, April 22, 2004.

[149] "China Must Accelerate Construction . . . ," 2004.

priority in its "four modernizations" program in the late 1970s.[150] China, however, has tried unsuccessfully for many years to promote the development of a domestic semiconductor industry. While China's semiconductor industry was started in the 1960s, it has only recently begun to reach world standards. Before the implementation of the economic reform policies in 1978, exports to China of much of the equipment needed to manufacture chips was prohibited. Despite these restrictions, China was able to develop equipment to manufacture 50-mm and 75-mm wafers.

Beginning in the 1980s, China was able to import wafer-manufacturing equipment and began to produce 75-mm wafers with 5-micron technology, leaving them five years behind Taiwan and a full decade behind what was then the state-of-the-art commercial IC production technology.[151] During the late 1980s, joint ventures with foreign companies began to be established, injecting more advanced technology into the industry. For example, 1988 witnessed the founding of Shanghai Belling Microelectronics Manufacturing Corporation, a joint venture involving Alcatel Bell, the Belgium branch of Alcatel, and Advanced Semiconductor Manufacturing Corporation, a joint venture involving Philips NV of the Netherlands.[152] At this time, however, China still lagged behind global standards, producing 5-inch wafers with 2-micron technology.[153] By 1995, the situation had not improved. Barry Naughton wrote, "China's most advanced producers were struggling to get 1-micron and 0.8-micron line-width IC production lines in operation and producing smoothly." China had made barely any progress in closing the technological gap. Chinese producers were still five years behind Taiwan and nine years behind industry leaders.[154]

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[150] Simon, Denis Fred, "The Microelectronics Industry Crosses A Critical Threshold," *The China Business Review* (online), November/ December 2001.

[151] Naughton, 1997c, p. 26.

[152] Pecht, Micahle, and David Hodges, "Semiconductor Companies in China," *Semiconductor International*, September 1, 2000.

[153] Ma Xinru, "Status of Semiconductor Equipment Industry," *Zhongguo Dianzi Bao*, November 10, 1998, p. 10 (in FBIS as "Status of Semiconductor Industry," November 10, 1998, p. 10).

[154] Naughton, 1997c, p. 26.

Regardless of the extent of actual progress, China was investing heavily in the semiconductor industry. Denis Fred Simon wrote, "From 1980 to 1999, according to *China Electronics News* (*Zhongguo Dianzi Bao*), a total of 25.7 billion RMB [Renminbi] ($3.11 billion) was invested in the country's integrated circuit (IC) industry. Of this amount, foreign investors provided 12.6 billion RMB ($1.52 billion)."[155] The first major product of this period was the 908 Project, which established China Huajing as a manufacturer of 6-inch wafers. This project was intended to make Huajing into a "national champion,"[156] but apparently did not meet expectations[157] and was supplemented in 1999 by the 909 Project, which established Shanghai Huahong NEC, billed as the most advanced fab in China, as a manufacturer of 8-inch wafers with 0.35-micron processing technology.[158] Despite these projects, Simon asserted that semiconductors remain the weakest link in China's electronics industry, as measured by the technological progress toward the global state of the art.[159]

It was not until 2000 that China developed a comprehensive policy to develop the semiconductor industry.[160] In April 2000, Minister of Information Industry Hu Qili wrote an article in the *People's Daily* identifying the semiconductor industry as a strategic, high-growth industry. Hu also described the semiconductor industry as "highly internationalized and most competitive," resulting in the need for strong government support and foreign investment. Hu wrote:

> If we just engage in development behind closed doors, totally rely on ourselves in the aspects of talented people, funds, and technologies, and produce products only to serve and support ourselves, it is absolutely impossible to establish

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[155] Simon, 2001.

[156] Pecht and Hodges, 2000.

[157] Yu dong, "A Review of Our Country's IC Industry in 1999," *China Electronic News*, April 21, 2000. This article states that in 1999 Huajing began to emerge from its problems.

[158] Chu Dechao, "Overview of the Semiconductor Market in China," *Semiconductor FPD World*, November 2000, pp. 176-179 (in FBIS as "Japanese Publication Discusses Semiconductor Industry In China," November 1, 2000).

[159] Simon, 2001.

[160] Simon, 2001.

> ourselves in the intense international competition. Therefore, the strategic guiding principle for our developing semiconductor industry should be basing the enterprises' positions on work market, the technological development on international cooperation, the application of talented people on a global scale, and the investing and financing policies on international fund markets.[161]

Hu then concluded:

> government must attach importance to creating a general environment which is suitable for the development of the semiconductor industry, providing preferential policies which are as good as those in the peripheral countries, simplifying examination and approval procedures, and encouraging foreign investment introduction and multi-channel financing as well as the development of a people-to-people software design industry.[162]

The renewed emphasis on the integrated circuits industry was reflected in the China's 10th Five Year Plan. The Plan identifies the time period to 2010 as critical to China's semiconductor industry and identifies three problems with the industry that must be solved: (1) The production scale is too small; in 2000, China constituted only 1.5 percent of the world market and was able to meet only 25 percent of domestic demand; (2) it lacks an ability to develop new products; and (3) the equipment and materials used in IC manufacturing are imported. To rectify these problems, the Five Year Plan sets out two major goals for the semiconductor industry:

1. By 2005, national IC production will reach 20 billion wafers with a sales amount between 60 and 80 billion RMB, constituting 2 to 3 percent of world sales and meeting 30 percent of domestic demand, with IC production for national defense and national economic security being principally domestic based. Eight-inch wafers with 0.25-micron technology will be standard.

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[161] Hu Qili, "Seize Opportunities to Develop China's Semiconductor Industry," *People's Daily*, April 19, 2000, p. 2 (in FBIS as "PRC Urged To Develop Semiconductor Industry," April 19, 2000).

[162] Hu Qili, 2000.

2. By 2010, national IC production will reach 50 billion wafers and sales will reach 200 billion RMB, constituting 5 percent of international sales and meeting 50 percent of domestic demand, with the complete assembly of IC being principally done in China.

To accomplish these goals, the 10th Five Year Plan document stated the following:

1. China will establish a national-level IC R&D center to research and develop large-scale technology production and system-level IC.
2. In regard to chip design, the government will support an independent design group with annual sales of more than 100 million RMB.
3. China will
   - o build two or three 6-inch wafer fabs
   - o build three to five 8-inch wafer fabs capable of manufacturing 0.18- to 0.35-micron process technology
   - o build one or two 12-inch wafer fabs capable of manufacturing 0.13- to 0.18-micron process technology
   - o construct five or six packaging plants that will each be able to produce 500 million to one billion pieces with 0.13- to 0.18-micron technology.[163]

The State Council also issued the document titled "Policies of Encouraging the Development of Software and Integrated Circuit Industries" (also known as "State Council Document 18") outlining a number of preferential policies for the semiconductor industry and encouraging Chinese and foreign enterprises to establish joint ventures or wholly owned enterprises. Companies investing more than 8 billion RMB to build an IC fab to manufacture wafers with less than 0.25-micron process technology will be taxed at a rate of 15 percent and will have

[163] All points above taken from the PRC Ministry of Information Industry Comprehensive Planning Company, *Zhongguo xinxi chanye "shiwu" fazhan guihua (The 10th Five Year Plan of China's Information Industry)*, Beijing: Electronics Industry Publishing House, 2001, pp. 33-42.

the 17 percent VAT refunded, to effect a net rate of 6 percent with the corresponding savings to be used in R&D and to expand production. Industry representatives in the United States charge that this tax break constitutes an illegal subsidy under World Trade Organization rules and forces foreign companies to establish manufacturing facilities in China to remain competitive with Chinese-based producers. Chinese IC manufacturers also receive customs incentives. Foreign investment in IC manufacturing will be exempted from tariffs and import-level VAT on importation of technology (including software), production machinery, and equipment. IC manufacturers investing more than 8 billion RMB to build an IC fab for producing integrated circuits with better than 0.25-micron technology will receive tariff and VAT exemption on the importation of raw materials and semi-finished goods necessary for IC production.[164]

In addition to the policies developed under the 10th Five Year Plan, other policies have been developed to promote the IC industry. For example, IC manufacturers and software enterprises are eligible to receive a two-year corporate tax exemption starting from the first profit-making year followed by a 50 percent reduction the next three years. This benefit, known as the "2 + 3 plan," will be withdrawn if a company ceases operation within the first ten years.

China's IC policies have drawn criticism from U.S. and other semiconductor manufacturers for violating free-trade commitments by putting companies not manufacturing in China at an unfair disadvantage.[165] Industry representatives in the United States charge that these tax breaks constitute an illegal subsidy under World Trade Organization rules, and force foreign companies to establish manufacturing facilities in China to remain competitive with Chinese-based producers. Perhaps in response to this criticism the Chinese government has stated that it has set up a team to study the reduction

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[164] PRC Ministry of Information Industry Comprehensive Planning Company, 2001, pp. 366-372.

[165] Cassel, Jonathan, "Why China Won't Drop Tax Breaks For Local Chipmakers," *CMPnetAsia.com*, December 20, 2002.

of the VAT from 17 percent to 13 percent for all companies.[166] That review has not resulted in a change in the policy, however, and China's trade policies became an issue in the campaign for the 2004 U.S. presidential election. As a result, in March 2004, the Bush administration filed a complaint against China at the WTO, charging that Chinese taxes on imported semiconductors violate Beijing's free trade commitments.[167]

Local Policies. Local government incentives are another critical element of China's plan to accelerate the formation of its IC industry. There is reportedly intense competition among cities to attract IC manufacturers, mainly between Beijing and Shanghai. Although interviewees would not comment on the specific local incentives offered to their companies, some indicated that these offers were at the outset similar to one another, but that in some cases local officials sought to beat their competitors by offering to sweeten a deal. For example, Beijing officials reportedly offered to beat whatever Shanghai offered in negotiations with a Taiwan company. In addition, both Shanghai and Beijing have announced goals of attracting certain numbers of IC fabs that far exceed the goals announced in the 10th Five Year Plan. Beijing, for example, plans to build five to eight 8-inch wafer fabs capable of producing 0.25-micron technology by 2005 and plans to build another ten advanced product lines by 2010.[168] Shanghai, meanwhile, plans to build approximately ten IC fabs capable of manufacturing 8-inch wafers with 0.35-micron technology by 2005.[169] If both plans are realized, the total number of IC fabs in Shanghai and Beijing alone could increase the original planned building of ten fabs to as much as 15 fabs by 2005.

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[166] "China May Lower VAT for Local Chip Consumption to 13 pct from 17 pct--Report," *AFX-Asia*, July 14, 2003.

[167] See Elizabeth Becker, "U.S. Files a Complaint Against China at the W.T.O.," *New York Times*, March 19, 2004.

[168] "The Blueprint and Development Strategy of Beijing IC Industry," Beijing IC website, http://www.bjic.org.cn/english/01zttq/001.html (last accessed on March 2004).

[169] Shanghai City Government, "Shanghaishi "shiwu" guomin jingji he shehui xinxihua zhogndian zhuanxiang guihua [Important Regulations on Shanghai City's 10th Five Year Plan for National Economic and Societal Informationization]," *Shanghai xinxihua* website, www.infooffice.sta.net.cn/xw/xw-qb.jsp?num=5-1 (last accessed March 2004).

Although no central government official policy exists for increasing the number of planned fabs, by publicizing a plan to attract an increased number of IC fabs, a local government can demonstrate a willingness to be an IC manufacturing hub.

Beijing's Preferential Policies. As indicated earlier in this chapter under "Shanghai Fever," Beijing faces significant challenges in attracting foreign investment in the semiconductor industry. Being less cosmopolitan and lacking the synergies of Shanghai, Beijing is also burdened with an arid environment that makes it prone to sandstorms, not an insignificant factor when semiconductor manufacturing requires a large and steady supply of water and clean facilities. Perhaps because of these challenges, Beijing has decided to also focus on chip design and the manufacture of six products that can increase demand for chips: IC cards, shared point-of-sale systems between banks and the taxation bureau, digital cameras, high-definition television, network computers, and mobile communication devices.[170]

Despite its disadvantages, the Beijing City government continues to offer three types of preferential policies for the software and IC industries. In terms of the first preferential policy--financial assistance--according to a *People's Daily* report, "The government will provide a grant equaling 15% of total project investment and will not take part in decision-making nor will it request dividends. It can transfer its share at a negotiated price. Furthermore, it will give 1.5-2 percentage points loan interest allowance for the approved IC manufacturing projects."[171]

In addition to these incentives, Beijing is also reportedly offering a "Shanghai + 1" incentive, which offers to better any financial incentive offered by Shanghai by an additional year.[172]

The second preferential policy concerns land prices. IC manufacturers, as well as software companies, can rent land free of charge for a maximum of 30 years. The third preferential policy centers

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[170] "Beijing to Foster Semiconductor Business," *People's Daily*, June 17, 2003.

[171] See Deng Gang, "Beijing Encourages Developing Software and IC Industries," *People's Daily* (online), February 27, 2001.

