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**The EC Policy Response
to Import Penetration
and Foreign Direct Investment in
the European Semiconductor Industry:
a Political Economy Analysis**

by

JUDITH M. VAN WALSUM, Drs.

A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfilment of
the requirements for the degree of

Master of Arts

The Norman Paterson School of International Affairs

Carleton University
Ottawa, Ontario
November 5, 1990
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ABSTRACT

In the 1980s, European demand for semiconductors was met predominantly by foreign producers, either exporting to the Community or located within the Community. This thesis describes and analyzes the policy response of the European Community to import penetration and foreign direct investment in the European semiconductor industry. The study finds that the objective of the EC semiconductor policies in the 1980s appeared to be the establishment of a competent and high value European-located semiconductor industry, rather than an exclusively European-owned production capability. Liberal economics would have rejected the policies that the EC selected on the basis of the associated welfare costs. Evoked by the developments in the international system and justified by an economic nationalist ideology, the European Community selected these policies in response to semiconductor producers' interests, which were channelled and strengthened by national governments and the European Community.

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Ottawa,
November 1990

Judith M. van Walsum

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GLOSSARY AND LIST OF ACRONYMS**Glossary**

Alvey	British cooperative semiconductor R&D program
Bipolar ICs	Junction ICs
Chip	Semiconductor
Council of Ministers	Council consisting of the relevant ministers of the EC member states. Task: decisionmaking
Diffusion	The printing of semiconductor circuits on the wafer
Digital Devices	Semiconductor devices that switch signals; digital devices turn the flow of current on or off in response to a signal
Diodes	Semiconductor devices whose function it is to rectify current, i.e. to allow it to pass in only one direction.
Discrete Devices	For example, diodes and transistors. Devices contain one element
European Commission	Council composed of at least one from each member state. Tasks: policy preparation and implementation
European Council	EC heads of state governments, assisted by their respective Foreign Affairs Ministers and member of the Commission.
Filière Electronique	French cooperative R&D program
Import Penetration	Imports as share of domestic consumption
Integrated Circuits	For example, bipolar and monolithic ICs. Devices contain more than one element or area, functioning as a transistor or a diode
Linear Devices	Semiconductor devices that amplify signals
MEGA	Dutch-German cooperative R&D program
Monolithic ICs	Undifferentiated, undivided ICs
Semiconductors	Used as synonym for semiconductor devices, i.e. devices that in the right conditions alternatively act as conductors affecting electrical current to flow or as insulators cutting the flow
Semiconductor Assembly	The cutting of the wafer into individual chips
Silicon	Key input for semiconductor production

Research Council
Transistors

Wafer

Research Ministers
Semiconductor devices in which one
current controls another. Transistors
can be used to amplify or switch
signals
Disc

Acronyms

CCT	Common Custom Tariff
DRAM	Dynamic Random Access Memory
EPROM	Erasable Programmable Read Only Memory
EEPROM	Electrical EPROM
ESPRIT	European Programme for Research and Development in Information Technologies
F	France
FDI	Foreign Direct Investment
FED	Future Electron Devices
FRG	Federal Republic of Germany
5G	Fifth Generation computer
GATT	General Agreement on Tariffs and Trade
I	Italy
IC	Integrated Circuit
IT	Information Technology
JESSI	Joint European Submicron Silicon Initiative
64K	64 Kilobyte
MISP	British microelectronics industrial support plan
MITI	Japanese Ministry of Trade and Industry
MNES	Multinational Enterprises or TNCs
MOS	Monolithic
NTT	Nippon Telegraph and Telephone Public Company
NL	The Netherlands
OEIC	Opto Electronic Integrated Circuits
OEM	Original Equipment Manufacturer
OJ	Official Journal of the European Community
POS	Point-of-Sale
R&D	Research and Development
ROM	Read Only Memory
SEA	Single European Act
SEMATECH	Semiconductor Manufacturing Technology Initiative
SME	Small to medium sized enterprises
SRAM	Static Random in Access Memory

TNCs	Transnational Corporations
UK	United Kingdom
UNCTC	United Nations Centre for Transnational Corporations
VHSIC	Very High Speed Integrated Circuit
VLSI	Very Large Scale Integrated.

CHAPTER I

INTRODUCTION

During the 1980s, the European Community, the United States and Japan supported and protected their semiconductor industries. This universal interventionist stance of governments towards the microelectronics or semiconductor industry was based on the perception that semiconductors would be of crucial importance to the long-term competitiveness of their economies.

Semiconductors are devices which are able to amplify or switch electronic signals. Two main categories of semiconductors exist: discrete devices, which contain only one element that can amplify or switch current, and the more advanced integrated circuits, which contain two or more amplifying or switching elements. These devices, which are used to increase the reliability of the products they serve and to reduce the capital requirements due to low energy and material consumption, have been called the "crude oil" of the 1980s (van Tulder and Junne 1988:8). Semiconductors are inputs for all information technology products ranging from consumer electronics such as televisions and compact disk players to robots and telecommunication equipment.

Consequently, the semiconductor industry which produces these key inputs is considered to be of strategic importance and is, as such, a focus of government concern and action. The subject of this study is the European Community and the Community's policies towards the European semiconductor industry.

1.1 STATEMENT OF THE PROBLEM

During the 1980s, the European semiconductor industry accounted for only a small percentage of world production, well behind Japan and the United States. In contrast to American and Japanese semiconductor producers, European producers could not affect the economic conditions they faced. In contrast to the American and Japanese governments, the European Community had only limited impact on politically determined prices and conditions. In economic terminology, the European Community, both its firms and governments, was a "small actor"¹.

Within the Common Market, in the 1980s the semiconductor industry was characterized by high rates of import penetration and foreign direct investment. European demand was met predominantly by foreign producers, either exporting to the Community or located within the Community. In addition, European production was characterized by a relatively large share of "mature" discrete devices, compared to Japan and the United States. These technologically inferior components yield relatively low growth rates, low prices and low profits (Langlois et al. 1988).

The relatively weak performance of the European semiconductor industry vis-à-vis its Japanese and American counterparts was a source of major concern to the European Community for three reasons. First, the Community's policy

makers were afraid that the lack of competitiveness in the semiconductor industry would thwart the development of new generations of semiconductor devices and thus further endanger the future of the European semiconductor industry. This, in turn, would impair the economic performance of the industries in which semiconductors are used as inputs, such as the computer and medical equipment industries. The European Community thus feared that negative developments in semiconductors would not only affect the semiconductor industry, but also would adversely affect the semiconductor consuming industries.

Second, the policy makers were concerned that dependence on foreign semiconductor suppliers would reduce the Community's control over developments in semiconductor technology and the social and cultural effects of these changes. Moreover, dependence on foreign semiconductor suppliers could reduce the political autonomy of the Community; foreign semiconductor suppliers could make the supply of these devices conditional upon certain concessions, et cetera.

Third, the policy makers worried that dependence on foreign semiconductor producers would undercut European prestige. It would imply that the Community firms were technologically lagging behind the most advanced firms. As emphasis is increasingly placed upon knowledge-intensive industries in the advanced industrialized world, the European

Community feared that it would be no longer perceived as an important player in world technology.

For those reasons, the Community policy makers felt that it was necessary to improve the performance of the European semiconductor industry. This thesis therefore focuses on the questions: (1) how did the Community respond to import penetration and foreign direct investment in the semiconductor industry, and (2) why did the Community select policies that according to liberal economics should be rejected on the basis of the associated welfare costs?

1.2 RESEARCH QUESTIONS, HYPOTHESES AND METHODOLOGY

This thesis focuses on two specific research questions. The first question asks how the EC responded to import penetration and foreign direct investment in the European semiconductor industry. This research question will be answered on the basis of a review of EC policies. The overview of EC policies is descriptive in nature and based on the primary sources and the existing literature in this area. However, the identification of the essence of these policies requires analysis. The analytical process consists of categorizing the policies mentioned according to their impact on domestic and foreign-owned semiconductor producers. The thesis argues that the EC policy response was characterized by promotion and protection of EC-owned semiconductor firms

in order to establish a competent indigenous (European-located) production capability.

The second research question seeks to explain why the EC responded in the ways it did, and focuses thereto on the political economy factors that conditioned the chosen EC policy response. This question will be answered by applying the IIII-approach as discussed below. The thesis argues that the European semiconductor policy response can be explained by the impact of the economic nationalist ideology, lobbying of firms, national governments seeking to maximize their interests, and the impact of external factors.

The structure of the thesis is as follows. Chapter II outlines the characteristics of the world semiconductor industry, including the European semiconductor industry. It is argued that the performance of the EC semiconductor industry over the 1980s was weak. Chapter III subsequently discusses the first research question of this thesis, namely how the EC responded to import penetration and foreign direct investment in the European semiconductor industry. Chapter IV analyzes the welfare and income effects of these policies. According to the economic liberal perspective, the EC policies adversely affected certain groups and imposed a welfare cost on the Community. Chapters V and VI subsequently address the question why the Community selected policies that (at least in theory) were injurious to certain groups within society and to society as a whole. Chapter V outlines an explanatory

framework for the European semiconductor policy response, namely the IIII-approach. Chapter VI applies this approach to the EC semiconductor case, thus answering the second research question of this thesis. Chapter VII concludes this thesis.

1.3 THEORETICAL FRAMEWORK

The IIII-approach, through which the second question is answered, outlines the author's view of the factors that determine policy choices and how these factors interact². The following section gives an overview of the theories on which this explanatory approach is based.

In general, theories explaining economic policy choices focus on two areas of inquiry: what factors impact on economic decisions, and how. In other words, what are the independent variables and how do these variables affect the dependent variables, namely the economic policy choices?

Cohen (1990:268-69) discerns the following two approaches: the system-level approach and the domestic-level approach. The former focuses on the constraints and incentives for government behaviour that derive from the broader structure of interstate relations. The latter concentrates on both the impact of "economic culture" that legitimates policy-making as well as the effects on policy choices of the strategic interactions among all domestic actors, inside or outside the government. In line with Cohen's suggestion

(1990:269), the approach in this thesis considers domestic- and system-level variables simultaneously.

Various authors have contributed to the literature on economic policy choices through case studies and theoretical models³. The explanatory approach that is used in this thesis is based, in particular, on the works of Bhagwati (1988:17-44) and Gourevitch (1986:54-63).

In Protectionism, Bhagwati (1988) analyzes the postwar liberalization of trade, the rise of the new protectionism and the counter-development of anti-protectionist forces. He identifies three interacting factors as policy-influencing and -conditioning variables: ideological factors (I_1), interests (I_2) and institutions (I_3).

Ideological factors (I_1) comprise "ideas", i.e. theories of economic policies, and "examples". Examples shape economic postures through their demonstration effect. Interests (I_2), on the other hand, refer to the preferences of various domestic and international actors for or against certain policies. Interests are defined by both "economics" (the economic situation that these actors face) as well as "politics" (non-economic objectives such as national security). Interests are justified by ideological factors. In turn, interests reinforce ideas. Finally, institutions (I_3), explicitly defined in Protectionism as the GATT, create opportunities and constraints for interests. Institutions are, in turn, shaped by interests.

Although Bhagwati (1988) provides a comprehensive and interactive framework for explaining policy choices, the three I approach used by Bhagwati is insufficient for our purposes. First of all, it is rather confusing to use the term "institutions" to describe a regime, or a system variable. Secondly, in the EC semiconductor case, institutions could better refer to a domestic variable, namely the two-tiered government system (member state governments and the European Community). Given the importance of both the EC governmental system and the international system as conditioning variables for the EC semiconductor industry and policies, we need to turn to the work of Gourevitch, where such factors are highlighted.

In Politics in Hard Times, Gourevitch (1986) identifies five explanations for economic policy choices: economic ideology, production profile, intermediate associations, state structure and international system explanations. Any policy outcome involves these five variables. The relationship among these explanations varies with circumstances and with time periods.

The economic ideology explanation points to the impact of national traditions and values concerning the economy on decision-making.

Economic policy choices are, according to the production profile explanation, affected by the pressures applied on governments by societal actors such as labour, firms and

sectors. The attitudes of societal actors towards economic policy are shaped by their economic situation.

The intermediate associations explanation stresses the role of organizations such as interest groups and political parties in linking the interests of societal actors to the government. Intermediate associations are organizations designed to represent societal actors; however, such organizations also have an impact upon policy outcomes which can be understood as independent from the actors they represent.

The state structure explanation stresses the impact of rules and institutions of the state on policy outcomes. The state, through its rules and regulations, moulds the behaviour of societal actors, and shapes the intermediate associations through which these actors channel their interest, thus impacting indirectly on the societal preferences. The state alters societal preferences directly through the process of aggregation of these preferences. Gourevitch (1986) also mentions the impact of the powers and skills of the officials who occupy positions in these institutions, i.e. the bureaucracy.

The international system explanation stresses the mechanisms and methods through which external conditions and actors shape domestic policies. The international system impacts on decision making through its effect on societal actors.

Although Gourevitch explicitly addresses the role of the international system and the state, Gourevitch's explanatory framework does not sufficiently fit the EC semiconductor case either. For example, should the European Community be addressed in the state explanation or in the international system explanation? Are European political parties intermediate associations or actors in the international system? Due to Gourevitch's classification of domestic actors into distinct groups, the approach fails to capture the EC dimension.

Both Bhagwati's approach (1988) and Gourevitch's explanations (1986) show thus some weaknesses if specifically applied to the EC semiconductor case. However, both frameworks share some strong points that should be included in the explanatory framework that is used in this thesis. In their approaches, Gourevitch and Bhagwati recognize similar, interacting, domestic- and system-level explanatory variables. Both Bhagwati and Gourevitch recognize the role of economic ideas (1) as an explanatory variable; Gourevitch's economic ideology explanation is comparable to Bhagwati's ideologies. Both authors identify the impact of actors at societal (2) and state (3) levels; while Gourevitch discusses these in the context of his production profile, intermediate organizations, and state-structures explanations, Bhagwati includes these actors within the interest explanation. System-level variables (4) are clearly represented in Gourevitch's international

system explanation and Bhagwati's institutions.

Based on these similarities between Bhagwati's and Gourevitch's approach, the author has constructed an explanatory framework for policy choices that is more applicable to the EC semiconductor case. In this thesis, European semiconductor policy choices are explained by the following set of interacting variables: Ideology (I_1), Interests (I_2), Institutions (I_3), and the International System (I_4), which we will call the IIII-approach. These variables affect the EC semiconductor policy choice, but are, in turn, affected by the EC semiconductor policies.

Because of the interaction between the independent variables, and the feedback impacts of EC policies on these variables, the distinction between independent and dependent variables and between exogenous and endogenous variables is not always clear-cut. In the context of this thesis, Ideology, Interests and Institutions are considered to be independent variables internal to the Community (domestic-level variables). The International System refers to independent variables external to the Community (system-level variables). The EC semiconductor response is considered to be the dependent variable.

In line with Bhagwati (1988), Ideology (I_1) consists of ideas and examples. What ideas (ideologies) and what examples impact on decision making and how? Interests (I_2) encompass non-state domestic actors, i.e. societal actors and their

representative associations. What domestic non-state actors affect policy choices and in what manner? Institutions (I_3) include domestic governmental actors, i.e. national and regional governments. What institutions impact on decision making and in what way? The International System (I_4) comprises general economic and political conditions and the external state and non-state actors operating within this framework. How does the international system affect economic policy choices? This thesis will discuss the IIII-approach in more detail in Chapter V.

1.4 SUMMARY OF THE ARGUMENT

The thesis argues that, in the 1980s, the EC policy response to import penetration and foreign direct investment in the semiconductor industry, was three-fold. First, the European Community protected its semiconductor industry against cheap imports through the Common Customs Tariff, the imposition of anti-dumping duties and the conclusion of price undertakings, thus seeking to diminish the import penetration rate.

Second, the Community sought to strengthen the European (owned) semiconductor producers and increase their international competitiveness through funding of cooperative R&D projects, namely the European Strategic Program for Research and Development in Information Technologies (ESPRIT)

and the Joint European Submicron Silicon Initiative (JESSI). The Community also protected the design of semiconductor topographies to improve the legal environment of R&D and production.

Finally, the European Community did not block foreign direct investment in the semiconductor industry. Community policies, however, had the intended or unintended effect of upgrading inward investment through various incentives and constraints. The Community stimulated investment in manufacturing operations in the Community instead of (exporting or) point-of-sales investments through the lower tariff on wafers. Anti-dumping suits or threat thereof indirectly had the same effect, stimulating manufacturing in the Community to obtain European "origin" status, thus avoiding any anti-dumping charges. The change in rules of origin indirectly stimulated foreign direct investment in diffusion operations instead of assembly. Since diffusion generally accounts for most of the value of the completed semiconductor and involves higher capital and R&D investments, this policy change also contributed to the upgrading of inward investment in the Community industry. The objective of the EC policies in the 1980s thus appeared to be the establishment of a competent and high value European-located semiconductor industry, rather than an exclusively European-owned production capability.

The EC policies appeared to be beneficial to European-

owned semiconductor producers and their share-holders. However, the EC policies were to the disadvantage of other actors such as semiconductor consumers, and, in certain cases, foreign exporters and foreign-owned subsidiaries located in the Community. According to the economic liberal perspective, the EC policies adversely affected certain groups in the Community and imposed a welfare cost on society as a whole.

The thesis addresses in Chapters V and VI the question of why the Community selected policies that, according to liberal economics, should be rejected. The EC policy choice can be explained by the following four, interacting factors. First, judging by the arguments used to justify government intervention in the semiconductor industry, the EC semiconductor policy choices have been affected by economic nationalist ideas, and, to a certain extent, strategic trade policy arguments. The Community did, however, not adhere to all economic nationalist policy prescriptions. In contrast to economic nationalist prescriptions, the Community was open to foreign direct investment. Neither did the member states adhere to the anti-FDI prescription. The Community considered its objective of a competitive European semiconductor industry for political, strategic and economic reasons to be better served through upgrading rather than blocking of foreign direct investment.

Second, both semiconductor consumers as well as semiconductor producers lobbied the European Commission to act

in accordance to their respective interests. In the DRAM anti-dumping case, producers would gain considerably from government intervention as would their share-holders, while consumers would lose substantially. However, the Commission adopted a policy line that benefitted the producers, indicative of the larger political power of producers over semiconductor consumers. The thesis illustrates that semiconductor producers were effective in lobbying for EC funding and protection due to their company size, their type of business operations and their political organization. Although the semiconductor consuming industry was also important, semiconductor consumers were far less effective in their lobby activities due to the smaller strategic importance of final products over key inputs. Semiconductor producers also effectively lobbied the national governments.

