Introduction

A. Research Synopsis

Many researchers have tended to group together Taiwan, Japan and Korea as following very similar models of development because of the strong central roles played by each state's national government. However, this research will conclude that in sharp contrast to Taiwan, the state in Japan and Korea has played a largely different role. In particular, the role of the state in the Japanese accelerated industrial catch up strategy for information technology (IT) hardware has changed significantly over time, and so did the state-society and state-business relations. The Japanese state through MITI was a major promoter of the IT hardware industry with a primary emphasis on exports in the 1960s. During most of the 1970s, the state drew and implemented numerous ambitious plans to promote the IT hardware manufacturing industry such as heading up technology consortium proposals and co-operative think tanks but most of them did not materialize as planned (Fallows 1994 pp.52-74).

A genuine accelerated IT hardware industrial catch up strategy took place in Korea after 1983 during which the state could not play a leading role for a number of reasons. A critical initial step toward becoming a world leading IT hardware industry was taken not by the state but by private firms in the early 1980s. It was only after 1986-87 that the state resumed its efforts to promote the IT hardware industry rather vigorously. This time, however, the state had neither been a dominant player nor a pure reactor to societal pressures. This shows that the role of the state in Korea was changing and evolving through time which was sometimes more dominant and at other times less. The state and private firms have been more equal or less equal partners in the shared long-term goal for making and implementing industrial policies on depending on which time one looks into. That is, responsible state agents/agencies have intimate contacts with major private firms in making and implementing IT hardware related policies. This same vacillation holds true for Japanese government involvement in IT

industrial targeting. Though state-run research institutes in Japan have played important roles in technological advance since the 1970s (Wade 1990 pp.200-226), three major electronics firms began to acquire excellent organizational and R&D capabilities by the mid 1980s. This enabled them to assume significant roles in the policy-making as well as implementation processes for the development of a world leading IT hardware industry. However, the state's role was not consistent over time. It was vacillating between greater and lesser policy intervention.

How can it be said in this study that Taiwanese, Korean and Japanese states played such different roles in the developmental process of the IT hardware industry, even though they have been commonly viewed as classic examples of the same model that Chalmers Johnson (1982 pp.5-14, 1987 pp.138-141) calls the "developmental state"? The existing views on East Asian development, those on the economic development of Taiwan and Japan in particular, cannot provide a complete and meaningful explanation to this critical question for a number of reasons that will be discussed later. Though Taiwan is called a newly industrialized country, the state is not new any more and neither are governmental organizations, industries, the people within them, state-society relations, nor the international political economic conditions and structures in which they are located. In other words, structures and institutions in regard to industrial policy-making and implementation are now well established (except for NPOs in Japan), and major players act and react according to the "rules of the game" that are unique to each society. Thus state dominance over economic policy-making and implementation is not consistently true, though the state tended to be dominant and pervasive in the process of economic development in the far past.

Considering these changes, this study adopts an "institutional approach to state-society and state-business relations," originally developed by Peter Hall (1986 pp.7-15) in his comparative study on the French and British economic policies and Peter Evans (1985

pp.13-25) in his study of "comparative institutional analysis" (CIA) for industrial transformation as well as many other scholars at Stanford University in the 1980's. In addition, the theoretical foundation for this new analytic method is founded on Von Neumann and Morgenstern's (1980 pp.2-28) theory of "bounded rationality" laid out in their now famous book entitled Theory of Games and Economic Behavior for which the first edition came out in 1944.

In 1999, in terms of the total shipment of ICs, Taiwan was ranked as #3, just behind the US and Japan (ERSO, 2000 pp.12-34). In less than 20 years, Taiwan producers not only greatly increased their production capacities and market shares in the IC industry, but also, more impressively, improved their R&D capabilities. In 1983, Korea and Taiwan were granted no IC-related patents in the US, whereas Germany received 110 patents. In 1997, 14 years later, Korea and Taiwan were granted 386 and267 IC-related patents in the US, respectively, whereas Germany was granted only 155 such patents (Chang, 1999 pp.35-55). Thanks to this explosive growth in IC-related patents, in 1999, Samsung Electronics was ranked as the #4 company in terms of the total number of patents granted in the US in all technology classes. In the same year, fabless design houses in Taiwan were rated as #2 in the world, just behind the US, capturing 20% of world market shares measured in terms of revenues in the chip design area; these design houses also began to produce a substantial number of patents (ERSO, 2000 pp.28-36). These statistics clearly suggest that Korea and Taiwan caught up with Germany, the UK, and France in the global IC industry, in terms of both market shares and patent numbers. In selected areas, the two countries are also threatening the leadership of the US and Japan.

How did Taiwanese IC firms acquire and develop technologies in such a rapid technological catch-up process? Almeida (1996 pp.155-161) shows that part of their learning behavior can be attributed to the activities of their subsidiaries in the US, which source technology locally. But there is also evidence to suggest that the inter-country exchange of

experts has played a crucial role. In its extensive analysis of the "Asian miracle," the World Bank (1993 pp.13-34) emphasizes that the return of foreign-educated nationals has provided significant transfer of best practices and state-of-the-art knowledge. Recent case studies (Hou & Gee 1993 pp.384-401; Kim 1997 pp.86-99; Cho,Kim,Rhee 1998 pp.489-501) also provide evidence of the importance of human-embodied technology transfer in the time compressed learning processes of Taiwanese firms in the IC and computer industry. Based in part on such evidence, the recent World Development Report on knowledge and economic development (World Bank 1998 pp.22-65) identifies the international movement of people as one of four principal channels for acquiring imported knowledge (along with trade, foreign direct investment, and technology licensing). Human exchange within or across firms has played a very important role in transferring knowledge or knowledge-building capabilities (Ettlie 1980 pp.1055-65; Leonard-Barton 1995 pp.99-156; Chesbrough 1999 pp.465-79).

This thesis will attempt to explain the causes of different industrial policy outcomes in Taiwan and Japan in regard to the IT hardware industry. It will be argued that the strategic institutional differences between Taiwan and Japan in three structural variables (business institutions, state institutions, NPO institutions and the relations between them), are largely responsible for the different policy paths taken by each state and different levels of success in achieving the same developmental goal, that is, accelerated industrial catch up strategy for IT.

B. IT Hardware Industry Overview

The personal computer revolution brought many chances for new countries to become integrated into the production network of the PC industry. The most remarkable newcomers were the newly industrializing economies (NIEs) of Asia: Korea, Taiwan, Singapore, and Hong Kong. The NIEs economies had grown at exponential rates on the strength of labor-intensive manufacturing and rising exports, but by the late 1970s, labor costs were going up and new competition was developing from lower wage countries in the region. The governments of Korea,

Taiwan, and Singapore already knew that their economies needed to move on to more capital- and technology-intensive types of production with more value added. In the electronics industry, the governments promoted production of more advanced consumer products, such as VCRs and microwave ovens, and sophisticated components such as semiconductors also known as integrated circuits (ICs). They also set up the infrastructure for computer production by arranging foreign investment and technology transfer, and by strongly promoting domestic technical and manufacturing capabilities.

When major world brand PC companies started looking for low-cost suppliers and subcontractors, they offered chances for Asian companies to enter the PC industry without having to master a wide range of technologies or develop their own marketing and distribution channels through original equipment manufacturing (hereafter OEM) type opportunities. A company could produce a cable, power supply, keyboard, or monitor based on IBM's design standards and sell the components to any PC maker. It could also assemble PCs or circuit boards for major companies that preferred to outsource some parts of the production process. The barriers to entry were low, and East Asian producers flooded into the market. However, Many business scholars consider OEM as just a short term strategy or stepping stone for getting started in IT hardware because they believe that the higher profitability potential lies only in developing brand name products by getting out of the OEM business and into the international brand recognition wars. Japan, Korea and Hong Kong believed in this western strategy and all got out of the OEM business as soon as possible. By 1989 only Taiwan still believed that OEM could be a profitable long term strategy and some of the well known leaders such as Miao Fengchiang of Mitac computers and Morris Chang of the Taiwan Semiconductor manufacturing Corporation (TSMC) had actually developed full scale plans for leveraging Taiwan's OEM based business infra-structure (苗豊強 1998 pp.86-95).

The direct investment and outsourcing by multinational computer makers and efforts

by local companies to become part of the supply chain combined to create a boom in computer production in East Asia. The combination of approaches was different in each situation. Singapore relied mostly on production by foreign multinationals, Taiwan and Hong Kong had a combination of foreign and domestic producers, and domestic firms dominated Korea's industry. During the 1980s, each of the four NIEs experienced high-speed growth in the manufacturing of computers and peripherals (Fig. 4-1). However, in the late 1980s and early 1990s, production levels stagnated in Korea, Japan and Hong Kong but surged in Taiwan and Singapore. This surge in Taiwan during the 1990's along with the commensurate decline of Japan, Korea and Hong Kong's market share along with an analysis of comparative organizational strategies is of primary concern in this dissertation (see Fig. 4.1 in Part 4). By the mid-1990s, the NIEs had developed strategies that earned them leading positions in many segments of the personal computer hardware industry (Table A.2 below). Taiwan then became the world leader in production of notebook computers, CD Rom drives, motherboards, scanners, keyboards, monitors and specialized ICs. Its companies were moving into higher technology products and providing design and distribution as well as production. Singapore led the world in production of hard disk drives and sound cards, and was fourth in PC assembly. Korea was challenging Japan's control of the DRAM market, but at the same time, its PC industry was losing its edge as global competition intensified. Hong Kong lost much of its manufacturing base, but retained a vital position in the industry by managing production in southern China. However, only Taiwan followed a strategy so radically contrary to the other Asian NIEs (the OEM strategy) and it is through looking at Taiwan's institutions that we can discover the strength of its unique organizational strategy.

While the Asian NIEs became major centers of hardware production, they failed to make a mark in the software and services industry-with the exception of Singapore, whose software industry nearly matched that of the United States as a percent of GDP. Software production in the NIEs consists mostly of custom programming or localization of imported

products. There are few commercially successful packaged applications, and software exports are very low. However, a high percentage of the software engineers working for large software companies such as Microsoft are Chinese, Taiwanese or Ethnic Chinese.

Table A.1 Computer Hardware Manufacturing Market Share for Japan and Asian NIEs, 1995 and 2000 Compared

	% Share (in units)	% Share of Global Production (in units) for various products.				(\$ Value)%
Region	Desk PC	Notebook	Monitors	Mother Boards	Hard Disk	ICs and related
	95---2000	95----2000	95---2000	95--2000	95---2000	95--2000
Korea	5---------9%	1---------5%	25-----31%	0-------2%	3-------6%	7------5%
Taiwan	10------17%	28-------56%	57-----52%	68----78%	n.a.	4-----14%
Singapore	3--------5%	12-------6%	5------- 5%	n.a.	45----49 %	1-----2%
Hong Kong	1--------2%	0---------1%	0--------0%	n.a.	n.a.	n.a.
NIEs share of world	19-----33%	41------68%	87------88%	68----80%	48---55%	12-----21%
Japan	6--------5%	33-------23%	5--------4%	5-------5%	30----27%	31-----20%

Sources: Market Intelligence Center/Institute for Information Industries (MIC/III), Asia IT Report (February 1996 and November 1996); Electronics Industries Association of Korea (EIAK), "95 Statistics of Electronic Industries (Seoul: EIAK, 1996). ITRI Statistics 1995 & 2000. *工業技術研究院* 2001. * Large companies and government agencies include merchant sales only. Does not include captive production by PC vendors.

As we see in Table A.1 above Taiwan made by far the biggest advances in the 3 most

value added areas of desk PC, Notebook PC and integrated circuits (ICs, a type of high value added of semiconductor). Missing from the list is the fact that Taiwan increased its share for CD Rom drives from 37% to 51% of world market. Also notice that Japan lost market share in every area of hardware while Korea made only mild advances compared with Taiwan. The reason for this dramatic performance increase by Taiwan can be attributed mostly to 9 Taiwan companies setting up OEM Win-Win alliances with 4 major Japanese manufacturers. The 8 are Mitac, Compal, Quanta, FIT, TSMC, UMC, Winbond, Inventec and Asustek. The 4 Japanese companies are Fujitsu, Sharp, NEC and Sony which may surprise some people because they were all considered to be strong in manufacturing in 1994 but during 1994-1998 these four were all persuaded by the Taiwan 8 to turn over more than 50% of their IT manufacturing to Taiwan OEM companies. Only Taiwanese companies have been successful at procuring very large production orders from major Japanese IT firms. This fact has rarely been reported in English publications and to my knowledge research has never been published in English concerning the unique Chinese organizational strategies utilized in the success of this contrarian methodology that resulted in long term OEM profitability. This research will use a bounded rationality methodology from the New Institutional Economics perspective developed first at Stanford University during the 1980's by people such as Peter Evans and Aoki Masahiko which they call comparative institutional analysis or CIA (see section 1.3 below).

C. Central Issues of this Doctoral Research

The central inquiry of the PhD dissertation explored the answers to the questions below that correlate to the 5 main points raised in each respective part of this study. Point 1-a. Evolution of Development Theories. How does this research conclude that in contrast to Taiwan, the state in Japan and Korea has played a largely different role? In particular, the role of the state in the Japanese accelerated industrial catch up strategy for

information technology (IT) hardware has changed significantly over time, and so did the state-society and state-business relations. Part I goes into detail about the historical background which led to development paths that appear similar between Japan and Taiwan but are actually quite different in both practice and results.

Point 1-b. The Comparative Institutional Approach. Why are "bounded rationality" methodologies, such as CIA and game theory more useful than conventional "rational expectations" economic models in analyzing economic development and transition economies? This is explained at the end of Part I and refers to the strong trend in the 1990's for using more and more bounded rationality as the new methodology comes of age.

Point 2. Political Intervention. Japan and Taiwan both experienced strong political intervention into the IT hardware industry however the end result was far different in each case why? Part II examines the history of these interventions and answers this question.

Point 3. Bureaucracy and NGOs. What was unique about Taiwan's state-business and state-society relations for IT hardware development and how did the human resource diversity strategy of "open pluralism" for state institutions differ from others using "bureau pluralism" such as Japan and South Korea?

Point 4. Corporate Culture of Diversity. What strategies were used in the Taiwanese IT hardware industry that helped achieve the highest average rate of both profitability and world market share increase during the 1985--2000 period? Also, from the perspective of institutional economics, what is unique about the organizational strategies of "human resource diversity" and "OEM vertical division of labor" (Win-Win strategy) for IT hardware companies and research institutions that make Taiwan stand out in East Asia?

Point 5. For and Against Taiwan. Why was the early 1990's filled with so many criticisms about Taiwan's IT development and business style with many experts explaining why Taiwan would soon fail? However, there were few experts explaining why Taiwan's IT strategy was leading the world in profitability and revenue growth from 1990 until 2002. Part V explains the misunderstandings about Taiwan's strategy and why nobody saw the strong success coming

in the future.

Addressing these questions through a complex comparative institutional analysis will be the supporting proof for this dissertation. Below in the "Overview" the analytical framework of the comparative institutional analysis approach will be introduced.

D. List of Working Definitions and Technical Terminology

List of Working Definitions for the Doctoral Dissertation

Institutional Analysis and Institutions

The concept of an institution and its effects upon human exchange is clearly stated in economic theory. By using the jargon of the economist, "institutions define and limit the set of choices of individuals" (North 1990 p.4), North defines the concept of institution as follows:

> Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction. In consequence they structure incentives in human exchange, whether political, social, or economic. Institutional change shapes the way societies evolve through time and hence is the key to understanding historical change. (North 1990 p.3)

An institution, therefore, is necessarily a broad concept. Virtually anything that affects the behavior of various actors in a given policy space is considered as a part of institutions. Institutions include not only state structures and the conventional interactions between bureaucratic agents and agencies, but also societal structures and the rules of the game to which key players in the policy-making process adhere. International political economy is also viewed as a part of institutions as long as it imposes constraints upon the behavior of relevant actors by defining and limiting the choices of action before them.

NPO Non Profit Organization

The status of NPO laws is unique to every country but in general they have many similarities that we will point out in order to create a working definition to be used in this research.

Although there are no international laws or guidelines for NPOs (just like private businesses) the common traits do seem to exist as follows:

1. The main purpose of activities is not to make a monetary profit.
2. The main purpose of activities is to try to somehow improve domestic or international society in some specified way.
3. The statement of purpose and parameters of activity are clearly stated within the NPO charter.
4. Organizations with the status of NPO get tax reductions.
5. People donating money to NPOs can receive a tax deduction on their corporate or personal income tax filings up to a certain specified limit.

In general these 5 aspects are common in most countries that legally accept NPOs around the world. The only difference is that some countries include religious organizations as NPOs and some don't. Also the amount of tax deduction allowed on each corporate or personal income tax filing is different for each country with Japan being the only developed country to not allow any income tax deductions at all on every kind of income tax filing. Because these 5 aspects are very common to most NPO laws around the world, these will be used as our working definition NPO for this research.

NGO Non Government Organization

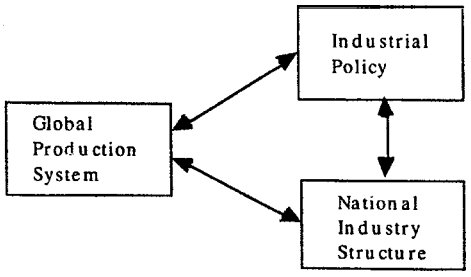
The definition of NGO does usually include NPOs as one common type of NGO but for the purpose of clarity in this thesis we will use NPO to mean only those NGOs that have the legal status of NPO in the home country and we will use NGO to mean any organization that doesn't have the legal status of a NPO, business or government organization in the home country.

Structure of the Global Computer Production System

Both the structure and the evolution of that system are important. This includes competition, alliances, and market transactions among companies at different levels of the production chain, from silicon to systems to software. It also includes the geographical structure of the global production network, that is, who makes what, and where.

Government Industrial Policies

These are the policies that influence the development of national IT industries. In an industry whose geographical structure is largely determined by the business decisions of a few MNCs, but also affected by the choices of thousands of small companies, government policy can be an important factor influencing those decisions. These policies include tariffs and other trade barriers, incentives to attract foreign investment or encourage local investment in computer production, export promotion, training of computer professionals, investment in infrastructure and R&D, and promotion of domestic computer use. Industrial policies can either help or harm a country's competitiveness, and policies that are helpful at one time can actually be counterproductive later on because of changes in the nature of the competitive environment



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National Computer Industry Structures

Each country has its own industry structure, marked by several features. Some countries' industries are dominated by foreign multinationals, while others consist mostly of domestic companies. In some countries, a few large, diversified firms lead the industry, and smaller companies are generally part of the supply chain of one of these firms. In others, entrepreneurial smaller companies compete with each other and have only loose ties to each other and to larger firms. A given industry structure may be advantageous for competing in one product area, yet be detrimental in other markets. Equally important is a country's managerial culture, which may or may not be well suited to the fast-changing, highly competitive computer industry. A country will ultimately succeed in computers to the extent that its domestic companies succeed or it is able to attract investment from successful foreign multinationals.

Path Dependencies

This refers to the development trajectories created by the acts of individual companies (or entrepreneurs j and countries, which become locked-in or amplified, leading to particular specialization patterns over time. A firm that has a first mover advantage, however small, may amplify that advantage into total market dominance. Similarly, a country that has a first mover advantage, however small, in attracting firms to engage in a particular computer sector, such as disk drive manufacturing, may become even more attractive to other firms engaged in similar or related activities (suppliers of materials, parts, subcomponents). Thus, the interactions in figure 1-1 must be seen as dynamic and evolving, rather than a fixed set of variables.

Increasing versus Decreasing Returns

Closely related to the notion of path dependency is the concept of increasing and decreasing returns to scale. While the neoclassical models that have dominated economics for decades have assumed decreasing returns to scale (at least beyond some level of production), a number of scholars have argued in recent years that increasing returns not only exist, but are important drivers of economic growth." In the case of standards-based competition, there is a tendency toward winner-take-all outcomes, as over time both users and creators of complementary assets such as software migrate to the standard that has the largest user base. However, while some segments of the industry, such as operating systems and microprocessors, are classic increasing-returns industries, much of the industry still operates under the traditional conditions of decreasing returns. This distinction is important in analyzing competition among both companies and countries.

List of Technical Terminology

Semiconductor products

Semiconductor.

A material that is a partial conductor of electric current (such as silicon, gallium arsenide). By modifying its conductivity through the introduction of extraneous materials, semiconductor materials can mimic the elements of electric circuits such as switches.

Semiconductor devices.

Products that contain semiconductor materials and which react dynamically to an input signal, either by adding energy to it or modifying it. Thus they are `active' components as opposed to `passive' elements such as capacitors and resistors.

Semiconductor devices are generally classified into the following categories:

- discretes

- integrated circuits:

- logic devices - analog devices - memory devices - microprocessors.

Discretes.

These are single components such as transistors, diodes or resistors.

(ICs).

A semiconductor device in which a large number of both active and passive discrete components are integrated into a single package. If they are all on a single piece of silicon ('chip') this is called a monolithic integrated circuit.

Logic devices.

These are ICs which accept binary signals and give binary output, processed according to logic functions such as `and', `nor' or 'nand'. The functions can be defined by hard wiring ('in the silicon'), by mask programming, or by field programming.

Analog devices.

These are ICs that accept analog (continuously varying) inputs and give analog or binary output. They are essential in capturing real-world data (which is always analog in nature) before it can be processed in digital form by computers.

Memory Devices

These are ICs that store and retrieve logic bits. They can be:

ROMs Read Only Memories - these are pre-loaded with data or instructions;

RAMs Random Access Memories - these can be filled with data and emptied over and over again. They can be dynamic (DRAMs) or static (SRAMs).

EPROMs Electrically Programmable ROMs - these are ROMs whose contents can be over-written.

Microprocessor Devices

These are ICs that act as computers, applying sequences of processes to bits of data according to the programs that are loaded into them. Microprocessors (MPUs) process data in terms of bit sequences; the earliest were 4-bit devices, going up to 8-bit, then 16-bit and 32-bit, which are the standard devices today. (A 32-bit microprocessor can accept file names in strings of up to x characters.) Embedded microcontrollers are microprocessor ICs contained within existing electronic products, endowing them with programmability.

Hybrid ICs

These mix semiconductor technology with other traditional devices within a single package.

Optoelectronic Devices

These are semiconductor devices that are light sensitive, either absorbing light as signal (e.g. photo sensors) or emitting it (e.g. liquid crystal displays (LCDs), light emitting diodes (LEDs).

IC Process Technology (Division of Labor for Taiwan IT Hardware)

Semiconductor products work differently depending on how they are designed and manufactured. ICs are integrated circuits which means that at least two or more functions are integrated into one single chip. For example, memory chips such as DRAMs or FLASH memory that only serve the one function of straight memory are not ICs. An IC must integrate at least two functions or components into one chip such as a SOC or system on a chip.

Bipolar Devices

These were the earliest forms of transistors, which worked like a switch through p and n junctions inserted in silicon wafers by the introduction of contaminants.

MOS Devices

These operate through an arrangement of Metal Oxide on Silicon. They can be NMOS or PMOS

depending on whether they utilize p or n junctions; or they can utilize both, as in Complementary MOS (CMOS) devices. CMOS has become the standard IC technology because of its low power consumption.

Fabrication Stages

The production of ICs entails a number of highly synchronized and delicate steps in which impurities and coatings are introduced into or on silicon wafers to get them to behave as circuits according to a particular design. The design is transferred to a transparent silicon sliver termed a mask, and its image is deposited (etched) on the silicon wafer through the action of light. This is termed photolithography (from the Greek `writing on stone') The analogy with printing, where an inked image on paper is achieved through first producing a plate, is quite close. The major steps involved are as follows:

Silicon Wafer Preparation

Ingots of pure silicon are produced, and then sliced to produce `wafers'. These are polished, and may have materials deposited on the surface to assist with later processing (e.g. epitaxial wafers).

Circuit Design

The circuit is designed and tested (through simulation) and printed out on large sheets. These are then decomposed into layers (up to 12 or even more) each of which is transferred to a mask. The IC is constructed sequentially as each circuit layer is laid down in silicon.

Photolithography

Masks are prepared as reticules, through light processes or, as the density of ICs increases, through X-ray diffraction. Wafers are cleaned and then coated with various forms of photo resistors, in order to generate an image through ‘etching’. Circuit images transmitted through the mask are then printed through ‘contact alignment’, with circuit images repeated sequentially in a process of `stepping' (where the aim is to pack as many ICs onto a wafer as possible).

Silicon Processing

Junction formation in the silicon is achieved through diffusion of diopants, and ion implantation. There is also epitaxial metal deposition where metal layers are deposited (through sputtering or evaporation) and multiple interconnects formed within the silicon.

Assembly

The individual circuits ('dies') now printed on the wafer are first separated, and then attached ('bonded') individually to a substrate or lead frame. Wire bonding is then effected to connect the circuit to the lead frame, ending in tapered pins which allow the
finished chip to be plugged into a circuit. The assembly is then packaged within a plastic or epoxy mold, to form a finished chip.

Testing

Chips are not dispatched before they are subjected to exhaustive testing to ensure that they behave as predicted by the circuit design. Testing procedures are frequently linked to the design itself (which is why `fabless' chip producers test their own products and secure a competitive advantage by doing so).

Customization

The technology of semiconductor manufacturing lends itself to varying degrees of customization, from totally standardized devices, such as DRAMs, to totally custom-specific ICs (CSICs). The variation in customization is achieved technically through: customizing one or more layers of the masks - since complex circuits can have up to 12 mask layers, this gives 12 degrees of customization; use of `cells' in circuits (i.e. blocks of standard architecture) - a `standard cell IC' is customized on all mask levels using a cell `library' of preformatted circuit structures; use of metal interconnect between layers of a circuit, between blocks of transistors organized in rows and columns (gates), hence a `gate array'; customization through programming by user - a programmable logic device (PLD). Examples are FPGAs (field programmable gate arrays) and EPACs (electrically programmable analog circuit).

Flexibility of Fabrication

Most semiconductor fabrication facilities (`fabs') are designed and built to produce a small range of similar products, such as DRAMs. The production steps are conducted within a clean room environment. A more flexible production system has been developed that utilizes clean room mini-environments. This has the dual advantage that the expensive clean environment is maintained within small capsules ('pods') that can be manipulated within normal operating conditions, and that different operations can be conducted alongside each other, in modular fashion. This technology utilizes standardized interfaces between the capsules, and so is termed Standard Mechanical Inter-Face (SMIF) technology. The Taiwanese silicon chip foundry, TSMC, was the first semiconductor facility to install fully modularized and encapsulated (SMIF) fabrication technology, provided by the US firm Asyst Technologies. For a description of the experience of TSMC with this fabrication technology, see Shu and Tu (1992).

E. List of Acronyms

ADT	Advanced Device Technology
AMPi	Advanced Microelectronics Products Taiwan, Inc.
ASIC	Application Specific Integrated Circuit
CEPD	Council for Economic Planning and Development
CMES	Comprehensive Measures for Economic Stabilization
CMOS	Complementary Metal Oxide Semiconductor
DRAM	Dynamic Random Access Memory
EEPROM	Electrically Erasable & Programmable ROM
EIAK	Electronics Industry Association of Korea
EPB	Economic Planning Board
EPROM	Erasable & Programmable Read Only Memory
EPZ	Export Processing Zone
ERSO	Electronic Research Service Organization
ETRI	Electronic Technology Research Institute

FEB	Finance and Economy Board
FIC	Fine Instrument Center
GATT	General Agreement of Tariffs and Trade
HMC	Hualong Microelectronics Corporation
HSIP	Hsinchu Science-Based Industrial Park
IBRD	International Bank for Reconstruction and Development
IDB	Industrial Development Bureau
IDF	Industry Development Fund
IMF	International Monetary Fund
ITRI	Industrial Technology Research Institute
KAIST	Korea Advanced Institute of Science and Technology
KDB	Korea Development Bank
KDI	Korea Development Institute
KIET	Korea Institute of Electronics Technology
KIST	Korea Institute of Science and Technology
KMT	Kuomintang
KSIA	Korea Semiconductor Industry Association
LDP	Liberal Democratic Party
MAFEZ	Masan Free Export Zone
MIC	Ministry of Information and Communication
MITI	Ministry of International Trade and Industry
MoC	Ministry of Communications
MNCs	Multinational Corporations
MoE	Ministry of Education
MoEA	Ministry of Economic Affairs
MoF	Ministry of Finance
MoND	Ministry of National Defense

MoST	Ministry of Science and Technology
MTI	Ministry of Trade and Industry
NFI	Non-banking Financial Institution
NIF	National Investment Fund
NSC	National Science Council
OSTA	Office of Science and Technology Advisors
PC	Personal Computer
R&D	Research and Development
S&T	Science and Technology
SDR	Special Drawing Right
SRAM	Static Random Access Memory
STAG	Science and Technology Advisory Group
TAC	Technical Advisory Committee
TRB	Technical Review Board
TSMC	Taiwanese Semiconductor Manufacturing Company
TSUS	Tariff Schedule of the United States
UMC	United Microelectronics Company
VLSI	Very Large Scale Integrated circuit
WTO	World Trade Organization

Taiwan Acronyms

CCL	Computing and Communications Laboratory
CEPD	Council for Economic Planning and Development
ERSO	Electronics Research Service Organization
HMC	Hualon Microelectronics Corp
III	Institute for Information Industry

IDB Industrial Development Bureau

ITIC Industrial Technology Investment Corporation

ITRI Industrial Technology Research Institute

MoC Ministry of Communications

MoEA Ministry of Economic Affairs

MXIC Macronix

NSC National Science Council

OESL Opto-Electronics Systems Laboratory

STAG Science and Technology Advisory Group

TEAMA Taiwan Electrical Appliances Manufacturers Association

TMC Taiwan Mask Corporation

TSMC Taiwan Semiconductor Manufacturing Corporation

UMC United Microelectronics Corporation

VISC Vanguard International Semiconductor Corporation

Semiconductor Industry

ASIC Application-Specific Integrated Circuit

ASSP Application-Specific Standard Product

CMOS Complementary metal oxide on silicon

CSIC Customer- Specific Integrated Circuit

DRAM Dynamic Random Access Memory

EPAC Electrically Programmable Analog Circuit EEPROM Electrically Erasable Programmable ROM EPROM Erasable Programmable ROM

FPGA Field Programmable Gate Array

HDTV High-Definition Television

IC Integrated Circuit

LCD	Liquid Crystal Display
LSI	Large-Scale Integration
MPU	Microprocessor unit
NMOS	N-metal oxide on silicon
PLC	Programmable Logic Circuit
PLD	Programmable Logic Device
ROM	Read-only memory
SMIF	Standard Mechanical Inter-Face
VLSI	Very Large Scale Integration

F. Overview of the Doctoral Dissertation and Analytical Framework

In Part I-- Analytic Survey of the Literature on East Asian Development and Institutions

The existing theoretical paradigms in explaining East Asian development are discussed in detail. Because these theories view the role of the state and other institutions in development in very different ways, we will conduct a close scrutinization of the theories of the state contained in each theoretical paradigm and how they understand the role of the state and state-society relations in the development process. By pointing out the weaknesses of the existing theories in explaining particular industrial policy outcomes in comparative contexts, it is productive to propose an alternative analytical framework, a comparative institutional approach, to state-society-business relations, which is a direct application of what Evans and Stephens (1988a pp.713-728, 1988b pp.745-766) and Professor Aoki Masahiko (Aoki 1995 pp.3-21, Aoki et al 1997 pp.10-22) called “the new comparative political economy” or “comparative institutional analysis.”

In Part II -- Political Intervention: Analysis of Organizational Strategies for State Institutions

Related to IT

Through a sketch of its developmental history for Taiwan and Japan, it is discussed how the unique state-society relations and organizational strategies in Taiwan and Japan affected the formation of formal and informal institutions concerning the development of the IT hardware industry in which the state and societal actors interact with each other. It will be argued that the Taiwanese state has played so dominant and pervasive role not because of the strong and autonomous state that was envisioned by the early statist literature, but because of the institutional strategies and state-society-business relations that are unique to the political economy of the accelerated industrial catch up strategy for IT in Taiwan. This section shows that although Taiwan's state literally built the whole IT sector in the beginning, it also built an enhanced version of a highly diverse free market "rules of the game" which unlike Japan and South Korea, did not grant special privileges to certain large firms but rather built a transparent and level playing field embracing both small and large enterprises. Taiwan also avoided bureau pluralism by embracing an open pluralism institutional strategy that involved the privatization of government think tanks and the spinning off of almost all state research programs into the private sector in order to create the fullest possible diversity of human resources.

In Part III--- Bureaucracy and NGOs in IT Industries: ITRI & MITI

The four major projects undertaken in the 1980s were the Fifth Generation Computer Systems Project, the Supercomputer Project, the TRON Project, and the Sigma Project. However, in the end, these projects as well as many others failed because of Japan's bureau pluralism which avoided diversity strategies. At the same time in Taiwan and the USA both government and private technology projects had opened themselves to the wide diversity of the world human resource network actively welcoming the top IT talent from around the world regardless of race or nationality. In the USA and Taiwan most high-tech projects had more than 50% of the leadership and engineers that were globally diverse (Saxenian 2002 pp.3-24).

Even large government projects in Taiwan and the USA often invited the best of the best from around the world to lead or participate in the top high-tech research projects. However, in the cases above for Japan, foreigners were never invited to lead a project or were they ever utilized for even minor engineering leadership roles. This is what Professor Aoki Masahiko of Tokyo University calls an "anti-diversity strategy" (青木 1995 pp.82-134).

Japan seemed to have all the ingredients for success in the PC era, from strong manufacturing skills and control of many key components technologies to a corporate structure that could support a sustained drive into export markets. Yet in spite of their success in components and peripherals, the Japanese computer makers have had only limited success in PCs, and have been virtually shut out of the software industry. The reasons for this mixed record are complex, yet the most important have to do with Japan's industry structure. Japan's large, vertically integrated firms were well suited to high-volume, capital-intensive components production. They also did quite well in the relatively stable mainframe industry, because they could marshal the necessary resources within their keiretsu groups and count on the members of those groups as captive customers. However, in industry segments such as PCs, ICs and hard disk drives, where product cycles are short and timing critical, the Japanese industry structure was a liability. Unable to make decisions quickly, Japan's computer makers had limited success in such businesses. Also unwilling to take advantage of global human resource diversity, possibly the only strategy success was never even pursued

The Triangle method for Public / Private Sector Balance.

Simply put, this is just bringing about a balance between the three basic types of organizations in a country: the balance and co-operation between the state, business and NPO / NGO sectors. Each state has its own unique organizational strategy for which it decides on the role within the triangle of each of these types of sectors. The striking characteristic about the Taiwanese state is its active participation in forming and promoting literally dozens of

specialized NPO organizations. Some like TSMC and UMC went on to be spun off as companies and others like ITRI and ERSO became autonomous NPOs. In 1995 more than 60% of all Taiwan technology patents were acquired by NPOs and they made up 5% of the economy.

In Part IV--- Background and Analysis of Corporate Organizational Strategies for Diversity for the IT Businesses with Case Studies

This section covers the unique organizational strategies of Taiwan's IT sector by explaining the background and innovations of Taiwan's Win-Win OEM strategy (**苗豊強** 1997 pp.188-198) with its primary focus on the strategy of vertical division of labor of IC manufacturing. It is well known that the IC industry is divided into highly specialized sectors, including IC design, mask making, wafer processing, and assembly and test. One of the most significant changes in the Taiwan IC industry in recent years has been the transition from a vertically integrated model to a vertical division of labor business model. This transition has been driven by the need to constantly adapt to the rapidly changing business environments that characterize each sector of the production cycle, and by the massive investment needed to remain competitive in the global economy. The so-called IDM (integrated device manufacturer) model, in which one company is responsible for all aspects of production, is no longer competitive due to the excessive strain it places on a company's financial, research and development, and management resources. As a result, the vertical division of labor of production is becoming the mainstream business model in Taiwan. Many case studies are used to offer abundant evidence of the unique organizational strategies of Taiwan's OEM IT manufacturing.

In Part V--- For and Against Taiwan: Confronting Criticisms and Revealing Success

All of the East Asian countries and especially the Chinese NIEs (Taiwan, Singapore, Hong Kong) have at one time or another come under critical attack in the 1990's as will be shown below. Although there are many different types of theoretical camps that have attacked Chinese NIEs and high performance Asian economies (HPAEs World Bank 1993 p.3) from their

various angles, this thesis focuses on four basic groups that will be explained in an overly simplistic manner due to the limited scope of this study.

In Francis Fukuyama's book Trust: The Social Virtues and the Creation of Prosperity (1995) he expounds on the weaknesses of the Chinese NIEs entrepreneurship and even more specifically the harmful effects of Confucian culture on business and regional integration because it involves trusting groups outside of the immediate family. Highly centralized authoritarian family controlled firms, nepotism, lack of Schumpeterian entrepreneurship and small scale OEM firms are the oft-cited weaknesses of the NIEs Chinese business practices. In addition he talks about the inability of Confucian Capitalism to have smooth transitions of power during generational changeovers as well as the inability to achieve international brand name recognition. Fukuyama sees the Ethnic Chinese NIEs entrepreneurship as a kind of anachronistic holdover of the mom and pop family management system unwilling to associate with outsiders and also unwilling to give up control to professional managers because of nepotism (pp.74-89) and therefore unable to develop large scale firms using a more Schumpeterian kind of entrepreneurship. Fukuyama attributes these weaknesses to what he calls lack of social trust, lack of spontaneous association and lack of civic virtue (pp.70-78) and blames this on the Confucian heritage.