[172] Interview, October 2002.

on personnel management. Beijing will offer relocation assistance to senior foreign managers. In addition, Chinese citizens can transfer their residency permits to Beijing after working in the city for three years, and college graduates can receive extended residency permits if they are employed by a high-technology enterprise located in Zhongguancun. The city will also provide monetary assistance to senior managers to purchase cars and houses.[173]

Shanghai's Preferential Policies. Shanghai is more secretive than Beijing about its investment policies. The Shanghai Foreign Development Office in Los Angeles declined to provide additional information about the incentives the city offers to prospective high-technology investors. It did state, however, that the various districts of Shanghai, and not the city of Shanghai itself, are responsible for offering local incentives. Other interviewees confirmed that Shanghai has a "5 + 5" policy of offering wafer manufacturers a five-year tax holiday and an additional five years at half the tax rate. In addition, according to a press report, Shanghai has established a $60.2 million fund to support research and exports and to provide capital to start up businesses. Shanghai will also pay 1 percent of the interest rate on bank loans.[174] The results of these policies have become evident. In 2000, SMIC was founded and began manufacturing 8-inch wafers with 0.18-micron process technology in 2002. GSMC, also founded in 2000, is preparing to begin production of 8-inch wafers with 0.22-micron process technology. Other companies also are following suit. In Taiwan, after much debate and lobbying, the government finally allowed Taiwan wafer manufacturers to build a total of three fabs in China that are able to produce 8-inch wafers with 0.25-micron process technology. Philips Electronics has also set up a joint venture fab operation. U.S. companies Motorola and On Semiconductor have also set up wafer fabs. Other companies of note include Intel, which is packaging and testing its Pentium IV processor in Shanghai[175] and Applied Materials (see the related discussion on

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[173] Deng Gang, 2001.

[174] "Shanghai Aims to Be Nation's IT Hub," *People's Daily* (online), December 8, 2000.

[175] "Intel to Set Up R&D Center in Shanghai," *SinoCast China Business Daily News*, July 10, 2003.

Applied Materials in the following boxed text), which has training and service facilities. In addition, the U.S. Department of Commerce stated that chip-making equipment exports to China increased 78 percent in 2002 to $350 million from $196 million in 2001. In total dollars, exports to China were less than half of the industry's exports to Japan and less than a third of the industry's exports to Taiwan, but the increase was in stark comparison to the 12 percent decline in total U.S. chip

Applied Materials has set its sights on China, where the growing semiconductor market is fueling demand for semiconductor manufacturing equipment. When Sunnyvale, California-based Applied Materials opened an office in Beijing in 1984, it was the first semiconductor equipment company with a service center in China. Applied Materials has since opened sales and support offices in Tianjin, Wuxi, and Shanghai. The company's newest office in China is located in the Zhangjiang Science and Technology (S&T) Park in the Pudong District of Shanghai and was opened on October 18, 2001. It combines a regional sales and marketing center with a technical training center that provides instruction on maintenance and operation of the company's equipment to engineers from customer companies including GSMC. Applied Materials forecasts that as much as 20 percent of its revenues over the next decade will come from sales to semiconductor manufacturers in China.

equipment exports.[176] Such infusions of foreign capital and technology have greatly assisted China in catching up with technology levels in other countries that have advanced semiconductor industries. (See the related discussion on the "Shenwei I" chip in the following boxed text.) The United States General Accounting Office (GAO) estimated in a 2002 report that China's semiconductor manufacturing capability was roughly two years behind current state-of-the-art commercial technology. The

[176] Mahoney, Jerry, "The Chinese Chip Challenge; The Communist Giant's Ambitions to Rapidly Ramp Up Its IC Industry Present Both Opportunities and Uncertainties," *Electronic Business*, July 1, 2003, p. 48.

report stated: "China's most advanced commercial manufacturing facilities can produce chips that are only one generation behind current, commercial state-of-the-art technology."[177]

On November 21, 2001, the *People's Daily* announced the development of the "Shenwei I" chip by Shanghai Fudan Microelectronics Company Limited. Using China's top domestic designers and only Chinese intellectual property, the company spent more than a year in developing the chip. This new chip is based on 32-bit architecture, marking a major leap forward in technology quality from 16-bit architecture and a step forward in breaking the foreign-held monopoly on central processing unit (CPU) core technology. The new platform is compatible with the market's most widely used X86 instruction set and X86-based complex instruction set computer (CISC) microprocessor, and can be widely used in fields such as industrial automation, electronic imaging, electronic banking products, intellectual terminal equipment, and aviation and aerospace.

China's IC Market. China's plans for the IC industry have also been aided by the growing interest of foreign companies in China's semiconductor market. In 2000, China accounted for 7 percent of world semiconductor demand, which increased to 13 percent in 2002, with much of the production in low-technology chips for consumer electronics, such as 5- and 6-inch wafers with 0.5- to 1.6-micron technology.[178] Manufacturers in China purchase $12 billion worth of semiconductors annually, of which approximately two-thirds are used in exports and one-third are used for goods sold domestically. Current domestic Chinese production, however, is estimated to be able to supply a mere 10-20

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[177] United States General Accounting Office, *Rapid Advances in China's Semiconductor Industry Underscore Need for Fundamental U.S. Policy Review*, Washington, D.C.: GAO, GAO-02-620, April 2002, p. 2.

[178] Pecht, Michael, Liu Weifeng, and David Hodges, "China's Semiconductor Industry," *Electronics Manufacturing Update*, International Technology Research Institute website.

percent of domestic demand.[179] More-recent statistics reveal that in the first six months of 2002, Chinese demand for ICs increased by 20 percent to 13.6 billion chips, while revenue increased 15 percent to $6.6 billion. During the same period, Chinese manufacturers produced only 2.9 billion chips, a production increase of 3.9 percent with a 31.2 percent rise in revenue.[180] Forecasts for the future of the chip market differ widely, however. The China Center of Information Industry Development predicted that China's chip market will increase to $36.1 billion by 2005.[181] On the other hand, the Chinese Ministry of Information Industry predicted the market will grow to $25 billion.[182] It has also been estimated that by 2010 China will become the world's second-largest semiconductor market, and that by the end of 2003 it will have 12 percent of the foundry capacity.

There are, however, some cautions that temper the current optimism that many express about China's semiconductor market, which is not developing as quickly as many analysts expected. In fact, some analysts speculate that the influx of foreign capital may cause a glut in the market. Most of the individuals we interviewed on this topic could not provide a definitive answer to the number of chip fabs the Chinese market can support, though SMIC reportedly projects that China could support 20 more fabs producing 45,000 8-inch wafers per month. On the other hand, some industry analysts say they doubt anyone really knows how many fabs China can support, with one analyst even estimating that China can support only five advanced fabs.

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[179] Hui Yuk-min, "Foundries to Make Mainland Big Player; Five New Prospects," *Business Post*, May 27, 2002a, p. 4., and testimony of Daryl G. Hatano, vice president, Public Policy, Semiconductor Industry Association, before the Office of the U.S. Trade Representative, September 18, 2002.

[180] Wen Dao, "China Still 'Highly Dependent' on Imports for Integrated Circuits," *China Daily* (online), July 29 2002 (in FBIS as "China Still 'Highly Dependent' On Imports For Integrated Circuits," July 29, 2002).

[181] "Cymer Expands its Global Presence to the People's Republic of China; New Shanghai Office to Provide Customers with Localised Service and Support," *PR Newswire*, March 10, 2003.

[182] Mahoney, 2003, p. 48.

Several factors influence whether China's semiconductor boom may turn into a bust. First, the aggressiveness of individual regions in attracting foreign capital may simply draw too many players. This possibility is reflected in the cumulative numbers of fabs China hopes to attract based on regional development plans as opposed to the nationally stated goals. The development plans of Beijing and Shanghai alone exceed the national goal of establishing fabs capable of manufacturing 8-inch wafers with 0.35-micron technology by five fabs. Second, the chip market is global. Stated shortfalls in chip production reflect the inability of Chinese domestic fabs to meet domestic demand and Chinese reliance on imports and do not reflect an overall shortage of chips in the Chinese market. An increase in domestic manufacturing may then cause an overall glut in the market.

Skilled labor also plays a role in the success or failure of China's semiconductor industry. The ability of Chinese-based semiconductor companies to attract and keep high-tech workers has remained a perennial problem. The semiconductor industry in the United States has relied on foreign workers to fill vacancies, and it is possible that China could follow this example. The ability of China, however, a developing country with all its inherent difficulties, to attract skilled foreign labor is limited. Overseas Chinese present one solution to this problem but enticing even them has been problematic, although recent trends indicate numbers are increasing.

Lastly, forecasts of the Chinese market assume that growth will continue. In fact, Chinese projections of growth are not universally accepted. One analyst who doubts the projections states, "China is aggressively building capacity and the assumption is that it would be for domestic electronics, but they're doing this even while their small manufacturers are already facing losses . . . The assumption is that the Chinese chip market will grow 10 percent every year and swell to $21 billion by 2005 . . . But those assumptions are very, very questionable. The Chinese are feeling the export slump, the recession of the United

States. China has only 80 million middle-class people in Shanghai and Beijing."[183]

Company Profiles

This section profiles Taiwan's major foundries, Taiwan Semiconductor Manufacturing Company and United Microelectronics Corporation, which together dominate the world market for made-to-order chips, and two of China's newest chipmakers, Shanghai-based upstarts Semiconductor Manufacturing International Corp. and Grace Semiconductor Manufacturing Corp., both of which were founded by Taiwanese industry heavyweights and have drawn on the island's extensive pool of engineering talent.

Taiwan Semiconductor Manufacturing Company. Founded on February 21, 1987, TSMC is the world's first and largest dedicated IC foundry. It is located in the Hsinchu Science-Based Industrial Park in Hsinchu, Taiwan. To strengthen its relationships with partners, TSMC's charter prevents it from designing, manufacturing, or marketing IC products under its own brand name. In September 2002, TSMC became the first Taiwanese semiconductor company to apply to the government for permission to set up a wafer manufacturing plant in China, and in June 2003 it signed a contract with the Shanghai government for an $898 million plant to produce 8-inch wafers with 0.25-micron process technology. According to a TSMC spokesman, the plant was expected to start small-scale production at the end of 2004.[184]

TSMC's stature as a dedicated IC foundry has been the key to its success. By focusing solely on manufacturing and not on design, TSMC positioned itself as *the* manufacturer for chip design houses, which are less capital intensive and easier to finance than wafer foundries. With the founding of TSMC, the growth of fabless[185] companies exploded. TSMC's model has been so successful that it is now estimated to serve 59

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[183] Yi, Matthew, "Land Rush to the East: Chipmakers Head to China in a Race to Get into Burgeoning Market," *Sfgate.com*, October 29, 2001.

[184] "TSMC Signs Shanghai Contracts," *South China Morning Post*, June 9, 2003.

[185] Fabless companies focus on the design, development, and marketing of chips rather than on manufacturing.

percent of the foundry market and nearly half of the world's 1,300 fabless companies.[186] TSMC operates one 6-inch wafer fab, five 8-inch wafer fabs, and one 12-inch wafer fab and is constructing another 12-inch wafer fab in Tainan. It also operates a joint-venture fab with Philips Semiconductor in Singapore. Total installed annual production capacity in 2002 was approximately 4.2 million 8-inch wafer equivalents. TSMC produces chips with process technology levels of 0.18, 0.15, and 0.13 microns and is developing 90-nm process technologies.[187]

Like several other companies, TSMC has been eyeing the Chinese market. For TSMC, there are at least three reasons for establishing a wafer fab in China. The most important reason to invest in China is to establish a position in the Chinese market, which is projected to constitute 10 percent of the global IC market by 2005. In fact, TSMC chairman Morris Chang has stated that the reason for setting up a fab in China would be to compete with mainland chip makers who are receiving preferential treatment from the Chinese government.[188] Second, TSMC must be in China to supply systems companies, such as Quanta, components as quickly as possible. A third reason is that TSMC's U.S., Japanese, and European customers want TSMC to open a fab in China, which would allow them to increase the amount of local content in their products so that they can meet Chinese government local content requirements for sales in China (local content restrictions apply only to sales within China and not to exports). While there are benefits to establishing a mainland presence, there are also risks, including the possibility of arbitrary policy changes and the rampant theft of intellectual property. The high costs of building a fab, however, would prohibit most companies from copying from TSMC even if they had all the information. Still, TSMC will try to get patents for its process technology in China.

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[186] "TSMC Sees Limited Room for Market Share to Rise Beyond 59 Pct," *AFX European Focus*, September 20, 2002; and Einhorn, Bruce, Frederik Balfour, Cliff Edwards, and Pete Engardio, "Betting Big on Chips," *Business Week*, April 30, 2001.

[187] TSMC company website, http://www.tsmc.com (last accessed August 2003).

[188] "TSMC China Plants Aimed at Local Market," *South China Morning Post* (online), May 7, 2002.

Industry experts say that by the time TSMC might consider using what is currently considered more advanced technology on the mainland, it will no longer be state of the art. Moreover, by the time TSMC wants to start using 0.18-micron technology in China, it will be employing 0.13-micron, 90-nm, or maybe even 65-nm technology in Taiwan. "The most advanced technology will stay in Taiwan," sources said, acknowledging that if TSMC needs to use 0.18-micron technology in China they will need to lobby the Taiwan and U.S. governments to relax restrictions, maybe starting in 2004.