Third, the interests expressed by semiconductor producers were channelled and reinforced by the national governments and the European Community. National governments which sought to improve the performance of the domestic semiconductor industry, and the European Community which aimed at the establishment of a competitive European semiconductor capability, perceived the producers' request to protect and strengthen their in-house semiconductor capabilities as contributing to the realization of their own interests.

The member state interests and the EC interests were not necessarily in accordance; national governments feared, in

particular, that the European semiconductor policies would supplant their policies. However, European policies appeared to be complementary to the member state ones, indicative of the impact of the member states on the EC semiconductor policy choice. Their impact was explained by the fact that the member states could express their interests in various ways and on crucial points in the EC decision-making process. However, the thesis also finds that the role played by the Commission, representing Community interests, relative to the Council, the platform for national interests, should not be underestimated.

Finally, the nature of the international system and the position of the EC within this system influenced the EC policy choice through the impact of this external variable on semiconductor firms, national governments and the European Community. The disintegration of the world-wide liberal GATT regime into trading blocs, the revival of protectionism, and the rise of managed trade threatened the position of EC firms in domestic and international markets, the autonomy of member states and the European Community. The international system also impacted on ideology; the recent developments strengthened the economic nationalist perception of the way in which the international system operated.

Evoked by the developments in the international system and justified by an economic nationalist ideology, the European Community thus selected policies, which according to liberal economics should be rejected, in response to the

interests of semiconductor producers, which were channelled and strengthened by the member state governments and the European Commission.

1.5 CONTRIBUTIONS TO THE LITERATURE

In comparison to the wealth of literature on American and Japanese semiconductor policies, little attention has been paid to EC semiconductor policies. Only a few authors, notably Malerba (1985) and Flamm (1990), have contributed to the description and analysis of the EC policy response to developments in the European semiconductor industry⁴.

Malerba (1985) gives, in The Semiconductor Business: the Economics of Rapid Growth and Decline, a detailed analysis of the evolution of the European semiconductor industry relative to its American and Japanese counterparts over the time period 1948-1982. In particular, Malerba addresses the questions as to why the European semiconductor industry declined and why it was then unable to catch up. The growth and decline of the European semiconductor industry is explained by four interacting factors: rapidly changing semiconductor technology, the size and sophistication of regional demand, the structure of the industry, and the timing, type and scale of government support. With respect to the latter variable, Malerba concludes that public policies have affected the rate and direction of technological change as well as the

international competitiveness of firms and countries; "public policy acted as a positive force in the United States and Japan and as a neutral force in most European countries" (Malerba 1988:235). Although Malerba does not cover the 1980s, his analysis of the European semiconductor industry emphasizes the relevance of government policies for developments in the semiconductor industry and thus justifies the topic of this study, the EC semiconductor policy response.

Flamm (1990) takes us into the 1990s. In his contribution to Hufbauer's Europe 1992 - an American Perspective, Flamm describes and analyzes the European semiconductor policies over the last decade. According to Flamm (1990:226), the EC policy response towards the semiconductor industry is best understood as a response to the changing international environment, which has been critically shaped by American and Japanese policies.

Flamm (1990:284-292) concludes by stating that EC semiconductor policies appear to combine reflexive and contradictory short-term policies with a rather clear and coherent long-term view. While Flamm argues that the Community's answers to short-term difficulties in the EC semiconductor industry are "bad copies" of American policies, the policy response in the longer term indicates the development of a domestic "technological bloc". According to Flamm, the Community aims at self-support in the long term; all the elements of the so-called "industrial foodchain" from

manufacturing equipment and chip design to producing the end product, should be available within the Community.

While Flamm emphasizes the role of system variables as explanation for the chosen EC policy response, other authors such as Ostry (1990) and van Tulder and Junne (1988) point also to the importance of domestic-level variables. In Governments and Corporations in a Shrinking World, Ostry (1990) provides an interesting overview of the EC anti-dumping policies, the change in rules of origin and the Community's strategic R&D programs. She argues that both member states as well as industrial interests have played a determining role in the formulation of EC trade and innovation policies. Ostry also elaborates on the role of economic ideas. In European Multinationals in Core Technologies, van Tulder and Junne (1988) endorse the importance of these variables in their discussion of the European semiconductor industry, the national and Community semiconductor policies.

This thesis contributes to the literature on EC semiconductor policies in the following ways. The thesis provides an up-to-date and comprehensive description of the EC policy response to import penetration and foreign direct investment in the European semiconductor industry. The study also analyzes the EC policy response, using a new IIII-approach developed by the author which includes both domestic-level as well as system-level explanatory variables. This thesis offers thus a case study on explaining economic policy

choices.

Further research is necessary to fill in some of the gaps or unanswered questions in this thesis. For example, what are the actual benefits and costs of foreign direct investment in the Community, and what will be the impact of diverging interests between small and large EC member states on EC policy formulation? Most of all, further research is necessary to stay up-to-date in an area that is so rapidly changing as the semiconductor industry.

ENDNOTES

1. An actor is small if it is a price taker in world markets, i.e. the actor accounts for such a small share of total world production and/or consumption that its actions have no perceptible impact on the world price (Yarbrough and Yarbrough 1988:144). However, in contrast to other semiconductor industries in small economies, the European semiconductor industry potentially has a huge domestic market. If backed up or supported by the EC government, this potential gives the European semiconductor industry more political and economic leverage in the international scene than other small-economy semiconductor industries have.

2. The author believes in the liberal principle that free trade yields welfare gains to society as a whole, but recognizes that the international trading system tends to operate on different premises. In general, the author believes that actors try to maximize their own perceived interests, whether economic or political.

3. For example, Jenkins (1986), Milner (1987, 1988), Bhagwati (1988), Gourevitch (1986), Hall (1986), Baldwin (1989), Goldstein (1989).

4. However, a broad literature exists on specific issues related to the topic of this thesis. For readers interested in more detailed information on the EC semiconductor policies, see, for example, Dosi, G. (1983). "Semiconductors: Europe's Precarious Survival in High Technology". G. Shepherd, F. Duchene, Ch. Saunders (eds) Europe's Industries. Public and Private Strategies for Change; Nelson, R.N. (1984). High-Technology Policies. A Five Nation Comparison; Beseler, J.F. and A.N. Williams (1986). Anti-Dumping and Anti-Subsidy Law. The European Communities; Vermulst, E. and P. Waer (1990) "European Community Rules of Origin as Commercial Policy Instruments. Journal of World Trade, June, 55-99; Mytelka, L.K (ed) (1990). Strategic Partnerships: States, Firms and International Competition. Pinter Publishers: UK; Durande, B. (1988). "Europe de la Technologie: du Defi aux Ambiguites". Chroniques d'Actualite de la S.E.D.E.I.S., 6, 15 Juin:237-245; and articles in European Law Review, Journal of World Trade, Internal Market, European Affairs, Intereconomics and Europe. For readers interested in more detailed information on the EC semiconductor industry, see Langlois et al (1988). Microelectronics: an Industry in Transition; UNCTC (1986). Transnational Corporations in the International Semiconductor Industry; excerpts from UNCTC (1988), Transnational Corporations in World Development; and the EC sections in Electronics, and The Economist.

CHAPTER II

THE SEMICONDUCTOR INDUSTRY

During the 1980s all governments of countries with a production capability in semiconductors protected and promoted their semiconductor industries. Semiconductor manufacturers in Japan, the European Community and the United States were protected through tariff and non-tariff barriers, and were net-receivers of large sums of public funds.

Prior to describing the policies that benefitted the European semiconductor industry, we need to discuss the characteristics of this industry. The chapter is divided into three sections. The first part outlines the technological dimension of the semiconductor industry. It describes the product and production processes in this industry and contributes to the understanding of its nature and the dynamics. The second part describes the historical evolution of the world semiconductor industry. The third section focuses on describing the current patterns of supply and demand in the world semiconductor industry in general and in the European semiconductor industry in particular. The fourth and fifth sections elaborate on the industry's structure and demand.

The purpose of this chapter is not only to introduce the reader to the topic of this thesis. The description of the semiconductor industry also contributes to the analysis of the EC semiconductor policy response. The technological dimension of the semiconductor industry will provide information vital to our understanding of the ideologies (I_1) that justified government intervention. Additionally, the description of the

industry structure, supply and demand patterns give insight in the interests of semiconductor producers which have affected EC policy choices (I_2). Moreover, the positioning of the European semiconductor industry into its international context will form a basis for the International System explanation (I_4) of the EC's policy response towards the European semiconductor industry, since the position of European producers relative to their American and Japanese counterparts plays an essential role in government subsidization and protection of the semiconductor industry.

2.1 THE SEMICONDUCTOR INDUSTRY: PRODUCTS AND PROCESSES

2.1.1 Semiconductor products

Although limited types of semiconductor devices were produced in the late 1930s and early 1940s, the event that effectively established the modern semiconductor industry was the fabrication of the first successful transistor at Bell Laboratories in 1947. Initially, the transistor was considered to be a curiosity rather than a substitute for the electric tube (a vacuum). Only later, when the transistor performed better than the electric tube, did it become the new basic component of the electronics industry.

Transistors are discrete devices, i.e. they contain only one element which can amplify or switch current. At present, the technology incorporated in these devices is considered to

be "mature"; as indicated above, the key technology was developed in 1947. In line with the product life cycle¹, these devices account only for a relatively small market share². Growth rates range from mediocre to negative and prices are low. In addition, intensive competition has led to further price erosion.

In the 1960s, the development of Integrated Circuit (IC) technology was a major technological breakthrough. ICs contain two or more elements that can amplify or switch current. At present, integrated circuits, comprising succeeding generations of chips, account for the largest share of the market³. The newest generations such as Dynamic Random Access Memory chips (DRAMs), show growth rates that verge on the spectacular. However, the total growth is moderated by the low to negative growth rates in older generation ICs⁴.

Due to increased competition, product life cycles have been "shortened"; new generations now follow each other more closely in time. New generations of chips are characterized by increased "density" of integration; i.e. the number of active elements per chip approximately doubles, while the material costs remain virtually fixed. Other advantages associated with the development of a new generation are lower power consumption, increase in speed, and greater immunity or resistance to noise and radiation damage (Langlois et al. 1988:12; Santo and Wollard 1988:31).

Figure 2.1 gives an overview of the major types of

Figure 2.1 Semiconductor Types

Notes

- 1 DRAM - Dynamic Random Access Memory. Generations:
 1K (1970); 4K (1973); 16K (1976); 64K (1978);
 256K (1980s); 1 and 4 Megabit (1980s)
- 2 SRAM - Static Random Access Memory
- 3 ROM - Read Only Memory
- 4 EPROM - Erasable Programmable ROM
- 5 EEPROM - Electrically EPROM

Source: Author's modifications of UNCTC (1986:3) based on data from Langlois et al. (1988:8-25).

discrete devices and integrated circuits.

2.1.2 Semiconductor Production Processes

The semiconductor production processes require silicon as key input. Silicon's noise, temperature and frequency characteristics were superior to those of germanium, which was used as input for transistors prior to the 1950s. Another advantage of silicon is its abundance: it is one of the most plentiful elements on earth. Moreover, the early emergence of silicon as the base material for semiconductors has endowed the industry with an extensive stock of knowledge of the characteristics and behaviour of silicon. It will be shown below that this benefits effective production (Langlois et al. 1988:21-22). The use of silicon as input is presently challenged by gallium arsenide. Although gallium arsenide has some advantages over silicon, it also has some disadvantages, which makes the use of this material for semiconductor production less attractive⁵.

The manufacturing of semiconductors consists of three basic stages, namely (1) the design and manufacture of a wafer or disc; (2) the printing of semiconductor circuits on the wafer (known as diffusion); and (3) the cutting of the wafer into individual chips (known as assembly) and final testing (Langlois et al. 1988:13). The different stages of the production process can be physically separated from each other without any significant increase in costs (Langlois et al.

1988:14)); inventory, storage and transportation costs are relatively low (Flamm 1985:49). The separability of the different stages of the production process and the nature of the semiconductor (high value added relative to weight) have made it possible to locate the different stages at different sites; the different requirements of the various stages have made it attractive to do so.

All stages in the manufacturing process are, with the exception of assembly, highly capital and R&D intensive. For example, in the early 1980s, simple semiconductor devices, characterized by a relatively low level of technology in design and manufacturing, required an investment of up to \$ 20 million⁶; at the same time, at least \$ 100 million had to be invested in R&D and production of advanced semiconductors (Wyatt 1987). Over the course of the decade, increasing complexity and rapid obsolescence of technology have sent the costs of R&D and equipment even higher. In contrast to the assembly stage, economies of scale and scope play therefore an important role in the design and manufacture, printing, and final testing stages in reducing the costs of production and spreading the risks⁷.

Learning economies⁸ also play a large role, as a consequence of the sensitivity of semiconductor production techniques to dust, temperature, timing, density of solution, vibration levels, etc. (Krugman and Baldwin 1988:173,174). In the early phase of the "product life cycle" of a chip, when

the exact conditions of production are not fully known, the yield is relatively small⁹. Consequently, the price of these devices is comparatively high. However, when the conditions for production are modified, the yield rises sharply and the price declines. Langlois et al. (1988:16) indicate that the cumulative unit cost falls on average approximately 30 percent as the cumulative production volume doubles.

The need to raise yields has incited semiconductor firms to produce high-volume devices that can act as "technology drivers". The rationale behind "technology drivers" is that the skills learned in production of relatively simple products on a large scale can be transferred to more complicated, higher value added chips, and help "drive" the firm down a steep learning curve. An example of a "technology driver" is the Dynamic Random Access Memory Chip (Yoffie 1988; Howell, Benz and Wolff 1986:247).

These scale and learning economies point to the existence of first-mover advantages. As explained by Langlois et al. (1988:109): "an innovator [semiconductor producing firm] which is able to build volume rapidly may maintain a cost advantage by staying ahead of imitative competitors on the experience curve." Also, rapid expansion gives the innovating firm the opportunity to capture the market and to enjoy a monopoly position before other firms enter to contest the innovator's position.

In contrast to the knowledge associated with a new

generation of semiconductors (design and basic techniques of manufacture), the knowledge gained from learning-by-doing and learning-by-using is highly appropriable but hardly transferable between units; the precise conditions of manufacturing are firm- or even plant-specific (Krugman and Baldwin 1988:176). Unlike the design of chips, the details of production are not evident in the final product (Krugman and Baldwin 1988:176; Langlois et al. 1988:16).

Having outlined the main types of semiconductor products and the nature of the semiconductor production processes, we turn now to the description of the semiconductor industry from an historical perspective.

2.2 A BRIEF HISTORY OF THE SEMICONDUCTOR INDUSTRY¹⁰

The first production of transistors by Bell Laboratories in 1947, as noted above, was soon followed by production by other American firms, mostly large vertically integrated producers of receiving tubes such as Western Electric, RCA, and Westinghouse. In the late 1940s, large European electronic firms such as Philips, Siemens, GEC and Thomson-Houston were also able to produce transistors.

During the 1950s, the world semiconductor industry experienced high rates of growth. While in the early 1950s the industry was almost non-existent, by 1960 sales had reached \$750 million. According to Malerba (1985:224), the world

semiconductor industry in that period, was characterized by both technological and competitive parity between the European and the American industries, with the Japanese industry lagging behind¹¹.

In absolute terms, however, US production was significantly larger than European and Japanese production. In 1958, the United States output constituted 84 percent of total production of the main semiconductor manufacturing countries¹². American consumption was also relatively large; in 1956 the United States consumed 87 percent of total consumption of the main semiconductor consuming countries (see figure 2.2 and table 2.1). Despite the lag in production, European countries were largely self-sufficient due to the equally small consumption of semiconductors. For example, in 1960, only 11 percent of the total European consumption of semiconductors was supplied by imports from the United States (Finan in Malerba 1985:40).

During the 1960s, the United States became the technological leader and the dominant producer of the more advanced and fast growing (digital) integrated circuits. The US defence and space programs provided the American semiconductor industry with a lucrative market, protected through various contract clauses and national security measures. Government policies also supported the establishment of "downstream" computer industries. Consequently, the structure of demand was characterized by a large share of

Figure 2.2 Distribution of World Semiconductor Production and Consumption over Time

Source: Table 2.1

Table 2.1 Distribution (in %) of World Semiconductor Production and Consumption over Time

Production				
Area/Year	1958	1964	1972	1978
USA	84.0	66.0	n.a.	59.0
Japan	6.8	14.4	n.a.	28.0
Europe ¹	9.3	19.6	n.a.	13.0
Total	100.1	100.0	n.a.	100.0

Consumption				
Area/Year	1956	1965	1972	1978
USA	87.0	76.7	57.1	37.0
Japan	5.4	9.5	24.8	27.0
Europe ¹	7.6	13.8	18.1	26.0
Rest				10.0
Total	100.0	100.0	100.0	100.0

Notes

¹ Data 1956, 1958, 1964, 1965: France, the United Kingdom and West Germany.

Source: Malerba 1985

public procurement and an increasing share of demand generated by the computer industry. The military demand for semiconductors pulled the industry in the direction of the technologically more advanced integrated circuits. At the same time, the computer industry stimulated the development of digital integrated circuits.

When the European demand for digital semiconductor devices started to grow during the 1960s, the American lead in these devices resulted in a penetration of the European market by American products. In these areas, European producers neither had the technological capability nor the production experience to outcompete the Americans (Malerba 1985:100-119).

In this period, Japanese producers still ranked below their European counterparts such as Philips and Siemens. However, unlike the European governments, the Japanese government protected the domestic market at both the input stage (semiconductor industry) as well as the final product stage (computer industry). The domestic market was protected by high tariff barriers and barriers to foreign direct investment (FDI). In addition, the "Buy Japan" policy of procurement in the computer industry also protected the domestic market from penetration by predominantly American products (Malerba 1985: 136-137).

By the 1970s, semiconductor market sales had increased to \$3,000 million. The United States remained by far the

largest producer of semiconductors. The position of the European industry had declined, while Japan's position had improved; in the early 1970s, Europe's ranking fell below Japan. Europe's share in world consumption also had declined (see figure 2.2 and table 2.1).

In the 1970s, the world semiconductor industry expanded from sales of \$ 3,000 million to \$ 16,900 million in 1980. Although the American share in world production and consumption declined, the United States remained the major producer and consumer of semiconductors, followed by Japan. Europe's share in world production declined but its share in world consumption increased (see table 2.1 and figure 2.2).