The second part of this section introduces the statistical data that gives us an idea of just how much more successful Taiwan's organizational strategies have been when compared with the traditional strategy of high vertically integrated "Big Brand" Makers such as IBM, NEC, Toshiba, etc. During the 1990's the ideas of "best practices" (Andersen 1998 pp.25-27) and "not invented here" (Bartlett and Ghoshal 95 p.648) became key concepts for restructuring and re-engineering in the massive attempt of huge corporations to downsize, decentralize, revitalize and cut costs (Hammer & Champy 1993 pp.3-18). However, these concepts, and

many others, for improving productivity through cross functional teams, niche marketing, strategic business units, decentralization, stewardship and information sharing were already being widely practiced in the 3 little tigers of Taiwan, Hong Kong and Singapore. Although these ideas have all caught on in the USA, very few publications give the Chinese NIEs any credit for their share of the innovations. Four primary types of OEM strategies used by the Taiwanese and Ethnic Chinese manufacturing community including:

1. Middleman co-ordination (subcontracting, arbitrage, trust building, etc…).
2. OEM and followership (product or process imitation and original equipment manufacturer).
3. Spin-offs and networked firms (mobility of know how).
4. Vertical division of labor of industry structure-- Win-Win OEM strategy (**苗豊強** 1997 pp.154-164).

PART I. Analytic Survey of the Literature on East Asian Development and Institutions

Introduction to Part I

In this part the existing theoretical paradigms in explaining East Asian development are discussed in detail. Because these theories view the role of the state and other institutions in development in very different ways, we will conduct a close scrutinization of the theories of the state contained in each theoretical paradigm and how they understand the role of the state and state-society relations in the development process. By pointing out the weaknesses of the existing theories in explaining particular industrial policy outcomes in comparative contexts, it is productive to propose an alternative analytical framework, a comparative institutional approach, to state-society-business relations, which is a direct application of what Evans and Stephens (1988a pp.713-728, 1988b pp.745-766) and Professor Aoki Masahiko (Aoki 1995 pp.3-21, Aoki et al 1997 pp.10-22) called "the new comparative political economy" or "comparative institutional analysis."

My main point in Part I is not how big the role-played but rather what kind of role was played by the state. Much of previous research focus only on the scope of the role but not the details of how that role actually worked out in real practice. By analyzing the institutional conditions of both domestic and international political economies that have affected the developmental processes of the IT hardware industry, this thesis will first explain how Taiwan and Japan could develop such impressive IT industries, and second, will uncover the causes of national variation between them. Only then can we go on to explaining the new Win-Win OEM partnerships that have formed between Taiwan and Japan within the IT hardware industry and why Taiwan's organizational strategy was able to formulate a totally new paradigm in the IT world. Both Taiwan and Japan have made successful bids into the IT hardware industry through a "accelerated catch up strategy."

Accelerated catch up strategy means the state initiated a broad strategy that would focus on building an industry that didn't already exist by using state initiatives and tax incentives to put it into motion where it would not have developed on its own in the free market place.

The following 2 points will be addressed in Part I that will serve to support the overall thesis of this dissertation. Point 1-a. Evolution of Development Theories: Part I will conclude that in contrast to Taiwan, the state in Japan and Korea has played a largely different role. In particular, the role of the state in the Japanese accelerated industrial catch up strategy for information technology (IT) hardware has changed remarkably over time, and so did the state-society and state-business relations. Part I goes into detail about the historical background which led to development paths that appear similar between Japan and Taiwan but are actually quite different in both practice and results. Point 1-b. The Comparative Institutional Approach: Why are "bounded rationality" methodologies, such as CIA and game theory more useful than conventional "rational expectations" economic models in analyzing economic development and transition economies?

In this part the existing theoretical paradigms in explaining East Asian development are discussed in detail. Because these theories view the role of the state and other institutions in development in very different ways, we will conduct a close scrutinization of the theories of the state contained in each theoretical paradigm and how they understand the role of the state and state-society relations in the development process. By pointing out the weaknesses of the existing theories in explaining particular industrial policy outcomes in comparative contexts, it is productive to propose an alternative analytical framework, a comparative institutional approach, to state-society-business relations, which is a direct application of what Evans and Stephens (1988a pp.713-728, 1988b pp.745-766) and Professor Aoki Masahiko (Aoki 1995 pp.3-21, Aoki et al 1997 pp.10-22) called "the new comparative political economy" or

"comparative institutional analysis."

Section 1.1 The Organization of the IT Hardware Industry in Taiwan and Japan

1.11 How to Organize?

The world has become greatly affected by the progress of information technology. The long-lasting domination of the world political economy by the highly developed economies after the Industrial Revolution had seemed to be strengthened due to the overwhelming technical superiority. As the world has gotten smaller through the development of information networks including the internet, the mastery of cutting-edge information and communication technologies, IT seems to be the most important component to becoming a major force in the international political economy in the years to come.

In addition to the highly industrialized countries, several newly developed countries are trying to promote domestic high-tech capabilities in order to improve their relative positions within the structure of international political system. For these developing countries it is not a matter of choice but of necessity because without having competitiveness in high-tech industries such as computers, software, and ICs, they are not able to accomplish their national goal, which usually involves becoming one of the advanced industrial countries sometime in the 21st century.

The IC industry is called the "heart of the IT era" which shows us the importance of IC (integrated circuit) devices as essential parts of various information technology (IT) and communications equipment. Almost all contemporary industrial products ranging from consumer electronic goods, heavy machinery, industrial robots, to ballistic missiles are not operable without certain types of ICs. This means that the IC industry is essential in the development of most other high-tech industries. More importantly, it means that there are a

variety of IC devices with differing levels of technical sophistication depending on where it is being used. Almost any small device has its own IC chips like in things like personal computers which have different types of chips including microprocessors and various standardized circuits. The characteristics of the IC industry, such as a wide range of IC devices with lower levels of technical sophistication, provided a good chance for some developing countries to get over the high entrance hurdles of the industry itself. Taiwan and Japan have been very successful in making their names known in the world IC market whereas many American and European IC manufacturers after 1985 have completely disappeared from the scene.

Taiwan and Japan have received a good deal of academic attention due to their outstanding economic performance during the past four decades. Beginning in the 1970s, both countries began to upgrade their industrial capabilities in order to adjust themselves to global economic turbulence of the gasoline shocks. By the 1980's Taiwan and Japan possessed local capacities for producing many knowledge intensive industrial products such as ICs and personal computers with Japan being about 8-10 years ahead of Taiwan in 1980. However, by 1994 Taiwan became almost equal to Japan in terms of technology and even ahead of Japan in terms of world market share for integrated circuits. How could Taiwan and Japan be successful in winning the world markets for their own IC industries? Were their developmental paths the same or at least quite similar to each other? If they experienced different "methods of success" to become competitive in the IC market, why and how do they differ from each other? These are some of the main questions that will be analyzed in this section.

Due to their superficial structural similarities shown in the process of economic development, Taiwan and Japan have been viewed as a possible pair for comparative studies such as Lau 1986; Fallows 1994; Johnson 1987; Wade 1990; Fukuyama 1995. Yet many differences have existed in the progress of economic development. Some of those differences include the policies and "rules of the game" of state intervention in the market, economic

structures, state institutions, policy-making networks, the linkage between the state and society, and the international political economic environments that they have existed in.

Developmental paths in the IC and IT industries are typical examples which demonstrate how different structural variables affect the interaction among the major players in the state and society and thereby the industrial outcomes. Among other things, a major difference is found in the role played by the state and state-business relations. As will be discussed in detail in the following sections, the state in Taiwan has played a much more aggressive yet neutral role than the state in Japan concerning the developmental process of the IC industry. This is in fact against the widely agreed view about the role of the state in the process of economic development in the two countries. In most of the existing literature about the development in East Asia, Taiwan and Japan are viewed as similar cases in terms of the role of the state in development. Even in some studies, it was argued that the state in Taiwan has been less aggressive than the state in Japan (for example, Chalmers 1987 pp.138-148; Fukuyama 1995 pp.166-170), meaning that the Japanese state has played a much larger role than the Taiwanese counterpart.

The main point in this research is not how big the role-played but rather what kind of role was played by the state. Much of previous research focuses only on the scope of the role but not the details of how that role actually worked out in real practice. In other words, they focused on the quantity of the state's role rather than the quality. By analyzing the institutional conditions of both domestic and international political economies that have affected the developmental processes of the IT hardware industry, this dissertation will first explain how Taiwan and Japan could develop such impressive IT industries, and secondly, will uncover the causes of national variation in methods and results between them. Only then can we go on to explaining the new Win-Win OEM partnerships like the unique "foundry system" and "fabless" system invented in Taiwan that have formed partnerships between Taiwan and

Japan within the IT hardware industry and why Taiwan's organizational strategy was able to formulate a totally new paradigm in the IT world. Both Taiwan and Japan have made successful bids into the IT hardware industry through an "accelerated catch up strategy." Accelerated catch up strategy means the state initiated a broad strategy that would focus on building an industry that didn't already exist by using state initiatives and tax incentives to put it into motion where it would not have developed on its own in the free market place.

Because Taiwan and Japan started their IT industries directly by importing key technologies already developed in the United States and Europe, their strategies can be identified as "accelerated industrial catch up strategies". Accelerated catch up strategy is not only a critical advantage to catch up economies as shown by Gerschenkron (1962 pp.92-136), but also a very important concept in studying late developers because the structures of the domestic and international political economies of a particular late developer usually affect the outcome of accelerated industrial catch up strategies.

Though some structural weaknesses still exist in both countries, [1] the experiences of Taiwan and Japan in accelerated catch up strategy for the IC and related industries are quite impressive according to most studies. Taiwan had no domestic IC manufacturing capability to speak of until the mid 1970s, yet it was still able to become a major supplier of personal computers and various applications of specific IC devices in world markets by the early 1990s. In particular, Taiwan has been very successful in the world personal computer market and its peripheral markets including motherboards, mice, scanners, monitors, and keyboards, as shown in Table A.1 (p.7). By the mid 1990s, Taiwan began to produce advanced memory chips such as 16M DRAMs by acquiring necessary manufacturing and process technologies from Japan and the US. [2]

In terms of the IC industry, [3] Japanese experience of accelerated industrial catch up

strategy shows a very impressive success as well. Japan did not own IC manufacturing capability up until the mid 1970's. But in less than twenty years, Japan had emerged as the second largest IC producer in the world with very sophisticated technologies enough to make cutting-edge memory chips. About 40 per cent of the world memory market (one type of IC) has been taken by Japan, most of which consists of DRAMs. This outstanding performance made Japan the largest memory producer in the world, and as a result, South Korean firms are now engaging in a fierce head-on competition with the Japanese DRAM manufacturers just as Taiwan (in 2001) pulls up closer to Japan in all IC categories except for DRAMs. [4]

Despite the more or less equally admirable industrial upgrading, however, their approaches to accelerated catch up strategy in this critical industrial sector have been very different from each other. Given the structural and historical similarities well documented in various literature on East Asian development (Lau 1986 pp.1-13; Johnson 1987 pp.136-148; Wade 1990 pp.11-26; **何錦堂** 1997 pp.111-148; Mathews 1995 pp.1-18; Fallows 1994 pp.13-26; **黃欽勇** 1996 pp.101-142), questions such as why and how they differ from each other deserve a good deal of analytic attention both from scholars who have research interests in the political economy of development as well as from those who actually do the policy-making and implementation.

As will be discussed later in greater detail, the national difference between Taiwan and Japan in regard to the development of the IT hardware industries has largely been shown in the role of the state and state-society-business (also NGOs) relations in making and implementing the related industrial policies. Industrial policy is defined as "the government's use of its authority and resources to administer policies that address the needs of specific sectors and industries (and, if necessary, those of certain firms) with the aim of raising the productivity of factor input" [5] (Okimoto 1994, p.9, also see Lau 1994). Or elsewhere, it is defined as "the state induced willful shifting of the industrial structure toward high-technology, high

value-added industries" (Dietrich 1991, p.57). Because late development is usually executed and pursued by active state intervention in the market (Gerschenkron 1962 pp.4-22; Hirschman1968 pp.6-32), the political economy of industrial policy becomes a critical part of understanding national development. Thus the state institutions, NPO/NGO institutions along with their relations to business and society are at the center of inquiry in analyzing industrial policy consequences.

I t is not uncommon that different countries to accomplish the same or similar goals adopt different policies. Yet understanding the causes of diverging policies for the same goals is not an easy task, mainly because policies are neither the simple sum of converging pressures from different social groups nor are they only reactions from the state to market forces. Also policies are seldom the unilateral behavior of the strong and autonomous state as an abstract entity. Rather policies are political outcomes for which different players interact with each other within particular political and social institutions that are unique to a given society, time, and industrial strategy (**青木、金、藤原** 1997 pp.6-18; Woo-Cumings 1997 pp.326-339).

In order to understand why different countries undertake different policy programs for the same goals, we need to know which institutions control or mediate the strategies and influence of different political actors upon certain policy outcomes. Institutions here refers to any rules of the game in a given policy space that "structure the relationship between individuals in various units of the polity and economy" (Hall 1986 p.19). Institutions include not only the state and state institutions, but also state-society relations, industrial (or business, NGO) institutions and structures, the relationship between social classes, the situation of special interest representation in domestic politics and the relative position of a country within the international political economic arena. Institutions are historically formulated through the accumulation of interactions between various players within a given policy space, both from the state, society, NGO's and businesses under the changing domestic and international constraints.

Institutions for this meaning are dynamic across time, society, and various industrial sectors.

The process of accelerated industrial catch up strategy for IT hardware in Taiwan and Japan revealed that both governments took very different approaches in order to accomplish the same policy goal, in this case, developing domestic IT hardware capabilities in order to upgrade each nation's industrial structure toward higher value-added, high-tech sectors. National variation was well illustrated by the different interactions between various players in policy-making as well as implementation processes. In particular as far as the IC industry is concerned, the state in Taiwan has consistently been much more impartially intrusive for most of the time compared with the more partially inclined state in Japan (i.e. Japan has produced very few new IC upstarts whereas Taiwan has produced 19 totally new large scale ventures by 1995). By impartially intrusive we mean that the state in Taiwan did not choose their favorite companies to bestow special benefits such as tax breaks, low interest loans, access to government research but rather their intrusion was aggressive but limited to "free market enhancing" impartial towards market players (**青木, 金、藤原** 1997, 1-15). This is rather an exceptional case because in most of the previous developmental periods, the state in Taiwan has maintained a relatively laissez-faire attitude in managing its economy (Wade 1990a pp.3-13) and also many researchers have not pointed out the fact that the state in Taiwan is only intrusive in a very free market way that treats both small and large enterprises impartially.

As Aoki (**青木, 金、藤原** 1997, 1-15) makes the point, the state in Taiwan has exercised more of a discretionary control of structural incentives to "enhance market signals", while the state in Japan has been far more partially intrusive and directive in favor of big business in managing the economy, and sometimes the state not only supplements but also directs the market (giving the signals to the market), especially for the promotion of the so-called strategic industries whereas the state in Taiwan takes its signals "from the market".

From the very beginning of its first IC project launched in 1974, the state in Taiwan created key state agencies such as state-run research institutes including the Industrial Technology Research Institute (ITRI) and the Electronic Research Service Organization (ERSO), and various S&T related agencies which include the Ministry of Economic Affairs (MoEA), the National Science Council (NSC), the Science and Technology Advisory Group (STAG) which had far greater autonomy than their counterparts in Japan and many eventually were spun off from the government completely becoming nonprofit organization (NPOs). After 1974, the state in Taiwan has exercised control only indirectly over the developmental process of the IC industry through these organizations. Even major private firms such as the United Microelectronics Co. (UMC) and the Taiwan Semiconductor Manufacturing Co. (TSMC) were created directly under the state's sponsorship, meaning that the state provided virtually everything needed for the formation of major IC manufacturing firms including investment capital, technologies, as well as manpower. However, very soon after their founding they were spun-off and essentially set free to pursue autonomous activities so that in essence Taiwan's government was only acting as an initial venture capitalist or angel investor. The astonishing point here is that it was the early 1980's and the concept of venture capitalism and angel investing had not even been fully developed yet in the West or anywhere else for that matter. This shows that Taiwan was already far ahead of even the US on the learning curve towards building highly innovative new institutions for the IT age that included venture capitalism (such as incubators), the foundry system, the fab-less IC design houses, and the whole B2B OEM division of labor innovation.

1.12 The State in Taiwan & Japan

In sharp contrast to Taiwan, the state in Japan has played a largely different role. In particular, the role of the state in the Japanese accelerated industrial catch up strategy for IT has changed remarkably over time, and so did the state-society relations. The Japanese state and MITI was a major promoter of the IT hardware industry with a primary emphasis on exports in the 1960s. During most of the 1970s, the state drew and implemented numerous

ambitious plans to promote the IT hardware industry such as heading up technology consortium proposals and co-operative think tanks but most of them did not materialize as planned (Fallows 1994 p.42-88). A genuine accelerated industrial catch up strategy took place after 1983 during which the state did not play a leading role for a number of reasons. A critical initial step toward the world leading IT hardware industry was taken not by the state but by private firms in the early 1980s.

It was only after 1986-87 that the state resumed its efforts to promote the IC industry rather vigorously. At that time, however, the state had neither been a dominant player nor a pure reactor to the pressures of change. The state and private firms have been more or less equal partners in the shared long-term goal for making and implementing industrial policies on IT hardware depending on which time period one looks at. That is, responsible state agents/agencies have intimate contacts with major firms in creating and initiating IC-related policies. Though state-run research institutes have played important roles in technological advance since the 1970s (Wade 1990 pp.25-35), three major electronics firms began to acquire excellent organizational and R&D capabilities by the mid 1980s. This enabled them to take on considerable roles in the policy-making as well as implementation processes for the development of a world leading IC manufacturing industry.

Why did the Taiwanese and Japanese states play such different roles in the developmental processes of the IC industry, even though they have been viewed as classic examples of what Chalmers Johnson (1982 pp.3-15, 1987 pp.136-148) calls the "developmental state"? The existing views on East Asian development, those on the economic development of Taiwan and Japan in particular, cannot give us complete and logical explanation to this important question for a number of reasons that are covered below. Though Taiwan is called a newly industrialized economy (NIEs), the government is not new any more and neither are social institutions, industries, the people within them, state-society relations, "rules of the

game", nor the international political economic conditions and structures in which they must operate on a day to day basis. To put it another way, the structures and institutions concerning industrial policy-making and the technology catch up strategy are now well established (except for NPOs in Japan), and major players act and react according to the "rules of the game" that are unique to each society (see North, 1990 pp.4-27). Thus state dominance over economic policy-making and implementation is not necessarily true, though the state tended to be dominant and pervasive in the process of economic development at certain times in the past.

Considering all of these factors, this research will utilize an "institutional approach to state-society relations," originally developed by Peter Evans (1986 pp.8-35) in his comparative study on economic policies conducted at Stanford University. This comparative institutional analysis (CIA) approach[7] will be used in an attempt to explain the causes of different industrial policy "path dependencies" and final results in Taiwan and Japan in regards to the IC industry. It will be argued that the strategic institutional differences between Taiwan and Japan in three structural variables (business institutions, state institutions, NPO / NGO institutions and the relations between them), are largely responsible for the different policy programs followed by each state in accomplishing the same economic goal, which is, accelerated industrial catch up strategy for IT hardware. In addition it will be shown that these different policies were "path dependant" as seen in the vastly different outcomes between the Japanese bureau-pluralism and the more successful Taiwanese open pluralism.

Section1.2 Some Different Theories on East Asian Development Concerning Taiwan and Japan

1.21 The Theoretical Camps

East Asia draws a big share of the academic spotlight due to the remarkable economic

success that has been accomplished during the past three or four decades. Even during the 1970s when the world economy went into recession, East Asian countries including Japan and Taiwan recorded a remarkable 7-8 per cent on average economic growth rate per annum. In explaining the causes of East Asian development, scholars have been divided into several theoretical camps including modernization theory that is actually a version of neo-classical economic theory, dependency and world-system approaches, neo-Marxist (class) analyses, and the developmental statist arguments. [8] Though the details vary, most of the studies can be divided into two major theoretical paradigms, which is, statist and anti-statist approaches according to which the role of the state, the role of institutions and state-society relations in development are viewed differently.

Statist approaches usually argue that the strong and autonomous state is responsible for economic development in East Asia and that economic policies are the direct reflection of state institutional structures and power. In contrast, anti-statist approaches mainly focus on the critical role of efficient market factors and/or the diversity of pluralist competition among various interest groups in the process of East Asian development as well as in institutional and industrial policy-making.

In addition, some progressively refined arguments or approaches have emerged mainly on Japanese political economy, which modify these two paradigms in some ways. For example, the patterned anti-statist theory argument by Muramatsu and Krauss (1987 pp.516-544) purports that even though the Japanese state has been strong, many different interest groups and political parties have penetrated to the inside. In the study of the Japanese energy industries, for example, Samuels (1987 pp.34-87) argues that the Japanese economic policies on energy sectors were so market conforming, not because of the state dominating but because of the reciprocal consent between the state and private sectors. In a study of Japanese high-tech industrial policy, Okimoto (沖本 1989 pp.7-35) argues that the structural

interdependence among the main players in Japanese high-tech industries (the MITI, the LDP, and big business) is the main feature of Japanese policy structure. The works of Samuels and Okimoto is often called the "developmental corporatist approach," which has as a main focus the corporatist (or co-operative) relationship between the government and capitalists without the participation of labor as being the primary cause of East Asian developmental success, especially Japan in particular. Under such a perspective, industrial policy is the direct outcome of constant bargaining and cooperation between the two roughly equal partners, the state and the capitalists. [9] Corporatism for the East Asian situation is very different from the European situation mainly because of the total exclusion of organized labor in corporatist decision-making structure and the mutual developmental targets of the government and the capitalists in the former. [10] And in another industry study, Friedman (1988 pp.6-22) emphasizes that the politics of the flexible production strategy that have been conventionally formulated in Japanese society are the main reason for the great success of the Japanese machine tools industry.

In various post-statist studies on development they also modify the statist paradigm by noticing the shifting balance of power between the state and private sector, especially the big conglomerates in Korea known as chaebols. By focusing on "the dynamic nature of state-business relations", they argue that state dominance is doomed to decline in the long-run due to the much faster growth of the private sector than the state sector (E. Kim 1987 pp.28-92). Professor Peter Evans originated this line of argument in his various essays on the dynamics of developmental states (Evans 1985 pp.192-205; 1986 pp791-804; 1992 pp.158-178). Evans (1995 pp.10-67) in his more recent comparative study on the Indian, Brazilian, and South Korean information industries, especially the computer industries, provides a similar explanation. He argues that "contrasts between intrusive and liberal or interventionist and non-interventionist states" confuse the basic issue on development (Evans 1995 p.10). Rather, he goes on to argue, "State intervention is a given. The appropriate question [in explaining

industrial transformation] is not how much but what kind (Evans 1995, 10).[11] In other words, he focuses on "embedded autonomy" of the state in making and implementing effective industrial policies. The meaning of embedded autonomy is the state autonomy that has been embedded or institutionalized in state-society relations in a particular country over time.

A major theoretical contrast between these different approaches lies in the different understanding about the role of the state in the whole progression of development. Based upon different theories of the government or upon the same theories of the government but different views on government-society relations, these various approaches show us a set of explanations about the role of the governments in development in particular as well as in individual industrial policy final results.[12] Therefore, the government institutions are the main focus of study in researching economic development and industrial policies because they are the deliberate efforts by the government institutions for the purpose of promoting the productivity of factor inputs.

Below is a selective summary of some of the previous studies with a focus on the explanations of the role of the government and state-society-business relations in industrial policy-making process. By doing this, it will be shown that although some of these theoretical methods may provide an acceptable explanation about developmental and institutional industrial policies in a certain country at a certain time, they for the most part fail to explain the widely differing industrial policy final results in comparative analysis mainly because Firstly, some of them tend to freeze in time the government and government-society-business relations in the process of development, which wrongly sees them as all too consistent over long time periods, across different cultures, and across industrial sectors, and also secondly, some researchers deal with the government and government-society-business relations exclusively at the early stage of development, assuming that it is consistent over long time periods and not taking into consideration the vacillations in the quantity and quality of the government's role

over time.

Theorists supporting a certain theory of the state often project a pattern of policy-making and special interest group representation onto most societies of a certain type without much regard to the particular historical and cultural factors in each case. However, in actual policy-deciding procedures people, institutions, goals of the government institutions, the regulatory powers available to the relevant bureaucrats, and the interactions between the main players in the given "rules of the game" are dynamically changing over time and across industrial sectors (青木 1995 pp.1-25), as do the domestic and international constraints that limit the options of a particular government (as well as other actors). Therefore a government in the 70s, 80s or 90s cannot be assumed to be the same strong and autonomous government through time as always constant, and the central government influencing such industries as machine tools, steel, cars, electronics, IT hardware , etc…, must be explained correctly according to the different overall structural constraints native to these particular industrial sectors.

As a more useful analytical framework, this research will attempt to use a comparative institutional approach to state-society-business relations that puts a strong focus on the factors that constrain or promote the interactions between various players within the "rules of the game" for a particular economic culture. Knowing that the CIA approach is a direct application of the "new comparative institutional analysis" proposed by Evans and Stephens at Stanford University (1988a pp.713-735, 1988b pp.739-772),[13] and also greatly developed and utilized by Aoki Masahiko when he was at both Stanford University and Tokyo University, therefore the framework of the new comparative institutional analysis (CIA) for political economy needs to be introduced in relation to other theoretical perspectives on institutions and economic development.

1.22 Statist Approaches

The statist paradigm has its intellectual roots in the works of Max Weber and Otto Hintze.[14] According to Weber (1958 pp.8-22), states are compulsory organizations claiming monopoly control over territories and the people within them. Administrative, legal, extractive, and coercive institutions including the bureaucracy run the state. People within the bureaucracy are elites in a society, and have their own goals and interests that are independent from other interests. Bureaucrats or state managers have enlightened visions about national interests including development, and pursue policies to those ends. Thus the structures and actions of the state and the bureaucrats within it are the major analytical concerns in the Weberian tradition of the statist paradigm.

Hintze adds an insightful dimension in analyzing the state, namely the historically changing transnational contexts that condition the structures and actions of the state (Gilbert 1975 pp.7-33). To say that states are groups of institutions which control fixed territories simply means that states are located in a complex web of interstate relations such as geopolitical domination and dependence, interstate competition, international communication, as well as economic transactions including international trade, investment, and finance. In this sense, "states necessarily stand at the intersections between domestic sociopolitical orders and the transnational relations within which they must maneuver for survival and advantage in relation to other states"(Skocpol 1985 p.8). Accordingly a central theme of the Weberian-Hintzean notion of the statist paradigm is to look at state structures and actions in conjunction with domestic as well as international contexts in explaining social and political outcomes.

In the statist paradigm, the state is viewed as a dominant actor in the policymaking process. The autonomy and capacity of the state are the two critical factors that influence political outcomes because the degree to which state actions are accomplished is depended upon

them. The state may be considered autonomous if it can "formulate and pursue goals that are not simply reflective of the demands or interests of social groups, classes, or society"(Skocpol 1985 p.9).[15] The effects of the autonomous state upon political outcomes are well illustrated by Stepan (1978 pp.16-89) who shows how the new military professionals installed corporatist regimes in Peru, and by Skocpol (1979 pp.11-179) who demonstrates the effects of revolutionary breaks upon the consolidation of state power in France, Russia, and China. Even in constitutional democracies, the state is viewed as autonomous in some issue areas as shown by Heclo (1974 pp.22-78) in social policies and Krasner (1978 pp.95-138) in American raw material policies.

State capacity refers to the degree that the state can "implement official goals, especially over the actual or potential opposition of powerful groups or in the face of recalcitrant socioeconomic circumstances"(Skocpol 1985 p.9). In addition to the general features of state capacity such as sovereignty, stable administrative and military control, and financial resources, policy tools available to the state and the existing policy-making network affect the degree of state capacity as well. Due to these factors, state capacity can vary across issues at hand. Accordingly most studies that deal with state capacity tend to focus on specific issue areas. Krasner describes the issue-specific nature of state capacity as follows:

> There is no reason to assume a priori that the pattern of strengths and weaknesses will be the same for all policies. One state may be unable to alter the structure of its medical system but be able to construct an efficient transportation network, while another can deal relatively easily with getting its citizens around but cannot get their illnesses cured. (Krasner 1978 p.58)

In short, both domestic and international political economic structures including the system of interest group representation, party structure, class structure, the degree of MNCs" penetration into the domestic political economy, international monetary system, and liberal or mercantilist world markets are examined whether they increase or decrease the autonomy and

capacity of the state (Skocpol and Amenta 1986 pp.131-157; Skocpol and Finegold 1982 pp.255-278; Evans 1979 pp.12-42). Thus policy outcomes are the direct reflection of the autonomy and capacity of the state that are constrained by both domestic and international political economic structures.

Gerschenkron successfully applied this type of the Weberian-Hintzean statist paradigm to development issues. In his well-known study of the European backward economies, Gerschenkron (1962 pp.14-33) emphasizes the necessity of having strong institutional mechanisms, that is, the strong and autonomous state, to pursue a coherent set of policies geared toward development. Thus development presupposes the effective state intervention in the market, which is equivalent to industrial policy. Industrial policies, which aim to transform a national economy, therefore, are the direct reflection of state structures and the resulting state capacity and autonomy.

Perhaps Chalmers Johnson is a pure descendent of this Weberian-Hintzean Gerschenkronian conjunction of the developmental statist perspective. In his study of the Japanese economic success, Johnson successfully applies the developmental statist approach to the East Asian setting. He defines the Japanese state as plan-rational, developmental, outcome-oriented, and effectiveness-oriented. At the center of the Japanese state is the powerful economic bureaucracy known as the Ministry of International Trade and Industry (MITI). The MITI has its own goals and visions about development independent from other interests, and has capacity and autonomy that are essential to accomplish its goals and visions. Therefore, "particular speed, form, and consequences of Japanese economic growth are not intelligible without reference to the contributions of MITI," according to Johnson (Johnson 1982 p.vii).

Developmental statist explanations are also preeminent in the literature on

Taiwanese and Korean development. Much of the literature on Taiwanese economic growth discusses the structural conditions that have been favorable to the strong and autonomous state such as the large state ownership of key industries, a remarkable success of land reform, one party dominance by the KMT, American military and economic aid allocated by the state, autonomous economic bureaucracy, and various policy tools available to them (Amsden 1979 pp.341-379; Gold 1986 pp.55-93; Chu 1987 pp.22-67; Myers 1986 pp.13-64; Wade 1990a pp.36-99). Numerous studies on Korean economic development also emphasize the critical roles played by the state such as the implementation of a series of five-year economic development plans, the extraordinarily strong and autonomous economic bureaucracy including the economic secretariat of the Blue House and the Economic Planning Board (EPB), [16] the presence of powerful military authoritarian political regimes, a total control over the banking system by the state, and the direct state involvement in some heavy industries (Mason et al. 1980 pp.9-123; H. Lim 1985 pp.7-44; Im 1987 pp.231-257; Amsden 1989 pp.13-37; Haggard 1990 pp.9-42; Woo 1991 pp.22-134; Gereffi and Wyman 1990 p.xiii). Given the structural similarities between Japanese and other East Asian political economies caused in part by such factors as Japanese colonial rule at the turn of the century, economic backwardness, and cultural affinities, the application of the developmental statist approach to the study of Taiwanese and Korean development is not so surprising.

According to the statist perspective, therefore, industrial policy is the direct outcome of the structure and actions of the state. States are supposed to play leading roles in economic development, meaning that states in the context of East Asian development tend to behave in high-handed ways, whereas states in more advanced societies tend to be less so. Three representative studies in this vein are the works of Amsden (1989 pp.139-156), Wade (1990b pp.236-256), and Woo (1991 pp.13-37). Let us see how these works view the state and state-society relations in East Asian development. Amsden in her book views Korea as a typical case of a late industrializer, and shows how the Korean state has managed its economy

by “getting relative prices [intentionally] wrong” (Amsden 1989 pp.139-56). She takes three sectoral examples, the textile, shipbuilding, and steel industries, in order to demonstrate how the state has managed sectoral mobility and accomplished developmental goals.

It was the state and its managers that mobilized the Korean society toward heavy industrial development, and the state also provided various incentives to industrial capitalists, such as the effective protection of the domestic industries from external competition and enormous financial backing for the targeted industries, which were indispensable for the success of the Korean economic miracle. Thus the remarkable success of the Korean economy including the three industrial sectors mentioned above would not have been accomplished in the first place, had it not been for the state.

Wade has a very similar view on Taiwan’s economic growth and on the role of the state in East Asian development in general (1990b pp.236-256). Wade’s main concern is to attack the anti-statist or neo-classical argument about the sources of East Asian development. Wade classifies the existing literature on East Asian development into three models, the Free Market theory, the Stimulated Market theory, and the Governed Market theory, and tries to prove the Governed Market theory (a version of the statist perspective) can best explain East Asian development. Thus when he reviews sectoral histories of the automobile and electronics industries in Taiwan and Korea in order to see whether the actions of the state (industrial policy) did make differences in sectoral development, Wade argues that the state has led rather than followed the market at various stages of industrial development (Wade 1990b, 236-56).

Perhaps Woo (1991 pp.31-98) is the one who provides the most meaningful and comprehensive analysis on the Korean state and its role in the process of development. By analyzing the Korean financial system and the evolution of the relationship between the state and business that have been restrained by both domestic and international political economies,

economic backwardness and geopolitics in particular, Woo shows how the Korean state could accomplish such a dominant position in the process of economic development. It is the complete control over the credit-based financial allocation system that enables the Korean state to lead private businesses and accomplish its developmental goals. Accordingly the Korean state is viewed as the headquarters of "Korea, Inc." and other social actors including big businesses have been under the firm control of the state.

All of these works view the state and state-society relations as contextually variant. In Amsden (1989), the argument that economic backwardness enabled the Korean state to play a leading role implies that the state can play very different roles when development is accomplished. Likewise if the structural conditions that enabled the Korean state to play such a leadership role (for example, the credit based financial allocation system, geopolitics, Korea's relative position in international political economy, and the strategies of international bankers and the MNCs) changed, the Korean state may play quite different (say, subordinate) roles in economic management (Woo 1991 pp.18-44). Wade also shows that state leadership in Taiwan varies over time and across industrial sectors (Wade 1990a pp.90-112).

Though all of these works correctly view the state and state-society relations in East Asian development as historically and structurally variant, none of them deals with the state that did not lead the market. In other words, the state in these studies always appears as a dominant actor and thereby truly plays a key role in economic development, which is exactly what Chalmers Johnson, calls the developmental state. The main reason for this seemingly contradictory treatment of the state can be found in the fact that these studies mainly focus on relatively early stages of development.

As Gerschenkron (1962 pp.8-27) and Rostow (1960 pp.12-44) point out, the state tends to be dominant in the early stages of late development. Beginning in the late 1970's early 1980s,

however, societal organizations are being fully established in Japan, Taiwan and Korea that may affect state-society relations in different ways compared to those in the past. To make things more complex, international contexts that affect the capacity and autonomy of a state are continuously changing over time. Eun Mee Kim's (1987 pp.32-197) dissertation on the changing Korean state-business relations which was well expressed as "from dominance to symbiosis" and Peter Evans subsequent discussion on "the dynamics of developmental states" (Evans 1992 pp.163-166) illustrate this point very well.

What is important in this dynamic relationship is that the effects of the changing state-society relations upon the formation of industrial policy may also vary according to the structural conditions of a particular industrial sector. By analyzing the institutional underpinnings of the 1980s and 1990s, during which the Taiwanese and Japanese states are at the peak stage of industrial competition for IT and IT hardware, this research will explore the causes and consequences of the institutional, sectoral, and historical variation of the state-business and state-society relations of Taiwan and Japan in East Asian development. Only then can we comprehend the significance of Taiwan's Win-Win OEM strategy (**苗豊強** 1997) that suddenly accomplished many productive partnerships with Japanese firms during the 1993-2000 period.

Wade's study on Taiwan (1990a pp.92-314) deserves closer analysis because it not only shows the variation of the state and state-society relations in development as a whole, but also provides relatively detailed accounts of sectoral histories including the IT hardware industry. Because Wade focuses on when, where, and how the state intervenes in the market and thus exercise its leadership, the causes of state withdrawal from certain industries are largely unexplained or simply viewed as the state's strategic choice that can be made without being constrained by both domestic and international political economic structures. The following paragraph reveals this problem very clearly.

> Broadly speaking, [the Taiwanese] government intervention of a leadership kind has focused on industries or projects which are capital-intensive (e.g.., steel, petrochemicals), or which use technology that must be imported from a small number of potential suppliers (e.g.., ICs), and also industries with an intimate relationship to national security (e.g.., shipping). Leadership is concentrated on industries that are expected to become internationally competitive but have not yet become so, and on industries which, though losing competitiveness, the government considers important for the economy's future growth. It is absent in industries or projects without these various characteristics (e.g.., wigs, wallets, and most nondurable consumer goods). Within "high-intervention" industries, leadership episodes are concentrated at the stage of creating distinctively new capacities (whether in new or existing industries), especially when such creation faces large indivisibilities or other entry barriers. So in any one industry, and in the industrial sector as a whole, we can distinguish episodes of leadership, followership, and laissez-faire. Sometimes the episodes begin with leadership and then move to followership (as in some of the heavy and chemical industries); sometimes they begin with laissez-faire or followership and then move to leadership (as in machine tools, where the government saw that without more assistance most of Taiwan's machine tool makers would not succeed in making the jump to computer-controlled machine tools). (Wade 1990a pp.303-4)

If this were the case, the Taiwanese state must be a truly strong and autonomous entity that can do anything it wants to do at any time, anywhere. Since states are situated at the intersection between domestic and international political economies that affect states" actions a great deal, this cannot be correct. Or if Wade did not intend to say that the state is such an omnipotent actor in the process of economic development, he simply causes unnecessary confusion to the reader by adding the above argument in his concluding chapter. In this research, it will be demonstrated that when the state plays a leadership role, meaning that the state institutions become dominant actors in policy-making and implementation processes, there are structural mechanisms (or institutions) that enable the state to do so, as will be shown in the Taiwanese IT hardware industry.

Also, it will be shown that the state in Taiwan spun off many state institutions to become independent NPOs, corporations and even autonomous government institutions thus demonstrating that the so called dominate intervention of the strong state in early development had actually transformed over time. By the late 1980's the Taiwanese state had actually delegated much of its earlier power to various autonomous NPO spin-off institutions (ITRI and ERSO) and corporations (UMC, Mitac, TSMC plus many others) that effectively changed the entire balance and dynamic of trilateral institutional relations (i.e. triangle of state, NPO/NGO and corporate institutional power relations i.e. the triangle method). Likewise when the state does not play such a leadership role, there must be structural impediments that limit state actions as will be shown in the Japanese IC industry.