TSMC expects to remain competitive even with companies like Grace and SMIC entering the market. Both companies are using advanced tools to produce mature technologies, so their costs are high. Several sources predicted that they would have financial problems, as SMIC and GSMC will be perceived as risky and new. Since it costs $10 million to develop a chip, companies may not contract with them, especially with the newer 0.13-micron or 90-nm technology. Contrary to many press reports, some sources in Taiwan say that there is no advantage for companies who jumped in early to invest in SMIC and Grace. "It was not a good investment," according to one knowledgeable source. Smaller players, such as Singapore-based Chartered Semiconductor Manufacturing, are having a lot of trouble, the source cautioned, so SMIC and Grace may not succeed. As for customers TSMC will work with in China, it remains unclear, although TSMC expects that the communications and consumer electronics companies that are its major customers will follow the company to China. Interestingly, Motorola reportedly wanted to sell its Tianjin fab to TSMC last year, but TSMC declined the offer.

TSMC disputes some published reports that as many as 400 TSMC engineers left the company to join SMIC, countering that the numbers floating around in the media are exaggerated. The company does acknowledge that more than 100 TSMC engineers left the company and went to SMIC.[189] In addition, TSMC in December 2003 filed a lawsuit against

[189] Most were young engineers who left the company seeking opportunities for rapid career advancement. Similarly, some of them left for stock options and possible IPO riches. Only one TSMC employee that went over to SMIC was a senior manager.

SMIC alleging that SMIC improperly obtained proprietary information from the former TSMC engineers and illegally copied TSMC's process flows, infringing on some of the company's U.S. patents. In a March 2004 filing associated with the lawsuit, TSMC stated that forensic examination of chips produced by SMIC revealed that SMIC had copied TSMC's process technology. TSMC also presented copies of e-mail correspondence between an SMIC official and a former TSMC employee in which the SMIC official requested that the employee provide SMIC with proprietary information regarding TSMC's manufacturing processes.[190]

United Microelectronics Corporation. Founded in May 1980, UMC was Taiwan's first semiconductor company. UMC is now the world's second-largest contract manufacturer of customer-designed integrated circuits and boasts that it holds more patents than any other Taiwanese IC company, including its main rival TSMC, the world's leading semiconductor foundry company.[191] In 2001 alone, UMC was granted 1,093 patents in Taiwan, 633 patents in the United States, and 77 patents in other countries. Among the other marks of its technological prowess, UMC was the first foundry to produce chips using state-of-the-art 0.13-micron process technology[192] and the first to produce chips on 12-inch wafers.[193] In addition, the company plans to begin pilot production using cutting-edge 90-nm process technology in the first quarter of 2003.

Headquartered in Taiwan, UMC also has offices in Japan, Singapore, Europe, and the United States. The company is headed by Robert Tsao, who served as its president for ten years before becoming chairman in 1991. Among the highlights of Tsao's 25-year career in the microelectronics industry was his involvement in the establishment of ITRI, which played

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[190] Hasseldahl, Arik, "Cross-Strait Chip War Heats Up," *Forbes*, March 23, 2004, http://www.forbes.com/2004/03/23/cx_ah_0323tsm.html. In the e-mail message, the SMIC official apologized for requesting such a large amount of information, writing, "Sorry for the long list, but we need a lot of material to set up the new operation."

[191] UMC company overview, UMC website, http://www.umc.com/english/about/o.asp.

[192] "UMC Produces Foundry Industry's First 0.13-micron Integrated Circuits," UMC press release, May 12, 2000.

[193] UMC company overview, UMC web site.

a key role in the development of the island's semiconductor industry. UMC has more than 8,500 employees worldwide and more than 60 percent of UMC's employees hold advanced degrees. In July 1985, UMC became the first semiconductor company listed on the Taiwan Stock Exchange. In September 2000, UMC launched a successful initial public offering on the New York Stock Exchange (NYSE).[194] The issuance raised $1.3 billion, making it "the largest dollar value achieved for any Taiwan corporate initial SEC filing to date," according to UMC company materials.

Since UMC became a pure-play foundry in 1995, the company's share of the foundry market has increased from about 5 percent to more than 30 percent, according to company materials. UMC currently has nine fabs in operation: One fab is based in Japan, and eight are located in Taiwan. Six of the Taiwanese fabs are located in the Hsin-chu Science-Based Industrial Park:

- Fab 6A, Hsin-chu: 0.45-micron process technology; 6-inch wafers; capacity of 48,000 per month
- Fab 8A, Hsin-chu: 0.25-micron technology; 8-inch wafers; capacity of 35,000 per month
- Fab 8B, Hsin-chu: 0.15-micron technology; 8-inch wafers; capacity of 35,000 per month
- Fab 8C, Hsin-chu: 0.15-0.35-micron process technology; 8-inch wafers; capacity of 35,000 per month
- Fab 8D, Hsin-chu: 0.13-micron process technology; 8-inch wafers; capacity of 35,000 per month
- Fab 8F, Hsin-chu: 0.13-micron process technology; 8-inch wafers; capacity of 40,000 per month.

The most technologically advanced of UMC's fabs in Taiwan is Fab 12A, located in the Tainan Science-Based Industrial Park, which uses 0.13-micron process technology and has a production capacity of 40,000 12-inch wafers per month. The 12-inch wafer fab in Tainan began production in 2001, and UMC plans to open two more 12-inch foundries

[194] Jorgensen, Barbara, "Getting on the Big Board," *Electronic Business*, November 1, 2000.

over the next several years in Singapore, allowing UMC to boast that it is "the only semiconductor foundry in the world with three 12-inch fab projects completed or in progress." Both of the planned Singapore foundries are joint ventures with foreign companies. Scheduled to have begun pilot production in the second quarter of 2003 is UMCi, UMC's joint venture partnership with Infineon. The second 12-inch wafer fab to be based in Singapore is AU Pte. Ltd., a joint venture with Sunnyvale, California-based AMD, which is slated to begin production using 65-nm technology in 2005.[195]

UMC's technological advances have been supported by substantial investments in R&D in recent years. Over a recent five-year period, according to company materials, UMC's research and development expenditures exceeded $740 million. In 2001, UMC spent nearly $250 million on R&D activities, up from $170 million the previous year. Partnerships with foreign companies are another key aspect of UMC's technological innovation strategy. For example, UMC's 0.13-micron process technology was developed in collaboration with Infineon and IBM; UMC has formed a "technology alliance" with AMD and Infineon to co-develop cutting-edge 65- and 45-nm process technologies.[196]

With one 12-inch fab in operation on the island, UMC is eligible under the revised semiconductor policy announced by the Taiwan government in late March 2002 to apply for permission to establish one fab producing 8-inch wafers with 0.25-micron process technology on the mainland, and like its giant rival TSMC, the company has shown strong interest in establishing a presence in China to gain access to the rapidly expanding mainland semiconductor market. It has been rumored that UMC is negotiating with Shanghai Belling Co. on a potential joint

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[195] For more on UMC's relationship with AMD, see Allan, Gabriel, "AMD Puts UMC in Its Corner," *Electronics Design Chain*, September 9, 2002. See also "AMD and UMC to Collaborate on 300-mm Wafer Fabrication Facility in Singapore," UMC press release, February 1, 2002.

[196] Deffree, Suzanne, "United They Stand," *Electronic News*, August 5, 2002. The three members of the alliance will each contribute an equal share of the R&D costs. The agreement also allows the companies to pool the risks associated with the pursuit of the most advanced process technologies. See also "AMD, Infineon, and UMC to Jointly Develop Advanced Manufacturing Platform Technologies," UMC press release, July 30, 2002.

venture,[197] but reports that UMC began investing in Suzhou before the Taiwan government announced the easing of restrictions on semiconductor investment in the mainland have drawn much greater attention. Indeed, the Taiwan government reportedly has launched an investigation into UMC's alleged investments in Suzhou.[198] The investigation centers on allegations reported in the *Asian Wall Street Journal* on April 1, 2002, that UMC illegally invested as much as $1 billion in a semiconductor facility in Suzhou through the He Jian Technology Company.[199]

It is unclear from available information whether UMC made an illegal investment on the mainland, but there is ample circumstantial evidence that ties the company to the Suzhou fab. First, it appears that He Jian Technology, which is registered in the British Virgin Islands, has close ties to UMC. Several of the top executives at He Jian Technology Company are former senior UMC employees. Some left UMC very recently. For example, J.H. Shyu, now the chairman and chief executive of He Jian Technology, left his job at UMC in March 2002. Chen Chun-ku, the head of Invest League Holdings Ltd., the holding company that controls He Jian Technology, is also a former UMC executive.[200] Second, meetings between senior UMC managers and Suzhou officials clearly reflect UMC's interest in establishing a presence in the city. In January 2002, UMC Vice Chairman John Hsuan visited Suzhou, and Suzhou mayor Yang Weize reportedly met with UMC executives during his late

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[197] See, for example, "UMC Reportedly Renews Cooperation with Shanghai Belling," *Nikkei Electronics Asia,* September 18, 2002. According to the report, He Jian Technology may transfer equipment purchased from an NEC Corporation plant in the United Kingdom to Shanghai Belling. Among other semiconductor companies rumored to be in negotiations with Shanghai Belling are Taiwan's Nan Ya Technology Corp. and Powerchip Semiconductor Corp. and Singapore-based Chartered Semiconductor.

[198] "UMC Denies Plant in China," *Taipei Times,* April 3, 2002.

[199] Dean, Jason, and Terho Uimonen, "Taiwan Partially Lifts Ban on Chip Ventures in China," *Asian Wall Street Journal,* April 1, 2002. Some sources say UMC shareholders are using private accounts to funnel money to He Jian.

[200] Dean and Uimonen, 2002. See also Hung, Faith, "Taiwan Government Probes UMC on China Investment," *Silicon Strategies,* April 2, 2002a.

February 2002 visit to Taiwan.[201] The following month, UMC reportedly signed the deal to build a $1 billion semiconductor production facility in the Suzhou Industrial Park. The incentives offered to UMC included free use of the site in the industrial park and a 50 percent reduction in corporate taxes for ten years, according to media reports.[202] Finally, UMC decided in January 2002 to sell 8-inch production equipment from its Fab 8B, where He Jian chairman J. H. Shyu was previously a deputy fab director, to a chip-equipment brokerage company called Happy Wealth Holdings Ltd. Industry observers say they have never heard of the company, which is registered in the British Virgin Islands, and some have speculated that UMC intended to "bend the rules aggressively" by using it as a cut-out to transfer the equipment to the mainland in defiance of Taiwan government regulations.[203]

UMC has denied the allegations that it made investments in He Jian or Invest League, although it has acknowledged that many of He Jian's managers are former UMC employees. The investigation is apparently ongoing, however, and officials from Taiwan's Ministry of Economic Affairs have stated that any companies found to have made illegal investments in China would face fines.[204]

Semiconductor Manufacturing International Corporation. SMIC was founded in April 2000 by Richard Chang, former CEO of the Taiwanese chipmaker World Semiconductor Manufacturing Company (WSMC) and is the most advanced wafer fab in China today. SMIC is registered in the Cayman Islands with an original investment of $1.48 billion and received approval to double its investment to $3 billion in October 2002 to establish two new product lines.[205] SMIC started production on September 26, 2001, and a year later Chang made a statement, which was rejected by

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[201] "Mayor of Suzhou Going to Macronix to Attract Business," *Taipei Times*, February 26, 2002.

[202] "Taiwan Chipmaker to Move to Suzhou," *China Economic Review*, March 2002.

[203] Interviews with industry analysts, Washington, D.C., September 2002.

[204] "UMC Denies Plant in China," 2002.

[205] "The Investment of Semiconductor Manufacturing International Corporation Doubled and Approved by MOFTEC," Shanghai Foreign Investment Service Center website, http://www.sfisc.com/ (last accessed November 2002).

analysts as being grossly optimistic, that he expected SMIC to be able to recoup its investments by 2003 due to orders from Japan and the United States and to break even on a cash-flow basis in September 2002.

SMIC is engaged in the design, mask-making, wafer fabrication, packaging, and testing of 8-inch wafers with 0.25-micron technology and 0.18-micron technology. By the end of 2002, SMIC plans to produce 25,000 wafers per month in Fab 1 and 7,000 wafers per month in Fab 2 and expected to reach full capacity by the end of 2004, at which time Fab 1 and Fab 2 will produce a combined total of 85,000 wafers per month. In 2004, SMIC was scheduled to start building Fab 4, Fab 5, and Fab 6B in its Zhangjiang S&T Park compound. According to company materials, SMIC plans to build six to nine fabs, some of which will produce 12-inch wafers.

SMIC expects the China semiconductor market to grow by an average rate of 25 percent in each year from 2004 through 2006 and projects the Chinese semiconductor market to be worth more than $36 billion by 2005. According to SMIC, this rapid growth in IC demand in China is outpacing the expansion of domestic IC supply and will result in a gap between demand and supply of $27.6 billion in 2005.