American producers such as Texas Instruments, Motorola, Fairchild, ITT and National Semiconductor remained the leading semiconductor manufacturers. All European producers, in contrast, were forced out of the high volume mainstream semiconductor market into the niche markets, or even out of business, with only five exceptions: Philips, Siemens, SGS, Sescosem (Thomson) and AEG-Telefunken. Only large, vertically integrated companies, either financially strong and/or government supported, could remain in the mainstream semiconductor production (Dosi 1981:185).

In contrast, Japanese firms such as Toshiba, Hitachi, Mitsubishi and Fujitsu developed a competitive semiconductor production capability due to government protection and a growing Japanese demand for computers, and thus for

semiconductors. In contrast to European governments which took few steps to promote or protect their semiconductor industries, the Japanese government targeted semiconductors as a strategic industry and favoured R&D cooperation among Japanese firms in order to avoid duplication of research efforts (Malerba 1986).

By 1980, the European semiconductor industry, once in parity with its American counterpart and superior to the Japanese semiconductor producers, had become a small actor in the world semiconductor industry. In 1980, the European semiconductor industry accounted for only 9.6 percent of world production and 21.7 percent of world semiconductor consumption, and was characterized by a high degree of import penetration and foreign direct investment. The following three sections paint a more detailed picture of the world and European semiconductor industries in the 1980s, in order to provide a proper background for the further discussion of the EC semiconductor industry.

2.3 SUPPLY AND DEMAND PATTERNS IN THE 1980S

In absolute terms, world semiconductor markets nearly tripled over the 1980s¹³. However, over the decade, the annual rates of growth varied considerably¹⁴. After a period of moderate growth in the early 1980s, world markets expanded in 1984 by 47.9 percent. In 1985, in contrast, markets shrank by

11.9 percent (Langlois et al. 1988:27, data production). After the recession years of 1985 and 1986 in the semiconductor industry, the market recovered in 1987 (Santo and Wollard 1988:30). In 1988, the world semiconductor markets enjoyed again a considerable expansion, followed by moderate growth in 1989.

Production and consumption of semiconductors was concentrated in Japan, the United States and Western Europe. As tables 2.2 and 2.4 show, production and consumption in the rest of the world was relatively insignificant. This notion of regional concentration of production and consumption is given even more substance when the distribution of production and consumption within the rest of the world is examined. Asia¹⁵ accounted in the early 1980s for about 65 percent of the "rest of the world share" in consumption of integrated circuits (UNCTC 1986:24). Here, the main producers of semiconductors were the rapidly growing South Korean firms: Samsung, Lucky-Goldstar, Hyundai and Daewoo (Wall Street Journal January 10, 1989:25)¹⁶. However, as the UNCTC (1986:16) points out, the small share of developing countries in semiconductor production obscured the actual role of these countries in the semiconductor industry. The production statistics, which were based on the home country of producing firms, concealed that certain stages in the production process, namely assembly and packaging operations, took place in developing countries¹⁷.

2.3.1 Production of Semiconductors

In 1986, the American semiconductor industry was the largest producer of semiconductors, followed by Japan. The 1980s showed an increase in the share of the Japanese semiconductor industry and a decline in the share of American producers. In the timespan 1980-1986, American production increased approximately by 50 percent; Japanese production, in contrast, tripled¹⁸. Consequently, in 1989, the Japanese semiconductor industry was the main producer of semiconductors, holding nearly 50 percent of the world market. The small share of European and other producers in world semiconductor production remained fairly stable over the decade (see table 2.2 and figure 2.3).

American and Japanese production were dominated by integrated circuits. In contrast, shares of integrated circuits in production of Europe and other countries were relatively low. Until 1983, the more mature discrete devices accounted for more than 50 percent of European and other countries' production, illustrating the technological lag and differences in demand structure of these countries relative to Japan and the United States (see table 2.2).

2.3.1.1 European Semiconductor Production

Judging by the Community's share in world production and the domination of the more mature devices in production, the

Figure 2.3 Percentage Distribution of World Semiconductor Production, 1970-1989

Source: Table 2.2

Table 2.2 Distribution (in %) of World Semiconductor Production by Home Country of Producing Firms, and Share (in %) of Integrated Circuits and Discrete Devices in Domestic Production, 1970, 1975, 1980-1986, 1989.

Year	1970	1975	1980	1981	1982	1983	1984	1985	1986	1989
United States	56.5	63.9	65.8	64.2	62.7	61.3	58.1	56.1	49.9	40.0
IC			81.3	82.1	83.5	84.3	86.5	86.7	86.8	
Discrete			18.7	17.9	16.5	15.7	13.5	13.3	13.2	
Japan	27.1	19.3	22.7	24.6	25.7	27.9	31.7	32.6	37.6	47.0
IC			63.8	62.1	66.7	71.2	74.7	74.8	74.9	
Discrete			36.2	37.9	33.3	28.8	25.3	25.2	25.1	
Western Europe ¹	16.1	16.7	9.6	9.1	9.7	8.9	8.3	9.1	9.6	13.0
IC			40.6	44.4	46.5	53.5	59.7	61.5	55.2	
Discrete			56.3	48.7	51.6	47.3	42.4	44.6	44.8	
Rest ²	0.3	1.1	1.9	2.1	2.0	1.9	1.9	2.2	2.9	
IC			40.6	44.4	46.5	53.5	59.7	61.5	66.7	
Discrete			59.3	55.6	53.5	46.5	40.3	38.5	33.3	
Total	100	100	100	100	100	100	100	100	100	100
Abs. (billion \$)			16.9	17.0	17.9	22.2	32.8	29.0	33.9	49.1
% Growth per year				.3	5.3	24.4	47.9	-11.9	16.9	-
IC			73.0	73.6	75.1	77.2	79.8	79.4	78.7	
Discrete			27.0	26.4	24.9	22.8	20.2	20.6	21.3	

Notes

- 1 Percentage for both Western Europe and other semiconductor producers.
 2 Including China, excluding CMEA countries.

Sources:

Data 1970/75: Braun & MacDonald (1982:153);
 Data 1980/86: Author's calculations based on data from Langlois et al. (1988:27).
 Data 1988: Business Week Jan. 8, 1990:100.

European semiconductor industry was the third, relatively weak actor in an oligopolistic industry dominated by Japan and the United States.

More than 80 percent of European production took place in the four main European countries: France, West Germany, Italy and the United Kingdom. A breakdown of total European semiconductor production by country shows that in the first half of the 1980s, West Germany was the largest producer of semiconductors followed by France and the United Kingdom. The German share declined over the first 5 years, probably due to decreasing competitiveness of Siemens, while the British share increased and the French share stayed relatively stable. In 1986, France was the largest producer of semiconductors, followed closely by West Germany and the United Kingdom. Italy and the Netherlands, producing approximately the same amount of devices (UNCTC 1986:48), kept a relatively stable share over time (see table 2.3).

According to the share of ICs in total semiconductor production, Italy's production was the most advanced in the early 1980s, followed by the other large European states. The relative share of ICs in production of the rest of Europe, including the Netherlands, was relatively low (see table 2.3).

2.3.2 Consumption of Semiconductors

During the first half of the 1980s, the United States was by far the largest semiconductor consumer. In 1985, the United

Table 2.3 Share (in %) of West Germany, United Kingdom, France, Italy and the Rest of Europe in Western European Semiconductor Production in the 1960s, Share of ICs (in %) in Total Domestic Production, and Total European Production in Millions of Dollars.

Country	Year				
	1980	1981	1982	1983	1986
Germany					
ICs	48.2	62.8	62.8	63.3	65.9
Total	32.6	27.9	27.4	26.9	24.9
Un. Kingdom					
ICs	42.9	68.6	68.0	69.6	74.7
Total	18.4	23.0	23.1	23.5	24.0
France					
ICs	22.2	53.4	53.4	54.9	61.8
Total	25.7	24.1	24.6	24.7	25.3
Italy					
ICs	54.6	69.3	70.4	71.5	78.4
Total	7.3	7.3	7.6	7.6	8.8
Rest ¹					
ICs	23.1	46.6	46.8	48.5	53.0
Total	16.0	17.7	17.4	17.2	17.0
Total					
Rel.	100.	100.	100.	100.	100.
Abs.	1,945	2,220	2,276	2,447	3,485

Notes

¹ The rest of Europe includes Scandinavia.

Source: Author's calculations based on data from UNCTC 1986:49 (1980-1983, 1986. Data 1983 and 1986 are estimates).

States still accounted for 52.3 percent of world consumption, compared to 19.9 percent for Japan, 17.3 percent for Western Europe and 10.6 percent for the rest of the world. However, this pattern changed drastically in the second half of the 1980s. In 1987, the American share in world consumption had dropped to 29.3 percent, while the Japanese share reached its peak at 45.5 percent. Electronics (January 1990:55) forecasts for 1990 that the United States and Japan will have a 36 percent and 40 percent share in semiconductor consumption respectively. According to the forecast, European consumption will be 15 percent in 1990. However, this prediction might be too low, judging from the 22 percent growth in European consumption recorded by the Financial Times (June 18, 1990)¹⁹. (see table 2.4 and figure 2.4).

In the early 1980s, the United States formed the largest market for integrated circuits. Over this time period, the share of integrated circuits increased in all geographic areas. Japan and other countries showed a sharp rise; Europe, in contrast, lagged behind (see table 2.4).

Unfortunately, no data were available on the share of integrated circuits in domestic consumption over the second half of the decade. However, on the basis of the increasing application of these devices, it is expected that the trend of rising shares has continued.

Figure 2.4 Percentage Distribution of World Semiconductor Consumption, 1970-1990

Source: Table 2.4

Table 2.4 Distribution (in %) of World Semiconductor Consumption by Geographical Areas, and Share (in %) of Integrated Circuits and Discrete Devices in Domestic Consumption, 1980-1988, 1990 (forecast).

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1990
United States	50.8	54.9	53.3	52.2	51.9	52.3	39.0	29.3	30.8	36.0
IC	84.9	85.8	85.7	86.0	87.7	89.6				
Discrete	15.1	14.2	14.3	14.0	12.3	10.4				
Japan	19.3	19.7	20.5	21.1	20.6	19.9	34.0	45.5	43.8	40.0
IC	63.2	71.5	71.4	73.8	76.6	79.5				
Discrete	36.8	28.5	28.6	26.2	23.4	20.5				
Western Europe	21.7	17.5	17.5	17.3	17.4	17.3	19.0	16.2	14.7	15.0
IC	62.2	61.3	61.6	63.3	65.1	66.5				
Discrete	37.8	38.7	38.4	36.7	34.9	33.5				
Rest of World	8.2	7.9	8.7	9.4	10.1	10.6	8.0	9.0	10.8	9.0
IC	50.9	41.0	51.1	54.5	62.0	67.2				
Discrete	49.1	59.0	48.9	45.5	38.0	32.8				
Total	100	100	100	100	100	100	100	100	100	100
Abs. (bill.\$)	16.9	17.0	17.7	19.9	23.9	29.5	-	38.9	49.1	47.8
% Growth p/y		.3	.4	12.8	20.0	23.0	-	-	26.2	-
IC	73.0	75.2	75.5	76.5	78.9	81.3	n.a	n.a	n.a	n.a
Discrete	27.0	24.8	24.5	23.5	21.1	18.7				

Sources:

Data 1980/85: Author's calculations based on data from UNCTC (1986:23).

Data 1986: Langlois et al. (1988:29).

Data 1987, 1988, 1990: Author's calculations based on data from Electronics (January 1989:55; January 1990:55).

2.3.2.1 European Semiconductor Consumption

In the 1980s, European consumption was thus relatively small and strongly dominated by the more mature discrete devices. More than 80 percent of European consumption took place in France, West Germany, the United Kingdom and Italy. Table 2.5 gives a country-by-country breakdown of European consumption. In the first half of the 1980s, West Germany constituted the largest market for semiconductor consumption, followed by the United Kingdom and France. Italy's share in European consumption was slightly higher than the Dutch share²⁰. In the second half of the 1980s, the Italian share rose considerably, probably due to the increasing importance of the Italian computer industry, surpassing France as the third largest semiconductor market in Europe. The German market stayed the largest, followed by the British market.

In the four largest European countries, the share of integrated circuits in European consumption was comparable to the Japanese and American average (70 to 80 percent). In particular, the British consumption was characterized by a relatively large share of ICs.

2.3.3 Trade in Semiconductors

The Integrated Circuit Engineering Corporation plotted the "traffic" in semiconductors between the United States, Japan, Europe and the rest of the world in 1983 (in Young 1985:55) (see figure 2.5). In 1983, the following patterns in

Table 2.5 Share (in %) of West Germany, United Kingdom, France, Italy and the Rest of Europe in Western European Semiconductor Consumption in the 1980s, Share of ICs (in %) in Total Domestic Consumption, and Total Domestic Consumption in Millions of Dollars.

Country	Year								
	1980	1981	1982	1984	1985	1986	1987	1988	1989
Germany									
ICs				73.2	72.4	75.6	76.0	78.3	77.4
Total	35.0	33.2	32.8	32.4	38.3	n.a.	31.8	32.1	31.4
Un. Kingdom									
ICs				78.6	92.5	80.2	83.5	85.2	85.4
Total	18.6	19.8	20.2	21.1	19.3	n.a.	25.5	23.6	23.1
France									
ICs				69.3	74.9	75.5	75.2	80.3	80.3
Total	17.7	18.8	18.9	17.1	17.9	n.a.	14.3	15.4	16.0
Italy									
ICs				70.6	74.3	74.5	73.8	82.3	83.3
Total	10.1	9.7	9.7	9.5	11.8	n.a.	9.3	17.2	17.8
Rest ¹									
Total	18.6	18.5	18.4	19.9	12.8	n.a.	19.1	12.0	11.8
Total									
Rel.	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Abs.	3,686	3,041	3,167	4,150	5,080	n.a.	6,300	7,200	7,700

Notes

¹ Includes Scandinavia.

Source: Author's calculations based on data from:

UNCTC 1986:25; Electronics Jan.1, 1985:67/68; Jan, 13 1986:39/43/47/50; Jan. 22, 1987:79/81/85/88; Jan. 21, 1988: 69/73/77; Jan. 1989:57/121/125/138/130; Jan. 1990:94/98/101/103.

Figure 2.5 World Wide Integrated Circuit Production and Traffic, 1983

* Includes production of US-owned plants in Europe

P = Production
C = Consumption

Source: Young (1985:55)

trade flows could be discerned:

1. American exports (including production of US plants located in Europe) were, in order of importance, directed at Europe, the developing countries and Japan. Imports into the United States originated mainly from Japan.
2. Japanese semiconductor exports were directed primarily at the American market, although a considerable amount was also exported to developing countries. Japanese exports to Europe were relatively small. Imports into the Japanese markets came solely from the United States.
3. European semiconductor exports were mainly directed at other European countries (UNCTC 1986). Relatively small amounts were exported to the United States and developing countries. Semiconductors were imported into Europe from the United States and since the mid-1970s also from Japan.
4. Exports from the rest of the world were limited, and solely directed at the United States. The rest of the world imported devices from all Triad powers.

Relating exports to domestic production and imports to domestic consumption, one can calculate the export orientation and import penetration, respectively (see table 2.6). In 1982, Europe and the rest of the world were heavily penetrated by imports, in contrast to the United States and Japan. None of the countries was heavily export oriented in 1982²¹, which implies that the majority of domestic production was supplying domestic demand. Japan showed the highest export orientation

(28.7 percent) and it is expected that the Japanese export orientation has increased in the second half of the 1980s.

These statistics do not reveal to what extent the trade flows between countries consisted of intra-firm trade. Grunwald and Flamm (1985:16) mention that in the case of American firms, intra-firm trade in semiconductor parts and finished products played an important role²². Therefore, import penetration and export orientation data might give a distorted picture. Table 2.7 indicates, by geographical area of consumption, to what extent domestic consumption was supplied by domestic or foreign firms (via exports or via production on the spot). The general conclusion, that Japan and the United States are largely self-sufficient while Europe and other countries show a high penetration rate, is confirmed by these data.

2.3.3.1 European Import Penetration

Although European production was largely sold on the domestic market (Flamm 1990:233), total European production was not large enough to meet total European demand. In 1985, 58.7 percent of European consumption was supplied through imports: 24 percent by American producers, 11.3 percent by Japanese firms, and 23.4 percent by other manufacturers (Malaysia, Hong Kong, etc.). The Japanese share in the European market increased particularly over the 1980s (European News 23, 1990: Memo 1/2/86).

Table 2.6 Export Orientation and Import Penetration (in %) in Integrated Circuits, 1982

Country penetration	Export orientation	Import
United States	19.1	7.2
Japan	28.7	13.9
Europe	17.7	65.8

Source: van Tulder and Junne (1988:133).

Table 2.7 Percentage of Consumption of Integrated Circuits by Geographical Area and by Supplier, 1983.

Consuming area	Percentage supplied by firms with a home base in:			
	United States	Japan	Europe	Rest of World
United States	<u>91</u>	7	1	<0.5
Japan	15	<u>85</u>	<0.5	<0.5
Europe	52	16	<u>32</u>	<0.5
Rest of World	41	42	4	<u>13</u>
Total	69	24	6	1

Source: Langlois et al. (1988:30).

Furthermore, neither of the European producing semiconductor countries was self-sufficient (UNCTC 1986:48). In the period 1983-1987, the five countries that accounted for the majority of European semiconductor production faced a net trade deficit in semiconductors, except for the Netherlands in 1986 and in 1987²³ (see table 2.8).

2.3.4 Investment Patterns

Three types of Foreign Direct Investment (FDI) are used by semiconductor firms, although in varying degrees:

1. investments in offshore assembly, primarily located in developing countries;
2. investments in point-of-sale assembly operations (POS), mainly located in developed countries;
3. investments in complete manufacturing, primarily located in developed countries (Langlois et al. 1988:67,68; UNCTC 1986:139-141).

The first type of investment seeks mainly to reduce the costs of labour, while the latter two types predominantly aim at securing market access. Patterns of intra-firm trade are associated with these patterns of investment; for example, components are exported for assembly and testing offshore, and then re-imported for sale or incorporated into end uses.

Two trends in FDI should be noted. First, in the 1980s, assembly has been subject to automatization²⁴ due to the rising labour costs in the host countries relative to other

Table 2.8 Trade of Diodes, Transistors, etc. (DD) and of Electronic Microcircuits (IC) in Thousands of US \$ and Trade Balance in Plus or Minus per Country, 1983-1987.