Statist approaches are also problematic in the conceptualization of their key unit of analysis, that is, the developmental state. First of all the statist paradigm views the state as an "internally cohesive, unitary, and sometimes even rational actor.[17] By doing so, it commits the fallacy of reductionism, that is, a false conceptualization of the state as something without internal conflicts, competition, and confrontation. In the real world of politics, the state and its actions are influenced by various factors. These factors include: the executive leadership, the bureaucratic institutions and their relations with the executive leadership, political parties and its ties to the executive branch as a whole and/or particular bureaucrats, political leaders, and a bureaucrat who is responsible for implementing any particular policy. Thus the seemingly cohesive, unitary, and rational action of the state, if any, is not the outcome of the unitary actor but that of continuous interaction among a complex web of interests between the state and society. This is why one needs to develop a new theoretical framework in explaining the East Asian experience of development.

Statist approaches also fail to provide a complete causal explanation about the relationship between the structure of the state and economic performance (Moon and Prasad 1994 p.34). Because the statist paradigm dichotomizes the state and society and argues that the former exercises a firm control over the latter in order to accomplish a fast economic growth, their explanation usually stops at answering questions such as what the intention of the state was, what policy tools were available to the state, and whether policies were actually implemented. In reality, private firms normally maintain economic activities and it is those firms and individuals who actually run businesses that are directly related to economic performance. State actions may change the rules of the game, in which firms and individuals are playing sometimes in an evolutionary manner and yet at other times, quite drastically. In some cases, business interests may be the causes of policy changes as the voice of private firms is increasingly heard due to the growing influence of the private sector. Policy changes, therefore, have to be understood in relation to how they affect (or are affected by) the calculations and behavior of actual economic players including both domestic and international.

The institutional approach to state-society relations adopted in this study will make up for this missing or ambiguous causal linkage between states actions and economic performance by analyzing how the changes in states institutional actions and the international environment created new rules of the game which directly affect business activities of private enterprises and vice versa.

1.23 Anti-statist Approaches

A second major paradigm in explaining East Asian development is called the anti-statist or market-oriented approach. Anti-statist theory has its intellectual roots in neo-classical economics. A distinctive nature of anti-statist theory is that individuals rather than

states or classes are a major unit of analysis. Individuals are free to choose in order to maximize their own utilities (Friedman and Friedman 1979 pp.9-37). Politics in anti-statist theory is just like a market place where political parties compete with each other for getting more votes from citizens (Downs 1957 pp.33-78). Unlike Marxists, classes are not fundamental cleavages in societies. Rather classes are understood as a group of individuals like other social groups such as religious, ethnic, regional, and occupational-groups. These groups can exercise their influence to get what they want from governments. Governments in anti-statist theory need to respond to the preferences of its citizens, individuals or groups of individuals, rather than having their own goals and interests independent from other interests (Dahl 1971 pp.1-35). In this view, governments are expected to serve the following economic functions:

1. Maintain macroeconomic stability.
2. Provide physical infrastructure, especially that which has high fixed costs in relation to variable costs, such as harbors, railways, irrigation canals, and sewers.
3. Supply "public goods," including defense and national security, education, basic research, market information, the legal system, and environmental protection.
4. Contribute to the development of institutions for improving the markets for labor, finance, technology, etc.
5. Offset or eliminate price distortions which arise in cases of demonstrable market failure redistribute income to the poorest in sufficient measure for them to meet basic needs.

(Source: Wade 1990a p.11)

Accordingly states in this view are not independent actors. States and state managers do not have their own goals and interests that are independent from other social groups and their interests. The capitalists and labor unions have neither a uniform interest nor are they hierarchically organized. Both businesses and labor unions are divided, and they act according to the issues at hand. Thus states do not initiate any outright measures called industrial policies targeting certain industrial sectors. If any policies were adopted for the purpose of

promoting specific industries, those are not initiated by the conscious economic bureaucrats, but are a mere response to the demands from various individuals and interest groups. Though they were not exactly industrial policies, various protectionist measures adopted by the American government for the textile, apparel, footwear, color TV, and automobile industries in the 1970s and 1980s are good examples of policies targeting specific industries (Yoffie 1983 pp.44-109). One joint effort between the government and the private sector to recover the competitive edge of the American IC industry (SEMATECH) seems to have characteristics of industrial policy (US Congress 1990 pp.78-146). These are, of course, the state's responses to the powerful lobbies from related interest groups such as the SIA of the United States rather than a conscious effort by economic bureaucrats. Because the state, including both the executive and legislative branches, is not an initiator but a reactor to the demands from society, industrial policies in anti-statist theory, if any, are usually ad hoc, reactive, and protective in nature.

Most of the early literature on East Asian development that advocates this view are the works of neo-classical economists (Hong and Krueger 1975 pp.1-124; Krueger 1978 pp.22-134; Kuznets 1977 pp.1-154; Fei et al. 1979 pp.1-165; Little 1979 pp.448-507; Balassa 1981 pp.1-156; Kuo 1981 pp.1-189). They do not deny the critical roles played by the state in the process of economic development. However the state has been viewed as a supporter and promoter of market forces, not as a creator of market signals. Major evidence of their argument stresses market-conforming characteristics of East Asian development strategy. According to this view, various market factors such as extraordinarily high saving rates, a highly educated work force, and interest rates are largely responsible for rapid economic growth in the East Asian countries. [18]

A major theoretical limit of this paradigm in explaining development is that it does view the role of the state and state-society relations as invariant through time, across industrial

sectors, and across countries. Based upon particular theories of the state, namely the anti-statist theories of the state, those who advocate market-oriented approaches tend to view the state as an empty shell and to downgrade the role of the state in the process of development. Thus when the state leads the market in certain industrial sectors, they have a hard time in explaining it. Or they often argue that market factors were at work well before state actions were undertaken. In many cases, however, it is very hard to tell because economic policies in late developers are usually adopted in continuous and coherent ways in the long run. Moreover there is plenty of evidence that at the initial stage of development, the state tends to behave in a highhanded way as well documented by many studies from the perspective of the statist paradigm (Gerschenkron 1962 pp.23-145; Evans 1986 pp.791-808; Amsden 1989 pp.23-145; Woo 1991 pp.6-158; Wade 1990a pp.1-321).

Recently a few revisionist arguments on East Asian development seem to replace the early neo-classical studies. One of them, called the "patterned pluralist theory," is advocated by Muramatsu and Krauss (1987 pp.516-554) about the Japanese political economy of development. They argue that patterned pluralist theory rather than the ruling triad (the strong economic bureaucracy, big businesses, and the Liberal Democratic Party) is the basic feature of the Japanese political economy of development. According to the patterned pluralist theory argument, the Japanese state has been strong but various interest groups and the ruling LDP have penetrated it. The near perpetual dominance of political power by the LDP makes the party responsive to a wide range of interests from society at least partially, because the LDP has to be a pragmatic, catchall party in order to maintain its power. The party-interest group alliances are more or less fixed due to their common ideology that is different from that of the opposition party. However the opposition party also has some influence on policy, even if through indirect means. According to Muramatsu and Krauss, the conservative party line of the ruling LDP has played a key role in producing patterned pluralist theory in Japanese society.[19] Under patterned pluralist theory, therefore, there are fairly consistent coalitions of actors and a

predictable degree of influence upon the policy-making process through time and across industrial sectors. In this sense patterned pluralist theory suffers from the same theoretical drawbacks shown in the works of neo-classical economists, that is, it freezes in time the state and state-society relations and thereby views them as invariant through time and across industrial sectors.

Another revisionist argument has been addressed especially on the Korean political economy of development. This view, which can be called a post-statist argument, originally emerged from the statist perspective.[20] In his study on the Brazilian computer industry, Peter Evans (1986 pp.791-808) observes that the state, may play a crucial role in the initiation of the new industries, but it is limited in its ability to act autonomously once an industry is established. Acknowledging the historical dynamism of state autonomy and capacity, the advocates of this view argue that developmental states are doomed to decline as development proceeds because of the inherent contradictions within them. According to Eun Mee Kim who pioneered the post-statist argument on the East Asian cases, developmental states have two structural contradictions: one is in their autonomy, and the other is in their institutions (E. Kim 1987 pp.16-56). Successful economic development, the number one priority of developmental states, has brought about drastic changes not only to their economies but also to their societies. In particular it blurs the separation between state elites and the capitalists that has been a vital condition to state autonomy. In addition other social groups such as labor unions, most of whom were weak at the initial stage of development, grew in the process of development as well. Consequently they would soon challenge state dominance over economic management.

Institutions in developmental states provide various functions for the private sector in order to accomplish developmental goals. Those functions include long-term plans, necessary capital and technology, and various direct and indirect assistance such as tariff protection, tax holidays, policy loans with very low interest rates, and so on. As developmental goals are

successfully accomplished, the private sector gains more resources and technology, and therefore, the services formerly provided by the state can hinder the efficient workings of the market economy due to various bureaucratic red-tape. In sum, developmental states contain their own seeds for decline from the very beginning because of the uneven growth between the state and society.

However as will be discussed below, the post-statist argument not only fails to explain properly the Taiwanese, Japanese or Korean experience of accelerated industrial catch up strategy for ICs, but also it cannot provide a sensible analytical framework for comparative studies. First of all, the post-statist argument on the Japanese and Korean experience of IC development emphasizes the emergence of liberalization policy in the early 1980s, and the resulting private initiative in the development of the IC industry, as major evidence for the decline of the developmental state. Consequently they argue that since the early 1980s, the balance of power between the state and private sector shifted in favor of the latter.

This is a kind of functional explanation because the outcome (for example, the private initiative in IC accelerated catch up strategy) is adopted as the cause of action (for example, shifting balance of power between the state and the private sector). The state's withdrawal from the active promotion of a particular industry, the IC industry in our case, may be viewed as a strategic choice of the strong, developmental state or as an inevitable path of action incurred by external pressures from international political economic conditions and structure. In addition, if the post-statist argument were correct, that is, the balance of power between the state and the private sector has been gradually shifted in favor of the latter due to development, how can we explain the active promotion of the IT hardware industry by the state since the mid 1980s, when a certain consensus on the necessity of state supports for the IT hardware industry was made among different state science and technology (S&T) agencies and other actors in society? Is this the result of a shifting balance of power again in favor of the state? If so, what are the

mechanisms behind the quick revival of state promotion? And why did it happen so quickly while the gradual decline of the state power took a much longer period of time?

The post-statist argument also fails to explain societal differences. If the Japanese or Korean state has been weakened as developmental goals are successfully accomplished particularly in the early 1980s, why does the Taiwanese state remain so strong and autonomous even though it has been equally or more successful in accomplishing its developmental goals? Though there is evidence of a shifting balance of power between the state and big businesses in both Japan and Korea, the post-statist argument fails to provide a complete causal linkage between the state/state-society relations and policy outcomes. By overemphasizing what they call "inherent contradictions of developmental states," the post-statist argument not only ignores the societal and sectoral variation but also fails to grasp the impacts of international constraints that may limit state autonomy and capacity in different ways.

1.24 Recent Revisionist Arguments

Due to the aforementioned criticisms and/or weaknesses of the two major paradigms in explaining the East Asian experience of development, quite a few alternative explanations seem to have emerged in recent years. Among them, three are worth reviewing in detail. They are: 1) what some people call developmental corporatism which has emerged in an effort to explain East Asian development by emphasizing the close ties and cooperation between the state and society; 2) the politics and flexible production strategy argument addressed by Friedman (1988 pp.36-118) about the Japanese machine tools industry; and 3) regional and global division of labor and/or production networks arguments which emphasize the patterns of a country's incorporation into the global economic structure.

Developmental Corporatism refers to a unique system of interest representation or

intermediation within a society. Schmitter views corporatism as "a system of interest and/or attitude representation, a particular modal or ideal-typical institutional arrangement for linking the associationally organized interests of civil society with the decisional structures of the state" (Schmitter 1979 pp.8-9). The concept of corporatism, however, is ambiguous and evocative, as Katzenstein admits. According to Katzenstein, corporatism has three different meanings:

(1) It refers to the political arrangement of several European states in the 1930s that has a close affinity to political authoritarianism and fascism. (2) [It] refers to the economic and political organization of modern capitalism, as expressed in contemporary discussion of" corporate capitalism" or "state corporatism." (3) [It refers] to the democratic corporatism (Katzenstein 1985 pp.30-41).

Democratic corporatism, or societal corporatism in contrast to the state corporatism, is essentially a European phenomenon, mostly found in the welfare states or social democratic countries. As a system of interest representation, it has three distinctive institutional traits. First, there is an ideology of social partnership expressed at the national level that mitigates class conflicts between the capitalists and labor unions. Second, there are relatively centralized and concentrated interest groups that facilitate the formation of a consensus within each class. Third, there is continuous bargaining among centralized interest groups, state bureaucracy, and political parties, through which voluntary and informal coordination of conflicting objectives are accomplished (Katzenstein 1985 pp.32). Various historical and structural commonalities of small European states have been viewed as essential conditions for the formation of the tripartite relationship among the state, capitalists, and labor unions. International economic difficulties in the 1930s, and again in the 1970s were also important factors for facilitating the harmony of interests among these actors.

In democratic corporatism, the state is neither a dominant actor nor a mere reactor to

various parochial interests. Rather it is an arbitrator that facilitates the compromise between conflicting interests, particularly between the capitalists and labor unions. Industrial policies, therefore, are the direct reflection of continuous bargaining and compromise among major interest groups in society, rather than the vision of the strong economic bureaucracy or a mere state reaction to the competing demands addressed by individuals and/or interest groups (Katzenstein 1985 pp.30-41).

It is Katzenstein's second notion of corporatism, the state corporatism or what could be called developmental corporatism that is applied to the East Asian setting. Katzenstein himself views Japan as a critical example of the state corporatism. [21] A distinctive feature of this Asian version of corporatism is that labor unions have been completely excluded from the bargaining process, meaning that the policy-making process is characterized by bilateral compromise between the state and the capitalists rather than the tripartite bargaining process seen in European corporatism. According to Pempel and Tsunekawa (1979 pp.231-258), Japanese political economy can be characterized as "corporatism without labor."[22] Though interest coalitions have been changed over time, from the alliance between the state and big businesses in the 1930s to the coalition among the state, big businesses, agriculture, and to a lesser extent, small and medium sized corporations in the postwar period, the Japanese state has always been aligned with the capitalists. Thus according to the state corporatism, industrial policy outcomes are formulated through continuous bargaining between the state and the capitalists without labor.

Another distinctive feature of this Asian version of corporatism is that both the state and the capitalists have distinct developmental goals that in most cases are shared between the two. This is a major reason why we should differentiate this Asian version of corporatism from the state corporatism in Latin America (for example, Stepan 1978 pp.12-34) by renaming the former as developmental corporatism. The state in developmental corporatism largely helps the

industry to be more competitive in the world market by employing various industrial policies. Nevertheless it remains as the corporatist state in the sense that it is not as strong and autonomous as the developmental state. That is, the state in developmental corporatism is more or less an equal partner in shaping industrial policies rather than a dominant actor. The capitalists in developmental corporatism consistently seek state help but at the same time they try to avoid state control as much as possible. In this context, the bargaining between the state and businesses mainly focus on the actual implementation of policies rather than policy goals.

Samuels (1987 pp.1-156) is the one who shows the applicability of the corporatist approach in explaining the industrial policy of East Asian political economies. In his analysis of the energy industries in Japan, Samuels argues that Japanese industrial policies on energy sectors including coal, electric power, oil, and others, have been so market-conforming, "not because it [the state] is strong enough to control by other means, nor because it is smart enough to appreciate the efficiency of the market, but because in the development of Japanese commerce and industry powerful and stable private actors emerged who established enduring alliances with politicians and bureaucrats" (Samuels 1987 p.2; italics added). Instead of bureaucratic dominance, or the statist approach in our terms, Samuels argues that "the politics of reciprocal consent" can best summarize the Japanese policies on energy sectors. By "reciprocity," Samuels means that jurisdiction can belong to both private firms and the state, and by "consent," he means both public and private jurisdictions in markets are negotiated and draw attention to the interdependence of public and private power. For the politics of reciprocal consent, therefore, negotiation and compromise are the essence of state-business relations. Samuels" notion of reciprocal consent is a logical extension of developmental corporatism, in which the state engages in continuous bargaining and compromise with certain segments of the private sector, while labor unions have completely been excluded from the scene.

A more sophisticated version of developmental corporatist studies that is often called the network approach is found in Okimoto (1989 pp.1-165) and Yeom (1989 pp.33-92).

Influenced by organization theory, those who advocate the network approach primarily focus on the relations between the state and society in order to explain "how behavior and institutions are affected by social relations" (Granovetter 1985 p.481). Networks are formed by continuous interaction among a group of people. Interaction can be seen in such forms as information transmission, boundary penetration, and resource exchange (Moon and Prasad 1994 p.38). The behavior of those who belong to a specific network can be distinguished from those of other networks because people in a particular network frequently interact with each other and are often connected by other ties such as schools, hometown and so on. In this context, Okimoto (1989 pp.231-248) observes that the historically formulated structural interdependence (that is, network) among the core actors in the Japanese high-tech industries, the MITI, the LDP, and the private sector, is the critical feature of the Japanese political economy. Industrial policy "has served as the main instrument for consensus building, the vehicle for information exchange and public-private communication" (Okimoto 1989 p.231). Thus Japanese industrial policies in the high-tech sectors are the direct outcomes of continuous bargaining and/or the coalition of interests among various actors in a particular network of the state and society, rather than that of state dominance or of pluralist competition.

A similar argument with a different name called "embedded autonomy" is addressed by Evans (1992 pp., 1995). He argues that East Asian states have functional links to their societies that is a key to understanding why the states in East Asia are benign or developmental rather than predatory like in Zaire. East Asian states are strong and autonomous, and have vertical ties with their societies. But at the same time, they have horizontal ties formed through formal and informal organic networks. Thus the autonomy of East Asian states is embedded in their society, which makes them be benign and developmental rather than predatory. Because the application of the corporatist approach to East Asian development is a very recent academic undertaking, there is no study that directly applies this to Taiwanese development. Given the structural closeness between Japan and other East Asian late developers, Korea in particular,

developmental corporatism might be a good alternative theoretical framework in explaining industrial policy outcomes in Korea or Taiwan.

1.25 Politics and Flexible Production Strategy Argument.

Inspired by Piore and Sabel (1984 pp.1-33), Friedman (1988 pp.16-45) provides an excellent study on the Japanese machine tool industry. According to Friedman, both the statist and anti-statist (mostly neo-classical) explanations cannot explain the Japanese economic growth properly. Instead Friedman focuses on the flexible production strategy that has been adopted by Japanese machine tool manufacturers and the effects of politics on specific industrial outcomes. Politics is viewed as "the fundamental orientation people possess about justice, appropriate behavior, and rights throughout society" (Friedman 1988 p.17). Politics is an important concern in the study of industrial outcomes because it shapes the whole industrial order including the market. Thus the Japanese market is not the same as that of the United States. In order to understand the Japanese market properly, one has to consider the historical and political contexts through which the market is shaped. The substantial role of small and medium sized enterprises whose estimated market share was about 70 per cent of the Japanese machine tool production, and the flexible production strategy adopted by them are cited as good evidence for MITI's inability to control the machine tools industry. By and large flexible production strategy and politics in the machine tools industry, rather than the invisible hand of the market or the visible hand of the state (MITI), are responsible for the success of the Japanese machinery industry, argues Friedman.

Global Division of Labor and Production Network Arguments:

Another revisionist argument about the sources of East Asian development can be called the "global division of labor and production network arguments," which emphasizes the ways that East Asian late developers are incorporated into the regional and global division of labor. The advocates of this view pay special attention to the fact that technologies and industries at the

mature stage usually transferred from the advanced industrial countries to late developers in the forms of foreign direct investments, off-shore manufacturing, and original equipment manufacturing production. To the governments of East Asian countries, this was viewed as a good opportunity to develop themselves, and thereby they tried to induce as much foreign investment as possible. Local capitalists and MNCs interact with each other in order to utilize this opportunity, and with the economic bureaucrats of the host countries, and domestic and international financial institutions. By doing so, East Asian countries were incorporated into the international division of labor and became a part of the international economic structure. The complex interplay among governments, local capitalists, and MNCs under the differing international political economic conditions and structures is analyzed as to how it affects the relative economic performance among different countries. The "flying geese model" argued by Akamutsu (1962 pp.3-25) can be viewed as a classic example in this view. Cumings' (1984 pp.12-56) well-known article about product life cycle and geopolitics is also a typical example, which argues the ways that product life cycle and geopolitical advantages are utilized by East Asian countries in achieving economic development. Similarly, Henderson (1989 pp.1-66) points out the importance of state intervention in the market at a time when foreign investments are coming into the developing countries. Though Bernard and Ravenhill (1995 pp.171-197) criticize the flying geese model of Akamutsu (1962 pp.3-25) and the product life cycle argument addressed by Cumings (1984 pp.12-56), they also pay much attention to the existence of regional production network centered on Japan in explaining the development of the electronics industry in East Asia. Likewise, Gereffi (1994 pp.1-22, 1996 pp.75-112) emphasizes the impacts of global commodity chains upon East Asian economic success.

Though the detailed arguments vary, the revisionist arguments introduced in this section commonly point out that the existing paradigm does not provide a complete explanation about East Asian development. Instead of arguing that either the state or the market is the source of development regardless of time, space, and industrial sectors, the revisionists argue that one

has to look at how state-society relations have been shaped under the changing global economic conditions and structures, and how they affect political and economic outcomes in a society at particular historical junctures. By doing so, the revisionists" studies on East Asian development commonly emphasize the importance of the complex interaction among major players in the process of development, and analyze what kind of structural constraints and/or chances delimit or mediate their interaction. This is why they can be seen as the application of the new comparative political economy advocated by Evans and Stephens (1988a pp.713-733, 1988b pp.739-773) or comparative institutional approach in Evans' (1985 pp.192-226) terminology. And now, a brief look into the theoretical superiority of comparative institutional approach in explaining East Asian development.

Section 1.3 Toward a New Comparative Approach: Comparative Institutional Analysis

1.31 Towards Understanding CIA

The state seldom remains as developmental, anti-statist, or corporatist in the policy-making and implementation process over time, not only because of the dynamic state-society relations but also because of the bureaucratic politics within the state that greatly affects the actions of the state which exercises some transformative power over the "rules of the game" operating within the society. The institutions of the industrial structure, the strategies adopted by major producers, and the people involved in sectoral politics are not necessarily the same through time (see for example, Friedman 1988 pp.1-134) so that the state in one sector may play radically different roles in other sectors (see for example, Krasner 1978 pp.34-127). To make things more complex, changes in international political economy may provoke a radical shift in the role of the state in industrial adjustment (Haggard and Kaufman 1992 pp.1-22), especially in the economies that are heavily dependent upon international trade such as Taiwan and Japan. But the adjustment strategies are not necessarily the same due in part to the different domestic political economic structures represented as the riles of the game. (See

for example, Stallings 1992 pp.41-86 and Kahler 1992 pp.89-138). Just like the liberal economic regime during the 1950s and 1960s provided good chances to East Asian late developers, the neo-protectionist tendency of the advanced industrial countries after the 1970s has imposed considerable constraints upon the same group of countries.

The existing literature on East Asian development provides unique sets of explanations about the role of the state in the process of development and the ways that industrial policies are shaped. They argue that industrial policies are the direct outcomes of the structures and actions of the state (the statist approach), of free market competition and utility maximization among interest groups and/or various market factors (the anti-statist approach), of concentration of interests between the state and capitalists without the participation of labor unions (developmental corporatism), of embedded autonomy of the state-society relations (embedded autonomy argument), of distinctive sectoral politics and production strategies as in Friedman (1988 pp.1-98), or of global division of labor and production networks.

As discussed earlier, some studies, mostly the neo-classical economic literature, tend to freeze in time, as being fixed or static, state and state-society or state-business relations in development, and thereby fallaciously see them as historically and/or structurally invariable through time. Thus when a committed anti-statist studies East Asian development, he/she tends to view the state as anti-statist and to look for the ways in which a plurality of interest groups have inputs into the policy-making process. Though the statist argument and its variant do recognize the historical, sectoral, and societal variation of the role of the state and state-society relations, most of them only cover relatively early stages of development, and therefore the state in the existing literature always plays a dominant and pervasive role in the process of development. More importantly, the statist and other structural studies cannot provide a complete set of causal argument due mainly to the lack of a complex understanding of the sophistication of state and state-society dynamics in their evolution spread through time.

Some sophisticated statist literature and recent revisionist arguments summarized in the previous sections, actually do share important commonalties despite their different views on the role of the state in development and industrial policy-making process (Chu 1987 pp.22-67; Amsden 1989 pp.13-57; Haggard 1990 pp.9-42; Woo 1991 pp.22-111; Friedman 1988 pp.16-45; Samuels 1987 pp.1-42; Okimoto 1989 pp.231-248; Evans 1992 pp.145-169, 1995 pp.1-66; Henderson 1989 pp.15-54; Bernard and Ravenhill 1995 pp.171-209; Gereffi 1994 pp.1-16, 1996 pp.75-112). These commonalties include the following: they have the same or similar theories of the capitalist state; they clearly differentiate between the theories of the state and the role of the state in the actual policy-making process; they openly recognize that the state, state-society and state business relations are variant through time, across societies, and across industrial sectors; and both domestic and international factors affect the political outcomes in a country, but the effects of international contexts upon the formation of industrial policies can vary according to structural conditions of a particular country such as state structure, class structure, production network, geopolitics, the nature of the domestic market including the financial market, the relative position of the country in international political system, and so on. This allows us to view these studies as the application of the new comparative political economy proposed by Evans and Stephens (1988a pp.739-773, 1988b pp.713-729).

According to Evans, Stephens, and 青木 etc. a new comparative institutional approach to political economy has emerged since the 1960s as a Lakatosian and Von Neumannian research program in the course of theoretical conflicts between major paradigms in the study of development, including modernization theory, dependency and world-system approaches, as well as the works of neo-Marxists and Third World scholars. They say:

> Its practitioners constitute a community of scholars who share important heuristic assumptions ... They attack a variety of substantive issues and are eclectic in their methodology but share a number

> of characteristics that in combination serve to distinguish them from earlier work ...the contemporary work on which we focus begins with the conviction that economic and political development cannot fruitfully be examined in isolation from each other. It has absorbed the lessons that grew out of work on dependency and world-system perspectives and is therefore much more sensitive to international factors than classic political economy, but it has rejected the idea that external factors determine the dynamics of domestic development. More generally, it rejects models that posit "necessary" outcomes, assuming instead that developmental paths are historically contingent. Multiple cases are preferred and when single cases are used they are set in a comparative framework. Quantitative and other cross-sectional data are located in the context of more historical evidence. (Evans and Stephens 1988b pp.713-4; italics added)

According to this new comparative institutional approach to political economy, the state is "an organization which, since it cannot be otherwise than a social network of people, exists in its own right and possesses interests of its own" (Cardoso 1979, 51).

The role of the state apparatus in development "must be considered along with the interaction of social classes if the politics of development is to be explained" (Evans and Stephens 1988b p.723). Domestic class structure and industrial structure, as well as the ways that interests are represented in a given society are the outcomes of historically contingent interactions between the state and society. The degree of state intervention is not constant but variant through time and space. As to the effects of international contexts upon domestic development, the new comparative political economy emphasizes:

> Instead of seeing the international system as determining the possibilities for national development the new comparative political economy takes a more recursive view in which the world political economy both shapes and is shaped by the historical trajectories of development within individual nation states. Further complexity is introduced by bringing geopolitics back into the traditionally economic analysis of core-periphery relations. (Evans and Stephens 1988b p.725)

In short, a new comparative political economy views the state and state-society relations as

historically and structurally variant, and thus the international system as well as geopolitics have an impact upon the rules of the game and policy-making process. Thus the state in this view cannot be reduced to an aggregation of individuals who possess certain positions within the bureaucracy at a particular time, and the policy outcomes cannot be reduced to the results of individual utility maximization regardless of time and space. Evans points out this very clearly:

> In the comparative institutional approach, the state is seen as a historically rooted institution, not simply a collection of strategic individuals. The interaction of state and society is constrained by institutionalized sets of relations. Economic outcomes are the products of social and political institutions, not just responses to prevailing market conditions. Understanding diverse outcomes is the aim, not forcing cases into a generic mold or onto a one-dimensional scale. (Evans 1995 p.18)

Let us take some examples to see how the works on East Asian development could be viewed as the application of a new comparative political economy deal with the state and state-society relations in the process of development as well as in the industrial policy-making process. Chu (1987 pp.88-255) in his study on different adjustment strategies taken by the East Asian NICs during the 1970s and early 1980s, argues:

> First, domestic structural arrangement can be an important source of national economic strategies even for countries that are constrained by limited domestic markets and highly dependent on external trade. Secondly, in state-dominated societies, the locus of domestic policy determinants lies in the public realm. In accounting for state policy responses at moments of international crises and changes, we should turn attention to the strategic behaviors of the government elite positioned in a distinctive state structure, with different policy tools and institutional resources at their disposal. (Chu 1987 p.245)

As shown above, it is clear that the role of the state can vary according to the structural constraints, both domestic and international, imposed upon the state and state-society relations.

Through a brief review of five industrial sectors (mostly heavy and chemical industries) in Korea during the 1970s, Woo (1991 pp.56-179) argues that the Korean state has dominated the process of economic development, not because of its historically strong and autonomous nature but because of the structural conditions in which the state has been located, such as Korea's relative position in the international system, its colonial legacy, international security environment, opportunity structure in international finance, and the nature of the leading industry. Haggard (1990 pp.39-63) also views the roles played by the East Asian state not as constant but as variant, and argues, "policies reflect the effort to build and sustain coalitions, but available organizational resources expand or contract politicians" freedom of maneuver. Characteristics of the state as an institution - the degree of autonomy from social forces, the cohesion of the policy-making apparatus, and the available policy instruments - are crucial in understanding policy reforms" (Haggard 1990 p.46).

Friedman (1988 pp.56-99) does criticize both the state dominance and market explanations in his account on the development of the Japanese machine tools industry. His alternative approach, the politics and flexible production strategy as the determinants of Japanese success in the industry, clearly admits the historical, structural, and sectoral contingency of the state and state-society relations. Though the post-statist argument correctly points out the changing state-society relations as shown in E. Kim (1987 pp.35-98), it is only partially successful in explaining the different roles of the state in the developmental process of Taiwan, Japan or Korea. As argued earlier, it cannot explain the societal differences manifested in the IT hardware development of Taiwan, Japan or Korea.

Though Samuels (1987 pp.234-279) views reciprocal consent as a major state-business relation in Japanese energy politics, he does not have a theory of the state different from that of other studies that could be viewed as the application of the new comparative political economy. He argues that "state intervention would be enhanced by six factors: market structure,

centralization, developmental timing and finance, openness to diversity, the nature of the ruling coalition, and administrative tradition" (Samuels 1987 p.265). He further argues:

> Understanding the Japanese policy process requires a prior appreciation of political conflict within and across sub governments rather than direct confrontation between unified actors. Some have termed that process "reciprocal consent," a formulation not completely inconsistent with Japan, Inc. To the extent that it can accommodate diversity and conflict, and to the extent that it can be disaggregated, Japan, Inc., may yet be the most elegant characterization of the Japanese political economy. (Samuels 1987 p.288)

From this quote, it is clear that the Japanese state has been corporative with businesses in conducting industrial policies for the energy sector, not because of the constant state-business relations as such but because of the structural conditions in which the state, state institutions, and the business have been located. The same is also true in Okimoto (1989 pp.219-238) who argues:

> Industrial policies for steel, lasers, and ICs pose a sharp contrast to those for agriculture, food processing, and construction. The differences can be attributed largely to variations in the patterns of interest aggregation involving the LDP, producer groups, and bureaucratic agencies. (Okimoto 1989 p.229)

Likewise, Gereffi (1994 pp.1-16) argues that the key of East Asian industrial success is neither the state nor the market. Rather it is the combination of organizational learning, openness to diversity and institutional responses by local firms and states to the ever-changing global commodity chains. Multi-layered production and marketing networks that have been provided by the manufacturers and retailers in the advanced industrial countries are major chances which allow East Asian NICs successful entry into the proper positions in global commodity chains.

In contrast to the "old" studies that tend to freeze in time the state and state-society relations in the process of East Asian development,[23] the studies that are categorized as the

application of a new comparative political economy rely on the same or similar theory of the state, which can be broadly defined as the capitalist theory of the state. That is, the state is an organization that exists in its own right and possesses interests of its own. What matters to the researcher who wants to explain the role of the state and other actors in the policy-making process are the structural conditions or so called "rules of the game" that limit or encourage the state and other actors in society to experiment with the diversity of trying different roles in the developmental process. Those structural conditions may include the distribution of power between classes, the degree of state autonomy and capacity, the degree of centralization of employers' associations and labor organizations, industrial structure, openness to diversity and experimentation, import/export controls, the alliances between the local entrepreneurs and MNCs, the relative position of a country in the international political economic system, and the geopolitical advantages and disadvantages that go along with that position.

Based upon the distinctive views on the state and state-society relations provided by a new comparative institutional Analysis, this dissertation specifically adopts a comparative institutional approach to state-society relations proposed by Peter Hall (1986 pp.288-318) and Aoki Masahiko (1995 pp.1-16). Though some existing studies on East Asian development (Taiwan and Korea in particular) correctly view the state and state-society relations as historically and/or structurally variant (for example, Amsden 1989 pp.123-178; Woo 1991 pp.167-208), they mostly discuss relatively early stages of development during which institutional arrangements were not well established and thereby the state more or less dominated the developmental process. After the mid 1980s, however, the institutional environment of these newly industrializing countries is not new any more, meaning that states are being constrained by institutional factors and rules of the game that are different from the previous decades.

Thus it is not so surprising that an increasing number of studies argue that either the

state or market paradigm could not explain East Asian development as a whole (Haggard 1990 pp.9-42; Haggard and Moon 1990 pp.210-237) and/or specific industry sectoral development (Arnold 1989 pp.178-214; Noble 1987 pp.683-704; Meany 1990 pp.22-45; Friedman 1988 pp.1-55; Evans and Tigre 1989 pp.751-768; Okimoto 1989 pp.134-196; Gereffi 1994 pp.1-22). The accelerated industrial catch up strategy for IT hardware has been made under these changing circumstances, which leads us to view Taiwan and Japan as more sophisticated countries than before though less advanced politically than the European countries and the United States. An institutional approach to state-society relations is particularly useful in explaining the different policies adopted by different countries of a similar level of development.

Let us first look at the meaning of institutions. In his study of the French and British economic policies, Hall defines institutions as "the formal rules, compliance procedures, and standard operating practices that structure the relationship between individuals in various units of the polity and economy" (Hall 1986 p.19). The characteristics of an institutional approach are well pointed out by Hall as follows:

> It [institutional approach] emphasizes the institutional relationships, both formal and conventional, that bind the components of the state together and structure its relations with society. While those relationships are subject to incremental change, and more radical change at critical conjunctures, they provide the context in which most normal politics is conducted. (Hall 1986 p.19)

The concept of an institution and its effects upon human exchange is clearly stated in economic theory as well. By arguing in the jargon of the economist," institutions define and limit the set of choices of individuals" (North 1990 p.4), North defines the concept of institution as:

> Institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction. In consequence they structure incentives in human exchange, whether political, social, or economic. Institutional change shapes the way societies evolve through time and hence is the key to understanding historical change. (North 1990 p.3)

An institution, therefore, is necessarily a broad concept. Virtually anything that affects the behavior of various actors in a given policy space is considered as a part of institutions. Institutions include not only state structures and the conventional interactions between bureaucratic agents and agencies, but also societal structures and the rules of the game to which key players in the policy-making process adhere. International political economy is also viewed as a part of institutions as long as it imposes constraints upon the behavior of relevant actors by defining and limiting the choices of action before them. Policies, by definition, are the actions of the state. However the state is seldom a unitary actor because it consists of various people and agencies. Various actors in society influence state actions as well. Related institutions structure the behavior and/or interests of actors because they provide the "rules of the game" in the policy-making process that each actor has to follow. Since institutions are historically formed through the accumulation of interactions among different players within a given policy space, they are necessarily dynamic through time, across societies, and across industrial sectors. In short, institutions are the historical and structural variables that delimit or mediate the actions and reactions of various players in the policy-making process.

State structures are considered as parts of institutions, and so are the societal structures including class structures, business structures, and the relationship between the state and society. States in this sense are necessarily dynamic because state agents and agencies as well as their goals and interests are not the same across time and industrial sectors, and neither are the external constraints that limit the behavior of relevant players in a given policy space. By bringing the state down to an institutional level, the institutional approach deals with the state as a variable rather than a constant. Therefore the institutional approach is particularly useful in examining historical, sectoral, and cross-national variation in policy outcomes. The rapid industrialization and the resulting changes in state-society relations in Taiwan and Japan add to the utility of the institutional approach in explaining the dynamic features of political and economic changes in their societies. The institutional approach is also

very useful in providing a more accurate causal explanation between state actions (that is, policies) and economic performance (that is, development of the IT hardware industry). As argued earlier in this section, most previous studies on East Asian development failed to explain the complete causal relations in the process of development. By adopting an institutional approach, this dissertation will cover both macro and micro variables so as to provide a complete set of explanations between institutions as constraints and/or chances and individual actions that are directly related to performance.