SMIC in March 2004 launched an IPO on the Hong Kong and New York Stock Exchanges. Although early expectations were positive, the IPO was a disappointment, with the value of SMIC's shares declining 11 percent in New York and 8 percent in Hong Kong on the first day.[206] In addition, according to press reports, the IPO was originally expected to take place in the second half of 2003. No reason was given for the delay, but market conditions and competition from chip leviathan TSMC may have been significant factors.[207]

SMIC established its first two overseas offices in 2002. It opened an office in the United States in June 2002, an office in Tokyo in September 2002, and is considering opening an office in Europe. The offices are primarily focused on sales and marketing.

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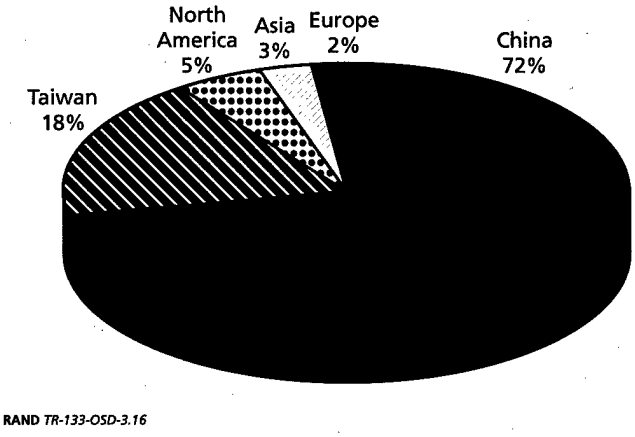
[206] Clendenin, Mike, "SMIC's IPO Flops," *EE Times*, March 18, 2004, http://www.eetimes.com/semi/news/showArticle.jhtml?articleId=18400735&kc=2515 (last accessed March 2004).

[207] "Semiconductor Manufacturing Delays Sales," *Taipei Times*, July 9, 2003.

SMIC has approximately 3,000 employees whose average age is less than 35. Approximately 72 percent of SMIC personnel are from China, while around 28 percent come from abroad. Of the employees coming from overseas, about 530 are from Taiwan, accounting for 18 percent of SMIC's total workforce (see Figure 3.16).

SMIC sources said that reports saying that as many as 500 SMIC employees came from TSMC were grossly exaggerated. They acknowledged that numerous SMIC employees came from TSMC, including one plant manager, but said that Taiwanese engineers from many other companies have also joined SMIC. The reason the greatest number have come from TSMC is largely because of TSMC's size and the numbers in its workforce.

Much of the SMIC workforce is relatively inexperienced, with 49 percent of employees having zero to one year of prior work experience. About 24 percent of SMIC employees have one to five years of experience, and roughly 27 percent have more than five years of experience. Only 3 percent of SMIC employees hold PhDs. About 15 percent hold master's degrees, 40 percent hold bachelor's degrees, and 42 percent hold other degrees. SMIC prefers to pick good people from local universities and mold them themselves rather than hire people who may have picked up bad habits from previous work experience.



SOURCE: Shanghai Semiconductor Manufacturing Corp.

Figure 3.16--Location of Last Degree Received by SMIC Employees (by Percentage of Employees)

Even though SMIC is a private company, it has adapted a *danwei* model[208] for its own employees and has developed its own residential community, complete with a bilingual (Chinese and English) school and kindergarten, as well as the only swimming pool in China with a retractable roof. SMIC has adopted this model to attract and retain qualified overseas employees, but its facilities are open to all SMIC employees.

-- SMIC's reliance on a large number of Taiwanese workers has led the company to consider suing the Taiwanese government on the basis that it violates Taiwanese constitutional rights on worker protection. SMIC stated that it is a foreign company registered in a foreign nation and that it is unfair for Taiwan to prohibit Taiwanese workers from working at its facility yet permit Taiwanese workers to work in the United States or Singapore.[209] In 2001 the U.S. government denied the export of chip-making equipment to SMIC by Advanced Materials. Since then, SMIC has secured the same type of equipment from European suppliers[210] and has obtained a license for 0.18-micron process technology for lower-power SRAMs from Toshiba, which has also provided SMIC with technology for 0.25-micron devices. It has also obtained 0.18-micron process technology from Singapore wafer manufacturer Chartered Semiconductor Manufacturing Ltd.[211] SMIC has also purchased an advanced lithography scanner from a European supplier that can be used on 0.13-micron designs and for 90-nm technology research and development. U.S. companies that have provided technology to SMIC include Axcelis Technologies, which provided ion implant, photostabilization, and photoresist dry step

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[208] *Danwei*, a work unit in Chinese, refers to the system in which a person's employer provides many benefits, such as housing, food, and schooling.

[209] "Semiconductor Firm in China May Sue Govt in Taipei," *CENS*, November 5, 2002.

[210] "SMIC Skirts U.S. Ban on 0.18-Micron Wafer Equipment," *CENS*, August 29, 2002.

[211] Addison, Craig, "China's Fabs Prepare for 0.18-Micron Production," *Semiconductor Magazine* (online), Vol. 3, No. 3, March 2002b.

tools;[212] Asyst Technologies, which provided Standard Mechanical Interface (SMIF)-based manufacturing automation systems;[213] and Praxair, which supplies industrial gases.[214] Officially, SMIC does not seem to view U.S. export controls as being draconian. Simon Yang, SMIC's vice president of technology, stated in an interview, "It's not something where we are trying to rush forward and be the world leader or trying to do some difficult non-commercial product. We just look at the market and tell the U.S. government that at a certain time we will need that technology to survive. In reality, based on my observation, the U.S. government has been very reasonable. Our only complaint is that it takes a little bit too long."[215]

SMIC reportedly has attracted 12 to 14 investors. Although the company is reluctant to reveal the identities of its major investors, other sources report that the list of investors includes Shanghai Industrial, Goldman Sachs, H&Q Asia Pacific, Walden International, Xianfeng International, Beijing University Jade Bird, Shougang, and Zhangjiang High-technology.[216] Shanghai Industrial, a municipal-government-backed syndicate that includes 20 strategic investors, has reportedly invested $183 million in SMIC, although the company's website put the amount at $110 million.[217] Chinese banks were confirmed by SMIC to have contributed $480 million. Half of SMIC's equity is said to be held by U.S. entities.[218] In reply to a question concerning allegations that the Taiwanese government had been pressuring Taiwanese investors to pull out of SMIC, SMIC's Chris Chang stated that he "really doesn't know

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[212] "China's SMIC Selects Axcelis Equipment for Shanghai Fab; Ion Implant, Photostabilization, and Photoresist Dry Strip Systems to Ship in August," *Business Wire*, April 17, 2001.

[213] "Asyst Receives $15 Million Order from SMIC--China's First 200mm Foundry; Second Chinese Win Signifies Asyst's Leadership of 200mm Automation Market," *Business Wire*, June 21, 2001.

[214] "Prazair China Signs Contract with Semiconductor Manufacturing International Corporation," *Business Wire*, December 11, 2000.

[215] Clendenin, Mike, "SMIC Steps Carefully Toward 90 NM Development," *EE Times* (online), October 28, 2002.

[216] Zhang Wenhao, "Ba yingcun xin pian kaiju, ("8-Inch Wafer Foundries Start Up"), *Caijing*, April 20 2002, p. 17.

[217] Carlsen, Clifford, "Microchip Investors make $1.1B Wager in China," *The Daily Deal*, November 20, 2001.

[218] Carlsen, 2001.

where indirect money comes from" and that he had heard reports that some Taiwanese were forced to pull their investments out of SMIC, but that this money could have been funneled through a third company instead of being invested directly. He also stated that the company did not necessarily know the identities of the ultimate investors.

SMIC has also invested $1.3 billion in an 8-inch wafer foundry in Beijing.[219] According to one press report, it is rumored that the reason SMIC founder Richard Chang agreed to set up a fab in Beijing is because the municipal government promised to order ID card chips from SMIC.[220] SMIC sources say the company decided to "help with construction and management" of the Beijing fab, but it is a different corporate entity with a different board of directors and some overlap in investors, including some from Beijing. While the Beijing entity will not be part of SMIC, Richard Chang is likely to serve as the president of the Beijing company.

SMIC is banking on its experienced management team (Richard Chang and others in SMIC's top management have worked for Texas Instruments), early market entry, solid financial backing, state-of-the-art fab facilities, engineering talent, and proximity to the Chinese market to ensure success.

According to knowledgeable sources, SMIC is not overly worried about competition from TSMC for two reasons. First, SMIC has a head start in the Chinese market. It will take at least a year for TSMC to finish its first plant on the mainland. By then, SMIC will have a production capacity of 45,000 wafer starts per month and will have advanced to 0.18-micron or perhaps even 0.13-micron process technology. TSMC and UMC, on the other hand, will be able to use only 0.25-micron and higher technology because of Taiwanese government restrictions; therefore, SMIC will have a technological edge. "In effect, the Taiwan government is helping us," a company official said. "TSMC is very good, but one of their hands has been tied politically."

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[219] Robertson, Jack, "Shanghai Foundry to Operate New Fab in Beijing," *EBN*, September 25, 2002; and "New Beijing Semiconductor Plant to Be Launched in August," *ChinaOnline*, July 29, 2002.

[220] "SMIC Is Proven to Set Up 8-inch and 12-inch Plants," *Financial Times*, July 25, 2002.

The restrictions on sending Taiwanese personnel to work in China also will put Taiwan companies such as TSMC and UMC at a disadvantage. SMIC's strategy is to develop its business quickly in case the Taiwanese government further relaxes restrictions on investment and technology transfer by Taiwanese semiconductor companies. There is a lot of pressure on SMIC's sales and marketing department to get more orders. SMIC is reportedly offering the lowest prices in the industry.[221] Second, SMIC believes that the emerging Chinese semiconductor market will be big enough to accommodate several players. One source said SMIC would be successful as long as it maintains quality and keeps its customers happy. "At the end of the day," the source stated, "we don't have to beat TSMC to survive. We can develop a niche market." When SMIC reaches full capacity, it will be producing at a level of 85,000 wafer starts per month, or roughly 1,000,000 per year, but that will fill about only 4 to 5 percent of what China needs, so there will be no problem with a glut of capacity over the next several years.

Grace Semiconductor Manufacturing Corp. GSMC was founded in November 2000 and is based in the Zhangjiang Science and Technology Park in Shanghai's Pudong new area and registered in the Cayman Islands. It has been the subject of an enormous amount of speculation and controversy, in large part because it was co-founded by Jiang Mianheng, the son of Chinese leader Jiang Zemin, and Taiwanese businessman Winston Wang (Wang Wen-yang), the son of one of Taiwan's most famous executives, Formosa Plastics tycoon Y. C. Wang.[222] Wang is CEO of GSMC,[223] but the

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[221] Redelfs, Richard, "Taiwan Semiconductor Faces Pressure from Rivals to Cut Rates," *Bloomberg News*, October 24, 2002.

[222] See, for example, Cheng, Allen T., "Bargaining Chips," *Asiaweek*, February 9, 2001a. Jiang and Wang reportedly met in the United States in 1995. The two are "firm friends," according to some accounts, and Wang has reportedly been invited to dinner at Jiang Zemin's private residence inside Zhongnanhai, the Chinese leadership compound in Beijing. See also LaPedus, Mark, "Shanghai Foundry to Start in 2002 with Backers in Taiwan, China," *Silicon Strategies*, September 15, 2000.

[223] Winston Wang's involvement in GSMC is viewed by some observers in Taiwan as emblematic of the supposed "hollowing out" of Taiwan's semiconductor industry and the island's growing economic ties with the mainland, which they worry might leave Taipei increasingly vulnerable to Chinese political, economic, and military pressure. See, for example, Cheng, 2001a.

extent of Jiang's current involvement with the company is unclear. The Chinese official media has apparently been forbidden from reporting on Jiang's business activities, and a *People's Daily* story on the founding of GSMC makes no mention of his involvement with the company.[224] Despite the sensitivity surrounding Jiang's involvement in business, company sources indicate that he was instrumental in the founding of GSMC. It has also been reported that Jiang is a vice chairman of the company,[225] and he was listed as a member of GSMC's board of directors on company documents filed with the Shanghai municipal government in November 2000.[226] According to GSMC employees, however, Jiang is no longer involved with the management or operations of the company.[227] At the same time, however, there are indications that, even though he has tried to keep a low profile in the corporate world since his appointment as a vice president of the Chinese Academy of Sciences (CAS), Jiang Mianheng still exerts substantial influence over several companies with which he has been affiliated, including GSMC. Indeed, knowledgeable observers indicate that Jiang "remains a key player . . . and is plugged in."[228]

Equally difficult to disentangle are the company's sources of funding. Some of the funding behind GSMC comes from major Chinese state-owned lenders, including the Bank of China, China Construction Bank, and China Commercial Bank. Much of GSMC's funding, however, reportedly comes from investors in Japan, South Korea, the United States, and companies in Taiwan, some of which have admitted under pressure from the Taiwanese government that their investments in GSMC violated Taiwanese laws and

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[224] "Major Company Set Up in Shanghai," *People's Daily*, November 18, 2000. The story also avoids mentioning Winston Wang.