	1983				1984				1985				1986				1987			
	DD	IC	DD	IC	DD	IC	DD	IC	DD	IC	DD	IC	DD	IC	DD	IC	DD	IC	DD	IC
FRG																				
M	333,626	814,365	400,613	1,258,703	437,129	1,323,628							545,038	1,511,868	620,479	1,819,476				
X	296,164	513,137	339,683	808,427	375,503	720,432							478,674	866,854	665,865	1,123,864				
B	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
F																				
M	168,650	394,964	180,032	632,336	202,204	633,454							267,674	675,489	316,200	1,062,522				
X	230,863	194,759	276,624	376,187	284,607	431,985							392,149	503,926	611,141	744,860				
B	+	-	+	-	+	-							+	-	+	-	-	-	-	-
UK																				
M	185,171	664,227	249,952	1,093,640	270,638	1,169,288							290,920	1,167,146	311,393	1,612,552				
X	129,591	393,934	204,858	663,161	199,676	894,689							228,842	920,699	284,936	1,076,132				
B	-	-	-	-	-	-							-	-	-	-	-	-	-	-
I																				
M	111,553	290,369	134,849	566,593	143,620	593,795							218,813	671,030	301,016	1,068,383				
X	77,874	159,164	79,996	241,238	87,322	259,696							118,131	247,922	180,324	496,112				
B	-	-	-	-	-	-							-	-	-	-	-	-	-	-
NL																				
M	102,761	179,395	121,671	351,160	119,796	316,322							159,037	373,452	199,435	403,213				
X	120,737	111,828	149,914	242,156	140,517	235,777							219,014	385,758	251,995	386,278				
B	+	-	+	-	+	-							+	+	+	-	-	-	-	-
EC																				
M	1,049,752	2,602,318	1,268,130	4,258,967	1,352,974	4,404,197							1,717,863	4,952,408	1,981,236	6,574,412				
X	900,767	1,542,282	1,096,894	2,622,293	1,119,013	2,812,664							1,496,830	3,180,988	2,071,062	4,110,321				
B	-	-	+	-	-	-							-	-	+	-	-	-	-	-

Source: based on International Trade Statistics Yearbook, 1987, vol.2. UN Trade by Commodity.

developing countries and the increasing complexity of technology affecting the assembly stages of the production process. According to Junne (1987:79):

Labour-saving technology will reduce the share of labour in total production costs and will change the structure of comparative advantages of many countries. Availability of cheap labour will no longer be decisive in location production facilities in the Third World. [...] In some cases there may even be some relocation of production facilities back to the industrialized countries.

In a number of cases, automation of the assembly stage has indeed led to the shutdown of facilities in developing countries²⁵ and a relocation of assembly operations to the home country. However, UNCTC (1986:xxvi) indicates that this has not been the general trend; instead, offshore assembly facilities have been automated. This trend can be explained by the costs of plant closure, the increasing importance of these locations as export platforms, and the growth of an internal market in the host countries (UNCTC 1988 and 1986:xxi; Langlois et al. 1988:55,56).

Second, customized production, which requires close coordination by a firm with its main customers and more flexible timing of deliveries, has made a location in the proximity of the main consumers increasingly important (Wall Street Journal, January 5, 1988:25; Langlois et al. 1988:55). As is stated by a semiconductor producer: "As our products become more customized and more customer specific [a trend incited by the increasing complexity of IC-designs], the very nature of that begins to drive you into a closer relationship

with your primary customers" (reported in the Wall Street Journal, Jan. 5, 1988:25). Cross-investments between the United States, Japan and the Community have become increasingly important to ensure a more secure access to these markets.

The above discussed patterns of FDI manifested themselves in different ways among the major actors. At the end of the 1960s, American merchant firms invested heavily in offshore assembly in low labour cost areas. Grunwald and Flamm (1985) estimate that approximately 40 percent of American production was assembled abroad in 1969. This share had risen to approximately 80 percent in 1981. The major share of the semiconductors that were processed in these facilities was shipped back to the United States for sale to original equipment manufacturers (OEMs) or distributors (Grunwald and Flamm 1985:15; UNCTC 1986). American firms also invested in point-of-sale assembly operations and complete manufacturing facilities in Europe. In the latter half of the 1980s, such investment increased in anticipation of 1992 and potential protectionist threats (The Economist, Feb.18, 1989:74). Recently, similar investments have been made in Japan.

Japanese firms were largely home based. The different stages in production took primarily place in automated facilities in Japan. In reaction to the American wave of investments in offshore assembly operations at the end of the 1960s, some Japanese firms also invested abroad. However,

these facilities were only a small percentage of the total Japanese assembly capabilities (UNCTC 1986:xxi). Japanese firms made only limited use of offshore assembly due to government imposed barriers to investment abroad and re-importation of devices²⁶. These constraints to offshore assembly implied that Japan had to cope with the high labour costs in alternative ways such as automation and international subcontracting.

In the 1980s, Japanese multinationals have expanded their offshore assembly operations in developing countries. In particular, these facilities assemble mature devices, and are frequently integrated with consumer electronics assembly operations. Grunwald and Flamm (1985) argue that a large part of the devices assembled abroad were not re-imported into Japan, but sold in local or in third markets.

In the 1980s, Japanese firms also invested in design and manufacturing facilities in the United States and Europe. While their investments in the United States were small acquisitions or de novo investments, in Europe Japanese producers invested in small and medium-sized subsidiaries, mainly in order to secure access to the (1992) single European market (Electronics Aug. 1989:44; Langlois et al. 1988:76). Another reason mentioned for these Japanese investments in Europe is the attempt to reduce their dependence on the American market. In the last few years, also the type of Japanese investment in the Community has changed;

increasingly, Japanese investments cover complete manufacturing processes.

With the exception of the major companies, European-owned firms have only rarely invested in offshore subsidiaries for assembly. The limited European assembly offshore can be explained by the fact that European firms faced and still face high tariff barriers on re-imports of components sent for assembly offshore (Grunwald and Flamm 1985:24-34). Instead, European firms have relied on automated, home based assembly or international subcontracting. In addition to intra-European foreign direct investment, European firms undertook equity investments in the United States at the end of the 1970s.

2.3.4.1 European Community: Host for FDI

In the 1980s, the European semiconductor industry was characterized by a large share of foreign direct investment. As table 2.9 shows, in 1988, seven out of the top 10 semiconductor producers in the Community were subsidiaries of foreign-based semiconductor producers. Remarkable was the high growth percentage in sales of Intel (USA), Toshiba (J) and NEC (J), which could be considered either an indication of their improved competitiveness or their increased activity in the European Community in anticipation of Europe 1992.

Table 2.9 Top Semiconductor Companies in Europe: Sales 1988 in \$m, Percentage Increase of Sales over 1987, Share of Companies in Total European Sales (TES) 1988.

	Sales 1988	Rate of Increase	Share in TES 1988
	in \$ million	in %	in %
Companies			
Philips (NL)	1,002	7.7	13.9
SGS-Thomson (F/I)	650	21.0	9.0
Texas Instruments (USA)	636	29.3	8.8
Motorola (USA)	616	28.9	8.6
Siemens (FRG)	571	20.2	7.9
Intel (USA)	485	71.4	6.7
Nat. Semiconductor (USA)	390	13.0	5.4
NEC (J)	370	48.6	5.1
Toshiba (J)	349	85.6	4.9
AMD (US)	279	18.7	3.9
Total Share in TES	5,348		74.3
Total European Sales	7,200		

Sources: The Economist Feb. 18, 1989:74; Electronics Jan. 1989:55

2.4 INDUSTRY STRUCTURE

The main actors in the semiconductor industry are multinational enterprises (MNEs)²⁷. Therefore, it is important to look at the structure of the industry: the level of concentration of firms, the extent to which they are vertically and horizontally integrated, and the linkages that exist between firms.

Although some semiconductor manufacturers are specialized in semiconductor production, in most cases production of these devices is only a small part in the total sales of the larger vertically and horizontally integrated electronics firms. The international production of each firm and its horizontal and vertical integration may be explained by reasons varying from appropriation of knowledge²⁸ and reduction of transaction costs²⁹ to overcoming government imposed barriers³⁰ and exploiting market imperfections such as market segmentation and entry barriers³¹.

In 1980 three Japanese firms, five American companies and two European firms were ranked in the top ten semiconductor producers³². In contrast, in 1988, six Japanese firms accounted for a top ten position, while only three American companies and one European were so ranked. The increasing presence of Japanese firms in the top ten illustrates the increasing importance of Japanese firms as large actors in the semiconductor industry (see table 2.10).

Table 2.10 World Market Share of the top Semiconductor Producers, 1974, 1980, 1983, 1986, 1988.

Company	Nationality	World Market Share				
		1974	1980	1983	1986	1988
Texas Instruments	USA	12.1	11.2	8.9	7.2	5.6
Motorola	USA	9.0	7.8	8.9	7.1	6.2
Fairchild	USA	6.0	4.0	-	-	-
Philips	NL	5.2	3.9	4.9	5.0	3.6
National Semiconductors	USA	3.8	5.5	4.9	3.9	-
Hitachi	J	3.6	4.7	5.9	8.8	7.1
Toshiba	J	3.2	4.5	5.1	9.7	8.8
ITT	USA	3.0	-	-	-	-
Matsushita	J	2.8	-	-	4.6	3.8
Siemens	FRG	2.6	3.0	-	-	-
Nec	J	-	5.4	7.7	10.5	9.2
Intel	USA	-	4.1	4.3	-	4.8
Fujitsu	J	-	-	3.0	4.9	4.8
Advanced Micro Devices	USA	-	-	2.8	-	-
Mitsubishi	J	-	-	-	4.5	4.6
Others		48.7	45.9	43.6	33.8	41.5
=====						
Total		100	100	100	100	100
Abs. (in billion \$)		5.4	14.1	17.4	26.4	49.1

(-) Not in Top Ten.

J = Japan
 USA = United States of America
 NL = The Netherlands
 FRG = Federal Republic of Germany.

Sources: Data 1974, 1980: Malerba (1985:159).

Data 1983: UNCTC (1986:139).

Data 1986: UNCTC (1988:46).

Data 1989: Author's calculations based on data from The Economist (Feb. 1989:74) and Electronics (Jan. 1989:55).

The Japanese, South Korean and European firms are large, multidivisional, vertically and horizontally integrated electronics companies. The Japanese firms are not vertically integrated in the usual sense; each firm buys most of its chips from other firms and sells most of its chip output to outside customers (Krugman and Baldwin 1988:178).

The American firms are either merchant producers or captive producers. Merchant firms produce predominantly for the open market. These companies are not vertically integrated and are heavily engaged in offshore assembly in developing countries to minimize the costs of production. In 1986, merchant producers accounted for 66.8 percent of the American IC-production (Langlois et al. 1988:27). Captive producers are subsidiaries or divisions of Original Equipment Manufacturers (OEMs) which produce semiconductors for internal needs. Captive firms are vertically integrated and primarily located in developed market economies (Langlois et al. 1988; Malerba 1983:42).

In contrast to captive producers, merchant firms cannot draw upon more profitable, higher value added production. The limited access of merchant firms to internal sources of capital relative to captive producers is reflected in the former's greater concern for short-term profit margins. Cost considerations thus play an important role in the strategy of merchant producers.

During the 1970s and 1980s, the world semiconductor

The different end-users experienced different rates of growth. The computer, communications and automotive industries were especially dynamic sectors (UNCTC 1986:30). These sectors therefore provided a major stimulus to growth in production of those semiconductors that served as their inputs.

However, even within the "growth" sectors, cycles appeared. Dataquest (in Electronic Engineering Times, Sept. 5, 1988:20) argues that the duration of each spurt was on average four years. These recurring periods of overcapacity and price cutting were mainly caused by changes in demand (Electronics 1986:53). The 1984 production growth, for example, was the response to the steep increase in demand for semiconductors by the computer industry. Computer firms stockpiled semiconductors in order to prevent shortages as occurred in 1983. However, when the demand for computers slackened in 1985, these companies cancelled their chip orders, and put the inventory into use instead. As a result of the falling demand and belated increase in capacity at the same time, the Japanese and American producers started to cut prices in order to capture maximum market share. (Electronics 1986:53, 1987:86; Santo and Wollard 1988:30).

In this context, the "stereotype" responses of the American and Japanese producers to periods of sluggish demand should be discussed. In times of recession, American firms cut production, as illustrated by the case of the 64 K chip in the 1970s and by the case of the "technology driving" DRAMS in

Main 1989:70).

The main semiconductor producers operate on a global scale through foreign direct investment, intra-firm trade and the establishment of a network of linkages among producers based on the relative strengths of the respective firms. These linkages, which are explored below, include patent licenses, second sourcing, joint industrial R&D, technology exchanges, joint manufacturing and marketing, and joint ventures.

Patent licenses issued by semiconductor firms are primarily used for protection, and in most instances involve no transfer of technology. Moreover, patent licenses are frequently used by the licensor as a means of obtaining access to the technological capability and patent rights of the licensee (UNCTC 1986:142).

Second source agreements, i.e. agreements to supply semiconductors to other firms, thus increasing the latter's security of supply, are the most prevalent form of non-equity linkages between semiconductor multinationals (UNCTC 1986). Second sources are not confined to national firms. Hitachi, for example, was a second source supplier for Motorola's 16 bit microprocessor (UNCTC 1986:144-146). Three reasons underlie the employment of second sourcing. First, it is a mechanism for providing a customer with the security of an alternative supplier (Langlois et al. 1988:87). The specific chip requirements of a customer imply that, in case of shortages, it is not possible to simply substitute one chip

for another. Second, it is seen as an instrument of technology transfer since it provides the alternative supplier with the production technology to that specific type of chip. Third, market considerations play a role; second-sourcing can lead to a greater end user acceptance of certain devices (Langlois et al. 1988:87; UNCTC 1986:142-143).

Inter-firm linkages are further encouraged by the fact that firms have to invest in R&D in order to stay competitive in the semiconductor industry. The increasing costs of R&D combined with a higher degree of uncertainty have led to an increasing number of cost-sharing arrangements, like joint industrial research and development. Another way to deal with this problem is through conclusion of exchanges of technology. Some firms have concluded joint production and marketing agreements, thus sharing costs, facilities of production and marketing capabilities. In addition, joint ventures have been established between firms, for different reasons. American firms, for example, have employed joint ventures as instruments of obtaining access to the Japanese markets, in exchange for technology. European companies, on the other hand, have engaged in joint ventures with American firms to get access to technology (UNCTC 1986; Electronics August 1989:109-110).

Inter-firm linkages have increased over time. Langlois et al. (1988:83) conclude on the basis of an inventory of 121 agreements involving 41 firms in the United States, Europe,

Japan and Korea, that the number of technical agreements between firms has been increasing since 1981, with a sharp growth in 1984. American firms were most active in forging technical linkages. American firms were also the principal partners of Japanese, European and Korean firms (Mytelka 1987: 19; Langlois et al. 1988: 83).

2.4.1 Structure of the European Semiconductor Industry

As table 2.9 shows, the degree of concentration in the European semiconductor industry was considerable; in 1988 the top ten European semiconductor producers supplied approximately 75 percent of the European market. As outlined above, this included subsidiaries of foreign-owned semiconductor producers. Only three European-owned producers were ranked in the top ten: in order of appearance³³ Philips (NL), Thomson-SGS (F-I) and Siemens (FRG)³⁴. These three firms, which competed in the mainstream commodity semiconductor markets, accounted in 1988 for approximately 31 percent of the European semiconductor sales.

In contrast to France, Italy, Germany and the Netherlands, the United Kingdom did not have a major producer of semiconductors. The relatively high share of the United Kingdom in European production is accounted for by foreign-based producers located in the United Kingdom such as Motorola, and by various, more customized producers the most important of which are INMOS³⁵, Plessey and Ferranti.

The degree of concentration in the European-owned semiconductor capability increased considerably over the 1980s. In the beginning of the decade, Malerba (1985:162) identified Philips, Siemens, Thomson, SGS Microelettronica, and INMOS as the most important European-owned semiconductor producers. However, in 1987 Thomson merged with SGS. Thomson-SGS, in which the French and the Italian governments held each 50 percent stakes, acquired the British semiconductor producer INMOS in 1989. In the same year, Siemens, after monopoly investigations by both the British Monopolies and Merger Commission and the European Community, jointly with General Electric Company (GEC) (UK), acquired another British producer, the cash rich³⁶ and profitable³⁷ Plessey (The Globe and Mail Jan.13, 1989:B15; Financial Post Dec.13, 1988:12; Electronics Dec. 17, 1987:152). In the controversy surrounding the latter bid, Plessey argued that the take-over would spell the death of the UK electronics industry³⁸. Siemens and GEC, in contrast, argued that the take-over would strengthen the competitive position of Community industry vis-a-vis Japan and the United States³⁹. However, by mid-1990, the de facto failure of the Siemens-GEC joint venture seemed to indicate that the motives of Siemens and GEC were less noble than stated, but aimed at the carving up of Plessey as an aggressive competitor⁴⁰. Ironically, Plessey used a similar argument when it took over the semiconductor unit of Ferranti (UK)⁴¹ in 1987.

Alongside Philips, Siemens and Thomson/SGS, the

respective "national champions" of the Netherlands, West Germany, France and Italy, nestled a collection of specialized European-owned semiconductor companies⁴², which produced smaller quantities for niche markets, such as military semiconductors and/or custom-designed chips (Dosi 1981:185; The Economist Feb.18, 1989:74; Sharp 1988:243-244). In addition to those, some predominantly captive producers operated in the European semiconductor business, for example Ericsson (semiconductor unit:RIFA) (S), Asea (semiconductor unit:HAFO) (S), Olivetti (I) and Bosch (FRG) (van Tulder and Junne 1988:68-69).

In anticipation of 1992, the inter-firm linkages between European firms also increased. Table 2.11 gives a breakdown according to the type of agreement in a sample of 38 major cooperation agreements in the semiconductor industry between January 1980 and July 1986 involving at least one European multinational. In the sample, joint industrial R&D, and joint ventures appear to be the type of cooperation most employed in the European semiconductor industry. Linkages between European and foreign firms also increased: Thomson-SGS, for example, relied heavily on NEC semiconductor technology, while Siemens cooperated with IBM.