1.32 Foundations of Comparative Institutional Analysis

The institutional approach is not a totally new analytic framework. The effects of institutions upon state actions have been a major analytic focus of neo-Marxist scholars.[24] It has been advocated by many neo-Marxists that the structural arrangements or rules of the game in the capitalist economy help to perpetuate the dominance of the capitalist class by structuring the behavior of state managers (Miliband 1969 pp.78-145; Poulantzas 1969 pp.78-179, 1978 pp.95-145; Offe 1974 pp.31-57, 1984 pp.34-99; Jessop 1977 pp.353-373, 1982 pp.112-179). Recently some studies on East Asian development begin to pay much attention to institutions in examining national differences. For example, in his study of the developmental process of the East Asian NICs, Haggard argues,

> Their [state elites] freedom of maneuver depends, however, on institutional setting and the organizational resources they have at their disposal. Three dimensions of the state as an institutional and legal structure bear on the ability of political elites to realize their interests. The first is degree of insulation from societal pressures, which in turn is a function of the institutional arrangements linking state and society. The second is cohesiveness of the decision-making structure itself. The third is instruments that are available to state elites in pursuing their political and substantive goals. Variations in these institutional characteristics influence policy choice and implementation. (Haggard 1990 pp.43-4)

Understanding institutional differences, therefore, is crucial to explaining the cross national

differences in policy outcomes.[25] While the institutional approach has merits in explaining historical, sectoral, and cross-national variations in policy outcomes, it is also subject to drawbacks. One possible criticism is that the institutional approach is nothing more than a synthesis or summing up of what various existing approaches say. This is in a sense valid because institutions include not only state structures but also norms and standard operating procedures in which various societal actors interact with each other. Institutions also include international contexts that delimit the interactions between players. In this sense, the institutional approach certainly loses theoretical conciseness. However considering the utility of the institutional approach, that is, its explanatory power in dealing with historical, sectoral as well as cross-national and temporal dynamics, the sophistication of institutional analysis may not be a serious theoretical weakness. Moreover when we analyze the cross-national variation in policy outcomes of IT hardware policies in this particular study, we in fact examine only the relevant differences rather than all institutions, which can relieve the complexity problem to a certain extent.

Why are "bounded rationality" methodologies, such as CIA and game theory more useful than conventional "rational expectations" economic models in analyzing economic development and transition economies?

Economists have started looking earnestly into these "bounded rationality" issues by broadening the theoretical perspective of economics. This is indicated by the emergence of a new field, Comparative Institutional Analysis (CIA). The CIA field is co-evolving with Historical Institutional Analysis (HIA) and Transition Economics. All these fields recognize that "institutions matter," and share methodological and analytical orientations and interests in many important ways. According to Aoki Masahiko's definition of the CIA approach:

> Major comparative institutional issues which have recently attracted the keen interest of economists include the following:
>
> 1. It has been increasingly recognized that within developed market systems there is a variety of institutional arrangements and that the differences between these may be important in determining

national or regional advantage and disadvantage in industrial productivity and international competitiveness. Trade imbalances between nations have often escalated disputes over institutional differences between trading partners. Do, should, or could institutional arrangements become convergent across economies? Or, is there any gain from diversity? If so, what is the best way of exploiting it?

2. In Eastern Europe the state apparatus of centrally planned economies suddenly collapsed. In spite of initial euphoria, however, the transition to market economies has turned out to be neither trivial, nor automatic through privatization. On the other hand, in China and Vietnam, where the transition has been gradual and the role of the state has been pivotal in designing new market oriented institutional arrangements, economic performances seem to have excelled those of Eastern European counterparts so far. Can the transition be free from the historical constraint of communist legacies? In what sequence? If there are a variety of institutional arrangements in market economies, at what model should transitional economies aim as a terminal state?

3. The publication of The East Asian Miracle: Economic Growth and Public Policy by the World Bank (1993) signaled a new stage of debate on the role of state in particular, and that of institutions in general, in the development process. The report documented various features of institutional arrangements allegedly common to East Asian economies and discussed their possible contributions to the high economic performance of that region relative to other developing regions. Does the East Asian state function as a response to pervasive market failures or rather as a complement to the enhancement of private order institutions which stimulates individual incentives? Is an observable difference in total factor productivity between Japan and other East Asian economies attributable to a difference in institutional infrastructure? Is it true that East Asian bureaucracies are less susceptible to unproductive rent-seeking behavior? If so, why? Are East Asian institutional arrangements only effective at the developmental stage and should they be eventually replaced by a more advanced, universalistic model of Western type?

On several occasions above, I have referred to "institutional arrangements" in the economy. What are institutions? How are they arranged and interrelated? According to North (1990),

"institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction" (p. 3). He argues that such constraints evolve as an outcome of the (political) interplay of self-interest seeking groups (Aoki 2000 159-161).

The state in Taiwan has been very dominant and pervasive in making and implementing the IC policies, while the state in Japan has been more or less cooperative with the private sector. This is truly a surprising fact because both states have been considered what Chalmers Johnson calls capitalist developmental states during most of the postwar period (Johnson 1982, 1987). It is also surprising because as far as the IC industry is concerned, both countries were far behind in the early 70's compared with other advanced countries, which may require a strong state leadership in the processes of industrial catch-up. In explaining the causes of this variation, this research primarily focus' on the differences in three structural variables, business structures, state structures, and NPO / NGO structures and tries to explain how these variables have changed the institutional settings, according to which the relevant actors in the state and society have interacted with each other in order to result in different organizational strategies.

Professor Aoki Masahiko has explained how the effective management of Japanese firm organization that endogenizes contextual skill formation has been supported by the complementarity of the contingent governance structure and the imperfect labor market. He argues that the contingent governance structure in turn has been supported by regulations restricting entry to many industries that have made it possible for these industries, such as main banks, to accrue rents. In Aoki's words:

..."bureau pluralism" is not an "open pluralism" as vested interests protected by bureaucratic administrative mediations merely coexist and various organizational modes cannot be freely created. This joint gain by all parties was made possible by the existence of quasi-rents acquired from the international market by upgrading the machine manufacturing industry, which accounts for 80 percent of exports. It was maintained by distributing the quasi-rents attained by the internationally

> advanced sectors to the underdeveloped sectors through such mechanisms as domestic price distortion, taxes and subsidies, and entrance regulations. If the learning or transplantation of these organizational innovations is combined with low cost factors of production overseas, the potential for the Japanese economy to acquire quasi-rents will rapidly decline. This trend will be further accelerated by organizational innovations or the emergence of new industries in other countries. In a previous work I referred to the following phenomenon as the "fundamental dilemma of bureau pluralism": advanced sectors that do not need bureaucratic protection tend to drift away from the bureau pluralistic framework, while less developed sectors tend to rely on it more (Aoki 2000 pp.129-131).

However, Aoki claims that if quasi-rents move toward extinction for the various reasons given above, the framework of bureau pluralism itself will be difficult to maintain. At that point he says that if comparatively disadvantaged industries seek continued protection, the advanced firms would either lose their competitiveness due to higher subsidization to disadvantageous sectors and interest groups, or would be under great pressure to move their manufacturing bases overseas to survive. The resulting dilemma would be that the only remaining employment opportunities would be in comparatively disadvantaged industries.

Aoki argues that, from the perspective of information processing, there is potential for the economy to continue to demonstrate efficiency in industries that can be characterized as high engineering industries. He also points out that a fairly high possibility that new innovations will be implemented domestically in cross-industrial technologies, such as formation technology driven electronic machinery, retail and service sector networking, and environmental management technologies. However, the dilemma of bureau pluralism might grow more serious, threatening the loss of international competitiveness of the leading industries according to his argument. How should this be handled? Aoki says:

> The combined effect of such factors as the bounded rationality of individuals, evolutionary pressures, and institutional complementarity is a tendency for a more or less homogeneous orga nizational

> convention to be adopted throughout a particular economy. However, different organizational conventions will evolve in different nations. This is an unintended outcome of the workings of bounded rationality. This chapter has made it clear that the potential gains from organizational diversity cannot be fully realized on a global scale merely through free trade. This is a proposition that stands even if we assume a purely theoretical situation in which all resources can be traded and there are no costs involved in transportation, storage, etc. If we acknowledge the existence of resources or services that cannot be traded, the proposition gains even more credence. …the world can enjoy the gains of trade by first converting these factors of production into outputs that can be traded. What has been emphasized here, however, is that a world comprised of boundedly rational individuals can reap economic gains because of the diversity of "organizational modes," a human construct. Theoretically, these could have been constructed by human intent anywhere, at any time. (Aoki 2000 pp.131-32)

Establishing a new organizational mode different from the prevailing convention is not so simple regardless of whether it is a creative innovation or a transplant from outside. The skill types needed to sustain a new organizational mode may not be readily available in the economy, and the institutional structure supporting the existing organizational mode may not be conducive to experimentation with mutant modes. Aoki says this places an exceptionally heavy burden on the Japanese economy, where bureau pluralism has been implemented, because tall barriers have been constructed to obstruct new entrants. By contrast, economies that have a regulatory stance are to allow free entry into industries, such as under the Anglo-American system, having institutional structures that are more tolerant of experimentation with mutant organizational modes.

Section 1.4 Diversity and Mobility of Human Resource Networking

1.41 Accelerated Catch-up for ICs

In 1999, in terms of the total shipment of ICs, Taiwan was ranked as #3, just behind the US and Japan (ERSO, 2000 pp.12-34). In less than 20 years, Taiwan producers not only

greatly increased their production capacities and market shares in the IC industry, but also, more impressively, improved their R&D capabilities. In 1983, Korea and Taiwan were granted no IC-related patents in the US, whereas Germany received 110 patents. In 1997, 14 years later, Korea and Taiwan were granted 386 and267 IC-related patents in the US, respectively, whereas Germany was granted only 155 such patents (Chang, 1999 pp.35-55). Thanks to this explosive growth in IC-related patents, in 1999, Samsung Electronics was ranked as the #4 company in terms of the total number of patents granted in the US in all technology classes. In the same year, fabless design houses in Taiwan were rated as #2 in the world, just behind the US, capturing 20% of world market shares measured in terms of revenues in the chip design area; these design houses also began to produce a substantial number of patents (ERSO, 2000 pp.28-36). These statistics clearly suggest that Korea and Taiwan caught up with Germany, the UK, and France in the global IC industry, in terms of both market shares and patent numbers. In selected areas, the two countries are also threatening the leadership of the US and Japan.

How did Taiwanese IC firms acquire and develop technologies in such a rapid technological catch-up process? Almeida (1996 pp.155-161) shows that part of their learning behavior can be attributed to the activities of their subsidiaries in the US, which source technology locally. But there is also evidence to suggest that the inter-country exchange of experts has played a crucial role. In its extensive analysis of the "Asian miracle," the World Bank (1993 pp.13-34) emphasizes that the return of foreign-educated nationals has provided considerable transfer of best practices and state-of-the-art knowledge. Recent case studies (Hou & Gee 1993 pp.384-401; Kim 1997 pp.86-99; Cho,Kim,Rhee 1998 pp.489-501) also provide evidence of the importance of human-embodied technology transfer in the time compressed learning processes of Taiwanese firms in the IC and computer industry. Based in part on such evidence, the recent World Development Report on knowledge and economic development (World Bank 1998 pp.22-65) identifies the international movement of people as one of four

principal channels for acquiring imported knowledge (along with trade, foreign direct investment, and technology licensing). Human exchange within or across firms has played a very important role in transferring knowledge or knowledge-building capabilities (Ettlie 1980 pp.1055-65; Leonard-Barton 1995 pp.99-156; Chesbrough 1999 pp.465-79).

In his pioneering work on the sociology of inventions, Gilfilian (1935 pp.1-21) suggested that labor exchange, especially among engineers, erodes the differential level of knowledge among firms. However, in spite of voluminous literature on the international transfer of technology, the impact of inter-firm human exchange on the cross-border knowledge acquisition and building process has received surprisingly little formal attention or rigorous analysis (Ettlie 1985 pp.1062-71). If we focus on the technological catching-up case of Taiwanese computer and IC firms and examine the role of human-embodied technology transfer across national borders in the acquisition and building of knowledge then we can see why Taiwan was successful in alliances with Japanese companies. Based on field interviews conducted in Taiwan and a review of relevant literature, we can further investigate the role of engineer exchange in the rapid technological catching-up process of Taiwanese computer and IC firms.

1.42 Theory and Propositions

Nature of Knowledge, Absorptive Capacity, and Learning-by-Hiring the knowledge needed for innovation may be obtained from a variety of sources. Although a firm itself is the source of much of the knowledge used in innovation, few firms possess all the inputs required for successful and continuous technological development. Firms often have to turn to external sources to fulfill their informational requirements. In fact, a major contribution to a firm's knowledge base is likely to come from outside sources. Allen and Cohen (1969 pp.12-20), in a study of 17 R&D laboratories, found that vendors, "unpaid outside consultants," and informal contacts with government bodies and universities are important sources of information used in research. In a study of major product and process innovations at Du Pont between 1920 and

1950, Mueller (1966 pp.95-134) observed that the original sources of most basic inventions came from outside the firm. Suppliers, buyers, universities, consultants, government agencies, and competitors all serve as sources of vital knowledge and expertise (Jewkes, Sawyers, and Stillerman, 1958 pp.1-23).

For firms or nations that lag others technologically, the challenge for technological catching-up is to acquire and build upon external knowledge that often resides in foreign countries or in their firms and institutions. The extent to which followers can acquire external knowledge is determined in part by the nature of knowledge (Zander and Kogut 1995 pp.76-92) and by the follower's absorptive capacities (Cohen and Levinthal, 1990 pp.135-52). State-of-the-art technologies, or the most valuable parts of knowledge, are often tacit (Winter, 1987). As we move further into the tacit domain, knowledge becomes increasingly difficult to separate from those who possess it.

At low levels of codification, knowledge transfer requires rich mechanisms of communication to facilitate its transfer. One such mechanism is the transfer of people (Leonard-Barton 1995 pp.9-48). Tacit knowledge can be acquired only through experience or learning-by-doing and thus can be transferred best through training and human transfer. The tacitness of knowledge often increases its value to the firm possessing it. A firm that holds a state-of-the-art technology is often reluctant to voluntarily transfer that technology, given that it can provide an important source of competitive advantage (since it is hard to imitate). Additionally, tacit knowledge may be embedded in the firm, making it difficult for other firms to imitate it or appropriate the rents from it. Thus, the tacitness of knowledge often leads to reluctance and inability on the part of technology holders to transfer their knowledge to other firms (Kogut and Zander 1996 pp.502-518). Even if technology holders are willing to transfer state-of-the-art knowledge to followers, the knowledge is often embedded in individuals, thus requiring the costly transfer of key personnel.

Organizational boundaries serve as knowledge envelopes and valuable knowledge is much more likely to be diffused within an organization than outside of it (Zucker, Darby, Brewer, and Peng, 1996 pp.90-113). The sticky nature of tacit knowledge means, of course that it does not necessarily flow easily or quickly even within a firm (Szulanski 1996 pp.27-43). Due to the limited speed and scope of diffusion across firm boundaries, it is difficult for outsiders to get access to and master such tacit and complex knowledge. As shown by Zander and Kogut (1995 pp.76-92) multinational firms are superior to alliances or markets as conduits of knowledge transfer and building, especially when the knowledge is tacit. Identifying, acquiring, and assimilating valuable external knowledge, especially tacit knowledge, requires a firm to possess a considerable level of absorptive capacity (Cohen & Levinthal 1990 pp.128-152). Cumulative experience with a technology often determines the absorptive capacity of the recipient in acquiring such tacit knowledge. Therefore, absorptive capacity varies considerably according to the prior knowledge base and cumulative investment in learning capabilities. Firms seek to acquire knowledge from outside when there is a considerable knowledge gap with industry leaders. Paradoxically, firms that developed some cumulative experience and a knowledge base are better positioned to acquire target technologies (Leonard-Barton, 1995 pp.).

Section 1.5 Case Study -- Integrated Silicone Solutions Networks in Silicon Valley: the Global Diversity of Human Resources

In 1996, 82 companies in the Hsinchu Science Park (or 40 percent of the total) were started by returnees from the United States, primarily from Silicon Valley, and there were some 2,563 returnees working in the park alone. Many other returnees work in IT businesses located closer to Taipei. (Hshinchu Science Park Statistical Record, 1998 pp.6-8)

In the 1960s and 1970s, the relationship between Taiwan and the United States was a textbook First-Third-World relationship. American businesses invested in Taiwan primarily to

take advantage of its low-wage manufacturing labor. Meanwhile, Taiwan's best and the brightest engineering students came to the United States for graduate education and created a classic "brain drain" when they chose to stay to pursue professional opportunities here. Many ended up in Silicon Valley.

This relationship has changed remarkably during the past decade. By the late 1980s, engineers began returning to Taiwan in large numbers, drawn by active government incentives of the "diversity strategy" and the chances created by rapid economic development. At the same time, a growing cohort of highly mobile engineers began to work in both the United States and Taiwan, commuting across the Pacific regularly. Typically Taiwan-born, U.S.-educated engineers, these jet setters have the global competency and language skills to function fluently in both the Silicon Valley and Taiwanese business cultures and to take advantage of the complementary strengths of the two regional economies. In fact, part of Taiwan's industrial strategy is based on alliances with foreign companies rather than confrontation in an attempt to maximize the complementarity between two regions rather than trying to be a carbon copy (see Aoki 2000 pp.129-135).

K. Y. Han is a typical case. After graduating from National Taiwan University in the 1970s, Han completed a master's degree in solid-state physics at the University of California at Santa Barbara. Like many Taiwanese engineers, Han was drawn to Silicon Valley in the early 1980s and worked for nearly a decade at a series of local IC companies before joining his college classmate and friend, Jimmy Lee, to start Integrated Silicon Solutions, Inc. (ISSI). After fronting the initial start-up with their own funds and those of other Taiwanese colleagues, they raised more than $9 million in venture capital. Their lack of managerial experience meant that Lee and Han were unable to raise funds from Silicon Valley's mainstream venture capital community. The early rounds of funding were thus exclusively from Asian sources, including the Walden International Investment Group, a San Francisco-based venture fund that

specializes in Asian investments, as well as from large industrial conglomerates based in Singapore and Taiwan.

Han and Lee mobilized their professional and personal networks in both Taiwan and the United States to expand ISSI. They recruited engineers (many of whom were Chinese) in their Silicon Valley headquarters to focus on R&D, product design, development, and sales of their high-speed static random access memory chips (SRAMs). They targeted their products at the personal computer market, and many of their initial customers were Taiwanese motherboard producers, which allowed them to grow very rapidly in the first several years. And, with the assistance of the Taiwanese government, they established manufacturing partnerships with Taiwan's state-of-the-art IC foundries and incorporated in the Hsinchu Science-Based Industrial Park to oversee assembly, packaging, and testing.

By 1995, when ISSI was listed on NASDAQ, Han was visiting Taiwan at least monthly to monitor the firm's manufacturing operations and to work with newly formed subsidiaries in Hong Kong and Mainland China. Finally, he joined thousands of other Silicon Valley "returnees" and moved his family back to Taiwan. This allowed Han to strengthen the already close relationship with their main foundry, the Taiwan IC Manufacturing Corporation, as well as to coordinate the logistics and production control process on a daily basis. The presence of a senior manager like Han also turned out to be an advantage for developing local customers. Han still spends an hour each day on the phone with Jimmy Lee and he returns to Silicon Valley as often as ten times a year. Today ISSI has $110 million in sales and 500 employees worldwide, including 350 in Silicon Valley.

A closely-knit community of Taiwanese returnees, astronauts, and U.S.-based engineers and entrepreneurs like Jimmy Lee and K. Y. Han has become the bridge between Silicon Valley and Hsinchu. These social ties, which often build on pre-existing alumni

relationships among graduates of Taiwan's elite engineering universities, were institutionalized in 1989 with the formation of the Monte Jade Science and Technology Association. Monte Jade's goal is the promotion of business cooperation, investment, and technology transfer between Chinese engineers in the Bay Area and Taiwan. Although the organization remains private, it works closely with local representatives of the Taiwanese government to encourage mutually beneficial investments and business collaborations. Like Silicon Valley's other ethnic associations, Monte Jade's social activities are often as important as its professional activities. In spite of the fact that the organization's official language is Mandarin (Chinese), the annual conference typically draws over 1,000 attendees for a day of technical and business analysis as well as a gala banquet. This transnational community has accelerated the upgrading of Taiwan's technological infrastructure by transferring technical know-how and organizational models as well as by forging closer ties with Silicon Valley. Observers note, for example, that management practices in Hsinchu companies are more like those of Silicon Valley than of the traditional family-firm model that dominates older industries in Taiwan. As a result, Taiwan is now the world's largest producer of notebook computers and a range of related PC components including motherboards, monitors, scanners, power supplies, and keyboards. In addition, Taiwan's IT and integrated circuit manufacturing capabilities are now on a par with the leading Japanese and U.S. producers; and its flexible, efficient and diverse networks of specialized small and medium-sized enterprises coordinate the diverse components of this sophisticated infrastructure.

Taiwan has also become an important source of capital for Silicon Valley start-ups—particularly those started by immigrant entrepreneurs who historically lacked contacts in the mainstream venture capital community. It is impossible to accurately estimate the total flow of capital from Taiwan to Silicon Valley because so much of it is invested informally by individual angel investors, but there is no doubt that it increased dramatically in the 1990s. Formal investments from Asia (not including Japan) were more than $500 million in

1997. This includes investments by funds based in Taiwan, Hong Kong, and Singapore as well as U.S.-based venture groups such as Walden International and Advent International that raise capital primarily from Asian sources. These investors often provide more than capital. According to Ken Tai, a founder of Acer and now head of venture fund, InveStar Capital: "When we invest we are also helping bring entrepreneurs back to Taiwan. It is relationship building . . . we help them get high level introductions to foundries (for manufacturing) and we help establish strategic opportunities and relationships with customers" (2001-7-12 interview in Taipei)

The growing integration of the technological communities of Silicon Valley and Hsinchu offers substantial benefits to both economies. Silicon Valley remains the center of new product definition and design and development of leading-edge technologies, whereas Taiwan offers world-class manufacturing, flexible development and integration, and access to key customers and markets in China and Southeast Asia. This appears a classic case of the economic benefits of comparative advantage. However, these economic gains from specialization and trade would not be possible without the underlying social structures and institutions provided by the community of Taiwanese engineers, which insures continuous flows of information between the two regions. Some say that Taiwan is like an extension of Silicon Valley, or that there is a "very small world" between Silicon Valley and Taiwan.

The reciprocal and decentralized nature of these relationships is distinctive. The ties between Japan and the United States in the 1980s were typically arm's-length, and technology transfers between large firms were managed from the top down. In Japan there was little or no government or private strategies set up to promote human resource diversity (see Part IV). The Silicon Valley-Hsinchu relationship, by contrast, consists of formal and informal collaborations between individual investors and entrepreneurs, small and medium-sized firms, as well as divisions of larger companies located on both sides of the Pacific. This has only been

possible because of the big push for diversity of human resources in Taiwan by both the state institutions and society. In this complex mix, the diverse social and professional ties among Taiwanese engineers and their U.S. counterparts are as important as the more formal corporate alliances and partnerships because they facilitate tacit knowledge transfer. As mentioned above, the sticky nature of tacit knowledge means, of course that it does not necessarily flow easily or quickly even within a firm (Szulanski 1996 pp.27-43). Due to the limited speed and scope of diffusion across firm boundaries, it is difficult for outsiders to get access to and master such tacit and complex knowledge unless a very intense program of human resource mobility is created.

At the same time that Silicon Valley's immigrant entrepreneurs organized local professional networks, they were also building ties back to their home countries. The region's Chinese engineers constructed a vibrant two-way bridge connecting the technology know how in Silicon Valley and Taiwan; their Indian counterparts became key middlemen linking U.S. businesses to low-cost software expertise in India. These cross-Pacific networks represent more than an additional "ethnic human resource" that supports entrepreneurial success; rather, they provide the region's skilled immigrants with an important advantage over their mainstream competitors who often lack the language skills, cultural competency and contacts to build business relationships in Asia.

The traditional image of the immigrant economy is the isolated Chinatown or "ethnic enclave" with limited ties to the outside economy. Silicon Valley's new immigrant entrepreneurs, by contrast, are increasingly building professional and social networks that span national boundaries and facilitate flows of capital, skill, and technology. In so doing, they are creating transnational communities that provide the shared information, contacts, and trust that allow local producers to participate in an increasingly global economy.

As recently as the 1970s, only very large corporations had the resources and capabilities to grow internationally, and they did so primarily by establishing marketing offices or branch plants overseas. Today, by contrast, new transportation and communications technologies allow even the smallest firms to build partnerships with foreign producers to tap overseas expertise, cost-savings, and markets. Start-ups in Silicon Valley today are often global actors from the day they begin operations: Many raise capital from Asian sources, others subcontract manufacturing to Taiwan or rely on software development in India, and virtually all sell their products in Asian markets.

The scarce resource in this new environment is the ability to transfer highly sophisticated knowledge quickly and to manage complex business relationships across cultural and linguistic boundaries. This is particularly a challenge in high-technology industries in which products, markets, and technologies are continually being redefined—and where product cycles are routinely shorter than nine months. First-generation immigrants like the Chinese and Indian engineers of Silicon Valley, who have the language and cultural as well as the technical skills to function well in both the United States and foreign markets are distinctly positioned to play a central role in this environment. They are creating social structures that enable even the smallest producers to locate and maintain mutually beneficial collaborations across long distances and that facilitate access to Asian sources of capital, manufacturing capabilities, skills, and markets.

These ties have measurable economic benefits. Researchers at the University of California at Berkeley have documented a considerable correlation between the presence of first-generation immigrants from a given country and exports from California. (For every 1 percent increase in the number of first-generation immigrants from a given country, exports from California go up nearly 0.5 percent.) Moreover, this effect is especially pronounced in the Asia-Pacific region where, all other things being equal, California exports nearly four times

more than it exports to comparable countries in other parts of the world.

The region's Taiwanese engineers have forged close social and economic ties to their counterparts in the Hsinchu region of Taiwan—the area, comparable in size to Silicon Valley that extends from Taipei to the Hsinchu Science-Based Industrial Park. They have created a diverse fabric of professional and business relationships that supports a two-way process of reciprocal industrial knowledge transfer. Silicon Valley's Indian engineers, by contrast, play a more arm's-length role as middlemen linking U.S.-based companies with low-cost software expertise in localities like Bangalore and Hyderabad. In both cases, the transnational engineers provide the critical contacts, information, and cultural know-how that link dynamic—but distant—regions in the global economy.

Conclusion Part I: Comparative Institutional Analysis as a Diversity Strategy

The following 2 points (1-a and 1-b) were addressed in Part I and served to support the overall thesis of this dissertation. Point 1-a. Evolution of Development Theories. Part I concludes that in contrast to Taiwan, the state in Japan and Korea has played a largely different role. In particular, the role of the state in the Japanese accelerated industrial catch up strategy for information technology (IT) hardware has changed remarkably over time, and so did the state-society and state-business relations. Part I went into detail about the historical background which led to development paths that appear similar between Japan and Taiwan but are actually quite different in both practice and results.

Though my conclusion on the role of the Taiwanese state in promoting the IC industry is the same as that of the developmental statist argument on the Taiwanese political economy (Amsden 1979, 1985; Wade 1990a, 1990b), the approach used here differs from the developmental statist argument. In contrast to the existing statist explanations, most of which emphasize economic backwardness as the source of state dominance over the market, this study analyzed a broader institutional relationship between the state and society which have

been historically contingent. The unique institutions in state-society relations in regard to the development of the IC industry include not only state structures and actions but also the relationship between different state agents and agencies, the academic community, foreign advisors, and the small and medium-size business structure, all of which affect the interaction between the state and the private sector in a predictable direction, that is, the dominant and pervasive role of the state. The high-tech circle and agencies within the Taiwanese state have played such pivotal roles, not because of the ahistorically strong and autonomous state in backward economies but because of the institutional strength of the high-tech related agents and/or agencies as well as the unique state-society relations which hinder the penetration of parochial interests into the IC policy-making process." Thus the extraordinarily dominant and pivotal roles played by the Taiwanese state must be understood from a broader perspective focusing on the interplay between the state, NPOs, business and society under particular historical and structural constraints, that is, comparative institutional analysis approach to state-society relations, rather than from a narrow statist perspective.

In terms of business structure, Taiwan and Japan differ dramatically from each other despite many structural similarities shown in their developmental trajectories. The Taiwanese economy has been composed of mostly small and medium-size OEM enterprises while a few conglomerate types of business, known as Zaibatsu, have dominated the Japanese economy. Though this was a direct outcome of adopting different policies toward capital concentration by each government, Taiwan and Japan have had different structural conditions that affected why each state had to adopt the policies as such. The IT hardware industry reflects similar degrees of capital concentration though the IT hardware industry in Taiwan has been a little more concentrated than other industrial sectors.

Point 1-b. The Comparative Institutional Approach: Why are "bounded rationality" methodologies, such as CIA and game theory more useful than conventional "rational expectations" economic models in analyzing economic development and transition economies?

Concerning bounded rationality, Aoki argues that, from the perspective of information processing, there is potential for the economy to continue to demonstrate efficiency in industries that can be characterized as high engineering industries. He also points out that a fairly high possibility that new innovations will be implemented domestically in cross-industrial technologies, such as formation technology driven electronic machinery, retail and service sector networking, and environmental management technologies. Aoki writes:

> The combined effect of such factors as the bounded rationality of individuals, evolutionary pressures, and institutional complementarity is a tendency for a more or less homogeneous organizational convention to be adopted throughout a particular economy. However, different organizational conventions will evolve in different nations. This is an unintended outcome of the workings of bounded rationality. This chapter has made it clear that the potential gains from organizational diversity cannot be fully realized on a global scale merely through free trade. This is a proposition that stands even if we assume a purely theoretical situation in which all resources can be traded and there are no costs involved in transportation, storage, etc. If we acknowledge the existence of resources or services that cannot be traded, the proposition gains even more credence. (Aoki 2000 pp.131-32)

Establishing a new organizational mode different from the prevailing convention is not so simple regardless of whether it is a creative innovation or a transplant from outside. The skill types needed to sustain a new organizational mode may not be readily available in the economy, and the institutional structure supporting the existing organizational mode may not be conducive to experimentation with mutant modes. Aoki says this places an exceptionally heavy burden on the Japanese economy, where bureau pluralism has been implemented, because tall barriers have been constructed to obstruct new entrants. By contrast, economies that have a regulatory stance are to allow free entry into industries, such as under the Anglo-American system, having institutional structures that are more tolerant of experimentation with mutant organizational modes.

Part II. Political Intervention: Analysis of Organizational Strategies for State Institutions Related to IT

Introduction to Part II

Through a sketch of its developmental history for Taiwan and Japan, it is discussed how the unique state-society relations and organizational strategies in Taiwan and Japan affected the formation of formal and informal institutions concerning the development of the IT hardware industry in which the state and societal actors interact with each other. It will be argued that the Taiwanese state has played so dominant and pervasive role not because of the strong and autonomous state that was envisioned by the early statist literature, but because of the institutional strategies and state-society-business relations that are unique to the political economy of the accelerated industrial catch up strategy for IT in Taiwan. This section shows that although Taiwan's state literally built the whole IT sector in the beginning, it also built an enhanced version of a highly diverse free market "rules of the game" which unlike Japan and South Korea, did not grant special privileges to certain large firms but rather built a transparent and level playing field embracing both small and large enterprises. Taiwan also avoided bureau pluralism by embracing an open pluralism institutional strategy that involved the privatization of government think tanks and the spinning off of almost all state research programs into the private sector in order to create the fullest possible diversity of human resources.

This part analyzes the state strategies of Taiwan's industrial catch-up for IT and ICs[26]. Prior to 1974, Taiwan had virtually no IC industry at all. During the next two decades, however, Taiwan did accomplish the world's fastest rate of progress in developing the IC industry, as well as other high-tech industries including the computer and its peripheral industries. By 1993, Taiwan boasted of having 64 design houses, 2 mask-making companies, 10 wafer fabricating manufacturers, 19 packaging companies, and numerous firms in computer and other high-tech

sectors. These firms possessed technological sophistication as well. Taiwan's IC manufacturers own about 0.6 micron level of Complementary Metal Oxide IC (CMOS) technology with the emphasis of various consumer ICs, communication ICs, computer peripherals, and ASIC products.[27] Taiwan has also produced memory chips in recent years including 16M DRAM and 64M DRAM, and plans to build up 128M-DRAM and 256M-DRAM production lines this year. During 1989-93, Taiwan's IC industry recorded an approximate 38.8 per cent growth rate per annum, and as a result, Taiwan's IC production reached NT$ 37.9 billion that was equivalent to about $1.43 billion. How could Taiwan accomplish such development in such a short period of time? What were the determining factors that enabled Taiwan to make such an impressive progress? Who were the responsible players in this dramatic ball game? How were the government's choices of action (that is, policies to promote the IC industry) made under what domestic and international contexts? And what were the effects of the government's promotion policies upon the behavior of private firms and other related actors?

For Point 2 we ask: Japan and Taiwan both experienced strong political intervention into the IT hardware industry however the end result was far different in each case why? Part II examines the history of these interventions and answers this question. These are the questions to be analyzed in this part.

Based upon the theoretical considerations discussed so far, let us examine the political economy of accelerated industrial catch up strategy for IT hardware in Taiwan and Japan in greater detail. Major analytic attention will be paid to how particular institutional arrangements in the state and state-society relations have been evolved throughout the whole period of the accelerated industrial catch up strategy for IT hardware in each country and therefore had a profound impact on the resulting organizational strategies. After explaining the different methods that each country used to accomplish the same policy goals, that is, developing the domestic IC industry, Taiwan and Japan will be compared in order to provide a complete explanation about how and why these countries took different paths for the same

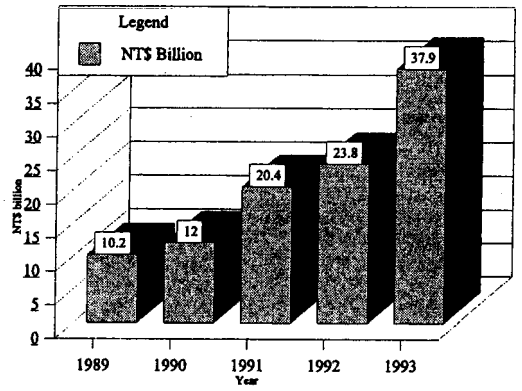
policy goals despite their historical and structural similarities seen in the course of economic development.

Section 2.1 Institutional History of Taiwan's New Paradigm for Rapid IT Development

2.11 Taiwan Makes Some Big Moves

As discussed above, there are two major theoretical paradigms in explaining East Asian economic growth: the neo-classical explanation (anti-statist) which argues for the market-led growth[28] and the developmental statist argument which puts much greater emphasis on the effective state intervention into the market[29] Because industrial policy itself presupposes active state intervention into the market, the statist arguments on Taiwan's economic development and their implications for the industrial catch-up for ICs will be analyzed in a greater detail.

Table 2.01 Growth of Taiwan's IC Industry, 1989-93



Source: ITIS (1994), pp. iii-4.

According to the statist paradigm, the Taiwanese state has been viewed as a typical case of the capitalist developmental state. At the center of the Taiwanese developmental state

are the Central Standing Committee of the KMT (Kuomintang), the Council for Economic Planning and Development (CEPD), and the Ministry of Economic Affairs (MoEA), which have played major roles in the postwar economic management. The KMT exercises a wide range of influence over the national economy through high-ranking party officials, the state bureaucracy, and public firms.[30] The CEPD and the MoEA in a combined form have played the role of the Japanese MITI by providing long-term plans and by implementing industrial policies. The Central Standing Committee of the KMT reviews and endorses virtually all-important policies of their concern.

It has been argued that the economic bureaucrat in Taiwan has played a somewhat different role compared with the Korean or the Japanese counterparts. That is, the Taiwanese state has been less biased in being intrusive than the Japanese or Korean state in the process of development; meaning that the former has exercised discretionary control of structural incentives to supplement market signals, while the latter has exercised detailed control over the industrial transformation (Chu 1987 pp.28-30; Wade 1990b p.257). This has been the case because the state's primary concern in Taiwan has been on "the relatively large-scale firms of the upstream industries, leaving the downstream smaller-scale firms much freer" (Wade 1990a p.73).

In the process of industrial catch-up for ICs, however, it is the Taiwanese state that has been much more intrusive but only in an impartial way. In fact, the Taiwanese state actually created the whole industry. As will be shown in this part, the impressive IC industry in Taiwan would not be possible in the first place, had it not been for the state. The state, however, could play such a dominant and pervasive role not because of its ahistorical strength and autonomy but because of the institutional arrangements and strategies that have been historically formulated throughout the whole period of the industrial catch-up for ICs. Therefore, it is through this analytical framework that we discover why the Win-Win OEM

strategy (**苗豐強** 1997 pp.86-112) could be formulated and carried out. This research will examine the evolution of institutions that affect the behavior and interplay of the contending actors from the state and society in the development of the IC industry in Taiwan. This in turn will give us insight into how this situation was conducive to the implementation of a whole new paradigm for organizational strategies such as the triangle method and the vertical division of labor OEM strategy that would eventually bring success.

In what follows, I will briefly sketch the distinctive developmental phases of Taiwan's IC industry with a special focus on the interactions between the policy-making elites and other relevant players in the state and society. These interactions are analyzed within the context of the broader S&T policy-making system because IC policies are largely viewed as a part of the S&T policies in Taiwan.

2.12 Stage 1: Start of IC Assembly (1965-73)

Taiwan's efforts for developing the domestic IC industry began in 1974 when the world economy went into a big trouble. Since then, the developmental process of Taiwan's IC industry can be divided into four different phases according to major projects and achievements. They are:

1) The creation of the Industrial Technology Research Institute (ITRI) and the Electronic Research Service Organization (ERSO) under the MoEA (1974-78);

2) The creation of the United Microelectronics Company (UMC), the Science and Technology Advisory Group (STAG), and the Hsinchu Science-Based Industrial Park (HSIP) (1979-83);

3) The adoption of the Very Large Scale Integrated circuit (VLSI) project and the formation of the Taiwanese IC Manufacturing Company (TSMC) (1984-89); and

4) The adoption of the sub micron project and the growth of private firms (1990-present). [31] In order to understand the particular timing when Taiwan's first IC project was launched, however, one has to look at the inception of the IC assembly and packaging industry into

Taiwan and the international economic condition in which the Taiwanese economy was located at the time when its first IC project was launched.