[225] Cheng, 2001a. Winston Wang says neither he nor Jiang Mianheng own any shares of GSMC, but Jiang reportedly owns 10 percent of two Shanghai factories that are part of another of Wang's companies, Grace THW Group.

[226] In addition, according to documents filed with the Shanghai municipal government in August 1998 and July 2000, Jiang Mianheng is also the deputy chairman of the board of directors of Winston Wang's Shanghai Grace Technology Company.

[227] Interviews with GSMC employees, October 2002.

[228] Interview with industry analyst, Hong Kong, October 2002.

regulations.[229] In addition, it is rumored that some of GSMC's financial backing may come from the Shanghai Municipal Government.

Stories about Jiang Mianheng's involvement with the company and apparently illegal investments from Taiwan notwithstanding, GSMC wants to project the image that "the company has state-of-the-art technology and an experienced management team, and is trying to make things happen," according to a GSMC engineer. The briefing that GSMC employees presented to the authors in October 2002 was consistent with this message, highlighting GSMC's technology and experienced management team.

GSMC has acquired equipment and technology from companies including Nikon, Tokyo Electron Ltd. (TEL), Applied Materials, Nissin, Axcelis, Mattson, Komatsu Electronic Metals Co., Ltd. (KEM), Noellus, and Ebara, according to a company briefing. According to industry reports, Applied Materials is the key provider of equipment and technology for GSMC. In October 2001, GSMC ordered more than $200 million worth of equipment--including multiple dielectric and conductor etch, CVD (chemical vapor deposition), CMP (chemical mechanical planarization), PVD (physical vapor deposition), RTP (rapid thermal processing), and ion implant and inspection-metrology systems--from Applied Materials. As part of the deal, Applied Materials also agreed to provide GSMC with a customized total support package that includes equipment maintenance, spare parts management, and technical support services. GSMC engineers will receive training on the maintenance and operation of the equipment at an Applied Materials technical training

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[229] Lin Miao-Jung, "MAC Gives Rules for Pros in China," *Taipei Times*, July 24, 2002b. According to Taiwanese government officials, several Taiwanese companies have acknowledged that they made illegal investments in GSMC, Semiconductor Manufacturing International Co., and He Jian Technology, a Suzhou-based semiconductor company that reputedly has close ties to UMC, Taiwan's second-largest semiconductor manufacturing company (see Joyce Huang, 2003). The authorities declined to identify the Taiwanese companies involved, pending the conclusion of an investigation into the matter. Due to the difficulties involved in tracing mainland investments that Taiwanese businesses route through other countries, the Taiwanese government asked some companies to sign pledges that they would not invest illegally in Chinese semiconductor manufacturers. Violators could face criminal charges.

center in Shanghai.[230] In addition, media reports indicate another source of GSMC's process technology is Oki Electric Industry Company of Japan.[231]

GSMC's wafer production facilities will start out using 0.22-micron process technology, but GSMC plans to upgrade to 0.18-micron process technology and to start developing 0.13-micron process technology next year. The company planned to begin mass production in March 2003. According to a GSMC engineer, the plan calls for a "very aggressive development rate."

In addition to advanced technology, GSMC employees also highlight the fact that the key members of the company's senior management team have extensive experience in the semiconductor industry and many hold advanced degrees from U.S. universities:

- Winston Wang, CEO and founder of GSMC, previously ran the Nan-Ya technology company in Taiwan and has served as the chairman of eight electronics manufacturing companies in the PRC since 1996. Wang is also a professor at University of California, Berkeley and is a dean at Chang-Ku University in Taiwan.
- Nasa Tsai, president and CEO of GSMC, holds a PhD from Stanford. Tsai founded Mosel in Taiwan; served as managing director of Vitelic Hong Kong; founded CSMC Technologies Corp., the PRC's largest state-owned IC company, located in Wuxi; and has also worked for Intel.
- T. Higashi, executive advisory president of GSMC, is a former vice president of OKI Electronic Co., Japan.
- Sweiyam Yu, executive vice president for marketing, has a PhD from State University of New York, Stony Brook. He previously worked for Intel and Mosel Vitelic, and served as president of a design company in the PRC.

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[230] "Applied Materials Receives Over $200 Million Order from New GSMC Foundry in China," AMD press release, October 18, 2001.

[231] Tsuda, Kenji, "Semiconductor Fabs Flock to Shanghai," *Nikkei Electronics Asia*, May 2002.

- Executive Vice President for Technology Development Bun-Jon Woo holds a PhD from the University of Southern California and previously worked for Xerox and Intel.[232]

GSMC plans to build four 8-inch and 12-inch wafer fabs on its site, each of which will have a production capacity equivalent to 50,000 8-inch wafers per month. The company's site occupies 240,000 square meters in the Zhangjiang S&T Park in Shanghai's Pudong new area. The expected total investment to construct the four planned fabs is $7.5 billion over a period of ten years. Phase 1, which includes the construction of the first two fabs, will cost about $1.63 billion. GSMC broke ground in late 2000 on its first wafer fab, which was originally scheduled to open in early 2002. By the end of 2001, however, the project was so far behind schedule and construction was progressing so slowly that sources in Shanghai were reporting the Grace plant "had not risen beyond the height of the fence." Some Hong Kong press reports were even more pessimistic, claiming that the Jiang-Wang venture had encountered serious problems and was in danger of stalling completely.[233] Several knowledgeable sources have said that GSMC is having serious financial difficulties.[234] "The money is falling apart," according to one source.[235]

GSMC engineers, on the other hand, said construction of Fab 1 and Fab 2 is taking a long time because the facilities are designed to accommodate either 8-inch or 12-inch equipment. The fabs will initially produce 8-inch wafers, but will be convertible to accommodate 12-inch equipment. Therefore, the basic structural poles and supports of the fabs must be capable of supporting 12-inch equipment. According to one

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[232] Other senior managers at GSMC include Y. R. Shine, the vice president for Operations, who has a PhD from the University of Illinois, Urbana and has worked for TSMC, and T. S. Yang, the vice president for Quality Assurance, who earned a PhD at Rutgers University.

[233] Hsia Wen-yi, "Jiang Zemin, Looking Tired and Exhausted, Intends to Place His Son on CPC Central Committee," *Kai Fang* [*Open Magazine*], May 1, 2002 (in FBIS May 7, 2002).

[234] Other reports cite rumors that Jiang and Wang had a falling out over Wang's alleged disclosure of the sources of GSMC's funding. See Hsia Wen-yi, 2002.

[235] Interview with industry analyst, Washington, D.C., April 2002.

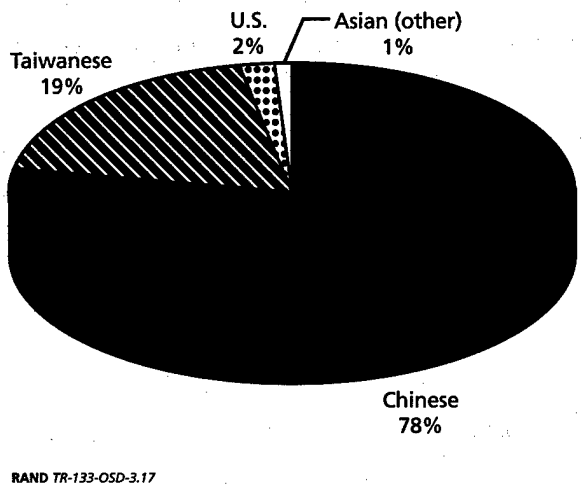
interviewee, one of the reasons that construction has been delayed is the difficulty in properly installing such poles and supports in a muddy area. Construction workers are simultaneously working on Fab 1 and Fab 2. The two fabs are scheduled to be completed at around the same time, but production on Fab 1 will begin first.

Whatever the reasons for the slowdown, the construction schedule for GSMC's fabs has been revised several times. Indeed, in March 2002, GSMC acknowledged that the construction of the first two plants was behind schedule and that chip production would not begin until March 2003. GSMC executives said at the time that the monthly production capacity of the two plants would reach approximately 25,000 wafers by the end of 2003. In May 2002, the company stated that it expected to complete the construction of the first two fabs in August 2002, move in its equipment in September 2002, begin producing prototype chips in December 2002, and start producing 8-inch wafers at full capacity in 2003.[236] The schedule was revised again when GSMC stated that it planned to start its first mass run on April 1, 2003, and reach a production level of 20,000 wafer starts per month by the end of 2003. Sources described the schedule as "very aggressive and very tight."[237] As of August 2003, however, GSMC had not started full production.

As of 2002, GSMC had a total of 812 employees, up from fewer than 400 in 2001, and had planned to expand to around 950 employees by the end of 2002. The staff will include about 750 Chinese employees and 200 employees from other countries. As of October 2002, approximately 78 percent of GSMC's employees are Chinese. The largest source of non-Chinese employees is Taiwan. Roughly 19 percent of GSMC's employees are from the island. Many of the Taiwanese engineers now working for GSMC came from TSMC, UMC, and Nanya Technology (at the beginning, most of GSMC's engineers came from TSMC and UMC). Around 2 percent of GSMC employees are from the United States, and they are all Chinese citizens or Chinese-Americans returning to their native country. The remaining 1 percent of GSMC's non-Chinese staff members are from Japan, Korea, and Singapore (see Figure 3.17). As for the educational qualifications of

[236] Tsuda, 2002.

[237] Interviews with industry analysts, Taipei, October 2002.



SOURCE: Grace Semiconductor Manufacturing Corp.

Figure 3.17--Grace Semiconductor Manufacturing Corp. Staff, by Nationality

the GSMC workforce, about 2 percent of GSMC employees have PhDs, while 15 percent have earned master's degrees, 40 percent hold bachelor's degrees, 34 percent hold associate's degrees, and 9 percent have completed only high school.

Experienced engineers from Taiwan, the United States, and other countries chose to join GSMC for a variety of reasons. One Taiwanese engineer said he was attracted to Grace because "China is the hot market of the next decade" and Winston Wang's solid relationships with key potential customers portend success for the company. The opportunity to "get in on the ground floor" with a company that is just starting up was another factor that several engineers said made GSMC an attractive option. "It's a chance to be part of history in the making and to get in on the early part in China," an engineer said. The employees at GSMC are receiving stock options, and the company plans to be listed somewhere on a stock exchange in the future, but there are no definite plans for an IPO as of yet.

Despite the delays in the construction of the first two GSMC fabs and the persistent rumors that the company is having financial problems,

employees remain optimistic about GSMC's prospects. According to one engineer, for GSMC to succeed it "doesn't need to beat everybody, just to find its own position in the market." The market is so big, the engineer said, that there is plenty of room, and "you really don't even have to compete that hard, just doing a good job is enough." In fact, GSMC estimates that China will be able to support around 40 fabs--20 using new equipment and 20 relying on old equipment--by 2008, including some producing low-end products and some servicing the high-end portion of the market. GSMC's plan is to focus on the high-end segment of the market, but many companies with 4-inch wafer fabs and other relatively less advanced fabs will stick to their own market specialties. GSMC plans to build all four of its fabs in Shanghai. "The plan is that we will not spread around to other parts of the country," a GSMC employee said. It is likely that GSMC will transfer its older technologies to other companies as its more advanced capabilities come online, but for now the company believes 8-inch wafers still "have quite a long lifetime ahead of them, although DRAM [dynamic random access memory] will move to 12-inch within the next two years." GSMC engineers say that early entrants into the Chinese market are likely to have an advantage. This is important to GSMC because its strategy is to focus on the domestic market.

CONCLUSIONS

This chapter illustrates the large-scale flow of Taiwanese high-technology trade and investment to the mainland. The attractiveness of the mainland as a base for low-cost production and as a huge market for semiconductor sales continues to trump Taiwan's economic and political concerns. This situation poses serious questions for Taiwan, China, and the United States, which are discussed in the next chapter.

4. ASSESSMENT OF KEY ANALYTICAL QUESTIONS AND POLICY IMPLICATIONS

This report's analysis raises policy issues not only for Taiwan and China, but also for the United States. In this chapter, we discuss the implications for Taiwan and China, and then address the implications regarding a key issue confronting U.S. policymakers: export controls on high-tech equipment related to semiconductor fabrication.

Cross-Strait flows of IT and investment capital raise several key questions worthy of analysis, the answers to which have significant implications for the strategic political and economic policies of Taiwan, China, and the United States:

- Is the movement of information technology and capital to China "hollowing out" Taiwan's IT industry?
- What are the implications of increasing economic integration for cross-Strait relations?
- What are the implications of cross-Strait IT flows for the greater China semiconductor industry?
- What are the implications of cross-Strait integration for Hong Kong?
- What are the implications of cross-Strait IT flows for U.S. export controls?

Each of these questions next will be examined in turn.

IS THE MOVEMENT OF TECHNOLOGY AND INVESTMENT TO CHINA "HOLLOWING OUT" TAIWAN'S IT INDUSTRY?