Table 2.11 Breakdown¹ according to Type of Agreement in a Sample of 58 major Cooperation Agreements in the Semiconductor Industry between January 1980 and July 1986, including at least one European Multinational. [exclusive cooperations agreements concluded in the context of ESPRIT]

Type of Agreement	Percentage
Licenses	10.5
Second Sourcing	16.5
Joint Industrial R&D	19.1
Technological Exchange	14.5
Joint Manufacturing and Marketing	9.2
Joint Ventures	19.5
Other	10.5

Notes

- ¹ To avoid double counting, agreements serving a double purpose (for ex. second sourcing and joint industrial R&D), have been counted half in each category.

Source: Author's calculations based on van Tulder and Junne (1988:238-240).

2.5 SEMICONDUCTOR DEMAND

The relative importance of the different end-users in the domestic market determines the size of demand, the type of devices required and the prospects for the member states' semiconductor industries. Over the last two decades, the semiconductors' share of value in electronic equipment has increased and the range of applications has widened (UNCTC 1986:30).

Six major groups of end-users emerged: the telecommunications industry, the computer industry, the automotive industry, consumer electronics, defense related industries, and industrial, medical and professional equipment industries⁴³ (UNCTC 1986:8). These industries were using different types of devices in different ratios. The consumer electronics industry, for example, required a relatively large share of linear integrated circuits, while the computer industry used MOS memories as principal components⁴⁴.

In the 1980s, in the United States, the computer industry was relatively important (UNCTC 1986:29). This was reflected in the relatively high share of integrated circuits in total semiconductor consumption. At the same time, the European industry and the Japanese semiconductor producers relied more on electronics applications than on the computer industry (UNCTC 1986:32). However, in the last decade, the relative importance of the latter in the Japanese economy increased.

The different end-users experienced different rates of growth. The computer, communications and automotive industries were especially dynamic sectors (UNCTC 1986:30). These sectors therefore provided a major stimulus to growth in production of those semiconductors that served as their inputs.

However, even within the "growth" sectors, cycles appeared. Dataquest (in Electronic Engineering Times, Sept. 5, 1988:20) argues that the duration of each spurt was on average four years. These recurring periods of overcapacity and price cutting were mainly caused by changes in demand (Electronics 1986:53). The 1984 production growth, for example, was the response to the steep increase in demand for semiconductors by the computer industry. Computer firms stockpiled semiconductors in order to prevent shortages as occurred in 1983. However, when the demand for computers slackened in 1985, these companies cancelled their chip orders, and put the inventory into use instead. As a result of the falling demand and belated increase in capacity at the same time, the Japanese and American producers started to cut prices in order to capture maximum market share. (Electronics 1986:53, 1987:86; Santo and Wollard 1988:30).

In this context, the "stereotype" responses of the American and Japanese producers to periods of sluggish demand should be discussed. In times of recession, American firms cut production, as illustrated by the case of the 64 K chip in the 1970s and by the case of the "technology driving" DRAMS in

1985-1986. As the Japanese producers generally did not reduce production, this American strategy of withdrawal left Japanese producers in effect as the main producers of semiconductors and thus in a position to control supplies (Wall Street Journal 1989, Aug. 22; Howell, Benz and Wolff 1986:249).

2.5.1 European Semiconductor Demand

As mentioned above, the European semiconductor industry was heavily oriented towards the consumer industry (UNCTC 1986:33). This was reflected in the low share of integrated circuits and relatively high share of discrete devices in European production. From a demand-side perspective, the orientation of the European semiconductor firms on the mature consumer electronics industry offered only limited prospects. Not only was the consumer industry characterized by low growth, but also high competition in the industry had a price-depressing effect on the already low-priced mature devices.

A related point was made by Walsh (1987), who argued that small industrialized countries faced a competitive threat from both the NICs as well as the industrialized superpowers, resulting in the so-called "small country squeeze". The NICs increasingly would dominate the markets for products which are relatively simple and based on mature technologies while the industrial superpowers increasingly would dominate the markets where the products are complex and based on new technologies. If this is the case, the prospects of the

European semiconductor industry, with its heavy emphasis on discrete devices, would be limited. Even a flight into the niches of the market, as has been the case in Europe, would not offer a long-term escape. The Economist argued that unlike some market niches, those in high technology seldom last. If a high-tech niche fails to grow, it usually would be eroded away by still newer technology. If it thrives, large companies would often "muscle aside" the start-up firm which pioneered the business (The Economist December 23, 1989:73-74).

2.6 CONCLUSIONS

Both world production and consumption of semiconductors increased over the last decade. The United States was, in the early 1980s, the main producer and consumer of chips. In the second half of the 1980s, Japan bypassed the United States as prime consumer and increasingly threatened the position of the United States as dominant producer in the industry. Europe accounted for only a small share in world production and consumption, well behind the United States and Japan. Within the Common Market, the semiconductor industry was characterized by a high rate of import penetration and foreign direct investment; European demand was met predominantly by foreign producers, either exporting to the Community or located within the Community.

The main producers of semiconductors were multinational

enterprises, mostly vertically integrated. The top ten firms were predominantly Japanese and American in origin. Their share in world sales was approximately 55 percent, indicating that the industry was not exceptionally concentrated. Within the Common market, the degree of concentration was substantially higher: the top ten European semiconductor firms supplied 75 percent of the European market. Only three European-owned firms were ranked in the European top ten: Philips, Siemens and SGS-Thomson.

Multinational enterprises entered foreign markets through exporting, cooperative ventures (patent licensing, second sourcing, joint industrial research, joint ventures), and foreign direct investment. The locational pattern of foreign direct investments was characterized by investments in assembly operations in developing countries and by investments in point-of-sales or complete manufacturing in industrialized countries. In particular, two trends should be noted in the area of FDI, the automatization of assembly operations and integration of assembly into other electronics operations, and the cross investments between Japan, the United States, South Korea and Europe. With respect to the latter, inflow of FDI into the European Community increased in anticipation of the completion of the single European market. Moreover, foreign companies increasingly invested in complete manufacturing operations within the Community.

The main consumers of semiconductors were the

telecommunications industry, the computer industry, the automotive industry, consumer electronics, defense related industries, and industrial, medical and professional equipment industries. The relative importance of the different end users in the domestic market determined the size of demand, the type of devices required and the prospects for the respective countries' semiconductor industries. Within the Common Market, consumer electronics, incorporating the more mature discrete devices, was relatively important, as reflected in the large share of these devices in European semiconductor production.

In short, the European semiconductor industry was characterized by a relatively small share in world production, a relatively high emphasis on the more mature devices, and a relatively high rate of import penetration and foreign direct investment. This status of the European semiconductor industry was of concern to the member state governments and the European Community and formed the impetus for government intervention in order to maintain and improve the performance of the European semiconductor industry. The following chapter discusses how the Community responded to import penetration and foreign direct investment in the European semiconductor industry.

ENDNOTES

1. The product life cycle refers to the stages of introduction, growth, maturity, saturation and decline of a product in the market. The early stages are characterized by high growth rates, high prices, significant profits, and an increasing penetration of the market. Later stages in production are characterized by diminished growth, lower prices, declining profits and a decreasing share of the product in the market (Andriessen 1983:29; Vernon 1966).

2. In 1986, discrete devices accounted for 18.7 percent of world consumption.

3. In 1986, integrated circuits accounted for 81.3 percent of world consumption.

4. Electronic Engineering Times (1989:20) indicates that in 1989 growth sectors included Random Access Memories (40 percent growth), Dynamic Random Access Memories (36 percent), and Semicustom ICs (27 percent). Product sectors showing declines in growth in 1989 concerned the Bipolar Digital Logic Circuits (-15 percent), Dedicated Linear Circuits (-20 percent) and Power Transistors (-1 percent).

5. Gallium arsenide has a higher speed and a larger band gap than silicon. However, gallium arsenide does not have its own mature oxide, in contrast to silicon, and is therefore less traceable (Langlois et al. 1988:22).

6. Dollar amounts are denoted in US \$ unless otherwise stated.

7. The high capital requirements for R&D and equipment have led firms to produce at a large scale at product line, plant and firm level. For example, Japanese companies in particular emphasize the production of high-volume, standardized products. American companies have huge plants dedicated to a single product or product type (Santo and Wollard 1988:31). The larger Japanese, American and European semiconductor firms operate on a global scale. These economies of scale may diminish with increasingly flexible processes and more customized production. However, plant and firm economies of scale may remain important due to the increasing costs of R&D and equipment, and the smaller recuperation time. Large sales are essential to generate the resources necessary and to reduce the costs of production per unit. The high R&D costs also have led firms to exploit economies of scope. An example of economies of scope is joint research and development on two different areas within a firm, namely semiconductor design and electronics product development, or on two different but related products, for example SRAMs and DRAMs. Joint research, necessitated

by the increasing complexity of IC-design and the growing impact of this design on the character of the electronics product, avoids duplication of research and thus an inefficient allocation of resources (Langlois et al. 1988:37).

8. Learning economies have resulted in the location of production of any one device in a few, specialized plants (Langlois et al. 1988:16; Santo and Wollard 1988:31). Only in the assembly stage, where learning economies play a limited role, have operations have been located in multiple sites.

9. The yield is the share of usable chips in total output. The yield depends on die size, number of mask steps, wafer size, feature size, materials purity, clean air control and especially experience. The yield determines the manufacturing cost per unit (Langlois et al. 1988:16). Langlois et al. mention a yield smaller than 10 percent for new devices.

10. Malerba 1985:vii-viii,100-119,129-139,224-245.

11. The capabilities of European firms in electrical and receiving tube technologies were as developed as those of American firms. European firms, moreover, were doing advanced research in solid-state physics and developing certain types of semiconductor diodes, as were American firms (Malerba 1985:224).

12. That is, Japan, the United States, France, the United Kingdom and West Germany.

13. World semiconductor markets grew from 16,915 million in 1980 to \$ 48.9 billion in 1989 (Langlois et al. 1988:27; Electronic Engineering Times Dec. 4, 1989:20).

14. See tables 2.2 and 2.4. The absolute data of world production and world consumption differ, likely due to differences in definitions used by the respective sources and/or statistical errors. Deviances in yearly consumption and production may also have been caused by stockpiling of semiconductors.

15. Mainly Hong-Kong, Indonesia, South Korea, Malaysia, Philippines, Singapore, India and China (UNCTC 1986; Business Korea Aug. 1987:84).

16. One should note that China, the Soviet Union, and the CMEA countries are also producers of semiconductors. However, these countries do not play any significant role in international trade.

17. The principal countries of assembly are: Malaysia, Singapore, Philippines, South Korea, Taiwan, Hong Kong, Mexico, Thailand, Indonesia, El Salvador, Brazil and Barbados. Portugal and Ireland should also be mentioned in this context (UNCTC 1986:37).

18. In 1980, American production of semiconductors totalled \$ 11,135 million, while Japanese production totalled \$ 3,840 million. In 1986, US-production increased to \$ 16,915 million; Japanese production to \$ 12,755 million.

19. As stated by the Financial Times (June 18, 1990): "After years of languishing in the doldrums, Europe's chip market is suddenly booming."

20. In the first half of the 1980s the share of the BENELUX in consumption of semiconductors was approximately 6 percent (UNCTC 1986:25).

21. These data give no insight in intra European trade flows. The export orientation of the individual EC countries is likely to be higher.

22. For example, in 1983, 70 percent of American imports of semiconductors entered the United States under heading 806 and 807. These imports are mostly re-imports of devices assembled abroad (intra-firm trade).

23. In 1986, the Netherlands faced a trade surplus in both transistors and microcircuits. In 1987, the trade balance on microcircuits was negative, although small enough to be compensated by the surplus on diodes, transistors, etc.

24. Automation lowers the labour time required (and therefore the labour costs), fully utilizes machinery, and secures uniformity and quality. On the other hand, automation increases the switching costs, i.e. the costs of adapting the machines to changes in semiconductor package designs, although new techniques increasingly add flexibility and precision to the automated assembly process (Langlois et al. 1988:55,56; UNCTC 1986:xxi).

25. For example, Thomson (van Tulder and Junne 1988:119-120).

26. In the 1960s and early 1970s Japanese firms faced restrictions on capital outflow, constraining the use of the foreign direct investment route in general. These restriction were eliminated in the mid-1970s, enabling Japanese firms to invest abroad on a larger scale. In addition, Japanese firms faced barriers on re-imports of components into the country. These barriers on re-imports contribute to an explanation of the Japanese export of offshore assembled semiconductors to third countries, and the sale of these semiconductors in the host countries' market (Grunwald and Flamm 1985:24-34).

27. "On a world wide basis, transnational corporations [multinational enterprises] account for the overwhelming share of semiconductor production and trade, and for the technologies necessary for state-of-the-art semiconductor manufacture. To a

considerable extent, competition among transnational corporations determines the direction, rate and extent of developments in this highly-technology intensive industry" (UNCTC 1986:xx).

28. Firms have opted for international production to appropriate knowledge. First, international production gives more protection than patents can provide to the design of topographies of semiconductors, etc. Patents only apply to certain areas for certain periods of time. The applicator for patent protection also has to release detailed information. Moreover, the costs of enforcing proprietary rights are avoided, as is opportunistic behaviour following from buyer uncertainty. Second, through internalization of production the highly appropriable, but hardly transferable, learning effects may be captured to a greater extent than is, for example, the case of licensing (Langlois et al. 1988).

29. Four transaction cost motives underlie forward integration of semiconductor producers into downstream operations (Langlois et al. 1988:37). First, semiconductor producers can coordinate product development and IC design more efficiently through forward (vertical) integration or location of design and production facilities closer to consumers. Producer-user proximity contributes to a more effective response of the seller to buyer's demands (Langlois et al. 1988:37,68; Sayer 1986:120). New production techniques contribute to the increased flexibility and precision of the production process, making producer-consumer proximity possible (Langlois et al. 1988:55,56; UNCTC 1986:100). Second, forward integration allows firms to capture the higher value added related to downstream operations. Third, forward integration might mitigate cycles in semiconductor sales. Fourth, forward integration can protect market outlets. Defensive forward integration can be seen as the response of semiconductor producers to increased backwards integration by semiconductor consumers, threatening to shrink the merchant market for semiconductor sales (Langlois et al. 1986:37).

Backwards integration gives semiconductor consumers the advantages of control over supply; the firm gains control over quality, reliability and continuity of supply.

30. By taking the foreign direct investment route, firms overcome tariff and non-tariff barriers and get access to markets.

31. Semiconductor firms have also opted for international production as it creates the opportunity to exploit endogenous market imperfections, such as entry barriers formed by scale and learning economies, and monopoly pricing. The latter can only be employed in the so-called "niches" of the market, and in the early stages of the product life cycle.

32. Note that the largest semiconductor producer, namely IBM, is not mentioned in the Top Ten; IBM's production is solely for in-house use.

33. In 1989 Siemens surpassed Thomson-SGS as Europe's second largest producer. Presently, it is threatening Philips' leading position (Electronic World News, Feb.5, 1990:E1).

34. The relative strength of these companies in both world and European markets, is partly due to the acquisition of American semiconductor operations yielding to the parent company new technology and a US marketing base. Philips acquired the American IC merchant vendor Signetics in 1975. (Philips also owns 35 percent of Matsushita Electronics, a Japanese producer of DRAMs.) Siemens took over in 1977 Litronix and in 1979 Microwave Semiconductor. In 1977, a minority stake was acquired in AMD. Thomson acquired in 1986 Mostek, an important US memory producer (Flamm 1990:256-257).

35. INMOS was privatized in 1984 and taken over by Thorn-EMI (UK).

36. In the 1980s, Plessey had taken over various (American) companies.

37. Profits 1988: \$377 million (The Globe and Mail May 23, 1989:B17).

38. "Plessey is the country's last remaining world semiconductor company, and as such of vital strategic significance" (Electronics, March 1989:56B).

39. GEC Managing Director Lord Weinstock: "I think this (acquisition) is very important because it is not just for itself, but the path of this whole European industry" (The Globe and Mail Sept. 9, 1989:B5). "[...] the partners saw their mission as "the creation of a major new European partnership" that would enable them to retain a fair share of world markets in the face of increasing competition from US and Japanese rivals" (Electronics March 1989:56B).

40. Other causes mentioned include the traditional difficulties in cooperation between the Germans and the British and personal conflicts between the responsible managers of Siemens and GEC.

41. "The move combines the UK's two largest semiconductor houses and it coincides (but does not result from) a recommendation by the British government that the country's IC businesses consolidate to survive in the competitive world climate" (Electronics, Dec. 17, 1987:182).

42. For example, Matra-Harris (F), Telefunken (FRG) and European Silicon Structures (Eur). Matra-Harris is a joint venture between Matra (F) and Harris (USA), concluded in 1978. European Silicon Structures was established in 1985 as a Eureka project. The main shareholders are Philips, Bull, Saab-Scania, Olivetti, Brown-

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(ANSI and ISO TEST CHART No. 2)

Boveri, Telefonica and British Aerospace (van Tulder and Junne 1987:38-39).

43. In 1984 the telecommunications industry accounted for 11.2 percent of the semiconductor market, the computer industry for 22.5 percent, the automotive industry for 6.3 percent, consumer electronics for 23.5 percent, defense related industries for 5.8 percent, and industrial, medical and professional equipment industries for 15.8 percent (UNCTC 1986:30). In 1989, the share of the computer industry in world wide semiconductor purchases had increased to 45.5 percent (Financial Times, June 18, 1990).

44. For example, nearly 50 percent of the integrated circuits employed in home electric appliances are bipolar linear circuits, compared to 4.6 percent in computers. Only 5.8 percent of the integrated circuits employed in home electric appliances are MOS-memory chips, compared to 45.6 percent in computers (UNCTC 1986:11).

June 22, 1989:8; EC Memo 32/89 of June 2, 1989). Japan subsequently modified its export system so that price restraints on exports of semiconductors to third countries were removed. Consequently, due to the Community's appeal to GATT, the prices and conditions imposed on the Community by the two dominating semiconductor producers were elevated.