The assembly of IC devices for foreign firms began in Taiwan around the middle of the 1960s when American IC firms looked for overseas production. At that time, the average wage level in the US was much higher than any other countries in the world. This became an important constraint to American manufacturing industries, and many US firms decided to go abroad in order to maintain their competitiveness in world markets. IC production has at least four distinctive steps: R&D investment for designing new devices, chip fabrication, chip assembly and packaging, and testing of the finished devices. Among these steps, the assembly and packaging of the silicon chips is highly labor intensive. Due to the labor-intensive nature of its assembly and packaging processes, the IC industry was the first US industry to go abroad on a large scale (Grunwald and Flamm 1985 pp.61-129).

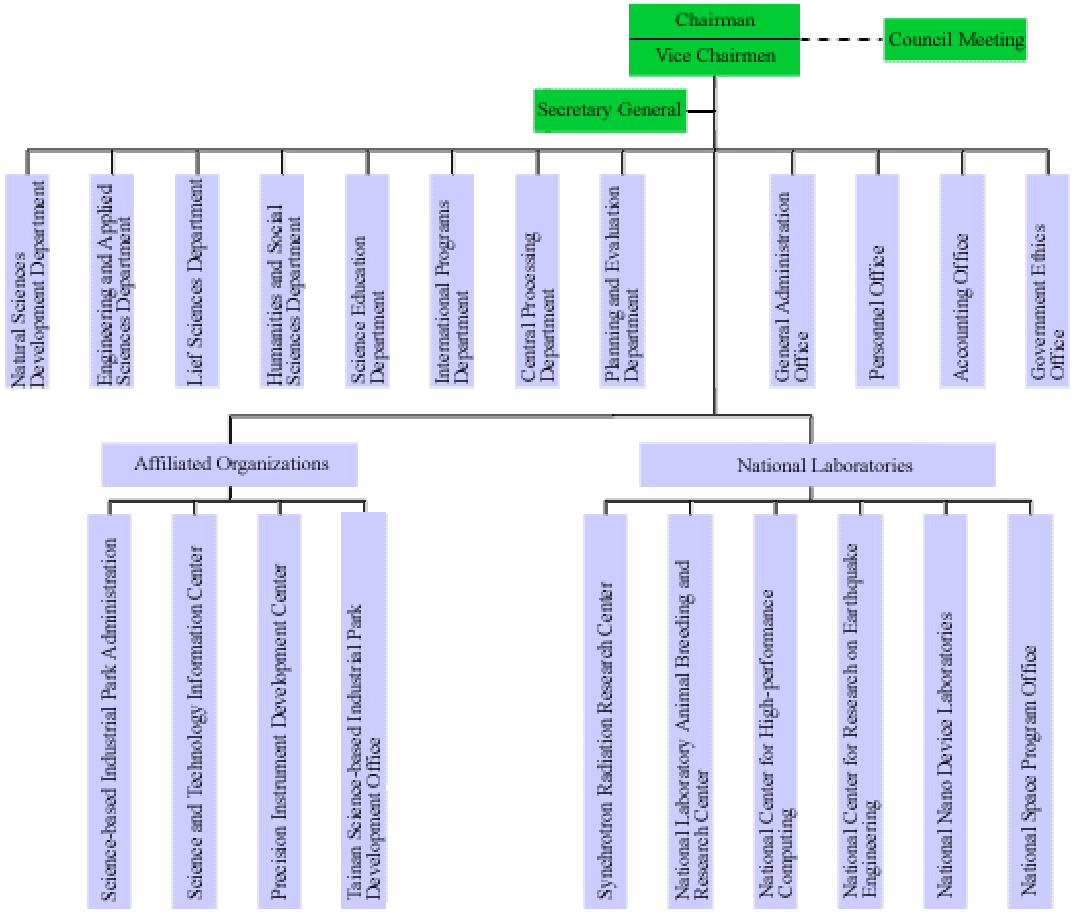
At first US firms established overseas production facilities mainly in Hong Kong. However the wage level in Hong Kong grew much faster than that of other Asian countries in the middle of the 1960s. The American IC producers picked up Taiwan and South Korea as alternative places for overseas production due to the low wage levels with relatively high labor productivity and the labor peace guaranteed by the repressive authoritarian regimes. The Taiwanese government quickly responded to this move by establishing Export Processing Zones (EPZ), and as a result, several US IC firms entered into Taiwan. The effects of the assembly and packaging of ICs upon the host countries were at best mixed. Overseas production strategy by the MNCs left positive impacts on the host countries in terms of employment and the balance of payment because most of the overseas production was imported by the parent firms (Grunwald and Flamm 1985 pp.109-18).[32] But the effect on technology transfer was not so impressive mainly because the assembly and packaging does not require any sophisticated manufacturing technologies. Although some independent subcontracting firms for the assembly and packaging

of IC devices appeared by the early 1970s, there were no direct forward and/or backward linkages between the assembly industry and the IC fabrication in later years.

In the early 1970s, the world economy went into a serious recession, and so did Taiwan, which had relied heavily upon exports. More than twenty years of the Pax Americana, the heyday of a liberal economic order, officially collapsed with the fall of the Bretton Woods System in 1971. Oil prices had skyrocketed as a result of the first Oil Shock in the fall of 1973. To make things worse, most advanced industrial countries began to suffer from high inflation rates with high unemployment rates, that is, stagflation. In the midst of these economic difficulties, Taiwan's major export items such as textiles and footwear began to lose international competitiveness due to the emerging competition from the less developed countries as well as due to the neo-protectionist policy measures adopted by the advanced industrial countries. It was in the middle of this economic recession that some Taiwanese high-ranking public officials began to think about industrial upgrading, and in the IT hardware industry, ICs as a part of it, was selected as one of the strategic sectors to be promoted for the future industrial adjustment.

The National Science Council（NSC is the department of the Republic of China (ROC) executive branch that responsible for the promotion of development in science and technology. A Chairman, who is supported by three Vice Chairmen, heads the NSC. There are eight departments and four offices within the NSC. In addition, there are four affiliated organizations and six national research laboratories under the NSC. (NSC Database, 2001).

Table 2.02 Taiwan's National Science Council.

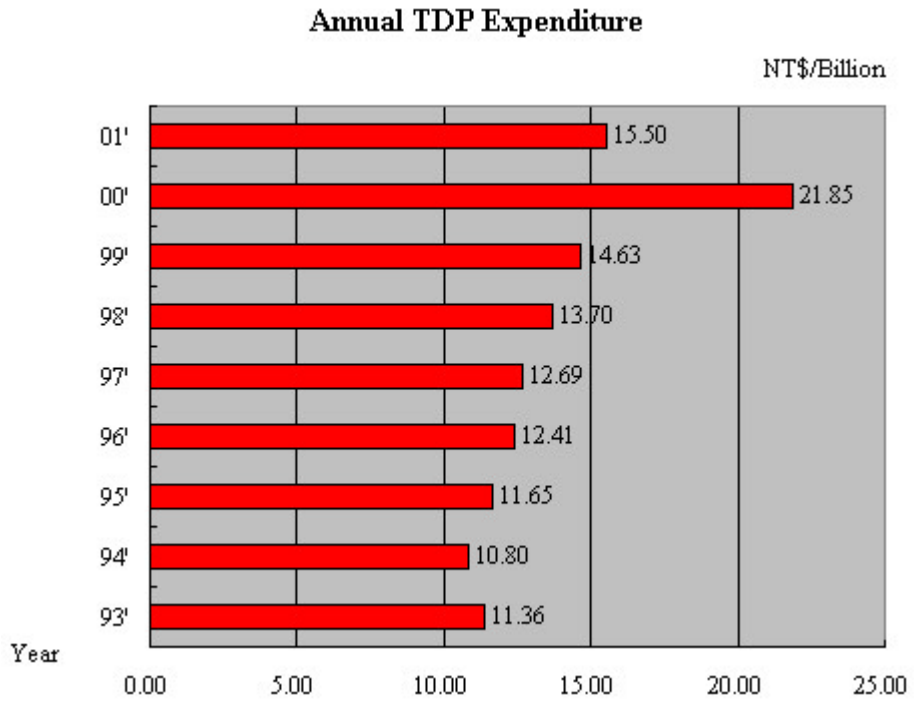


Source: (ROC Statistical Database 2001 pp.72-79)

Table 2.03 Expenditure for Research by the Science Council.(Unit: 100 million TWD)

Year	93'	94'	95'	96'	97'	98'	99'	00'	01'
Expenditure	113.58	108.07	116.46	124.14	126.89	136.99	146.24	218.53	155.08

Note: Year2000 refers to a period of July 1999-December 2000(18 months).



Source: (ROC Statistical Database 2001 pp.67-72)

Table 2.04 TDP Performance

TDP Performance and Benefit			
Item Year	1998	1999	2000
R.O.C. Patent Awards(cases)	262	244	499
Overseas Patent Awards(cases)	222	300	476
Patent Applications(cases)	147	335	212
R.O.C. Technology Theses(papers)	1327	1240	1281
Overseas Technology Theses(papers)	303	266	440
Technology Reports(papers)	4685	4163	4942
Introduction Technology(cases)	49	53	135
Transfer Technology(cases)	1086	1041	1285
Project Subcontract(cases)	613	582	1013
Contracts and Industrial Services(cases)	9343	16641	13452
Enterprise Investments(cases)	637	509	610
Technical Conferences(numbers)	971	549	685

Note: Year2000 refers to a period of July 1999-December 2000(18 months).

Table 2.05 TDP Application in 2000.

TDP Benefit Application, Year 2000 NT$/Million

Year	97'	98'	99'	00'
Transfer Technology	434.6	408.1	408.6	851
Enterprise Investments	69178.5	95645.4	97604.7	54028.2

Note: Year2000 refers to a period of July 1999-December 2000(18 months).

Source: (ROC Statistical Database 2001 p.84)

2.13 Stage 2: Establishing UMC, STAG, & Hsinchu Science Based Industrial Park (1979-83)

By accomplishing the first phase successfully, Taiwan could develop some IC manufacturing technologies. Because both ITRI and ERSO were basically non-profit research

organizations, there should be someone else who would like to commercialize the technologies developed by ITRI/ERSO. Thus the next mission for the high-tech policy-makers in the Taiwanese government was to transfer these technologies from ERSO's laboratory to the private sector. In the late 1970s, however, no one in the private sector was willing to participate in the IC business because of the huge initial investments and uncertain profitability. There were only two choices left: establishing a new state-owned firm or creating a state-private joint venture.

The idea of creating a new public firm was quickly abandoned because Taiwan already had too many public firms. Minister Sun himself was also against the idea of forming a new joint venture (**楊文利** 1989 p.36), because one of the basic economic policy agendas adopted by the Taiwanese government since the mid 1960s was the active privatization of public firms. In 1960, For example, the public sector was responsible for about 48 per cent of national output. After 1965, however, the private share has increased dramatically. This change was incurred not only by the rapid growth of the private sector, but also by the state's effort for privatizing many public firms for the purpose of increasing productivity. The high-ranking government officials in Taiwan did not view thus forming a new public firm for the IC industry as a good alternative (**陳競玲** 1999 pp.55-67).

Mr. Chintay Shih, one of the 40 trainees at RCA, and Dr. Tinghua Hu, the head of ERSO, submitted a joint proposal to the MoEA for the creation of a state-private joint venture in 1978. The MoEA accepted the proposal and tried to mobilize private participation into the joint venture, later named the UMC. The MoEA including Sampo, Tatung, Tongyuan, and Yueloong invited several "big" companies, but none of them was willing to invest in the joint venture business. Because the state's share could not exceed 49 per cent in order to maintain the private status in a legal sense, the MoEA had to exercise its influence to have the private share of 51 per cent for the UMC project. The state share was invested by the Bank of

Communications (later the Bank of Export and Import), and the private share (51 per cent) was "distributed" to a number of local companies based upon their relative capabilities. Thus it is clear that the private share would not have been mobilized had it not been for the direct "influence" of the MoEA (**陳競玲** 1999 pp.67-72).

After a couple of years of struggling, UMC as a public private joint venture was formed in 1979 with the initial capital of $20 million. ERSO provided virtually everything needed for the formation of UMC including plants, equipment, technologies, and people for both engineering and marketing. In other words, UMC was spun off directly from ERSO. ERSO also provided short-term technical training for the new personnel recruited locally by the UMC. UMC as a business turned out to be very successful. It produced a variety of ICs for consumer applications such as toys, telephones, watches, calculators, and recently memory chips.

After UMC began its commercial production of IC devices, an inevitable conflict between ERSO and UMC took place because both produced the same products and used the same marketing channels. UMC people argued that ERSO should stop its wafer fabrication and marketing its wafers because ERSO was a research organization and therefore should not compete with the private producers such as UMC. In contrast, the top managers of ERSO, including Mr. Shih, argued that ERSO should remain in the market in order to continue R&D investments for further technological advance. ERSO's position was credited and the state continued its role as an enterprise through ERSO (**陳競玲** 1999 pp.73-78).

Another important development that occurred during this period was related to the organizational change in the Taiwanese government concerning the IC initiative. Dr. Yun-hsuan Sun, the Minister of Economic Affairs who played the role of the Godfather during the first phase and at the beginning of the second phase, got promoted to the position of the Premier of the Executive Yuan in 1979. From that time on, the IC project was no longer under

the direct personal control of Dr. Sun. In order to maintain his personal influence on the IC project, it was argued, Dr. Sun created a permanent advisory organization called the STAG directly under the Executive Yuan.[43] The STAG was located directly under the Office of the Premier, and Premier Sun asked his close friend, Dr. Kuo-ting Li, to be in charge.[44] The missions of the STAG were officially stated as follows:

> To accelerate the development of science and technology in the Republic of China, the Premier is entitled to invite eminent leaders in the field of science and technology from abroad and a Science & Technology Advisory Group (STAG) be established under the Executive Yuan to:
>
> 1) Provide recommendations for national policy-making related to the development of science and technology.
> 2) Comment on the contents of S&T Development Program and evaluate on the performance of its implementation.
> 3) Furnish recommendations and consultations on national science and technology development projects, especially in their respective fields of interest.
> 4) Collect and disseminate important information related to science and technology development.
> 5) Other matters as may be instructed by the Premier. (STAG 1990a pp.22-24)

As shown above, the STAG is not the organization solely devoted to the IC project. It was formed as a personal advisory group for the Premier in various S&T policy areas. The advisors in the STAG are all foreigners, and each member is a leading engineer or scholar in his/her own field. At the beginning, STAG members were recruited among the personal friends of Dr. Yun-hsuan Sun and Dr. Kuo-ting Li.[45] Dr. Bob O. Evans, a former vice-president for development at IBM, played a particularly important role in the subsequent IC projects by recommending aggressive direction for the IC industry in Taiwan such as the DRAM business

in the late 1980s. As will be shown later, the STAG has evolved as an important player in the policy-making process for S&T in general and ICs in particular.

Table 2.06 Occupancy of Hsinchu Science-Based Industrial Park, 1993

Types of Industry	# of Firms		(%) Percentage of Sales
Total	150	-100	100 ($4.9 billion)
ICs	43	-28.7	43.23
Computer/Peripherals	42	-28	41.94
Communications	25	-16.7	10.43
Opto-electronics	20	-13.3	2.76
Others	20	-13.3	1.64

Source: Revised from Science Park Administration (1994 p.15).

Another important development during this period was the creation of Hsinchu Science-Based Industrial Park (HSIP). The idea of creating an industrial park to promote the high-tech industries was conceived after 1969 by the NSC. It was said that Hsinchu was chosen primarily because of its having two of Taiwan's leading engineering universities, the National Chiaotung University and the National Chinghua University (Simon and Schive 1986 p.204). By and large, the HSIP represented Taiwan's major movement toward the high-tech industries.

The primary objectives of the HSIP were to create an infrastructure for the high-tech industries including R&D capabilities, and to attract as many Chinese graduates as possible who were educated abroad.[46] The government provided a variety of incentives to local as well

as joint venture high-tech firms coming into the HSIP. Some of those incentives included tax holidays for five years, duty-free imports for equipment, raw material and semi finished goods, exemption from commodity taxes on exports, low interest rate loans, and R&D matching funds.[47] As shown in Table 3.2, firms in the computer and the IC industries have the largest share in the HSIP, which reached 85 out of 150 companies (56.7 per cent) in 1993. By the mid 1990s all IC firms in Taiwan have their plants in the HSIP including several private companies such as Winbond, Hualong Microelectronics Corporation (HMC), Advanced Microelectronics Products Taiwan, Inc. (AMPi), and TI-Acer. Most of the design houses in Taiwan are also located in the HSIP. In short, by having proper ingredients for the development of the high-tech industries such as the supply of manpower by two major engineering universities, the customers including many computer manufacturers, the design houses which provide necessary designs for various ASIC products, and a IC foundry (TSMC), the HSIP became the center place of Taiwan's electronics industry in general and the IC industry in particular. The HSIP, For example, recorded $4.9 billion sales in 1993.

2.14 Stage 3 VLSI Project and the Creation of TSMC (1984-88)

In 1982 Dr. Bob O. Evans, a foreign advisor in the STAG, submitted a recommendation to Premier Sun and Dr. Kuo-ting Li, arguing for the adoption of the VLSI project which required a much bigger commitment of resources to accomplish. There were fierce debates between conservative economic bureaucrats and ambitious high-tech circles for about two years in which the latter eventually prevailed. In the meantime, Premier Sun had a stroke and was paralyzed in 1984. The direct personal control of Dr. Sun over the IC project had finally come to an end. Before his retirement, however, Premier Sun could ensure the adoption of the VLSI project.

Based upon the recommendation made by Dr. Bob Evans, the ERSO drew up a five-year plan for the development of VLSI technology with a total budget of $74 million in 1983.

This time, ERSO decided not to purchase the VLSI technologies directly from foreign IC giants, but signed a joint research contract with Vitelic, a small research-oriented company in Silicon Valley formed in 1983 by an overseas Chinese (Schive 1990 p.277). The joint research between Vitelic and ERSO was very successful by developing production technology for 1Meg DRAMs in June 1986. However, Vitelic decided to sell the 1Meg DRAM process technology developed in ERSO's lab to a Korean chipmaker because "neither the government nor private sector in Taiwan was willing to supply the necessary manufacturing facility for their advanced chip" (Meany 1990 p.11). This embarrassing situation seriously weakened the position of conservative economic bureaucrats. At the same time, it reinforced the position of high-tech people who argued for a more aggressive direction of Taiwan's IC project, that is, the entry into the DRAM business. Later this became an important factor when Taiwan entered the risky DRAM business after 1989 (**台湾区電機電子工業** 1998 pp.17-24).

After Dr. Sun's retirement, the question for his successor, Premier Kuo-hua Yu was not whether the VLSI project should be pursued but who should do it, either the state (ERSO) or the industry (UMC). It was said that Bob Evans played a major role for ERSO's position, and the state continued its role as an entrepreneur. UMC, the only private IC manufacturer in Taiwan at that time, followed ERSO's suit in developing VLSI design technologies by signing numerous research contracts with foreign firms as well as creating a subsidiary named the Unicorn Microelectronics Corporation in Silicon Valley.

By the end of 1986, Taiwan achieved much progress in developing VLSI design technologies. However Taiwan did not own manufacturing capability needed for the mass production of VLSI chips which required a huge investment. Due to the lack of mass production capability, many technologies developed by the small design houses (both local and joint ventures) in Taiwan were sold to foreign IC firms. To give some examples, Mosel sold its 16K SRAM technology to Fujitsu of Japan, 64K SRAM technology to Hyundai of Korea, and 256K

SRAM technologies to Sharp of Japan. Vitelic licensed its design technologies to various Japanese and Korean IC manufacturers, and it was reported that about half of Vitelic's revenue in 1987, which amounted to about $30 million, came from royalty payments (Schive 1990 p.278). Therefore having manufacturing capability for the production of VLSI chips became an acute concern to the Taiwanese policy-makers concerning the high-tech industries.

In the meantime, Bob Evans and Dr. Kuo-ting Li recruited Morris Chang as the head of ITRI. He had a joint appointment as the Chairman of UMC as well. In order to create a large-scale IC firm that could compete with the Korean and Japanese manufacturers, Premier Yu and Morris Chang came up with the idea of establishing the TSMC. Creating a new company like the TSMC was also needed for Taiwan in order to transfer VLSI technology developed in ERSO's lab to the industry. With the initial investment of $207 million, the TSMC was founded in 1986 as a joint venture in which the state (49 per cent), Phillips (27.5 per cent) and various local capitalists participated, such as Formosa Plastics (5 per cent), Sino-American Petroleum (4 per cent), and many other small local investors (1 per cent each).[48]

Even though the UMC in business was very successful, local investors were not willing to participate in the TSMC formation mainly due to their smallness and the resulting short-term view on profits. Though the details were not readily available, it was said that the MoEA once again had to exercise its "influence" in order to get needed private investments for the formation of the TSMC. Morris Chang recruited Jim Dykes, a former vice-president of the silicon chip division at General Electric, to be in charge of the TSMC. Unlike the UMC, the TSMC was established as a pure foundry, that is, it only produces wafers without engaging in design or marketing. By doing so it would not compete with the existing IC firm, the UMC at that time. This turned out to be a very important decision because within a year of its formation, about 40 small design houses were set up in Hsinchu. The limitation of TSMC as a pure foundry also shows a political compromise between the state and private sector, which was

represented by the ITRI/ERSO and the UMC (Wade 1990 pp.58-64).

A minor organizational change within the state apparatus concerning the high-tech industry promotion also occurred during this period. The main purpose of the organizational change was to strengthen the autonomy of the high-tech group after Dr. Sun's retirement. As seen in the increasing role played by Bob Evans, STAG's influence over the high-tech policy-making process increased gradually. In addition to this active role of STAG membership, two Technical Review Boards (TRBs) were established within the STAG, one for electronics and ICs headed by Bob Evans, and the other for telecommunications headed by Dr. Mackay. The TRBs consisted of foreign and local specialists, though foreigners were predominant. All foreigners for the electronics TRB were selected by Bob Evans personally. The TRBs are supposed to review related projects and to make recommendations that go directly to the NSC and the ITRI. The following statement by Meaney provides an idea about the nature of TRB's recommendation and the elevated position of the STAG within the Taiwanese high-tech policy-making organization:

> TRB recommendations are supposed to be "reference material," and do not have to [be] acted upon. However, one source noted that if a recommendation were not accepted, ITRI would have to explain why. Concerned parties have normally been invited to TRB meetings and convinced to go along before STAG makes a recommendation. STAG also has clout because it screens the (hi-tech) budget. It appears that STAG played a key role both in convincing other agencies within the government to proceed with VLSI and the TSMC venture and in pressuring ITRI/ERSO to modify its design orientation and add more costly and risky memory chip business. (Meany 1990 p.13)

As discussed so far, Taiwan's IC industry during the 1984-89 period experienced a continued state dominance in the developmental process. Personal care and influence of several key actors since the early phase came to an end with Dr. Sun's retirement in 1984. From that time on, organizations such as the STAG and the ITRI/ERSO became indispensable institutional arrangements in the development of the IC industry by replacing the personal

influence of Dr. Sun and Dr. Pan. The institutions such as STAG and ITRI, by interacting with each other, continued to play leading roles in Taiwan's strategy of industrial catch-up for the IC industry.

2.15 Stage 4: The Submicron Project and the Growth of Privatization (1989 TO 1997)

In 1987 Taiwan's IC industry owned about a 1.2-micron level of CMOS technology with two wafer fabricating companies, UMC and TSMC. Since the 1987-88 period, local capitalists have begun to show keen interest in the IC business stimulated in part by the success of the UMC and TSMC businesses as well as the IC shortage in the late 1980s. By 1989 some private companies in the electronics industry began to consider that the DRAM business was not so risky in Taiwan due to the burgeoning domestic market. The STAG also recommended that the DRAM business would be indispensable for a sustained growth of Taiwan's IC industry. The period after 1989 shows another breakthrough in the IC industry in Taiwan, during which Taiwan's IC industry is being reshuffled by the participation of private firms and the technological upgrading toward the sub micron level and the DRAM business.

The success of the UMC and TSMC businesses stimulated local electronics firms to invest in the IC manufacturing business. Due to the fast growing domestic stock market and venture capital markets, new IC firms could finance their start-up costs without much difficulty. The government also provided various incentives such as tax holidays, tariff exemption for intermediate goods for the newly established IC firms (in fact, electronics firms in general) including venture capital service for the overseas Chinese engineers who want to start their own businesses in Taiwan. As of 1989, six companies were actually engaging in wafer fabrication and by 1993, 10 wafer fabricating firms were in operation with the combined revenue of NT$ 41.5 billion (see Tables 2.07 and 2.08).

Table 2.07 Details of Taiwan's Early IC Manufacturers, 1989-93

Year	1989	1990	1991	1992	1993
# of firms	6	8	10	10	10
Revenue (NT$billion)	7.60	9.08	16.79	23.46	41.50
Growth Rates (%)	72.7	19.5	84.9	39.7	76.9
Tech. Capability (/t)	1.2	1.0	0.8	0.8	0.6
Domestic / Export	45 / 55	59 / 41	64 / 36	54 / 46	47 / 53
Capital/Revenue (%)	64.4	120.3	116.9	40.7	25.4
R&D/Revenue (%)	10.0	8.8	9.6	7.9	6.3
Ave. R&D Year	2.6	3.7	4.0	4.0	4.4

Source: ITIS (1994 pp. iii-17 Compiled by author)

Table 2.08 Early IC Manufacturers in Taiwan, 1993

Company	Revenue	Date of	Technology	Growth
TSMC	465.9	1987	ERSO/Phillips	77.9
UMC	378.8	1982	ERSO	49.1
TI-Acer	231.1	1990	TI	242.4
Winbond	185.6	1988	ERSO	56.0
Macronix	143.9	1991	Macronix	113.2
HMC	86.0	1988	ERSO	-5.8
Holtek	56.8	1990	ERSO	19.4
Episil	14.8	1991	n.a.	24.4
ADT	5.3	1986	ERSO	-15.8
AMPi	3.8	1988	ERSO	-5.0
Total	1,572.0			68.8

Source: ITRI (1993 pp.34-42 compiled by author)

During the 1987-88 period, a shortage of memory chips hit Taiwan's computer industry. After this shortage of memory chips, many computer manufacturers including Acer began to express their interests in DRAM business, and pushed for local DRAM production. In its recommendation of October 1988, the STAG also argued for the state's commitment to the DRAM business. ERSO's original position, that is, the emphasis on design technologies and ASICs rather than the risky DRAM business, had been continuously challenged by these moves from both the private sector and other state agencies. After a series of interactions between the state (the IDB of the MoEA, ITRI/ERSO, STAG, TRB, and the NSC), academic community, and the private sector (TI-Acer and others), TSMC began to produce DRAMs in the summer of 1989. TI-Acer began 1Meg DRAM production since 1989, and TSMC announced technology cooperation with Intel to produce 256K DRAMs and 1Meg DRAMs in May 1990. TSMC agreed to produce 4M/8M EPROM and Flash EPROM as an OEM (Original Equipment Manufacturers) basis with Intel in November 1990. In July 1990 HMC concluded a contract for a joint venture with SEEQ Technology of the US in order to produce Flash EPROM and EEPROM. As a result of these vigorous efforts, Taiwan is now producing 4M and 16M DRAMs, and plans to have 64M-DRAM production lines in the near future.

Table 2.09 Taiwan's Production Lines for 16M DRAM, 1996

Company	Prod. Lines	Wafers/Month	Date of Prod.
Macron ix	I(2nd)	30,000	2nd Qtr., 1997
Mosel-Vitelic	1(2 d)	40,000	1st Qtr., 1997
Nanya Tech.	1(1 s	25,000	2nd Qtr., 1996
Powerchip Semi.	I(III)	15,000	3rd Qtr., 1997
TSMC	2(4th, 5th)	60,000	Pt, 3rd Qtr., 1997
TI-Acer	I (2nd)	50,000	1St Qtr., 1997
UMC	3(2 nd-4th)	75,000	2nd, 3rd Qtr., 1997
Winbond	2(3rd, 4th)	40,000	4th Qtr., 96; 3rd Qtr.,97
Total		325,000	

Source: Various Years ITRI Statistical Data, (1997-99 pp.35-69 compiled by author)

Because having a healthy IC industry is viewed as the key for the continuing success of Taiwan's brilliant PC industry, Taiwan's effort to become a major supplier of DRAMs in the world market continues even from 1996 onward when the price of 16M DRAM plummeted to less than $8 per chip. This is in a sense quite a distinguished move because most Japanese and Korean chipmakers are postponing their investment plans due to the dramatic fall in price of 16M DRAMs. Table 2.91 shows the fabrication lines for 16M-DRAM production (using 8 inch wafers) of major IC manufacturers in Taiwan.

By this aggressive move, Taiwan had been planning to produce $16.9 billion of ICs in the year 2000, and $42 billion in 2005 which may be equivalent to about 7 per cent of the world

IC market. Actually, to the great surprise of many, Taiwan produced $22.5 billion of ICs in the year 2000 and could possibly overshoot the 2005 estimate $42 billion by as much as $8 billion which may be 9.5% of the world market. For this plan to have been successfully implemented, Taiwan must have had to become an important memory producer by 1998, which it did, and three East Asian countries (Taiwan, South Korea, and Japan) were then able to dominate the world memory market to some extent.

As discussed so far, there have been many important changes and path-breaking moments in the process of Taiwan's IC development. Industrial catch-up for ICs originally began mainly by the personal enthusiasm and initiatives of a few high-ranking public officials who responded to the economic difficulties in the early 1970s. The enlightened visions of a few high-ranking public officials were gradually institutionalized throughout the whole developmental period. Overseas Chinese engineers played a crucial role by providing valuable advice and/or by taking positions within various high-tech related organizations. The leadership of the related organizations has changed as time goes by. The private sector also underwent considerable changes. It is apparent that the state as represented by numerous organizations and the people within them has played a dominant role by initiating the IC project, by creating commercial firms and NPOs, and by maintaining necessary investments for further technological upgrading. The state not only initiated various IC projects, but also pushed the reluctant private sector into the IC business, as was seen in the formation of the UMC and the TSMC. Thus we can conclude that there would be no domestic IC-industry in Taiwan had it not been for the state.

Although this brief sketch of Taiwan's experience of IC development provides a specific understanding on how the Taiwanese IC industry has developed and under what domestic and international environments, we still need to look at the broad context of a S&T policy-making network in Taiwan because IC policies have been a part of the high-tech development programs

pursued by the Taiwanese state since the early 1970s.

Section 2.2 The Role of the State

2.21 Taiwan Style Intervention

Until recently, all major R&D projects for the IC industry have been planned and administered by the state through ITRI/ERSO and other related state agencies. The private sector began their major investments after the 1988-89 period, but most of the private investments have been devoted to the expansion of facilities such as the construction of new fabs. Though it is very difficult to get R&D data on individual companies due to confidentiality, R&D investment in the UMC was estimated at about $4.4 million in 1987 and $6 million in 1988. In the case of the TSMC, the investments for facilities during 1987-89 period were $21 million, $25 million, and $123 million, respectively. During the same period, the TSMC only spent $0.3 million in 1987, $0.9 million in 1988, and $2.6 million in 1989 for R&D. Since the R&D investment in 1989 for TSMC included royalty payments, the actual R&D spending would be much smaller than the figure given above (data from ERSO).

As shown in this section, a small group of people in the state including high-ranking government officials with engineering backgrounds, senior managers of the ITRI/ERSO, the majority of whom were trained at RCA, foreign advisors, and the overseas Chinese engineers, had enlightened visions about the future of Taiwan's IC industry, and pushed the IC project ahead. The direct outcomes of the aggressive state's efforts were the formation of the UMC, the TSMC, and other manufacturers as well as various technological upgrading represented by the VLSI project, the sub micron project, and the DRAM business. The IC industry, therefore, has been created directly by the state and the Taiwanese high-tech circle has played very similar roles to the Japanese MITI as described by Chalmers Johnson (1982 pp.45-98).

Though my conclusion on the role of the Taiwanese state in promoting the IC industry is the same as that of the developmental statist argument on the Taiwanese political economy (Amsden 1979 pp.341-379, 1985 pp.98-134; Wade 1990a pp.256-314, 1990b pp.231-255), the approach I took differs from the developmental statist argument. In contrast to the existing statist explanations, most of which emphasize economic backwardness as the source of state dominance over the market, I analyzed a broader institutional relationship between the state and society which have been historically contingent. The unique institutions in state-society relations in regard to the development of the IC industry include not only state structures and actions but also the relationship between different state agents and agencies, the academic community, foreign advisors, and the small and medium-size business structure, all of which affect the interaction between the state and the private sector in a predictable direction, that is, the dominant and pervasive role of the state.

The high-tech circle and agencies within the Taiwanese state have played such pivotal roles, not because of the ahistorically strong and autonomous state in backward economies but because of the institutional strength of the high-tech related agents and/or agencies as well as the unique state-society relations which hinder the penetration of parochial interests into the IC policy-making process.[57] Thus the extraordinarily dominant and pivotal roles played by the Taiwanese state must be understood from a broader perspective focusing on the interplay between the state and society under particular historical and structural constraints, that is, an institutional approach to state-society relations, rather than from a narrow statist perspective.

Section 2.3 Leadership, Politics and IT Policy in Japan

2.31 Intervention Japanese Style

This discussion considers the reasons for Japan's successes and failures in the PC era but leave some troubling questions. For example, why were Japanese companies slow to recognize

the importance of the PC, remaining fixated instead on the mainframe industry and IBM during the period of 1985-92? Why did MITI fail to stimulate a new wave of start-up companies to compete in the wide-open early days of the PC industry? Why has Japan been almost uniformly unable to develop an independent software industry even though MITI and many consortiums poured a lot of money into their software strategy? And why did most Japanese companies concentrate on the small Japanese PC market and make only halfhearted attempts to penetrate foreign markets?

The answers to these questions are complex, and they go to the heart of Japan's industry structure's rules of the game and corporate culture lack of diversity strategy. The size, diversification, and vertical integration of Japan's computer makers are advantages in producing high-volume hardware products with stable technologies and long product cycles, but they are a liability in the PC industry, with its unpredictable market and technology shifts. Also, the hardware orientation of Japan's electronics industry has meant that software is not given the prominence it deserves, given its critical role in establishing technology standards. Finally, Japan's educational system has been very good at turning out a skilled manufacturing work-force, but it tends to stifle the kind of creativity and initiative that is needed in the innovation-driven segments of the industry as well as the white-collar sector.

A final question must be addressed. Why did the bureaucrats who had guided Japan's mainframe industry fail to come up with a successful strategy to help Japan compete in the PC era? This question becomes even more cogent when we look at the highly effective government policies employed in Singapore and Taiwan that helped those countries become important centers of PC production. To consider these issues in more detail, we look first at Japan's industry structure and business strategies, and then review the industrial policies employed by the Japanese government during the PC era.

Industry Structure: Japan's industry structure and corporate culture made it difficult for Japanese companies to recognize and respond to the PC revolution. While constant churning of people and companies marks Silicon Valley, Japan is marked by stability. The same companies that created Japan's computer industry in the 1960s still dominate in the 1990s. Stability might be desirable in a mature industry such as automobiles or even mainframe computers, but in a dynamic environment like the PC industry, it can be synonymous with stagnation. It is not simply the size of Japan's computer giants that makes it difficult for them to compete in PCs, but their tendency toward vertical integration and bureaucratic decision-making. Worse yet is their ability to lock newcomers out of the domestic market, preventing the emergence of a new wave of entrepreneurial PC-oriented companies like those in the United States, Taiwan, and elsewhere.

2.32 Japan and the PC Revolution

The personal computer revolution appeared to offer a tremendous opportunity for Japan. Combining their strengths in electronic components with their growing capabilities in computer technology, the Japanese computer makers appeared likely to become major competitors in the global PC industry. In fact, some in the United States expected that Japanese companies would eventually use their control over upstream components and technologies to dominate the industry. Former U.S. Trade Representative Clyde Prestowitz, predicted that the Japanese would run away with the world computer market.[58] Intel's Andrew Grove predicted that Japan would overtake the United States as the dominant world supplier of computer systems by 1992.[59] What few suspected was that the PC revolution would so change the nature of the computer industry that many of the presumed strengths of the Japanese companies would turn out to be liabilities in the PC industry.

Japanese companies did succeed in controlling the market for many PC components and peripherals, including DRAMs, flat-panel displays, and floppy disk drives, as well as many key

subcomponents and materials. But for the most part they failed to build on those strengths to compete in the PC systems market. They were also unable to use their strength in DRAMs and other semiconductors as a base for challenging Intel's dominance in microprocessors and were locked almost entirely out of the PC software market. While Japan's computer hardware production grew rapidly, its companies were largely relegated to the decreasing returns segments of the industry.

Japanese companies are still world leaders in many components and peripherals, but aggressive competitors elsewhere in Asia have challenged their leadership. In 1996, a decade after driving Intel and other U.S. companies out of the DRAM business, Japan was passed by Korea as the leading producer of DRAMs. Korea's electronics companies were also gearing up for a challenge in flat-panel displays, another Japanese stronghold. Meanwhile, Taiwan had become so adept at producing PCs and components that Japan's computer makers were outsourcing production to Taiwanese OEMs to cut costs and get products to market more quickly. Japan's problems were reflected in a steep decline in computer production in the early 1990s, reversing a decade of rapid growth. Total output declined by 20% from 1991 to 1993, before rebounding slowly from 1994 to 1996. Most dramatic was the decline in mainframe production, as the shift from mainframes to PCs finally hit the Japanese market. Much of the short-term decline in production can be attributed to the stagnation of the Japanese economy in the aftermath of the "bubble" economy of the late 1980s. Economic growth hovered around 1 % per year from 1992 to 1995, and the Japanese computer industry, heavily dependent on the domestic market, was especially hard hit. The domestic downturn also forced Japanese components manufacturers to reduce investment just as they were facing increased competition from U.S. and Asian competitors.

The problems of the computer industry went far beyond the temporary drop in domestic demand, however. The deeper problems involved Japan's industry structure and managerial

culture, the fragmented development of its domestic PC market, and its weaknesses in software and associated "soft" skills. There was also a matter of strategic focus. Japanese computer makers remained obsessed with beating IBM, even as Microsoft, Intel, and Compaq were pummeling IBM. Ironically, IBM was equally worried about the Japanese challenge, having seen U.S. leaders in other industries humbled by Japanese competitors.[60] While the Japanese chased IBM, and IBM gazed in the rear view mirror at the Japanese, they both drove off the same cliff when the mainframe market collapsed, with each side suffering billions of dollars in losses (table 3-1).