China's displacement of Taiwan as the world's third-largest producer of information technology hardware items, in large part as a result of the relocation of so much of the island's IT production capacity to the mainland, has touched off a debate in Taiwan about the supposed "hollowing out" of the island's economy.[1] A process of

[1] Lardy, Nicholas, "China an Awakened Giant," *The Nation Asia News Network*, October 19, 2002a.

restructuring, in which manufacturing jobs have been flowing out of Taiwan as the island moves into the production of high-technology products, has been underway for well over a decade. The number of people employed in manufacturing in Taiwan fell by 16 percent between 1987 and 1995.[2] For most of this period, however, incomes were rising and unemployment remained low, but the economic downturn that began in 2001 made the loss of manufacturing jobs into a controversial issue in Taiwan politics.

Many politicians and pundits in Taiwan blame the increasing outflow of investment capital to the mainland for the recent economic downturn in Taiwan. Capital flows to China are a scapegoat for low economic growth, sluggish domestic investment, and record levels of unemployment. In 2001, the unemployment rate reached 4.5 percent, and in 2002, it surpassed 5 percent (see Figure 4.1).

The supposed "hollowing out" of the island's economy has become a highly charged political issue in Taipei. A report issued by the Control Yuan in September 2002, for example, criticized the government for failing to stem the tide of capital flowing to China. The report asserted that Taiwanese companies investing in China have remitted only the equivalent of 1.18 percent of their mainland investments back to Taiwan and alleged that this investment imbalance was one of the major causes of the economic downturn on the island.[3] One recent editorial charged that "China fever has borne no economic fruit for Taiwan over the past decade" and has "diverted resources away from . . . integration with the innovative developed world, investment in basic and applied research, and the building of a modern infrastructure conducive to sustained growth in living standards."[4]

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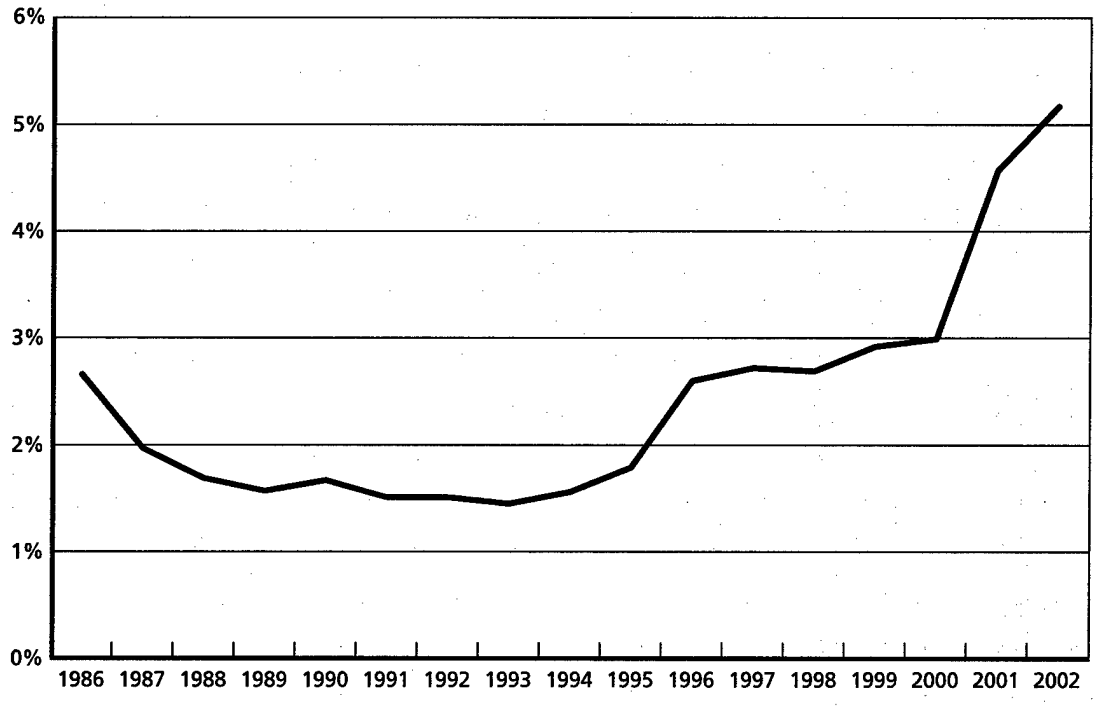
[2] Naughton, 1997c, p. 13.

[3] "Cabinet Failure to Stem Capital Outflow Censured: Watchdog Finds Only 1% of China Investment Sent Back to Taiwan," *Taiwan News*, September 19, 2002.

[4] See Hwan C. Lin, "Taiwan Has Overinvested in China," *Taipei Times*, October 31, 2002.



SOURCE: Directorate General of Budget, Accounting, and Statistics, Republic of China.

Figure 4.1--Taiwan's Unemployment Rate, 1986-2002

The public is also concerned about the supposed "hollowing out" of Taiwan's economy. According to a poll conducted in October 2002[5] by a think tank affiliated with former President Lee Teng-hui's Taiwan Solidarity Union, which has publicly articulated its support for independence, the widespread view in Taiwan is that the flow of Taiwan investment to the mainland is the main cause of the economic downturn. For example, more than 66 percent of respondents to the poll indicated that they suspect the relocation of Taiwan manufacturing to the mainland has led to rising unemployment on the island. Some reports have even

[5] "Downturn Due to 'China Fever:' Poll," *Central News Agency*, October 16, 2002.

blamed swelling Taiwanese investment in the mainland for problems in the island's travel, real estate, automobile, and restaurant industries.[6]

However, other observers argue that the concerns over the migration of manufacturing capacity to the mainland are misplaced and that the "hollowing-out" argument is largely political. "The movement of manufacturing is very natural for industry," one senior Taiwanese government official said. "It should be seen as a matter of historical and economic evolution, not a political issue."[7] Echoing the official's views, senior executives at many high-technology companies say they do not believe that Taiwan's economy will be "hollowed out."[8] Moreover, most economists and industry analysts cast doubt on the "hollowing out" argument, assessing that Taiwan's economic problems are not the result of increasing flows of Taiwanese investment to the mainland. A recent analysis by Deutsche Bank economists,[9] for example, questions the "hollowing out" thesis. Deutsche Bank economic modeling found little correlation between investment in the mainland and Taiwan GDP growth, and almost no correlation at all between Taiwanese investment in the mainland and manufacturing employment on the island. The report concluded that there is "no convincing evidence that Taiwanese investment in China has actually caused a 'hollowing out' of the Taiwanese economy,"[10] and "mounting Taiwanese capital outflow to the mainland is not the root cause of Taiwan's economic recession seen in 2001."[11] Similarly, other economists have argued that structural problems with Taiwan's economy, including government budget deficits, state dominance of the banking sector and an excess of non-performing loans, and the effects of the global economic downturn--especially given Taiwan's dependence on IT exports to the United States, which is also in

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[6] "Cross-Strait Exodus Taking Toll on Travel and Housing," *South China Morning Post*, September 2, 2002.

[7] Interview with Taiwanese government official, Taipei, October 2002.

[8] Interviews with company executives, Taipei, April 2002 and October 2002.

[9] Ma Jun et al., 2002.

[10] Ma Jun et al., 2002, p. 1.

[11] Ma Jun et al., 2002, pp. 17-19.

the midst of a sluggish economy--are the real culprits.[12] Moreover, some argue that Taiwanese investment in China and the shift of capacity to the mainland are part of a naturally evolving division of labor that is allowing Taiwan to outsource production while at the same time upgrading its industrial structure.

In the words of the Deutsche Bank study, "Taiwanese investment in the mainland has led to a new division of labor across the strait, with the Taiwanese conducting R&D, producing key components, and taking orders on the one side, and the mainland producing/assembling on the other side. In many cases, this division of labor requires heavier investment in Taiwan than in the mainland."[13]

Taiwan's MoEA estimates that the percentage of Taiwanese companies that take orders in Taiwan but manufacture their products overseas rose from 16.6 percent in September 1996 to 22.5 percent in December 2001. According to the MoEA report, about 40 percent of information industry production has moved abroad.[14] This cross-Strait division of labor for IT products manufacturing is illustrated by the case of Primax, a Taiwanese company that manufactures computer mice, surge protectors, cell phone chargers, scanners, and computer cables. The company produces approximately 95 percent of its products in Dongguan, but its management, marketing, and design work is all done in Taiwan.[15]

The movement of industry to China will be gradual, and the problem Taiwan faces is determining what it can do to increase value added at home. The outcome depends on whether Taiwan replaces the production that is leaving with more-advanced, high-added-value products. "The key is

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[12] See, for example, Heaney, Bill, "Economist Says China Can't Be Blamed for Woes," *Taipei Times*, November 7, 2002. The article quotes Paul Cavey, chief economist at the Economist Intelligence Unit, who says, "The hollowing out to China is not the problem. The 2001 slump was triggered by slow global growth." In addition, Cavey argues that the simultaneous increase in Taiwanese investment on the mainland and the decrease in the island's GDP is "a situation of coincidence rather than cause and effect."

[13] Ma Jun et al., 2002, p. 20.

[14] "Taiwan Is Worried About Companies Moving Production Abroad," *Inside China Today*, February 4, 2002.

[15] Kroeber, 2002. Primax has nine plants and employs 4,000 workers in Dongguan.

managing the transition," one researcher said. Taiwan must move into more sophisticated production as labor-intensive, environmentally demanding production is increasingly outsourced.

One official noted that Taiwanese companies invest less upstream and downstream, but stay in the middle for the most part, which is not a sustainable strategy. "Taiwan can't stay in the middle forever," the official said. "The challenge we face is moving in both directions."[16] Taiwanese government incentive programs are focusing on this problem. The plan includes several elements. The first is encouraging global companies to establish R&D centers in Taiwan.[17] The second element is moving up from OEM to ODM (original design manufacturer) to design and development.[18] Global companies can shift some development and application research to Taiwan. Notebook design, for example, is already done in Taiwan, and cell phone, personal digital assistant (PDA), and digital camera design will soon follow. This is a change that is helping Taiwan IT companies to move upstream, the official said. The plan calls for design work to be undertaken in Taiwan and manufacturing to be done on the mainland. In February 2004, Taiwan established a national design center to promote these efforts. Supported by government organizations such as the MoEA, ITRI, and III, as well as several private companies, the center provides training and education to boost Taiwan's local design capabilities.

Another senior official said that global companies can use Taiwan as a "hub" for their Greater China businesses.[19] Businessmen in Taiwan

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[16] Interview with government official, Taipei, October 2002.

[17] The Taiwanese government is reportedly planning to offer income tax exemptions to attract foreign technology professionals to Taiwan as part of an effort to boost R&D on the island.

[18] An original equipment manufacturer provides equipment or components to another company, which incorporates them into another product and markets the product under its own brand name or sells it directly under its own brand name. For example, a Taiwanese company that produces computer monitors and sells them to IBM, Compaq, or Dell, which then incorporates them into a package and sells them under its own brand name, is an OEM. An original design manufacturer (ODM) also provides equipment or components to another company that markets them under its own brand name, but unlike an OEM, it is also responsible for the design of those products or components.

[19] Interview with government official, Taipei, October 2002.

also envision another potential role for the island: a bridge to the mainland for multinational companies. The island can be a technology hub, R&D hub, and information hub.

"Taiwan is a place where you can protect company information because it has a well-established rule of law," the official said, implicitly contrasting the island to China, where IPR violations constitute a major problem for many foreign companies. For many multinational high-tech companies, their research centers in Taiwan, where work is done on product development, are different from their research centers in China, where they conduct only basic research. Yet, Taiwan has its own IPR problems, and there are indications that Beijing may be able to use market access as leverage to convince high-tech companies to conduct increasingly sophisticated R&D in China.

Taiwanese businessmen say that Taiwanese companies that cannot make money if they stay in Taiwan will move their manufacturing operations to China, but will keep their sensitive technology in Taiwan. The semiconductor industry's advanced research and development and advanced technology, for example, will stay in Taiwan, although some companies may set up less-advanced R&D centers in China in the future. For their part, Taiwanese high-tech executives plan to keep most of the sector's R&D in Taiwan even as manufacturing shifts to China. In the words of one industry executive, it is in the interests of Taiwanese companies to "maintain some balance."[20]

An IT industry analyst said that as a result of this trend, Taiwan is "finding its feet" and transforming the sectoral balances in the industry.[21] Taiwanese technology investment in China is mostly in manufacturing, much of it downstream, and is taking advantage of lower costs. For Taiwan, the challenge is to "move up the food chain in a global context," the analyst said. The basic issue is, "What's Taiwan going to be in five years?" The analyst said he is "guardedly optimistic that Taiwan can make the transition," although he is concerned that "corporate governance in Taiwan is less than visionary, and few people

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[20] Interview with Taiwanese IT industry executive, Taipei, April 2002.

[21] Interview with Taiwanese industry analyst, Taipei, October 2002.

are jumping in to capitalize on growth opportunities." Taiwanese companies need to move beyond their traditional manufacturing models, he asserted, and develop some of their own intellectual property.