In the interim, a second issue arose related to the 1986 Semiconductor Agreement. This issue also illustrates the impact that foreign policies may have on the European semiconductor industry, even if these policies are not directly aimed at the Community. In 1987, the United States alleged Japanese producers were violating the agreement, and subsequently imposed duties. According to the European Community, these sanctions could have led to a deflection of Japanese exports to the Common Market. The resulting increase of the Community's imports from Japan would have a price depressing effect, thus negatively influencing the financial performance of the competing European industry. In response, therefore, in May 1987, the Community introduced temporary surveillance prior to importation of these Japanese goods into the European Community. The Council decided that if trade deflection did take place, 100 percent duties would be imposed on the products in question (EC Memo 6734 en/87 of 25/26 May 1987). The surveillance was extended in October 1987 for a second period of six months (until May 31, 1988). However, no cases of trade deflection are known to the author. The

This chapter discusses the EC policy response to import penetration and foreign direct investment in the European semiconductor industry. The EC semiconductor policy response is the dependent variable, which will be explained in Chapters 5 and 6 by Ideology (I_1), Interests (I_2), Institutions (I_3) and the International System (I_4). By outlining what the Community did to improve the standing of its semiconductor industry, a core high tech industry, this chapter thus answers the first research question of this thesis, namely how did the Community respond to import penetration and foreign direct investment in the semiconductor industry (see 1.3).

The chapter starts by giving a comparative overview of the main semiconductor policies of Japan, the United States and the European Community to position the European policies in their international context. The core of this chapter subsequently outlines the EC policies directly¹ aimed at the European semiconductor industry. Finally, attention is paid to the semiconductor policies at the member state level, this time to position the EC policies vis-à-vis the national semiconductor policies.

3.1 INTERNATIONAL SEMICONDUCTOR POLICIES

Not only the European Community, but also Japan and the United States protected and promoted their respective semiconductor industries in the 1980s. Due to the global

character of the industry, American and Japanese semiconductor policies have affected the Community industry and EC policy response. The large Japanese R&D programs, for example, have prompted the Community to initiate similar projects to provide the European firms with similar competitive benefits. Moreover, EC policies impacted on the American and Japanese industries and policies. For example, EC anti-dumping practices are said to have evoked foreign producers to "Buy European" strategies and inward investments, not to mention the fact that these policies have caused trade frictions at the inter-governmental level. In order to capture the international dimension of policy effects, this section gives a comparative overview of the main American, EC and Japanese semiconductor policies.

3.1.1 American, Japanese and EC Semiconductor Policies

The United States, Japan and the European Community predominantly employed trade and firm specific policies² to protect and improve the standing of their respective semiconductor industries. These policies and instruments of intervention are outlined in tables 3.1 and 3.2. Other policies include market perfecting, general factor, and industrial policies³. These are covered by tables 3.3, 3.4 and 3.5.

The United States protected its industry through defence procurement, tariffs (until 1985), the 1986 Semiconductor

Table 3.1 Japanese, European and American Policies and Instruments: Trade Policies

Policies/Instruments	USA	Japan	EC
Trade Policies			
Import Restrictions			
Tariffs	Tariff until 1985 ¹ .	Tariff until 1985 ¹ .	Common Customs tariff.
Quotas	--	--	--
Price Undertakings	Semiconductor Agreement 1986 J-US.	Semiconductor Agreement 1986 J-US.	Minimum Price Agreement 1990 J-EC
Quantitative Undertakings: VETs	--	--	--
Restrictions based on government standards: technical product standards, local content requirements, administrative standards	--	--	--
Restrictions based on unfair trade/emergency: anti-dumping, countervailing duties, safeguards, infringements laws	Anti-dumping cases. Section 301 (1985) ¹ . Sanctions violation Semiconductor Agreement 1986 (1987). Restrictions based on infringement US patent (1987).	[Payment of duties]	Anti-dumping case.
Export Support			
Subsidies: export subsidies, import taxes (neg. subs.)	--	--	--
Government Procurement	Defence procurement.	NTT procurement.	--
Market Access Arrangement	Semiconductor Agreement 1986 J-US.	Semiconductor Agreement 1986 J-US.	--
Monitoring	Semiconductor Agreement 1986 J-US.	--	Surveillance re. potential trade deflection.
GATT involvement	--	Consultation re. sanctions imposed by US (1987).	Investigation re. Semiconductor Agreement 1986.

Notes

* These notes do not include further elaborations on EC policy instruments or instruments related to the 1986 Semiconductor Agreement since these are discussed in the main text.

¹ During the period 1984-1987 the American tariffs on semiconductors were on average 4 percent, varying from 11.2 percent to 0 percent (Kostecki 1989:27). The zero rate follows from elimination of the tariffs in 1985.

² The 1984 Tariff and Trade Act includes a provision which clarifies that denial of "fair and equitable market access" is a basis to petition for relief under section 301 of the Trade Act of 1974. Section 301 allows the President to exclude from the country goods that have been marketed with unfair import practices and provides for retaliation against countries that unfairly restrict their markets to US exports (Ethier 1988:235).

³ The imposition of sanctions based on the infringement of US patent and copyright laws were never implemented since the parties concerned (Samsung (Korea) and Texas Instruments (USA)) concluded a provisional licensing arrangement (Kostecki 1989:33).

⁴ In 1985, Japanese tariffs on imported semiconductors were reduced to zero.

Sources: Yoffie, 1988; Nelson, 1984; Borrus, 1988; Dos1, 1983.

**Table 3.2 Japanese, European and American Policies and Instruments:
Firmspecific Policies**

Policies/Instruments	USA	Japan	EC
Firmspecific Policies			
Subsidies/Taxes: production subsidies, tax exemptions	SEMATECH (1987) ¹ . VHSIC (1980- 1989) ² .	MITI: 5G computer project (1981-91) ³ . OEIC project (1981) ⁴ . New Functions Elements project ⁵ .	ESPRIT (1984-1993) JESSI
Government Procurement	Defence procurement, incl. VHSIC.	NTT ⁶ .	--

Notes^{*}

^{*} These notes do not include further elaborations on EC policy instruments or instruments related to the 1986 Semiconductor Agreement since these are discussed in the main text.

¹ Langlois et al. (1988:144) describe the VHSIC program as a \$ 900 million, ten year effort, to meet military needs to highly specialized silicon based digital IC technologies. The main contractors of this cooperative research program are large cooperations, joined by other companies, universities and research institutes. The program is financed by the Defense Department in order to secure the long term shaping of semiconductor technology in line with military interests. In addition, VHSIC contractors have invested \$ 300 million in the program (Langlois et al. 1988:47,144; Molina 1989:70-79).

² Sematech is a \$1 billion, government sponsored, cooperative venture intended to develop next generation manufacturing technology. The consortium includes both US based semiconductor producers as well as their US suppliers and US customers (computer industry) (Molina 1989:75; Borrus 1988:217). Its activities comprise the promotion of R&D collaborative ventures and the generation of an advanced production facility (Molina 1989: 750). The military importance attached to semiconductors is also demonstrated in this program. Congress reserved \$ 100 million for Sematech in the fiscal 1988 defense appropriation bill.

³ The 5G computer project is a ten year, \$ 425 million initiative aimed at the development of a new generation computer with artificial intelligence. The research on computing and artificial intelligence includes semiconductor research. The project is jointly financed by government and industry. Participants are two national laboratories and a research association of eight computer and microelectronics firms (Langlois et al. 1988:130-133).

⁴ The OEIC program is a joint industry-government funded project, geared at the development of basic technologies for optical electronic ICs. In this program the government's Electrotechnical Laboratory of the Industrial Science and Technology Agency works together with nine leading companies. The project falls under the policy direction of MITI (Langlois et al. 1988:132).

⁵ The New Functions Elements program is a ten year project in which eleven firms collaborate through the R&D Association for Future Electron Devices (FED). The program, jointly funded by government and industry, is aimed at research on various types of devices (super lattice devices, three dimensional ICs, fortified ICs). The program falls under supervision of MITI (Langlois et al. 1988:132).

⁶ Procurement by the government owned Nippon Telegraph and Telephone Public Company (NTT), played an important role in stimulating the demand for semiconductors. However, in 1985 NTT was privatized (Hill 1989:111).

Sources: Yoffie, 1988; Nelson, 1984; Borrus, 1988; Dosi, 1983.

Table 3.3 Japanese, European and American Policies and Instruments: Market Perfecting Policies

Policies/Instruments	USA	Japan	EC
Market Perfecting Policies			
Intellectual Property Rights	Semiconductor Chip Protection Act '84. Extension to foreign firms 1987 ¹ .	Equivalent.	Legal protection to the topography of semiconductors.
Antitrust Legislation	--	--	--

Notes^{*}

* These notes do not include further elaborations on EC policy instruments or instruments related to the 1986 Semiconductor Agreement since these are discussed in the main text.

¹ The 1987 extension refers to the increase in scope of the Commerce Department's authority to provide foreign manufacturers with interim protection of chips (Kostecki 1989:33).

Sources: Yoffie, 1988; Nelson, 1984; Borrus, 1988; Dosi, 1983.

Table 3.4 Japanese, European and American Policies and Instruments: General Factor Policies

Policies/Instruments	USA	Japan	EC
General Factor Policies			
Education	--	--	--
R&D	National Co-operative Research Act 1984 ¹ .	--	--

Notes^{*}

* These notes do not include further elaborations on EC policy instruments or instruments related to the 1986 Semiconductor Agreement since these are discussed in the main text.

¹ The National Cooperation Research Act eases anti-trust restrictions against cooperative R&D ventures such as Sematech.

Sources: Yoffie, 1988; Nelson, 1984; Borrus, 1988; Dosi, 1983.

**Table 3.5 Japanese, European and American Policies and Instruments:
Industrial Policies**

Policies/Instruments	USA	Japan	EC
Industrial Policies			
Subsidies/Taxes	--	--	--
Government Regulations: product standards, guidelines for firms	--	MITI: micro- level plan for semicon- ductor industry ¹ .	R&D Frame- work Pro- gram.

Notes^{*}

* These notes do not include further elaborations on EC policy instruments or instruments related to the 1986 Semiconductor Agreement since these are discussed in the main text.

¹ Okimoto (1984:101) describes how the Ministry of Trade and Industry (MITI) formulates for each industry micro-level plans including a fairly concrete agenda of national research priorities, based on an assessment of technological needs and prospects, commercial opportunities, foreign competition, long term trends, and desired directions. In 1982, for example, the areas defined as high priority to Japan's technological development included Very Large Scale Integrated Circuits (VLSI) research and applications, laser beam technology, software capability, High Speed Computational Systems, and a fifth generation computer. In the context of such priorities, the Japanese government organizes, coordinates and subsidizes projects.

Sources: Yoffie, 1988; Nelson, 1984; Borrus, 1988; Dosi, 1983.

Agreement with Japan, and various legal cases based on unfair trade or infringement of agreements. Legal protection was given to chips in the US Semiconductor Chip Protection Act. These protectionist measures were supplemented by stimulating measures such as defence procurement and cooperative R&D programs, e.g. the Semiconductor Manufacturing Technology Initiative (Sematech) and the Very High Speed Integrated Circuit (VHSIC) program.

Japan protected its semiconductor industry through tariffs (until 1985) and Nippon Telegraph and Telephone (NTT) procurement. Similar measures as the US Chip Protection Act were undertaken. Instruments of support included NTT procurement, and cooperative R&D projects such as the Fifth Generation Computer Project.

The European Community protected its semiconductor industry through trade policy instruments such as the external tariff, anti-dumping duties, and price agreements. No formal investment barriers were imposed. The European Community promoted its industry through the European Strategic Program of Research and Development in Information Technologies (ESPRIT), aimed at stimulating and subsidizing cooperative R&D, and the Joint European Submicron Silicon Initiative (JESSI).

The 1986 Semiconductor Agreement between the United States and Japan illustrates particularly well the impact that an undertaking concluded beyond the Community has had on the

EC. The following section outlines the policy response of the Community to the 1986 Semiconductor Agreement.

**3.1.2 The EC Response to the 1986 Semiconductor Agreement
between Japan and the United States**

In 1986, Japan and the United States concluded an arrangement, the 1986 Semiconductor Agreement, which resulted from various anti-dumping charges initiated by the United States against Japanese exporters. The agreement, covering eight semiconductor products and product categories, contained three elements (Kostecki 1989:27), namely:

1. monitoring of production costs and prices of certain semiconductor exports from Japan to the United States;
2. monitoring of production costs and prices of certain semiconductors exported from Japan to third countries;
3. improved market access for foreign based semiconductors in Japan.

The European Community condemned this accord since the undertaking did not only affect the two negotiators but also third countries, while these latter countries had not had any input into the decision-making. The Commission considered it unacceptable that the main exporter would unilaterally determine its export prices in a sensitive sector such as the semiconductor industry, and thus threaten legitimate Community interests (Europe June 22, 1989:8; EC Memo 79/87, July 7, 1987).

Interference into other countries' markets was considered by the Community to be contrary to the GATT Anti-Dumping Code, under which it was left to the sole judgement of the countries concerned to decide whether or not to initiate an anti-dumping measure or to conclude an undertaking in their respective domestic markets (EC Memo 112/86, Oct. 8, 1986). In addition, the European Community condemned the agreement since it granted special, and thus discriminatory, access to the Japanese market to American producers.

According to the European Commission (EC Memo 112/86 Oct. 8, 1986), the United States had pressed for these provisions to improve the competitive position of US firms exporting semiconductors, and to avoid greater competition from firms in countries which incorporate Japanese semiconductors in their finished products. Although the 1986 Semiconductor Agreement benefitted the European manufacturers of semiconductors through the higher prices for semiconductors, European semiconductor consuming firms would face increased costs.

Therefore, in October 1986, the European Community started proceedings under GATT Article XXII:1⁴. A GATT panel was established to advise the GATT Council on this issue. In May 1988, the GATT Council concluded, in line with the GATT panel report, that the agreement on trade in semiconductors between the United States and Japan amounted to an export restriction incompatible with the rules of the GATT (Europe

June 22, 1989:8; EC Memo 32/89 of June 2, 1989). Japan subsequently modified its export system so that price restraints on exports of semiconductors to third countries were removed. Consequently, due to the Community's appeal to GATT, the prices and conditions imposed on the Community by the two dominating semiconductor producers were elevated.

In the interim, a second issue arose related to the 1986 Semiconductor Agreement. This issue also illustrates the impact that foreign policies may have on the European semiconductor industry, even if these policies are not directly aimed at the Community. In 1987, the United States alleged Japanese producers were violating the agreement, and subsequently imposed duties. According to the European Community, these sanctions could have led to a deflection of Japanese exports to the Common Market. The resulting increase of the Community's imports from Japan would have a price depressing effect, thus negatively influencing the financial performance of the competing European industry. In response, therefore, in May 1987, the Community introduced temporary surveillance prior to importation of these Japanese goods into the European Community. The Council decided that if trade deflection did take place, 100 percent duties would be imposed on the products in question (EC Memo 6734 en/87 of 25/26 May 1987). The surveillance was extended in October 1987 for a second period of six months (until May 31, 1988). However, no cases of trade deflection are known to the author. The

American sanctions were (partially) relaxed after consultation between Japan and the United States in the GATT under Article 23:1⁵ (Kostecki 1989:29).

The EC response to the 1986 Semiconductor Agreement (see table 3.6) illustrates that the Community was affected by and responsive to foreign policies. The Community tried, through price monitoring and appeal to the GATT, to protect the European semiconductor industry from conditions that were politically determined by the United States and Japan.

Shifting our attention away from the international level, we will now focus on the question as to how the European Community responded to the comparatively poor performance of its semiconductor industry.

3.2 EC SEMICONDUCTOR POLICIES

From the early 1970s on, the European Commission had been eager to undertake far-reaching technological programs, but until 1980 the larger member states had blocked a move in that direction (van Tulder and Junne 1988:212). Attempts to collaborate were largely frustrated by national ambitions and the reluctance of major companies to reveal their industrial plans or research (ECC Background Report 1983, January 27). By the end of the 1970s, cooperation at European level was considered necessary in order to share the high costs of research, avoid duplication, increase technology exchange, and

Table 3.6 Chronological overview of EC Reaction in the 1986 Semiconductor Agreement between Japan and the United States

Date	Event
October 1986	Start of proceedings under GATT Article XXII:1 and into the Commission on Anti-Dumping to challenge the 1986 Semiconductor Agreement between the United States and Japan.
May 1987	Introduction of temporary Community surveillance prior to importation of certain products (personal computers, electric handtools, colour television receivers), originating in Japan. Council Decision to impose 100 percent duties on the products in question if such a deflection of trade would take place.
October 1987	Extension of the validity of the regulation introducing temporary Community surveillance prior to imports of certain products originating in Japan, for six months.
May 1988	GATT Panel Report of April 1988 adopted by the GATT Council. Conclusion: Japanese export control system is a restraint on trade, incompatible with GATT. Japan is called upon to adjust its system.
June 1989	Announcement by Japan stating that it will fully comply with the GATT Council Recommendations.

create a sufficiently large market⁶. As illustrated by Genscher (in Smith 1986:219):

No (European) country can on its own keep up with developments in high technology in the United States and Japan. Only the European democracies in their entirety have the researchers and the engineers, the wealth of companies both large and small, the capital and above all, the market to be competitive in the new technologies.

Thus, in response to the American and Japanese "challenge", the various national governments overcame their initial reservations and agreed to the development of a semiconductor policy at EC level. The following section describes the principal EC semiconductor policies in the 1980s. Attention is paid to the EC protection of semiconductor topographies, the Common Customs Tariff, anti-dumping cases and price agreements, EC rules of origin, and cooperative R&D projects. In particular, the effect of these policies on the European semiconductor industry (both European and foreign-owned producers) is discussed.

3.2.1 Legal Protection: Intellectual Property Rights

Intellectual property rights in the form of patents, trademarks and copyrights are especially relevant to the semiconductor industry, in which the design and basic techniques of manufacture are readily copiable (see 2.1.2).

During the 1980s, no general copyright legislation existed at EC level. However, in 1986, the Council did adopt a directive⁷ which stipulated member states to give legal

protection, according to common rules, to the topography⁸ of semiconductor products used in data processing technology. The directive awarded rights of reproduction or commercial exploitation to the creators of the devices for a period of ten years. This directive was motivated by the discrepancy between the high costs of development of semiconductors on the one hand and the low cost of plagiarizing existing topographies on the other⁹. Main beneficiaries of this regulation were thus the domestic semiconductor producers. Similar measures had been taken by the United States and Japan (European file 17/89)¹⁰.

3.2.2 The Common Customs Tariff

Analogous to the provisions in GATT Article XXIV concerning the establishment of a customs union¹¹, the European Community has put into place a Common Customs Tariff (CCT)¹² that is applicable to imports from outside the area¹³. These tariffs predominantly benefitted the domestic semiconductor producers, since the tariff increased the price of competing semiconductor imports, thus reducing the competitiveness of these devices in the internal market.