While the corporate losses of the Japanese vendors did not match those of IBM, the impacts were greater than the numbers would suggest. For example, Fujitsu showed a corporate profit of US$300 million in 1994, yet McKinsey & Company estimate that it lost US$583 million in the computer business that year. The decline in revenues and profits at Fujitsu's U.S. mainframe subsidiary, Amdahl, was another warning sign to Fujitsu. Equally troubling for IBM and the big Japanese mainframe companies was the stagnation in revenues that occurred from 1991 to 1995, at a time when the computer industry as a whole was recording double-digit growth rates.

While mainframe and minicomputer companies around the world were victims of the PC revolution, in the United States their decline was compensated for by the rapid ascent of new PC-oriented companies such as Apple, Compaq, Dell, Microsoft, Novell, and Lotus. The problem for Japan was that its decline in computers was systemic. The handful of large companies that control most of Japan's computer industry all faced serious downturns in the 1990s, and there were few newcomers to take up the slack. And while IBM was able to reverse its fortunes through a painful restructuring and by shifting focus to emphasize its service and network businesses, the Japanese giants were hamstrung in their efforts to shift course by practices such as lifetime employment and seniority-based promotion. These practices-along with

Japan's egalitarian educational system and emphasis on incremental improvement-were well suited to stable, decreasing returns manufacturing businesses, but they were liabilities in the unpredictable, rapidly changing increasing returns world of the PC industry.

2.33 History of Japan's PC Industry

Japan's PC industry developed in parallel with the global industry, but for well over a decade did not converge with it.[61]The first 8-bit Japanese PCs were introduced in the mid-1970s soon after the first Altairs, Apples, and Commodores, and as in the United States, a variety of incompatible architectures competed in the market. But in the 1980s, while the United States and the rest of the world were standardizing on the IBM-PC architecture, with corresponding growth and competition in all segments of the industry, Japan remained a backwater of incompatible standards, high prices, and slow growth.

The fragmentation of the domestic market was due in part to the complexity of the Japanese written language. [62] Japanese PCs had to be able to input, store, display, and print around 6,000 kanji characters, compared to about 200 for European languages. This meant that IBM PC-compatible computers lacked the power to handle the complex Japanese language without special hardware until the 80486 generation of microprocessors became available in the late 1980s.

Table2.10 Computer Hardware Manufacturing Market Share: Japan, Taiwan, Korea 1995 and 2000 Compared.

	% Share (in units)	% Share of Global Production (in units) for various products.				($ Value)%	($ Value)%
Region	Desk PC	Notebook PC	Monitors & LCDs	Mother Boards	Hard Disk	ICs & related	SRAM & Flash
	95---2000	95----2000	95---2000	95--2000	95----- 2000	95--2000	95--2000
Korea	5---------9%	1----------3%	19-----31%	0-------2%	3-------6%	7------5%	30---36%
Taiwan	10------17%	28-------51%	30-----33%	68----78%	n.a.	4-----14%	2-----11%
Japan	6--------5%	37-------27%	40------34%	5-------5%	30----27%	31----20%	38----29%

Sources: (Institute for Information Industries (MIC/III), Asia IT Report (February 1996 and November 1996); Electronics Industries Association of Korea (EIAK), 1995 Statistics of Electronic Industries (Seoul: EIAK, 1996 pp.34-87); ITRI Statistics 1995 & 2000 pp.65-98; 工業技術研究院 2001 pp.78-113. (Compiled by author) * Large companies and government agencies include merchant sales only. Does not include captive production by PC vendors.

The high cost of PCs kept demand low, and Japan's PC penetration level remained about one-third that of the United States well into the 1990s. The demand for PCs was also limited by the difficulty of using DOS-based Japanese PCs. Typing kanji characters on a keyboard requires multiple keystrokes and choices among different characters to represent the correct meaning among homonyms (which are very common in the Japanese spoken language). Rather than buy PCs, many users opted for specialized word processing machines designed to handle Japanese text more easily. Several developments changed the face of the Japanese PC market in the 1990s, however. One was the availability of more powerful microprocessors capable of doing higher-level tasks that previously were handled by mainframes, such as financial analysis and database management. These processors were also able to handle

Japanese characters directly in the operating system more easily, making possible three major developments in the Japanese software market.

The first crucial development was IBM's 1991 introduction of the DOS/ V operating system, which handled Japanese characters entirely in software that could run on global-standard IBM-compatible PCs. This opened the door to foreign PC makers by making thousands of DOS-based applications available on a standard Japanese operating system. IBM organized the PC Open Architecture Developers' Group, which was joined by U.S. and other foreign PC makers, as well as Toshiba and most of the smaller Japanese PC companies. DOS/V gained critical support in 1993 when Fujitsu announced a DOS/ V compatible version of its FM Towns multimedia computer. Even Seiko Epson announced in 1994 that it would shift from producing NEC clones to DOS/V machines. With the support of the major Japanese PC makers and IBM's efforts to court software developers, by 1994 there were over 5,000 software packages available to run on DOS/V.

In the second key development, Apple began to make great gains with a Japanese version of its Macintosh system, whose icon-based interface was much easier to use than the text-based DOS interface. Apple gained market share by aggressively expanding its distribution channels and developing agreements with Japanese partners such as Canon, Minolta, Fuji Xerox, and Sony, and Apple's market share grew from 1 % in 1990 to 15.4% in 1994. The success of the Macintosh introduced Japanese users to the advantages of a graphical user interface and helped pave the way for the third key development in the Japanese operating system market.

That development was Microsoft's introduction in 1993 of a Japanese version of Windows 3.1 that could run on both NEC and DOS/V hardware. This effectively unified a majority of the packaged software market by allowing developers in Japan to write programs

that would run on both hardware platforms. It also broke down the wall between Japan and the global market by allowing software packages and CD-ROMs developed for standard Wintel PCs to run on most Japanese PCs.[63] The spread of Windows 3.1 (J) extended Microsoft's dominance of the Japanese operating system market. By 1995, the introduction of Windows 95 in Japan was met by lines of PC users waiting to get a copy, just as in the United States. The shift from DOS to Windows applications eliminated much of NEC's advantage in complementary assets by making its library of DOS-based applications obsolete. NEC was left to compete on the basis of price and features, and its competitors were already targeting its high margins with low-cost PCs that took advantage of cheap components sourced from the global production network.

Compaq was the first to shake up the cozy Japanese market in 1992, when it introduced PCs in Japan at half the price of equivalent NEC machines. IBM quickly followed suit, and other clone makers such as Dell and Acer entered the market with low-cost PCs. NEC initially responded to the so-called "Compaq shock" by stating it would not take part in a price war in Japan. [64] Rather it emphasized the large software library and nationwide service network available for the PC-98 series. NEC also appeared indignant that Compaq would break the unwritten rule against direct price competition in the Japanese market. Chairman Tadahiro Sekimoto complained, "I'm slightly angry at what happened, because what they did was demagoguery.... Compaq made an announcement of a PC with efficiency almost the same as existing Japanese models, but priced lower at 120,000 yen as opposed to 240,000. But Compaq's PC had only a single disk drive so that as a word processor ... it was not able to operate efficiently. In order to have the ability to do word processing, you would have to add another floppy or hard-disk drive." Sekimoto failed to mention that Compaq simultaneously introduced a model with a 40 MB hard disk for 168,000 yen, still far below NEC's price. [65]

Even some elements of the Japanese press came to NEC's defense. An article in Asahi Personal Computing focusing on the PC-98 compared the increase of U.S. computer imports

with the “Black Ships,” the American fleet that in 1854 forced Japan to open its ports to foreign trade. It argued that NEC computers were as Japanese as rice and that “patriotic PC users” were delighted when NEC introduced a new product lineup.[66] Unfortunately for NEC, not only Compaq was invading its market. Other Japanese PC makers were cutting their own prices and turning to Taiwanese and other Asian companies to source components and contract out manufacturing. NEC was finally forced to defend its market share by cutting prices and sourcing more components offshore to lower its costs.[67]

Under the combined assault of Apple and U.S. vendors selling DOS/V machines, NEC’s market share began to erode, from 52% in 1991 to 43% in 1994 (table 3-2). Fujitsu, Toshiba, and Seiko Epson also lost ground, while U.S. companies grabbed a 30% market share. The Japanese market had been cracked open by the efforts of IBM, Compaq, Apple, and Microsoft, which had done in computers what U.S. trade negotiators had struggled to accomplish in other sectors. However, the Japanese companies were not ready to capitulate in their home market, and in 1995 Fujitsu launched its own price war, leaving both NEC and the U.S. vendors reeling.

Compared to the tremor in the market caused by “Compaq shock,” “Fujitsu shock” was a major earthquake. Fujitsu cut prices so low that many analysts claimed the company was losing hundreds of dollars on each PC it sold (a claim refuted by Fujitsu, which argued that those estimates included initial investments in marketing, distribution, and product development). And while limited distribution channels and lack of brand name recognition hindered Compaq, Fujitsu was able to mobilize its vast Japanese distribution system to challenge NEC. Fujitsu introduced a rash of new low-cost models, many of which were sourced from Taiwan to cut costs and quickly ramp up volume. The result was a leap in market share from just 9% in 1994 to 18% in 1995 and 22% in 1996. Some of Fujitsu’s gains came at the expense of Apple, whose more general corporate problems were spilling over into Japan, but most of the gains came at the expense of NEC, whose market share dropped to 33% in 1996. By

1996, NEC announced that it would begin selling DOS/V machines in Japan via its Packard Bell/NEC subsidiary, in effect acknowledging that the PC-98's days were numbered. The other impact of Fujitsu shock was a boom in PC sales. Interest in PCs was spurred by a multimedia fad in 1994 and Internet fever in 1995, and as prices fell, demand soared. Japan's PC market grew from 3.2 million units in 1994 to more than 8 million units in 1996, as Japanese businesses and households finally embraced the PC.

Table 2.11 Revenues and Profits of IBM and Japanese Computer Makers

(In US$ Millions)

	1990	1991	1992	1993	1994	1995
IBM Revenues	65,958	60,479	59,657	57,778	62,065	69,473
Profits	5,719	-2,827	-6,870	-7,506	2,784	3,975
NEC Revenues-computer	10,145	13,033	13,234	14,452	15,700	18,365
Profits-corporate'	580	370	120	-375	70	700
Fujitsu Revenues-computer	17,890	17,839	20,047	20,738	23,514	28,283
Profits-computer	440	338	21	-92	-583	911
Amdahl Revenues	2,159	1,703	2,525	1,681	1,639	1,516
Profits	184	11	-1	-35	75	29
Hitachi Revenues-computer	11,166	10,290	11,352	11,700	14,673	15,672
Profits-corporate'	1,703	1,091	666	634	1,280	1,337

Sources: McKinsey & Company, The 1993 Report on the Computer Industry; The 1994 Report on the Computer Industry; and The 1996 Report on the Computer Industry (New York: McKinsey & Company, 1993, 1994, and 1996); Datamation, The Datamation 100 (June 15, 1996, and June 15, 1993); Electronic Business Asia (various issues 1994-1997) (compiled by author).

'Separate computer industry net income data not available for NEC and Hitachi

U.S. companies, who unified the Japanese software market and introduced price competition, yet the consequences for those companies have been mixed, largely instigated the revolution in Japan's PC market. Microsoft has been the biggest winner, enjoying rapid growth in demand for its operating systems and applications, while Intel has likewise benefited from growth in demand for its microprocessors. For IBM and Compaq the results have been more ambiguous. Neither was able to make major inroads into the Japanese PC market, and their growth in sales volume was balanced by shrinking profit margins caused by Fujitsu's price war. More ominously, the challenge in their domestic market has led Japan's PC makers finally to become serious about competing in the global market where Compaq and IBM are the leaders.

Besides the role of U.S. companies in shaking up Japan's PC industry, the biggest story in recent years was Fujitsu Shock. Why did this stodgy mainframe vendor suddenly leap into the PC era with such an atypical strategy for a Japanese company? The most plausible answer, and one that is supported by discussions with a few Fujitsu managers, points to the decline in the mainframe business, which accounted for about 40% of Fujitsu's revenues in 1992.[68] Having gone into the red, and seeing its subsidiaries Amdahl and ICL in similar trouble, Fujitsu responded with an all-out price war to buy market share in the PC industry. The company felt that it could only compete by increasing its sales volume and gaining the economies of scale enjoyed by IBM, Compaq, and others. It targeted the export market, but initially it could get the biggest impact in the domestic market, where it could deploy existing production and distribution channels to rapidly increase its sales volume. By 1996, PC prices had begun to stabilize and Fujitsu had established itself as the major competitor to NEC in the Japanese market.

2.34 Global Competitiveness

Rather than use their insulated home market as a profit sanctuary from which to invade foreign markets, Japan's leading computer makers --Fujitsu, Hitachi, and NEC-- spent the first decade of the PC revolution fighting over the Japanese market. The only exception was Toshiba, which successfully targeted the global market with its line of portable PCs. However, Japan's PC makers might yet make their presence felt in the United States and other markets in the 21st Century. Having driven the foreigners back from the ramparts of their domestic market, the Japanese vendors ventured into the U.S. market in 1997. Fujitsu and Hitachi established product development and assembly facilities in California to design and produce notebook PCs for the U.S. market. Consumer electronics leader Sony introduced multimedia PCs made by Intel for the U.S. market, hoping to position itself for the convergence of computers and consumer electronics. Toshiba began to move beyond its niche in notebook PCs by introducing a multimedia desktop PC for consumers in the United States in 1996 and followed with a line of desktops and servers for the business market in 1997. NEC went a step further and purchased a controlling interest in the U.S. PC maker Packard-Bell, which had used low-priced machines to take first place in the U.S. consumer market but had nearly gone bankrupt doing so. The Japanese vendors also abandoned many of their domestic suppliers and began tapping the global production system to cut production costs.

Sony's strengths in the consumer electronics market may translate into success in the consumer PC market, but that market is the most competitive and least profitable of the entire industry. Sony's longer-term goal is to position itself in the new consumer markets expected to be created by the convergence of computers, consumer electronics, and entertainment (where it already is a major force through its Sony Pictures and Sony Music divisions). So far, however, none of the Japanese vendors have been particularly innovative in product design, marketing, or distribution, relying instead on heavy advertising as a means to attract visibility in the market.

Failures in Soft Wars: While the Japanese hardware industry has had mixed success in the PC era, the software industry has been an almost unqualified failure. The software and information services market is actually very large, totaling US$41.8 billion in 1995 210.6 billion in 2000. However, packaged software accounted for only 23.6% of the Japanese software and services market, with users still relying largely on custom programs. In comparison, packaged applications accounted for more than 37% of U.S. software and services spending in 1995.[69] The balance is now shifting in Japan as PCs become more widely diffused in 2000 and 2001, but the slow adoption of packaged software was detrimental to the Japanese software industry.

Packaged software can be commercialized and exported, while custom software is written to the specifications of a particular user. Producing packaged software is also an effective use of programmers' time. While a custom program will be written once and used by one customer, a packaged product will be written once and used by thousands or even millions of users. So far, Japan has been unable to develop an internationally competitive software industry. In 1995, Japan ran a US$3.9 billion trade deficit in computer software (excluding games).[70] Japanese software makers are unable to compete effectively even in their domestic market. More than 60% of the packaged software sold in Japan is imported, mostly from the United States.[71] This is surprising because domestic producers should have an advantage in a local market, especially one with a unique language. Yet foreign producers have been able to adapt their programs to the Japanese language and market. Much of the PC software market is dominated by Microsoft, which not only controls over 80% of the operating systems market, but also has a majority of the office suite market with the Japanese version of Microsoft Office. Oracle also has made large inroads into the Japanese market, gaining more than 40% of the corporate database market in competition with proprietary products from Fujitsu and other Japanese vendors.

Japan's Hardware Gets Softer: While Japan has struggled in PCs and software, it remains a world leader in a wide range of components and peripherals. Japanese companies are leading producers of DRAMs, flat-panel displays, floppy disk drives, CD-ROMs, laser printer engines, and cathode ray tubes for monitors. At the subcomponent level, Japanese companies have leading positions in everything from disk drive motors and heads to pure silicon wafers, ceramic packaging, and quartz parts.

Japan's strengths cover a wide range of technologies, including materials for silicon wafers, ceramic castings, read-write heads for various disk drives, and optoelectronics technologies for laser printers and semiconductor steppers. Most of these capabilities were developed initially in the consumer electronics industry. For example, LCD technology developed for calculators and watches eventually led to Japanese dominance in flat-panel displays for notebook computers. Magnetic recording technologies developed for VCRs and camcorders were transferred to computer tape and disk drives. Optoelectronics technologies and manufacturing techniques developed for cameras were transferred to fax machines, copiers, and eventually laser printers and steppers. CRT technology for television sets was used in computer monitors. Finally, because of Korea's challenge in DRAMs, Intel's dominance in microprocessors and Taiwan's new domination of ICs Japan, in 2000, retains only about 65% of its 1995 share in the semiconductor industry. The inside of most PCs, printers, disk drives, and other computer products were full of Japanese chips in 1995 but now Japanese companies control only the important markets for advanced materials, components, and production equipment.

Some of the biggest Japanese beneficiaries of the PC revolution are not PC makers but specialized components makers. Sharp is the leading producer of flat-panel displays, Canon dominates in laser printer engines, and companies such as Kyocera, TDK, and Yamaha are leaders in various subcomponents markets. Japan's computer vendors such as Toshiba, NEC,

and Fujitsu also have continued to benefit from the growth of the PC industry, but primarily as suppliers. What they cannot expect is that their PC business will get much benefit from their strength in components. While Toshiba used its strength in LCD screens to gain an advantage in notebook PCs, there is now an adequate supply of displays on the market and having a captive supply is probably not much of an advantage. In the present market, there are few components that cannot be bought from outside suppliers, and the benefits of having a captive supply during a shortage are neutralized by the costs of being stuck with that supply during a glut.

U.S. Standards Make Japan Reliant: The inability of Japanese companies to control any of the major architectures for hardware or software has plagued the industry from the beginning. Mochio Umeda argues that while Japanese companies know how to manufacture, they lag behind American firms in knowing what to manufacture, allowing the United States to maintain its control over key standards.[72] For example, Japanese mainframe makers had caught up with IBM in performance by the early 1980s but still depended on IBM standards and were forced to make large royalty payments to IBM. Japanese supercomputers had surpassed U.S. machines in some speed benchmarks by the late 1980s, but the large library of software available for Cray supercomputers allowed Cray to maintain its lead in the commercial market. The pattern repeated itself in the PC industry, where Japan's development of incompatible PC architectures left it isolated from international standards that were controlled by U.S. companies. Dependence on U.S. standards has trapped the Japanese computer industry in the decreasing returns segments of the PC industry. While Japanese companies do hold near-monopoly positions in some profitable upstream technologies, they have been unable to break into the large increasing returns markets for software and microprocessors. Even NEC's proprietary PC-98 architecture was based on Intel chips and Microsoft's operating system. NEC was unable to protect its PC standard when IBM and Microsoft created open standards for the Japanese market.

Japan's dependence on Microsoft's software standards is not surprising, given its general weakness in software. Somewhat more surprising has been the failure of Japan's semiconductor industry to break Intel's control of the microprocessor market. Each of the major Japanese PC platforms was based on Intel processors, but there once appeared to be a good possibility that the Japanese could eventually challenge Intel's leadership. For example, while NEC used Intel chips in the PC-98, it also developed its own version of the 80X86 chips, called the V-series. Intel sued NEC for patent infringement, but in 1989 a U.S. court ruled against Intel, opening the door for NEC to sell its V-series processors to any PC maker. At the time, many in the United States predicted that the Japanese, no longer blocked by legal challenges from Intel, would overwhelm the U.S. microprocessor industry. Japan's dominance of the DRAM industry was expected to give the Japanese chipmakers a critical advantage in achieving higher yields and lower production costs by applying process technologies developed for DRAM production. NEC was not the only likely challenger; Fujitsu, Hitachi, and Toshiba all had experience as second source producers of earlier Intel or Motorola processors and were licensing new RISC designs from U.S. companies. When they tried to challenge Intel, however, Japan's chipmakers came up against the power of increasing returns in the form of Intel's control of the x86 standard. NEC's V-series chips never caught on with PC makers, and by 1993 the company had stopped using them even in its own computers.

NEC then shifted to a RISC strategy with its VR-series of processors based on designs by the U.S. Company, MIPS. But RISC processors never made it into the mainstream PC market, thanks in part to the huge library of x86compatible software and also Intel's ability to squeeze more performance out of the x86 architecture than many had expected. NEC's PC division continued to use Intel chips for the PC-98, and the VR series was relegated to specialized markets such as workstations and microcontrollers. Fujitsu did somewhat better, becoming a major producer of Sun SPARC processors for the workstation market. But as a

group, the Japanese companies failed to make even a dent in the mainstream PC microprocessor market. By the mid-1990s, most Japanese PCs carried the "Intel Inside" label, a small oval symbol of Japan's continuing dependence on standards set in the United States. Rather than defining standards for the PC industry, Japanese computer makers have been forced to develop software and hardware based on architectures controlled by U.S. companies. The strategy of technological imitation that worked so well in other industries has kept the Japanese companies in the lower margin decreasing returns segments of the industry. And with Intel's control over hardware standards expanding (e.g., into chip sets, multimedia features, and networking functions), profit opportunities in the rest of the PC hardware industry continue to shrink.

The second category of explanations focuses on the dominance of the Japanese economy by the giant keiretsu, who control access to capital and distribution channels. This argument is supported by the example of NEC's use of an extensive distribution channel to dominate the PC market. However, this does not explain the absence of export-oriented start-ups, since the keiretsu's distribution channels did not influence international markets. Why were small Taiwanese companies able to develop linkages to the global production network, while small Japanese companies were left out? It is not surprising that existing small companies remained tied to their parent companies' domestic production chains, but why the lack of newcomers to test the international waters?

Industry Structure for Software: The entire Japanese computer industry has been hobbled by its weakness in software, and the problem has been especially serious in the PC industry. While Japan's software industry is said to outperform its U.S. counterparts in some measures of programmer productivity and quality control, it has grown more slowly and is less innovative than the U.S. industry. Perhaps the most serious problem is that Japan has failed to develop a vibrant independent software industry able to produce a broad variety of commercial

software packages for the PC. There are few Japanese equivalents to independent U.S. firms that dominate the global packaged software industry-and which now control more than half of the Japanese packaged software market. By contrast, most independent Japanese software firms are relatively small and sell only to the domestic market.

Some of Japan's software problems are the result of the evolution of the industry. Japan's computer makers originally sold software and services in conjunction with hardware sales, just as IBM had before it unbundled its software and hardware in 1969. The Japanese government required unbundling in 1977, but the practice of treating software as part of the hardware package remained common, hindering the growth of an independent software industry. Instead, most software was developed either by the hardware makers, their subsidiaries, or by users themselves. In each case, the focus was on custom software, either to lock in customers to the vendor's proprietary hardware or to offer users a perceived competitive advantage in their own industry by developing software tailored to their business processes.[73]

The custom approach created problems for the Japanese software industry. Custom programming is labor intensive and exacerbates the critical shortage of software personnel. If a Japanese programmer can produce more lines of code per hour than an American programmer, it would appear that the Japanese programmer is more productive. But this calculation is deceiving. If the Japanese program has only one user, while thousands use the American program, the American programmer has actually been thousands of times as productive in terms of the value of his or her output. Also, the claims that Japanese programmers deliver code with fewer errors[74] is misleading, since Japanese programmers are often making minor modifications on existing programs, while American programmers are more likely to be developing new products or major modifications of old programs.[75]

The custom software approach led to a rigid division of labor coordinated by hardware

vendors and large users.[76] In the beginning, vendors would assign personnel to the user site to develop custom programs and train the users' own information systems departments. Over time, both vendors and users began to spin-off their application developers into subsidiaries that now dominate the software and systems integration business in Japan. These include vendor spin-offs such as Fujitsu FIP, Hitachi Information Systems, Toshiba Information Systems, and NEC Software, and user spin-offs such as NTT Data Systems, Nomura Research Institute, and Nippon Steel Information Systems. While hardware vendors keep operating system development in-house, the vendor and user spin-offs coordinate and develop most applications, contracting lower level activities to independent software houses, which subcontract work to even smaller firms. Software development is implemented through a top-down, centrally coordinated management system that bears a strong resemblance to Japan's manufacturing structure. Japanese companies treat software production as a factory operation, breaking development down into a linear progression of planning, design, system engineering, and coding. This process creates coordination problems and discourages creativity throughout the system.

Another problem is that custom programming is focused on the mainframe and minicomputer markets, and the skills required to develop and market custom programs do not translate easily to the rapidly growing PC software market. Packaged software requires a focus on creating products that are valuable to a large number of users, which is contrary to the idea of developing customized solutions to a specific user's needs. The inability of older software companies to make the switch to the PC market would not be a problem if new independent software houses were able to meet the demand for packaged software.[77] But while many software vendors did spring up to develop PC applications, their growth was stunted by barriers related to Japan's industry structure. These include lack of access to capital and barriers to distribution channels.

The shortage of venture capital is especially acute in the software industry. Japan's capital markets lack the knowledge and experience needed to evaluate software makers, whose assets are intellectual and intangible, and whose future profitability is difficult to predict. In the United States, there are venture capitalists that specialize in software companies and have the experience to judge their prospects more accurately. The Japanese venture capital market consists mostly of firms affiliated with banks and securities firms, who tend to invest in more traditional industries. In 1989, only 0.04% of total investment by venture capitalists in Japan went to the software industry, compared to 11% in the United States. [78]

There has been some effort by the government and banks to increase venture capital investment in software. The government has offered grants and loans to software companies with innovative products, although many argue that these are little more than bailouts to small subcontractors who have been squeezed by the recession. Also, software distributor Softbank has offered to help private banks screen software companies for investment. Softbank is one of the few big entrepreneurial success stories in the Japanese computer industry, but it remains to be seen if it has good instincts in the venture capital market. The software industry also suffers from shortages and poor deployment of human resources. Most computer science graduates end up in large hardware firms. Software firms therefore are usually left hiring people with no training in computer science, which they then must train as programmers. The small independent companies at the bottom of the software production chain are given such specialized tasks to perform that their staff is unlikely ever to gain the breadth of experience needed to take on more complex tasks. These companies find it difficult to hire or develop the skilled people that they would need to move into development of packaged programs. The training and personnel management in Japanese software companies tends to stifle creativity as well. New hires are all trained in identical programs, regardless of their previous education or experience, and the practice of seniority-based promotion does not reward a programmer's productivity or creativity.

Finally, software is simply not highly respected as a product in Japan. The tradition of bundling hardware and software caused both vendors and users to undervalue software, since it was not paid for separately. As a result, software professionals do not receive the respect given to hardware specialists. They generally do not receive top salaries, nor are they likely to rise to top management positions in major corporations. This discourages bright students from studying for careers in software. Likewise, Japan's highly regimented software industry has not produced any equivalent to Microsoft, Adobe, Novell, or other successful software start-ups in the United States. With few exceptions, the best-known companies and recognizable individuals in Japan are on the hardware side. As one software professional put it, "Software is not respected. It is not a good job to have because software people cannot be promoted to the top."[79] Such factors have been obstacles to the development of Japan's software industry. Most important, these factors have severely stunted the growth of independent software companies producing packaged software. The weakness of Japanese packaged software is most vividly illustrated by the fact that over 60% of the packaged software market consists of imported programs. Add to that the large amount of pirated software in use, most of which is undoubtedly foreign in origin, and it is clear that very little of the software running on Japanese PCs originated in Japan. Software and information services are the fastest growing segments of the IT industry, and will become even more important as national and global information infrastructures are developed.

The big beneficiaries of the shift to PCs and packaged software have been U.S. companies. Microsoft dominates the market for PC applications and Oracle is now the number one seller of database packages in Japan, competing against the proprietary products from Fujitsu and Hitachi. Developers of packaged software for the PC98 platform now find their DOS-based applications obsolete and they must compete with giants like Microsoft in the Windows market. And while the big U.S. vendors have the resources to develop

Japanese-language versions of their products, few Japanese firms can develop and market products for international markets.

2.35 Domestic Market: Slow Adoption of Information Technology

Japan is an advanced user of some technologies, such as on-line banking systems, but it is far behind in implementing client-server computing, local area networks (about one-fourth the U.S. level), and the Internet (one-tenth the U.S. level). Internet mania finally arrived in 1995, but the high cost of telecommunications and access services limited the diffusion of Internet use in Japan. The greatest benefits from PCs come when they are connected together in a network, creating "network economies" that can only be accomplished when a considerable number of computers are linked together .[80] Japan has been slow to realize these benefits.

The Japanese market has been conservative, lagging behind the United States in shifting from mainframes to PCs and adopting the Internet. This is partly because computer vendors did not encourage users to give up their expensive proprietary mainframes for cheap PCs. It is also due to the conservative nature of user organizations. Big companies were accustomed to centralized computing systems, and there was no ground swell from individuals or departments demanding PCs on their desktops. The PC was seen by users as a tool for secretaries, not managers, and communications systems such as e-mail were seen as impersonal and difficult to use with Japanese characters.

The conservative use of computers in Japan has limited the country's ability to achieve productivity gains by applying information technology. The muted competition in the PC market before 1992 also put the computer makers at a competitive disadvantage internationally. Japanese PC companies were not able to use the domestic market as a base for developing competitive products as they had in other industries, such as consumer electronics and automobiles. With the Japanese PC market fragmented among different standards and

limited by high prices, no one could achieve economies of scale. Nor could they export the products they sold in Japan, since they were not built to international standards. Rather than an asset, the domestic market became a distraction that kept the Japanese industry from focusing on the U.S. market, where technology trends and standards were being set. The protected, profitable domestic market was big enough to support a few PC companies, reducing the imperative to do battle in more competitive global markets. This contrasts with Taiwanese companies such as Acer, which could not survive off the domestic market and so were forced to think globally.

The costs of a backward domestic market were even greater for the software and services industries. Close interaction between producers and sophisticated users is critical in the software development process. For example, the alpha and beta testing of new software generations provides invaluable feedback to software developers on the features desired by users and helps eliminate bugs before the program is commercialized .[81] Sophisticated users also find new applications for programs that help expand the market for a product. In the rapidly growing systems integration industry, interaction between providers and users is vital to improving the knowledge and capabilities of both parties.

The PC boom of the mid-1990s helped bring Japan closer to international levels of computer use. With PCs, networking, and Internet use became more widespread by 2000, Japan finally came more into the mainstream of the global computer market. This change may still help Japan reap productivity gains in industry and government by 2004. NEC giving up the PC98 system and the unification of much of the Japanese PC industry around the Wintel standard made it more competitive internationally in hardware, but the prospects for the software industry are less promising.

Human Resources

Japan has a large, high-quality pool of engineers to support its electronics and semiconductor industries, with particular strength in process engineering. Japanese universities granted 81,355 bachelor's degrees in engineering in 1990, compared to 64,705 for the United States.[82] Japan only produced 1,370 doctoral degrees in engineering, compared to 5,696 in the United States. Hardware skills such as electronics engineering have long been in high demand by the big electronics firms, which offer good salaries, job security, and prestige. This has lured top students into such fields, and the flow of top students into such companies has reinforced their competitive edge.

On the other hand, Japan has a serious shortage of computer professionals. While the number of software professionals as a share of total population in Japan is comparable to the United States, there is a much lower level of university-trained computer specialists. The number of graduates with bachelor's degrees in math and computer science was just 3,125 in 1990, compared to 42,369 in the United States and this trend continued through the 90's affecting the IT industry severely. It is estimated that only 20% to 30% of the courses offered in Japanese computer science programs are comparable to courses in the U.S. standard ACM curriculum.[83] The situation is worse in advanced degrees. Japan has never produced more than 88 doctoral degrees in math and computer science in a single year, while the United States produced 2,024 in 1993 alone.[84] Japan has also sent far fewer students to the United States for graduate degrees in science and engineering than have other Asian countries such as China, Korea, and Taiwan.

Most of the small number of computer science graduates ends up working for major hardware vendors or large software firms, leaving the rest of the industry to get by with university graduates from other majors and graduates of vocational schools, two-year colleges, technical schools, and high schools. User organizations likewise have a limited pool of professionals to draw upon. Most computer skills are developed through on-the-job training,

and few companies provide workers with systematic outside training in computer skills.

The lack of job mobility between Japanese companies often makes it difficult for companies to get experienced workers and limits the dissemination of skills throughout the industry. Also, the job status and compensation offered by the larger companies can not be matched by small companies, making it difficult for more dynamic small companies to get the skills they need to succeed. Strict limits on immigration into Japan shut off a supply of skilled foreign workers that has been very important to the U.S. industry. The shortage and poor deployment of human resources is an obstacle to Japan's ability to compete in computer systems, develop an independent software industry, and effectively apply computers throughout the economy. Not only does Japan need more computer professionals, it also needs to increase the computer literacy of its entire workforce, from top management to the shop floor.

Conclusion Part II

The main question that we posed for this section was: Point 2. Japan and Taiwan both experienced strong political intervention into the IT hardware industry however the end result was far different in each case why? And this answer can be summarized as follows:

Taiwan and Japan have taken largely different paths for the same policy goal mainly due to the institutional differences caused by different structures in business, state, and NPO / NGO sectors. These institutional differences in a combined way affect the interactions between the core players in the state and society and also affect the path dependency and options for their respective organizational strategies. By showing the different organizational strategies that were formulated and implemented by the states of Taiwan and Japan, and by uncovering the causes of such variation, this dissertation argues that the state and state-society relations

in the development of organizing institutions for all sectors (institutional development in particular) vary through time, across societies, and across industrial sectors. Once economic backwardness has been overcome to a certain extent, institutions in the state and state-society relations that have been formulated throughout the developmental process may vary across societies and across industrial sectors and also time. Different institutions, in turn, affect the interactions among the people involved in the policy-making process as well as in interest group representation in a given society, which may result in different political and economic outcomes as shown in this dissertation.

The combination of industry structure, domestic market, and national capabilities (especially human resources) explains why Japanese companies thrived as producers of high-volume hardware and became competitive in the mainframe business, yet struggled in PCs and software. The closely integrated keiretsu industry structure provided ready capital, reliable supply chains, and captive customers. The domestic market also served as a proving ground for both consumer electronics and electronics components that could be exported in high volumes. However, both producers and users were slow to react to the PC revolution. Vertical integration left Japan partly isolated from the dynamic global production system for PC hardware. Software factories were of no use in creating packaged software. Entrepreneurial start-ups were starved for capital and access to distribution channels. And engineers, programmers, and other professionals were trained to be average, and they were lured into large organizations that offered prestige but discouraged innovation. Only in the 1990s, faced with a slump in the entire electronics industry, did Japanese companies begin to make changes in their corporate cultures and practices, and these changes have been very slow at best.

These facts return us to the question raised earlier concerning the ineffectiveness of Japan's industrial policies in the PC era. The concept of the capitalist development state rests on the notion of enlightened industrial policy guided by an economic "pilot agency" and carried

out through close cooperation between government and industry. The prototype for this model was Japan's Ministry of International Trade and Industry or MITI, which has been credited for engineering the Japanese economic miracle, in particular by targeting key industries and successfully "choosing winners" in those industries. This appeared to be exactly the case in the development of Japan's mainframe computer industry. Why then, was MITI unable to help the Japanese computer industry make the adjustments necessary to compete in the PC era?

Japan's large, vertically integrated firms were well suited to high-volume, capital-intensive components production. They also did quite well in the relatively stable mainframe industry, because they could marshal the necessary resources within their keiretsu groups and count on the members of those groups as captive customers. However, in industry segments such as PCs, ICs and hard disk drives, where product cycles are short and timing critical, the Japanese industry structure was a liability. Unable to make decisions quickly, Japan's computer makers had limited success in such businesses. Also unwilling to take advantage of global human resource diversity, possibly the only strategy that could have been successful, was never even pursued. By analyzing the institutional conditions of both domestic and international political economies that have affected the developmental processes of the IT hardware industry, this thesis will first explain how Taiwan and Japan could develop such impressive IT industries, and second, will uncover the causes of national variation between them. Only then can we go on to explaining the new Win-Win OEM partnerships that have formed between Taiwan and Japan within the IT hardware industry and why Taiwan's organizational strategy was able to formulate a totally new paradigm in the IT world. Both Taiwan and Japan have made successful bids into the IT hardware industry through a "accelerated catch up strategy." Accelerated catch up strategy means the state initiated a broad strategy that would focus on building an industry that didn't already exist by using state initiatives and tax incentives to put it into motion where it would not have developed on its own in the free market place.

Part III. Bureaucracy and NGOs in IT Industries: ITRI & MITI

Introduction Part III

Japan's Bureau Pluralism & Taiwan's Open Pluralism is the topic of Point 3. What was unique about Taiwan's state-business and state-society relations for IT hardware development and how did the human resource diversity strategy of "open pluralism" for state institutions differ from others using "bureau pluralism" such as Japan and South Korea?

In the developmental history for Taiwan and Japan, it was shown how the unique state-society relations and organizational strategies in Taiwan and Japan affected the formation of formal and informal institutions concerning the development of the IT hardware industry in which the state and societal actors interact with each other. It was argued that the Taiwanese state has played so dominant and pervasive role not because of the strong and autonomous state that was envisioned by the early statist literature, but because of the institutional strategies and state-society-business relations that are unique to the political economy of the accelerated industrial catch up strategy for IT in Taiwan. It was shown that although Taiwan's state literally built the whole IT sector in the beginning, it also built an enhanced version of a highly diverse free market "rules of the game" which unlike Japan and South Korea, did not grant special privileges to certain large firms but rather built a transparent and level playing field embracing both small and large enterprises. Taiwan also avoided bureau pluralism by embracing an open pluralism institutional strategy that involved the privatization of government think tanks and the spinning off of almost all state research programs into the private sector in order to create the fullest possible diversity of human resources.