To put the current situation in perspective, the semiconductor industry represents one of the last waves in the movement of production to the mainland. The movement of semiconductor production was preceded by the wholesale movement of lower-end technology assembly, such as assembly of motherboards, keyboards, and computer mice. It is important to note, however, that most of the "fabless" companies moving to China are part of the low end of the market. The low end of IC design will move to the PRC, but the high-end players will stay in Taiwan. The lower-end companies are trying to take advantage of a vast pool of engineering talent and lower their costs by moving to the mainland.

The government also has ambitious plans to help develop the island's prowess in sectors such as nanotechnology, biotechnology, and IC design. Taiwan will invest more than $600 million in developing its nanotechnology industry.[22] With the level of funding devoted to the development of the nanotechnology industry, the government has clearly identified the development of the sector as one of the key elements of its plan to upgrade Taiwan's economy even as more manufacturing operations shift to the mainland. Taiwan has high hopes for biotechnology in the future.[23] The Hsinchu science-based industrial park recently opened a new extension dedicated to attracting biotech companies, and the government plans to spend $850 million on research and development to encourage the expansion of the industry. The goal is to have hundreds of biotech companies, including at least one in a leading position in the global industry, within less than ten years. In addition, the government has announced plans to spend about $200 million over the next six years to support the development of the island's IC design sector.

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[22] See, for example, Ho, Laura, "ITRI Addresses Innovation Capabilities," *China Post*, October 31, 2002; and "Nano-technology Gets Boost from Cabinet," *Taiwan News*, November 6, 2002.

[23] Cheng, Allen T., "Taiwan Puts Its Chips on Biotech," *Fortune*, October 28, 2002b.

In October 2002, Taiwan established a new science-based industrial park in Taichung. It will be the island's third science-based industrial park when it opens in early 2004 and will focus on attracting nanotechnology companies. The National Science Council, which supervises the management of science-based industrial parks, is planning to make central Taiwan a nanotechnology center and to support the development of an optoelectronics cluster in the southern part of the island to complement the semiconductor industry that is centered on the Hsinchu science-based industrial park in the north. It is hoped that these new technological initiatives will replace computers and semiconductors as the cutting-edge elements of Taiwanese national R&D, allowing the island to leap ahead while continuing to exploit China as its production base.

WHAT ARE THE IMPLICATIONS OF INCREASING ECONOMIC INTEGRATION FOR CROSS-STRAIT RELATIONS?

Increasing economic integration between Taiwan and China has caused some concern that China could use its economic muscle to influence Taiwan's domestic politics, pressuring Taiwanese businessmen to influence their own government. After Chen Shui-bian was elected in 2000, mainland officials reportedly threatened to shut down Taiwanese shipping company Evergreen Marine's mainland operations and held up shipments by checking the documents of every item shipped because of Evergreen chairman Chang Yung-fa's membership in Chen's national advisory council. Acer also reportedly ran into difficulties because of chairman Stan Shih's support of Chen. Chinese government officials reportedly investigated Acer's Guangdong and Shanghai factories for irregularities.[24]

Such reports appear to lend credence to fears of increasing Chinese influence over Taiwan's political system. Indeed, Beijing's strategy does seem to center on promoting increasing economic integration in order to evolve into, or force, political integration. Taiwanese business officials whom we interviewed, however, all agreed that they did not expect China to use them to influence Taipei, though

[24] Cheng, Allen T., "It's Business As Usual," *Asiaweek* (online), September 1, 2000.

some did allude to Stan Shih's problems in 2000.[25] On closer examination, the subject of leverage may be less important than some believe. Beyond influencing the actions of individual Taiwanese businessmen, it is unlikely that Beijing could use economics to alter Taiwanese policy. In fact, a scholar at a Chinese think tank lamented that China has come to understand that its influence over Taiwanese policymaking is limited.[26] Furthermore, if China did have such power, one might expect China to use it to influence the Chen administration to cease activities that it perceives as "creeping independence" or to compel Taipei to agree to establish the "three links"--the direct transportation, trade, and postal links between Taiwan and China.

In addition, making life more difficult for Taiwanese investors would be counter to China's development plans, as Taiwanese companies now form the backbone of China's high-technology industry. Indeed, China's reliance on Taiwan's high-technology industry to provide know-how, technology, and jobs suggests that Taiwan may also gain some leverage from its interactions with the mainland, although the historic inability of the Taiwanese government to stop trade and investment flows to China would also suggest that Taiwan's ability to leverage this economic advantage is also limited. In addition, Taipei is not above placing pressure on Taiwanese businessmen for its own purposes, as illustrated by the incident in which the Taiwanese government asked two executives not to attend an investment conference in Shanghai.

This cross-Strait interdependence, in which China needs Taiwanese investments and Taiwan needs China's market and cheap labor, indicates that both sides have limited ability to use economics as a leverage in cross-Strait maneuverings. While it is true that China could nationalize Taiwanese investments in an extreme crisis, the broader negative repercussions of such a move to the global investment community would seem to preclude its employment. In addition, Beijing's strategy could backfire with friendly constituencies, disillusioning Taiwanese businessmen who are pro-Beijing or radicalizing those not currently involved in politics. Still, Beijing may be the net winner in this

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[25] Interviews with Taiwanese business executives, October 2002.
[26] Interview with scholar at Chinese think tank, December 2002.

contest. As Taiwanese businesses become more heavily invested in the mainland, they may become more sensitive to cross-Strait instability. This situation may cause the Taiwanese business community to put pressure on the Taiwanese government to pursue moderate cross-Strait policies--not because Beijing has asked them to do so, but because it is in their best interests.

Many commentators have also argued that China's desire to attract investment and technology from Taiwan will decrease the likelihood of conflict in the Taiwan Strait by making the costs of any potentially provocative move prohibitively high for both sides. In other words, they contend, integration makes war so costly that neither side would risk contemplating any action that might ignite a serious conflict. In explicating this economic interdependence argument in a Taiwanese context, for example, one analyst wrote, "For all its official distaste for the rebel regime in Taipei, mainland China wants Taiwan's capital and technological expertise. That's the main reason you haven't read recently about missile tests aimed across the Strait."[27] In a more in-depth treatment of this argument, Craig Addison wrote that Taiwan's importance in the global IT supply chain means that "China's hands are tied" when it comes to the possible use of force to coerce Taipei or compel it to accept unification on China's terms.[28] According to Addison, "Taiwan's place as a key manufacturer of silicon and hardware for the digital economy . . . provides an effective means of defense against Chinese aggression."[29] In Addison's view, increasing economic integration with the mainland is the best guarantee of the island's security for two reasons. First, any conflict with Taiwan would damage not only Taiwan's economy, but the Chinese economy as well. Second, keeping the global IT supply chain moving is as critical to the U.S., Japanese, and European economies as is maintaining access to oil supplies; therefore, the United States would come to Taiwan's aid in any

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[27] Meredith, 2002.

[28] Addison, Craig, *Silicon Shield: Taiwan's Protection Against Chinese Attack*, Irving, Tex.: Fusion Press, 2001, p. 48.

[29] Addison, 2001, p. 48.

conflict to prevent disruption of the global supply of IT hardware and integrated circuits.

While Addison is correct in asserting that any China-Taiwan conflict would be enormously costly for China as well as for Taiwan, and in concluding that the United States would likely come to Taiwan's aid in the event of such a conflict (although it would do so primarily for reasons other than the ones he lists), increasing economic integration is far from a guarantee of peace in the Taiwan Strait. Chinese leaders might very well be willing to bear the economic costs of a conflict if they calculated that military action was necessary to prevent the permanent separation of Taiwan from the mainland. Moreover, Beijing might believe that only minimal economic disruption would result from a coercive use of force against the island that is designed to achieve limited political objectives.

WHAT ARE THE IMPLICATIONS OF CROSS-STRAIT IT FLOWS FOR THE GREATER CHINA SEMICONDUCTOR INDUSTRY?

Global Semiconductor Market

The semiconductor industry is still depressed, trying to recover from the downturn that made 2001 its worst year ever. The downturn was a natural consequence of the overall downturn in the global information technology market. While the chip industry has historically experienced periodic peaks and troughs of supply and demand, driven by the logic of Moore's Law (discussed in Chapter 3), the continuing demand in China for chips has been a notable outlier. Indeed, Merrill Lynch estimated that the Chinese chip market will grow at an annual rate of 25 percent from 2003 through 2006--twice the predicted growth rate for the worldwide IC market.[30] Thus, continued economic growth in China, which is the basis for China's enormous telecommunications network build-out, and the successful or unsuccessful integration of the greater Chinese semiconductor industry will have a dramatic effect on the trajectory and ultimate recovery of the global semiconductor market.

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[30] Einhorn, Bruce, "China's Chip Binge," *Business Week*, January 21, 2002a.

Overall Greater China Semiconductor Industry

This report concludes that, given the current trend lines in cross-Strait IT flows, the greater China region will increasingly be the locus for IC production globally. Slowing economic growth in China, or a breakdown in the integration of the Chinese and Taiwanese semiconductor industries due to political or military conflict, will likely interrupt these trends.

Chinese semiconductor companies will face serious challenges as they attempt to compete with established Taiwanese foundry giants. The first challenge to overcome may be a lack of focus. "These guys are trying to be too many things to too many people," said one industry analyst. "They should focus more narrowly on one or two specialties."[31] Indeed, GSMC and SMIC will have to develop their own specialties--and find their own customers. This is no easy task, according to Taiwanese executives, in large part because TSMC and UMC already have the largest and best customers. Yet, TSMC and UMC do not want small orders and must avoid "stepping on any toes" by competing with their customers, and this may present opportunities for GSMC and SMIC.

Another problem facing GSMC and SMIC is that while they are capable of producing mature (old) technologies, they are using advanced tools to do so; therefore, their costs are high. In an interview with RAND in October 2002, Taiwanese semiconductor industry executives predicted that GSMC and SMIC would have financial problems. In addition, potential customers may perceive SMIC and GSMC as untested and new, in terms of both IPR protection and technological expertise. Concerns about intellectual property security are making some chip designers reluctant to outsource production to mainland-based companies. Even designers of relatively low-end chips, such as those used in electronic toys, are wary about the risks of design theft in China. For example, the company that designs the chips used in toys such as Furby and Tamagotchi continues to rely on TSMC and UMC even though the Taiwanese chipmakers are more expensive than their mainland rivals.[32] In addition, according

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[31] Interview with industry analyst, Hong Kong, October 2002.

[32] Culpan, Tim, "Taiwan Wary of Design Theft in Mainland," *South China Morning Post*, June 19, 2002b.

to a senior Taiwanese executive: "Who will risk letting them produce 0.13-micron or 90-nanometer technology?"[33] Process technology is another potential problem for the Chinese companies. If they infringe on TSMC patents, then TSMC could sue them in the United States.

All of these concerns have led some leading industry analysts to express doubts about the potential of SMIC and GSMC to thrive in an industry that is extremely difficult for smaller players. Some have concluded, "The threat of Shanghai may well be more hype than reality."[34] According to Craig Addison, "The reality is that both Shanghai fabs have a long, difficult road ahead of them, just as TSMC and UMC did when they were starting out." While SMIC and GSMC struggle to establish themselves, Addison says, Taiwan will continue moving ahead and rising to a higher place on the technology food chain. "Moving lower-end design and production to China will enable Taiwan chipmakers to devote their stretched resources to more advanced, and therefore more profitable, activities," Addison predicts.[35] Indeed, although plans for the construction of 12-inch wafer fabs have been delayed by the global IT slowdown, Taiwan will still very likely have five of the first ten 12-inch fabs to be built in the world. The strategies that TSMC and UMC are pursuing are "logical and sensible," according to industry analysts.[36]

Technology Levels

At least one fab in China (SMIC) is currently producing near-state-of-the-art 8-inch wafers with 0.18-micron technology, which is roughly one generation behind more-advanced efforts at Intel, UMC, and TSMC, which are already producing chips with 0.13-micron technology and have plans to produce chips with 90-nm technology. Intel does not have any plans to move their most-advanced fabs to China, and TSMC and other Taiwan-based fabs are approaching a move to China slowly. Even after

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[33] Interview with Taiwanese executive, Taipei, October 2002.

[34] Liao, Berta, "Taiwan Holds on to Its Chips," *Topics Online Magazine*, American Chamber of Commerce: Taipei, November 1, 2002.

[35] Addison, Craig, "China's Chip Ambitions Won't Threaten Taiwan Anytime Soon," *Semiconductor Magazine*, January 2002a.

[36] Addison, 2002a.

they receive approval from the Taiwan government, it will take some time for Taiwanese companies to move their fabs to China. "It will be a gradual transition," said one senior Taiwanese government researcher.[37]

Meanwhile, many companies are slowing down their plans for production of state-of-the-art 12-inch wafers due to sluggish global demand and the overall state of the world economy. The reason that companies are producing 12-inch wafers at present is largely because they are trying to position themselves in the market so that they are ready when the global IC market picks up, according to industry analysts.[38] As a result of the high costs associated with 12-inch wafer facilities and production, few players will be successful and will stay in the market. In fact, costs of production at that level are so high that they will likely prevent many aspirants from breaking into the field even if they can acquire the necessary technology.