Table 3.7 gives an overview of the rate of duties affecting imported semiconductors during the 1980s. On average, imported semiconductor devices were subject to a 17 percent duty in the period prior to 1986, and a 14 percent duty after 1986. Wafers, not yet cut into chips, were subject

Table 3.7 (Simplified) EC Nomenclature and the Corresponding Conventional Rates of Duty of the Common Customs Tariff, 1980-1990

Devices	Year	81	82	83	84	85	86	87	88	89	90
	1980										
Electronic Integrated Circuits and Micro- Assemblies²											
Electronic Micro-circuits											
Wafers	9	9	9	9	9	9	9	9			
Other	17	17	17	17	17	17	17	14			
Monolithic Integrated Circuits											
Digital											
- Wafers									9	9	9
- Chips									14	14	14
- Other									14	14	14
Other											
- Wafers									9	9	9
- Other									14	14	14
Hybrid Integrated Circuits											
Microcomputers & processors									14		
Amplifiers										14	14
Other										14	14
Other									14	14	14
Parts									5.8	5.8	5.8
Diodes, Transistors and similar Semiconductor Devices; Photosensitive Semiconductor Devices; Light Emitting Diodes; Mounted Piezo-electric Crystals³											
Diodes, other than Photosensitive or Light Emitting Diodes											
Wafers	9	9	9	9	9	9	9	9	9	9	9
Other	17	17	17	17	17	17	17	14	14	14	14
Transistors, other than Photosensitive											
Wafers									9	9	9
Other									14	14	14
Thyristors, Diacs & Triacs, other than Photosensitive Devices											
Wafers									9	9	9
Other									14	14	14
Photosensitive Semiconductor Devices; Light Emitting Diodes											
Light Emitting Diodes	17	17	17	17	17	17	17	14	14	14	14
Other									4.6	4.6	4.6
Other Semiconductor Devices											
Wafers									9	9	9
Other									14	14	14
Mounted Piezo-Electric Crystals											
	8	8	8	8	8	8	8	8	8	8	8
Parts	8.6	8.2	7.8	7.4	7.0	6.6	5.8	5.8	5.8	5.8	5.8

Notes

1. Conventional duties are applied to imported goods originating in countries which are contracting parties to the General Agreement of Tariffs and Trade or with which the European Community has concluded agreements containing the most-favoured-nation tariff. Unless otherwise stated, these conventional duties are also applicable to goods, other than those referred to above, imported from any third country (OJ L256 of September 7, 1987).

2. Electronic integrated circuits and micro assemblies are defined as:

- a. Monolithic integrated circuits in which the circuit elements (diodes, transistors, capacitors, interconnections, etc.) are created in the mass (essentially) and on the surface of a semiconductor material (silicon, for example), and are inseparably associated;
- b. Hybrid integrated circuits in which passive elements (resistors, capacitors, interconnections, etc.) obtained by thin or thick film technology, and active elements (diodes, transistors, monolithic integrated circuits, etc.), obtained by semiconductor technology, are combined to all intents and purposes indivisibly, on a single insulating substrate (glass, ceramic, etc.). These circuits may also include discrete components;
- c. Micro assemblies of the moulded module, micromodule or similar types, consisting of discrete, active, or both active and passive components which are combined interconnected (OJ L256 of September 9, 1989).

3. Diodes, transistors, and similar semiconductor devices are defined as devices of which the operation depends on the variations in resistivity on the applications of an electric field (OJ L256 of September 7, 1989).

Sources

Data 1980 - Official Journal (OJ) L342 Dec. 31, 1979. Council Regulation (EEC) No. 3000/79 of Dec. 20, 1979, amending Regulation (EEC) No. 950/68 on the CCT.

Data 1981 - Official Journal (OJ) L315 Oct. 28, 1980. Council Regulation (EEC) No. 3000/80 of Oct. 28, 1980, amending Regulation (EEC) No. 950/68 on the CCT.

Data 1982 - Official Journal (OJ) L335 Nov. 23, 1981. Council Regulation (EEC) No. 3300/81 of Nov. 16, 1981 amending Regulation (EEC) No. 950/68 on the CCT.

Data 1983 - Official Journal (OJ) L318 Nov. 15, 1982. Council Regulation (EEC) No. 3000/82 of Oct. 19, 1982 amending Regulation (EEC) No. 950/68 on the CCT.

Data 1984 - Official Journal (OJ) L313 Nov. 14, 1983. Council Regulation (EEC) No. 3333/83 of Nov. 4, 1983 on Regulation (EEC) No. 950/68 on the CCT.

Data 1985 - Official Journal (OJ) L320 Dec. 10, 1984. Council Regulation (EEC) No. 3400/84 of Nov. 27 1984, amending Regulation (EEC) No. 950/68 on the CCT.

Data 1986 - Official Journal (OJ) L331 Dec. 9, 1985. Council Regulation (EEC) No. 3331/85 of Dec. 5 1985, amending Regulation (EEC) No. 950/68 on the CCT.

Data 1987 - Official Journal (OJ) L345 Dec. 8, 1986. Council Regulation (EEC) No. 3616/86 of Nov. 24, 1986 amending Regulation (EEC) No. 3331/86, amending Regulation (EEC) No. 950/68 on the CCT: 85.21.

Data 1988 - Official Journal (OJ) L256 Sept. 7, 1987. Council Regulation (EEC) No. 2658/87 of July 23, 1987: 8541, 8542.

Data 1989 - Official Journal (OJ) L298 Oct. 31, 1988. Commission Regulation (EEC) No. 3174/88 of Sept. 21, 1988 amending Annex 1 to Council Regulation (EEC) No. 2658/87 on the tariff and statistical nomenclature and the CCT: 8541, 8542.

Data 1990 - Official Journal (OJ) L282 Oct. 2, 1989. Commission Regulation (EEC) No. 2886/89 of Aug. 2, 1989: 8541, 8542.

to a 9 percent duty during the whole decade. For non-European semiconductor producers, the lower rate of duty levied on wafers constituted a way to evade the high tariff on semiconductor devices; foreign producers were encouraged to invest in assembly facilities to cut, band, test and package chips for the Common Market within the EC tariff walls (Flamm 1985:57).

In 1986 the level of the external tariff was altered in the context of a managed trade dispute. In January of that year the European Council increased the EC tariffs on Video Camera Recorders (VCRs) from 8 to 14 percent in order to prevent an influx of Japanese VCRs into the Community after the expiration of the voluntary export restraint agreement with Japan in this sector. As compensation to Japan, the European Community (temporarily¹⁴) removed tariffs on pocket calculators, portable cassette recorders, clock radios and portable radios, and reduced the tariff on semiconductors (Kostecki 1989:24). The threat of increased duties on VCRs and the potential benefits of voluntary export restraints convinced Japan to extend the export agreements on Japanese exports of VCRs to the Community (Kostecki 1989:24).

3.2.3 Anti-Dumping Duties and Undertakings

According to EC legislation on anti-dumping¹⁵, the Community may initiate, in response to a complaint of the Community industry, an anti-dumping investigation as to

whether foreign products have been dumped¹⁶ and if so, whether dumping has caused injury¹⁷. If these two conditions have been met, the Community imposes provisional anti-dumping duties. The Council subsequently determines what proportion of the provisional duty is to be definitively collected. The foreign exporter can avoid the imposition of such duties by offering a satisfying price or quantitative undertaking (arrangement) during the course of investigation. Under a price agreement, the exporter agrees to sell its products at a sufficiently high minimum price. When a quantitative undertaking is concluded, the foreign firm agrees to restrict its exports. The latter also has a price raising effect.

In the international trading regime, dumping is seen as an unfair trading practice against which protection is legitimate. While earlier EC regulations on dumping¹⁸ were derived closely from the text of GATT Article 6 and the 1979 GATT Anti-Dumping Code, the most recent EC regulation (Regulation 2423/88) stretches the definition of what is permissible under GATT to a breaking point (The Economist, September 10, 1988:77 and October 9, 1988; Norall 1989:83)¹⁹. The deviation from previous EC interpretations has provoked criticism that the European use of anti-dumping duties goes beyond the legitimate purpose of defence against unfair trade for which the instrument was originally designed. Instead, it is argued that the European Community uses anti-dumping duties for undue protectionist objectives (The Economist, Sept. 9;

Ethier 1988:234)²⁰.

Protectionist or not, the imposition of anti-dumping duties benefits the Community industry, penalizes the foreign exporters (the "dumpers") and may also affect other interest groups, as is illustrated in the following section by the DRAM anti-dumping suit.

3.2.3.1 The 1987 Anti-Dumping Case of DRAMS

In 1987, the European Commission initiated anti-dumping proceedings concerning imports of DRAMS originating in Japan²¹. The DRAM anti-dumping complaint was filed by the European Electronic Component Manufacturers' Association (EECA) which claimed to represent practically all actual or potential Community producers of DRAMS. More specifically, EECA represented Motorola (US)²², Siemens (FRG), SGS (I), and Thomson (F) (OJ C181/3). Over the years 1987-1989, the Commission subsequently requested and received information from initially eight²³ and later eleven Japanese producers/exporters of DRAMS, their subsidiaries in the European Community, and from all complainant companies on behalf of the dumping investigation.

Early in 1989, it became clear to the general public that the option of a minimum price agreement was being discussed (Europe January 13/14, 1989 and February 15, 1989:10). The undertaking would provide for a floor price for DRAMS for a period of approximately five years based on the Japanese cost

of production. The Community DRAM producers reacted positively to the proposed minimum price agreement. The undertaking would protect them against "unfair" trade practices by creating a safety net against predatory pricing (Financial Times (London) July 27, 1989:3; Europe June 22, 1989:8). Moreover, producers felt that an undertaking would allow for the termination of the anti-dumping case in the short term, and thus for an early relief of competitive pressures²⁴. Consumers of DRAMS, however, were strongly opposed to the proposed agreement. As buyers of DRAMS, they had a vested interest in buying the lowest price for their inputs (Koopmann and Scharrer 1988:212).

In practice, the fears of Community DRAM producers for too low prices for outputs and the fear of Community DRAM consumers for too high floor prices for inputs were unfounded; due to the shortage of 256 K DRAMS (caused by increased demand combined with MITI restrictions on Japanese production which were established under pressure of US trade negotiators) the price of these devices had risen above the likely floor (see figure 3.1). According to Flamm (Financial Times July 27, 1989:3), the arrangement would only begin to bite when the floor price was applied to new generation devices. In the case of a recession, or the expiry of the 1986 Semiconductor Agreement between Japan and the United States, the situation would be further exacerbated.

In January 1990, the European Commission outlined the results of the anti-dumping investigation in Commission

Figure 3.1 Course of Prices of 256K DRAMS over the Period 1986-89

Source: Flamm (1990:253)

Regulation (EEC) No. 165/90 which can be summarized as follows. First, the Commission concluded that DRAMs had been dumped. Dumping margins²⁵ were found which [expressed as a percentage of the CIF (Cargo, Insurance Freight) EC border price] varied between 8.5 and 206.2 percent. Second, the Commission found that the EC DRAM industry had suffered either material injury or injury in the form of material retardation. Third, the Commission concluded that there was a causal link between the dumped devices and the found injury.

The Commission argued that the dumping of DRAMs had led to a substantial price depression in the Common market and an increase in the European market share of Japanese producers. As a consequence, Community producers were not able to exploit their available production capacities or to gain any share in the Community market. They were not able to implement existing plans to build new production facilities, or to increase existing capacity. This situation caused, according to the Commission, financial losses to the Community DRAM industry (European News Jan. 23, 1990; OJ L20/21 Jan. 25, 1990).

In deciding what action to undertake, the Commission had to weigh the interests of both the DRAM producing industry as well as the DRAM consuming industry. In conclusion, the Commission considered it in the interest of the Community to grant protection to the Community DRAM industry (European News, January 23, 1990). However, given the characteristics of the DRAM industry (the short product life cycles, the

volatile and rapidly declining costs and prices, the price development since the investigation period), the Commission argued that protection should be given by means of a measure which could be suitably tailored to follow the dynamics of the DRAM industry without causing unnecessary hindrance to the consuming industries (European News Jan.23, 1990). Consequently, the European Commission decided to accept price undertakings offered by all known Japanese DRAM manufacturers, thus terminating the investigation in their respect. Table 3.8 summarizes the main points of the minimum price agreement concluded. In addition, the Community imposed provisional anti-dumping duties on all other Japanese semiconductor producers. In July 1990, the Community started to collect definitive anti-dumping duties (OJ L193/1 July 27,1990). A chronological overview of some key data and decisions on the anti-dumping case is given in table 3.9.

While anti-dumping charges or even the threat of such charges may evoke foreign companies to invest in manufacturing in the Community rather than to export or, similarly, only to invest in points-of-sales, recent changes in the EC rules of origin seem to indicate that also the nature of manufacturing matters.

3.2.4 EC Rules of Origin

In anti-dumping investigations, like the above described DRAM anti-dumping case, the determination of origin is crucial

Table 3.8 Main points 1990 of the Minimum Price Agreement between Japan and the European Community

1. Minimum Price Calculation

The undertakings provide for minimum prices per density based on weighted average cost of production for the cheapest device type, whereby the weighing is done on the basis of each producers' sales volume in the European Community. Given that the producers with the lowest costs tend to be the ones with the high sales volume in the Community, it can be expected that the reference prices will be rather close to the cost of production of the lowest cost producers. A profit margin of 9.5 percent on cost of goods sold is added, this margin being a minimum designed for a situation of price collapse. This solution, while user friendly, is considered by the Commission as a sufficient guarantee against unfair price competition from Japan.

2. Adjustment of Reference Prices

Reference prices calculated according to the undertakings are expected to be significantly below current market prices. These minimum prices will be revised quarterly on the basis of the most up-to-date cost of production data provided by the Japanese producers. This allows the user industries to benefit from subsequent cost reductions which in this sector can be considerable.

3. Coverage

All DRAM products, irrespective of density, packaging, speed or other characteristics, are covered by the undertaking. In practice, the undertakings concern mainly DRAMS with a storage capacity of 256 K and above. New DRAM generations are subject to the undertaking, but under a special formula which should encourage the user industries to employ most recent technologies as early as possible so as to remain competitive. Users may obtain new generation products at a lower price for a certain period of time following their first introduction to the market.

4. Revision of terms of Agreement

The Commission is aware that the expiration of the US -Japan Semiconductor Agreement and the suspension agreements concluded between the Japanese DRAM exporters and the US administration, which is due to occur in September 1991, might also significantly affect the EC DRAM market situation. Therefore, the Commission is prepared to review the measures adopted in the event of an effective and definitive termination of the US measure concerning DRAMS from Japan in September 1991.

Sources: Excerpts from Europe (Jan.31 1990:12) and EC News (Jan.23 1990).

Table 3.9 Chronological Overview of EC Reaction in the DRAM Anti-Dumping Case

Date	Event
July 1987	Notice of initiation of anti-dumping proceedings concerning imports of certain types of electronic microcircuits known as DRAMs originating in Japan.
January 1990	Acceptation of price undertakings offered by certain Japanese DRAM manufacturers, thus terminating the investigation in their respect, and imposition of a provisional anti-dumping duty for exporters which have not offered any undertakings.
April 1990	Proposal presented by Commission for a Council Regulation extending the provisional anti-dumping duty on imports of certain types of electronic microcircuits known as DRAMs originating in Japan.
July 1990	Commission started to collect definitive anti-dumping duties

to the definition of the foreign like product and foreign production, and the delineation of the domestic industry (Vermulst and Waer, 1990). In general, the Community determines the origin of a product on basis of the location of the "last substantial process"²⁶, referring to the process that changes the properties and composition of the product and thus brings about a qualitative change ("substantial transformation")²⁷.

With respect to semiconductor production, the Community had determined the origin of a chip by the location of the assembly stage as the "last substantial process". However, in 1989, following concerted lobbying by the European-owned semiconductor industry, the Community changed its rules of origin (Vermulst and Waer:1990). The new rules determine the origin of chips by the location of diffusion, i.e. the location of the wafer fabrication plant where a chip is processed (OJ L33/24 of February 4, 1989: Commission Regulation No. 288/89). Although the employment, costs and value added involved in assembly may be higher than in the diffusion stage, diffusion accounts for approximately 60 to 70 percent of the value of the completed chip and involves higher capital and R&D investments.

This change in rules of origin benefitted the European-owned semiconductor producers which, at time of adoption, performed the diffusion process in the Community with testing and assembly in third countries. The change in rules was,

however, to the disadvantage of the Japanese semiconductor producers located in the Community, which assembled and tested in the Community, but had located their diffusion processes elsewhere.

Under the previous interpretation of the "last substantial process", the products manufactured by the European-owned companies would not be considered European. As a consequence, the European-owned semiconductor industry would neither be considered "Community industry"²⁸. Under those rules, the European-owned industry could therefore not benefit from EC protection against unfair trade, etc. Japanese production in the Community, however, would be considered "Community" production. Under the current interpretation of the "last substantial process", this situation was reversed; the European-owned firms would be considered "Community" producers, manufacturing "European" products, while the Japanese-owned producers were regarded as non-Community manufacturers (Vermulst and Waer:1990).

In the DRAM anti-dumping case, none of the complainants commercially manufactured DRAMS during the period of investigation. Japanese-owned subsidiaries, in contrast, did produce DRAMS. Adherence to the previous rules of origins would have led to the conclusion that the "Community industry" which existed was entirely Japanese-owned. However, the Commission could have used the new rules of origin to "reverse" the situation, but did not since the Japanese

subsidiaries contributed substantially to the value added and employment in the Community. Instead, the Community eliminated the Japanese-owned production facilities from the scope of the domestic industry through the related-party provision²⁹. Because of the significant investment costs incurred in (unsuccessfully) setting up DRAM production facilities, the Commission defined the "Community industry" subsequently as consisting of the four complainants (Vermulst and Waer, 1990).

In effect, the changed rules of origin reduced the category of chips and products using chips that are considered to be "European" and thus increased the chance of dumping charges. Indirectly, this change evoked foreign companies to invest in diffusion facilities rather than assembly. As the Financial Post (April 11, 1989) notices: "Japanese chip makers have been quick to react to this change by announcing plans for new factories in Europe."

The change in rules of origin could be interpreted as a way for the European Community to increase its benefits from foreign direct investment relative to the benefits that foreign producers received. In that case, the Community would not so much object the presence of foreign-owned subsidiaries in the Community. Foreign semiconductor producers could benefit from the advantages of the European market on the condition that the Community and its industry would benefit from their presence too.