Japan seemed to have all the ingredients for success in the PC era, from strong manufacturing skills and control of many key components technologies to a corporate structure that could support a sustained drive into export markets. Yet in spite of their success in components and peripherals, the Japanese computer makers have had only limited success in PCs, and have been virtually shut out of the software industry. The reasons for this mixed record are complex, yet the most important have to do with Japan's industry structure. Japan's large, vertically integrated firms were well suited to high-volume, capital-intensive components production. However, in industry segments such as PCs, ICs and hard disk drives, where product cycles are short and timing critical, the Japanese industry structure was a liability. Unable to make decisions quickly, Japan's computer makers had limited success in such businesses. Also unwilling to take advantage of global human resource diversity, possibly the only strategy success was never even pursued

Industrial policy in Japan was guided by MITI throughout most of the postwar era. MITI's preeminent position as an economic "pilot agency" was explicitly linked to Japan's economic miracle in 1982 by Chalmers Johnson's MITI and the Japanese Miracle. MITI's specific role in promoting the computer industry was brought to light in books and articles by scholars such as Marie Anchordoguy, Martin Fransman, and Fumio Kodama.[101] However, at about the time that the rest of the world was becoming aware of MITI's role in directing Japan's industrial development, MITI found itself facing competition for policy leadership in the information technology sector from an unexpected rival, the Ministry of Posts and Telecommunications (MPT). The catalyst of this competition came in the early 1980s with the arrival of value-added networks (VANs) that provided on-line information and digital communications services. VANs were an early form of convergence between computers and communications, and since communications were involved, MPT saw regulation of VANs as

falling under its jurisdiction. From 1981 to 1984, MPT battled MITI over how to regulate VANs, with MPT favoring stricter regulation and MITI favoring more competition. In the end a compromise was reached, but MPT had successfully staked its claim to a piece of information technology policy turf.[102] Right at the time when MITI was starting to open itself up to global diversity it then became stuck in the Japanese system of bureau pluralism or the in fighting between ministries within the closed bureaucratic structure of Japan (青木 1995 pp.23-46).

Section 3.1 Diversity of Institutions: NGOs & NPOs & IPOs

3.11 The General Definition of NGO, NPO and the Triangle Method

In most countries around the world organizations are divided into the 3 sectors of government organizations or the public sector (the first sector), private businesses (the second sector) and non-government organizations (or NGO's the third sector) that is now mostly non profit organizations (NPOs). All three types of organizations fulfill very unique and important roles within most societies around the world. If we look back 150 years ago in Europe and the USA, NGOs or the third sector made up a very small portion the economy in most countries usually only 2-3 percent and those were mostly religious groups. However, along with the later stages of the industrial revolution came the need for labor unions, charities, educational funds, volunteer civic groups, private think tanks and many other useful associations. These groups were grass roots organizations that had direct contact with every person in society. They had some aspects of government organizations and other aspects of private businesses. Their greatest value to society was to act as a concrete link between the government of a country and its citizens.

When we think about it, without NGOs there would be very little contact between a government and its people except for their work place, that is, private businesses. The problem with this is that in modern society there is a natural adversarial relationship between

most employers and employees that has usually been a constant part of modern society. This leaves NGOs as the only ideal form of connectivity between the state government and its citizens down below. In addition, NPOs now account for more than 80% of all NGOs because of the widening scope of the tax free status they have acquired over the last 70 years in most western countries.

Many important research institutes as well as charities and international co-operation associations are now listed as NPOs. In countries such as the USA, Canada and Taiwan some of the leading research centers for IT and medicine have made the transition from either government organization to NPO or from for profit NGO to non-profit NPO. There are now NPOs with an annual revenue of nearly one billion $US. The status of NPO laws is unique to every country but in general they have many similarities that we will point out in order to create a working definition to be used in this research. Although there are no international laws or guidelines for NPOs (just like private businesses) the common traits do seem to exist as follows:

Table 3.01 The 5 General Aspects of NPOs Around the World

1. The main purpose of activities is not to make a monetary profit.
2. The main purpose of activities is to try to somehow improve domestic or international society in some specified way.
3. The statement of purpose and parameters of activity are clearly stated within the NPO charter.
4. Organizations with the status of NPO get tax reductions.
5. People donating money to NPOs can receive a tax deduction on their corporate or personal income tax filings up to a certain specified limit.

In general these 5 aspects are common in most countries that legally accept NPOs

around the world. The only difference is that some countries include religious organizations as NPOs and some don't. Also the amount of tax deduction allowed on each corporate or personal income tax filing is different for each country with Japan being the only developed country to not allow any income tax deductions at all on every kind of income tax filing. Because these 5 aspects are very common to most NPO laws around the world, these will be used as our working definition NPO for this research.

The Working Definition of NPO and NGO for this Study

The definition of NGO does usually include NPOs as one common type of NGO but for the purpose of clarity in this thesis we will use NPO to mean only those NGOs that have the legal status of NPO in the home country and we will use NGO to mean any organization that doesn't have the legal status of a NPO, business or government organization in the home country.

The Triangle Method for Public / Private Sector Balance

Simply put, this is just bringing about a balance between the three basic types of institutions in a country: the balance and co-operation between the state, business and NPO / NGO sectors. Each state has its own unique organizational strategy for which it decides on the role within the triangle of each of these types of sectors. The striking characteristic about the Taiwanese state is its active participation in forming and promoting literally dozens of specialized NPO organizations. Some like TSMC and UMC went on to be spun off as companies and others like ITRI and ERSO became autonomous NPOs. In 1995 more than 60% of all Taiwan IT patents were acquired by NPOs and they made up 5% of the economy. In Japan for 1995 there were zero IT patents and zero percent of the IT economy for NPOs in Japan because the law that officially allows for NPOs was not passed until 2001. This has led many Japanese scholars to speculate on what could have been the role of non-profit research institutes in Japan if they had been allowed 10-30 years earlier.

3.12 The Role NPOs and NGOs in Japan's Economy and IT Hardware Industry

It may surprise many people that the Japanese government has only recently in 2001 passed a new law that recognizes non-profit organizations (NPOs) officially into the Japanese system. In Taiwan and many other countries NPOs have played a key role in supporting rapid technology development and even supplying most of the cutting edge research. Therefore, it is critical that we at least take a look at the possible damage caused to Japan's industries by not allowing NPOs for the last 100 years. Although Japan has allowed special groups called "shadan hojin" and others to fill the role of NPOs, actually the strict regulations, cumbersome incorporation process and lack of almost all tax benefits means that they weren't really acting as NPOs. Here is a quote from one leading Japanese NPO expert Tsuyoshi Kusumi describing the government attitude in Japan:

> The implied meaning of "expanding NPO and civil activities" is that proper, balance between the societal sectors both state and civil society must be recovered and actualized. If we imagine a see-saw with the public and business sectors on the left and the NPO / Civil sectors on the right, it is easy to see that our see-saw is pulled down on the left side heavily favoring the public and business sectors while consuming the lion's share of society's resources. On the other hand, the social existence of the NPO / civil sector is taken too lightly appearing as just a small speck on the right side of the imbalance. The result is an imbalance of social values that weighs far too lightly the significance of autonomous and life values within the private sectors civil society. Therefore, we must work on strengthening this sector and bringing back balance through NPO clearly making civil society activities more of a "main social pillar" in Japanese society. (Kusumi 2002 p.24)

The primary problem is that Japan has no balance between the public and private sectors that would allow more specialized and various services to society. He then goes on to explain the historical background in Japan:

> The fundamental problem of Government-NPO relations concerns the method by which the supplying of social services is apportioned between the state and civil sectors. Starting from the Meiji period until now the fixed hegemonic posture of the central government and bureaucratic system has dictated to Japanese citizens under the two concepts of "hard labor as the duty of citizens, public

service as the duty of the state" and also "good citizens are state ignorant and state dependant". In addition to the above system, the effect was multiplied by the peoples' consciousness of "okami" (the state as supreme overlord), where private enterprises and especially civil society were strictly excluded from providing mainstream public services and it was considered that only the government should have the responsibility and play the role of monopolizing the provision of public or social services. It can be said that this resulted in an extreme limitation on the chances for civil organizations to be a main pillar in providing social services. In other words, the state was the overwhelming central actor while private enterprise and civil society were only considered as playing the role of helper or participant, and although civil society had decided intentions of "public" and "dynamic" civic vitality towards public affairs, its ultimate expression was shown by mere "participation".

In regards to the present social demands for establishing NPO, the master servant relations of the existing public services means that changes are being pressed for. Another factor is that the limitations are being revealed for the existing public service structure and policy structure of Japan's highly centralized government. It would not be an exaggeration to say that Japan's government exists in a backdrop where both the national and local citizens have discredited it. . (Kusumi 2002 p.24).

This shows a stark contrast to the state in Taiwan where the government not only promoted the full recognition and benefits of NPOs but also even spent a lot of state money to set them up and then spin them off as autonomous organizations. Kusumi then goes on to say:

…hot debates have been rising up through the central government and even in the local government about reforming the legal system and the movement towards state support civic activities. As mentioned above, the balancing of the current imbalance in Japanese society between the state and private sector (including NPOs) is our most important fundamental goal and also the way towards expanding on the meaningfulness of NPO in Japanese society. Nevertheless, if the state labels something as "support" but then goes ahead and keeps interfering with NPO operations, then the result is the expansion of the first sector (government) and the contraction of the third sector (civil society). We are still in the situation where the appropriate amount of social resources is still not

> flowing to the NPO side of society (i.e. the third sector). It is because the first sector monopolizes public services too much so, consequently, Japan has this misbalance of social resources. . (Kusumi 2002 p.26)

Because the Japanese state has not allowed the type of NPOs that Taiwan, USA and Europe has had, we can only wonder about how much they might have contributed to Japanese society if they had been allowed 30 years ago or even promoted as in Taiwan and other countries. The Taiwanese state actually allowed many huge government research groups like ITRI and ERSO to become NPOs in the 1980's. This was a huge advantage for Taiwan because of the vertical division of labor approach to organizational strategy.

Section 3.2 The Case Study for ITRI and ERSO (1974-78)

Sometime in August 1974, Dr. Yun-hsuan Sun,[33] then the Minister of Economic Affairs, visited Dr. Wenyuan Pan,[34] a Chinese-American electronic engineer employed at RCA at that time, and asked his advice about how to promote the high-tech industries in Taiwan. After having serious talks for three days, they agreed three major points: 1) The electronics industry is the most important sector to be promoted in order to upgrade Taiwan's industrial capability, and having IC technology is the key for the success of the electronics industry; 2) IC technology should be purchased rather than developed by the Taiwanese themselves because the latter would cost too much and take much longer time than the former; and 3) In order to prepare and undertake various IC projects, overseas Chinese engineers and scientists should be mobilized because no one in Taiwan was familiar with ICs at that time.

Considering Taiwan's industrial capability in the early 1970s, which was still highly labor-intensive by all standards, these decisions might be viewed as a pie in the sky dream. But Taiwan had to upgrade its industrial structure anyway due to the increasing competition from the less developed countries. Electronic products are diverse, ranging from watches, toys, and

color TVs to VCRs and automation equipment. ICs as major components for electronic goods are also diverse, which allows Taiwan to take advantage of many diverse niche markets. Taiwan's having a small and medium size corporate structure was thought to be well suited to the diverse niche markets, some of which could be accessed with relatively low technological levels. The highly educated work force that Taiwan has boasted of was considered an additional advantage for Taiwan. The availability of overseas Chinese engineers was a particularly good comparative advantage, which was viewed as a critical factor for Taiwan's technological upgrading. By aiming at small niche markets that require low levels of technology, it was believed that the electronics and IC industries in Taiwan could have international competitiveness.

After having agreed with Dr. Sun, Dr. Pan organized the Technical Advisory Committee (TAC) in 1974, with seven initiating members in the United States. TAC's original mission was to assist Taiwan's effort in upgrading industrial structure. For the IC industry, TAC's mission was to provide necessary advice to launch the first IC project, which included the selection of a particular technology on IC specification and the invitation of bids for technology imports. TAC is continuing its service today, and getting stronger in its role as an advisory committee for the electronics industry (ICs as a part of it) and other S&T policies.[35] As a result of a series of meetings, TAC members agreed upon the following four points and submitted a report to the Taiwanese government.

First, technology transfer should be opened to bids from a variety of firms mostly in the United States. They finally decided 14 companies as bidders, and sent letters of invitation. Eight out of 14 companies replied to TAC's bidding request, and RCA was selected as the source of technology import.[36] Second, they decided CMOS as the specification of IC technology in Taiwan. This is considered a landmark decision because CMOS turned out to be the major specification for various IC products in the following decades. Third, TAC members agreed upon

the importance of manpower training for subsequent IC projects. In fact, one of the most important reasons for the selection of RCA as the source of technology was said that RCA agreed to provide technical training as well as design and production capabilities including the information about product applications.

The fourth decision was about how big the core group should be, that is, how many people should be trained at RCA. After consulting many IC specialists such as Morris Chang, then the Vice-president of Texas Instrument (TI), TAC decided the size of the training group should be 40. Most of the groups were graduates from local Taiwanese universities such as the National Taiwan, Chinghua, and Chiaotung universities. As will be shown later in this section, these 40 people who were dispatched to RCA for one-year technical training evolved to be the core group in the developmental process of the IC industry in Taiwan.[37] Based upon the TAC report, the Taiwanese government signed a technology transfer contract with RCA under the condition that RCA would provide not only production technology but also other benefits such as manpower training and on-site technical assistance.

In the meantime, Minister Yun-hsuan Sun of the MoEA tried to create the necessary organizations for the successful implementation of the IC project within the Taiwanese government. First of all, ITRI was founded in January 1973. Dr. Sun diverted electronics R&D from the existing telecommunications laboratory under the Ministry of Communications (MoC) into the newly established ITRI.[38] ITRI was placed directly under the MoEA where Minister Sun could exercise an exclusive control. Opposition from other parts of the government against this new organization was heard, but it has been said that Minister Sun could overcome all those criticisms without much difficulty because of his political influence within the Taiwanese state as well as in the KMT leadership.

As a national research institute, ITRI undertakes applied research for the

development of industrial technologies. It carries out long- and medium-term applied researches relevant to national needs, and most of these R&D projects are financed by the state. The results of research are transferred to private firms at the appropriate time through multiple channels. ITRI has eleven divisions according to the strategic sectors to be promoted.[39] The electronics industry was designated as one of the strategic sectors, and in September 1974, ERSO was established within ITRI as a main research-organization for the electronics industry. For the purpose of developing electronics technologies in Taiwan, ERSO concentrates on five technology areas: ICs, computers and communications, industrial automation, quality and reliability, and thin film technologies. ERSO develop various IC technologies including consumer ICs, communication ICs, ASIC designs and VLSI, and transfers them to the private industry for commercial production. At first, the head of ERSO came from the telecommunications laboratory, but only one year later, Dr. Tinghua Hu, who was a professor of the National Chiaotung University, replaced him. Both ITRI and ERSO were entirely funded by the state in this early stage before becoming NPOs. Their budgets are screened by the MoEA, reviewed by the National Science Council (NSC) and the STAG, and then approved by the Executive Yuan and the Legislative Yuan.

By 1975-76, everything needed to start the first IC production was ready. Organizations such as ITRI and ERSO were set up; 40 local engineers trained at RCA were just about to come back; equipment needed for production was purchased and shipped to Taiwan; and facilities for research and pilot production within ERSO were constructed in Hsinchu. Engineers from RCA came to Taiwan in order to provide on-site technical assistance according to the technology transfer contract. In 1977-78, the first trial wafers were produced, and the 40 local engineers trained at RCA took over various positions in ERSO. After this first pilot production, ERSO began to produce and sell wafers along with continuing R&D activities. The profits from the sales of silicon wafers and the fees paid by the private manufacturers in return for technology transfers became another source of ERSO's budget.[40]

As various interviewees admit, there was much criticism and skepticism about this first ambitious IC project within the Taiwanese government. To take an example, economic bureaucrats severely criticized Dr. Pan and his colleagues because of the impracticability of such a huge project with so few resources amounting to only about $15 million. The opponents argued that Canada failed to accomplish a very similar project even though it spent more than ten times of the amount which the Taiwanese were going to spend.[41] All this opposition, however, was successfully managed by the powerful Minister Sun, and the crews for the Taiwanese IC development could continue a relatively peaceful march toward the next phase.[42] This was possible mainly because of Minister Sun's political power and influence emerging from his occupation of the minister ship of the MoC, the MoEA, and later the Premier of the Executive Yuan, as well as his membership of the Central Standing Committee of the KMT.

ITRI started its own incubator to help entrepreneurs start up their new technology-based businesses, and in the process to contribute to the growth of innovations and the continuous regeneration of an environment conductive to entrepreneurship. Outlook: providing a favorable environment to smooth the way for the entrepreneurs to shape their technological ideas into new businesses. Management: provided by ITRI's investment arm - the Industrial Technology Investment Corporation (ITIC)

Details of ITRI's Incubator and Organization

Floor Space: 89,000 square feet in ITRI's new R&D complex Targeted Capacity: 30 to 35 tenant companies on a full-occupancy basis at a 2-year average incubation period

Residence Period: no more than three years Rental Subsidies

・First year: 25 percent

・Second year: 15 percent

・Third year: 5 percent

Present Status

・ In operation since July 1996

・ Total tenant companies incubated: 68

・ Graduated tenant companies: 41

・ Present occupancy: 26 companies at a total square footage of 64,000 (71.55 percent of total available space)

Source：ITRI Yearbook (2001 pp.35-54)

The Role of NPO's Spun Off From State Agencies:

The ERSO has played a major role in the expansion of the private sector by providing necessary technologies and personnel. As discussed earlier, mainly the people from ERSO who were trained at RCA in the early 1970s formed the UMC and the TSMC.[23] Mr. Ding-yuan Yang, who is also one of the 40 original trainees at RCA, established another private firm, Winbond. Mr. Yang left ERSO in 1987 with a large number of personnel and started his own business. Other private companies such as Advanced Device Technology (ADT), AMPi, and Hualong Microelectronics Company (HMC) took a similar step to acquire proper technologies and personnel (see Table 3.4). The ERSO has also served as a major source of manpower training for the newly formed private firms in the IC industry. According to the employees at Winbond, most of the workers in private firms began their careers in the ITRI/ERSO (June 2000). They usually find better jobs in private IC firms after working at ITRI/ERSO for about a couple of years. Mr. Chin-tay Shih, the executive vice-president of ITRI, said that the core technologies and talents of every company in the HSIP are linked to the ITRI. The ITRI has approximately 15 per cent turnover rate annually, which implies that each year about 800 of ITRI/ERSO's staffs leave to join private firms or to start their own businesses.

Beginning in the 1990s, the role of the ITRI/ERSO as a source of IT hardware technologies and manpower decreased a little due to the newcomers such as TI Acer and Macronix (see Table 3.4) that entered the IC industry in the form of foreign direct investments or joint ventures. Acer (formerly Multitech), Taiwan's leading computer manufacturer, concluded a technology transfer agreement with TI in 1989, and became the seventh IC manufacturer in Taiwan. The initial investment for TI-Acer was $250 million, which was shared between Acer (74 per cent) and TI (26 per cent).[49] TI-Acer began its production in the middle of 1991. It became the first private IC firm (though it is a joint venture between foreign and local capital) that acquires necessary technologies from the sources other than the ITRI/ERSO. Other IC firms also concluded many technology transfer contracts with such foreign companies as Intel and Motorola mostly on memory chips. The state, mainly the Industrial Development Bureau (IDB) of the MoEA, does not intervene in the conditions of technology transfer contracts, according to the director general of the IDB.

The changes in the private sector indicate that the monopoly influence of the high-tech circle, originally trained at RCA and served in ITRI/ERSO, upon the national IC project began to be eroded. Along with the roles played by the STAG and its TRBs, the expansion of the private sector became an important source of change in Taiwan's IC policy toward a more aggressive direction, that is, the adoption of the sub micron project and the entrance in the DRAM business.

It has been said that the sub micron project came out in discussion with the private manufacturers. This procedure is quite different from the policy-making process in the previous phases, during which an enlightened vision of high-ranking public officials advised by overseas Chinese engineers and/or foreigners directly became policies. This, however, does not indicate that the private sector was the primary source of influence in pursuing the sub micron project. This is so mainly because technological upgrading toward the sub micron level was inevitable

for Taiwan in order to survive in the competitive world market. ERSO had the same opinion and tried to get approval for the sub micron project from various related state agencies such as the IDB of the MoEA, NSC, and STAG. Although Taiwan's industrial policy-making process allows the participation of various societal actors, the actual contribution of the private sector to a particular project seems to be minimal due to the highly centralized S&T policy-making network that will be discussed later.

The sub micron project had been discussed since 1985, but it was not decided until 1988. In August 1989, the ERSO submitted a Five Year Development Plan for developing sub micron technology to the MoEA. The plan involves an expenditure of NT$5.5 billion, and the six existing companies as of 1989 were invited to participate in the project (Meany 1990, 13). The NSC wrote another long-term plan called the Science and Technology Development Plan that will last for twelve years beginning from the fiscal year of 1991/92. According to the IC section of the NSC plan, the first part of the sub micron project covers the period between 1991 and 1995, during which basic technology for about the 0.3-micron level would be developed. The second part covers the 1996-2000 period, during which applied technology for the 0.3-micron level will be developed. Based upon the NSC plan (and ERSO's original plan), a sub micron laboratory was established at the National Chiaotung University in Hsinchu, and the construction of a building for another sub micron laboratory within the ERSO began in November 1990. Both laboratories were entirely funded by the state, both for the construction of facilities and the needed R&D investments.

Another progress made during this final phase is the decision to enter into the DRAM business. In fact, sub micron technology is a prerequisite for the production of the advanced DRAMs. Until 1989 Taiwan's major IC products were limited to consumer ICs, basic communication ICs, and relatively simple ASICs, in which about one-micron level of the design technology would be enough. In the past, DRAM production had been viewed as too risky a

business, and Taiwan's high-tech circle, mainly the people from RCA/ITRI/ERSO, had tried to find low technology niche markets that would be appropriate to Taiwan's technology level as well as the small and medium-size business structure. DRAM business requires not only a high technological level but also huge initial investments for facilities and continuing enormous R&D investments for survival. Moreover the Japanese and Korean DRAM producers are already far ahead of Taiwan, and it would be very difficult for Taiwan to catch up to those forerunners. Thus the decision to enter into the DRAM business represents a dramatic departure from the previous policy direction in Taiwan.

Section 3.3 Bureaucracy and Open Pluralism in Taiwan's IT Success

3.31 The National Science Council and National S&T Conferences

Taiwan's effort for S&T development dated back to 1959 when the government approved the "Guidelines for National Long-term Science Development." The major thrust of the Guideline was to cultivate an environment for S&T development in Taiwan. In 1959 a task force named the National Long-term Science Development Council was established. In 1967 the Science Development Steering Committee under the National Security Council of the Office of the President recommended an expansion of the above task force and renamed it as the National Science Council. From that time on, the NSC has served as the top agency on S&T development in Taiwan. Located directly under the Executive Yuan, the NSC has eight divisions that cover different S&T areas and three special subunits.[50]

The NSC is charged with the planning and promotion of S&T development in Taiwan. Its official functions include "drafting S&T policies and strategies as well as proposing plans and programs for S&T development; promoting both basic research and applied technology pilot research; improving science and technology research environment; and cultivating and recruiting S&T personnel". (NSC 1988, 18). All policy proposals and/or recommendations

regarding S&T issues in Taiwan should go through the NSC. Depending upon the contents of policy proposals, several divisions are involved in order to review their appropriateness. For example, the Science-Based Industrial Park Administration may evaluate proposals on ICs, analyzed, and integrated by the divisions such as Engineering and Applied Science, Science Education, and Planning and Evaluation. Thus in reality, a major function of the NSC is to coordinate S&T policy proposals and/or recommendations from various S&T related units within the government so as to reduce the possible waste of scarce resources. Another important function of the NSC is to adjust those proposals according to long-term plans, and thereby to guide national S&T activities to accomplish the goals set by the government. One manager from the NSC describes the NSC's activities (and S&T policy-making in general) as "something in the middle of the totalitarian and anti-statist modes." He adds that certain types of "art" are necessary in order to build a consensus or agreement among the related government agencies. [51]

All ministries and government agencies can submit policy proposals and recommendations. Perhaps the most important source of recommendations for long-term S&T policies would be the National Science and Technology Conference held once every four years. Hundreds of S&T specialists get together, both at home and abroad, with entrepreneurs as well as administrators from government agencies, and evaluate the past performance and discuss the future direction of S&T development. The first National S&T Conference was held in 1978, and the results of the Conference was adopted by the NSC and approved by the Executive Yuan in May 1979 as the "Science and Technology Development Program." In this program, four strategic sectors were identified: energy, material, information, and automation. The IC industry was viewed as a part of the information sector. A direct outcome of the Conference on the IC industry was the formation of the STAG directly under the Premier of the Executive Yuan.[52] In the second National S&T Conference held in 1982, four more sectors were added as strategic sectors,[53] and the Taiwanese S&T policies were revised according to the

recommendations made by the Conference. The main thrust of the second Conference was about training and education of high quality S&T manpower, and the "Technical Manpower Cultivation and Recruiting Program" was adopted in 1983.

The third Conference was held in 1986, and the Ten-year S&T Development Plan that covers the 1986-95 period was adopted by the NSC, and approved by the Executive Yuan. Though the Plan covered virtually all aspects of S&T development in Taiwan, two segments were particularly important to the IC industry. One is about R&D investments (NSC 1986, 9-13). The Plan demanded continuous increase of overall R&D investments toward the next decade and efficient allocation of R&D funds. More importantly, the Plan adopts several policy measures in order to encourage private R&D investments such as tax incentives, subsidies for private R&D projects through the ITRI, government procurement, and so on (NSC 1986, 31-3).

The other segment concerned the development of the high-tech industries. For this purpose, the Plan identified five policy measures: 1) Provide further guidance and assistance to high-tech industry investments; 2) Promote joint ventures in high risk projects; 3) Further develop the HSIP; 4) Promote regional characteristics and resources to develop a "community" among industry, schools, research institutes, and government agencies; and 5) Support ITRI in developing or importing necessary technologies (NSC 1986 pp.34-5). The fourth S&T Conference was held in 1991, and the NSC based upon the recommendations made by the participants in that conference as already discussed prepared a 12-year plan.

3.32 The Ministry of Economic Affairs

Because IC technologies are classified as an industrial technology, the MoEA that is in charge of industrial policy is the single most important state agency in promoting the IC industry. Within the MoEA, three organizations are particularly important in making and implementing IC related policies: 1) The IDB whose major responsibility is to implement

policies for the purpose of promoting industrial technologies; 2) The ITRI/ERSO, one of eleven non-profit state-run research institutes under the MoEA; and 3) the Office of Science and Technology Advisors (OSTA), whose main responsibility is advising the Minister of Economic Affairs on S&T issues.

Located within the MoEA, the IDB is primarily responsible for implementing S&T policies in Taiwan. It also serves as a source of policy proposals and recommendations because all the S&T related proposals prepared by ITRI and ERSO are submitted to the IDB. The IDB has three major functions in promoting the industrial development in Taiwan. The first function is policy recommendations for industries such as tariff structures, new industrial products, and various incentive programs. The second function is to develop and evaluate R&D projects. Each year the IDB makes about 140 R&D contracts with universities, research institutes, and private producers in order to upgrade industrial technologies in such sectors as electronics, information, automation, and quality control. The third major function concerns administrative works for private firms such as company licensing and regulations.[54]

The IC industry was designated as one of the strategic sectors to be promoted in 1979. Even before this, the MoEA, the IDB to be more specific, had played a crucial role for the inception of the IC industry because Dr. Yun-hsuan Sun was the Minister of Economic Affairs until 1978. Because the major state-run research institutes for ICs (ITRI and ERSO) were located under the MoEA, the IDB exercises a wide range of influence in making and implementing policies for the development of the IC industry.

In recent years, several policy measures were undertaken by the IDB particularly for the IC industry under the "ROC's Categories of Productive Enterprises Eligible for Encouragement Act," though they are not exclusively for the IC industry. First of all, tax holidays for four to five years and accelerated depreciation of the fixed assets are available for

the new IC firms or the existing firms undergoing expansion. A certain level of income tax reduction is available for the shareholders. High-tech firms are eligible for income tax ceilings (20 percent) annually. The 11313 also provides half of the costs for manpower training for private electronic and IC firms after 1990, and NT$20 million per year has been funded for this particular program. The IDB provides a half of the initial investment for the new IC firms (and for other manufacturing firms) as well. In addition, low interest rate loans for R&D and facility investments, and tariff exemption for the imports of machinery and equipments are important policy tools, which relieve much of the financial burden of the private manufacturers including many new IC companies. The IDB also devised a new program called "Important Technology Specialty IC Producers" for the IC manufacturers. The program aims to double up the total paid-in capital of the IC manufacturers in order to nurture big firms that can compete with the Japanese and Korean counterparts. As of the summer of 1991, all the existing eight IC firms applied for this program. By accomplishing this program, For example, it is expected that the investment capital of UMC would be increased from NT$3.93 billion to NT$6.67 billion. TSMC's paid-in capital is expected to be NT$ 6.67 billion from NT$3.9 billion, and TI-Acer's paid-in capital would be increased from NT$3.89 billion to NT$7.7 (data from the IDB).

As such, the IDB has played a crucial role in promoting the IC industry. Various subsidy programs such as R&D projects, training IC personnel, and doubling up the paid-in capital have been particularly important for Taiwan's IC manufacturers whose sizes are relatively small compared with the Korean and Japanese firms. Other crucial organizations such as ITRI and ERSO are closely coordinated with the MoEA. As explained earlier, Dr. Yun-hsuan Sun created these research organizations at the very beginning of Taiwan's industrial catch-up for ICs. Established in 1973, ITRI evolved to be the most important state agency in the development of the IC industry by proposing many policy recommendations as well as by engaging in actual researches on IC technologies. ERSO was formed in 1974 under ITRI with a special focus on the research in the fields of electronics and ICs. During the past

two decades, the size of ITRI and ERSO has grown remarkably. Beginning with 502 employees in 1973, the total number of employees in ITRI became 4,936 in 1988. ERSO has the biggest share in terms of employment size with 33 per cent or 1,632 employees (data from ERSO). As shown earlier, most of the IC project including the UMC and TSMC spin-offs was initiated by ITRI/ERSO.

Almost all the people in Taiwan's IC industry, both in the government and the private sector, usually begin their careers in these two organizations. Among many research institutes within the MoEA, ERSO has spent the biggest share of the MoEA's S&T expenditure. In the fiscal year 1990, For example, ERSO spent about 22.64 per cent of the total S&T expenditure of the MoEA that amounted to about NT$1,383 million (MoEA 1990 p.6). The ERSO, however, usually spends much more than that because it receives fees from private firms for transferring technologies as well as signing research contracts. According to interview with a senior manager in ERSO's marketing division (June 2000), about 60 per cent of ERSO's budget comes from the government and the rest comes from profits through technology transfers and other R&D contracts with the private sector. At the beginning, ERSO was entirely funded by the state. Making profits through the sales of wafers and technology transfers to the private sector was introduced in order to catch two birds with one bullet. On the one hand, it can relieve the financial burden on the part of the state, and on the other hand, ERSO can continue its R&D investments for upgrading IC technologies.

As profits grew, however, complaints were heard from two different directions. One was the complaint by the private sector (the UMC in particular), which argues that ERSO's marketing function has to be stopped because it hurts the private sector. The other was the pressure from the MoEA, which demanded that ERSO should not make too much profit. Ironically, therefore, ERSO's marketing division tries not to make a huge profit but to manage it at the level that the MoEA would be happy with. This can be interpreted in two different ways.

The pressure might originally be incurred by the private sector that directly competes with ERSO's marketing function. Or it might be pressure from the bureaucrats within the MoEA, who are afraid of ERSO's increasing role as an independent organization. They might think that their influence upon ERSO is being decreased due to ERSO's reduced dependence on state finance. Although not fully verified, I think the truth lies somewhere between the two. By and large, this indicates that agencies within the state are checking with each other and interacting with other social forces in making S&T policies, though in a limited way.

The OSTA within the MoEA is basically an advisory unit for the Minister on S&T issues. It reviews and evaluates numerous high-tech projects including those on ICs. The OSTA also communicates with the people in the USTG, the NSC, and overseas Chinese community with S&T backgrounds. This seems to be a very important function because by communicating with other S&T agencies, the OSTA links virtually all S&T organizations in Taiwan together. Other ministries also have their own Otis, and people in Otis work together very closely. Through the activities of the OSTAs, a certain amount of policy coordination between the related ministries can be made prior to submitting proposals or recommendations to the higher agencies such as the NSC. The IDB also makes contacts with the OSTA whenever it is necessary. In short, the OSTA under the MoEA not only serves as an advisory office for the Minister, but also plays the role as a provider of information, an evaluator-of S&T projects, and a communicator among various S&T institutions.

3.33 Other Ministries and Their OSTAs

Because ICs are indispensable in the information era, the MoEA is not the only ministry involved in the IC initiative in Taiwan. Notably the MoC, the MoE, and the Ministry of National Defense (MoND) have been closely related to the development of the IC industry, depending upon the contents and scope of individual projects. Each of these ministries has its own OSTA, which is mainly responsible for reviewing, and evaluating policy proposals and

recommendations submitted to its Ministry. The MoE and its OSTA are particularly important in terms of manpower policy. While the ITRI/ERSO put much emphasis on short-term technical training, the MoE plays a crucial role in the promotion of long-term S&T education.

Because of its emphasis on general education, the role of the MoE in IC development is relatively difficult to be distinguished. But the case of a sub micron lab established at the National Chiaotung University in Hsinchu clearly shows that the MoE has a voice in the IC policy-making process. Research funds for universities are available within the budget of the MoE, and the OSTA has a loud voice in determining proper research projects to be funded. Given the importance of qualified manpower for the successful high-tech development, the role played by the MoE should not be underestimated. As was the case of the OSTA in the MoEA, people in OSTAs within related ministries have a close relationship with each other as well as with other S&T agencies.

The Science and Technology Advisory Group

Established in 1979, the STAG was originally an advisory organization under the Premier of the Executive Yuan. It reviews S&T proposals, and makes valuable recommendations. STAG's recommendations are valued because they are viewed as the opinion of a third party. This has been the case because STAG members are all foreigners who are believed not to have vested interests with any local S&T groups and private firms in Taiwan. Recently USTG's role in the IC policy-making process has increased consistently as shown in the sub micron project and the decision to enter into the DRAM business. USTG members come to Taiwan at least once a year and participate in S&T Advisory Board meetings, in which other S&T agencies within the state, academic community, and the industries also participate. According to the people interviewed most of the annual projects on S&T policies are reviewed, evaluated, and coordinated in this meeting.

Academia and Overseas Chinese Engineers

Colleges and universities in Taiwan work very closely with other S&T players. Professors in engineering departments are consistently contacted by various research institutes and government agencies, and provide valuable advice. By participating in the National S&T Conference, people from the academic community exercise a certain influence upon the S&T policy-making process. Moreover most of research funds for universities are provided by the state. As discussed earlier, the sub micron lab at the National Chiaotung University is entirely funded by the state. In the case of the Department of Electrical Engineering at the National Taiwan University, a total of 111 research projects were awarded during the 1990/91 school year. Among them, 65 projects were awarded by the NSC amounting to NT$ 77,459,700; 18 projects were awarded by defense research amounting to NT$25,790,340; 8 projects awarded jointly by the NSC and the Telecommunications Lab under the MoC amounting to NT$7,626,500; 9 projects were awarded by the ITRI amounting to NT$3,866,176; and only 6 projects were awarded by non-state sources including industries which amounted to NT$4,200,370.[55] This means that about 95 per cent of total research funds available to the department during the 1991/92 school year had been funded by the state.

Overseas Chinese engineers have been very important players in the S&T policy-making process from the very beginning of the first IC project as shown in the activities of the TAC and Dr. Wenyuan Pan. The TAC is still active and provides valuable services to Taiwan's high-tech industries (see section 1.5 case study p.85 above). The IC industry itself may not be possible without the contribution of the overseas Chinese engineers involved in this critical initiating period. Recently the Taiwanese government has tried to bring talented overseas Chinese into the island in order to fill the shortage of high-tech personnel. Multiple channels are available through which the overseas Chinese engineers can participate in the S&T policy-making process including the National S&T Conferences and the TAC.

In short, Taiwan's policy-making process and the policy network can be summarized as follows. The ITRI and ERSO usually make proposals and recommendations. At this stage voices from the industry, academia, as well as other government agencies are heard. According to the interviews with the staff in ITRI and ERSO, academia is the most important source of influence at this stage, the role played by the private sector seems to be the least influential even though private IC firms have close personal connections with the staffs in such organizations as ITRI and ERSO. This is so not only because the private firms in the IC industry are not yet fully developed, but also because the relationship between the state and business has been more or less independent rather than interdependent since the KMT moved into Taiwan.[56]

Proposals prepared by ITRI and ERSO are submitted to the MoEA, which will review them with the help of the OSTA and the IDB. Other ministries such as the MoE and the MoC also can make proposals of their concerns. At this stage, certain types of communications are made with other S&T agencies through the OSTAs. Then the proposals are submitted to the NSC. The NSC evaluates and integrates proposals from a long-term S&T perspective usually formulated through the annual USTG board meetings and the National S&T Conferences. Once the NSC integrates proposals, they are submitted to the Office of the Premier, the head of the Executive Yuan. The Minister without Portfolio reviews the proposals, and the STAG plays a major role at this stage by providing necessary advice. The critical concern at this stage is about budget allocation. Once approved by the Executive Yuan, proposals are sent to the Legislative Yuan for final approval.

This policy-making system was established at first by the high-ranking public officials such as Dr. Yun-hsuan Sun and Dr. Kuo-ting Li, and later became institutionalized throughout the 1980s. As is clearly shown, Taiwan's high-tech policy-making process is highly centralized, first by the NSC, and then by the Office of the Premier with the strong influence of the USTG. At the same time, coordination mechanisms within the state as well as between the state and

society (businesses, academic community, and overseas Chinese specialists) are well developed in order to facilitate the central control of the NSC and the Premier.