WHAT ARE THE IMPLICATIONS OF CROSS-STRAIT INTEGRATION FOR HONG KONG?

Hong Kong has been the most important conduit for cross-Strait trade for more than two decades. Some 3,500 Taiwanese companies have established a presence in Hong Kong, and about 80 percent of cross-Strait trade is re-exported or transshipped through Hong Kong.[39] While Hong Kong has clearly benefited from the rapid expansion of cross-Strait economic interaction, some fear that the territory--already suffering from a protracted economic downturn (including unusually high unemployment, anemic consumer confidence, persistent deflation, and a ballooning budget deficit) and diminishing confidence in the Beijing-appointed government--will suffer another serious blow, losing its importance in cross-Strait trade if Taiwan and China agree to the

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[37] Interview with government researcher, Taipei, October 2002.

[38] Interviews with industry analysts, Taipei, Taiwan, and Hong Kong, October 2002.

[39] Ma Jun et al., pp. 9, 27. For many companies, the primary function of these operations is to support manufacturing facilities in China. The remaining 20 percent of trade is accounted for by transshipment via Japan and Korea, mini-direct links, and various types of semi-legal and illegal shipments.

establishment of direct links.[40] Many businessmen in the region say that the establishment of the "three links" would be "another nail in the coffin" for Hong Kong, rapidly eroding the city's position as a transshipment depot and travel hub.[41] Some are even more extreme in their pessimism about Hong Kong's prospects. If there were direct trade and travel links between the PRC and Taiwan, one Taiwanese executive said, "Hong Kong would totally disappear."[42] Hong Kong-based businessmen say that many Hong Kong leaders seem to believe "it could be a struggle to the death with Shanghai."[43]

Those assessments may be extreme, but recent economic modeling by Deutsche Bank analysts confirms the widespread suspicion that Hong Kong would be "the single largest loser as a result of direct links." In the first year after the establishment of the three links, the former colony's re-exports would fall by 6 percent, and during the five years following the implementation of direct links, the territory would suffer a cumulative loss of 1.5 percent of its GDP, according to the Deutsche Bank analysis.[44] About two-thirds of the 1.5 percent loss in Hong Kong's GDP will come in the first year after the establishment of direct links, and its trade and transportation sectors will bear the brunt of the economic impact of direct links. According to the Deutsche Bank study, "Direct links will significantly undermine Hong Kong's role as a trade and transportation intermediary for cross-Strait trade." The establishment of direct transportation links between China and Taiwan would result in a loss of about 5 to 6 percent of the shipping traffic in Hong Kong and several nearby Chinese ports for the first few years.

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[40] For a survey of Hong Kong's social and economic malaise, see Ng, David, "Anywhere But Here," *Far Eastern Economic Review*, October 17, 2002.

[41] Interviews with industry analysts, Washington, D.C., May 2002.

[42] Interview with Taiwanese business executive, Taipei, April 2002. The potential effects on Hong Kong's already weak economy have led some to speculate that Beijing might not really want direct links. As the Taiwanese business executive put it, "What happens to Hong Kong if you have the three links? Isn't it possible that China might not want this because it would damage Hong Kong?"

[43] Interview with business representatives, Hong Kong, October 2002.

[44] Ma Jun et al., 2002, pp. 26-28.

Air traffic through Hong Kong, such as Cathay Pacific's daily Hong Kong-Taipei flight, would be much more heavily affected.

Even optimists allow that the three links would certainly have an impact, although they also say that the consequences for Hong Kong would not be as dire as some analysts have predicted. Indeed, some observers remain optimistic about Hong Kong's future role in cross-Strait economic relations and believe the city will be able to weather the potential impact on its economy from the establishment of the three links. The attractiveness of Shanghai as a high-technology manufacturing center, for example, doesn't spell the economic end for Hong Kong, according to many analysts, despite some dire predictions. There are still more than 900 companies with regional headquarters in Hong Kong. Many are planning to keep their headquarters in Hong Kong even as they transfer some staff to Shanghai.[45] The predictions of Hong Kong's demise notwithstanding, some observers believe that the city is still in a relatively strong competitive position. "Hong Kong continuously reinvents itself," one investment banker said. "Every city in China is a gateway now, so Hong Kong gave up the idea that it was *the* gateway about five years ago. It's happening, but it's not the end of the world for Hong Kong."[46]

Even after the establishment of the three links, Hong Kong would still maintain a key, if somewhat diminished, role in cross-Strait trade and investment. Although cross-Strait shipments destined for the Yangtze River Delta will be shipped to closer ports, Guangdong Province is involved in about half of all cross-Strait trade, and it is likely that many of those shipments destined for the Pearl River Delta will still be shipped via Hong Kong.[47] In addition, Taiwanese firms exporting their products from their manufacturing bases in the Pearl River Delta will continue to rely on Hong Kong's port facilities. Overall, one observer said, the establishment of the three links would mark a political breakthrough in China-Taiwan relations and would therefore be good for trade and business, which in turn would ultimately be good for Hong Kong

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[45] For now, many companies are "keeping the planes full," but some say their Chinese teams will eventually move to Shanghai.

[46] Interview with industry analyst, Hong Kong, October 2002.

[47] Ma Jun et al., 2002, pp. 26-28.

and would offset the loss in shipping traffic.[48] Indeed, Deutsche Bank analysts predict that cross-Strait trade will increase by about 50 percent after the opening of direct links.[49] This could be a potential silver lining for Hong Kong.

Another potential source of optimism is the conclusion in June 2003 of a free trade agreement between Hong Kong and China. The trade accord, called the Mainland and Hong Kong Closer Economic Partnership Agreement, promises increased access to the Chinese market for Hong Kong businesses, including firms in the shipping, transportation, and movie-making industries, and eliminates most tariffs on imports from Hong Kong.[50]

Regardless of whether direct cross-Strait links materialize over the next few years, Hong Kong's future is tied to that of a larger region, the Pearl River Delta--which includes Dongguan, Shenzhen, and Guangdong--and its struggle to maintain its competitive position as Shanghai emerges as the center of China's rapidly developing high-technology sector. As will officials in Hong Kong, officials in the Pearl River Delta will fight back to ensure the region continues to attract Taiwanese IT investment. Businesses and government officials in the Pearl River Delta do not want to "lie down" and produce just toys, garments, and low-end consumer electronics, according to a member of the Hong Kong business community.[51] Indeed, Dongguan received about $1.8 billion in FDI in 2001, and Guangdong provincial officials say that investment is still flowing into the region from a variety of sources, including Taiwan. In the first half of 2002, more than 600 new Taiwanese firms opened in Guangdong, an increase of more than 18 percent in the number of Taiwanese firms in Guangdong over the first half of the previous year. Actual FDI by Taiwanese companies in Guangdong in the first half of 2002 was up 48 percent over the same period in 2001 to

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[48] Interview with a business community representative, Hong Kong, October 2002.

[49] Ma Jun et al., 2002.

[50] Bradsher, Keith, "With Unrest Rising, Hong Kong and China Conclude an Agreement to Liberalize Trade," *New York Times*, June 30, 2003b.

[51] Interview with business community member, Hong Kong, October 2002.

$1.34 billion, and new contracted FDI from Taiwanese companies reached $2 billion, up a dramatic 112 percent over the first half of 2001.

WHAT ARE THE IMPLICATIONS OF CROSS-STRAIT IT FLOWS FOR U.S. EXPORT CONTROLS?

The implications of the current trends in cross-Strait information technology and investment flows for U.S. government policymaking largely concern the potential advisability of export controls on IT-related manufacturing equipment and technology to China and Taiwan.

The rise of the information technology sector in China, combined with concerns about the modernization of the Chinese military and the possibility of U.S.-China military conflict over Taiwan, have ignited a new debate in Washington about export controls on IT-related technology to China. The increase in fabrication facility construction in China over the past several years has given rise to concerns that Chinese government trade and industrial policies are tipping the scales unfairly in China's favor at a time when the IT industry is struggling worldwide.[52] A GAO report on Chinese semiconductors, for instance, concludes that China has closed the gap on chip technology to a single generation behind the state of the art, fueled by acquisition of technology from abroad, and recommends a reassessment of U.S. export control policies on semiconductor manufacturing equipment and materials.[53] Concerns about migration of U.S. semiconductor manufacturing overseas are also highlighted in a white paper by U.S. Senator Joseph Lieberman.[54] Lieberman argues that foreign government

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[52] Lieberman, Joseph, "White Paper: National Security Aspects of the Global Migration of the U.S. Semiconductor Industry," June 2003, pp.3-5.

[53] United States General Accounting Office, 2002, p. 2.

[54] Lieberman, 2003. Senator Lieberman's paper charges that the Chinese government's incentive policies "reflect a strategic decision and represent a concerted effort by the Chinese government to capture the benefits of this enabling, high-tech industry," threatening to place China in a position that will allow it to control the price and supply of chips. The Chinese government has indeed embarked on a concerted attempt to boost the Chinese semiconductor industry, and some of its policies almost certainly constitute unfair trade practices. The conclusion that these policies will place China in such a dominant market position seems overblown, however, especially in light of the

incentives that are designed to take advantage of changes underway in the global IT industry and to draw away investment in semiconductor manufacturing constitute an "imminent threat" to U.S. national security. Concerns about Export control have even been raised about the export of IC manufacturing technologies to Taiwan, on the premise that the technologies might be transferred to the mainland in the course of cross-Strait trade. On the other side of the debate, free-traders and IT experts argue that controls on the export of IT products are both detrimental to the U.S. economy and impossible to enforce in a global economy.

Our research and fieldwork strongly confirm the latter view. It is true that foreign companies, through transfers of know-how, technology, and capital, have aided the progress of the Chinese IT industry, thereby allowing new entrants, such as GSMC and SMIC, to both enter the market and potentially provide a commercial channel for advanced information technologies to the Chinese military. But export controls will not solve this potential problem. First, export controls face some 21st-century realities that impede their enforcement: (1) the evolution from analog to digital technologies, which has greatly facilitated miniaturization of key products; (2) the increasing importance of components ("black boxes") rather than platforms; (3) the inherent "dual-use" nature (both civilian/commercial and military applications) of most export-controlled technologies; (4) the global military trend toward the use of commercial-off-the-shelf information technologies; (5) the driving force in the industry of commercial R&D rather than defense R&D; and (6) globalization of the world economy.

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recent problems experienced by several start-up foundry companies in China, which are leading some industry analysts to downwardly revise their expectations for the development of China's semiconductor industry. Executives from leading semiconductor companies in Taiwan are indicating that establishing manufacturing facilities in China has become a less urgent issue. Moreover, only one Taiwanese semiconductor manufacturer has submitted an application to invest in China, despite the flaring of concerns over the past few years that the island might quickly lose its edge in the foundry business to newly established mainland firms.

In the case of semiconductors, the export control argument is further undermined by the complexities of the relationship between state-of-the-art chips and state-of-the-art weaponry. Some defense and intelligence applications demand state-of-the-art chips, but many do not. For example, the GAO reports that the avionics of the U.S. Air Force's most advanced future combat aircraft, the F-22, uses an Intel i960MX microprocessor that has a feature size (line width of the chip) of 0.8 micron, which is four generations behind what China can currently produce domestically.[55] China therefore does not necessarily need advanced semiconductors to develop advanced weaponry. Considering the difficulties in preventing China from acquiring advanced semiconductor technology, developing an export control regime that could truly prevent China from developing advanced weaponry would require restrictions on technology that is so outdated that the export control regime would be impossible to enforce.

Moreover, our analysis of the dynamic cross-Strait IT flows and interviews with experts from government and industry leads us to the conclusion that export controls on information technologies would not have a meaningful impact on the trajectory of the Chinese IT sector's growth or technology levels. Indeed, controls would likely only hurt American industry and the U.S. economy, both of which are trying to recover from a recession caused in large measure by a decline in spending on IT products. American companies do not have a measurable technological lead, and European and Japanese competitors have historically shown a willingness to place less of a priority on security concerns as a determinant of export policies.[56]

Finally, the United States can maintain sufficient domestic production capabilities in key areas without imposing export controls. Enticing manufacturers to locate facilities in the United States is in

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[55] United States General Accounting Office, 2002, p. 16.

[56] For example, Germany's Infineon Technologies in December 2002 agreed to transfer 0.14-micron DRAM technology to SMIC with an option to transfer 0.11-micron technology in the future. "Infineon Signs Major Foundry Agreement with SMIC in China Securing Access to Further Capacities to Support Infineon's Growth in the Memory Chip Market," *Semiseeknews.com,* December 9, 2002.

large part a question of providing the right mix of incentives, as demonstrated by IBM's selection of East Fishkill, New York, as the site for its newest semiconductor production facility.

In addition, to address national security concerns, the U.S. Department of Defense is contracting with IBM to provide a secure source of advanced chips tailored for defense and intelligence applications.[57]

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[57] "600 Million over 10 Years for IBM's 'Trusted Foundry,'" *Manufacturing & Technology News*, February 3, 2004.

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