One important missing part of this system is that the Central Standing Committee of the KMT and the CEPD are largely excluded. Despite the critical roles played by the KMT and the CEPD in Taiwan's economic development since the late 1950s, no one in Taiwan's high-tech circle mentioned about the roles played by the KMT party and the CEPD in the developmental process of the IC industry. This, however, does not mean that these two organizations have been completely excluded from the scene. Rather it implies that these organizations were at first successfully persuaded by the high-ranking public officials, particularly Dr. Yun-hsuan Sun. Later the aforementioned policy-making system has been fully institutionalized due to the successful accomplishments of a series of IC projects, and thereby these organizations did not have much to say about the on-going state's IC policies. This indicates that the S&T policy-makers in Taiwan could have a high degree of autonomy from other political entities, which was originally desired by its founding fathers.

Section 3.4 Bureaucracy & IT Policy in Japan: MITI and Bureau Pluralism

3.41 Introduction to "Bureau Pluralism" in Japan

Industrial policy in Japan was guided by MITI throughout most of the postwar era. MITI's preeminent position as an economic "pilot agency" was explicitly linked to Japan's economic miracle in 1982 by Chalmers Johnson's MITI and the Japanese Miracle. MITI's specific role in promoting the computer industry was brought to light in books and articles by scholars such as Marie Anchordoguy, Martin Fransman, and Fumio Kodama.[101] However, at about the time that the rest of the world was becoming aware of MITI's role in directing Japan's industrial development, MITI found itself facing competition for policy leadership in the information technology sector from an unexpected rival, the Ministry of Posts and

Telecommunications (MPT). The catalyst of this competition came in the early 1980s with the arrival of value-added networks (VANs) that provided on-line information and digital communications services. VANs were an early form of convergence between computers and communications, and since communications were involved, MPT saw regulation of VANs as falling under its jurisdiction. From 1981 to 1984, MPT battled MITI over how to regulate VANs, with MPT favoring stricter regulation and MITI favoring more competition. In the end a compromise was reached, but MPT had successfully staked its claim to a piece of information technology policy turf.[102] Right at the time when MITI was starting to open itself up to global diversity it then became stuck in the Japanese system of bureau pluralism or the in fighting between ministries within the closed secrete society of Japan (青木 1995 pp.23-46).

The Dilemma of "Bureau Pluralism" in Japan

Professor Aoki Masahiko has explained how the effective management of Japanese firm organization that endogenizes contextual skill formation has been supported by the complementarity of the contingent governance structure and the imperfect labor market. He argues that the contingent governance structure in turn has been supported by regulations restricting entry to many industries that have made it possible for these industries, such as main banks, to accrue rents. In Aoki's words:

> The regulation of entry into an industry and the protection of weak firms in disadvantaged industries has been one of the primary institutional elements sustaining the Japanese economy. By committing to the protection of the human capital value of the specific skills formed in each industry, they have provided economic agents with incentives to invest in contextual skills.. In Japan, most working people in all fields have been expecting the value of their human capital to be maintained through a multilayered structure comprising their employing firm, the industrial associations in their industry, and the ministry that oversees that industry. In my book published in 1988, this system was referred to as "bureau pluralism. The term "bureau" originally referred to a "drawer" and implied sorting or arranging something. The bureaucracy has played an important role as agent and arbitrator in

protecting the vested interests of pluralistic groups in different fields. However, "bureau pluralism" is not an "open pluralism" as vested interests protected by bureaucratic administrative mediations merely coexist and various organizational modes cannot be freely created. This joint gain by all parties was made possible by the existence of quasi-rents acquired from the international market by upgrading the machine manufacturing industry, which accounts for 80 percent of exports. It was maintained by distributing the quasi-rents attained by the internationally advanced sectors to the underdeveloped sectors through such mechanisms as domestic price distortion, taxes and subsidies, and entrance regulations.

If the learning or transplantation of these organizational innovations is combined with low cost factors of production overseas, the potential for the Japanese economy to acquire quasi-rents will rapidly decline. This trend will be further accelerated by organizational innovations or the emergence of new industries in other countries. In a previous work I referred to the following phenomenon as the "fundamental dilemma of bureau pluralism": advanced sectors that do not need bureaucratic protection tend to drift away from the bureau pluralistic framework, while less developed sectors tend to rely on it more.' As long as the acquisition of quasi-rents from the international market by the former is possible, the size of the pie that can be distributed among interest groups will expand, so that the maintenance of bureau pluralism will not be especially problematic. It may even contribute to social stabilization. (Aoki 2000 pp.129-131)

However, Aoki claims that if quasi-rents move toward extinction for the various reasons given above, the framework of bureau pluralism itself will be difficult to maintain. At that point he says that if comparatively disadvantaged industries seek continued protection, the advanced firms would either lose their competitiveness due to higher subsidization to disadvantageous sectors and interest groups, or would be under great pressure to move their manufacturing bases overseas to survive. The resulting dilemma would be that the only remaining employment opportunities would be in comparatively disadvantaged industries.

Aoki argues that, from the perspective of information processing, there is potential for the economy to continue to demonstrate efficiency in industries that can be characterized as

high engineering industries. He also points out that a fairly high possibility that new innovations will be implemented domestically in cross-industrial technologies, such as formation technology driven electronic machinery, retail and service sector networking, and environmental management technologies. However, the dilemma of bureau pluralism might grow more serious, threatening the loss of international competitiveness of the leading industries according to his argument. How should this be handled? Aoki says:

> The combined effect of such factors as the bounded rationality of individuals, evolutionary pressures, and institutional complementarity is a tendency for a more or less homogeneous organizational convention to be adopted throughout a particular economy. However, different organizational conventions will evolve in different nations. This is an unintended outcome of the workings of bounded rationality. This chapter has made it clear that the potential gains from organizational diversity cannot be fully realized on a global scale merely through free trade. This is a proposition that stands even if we assume a purely theoretical situation in which all resources can be traded and there are no costs involved in transportation, storage, etc. If we acknowledge the existence of resources or services that cannot be traded, the proposition gains even more credence.
>
> In Ricardian classical trade theory, the primary source of comparative advantage within an economy is the relative quantities of the "primary factors of production"- land, labor, and capital - which cannot themselves be moved between countries. The world can enjoy the gains of trade by first converting these factors of production into outputs that can be traded. What has been emphasized here, however, is that a world comprised of boundedly rational individuals can reap economic gains because of the diversity of "organizational modes," a human construct. Theoretically, these could have been constructed by human intent anywhere, at any time. (Aoki 2000 pp.131-32)

Establishing a new organizational mode different from the prevailing convention is not so simple regardless of whether it is a creative innovation or a transplant from outside. The skill types needed to sustain a new organizational mode may not be readily available in the economy, and the institutional structure supporting the existing organizational mode may not be conducive to experimentation with mutant modes. Aoki says this places an exceptionally

heavy burden on the Japanese economy, where bureau pluralism has been implemented, because tall barriers have been constructed to obstruct new entrants. By contrast, economies that have a regulatory stance are to allow free entry into industries, such as under the Anglo-American system, having institutional structures that are more tolerant of experimentation with mutant organizational modes. He then goes on to add:

> Accordingly, permanently solving the dilemma of bureau pluralism requires institutional reform that allows new organizational modes to be experimented with and implemented in industries where the conventional assimilated information structure is inefficient. There is no guarantee that the Japanese-type of horizontal hierarchy will maintain an absolute advantage in the industries in which it was originally an organizational innovation. The operations of a self-sufficient horizontal hierarchy may be especially inefficient in fields in which strategic alliances between various firms can be expected, like the communications industry. In these fields, the relevant systemic environment extends across several industries, and processing information regarding that environment may require a greater breadth of information processing capabilities than can be accumulated by a single firm. However, it is not yet altogether clear which organizational mode is most suitable for these industries. In the USA, firms are experimenting with various organizational modes and strategic alliances premised on information differentiation. Adaptable organizations will be evolutionarily selected through the process of experimentation and competition. This being the case, the framework of bureau pluralism should be revised to allow organizational experimentation even in industries in which Japan holds the comparative competitive advantage (Aoki 2000 pp.133-34).

Bureau pluralism is by nature resistant to institutional reforms that threaten the vested interests of certain interest groups, making it politically difficult to carry out radical reforms. However, bureau pluralism cannot be sustained, as the quasi rents are inevitably eliminated by the maturation of that pluralism itself and by changes in the international environment. As Aoki repeatedly emphasizes, attempts to sustain it would only result in the loss of comparatively advantaged industries. Thus, the only tenable choice remaining is to seek a new path to economic gains by lowering barriers in all industries and allowing the entry of diverse

organizational modes from both domestic and foreign sources in order to fully take advantage of global human resource diversity. Japan needs to make the painstaking efforts needed to endogenize the economic gains from diversity.

3.42 Bureaucratic Industrial Policy

By the 1980s, Japanese industries were reaching the limits of a strategy that depended on acquiring and applying technology developed elsewhere. Japan had caught up in many technologies, and foreign competitors were becoming more protective of their own technology. As a rich nation, Japan also was coming under international pressure to contribute its share to the creation of new knowledge. Meanwhile, MITI had become a victim of its own success in helping create Japan's manufacturing and export powerhouse and was casting about for a new role. There was no longer a need for outright protection or subsidies for most industries. Japan was lowering formal trade barriers under continued pressure from the United States and Europe. Other barriers to trade and foreign investment were embedded in the Japanese industrial structure-in the form of closed distribution systems, bid rigging in government procurement, and the "old boy network" of university alumni-and so MITI's protection was no longer needed. Also, Japanese corporations had gained confidence in their own capabilities and were less willing to seek or follow MITI's guidance.

The Ministry's role was therefore being reduced to the restructuring of declining industries and promoting imports to ease trade tensions not a very appealing prospect for the oft-proclaimed architects of the Japanese miracle.[85] It was also facing new competition from the Ministry of Posts and Telecommunications (MPT), which hoped to use its regulatory power over the telecommunications industry as a basis for expanding its role in the newly evolving information industries (Fallows 1995 pp.173-195). MITI saw more attractive possibilities in the realm of technology promotion, and it began to shift its emphasis from industrial policy to

technology policy.

R&D Consortia and Bureaucracy: In the field of computers, MITI was concerned about Japan's continued vulnerability to IBM's control over key standards and architectures in the mainframe industry. One way to escape this threat would be to develop a new architecture that would be superior to IBM's. In essence MITI was looking to leapfrog IBM by creating a new generation of computers incorporating artificial intelligence and parallel processing. To accomplish this, MITI employed a strategy that it had used in its efforts to catch up in mainframes and semiconductors-the R&D consortium (see Fallows 1995 pp.103-129). MITI initiated R&D projects aimed at moving Japan to the technological frontiers of hardware performance and developing a new generation of computer architectures. In addition, MITI supported consortia to develop non-IBM software standards for PCs and workstations.

The four major projects undertaken in the 1980s were the Fifth Generation Computer Systems Project, the Supercomputer Project, the TRON Project, and the Sigma Project. However, in the end, this project as well as many others failed because of Japan's bureau pluralism that avoided diversity strategies. At the same time in Taiwan and the USA both government and private technology projects had opened themselves to the wide diversity of the world human resource network actively welcoming the top IT talent from around the world regardless of race or nationality. In the USA and Taiwan most high-tech projects had more than 50% of the leadership and engineers that were globally diverse (Saxenian 2002 pp.3-24). Even large government projects in Taiwan and the USA often invited the best of the best from around the world to lead or participate in the top high-tech research projects. However, in the cases below for Japan, foreigners were never invited to lead a project or were they ever utilized for even minor engineering leadership roles. This is what Professor Aoki Masahiko of Tokyo University calls an "anti-diversity strategy" (青木 1995 pp.82-134).

Fifth Generation Computer Systems (FGCS) Project. The Fifth Generation Project was funded by MITI and the Science and Technology Agency (STA), receiving 54 billion yen (US$356 million) over eleven years. Eight computer vendors and NTT participated, but all refused to provide funding, feeling the project's goals were too vague and noncommercial. The goal was the development of computers based on parallel and inference processing architecture, rather than conventional Von Neumann architecture. The goal was to develop computers that would mimic some aspects of human thinking, achieving so-called "artificial intelligence."

The project initially drew a great deal of attention, because it offered the promise of a new generation of computers based on Japanese technology. Joel West notes that the project was used to manufacture hysteria in the United States, particularly by proponents of a more active industrial policy.[86] However, as the project progressed, it failed to live up to expectations and was labeled a major disappointment, especially by U.S. opponents of industrial targeting, who were anxious to pounce on such a failure. But while the project did not propel Japan to the forefront of computer technology, its backers claim that it accomplished quite a bit. In 1992, the Institute for New Generation Computer Technology (ICOT), which is the home of the project, exhibited prototypes of five types of fifth-generation computers produced by Fujitsu, Hitachi, Mitsubishi, Toshiba, and Oki. It also demonstrated more than twenty types of new software and released, free of charge, seventy-one software applications developed by the project[87] in the hope that research institutes and companies would develop commercial products (see Fallows 1995 pp.173-185).

Supporters of the project claim that the project allowed risky and future oriented R&D to be conducted, something that would not be carried out by the private sector. Still, there is no question that the project failed to come near its initial goals of creating a new computing paradigm in which Japan would be a leader.

Supercomputer Project: The Supercomputer Project, which ran from 1981 to 1989, targeted development of massively parallel processing (MPP) supercomputers. Parallel processing offers the possibility of tremendous performance gains over existing supercomputers, and the technology has potential applications in areas such as telecommunications. The technology was still in the early research stages and was too risky for the private sector to make major investments. So the project was funded completely by the government at a level of US$104 million over the life of the project.

Major areas explored were high-speed chip technology, Josephson junctions (high-speed switching using superconductivity), high-speed parallel processing, and control software. The six major computer makers were involved, with work divided up among the companies. NTT also conducted its own supercomputing research in cooperation with Fujitsu, Hitachi, and NEC. The Supercomputer Project was marked by a lack of cooperation among the participants that bordered on outright hostility. The work was done in-house and the companies were reluctant to share results with their competitors. The companies developed their own supercomputers with performance equivalent to American machines, but they were based on conventional technologies, not parallel processing.

The Sigma Project: The Sigma Project, conducted from 1985 to 1990, was aimed at improving software development productivity by providing developers with the latest technologies and tools. Another goal was to create UNIX-based software as an alternative to software based on IBM's proprietary operating systems. All the major Japanese hardware and software companies were involved and the 22 billion yen (US$ 147 million) cost was split evenly between the government and the companies.[88] A national company called the Sigma Center was created to build a workstation for software development and to house a database containing software development tools. A national network was established to give developers access to the Sigma Center databases. The project resulted in the development of just sixty programs, whose

yearly sales are only 30 million yen, while the Sigma System, a company established to commercialize products from the project, lost 260 million yen. [89] The failure of the Sigma Project has been blamed on rigid planning, lack of cooperation and inflexibility in recruiting global talent that was much needed for a very fluid technology. The software selected for Sigma's software development program was obsolete after being on the market only five years,[90] and Japanese companies have failed to make inroads into the market for UNIX-based software.

The TRON Project: The Real Time Operating System Nucleus (TRON) project was an attempt to develop a purely Japanese computer architecture with a common operating system that could run on a wide range of information appliances. The originator of the TRON project was Professor Ken Sakamura of the University of Tokyo. Sakamura envisioned TRON as a series of intelligent objects that would be incorporated into buildings, appliances, and other everyday items, linked together into integrated wireless networks. The project was initiated in 1984; the first goal was to develop a personal computer for use in Japanese schools as a way of introducing TRON technology and software into the market. The government planned to require that all schools buy TRON machines for the classroom, and telecommunications giant NTT had announced plans to implement TRON technology in its communications networks. The U.S. government saw TRON as an attempt to lock U.S. companies out of the Japanese PC market and pressured the Japanese government not to require schools to use TRON computers because TRON could only be developed with the cooperation of diverse talent from around the world and this made MITI very reluctant to develop it (Fallows 1995 p.145). The Japanese government dropped its plans to use TRON in the schools, and it never caught on in the commercial marketplace. Ironically, it was NEC who had tried to stall the TRON project, since it dominated Japan's PC market and stood to lose the most from the development of a new standard. The intervention of the U.S. government saved NEC without the company having to look like it was putting its own profits ahead of the national interest.[91]

3.43 R&D Projects of the 1980s

The four projects have not come close to achieving the ambitious objectives set for them. Japan never became a world leader in supercomputers (with TRON) and lags behind the United States in development of massively parallel supercomputers. The Sigma Project was nearly a total failure, and the TRON project failed to develop a commercially viable Japanese computing architecture. The Fifth Generation Project did not produce any commercial hardware or software in spite of some impressive amount of money that was spent on the project. Each of the R&D projects involved attempts to end Japan's dependence on standards and architectures controlled by U.S. companies and to address Japan's fundamental weaknesses in software and innovation. In every case the Japanese bureaucracies gave up on a project when it got to the point where international diversity was needed (Fallows 1995 pp.33-74). While some successes have been claimed for each project, the combined effort did miss its target every time and none of the projects brought a new product to market or brought Japan any closer to controlling any key standards in the computer industry.

The poor performance of the R&D consortia was largely due to the lack of enthusiasm displayed by the participating companies and the stubborn refusal of MITI to bring in diverse talent from around the world. They somehow thought that they could ignore the diversity strategy used throughout the entire IT industry around the world. Private corporations went along with such projects in order to keep tabs on each other and maintain favor with the bureaucrats, but they were not willing to share their own independently developed technologies with their partners. In economics there are basically just two strategies. You can make a bigger pie or you can try to take a bigger piece of the small pie you have now. Without fully using the global talent pool, MITI and companies were forever trapped into fighting over their small pie. Callon details the high level of tension among the participants in the supercomputer

project. Fujitsu, which was in charge of the CPU subsystem, refused to allow engineers from NEC and Hitachi even to see the computer for which they were developing subsystems (Fallows pp.173-188). NEC and Hitachi engineers were not allowed to ride a bus or eat with Fujitsu engineers for fear that they would overhear Fujitsu secrets. Most of the research in the R&D consortia was actually conducted in company labs, and joint labs produced only a few of the patents that came out of the consortia.[92] It couldn't be expected that Japan would cooperate globally if they could not even cooperate with other Japanese (see Fallows 1995 pp.173-211).

Historically, Japan's R&D consortia have had their share of success and failure. In general, projects have worked best when the business community has had a leading role in selecting and implementing them, and when the projects had clear and specific goals.[93] This was not the case in the R&D consortia of the 1980s. Rather than responding to immediate needs of industry, the projects were designed by government committees[94] and had vague, long-term goals. The fact that the companies refused to invest their own money in the Fifth Generation project is evidence of their lack of confidence. The projects were also too long-term in their planning and too inflexible in implementation. While Japan is often praised for its long-term strategic planning, computer technology changes too quickly for ten-year plans. Any government technology policy must be responsive to changes in technology and markets if it is to succeed. In the old era of catching up to IBM, it was more reasonable to undertake large-scale efforts targeting specific technologies with confidence that those technologies would still be relevant several years later. In the PC era, there are numerous targets to aim for, and they keep moving.

A fundamental problem with joint government-industry R&D consortia is the tug of competing interests among the participants. The government's interest is in improving the technology base of the nation as a whole, while the individual firms are more interested in improving their own position relative to their competitors, with whom they are expected to

collaborate in such projects. The closer the research is to commercial development, the less cooperation is likely. However, as the focus moves toward more basic research, the question must be raised whether industrial consortia are really an effective mechanism for technology development. In the history of consortia, none have ever been successful if they were set up in this manner.

Targeting Software

MITI looks at the electronics and computer industries as a food chain, from silicon to software, and targets areas where Japan is weak. Software is clearly Japan's weakest link in the chain. MITI is trying to strengthen the software industry by providing tax incentives to the private sector, and by encouraging a realistic pricing structure that unbundles software and services from hardware so that their true value is reflected in prices. It is also working with the Ministry of Education (MOE) to increase the number of university courses in computer science and establishing curricula for students and workers to upgrade their IT skills in private schools. MITI says that the MOE is open to such changes but lacks the human and financial resources to implement them quickly."[95] However, the one thing MITI will not allow for is giving away Japanese high-tech jobs to international talent. In hind sight we can now see that all of the most successful IT projects around the world involved not just allowing foreign talent to come in, but rather the actual relentless head hunting and recruitment of all top talent from around the world. In the long run this would have stimulated the abilities of Japanese engineers to sink or swim in the midst of world talent but also could have been a winning formula although lacking the ability to proudly say it was a purely Japanese effort. In other words, ego was more important than simply winning.

MITI made various efforts over the years to subsidize R&D by independent software

companies, including providing funds to the Information Technology Promotion Agency (ITPA) during the 1970s to provide R&D subsidies and help software firms obtain more than US$450 million in loans. In 1979, the ITPA enacted tax breaks to software houses, exempting 50% of licensing revenues from taxes for five years.[96] MITI also offers grants and low-interest loans to software companies with promising products, but it is not clear that MITI has the ability to judge the promise of software products. The government has not settled for simply trying to support Japan's software companies, however. It has also engaged in a series of efforts to weaken intellectual property protection to help Japanese companies decompile and reverse engineer software developed by U.S. companies.[97] This means the original program is decompiled to deduce much of its source code and develop an imitation of a program for a fraction of the cost of developing the original. Although this is highly illegal by copyright law, it is far cheaper than inviting overseas software experts to write new programs (See Fallows 1995 pp.192-223).

Japan's computer industry was split on the issue of decompilation during a 1993-1994 debate over copyright revision. Hardware companies and the custom software vendors supported decompilation as a means of catching up with the United States in software and increasing demand for Japanese hardware. For example, Fujitsu announced in 1993 that it would not renew its license for compatibility data from IBM's mainframe operating system; it argued in favor of legalized decompilation to allow it to develop products compatible with the IBM standard without paying licensing fees to IBM. The fledgling packaged software industry was opposed to decompilation, since vendors were anxious to protect their own intellectual property, both in Japan and elsewhere in Asia. The issue grew into a dispute pitting leading U.S. software vendors and the U.S. government against the Japanese computer industry and a few sympathetic U.S. companies. The Japanese government ultimately settled for issuing a series of options, rather than recommendations. As of 1997, the issue remained dormant in Japan, but was under consideration in Australia, the Philippines, and Hong Kong, with Fujitsu and other

Japanese companies favoring decompilation.

In another trade dispute, the Japanese government announced in 1995 that it would require software makers to meet a variant of ISO 9000 quality standards to sell software in Japan. Most U.S. software makers saw this as a potential trade barrier, because Japan would have its own unique standards for software. It was also seen as a possible attempt to steal trade secrets by subjecting software code to inspection by Japanese auditors. The U.S. software industry appealed to the U.S. Trade Representative, and a private agreement was reached in the summer of 1995 between the U.S. and Japanese standards organizations, ANSI and JAB. However, in the fall of 1995, Computing Japan reported that the two sides' interpretations of the agreement were very different, and it appeared that the issue was not quite solved. Finally, under pressure from the United States, the Japanese government decided to drop the issue.

Each of the issues were examples of the ongoing effort of the Japanese government to challenge U.S. software hegemony by weakening intellectual property rights (IPR). Weak IPR protection might be justified, at least domestically, if it helped Japan's software industry catch up to the United States. However, lack of protection is just as likely to damage innovative Japanese software companies by making it difficult for them to earn a decent return on their investment in product development. It would mainly benefit imitative companies that want to produce "me-too" products, or companies that want to avoid licensing fees for existing software .[98] On a more positive note, protection of intellectual property has actually improved in recent years, with software piracy rates dropping from 66% in 1994 to 41% in 1996, possibly reflecting a change in attitudes toward IPR on the part of government and industry.

3.44 MITI Policy and Bureau Pluralism in the 1990s

The government initiated several new IT projects in the 1990s. They include R&D projects such as the Real World Computing Program and the Micro Machine Project, and some

efforts to promote small business and independent software firms. The major focus has been on developing a National Information Infrastructure (NII), an initiative that has fallen victim to the bureaucratic competition so prevalent in recent years. Two new projects have been undertaken to develop new frontiers of computer technology. The first is the Real World Computing Program, which was announced in 1992 as a follow-up to the Fifth Generation project. The project applies neural computing, a concept based on creating computers that imitate the neural networks of the human brain. The goal is to develop applications that can rapidly process large volumes of incomplete data and allow management of large diverse networks, which are not always logically consistent. The implementation and direction of the project is more flexible and less centralized than in previous projects, and efforts are made to encourage sharing of findings. The Micro Machine Project is studying and developing component technologies and searching for principles unique to the micro world. [99]

The new R&D projects are being carried out by consortia of Japanese and foreign enterprises and institutes, a trend that started with the projects of the 1990s. The slight inclusion of foreign partners is part of what one MITI official referred to as a policy of "MITI for the world," rather than "MITI for Japan." Including foreign companies in this offers Japan opportunities to benefit from their expertise, as well as providing evidence to Japan's increasingly demanding trading partners of Japan's willingness to open itself to the world but at a very slow pace.

Small Business Promotion

MITI has established a fund of 1 trillion yen (about US$ 10 billion) to support R&D by small companies. Funding is based on a competitive proposal process, with support given to companies that have good technology ideas. There is no targeting of particular industries; rather projects are evaluated on the basis of potential market demand and job creation. Support is in the form of R&D subsidies, loans, loan guarantees, and direct investment. MITI studied

the venture capital system and over-the counter stock market in the United States, and tried to create a similar "cradle to adult" system of support for start-ups. There are three stages in the program: (1) seed money for the start-up process; (2) enterprise development for product commercialization; and (3) over-the-counter stock listing. Pure startups will be favored over spin-offs, which might be supported in another program.[100] MITI has also been pressuring MOF to revise many of the regulations that are seen as hampering venture businesses. However, one major flaw in MITI's plan is that the large IT Firms in Japan are allowed to use corporate resources to open new small ventures under this program. MITI does not require public disclosure of subsidiaries for granting these "small business" venture funds. Therefore, the big IT firms have overwhelmed the entire program with their own applications often receiving most of the grant money because they have the experts to prepare the documents and also the connections with the right people in MITI. They simply open 200 new ventures if they want and their subsidiaries can take most of the funding.

Policy Coordination: Bureau Pluralism and Competition with the NII:

Industrial policy in Japan was guided by MITI throughout most of the postwar era. MITI's preeminent position as an economic "pilot agency" was explicitly linked to Japan's economic miracle in 1982 by Chalmers Johnson's MITI and the Japanese Miracle. MITI's specific role in promoting the computer industry was brought to light in books and articles by scholars such as Marie Anchordoguy, Martin Fransman, and Fumio Kodama.[101] However, at about the time that the rest of the world was becoming aware of MITI's role in directing Japan's industrial development, MITI found itself facing competition for policy leadership in the information technology sector from an unexpected rival, the Ministry of Posts and Telecommunications (MPT). The catalyst of this competition came in the early 1980s with the arrival of value-added networks (VANs) that provided on-line information and digital communications services. VANs were an early form of convergence between computers and communications, and since communications were involved, MPT saw regulation of VANs as

falling under its jurisdiction. From 1981 to 1984, MPT battled MITI over how to regulate VANs, with MPT favoring stricter regulation and MITI favoring more competition. In the end a compromise was reached, but MPT had successfully staked its claim to a piece of information technology policy turf.[102] Right at the time when MITI was starting to open itself up to global diversity it then became stuck in the Japanese system of bureau pluralism or the in fighting between ministries within the closed bureaucratic society of Japan (青木 1995 pp.23-46; also Fallows 1995 pp.173-245).

MPT's strength relative to MITI continued to grow as convergence accelerated, and as MPT strove to join the elite ranks of Japanese bureaucracies. The battle with MITI reached its peak in the mid-1990s when Vice-President Al Gore announced the U.S. national information infrastructure (NII) initiative. The Japanese government viewed Gore's NII, or "information superhighway," plans as a major threat, fearing that the United States would gain a critical competitive advantage both as a producer and user of information technologies by building such an infrastructure. Both MPT and MITI developed their own NII plans for Japan, as did telecommunications giant NTT, and competition ensued over who would lead the Japanese NII response. Rather than cooperate, the two ministries and NTT all developed their own NII test-bed projects and trials, often duplicating each other's efforts and wasting billions of Yen in the struggle.[103]

Meanwhile the two ministries disagreed over the issue of NTT's future. NTT had gone from being a government corporation to a private company in 1985, although the government retained about two-thirds of NTT's stock. MPT favored breaking NTT up into competing local and long distance companies to promote a more dynamic domestic market and reduce telecommunications prices via competition. MITI sided with NTT, which opposed the breakup and wanted to be allowed to compete in international markets. In the end, a compromise was reached which broke NTT into three companies under the control of a parent holding company

and allowed NTT to compete internationally. This decision was a transparent move aimed at giving the appearance of promoting competition while actually increasing NTT's power, since no real breakup had occurred. After 1996, NTT was even more directly controlled by the government because of holding controlling interest in the holding company of NTT even though they had none in the new 3 individual branches. This fooled the public for holding companies are rare in Japan and most people are not even aware of what they are (青木 2000 pp.132-149).

The victory of NTT was a setback for MPT, but it was also not much of a victory for MITI. MITI has not found a major role in important new policy areas such as the Internet and network computing. Instead, the stalemate between MITI and MPT has prevented Japan from developing coherent, coordinated strategies to deal with the policy issues raised by convergence, network computing, and the Internet. The two are pursuing their independent NII strategies, while NTT will be left to make the major investments and decide the form that Japan's NII will take. The management decisions of NEC, Fujitsu, Toshiba, Hitachi, and the other major companies are likewise shaping the future of Japan's computer industry. Japan's bureaucrats have not become irrelevant, but they are hardly the visible hand guiding the computer industry that they were in the past.

Several analysts argue that a key factor was the shortage of venture capital, which they blame largely on the Ministry of Finance (MOF) for limiting the number of initial public offerings (IPOs) by Japanese venture companies. Without the prospect of a big payoff from an IPO, venture capitalists have been unwilling to make risky investments. Also, Japanese companies cannot attract top workers with offers of stock options, as U.S. venture companies often do, since stock options have little value without the prospect of an IPO. The Finance Ministry squeezed IPOs to almost zero after the stock market crash in the early 1990s in order to prevent dilution of stock prices of existing companies and protect the banking system from a further meltdown of the stock market. The effect was to protect large companies, as well as

investors, while starving small companies of capital.

Japan's Fair Trade Commission also prevents venture capitalists from serving as board members on businesses in which they have a stake. This discourages investment-since investors have no influence over company management-and also robs the venture companies of a valuable source of managerial expertise. In the United States, venture capitalists help to guide new companies through the growth process until, and sometimes after, a successful IPO. Many U.S. venture capitalists point to this exclusion as a key reason for the shortage of venture capital in Japan.

MITI has recently been pressuring MOF to loosen its restrictions on IPOs, and the number of IPOs did rebound after 1993. However, this might have been only a temporary phenomenon related to an upturn on the Tokyo exchange. Asking a bureaucracy (Japanese or otherwise) to give up regulatory powers is something akin to asking a person to cut off a body part. Even as it pressures other ministries to deregulate, MITI itself remains one of the leading propagators of regulation in Japan, and has not offered to reduce its own regulatory role. To create a truly dynamic venture business sector in Japan would probably require a radical change in bureaucratic mentality, as well as a willingness to shake up an industry structure that tends to block newcomers out of distribution channels and production networks. Such change is unlikely, but even some moderate changes in the regulatory and tax system could unleash quite a bit of entrepreneurial activity.

Conclusion Part III: Open Pluralism Has Some Advantages Over Bureau Pluralism

Point 3. What was unique about Taiwan's state-business and state-society relations for IT hardware development and how did the human resource diversity strategy of "open pluralism" for state institutions differ from others using "bureau pluralism" such as Japan and South Korea?

In the developmental history for Taiwan and Japan, it was shown how the unique state-society relations and organizational strategies in Taiwan and Japan affected the formation of formal and informal institutions concerning the development of the IT hardware industry in which the state and societal actors interact with each other. It was argued that the Taiwanese state has played so dominant and pervasive role not because of the strong and autonomous state that was envisioned by the early statist literature, but because of the institutional strategies and state-society-business relations that are unique to the political economy of the accelerated industrial catch up strategy for IT in Taiwan. It was shown that although Taiwan's state literally built the whole IT sector in the beginning, it also built an enhanced version of a highly diverse free market "rules of the game" which unlike Japan and South Korea, did not grant special privileges to certain large firms but rather built a transparent and level playing field embracing both small and large enterprises. Taiwan also avoided bureau pluralism by embracing an open pluralism institutional strategy that involved the privatization of government think tanks and the spinning off of almost all state research programs into the private sector in order to create the fullest possible diversity of human resources.

Industrial policy in Japan was guided by MITI throughout most of the postwar era. MITI's preeminent position as an economic "pilot agency" was explicitly linked to Japan's economic miracle in 1982 by Chalmers Johnson's MITI and the Japanese Miracle. MITI's specific role in promoting the computer industry was brought to light in books and articles by

scholars such as Marie Anchordoguy, Martin Fransman, and Fumio Kodama.[101] However, at about the time that the rest of the world was becoming aware of MITI's role in directing Japan's industrial development, MITI found itself facing competition for policy leadership in the information technology sector from an unexpected rival, the Ministry of Posts and Telecommunications (MPT). The catalyst of this competition came in the early 1980s with the arrival of value-added networks (VANs) that provided on-line information and digital communications services. VANs were an early form of convergence between computers and communications, and since communications were involved, MPT saw regulation of VANs as falling under its jurisdiction. From 1981 to 1984, MPT battled MITI over how to regulate VANs, with MPT favoring stricter regulation and MITI favoring more competition. In the end a compromise was reached, but MPT had successfully staked its claim to a piece of information technology policy turf.[102] Right at the time when MITI was starting to open itself up to global diversity it then became stuck in the Japanese system of bureau pluralism or the in fighting between ministries within the closed bureaucratic structure of Japan (青木 1995 pp.23-46).

The Dilemma of "Bureau Pluralism"

This part explained how the effective management of Japanese firm organization that endogenizes contextual skill formation has been supported by the complementarity of the contingent governance structure and the imperfect labor market. He argues that the contingent governance structure in turn has been supported by regulations restricting entry to many industries that have made it possible for these industries, such as main banks, to accrue rents. In Aoki's words:

> The regulation of entry into an industry and the protection of weak firms in disadvantaged industries has been one of the primary institutional elements sustaining the Japanese economy. By committing to the protection of the human capital value of the specific skills formed in each industry, they have provided economic agents with incentives to invest in contextual skills.. In Japan, most working people in all fields have been expecting the value

> of their human capital to be maintained through a multilayered structure comprising their employing firm, the industrial associations in their industry, and the ministry that oversees that industry. In my book published in 1988, this system was referred to as "bureau pluralism. The term "bureau" originally referred to a "drawer" and implied sorting or arranging something. The bureaucracy has played an important role as agent and arbitrator in protecting the vested interests of pluralistic groups in different fields. However, "bureau pluralism" is not an "open pluralism" as vested interests protected by bureaucratic administrative mediations merely coexist and various organizational modes cannot be freely created. (Aoki 2000 pp.129-131)

However, Aoki claims that if quasi-rents move toward extinction for the various reasons given above, the framework of bureau pluralism itself will be difficult to maintain. At that point he says that if comparatively disadvantaged industries seek continued protection, the advanced firms would either lose their competitiveness due to higher subsidization to disadvantageous sectors and interest groups, or would be under great pressure to move their manufacturing bases overseas to survive. The resulting dilemma would be that the only remaining employment opportunities would be in comparatively disadvantaged industries.

The skill types needed to sustain a new organizational mode may not be readily available in the economy, and the institutional structure supporting the existing organizational mode may not be conducive to experimentation with mutant modes. Aoki says this places an exceptionally heavy burden on the Japanese economy, where bureau pluralism has been implemented, because tall barriers have been constructed to obstruct new entrants. By contrast, economies that have a regulatory stance is to allow free entry into industries, such as under the Anglo-American system, have institutional structures that are more tolerant of experimentation with mutant organizational modes. He then goes on to add:

> Accordingly, permanently solving the dilemma of bureau pluralism requires institutional reform that allows new organizational modes to be experimented with and implemente d in industries where the conventional assimilated information structure is inefficient. There is no guarantee that the Japanese-type of horizontal hierarchy will

> maintain an absolute advantage in the industries in which it was originally an organizational innovation. The operations of a self-sufficient horizontal hierarchy may be especially inefficient in fields in which strategic alliances between various firms can be expected, like the communications industry. In these fields, the relevant systemic environment extends across several industries, and processing information regarding that environment may require a greater breadth of information processing capabilities than can be accumulated by a single firm. However, it is not yet altogether clear which organizational mode is most suitable for these industries. (Aoki 2000 pp.133-34)

Bureau pluralism is by nature resistant to institutional reforms that threaten the vested interests of certain interest groups, making it politically difficult to carry out radical reforms. However, bureau pluralism cannot be sustained, as the quasi rents are inevitably eliminated by the maturation of that pluralism itself and by changes in the international environment. As Aoki repeatedly emphasizes, attempts to sustain it would only result in the loss of comparatively advantaged industries. Thus, the only tenable choice remaining is to seek a new path to economic gains by lowering barriers in all industries and allowing the entry of diverse organizational modes from both domestic and foreign sources in order to fully take advantage of global human resource diversity. Japan needs to make the painstaking efforts needed to endogenize the economic gains from diversity.

The four major projects undertaken in the 1980s were the Fifth Generation Computer Systems Project, the Supercomputer Project, the TRON Project, and the Sigma Project. However, in the end, these projects as well as many others failed because of Japan's bureau pluralism which avoided diversity strategies. At the same time in Taiwan and the USA both government and private technology projects had opened themselves to the wide diversity of the world human resource network actively welcoming the top IT talent from around the world regardless of race or nationality. In the USA and Taiwan most high-tech projects had more

than 50% of the leadership and engineers that were globally diverse (Saxenian 2002 pp.3-24). Even large government projects in Taiwan and the USA often invited the best of the best from around the world to lead or participate in the top high-tech research projects. However, in the cases above for Japan, foreigners were never invited to lead a project or were they ever utilized for even minor engineering leadership roles. This is what Professor Aoki Masahiko of Tokyo University calls an "anti-diversity strategy" (青木 1995 pp.82-134).