3.2.5 Cooperative R&D Programs: ESPRIT AND JESSI

In the context of the Community's Research and Technological Development (R&TD) policy as provided for in the Single European Act (SEA)³⁰, member states must unanimously adopt every five years, after consulting the European Parliament and the Economic and Social Committee, long-term R&TD framework programs. These frameworks, the first of which appeared prior to the SEA in 1984, define the Community's "common" strategy in the field of research and development³¹, and operate as middle term instruments for programming the Community's activities in the field of R&TD³². Both the first and the second framework program provided for programs seeking to support the information technology (IT) industry³³. The first Community IT program to be implemented was the European Strategic Program for Research and Development in Information Technology (ESPRIT).³⁴

3.2.5.1 ESPRIT

In 1980, Davignon, then Commissioner of Industry in the Community, invited the twelve largest European electronics companies³⁵ (Round Table Group), representing 70 to 80 percent of European industrial research facilities in the field of electronics (Langlois et al. 1988:139), to draw up a work program for their industry (Mytelka 1990:10). The Commission subsequently formulated, in close cooperation with the twelve companies, a proposal for a concrete program of action. In

June 1982, the Council of Ministers adopted the guidelines for the resulting ESPRIT program (ECC Background Report ISEC/B1/83, Jan. 27, 1983; van Tulder and Junne 1988:213).

ESPRIT has three objectives: (1) to provide the European IT industry with the basic technologies that it needs to meet the competitive requirements of the 1990s; (2) to promote European industrial cooperation in information technology, including microelectronics³⁶; and (3) to contribute to the development of internationally accepted standards (CEC 1988:4).

The first phase of ESPRIT (1984-1988) had a budget of 1500 million ECU (MECU) of which 50 percent was financed by the Community and the other half by the participants in the ESPRIT program. The Community budgeted the second phase (1989-1993) for 3200 MECU, of which approximately 30 percent was allocated to microelectronics and peripheral technologies.

The funds available under ESPRIT were allocated towards cooperative projects, which were open to anyone in the Community who fulfils the requirements. Participants had to be established in the European Community for several years and had to carry out R&D in IT in the Community. This covered companies of any size or nationality³⁷, universities and other educational establishments, research organizations and individuals. In addition, at least two parties from different member states had to participate in these projects. Finally, each participant had to share background information, if

needed by the partners, and research results³⁸.

While in the first phase of ESPRIT almost 65 percent of the 225 projects were focused on precompetitive R&D, the share of such projects declined in the second phase of ESPRIT to 52.3 percent to the advantage of application specific projects in order to assure that the program would directly contribute to improving the competitiveness of European companies (Mytelka 1990:11-13).

The member states delayed the decision-making on both the first and second phase of the ten-year program; the adoption of the financial package of ESPRIT 1 was delayed for four months since West Germany and the United Kingdom had made their approval conditional upon the decision of the European Council on budgetary reforms, while the Council failed to come to a conclusion on this issue. The adoption of the second phase of ESPRIT was made conditional upon political consensus on the Community's second Framework Program. The adoption of the Framework Program, however, was stalled by the diverging opinions between the European Commission and the smaller member states on the one hand and the larger ones on the other, on the question as to whether European projects should substitute national programs or merely be complementary (van Tulder and Junne 1988:224).

European-owned semiconductor producers and under certain conditions also foreign-owned subsidiaries, benefitted from the ESPRIT program, since ESPRIT allowed them to participate

in projects which were financially feasible due to cost sharing. In particular, the largest electronics companies benefitted from Community funding (DG XIII, Esprit Midterm Review Report 1989:17). The producers benefitted further from the ESPRIT program since ESPRIT allowed them to freely share information, and to take advantage of complementarity in knowledge. Semiconductor manufacturers also used the opportunity to set up a network of alliances aimed at knowledge production and knowledge sharing beyond the context of ESPRIT.³⁹

3.2.5.2 JESSI

In addition to ESPRIT, the European Community subsidized projects in the context of JESSI, the Joint European Submicron Silicon program, although JESSI is considered to be a cooperative initiative between five European countries rather than an EC program. JESSI was initiated in December 1986 by the governments of France, Germany, Italy, the Netherlands and the United Kingdom, and their respective national champions, within the context of EUREKA⁴⁰.

JESSI, the "European equivalent" of Sematech, sought to improve Europe's competitiveness in the semiconductor industry⁴¹ and to counter Japanese and US domination of the microchip industry. Areas of research and development included memory chips and manufacturing techniques, equipment and materials, computer assisted design and its applications, and

basic and long-term research (EC Press Release IP (89)4778).

The \$4.5 billion program, which started in 1989, was funded by the participating companies, the national governments, and recently also by the European Community (The Economist 1989, Feb.2:74; Financial Times 1990, June 18). Participation was in principle open to European and foreign-owned undertakings. Foreign-owned firms could participate if they had production facilities in Europe and could prove their commitment to research in Europe. These firms also should face similar conditions to European-owned firms in order to participate in JESSI. As in ESPRIT, semiconductor producers participating in JESSI benefited from funding, exchange of information and networking.

However, the Dutch participation in JESSI has become subject to reservations due to the withdrawal of Philips from the SRAM project (August 1990) following the financial difficulties that the company encountered in 1990. Participation of Dutch technical universities and research institutions (which have built up an expertise in semiconductor technology) in JESSI's basic and long-term research area could continue, depending on government support (DELTA September 13, 1990:6; Algemeen Dagblad September 6, 1990:3).

3.2.6 European Semiconductor Policy Response

The EC policy response to import penetration and foreign direct investment in the semiconductor industry in the 1980s, was three-fold. The European Community protected its semiconductor industry against cheap imports through the Common Customs Tariff, the imposition of anti-dumping duties and the conclusion of price undertakings, thus seeking to diminish the import penetration rate.

Additionally, the Community sought to strengthen the European (owned) semiconductor producers and increase their international competitiveness through funding of cooperative R&D projects, namely the European Strategic Program for Research and Development in Information Technologies (ESPRIT) and the Joint European Submicron Silicon Initiative (JESSI). The Community also protected the design of semiconductor topographies to improve the legal environment of R&D and production.

Finally, the European Community did not block foreign direct investment in the semiconductor industry. Community policies, however, had the intended or unintended effect of upgrading inward investment through various incentives and constraints. The Community stimulated investment in manufacturing operations in the Community instead of (exporting or) point-of-sales investments through the lower tariff on wafers. Anti-dumping suits or threat thereof indirectly had the same effect, stimulating manufacturing in

the Community to obtain European "origin" status, thus avoiding any anti-dumping charges. The change in rules of origin indirectly stimulated foreign direct investment in diffusion operations instead of assembly. Since diffusion generally accounts for most of the value of the completed chip and involves higher capital and R&D investments, this policy change also contributed to the upgrading of inward investment in the Community industry.

The objective of the EC policies in the 1980s thus appeared to be the establishment of a competent and high value European-located semiconductor industry, rather than an exclusively European-owned production capability. However, the EC policies as described above did not replace national semiconductor policies. The following section on the policies of the five main semiconductor producing EC countries is included to illustrate the extent to which member states governments thought "national" rather than "European" with respect to the semiconductor industry.

3.3 NATIONAL SEMICONDUCTOR POLICIES

Over the 1980s, France, Italy, West Germany, the United Kingdom and the Netherlands, accounting for approximately 90 percent of European semiconductor production, all supported and/or intervened in their respective domestic semiconductor industries. Three main instruments characterized the national

semiconductor policies, namely government subsidized R&D programs and investments, government procurement, and state ownership. The extent to which these instruments were employed varied across the five states. Appendix B gives an overview of the national semiconductor policies during the 1980s.

All five countries made available large sums of money for R&D on semiconductor technology, mostly within the larger framework of policies and programs stimulating the whole electronics industry. Varying over the countries, the public funds were allocated towards military R&D and/or civilian programs. In West Germany the subsidized programs had a predominantly commercial orientation, while both France and the United Kingdom channelled considerable sums of government funds into military projects. In the latter countries, military procurement also played a substantial role.

Main beneficiaries of the government funding (and procurement) were the "national champions", the large semiconductor producers located in the respective countries. However, foreign firms could also benefit under certain conditions such as the availability of domestic characteristics and the presence of joint ventures with national firms. National governments also directly contributed to the multilateral programs MEGA (West Germany and the Netherlands), and JESSI (all five countries).

State ownership played in particular a role in France, Italy and the United Kingdom. In 1982, France nationalized the

major electronics firms, including Thomson, to restructure the French electronics industry and to channel public funds to these companies. Moreover, in 1987, the French and Italian government each acquired a 50 percent stake in the French - Italian Thomson-SGS. The United Kingdom owned INMOS from 1978 to 1984, to secure a British production capability in VLSI memories and microprocessors.

Judging by the size of government support of the domestic semiconductor industry in addition to benefits that the various national firms derived from EC funding, it is clear that the member state governments attached a great importance to the viability of their domestic production capability.

EC policies therefore did not replace national policies. Rather, the Community policies complemented and coordinated the national ones. For example, all governments had national projects comparable to those of the European Community, illustrating that the EC R&D programs complemented instead of supplanting national programs. In some cases such as Alvey, even a considerable overlap existed⁴² (van Tulder and Junne 1988:224). The EC directive to protect semiconductor topographies points to the Community's coordinative function. The directive was issued at Community level to ensure the same effect in each member state, thus stimulating spending that could only be profitable on a European scale⁴³.

3.4 CONCLUSION

In the early 1980s, in response to the American and Japanese "challenge" the various national governments overcame their initial reservations and agreed to the development of a semiconductor policy at the EC level. The EC policy response to import penetration and foreign direct investment in the semiconductor industry in the 1980s was three-fold. The European Community sought to diminish the import penetration rate through various instruments of protection. Additionally, the Community sought to strengthen the European (owned) semiconductor producers and increase their international competitiveness through funding of cooperative R&D projects. Finally, the European Community did not block foreign direct investment in the semiconductor industry. Rather, Community policies had the intended or unintended effect of upgrading inward investment through various incentives and constraints. The objective of the EC policies in the 1980s thus appeared to be the establishment of a competent and high value European-located semiconductor industry, rather than an exclusively European-owned production capability.

In terms of outward policies, the Community also tried to protect the European semiconductor industry from the constraining effects of foreign semiconductor policies. In relation to the member state policies, the EC policies as described above did not supplant national semiconductor

policies. Instead, the Community policies complemented and coordinated national policies.

The EC policies sought to improve the standing of the European semiconductor industry, and appeared (as indicated) to be beneficial to European-owned semiconductor producers. However, the EC policies were to the disadvantage of other actors such as foreign exporters and, in certain cases, foreign-owned subsidiaries in the Community. The following chapter will outline the welfare effects for the various actors involved in the EC semiconductor case and for the Community as a whole of the EC semiconductor policies.

ENDNOTES

1. Note that only those policies that are aimed directly at the European semiconductor industry are discussed. This limitation has two implications. First, it implies that policies geared at the protection and stimulation of semiconductor consuming industries will not be discussed, although these policies might indirectly benefit the European semiconductor industry. Examples of this category of policies are export restraining arrangements, for example, of consumer electronics (Koopmann and Scharrer 1989:250). Second, it implies that policies that improve the economic "infrastructure", such as education and competition policies, will not be addressed. Education policies, such as ERASMUS, contribute to an adaptation of human resources to new technologies and an international labour market. Competition policies impede or allow cooperation between companies; an essential element in the European semiconductor policies. Intellectual property rights will be discussed in detail, i.e. those laws and rules on intellectual property rights that directly affect the semiconductor industry.

2. Trade policies comprise the use of tariff and non-tariff barriers, while firm specific policies aim directly at promoting or preserving specific firms, often the "national champion" (Richardson 1990:17-18).

3. Market perfecting policies comprise those policies that correct market failure such as the provision of public goods (defense, justice), and the compensation for externalities. General factor policies include inducements to education, savings, and research and development. Industrial policies target various industries through subsidizing, taxing, etc. (Richardson 1990:17-18).

4. Article XXII:1 of the GATT states that: "each contracting party shall accord sympathetic consideration to, and shall afford adequate opportunity for consultation regarding, such interpretations as may be made by another contracting party with respect to any matter affecting the operations of this Agreement."

5. GATT Article XXIII:1 offers ways to adjust situations in which any contracting party feels that the benefits accruing to it indirectly or directly under the GATT are being nullified or impaired or that the attainment of any objective of the Agreement is being impeded for various reasons. Article XXIII:1 offers the contracting party to make written representations or proposals to other parties concerned, in order to come to a satisfactory adjustment of the matter.

6. The various national policies had fragmented the European market into small, non-profitable units. As stated by ECC Background Report (ISEC/B1/83 of Jan. 27 1983): "The home markets do not offer a sufficient base for the innovation and flexibility required in an industry where obsolescence is so rapid." National coordination and concentration agreements had been concluded where necessary and feasible, however, without improving international competitiveness (as expressed by the share of European production in world production) (van Tulder and Junne 1988:212). It was argued that the necessary resources and know-how could be mobilized only through international cooperation agreements. In addition, the lack of coordination between the different national technology programs led to considerable overlap of efforts and therefore an inefficient allocation of resources at European level. A minimum of coordination or common programs seemed necessary.

7. Council Directive of 16 December 1986 on the legal protection of topographies of semiconductor producers, OJ L24 of January 27, 1987.

8. The topography of a semiconductor product has been defined as a series of related images, however fixed or encoded; (i) representing the three-dimensional pattern of the layers of which a semiconductor product is composed; and (ii) in which series, each image has the pattern of the semiconductor product at any stage of its manufacture (OJ L24/37 of Jan. 27, 1987).

9. The European Community estimates that the development of a sophisticated microchip can require an investment of ECU 100 million, while it costs only ECU 50.000 to 100.000 to plagiarize an existing topography (ECU = European Currency Unit. ECU 1 = US \$ 1.1 de dato October 30, 1989) (European File 17/89).

10. Other semiconductor producing countries such as Canada also have adopted similar regulations.

11. The European Community operates as a customs union, although the Community never has been approved formally by the GATT due to inconsistencies with GATT Article XXIV (Stone 1987:69-70).

12. The Common Customs Tariff finds its legal basis in the Treaty establishing the European Community, and since 1987 also in the Single European Act (SEA). Article 3:b provides for the establishment of a common tariff (and a common commercial policy) towards third countries. The original creation of the CCT, the determination of the tariff level and changes herein are outlined in Articles 18 to 29 of the Treaty establishing the European Community. Article 28 (since 1987: Article 16:1 of the SEA) outlines that any autonomous alteration or suspension of duties in the CCT shall be decided by the Council acting by a qualified majority on a proposal of the Commission.

13. Semiconductors are eligible for duty free treatment under the European Community's Generalized System of Preferences. The quantities allowed under this regime are, however, very limited (Langlois et al. 1988:63). Flamm (1985:58) indicates that for 1978 the total European quota was little more than 0.35 percent of the estimated European consumption of semiconductors.

14. The tariffs on pocket calculators, etc. were reimposed after a short period of time.

15. In EC law, Article 113:1 of the Treaty establishing the European Community provides the legal basis for protective measures to be employed in the case of dumping. In implementation of Article 113:1 of the Treaty, Council Regulation 2423/88 (OJ L209/4 1988) lays down the current provisions for protection against dumped imports from countries which are not members of the European Community.

16. "A product shall be considered to have been dumped if its export price is less than the normal value of the like product." (Official Journal No. L 209/4: Regulation 2423/88 Article 2.2). The "normal value" has been defined as the comparable price of the like product actually paid or payable in the exporting country or country of origin. In absence of such a domestic price, the comparable price of the like product when exported to any third country is used, or a constructed value. The latter is calculated by adding to the costs of production, a reasonable amount for any other costs such as administrative selling, and for profits (Regulation 2423/88: Article 2.3). The "export price" has been defined as the price actually paid or payable for the product sold for export to the Community net of all taxes, discounts and rebates actually granted and directly related to the sales under consideration. In cases where there is no export price or where the export price appears to be unreliable, the export price may be constructed. The export price is constructed either on basis the price at which the imported product is first resold to an independent buyer, or if the product is not resold to an independent buyer, or not resold in the condition imported, on any reasonable basis. The latter takes into account all costs incurred between importation and resale and a reasonable profit margin (Regulation 2423/88: Article 2.8). These rules are based on the GATT Customs Valuation Code instituted after the Tokyo Round.

17. "Causing injury" has been defined as: "causing or threatening to cause material injury to an established Community industry or materially retarding the establishment of such an industry." (Regulation 2423/88: Article 4:1). The term "Community industry" refers to "the Community producers as a whole of the like product" or "to those of them whose collective output of the products constitutes a major proportion of those products" (Regulation 2423/88: Article 4.5).

18. See appendix A to this chapter.

19. Norall (1989:83) argues that "the new regulation makes more explicit and provides a clearer legal basis (as a matter of Community Law) for some of the Commission's more controversial practices." The Economist (October 9, 1988) states that "governments in target countries should insist that GATT scrutinizes some recent American and European anti-dumping decisions to see if they conform to GATT's view of its own code in today's world."

20. Ethier (1988:234) states that "the statute [anti-dumping duties] is likely to become a principal protectionist tool." The Economist (Sept. 9, 1989) also concludes that "GATT's vague rules frequently allow [the European Community] to use anti-dumping actions to camouflage protectionism."

21. In 1987, the European Commission also initiated anti-dumping proceedings concerning imports of EPROMs. The latter has not yet been concluded.

22. Community or domestic industry is understood as the industry producing (and selling) in the Community, which may include non-European-owned producers. Motorola, for example, is American-owned but located in the United Kingdom (see also 3.2.4).

23. Fujitsu, Hitachi, Mitsubishi, NEC, NMB, OKI, Texas Instruments (American-owned subsidiary in Japan), and Toshiba. At a later stage in the investigation three other Japanese DRAMS producers/exporters requested to be included, namely Matsushita, Sanyo and Sharp.

24. As stated by the Financial Times (July 27, 1989:3): A price undertaking is necessary since the semiconductor business is a fast moving industry. Dumping inquiries take so long to complete that the damage to home producers is often irreparable by the time action is taken.

25. The dumping margin is the amount by which the normal value exceeds the export price.

26. The basis of the EC rules of origin are laid down in EC Regulation 802/68, which states that goods wholly obtained in one country shall be considered as originating in that country. Goods in the production of which two or more countries were involved shall be considered as originating in the country in which (1) the last substantial process or operation that is (2) economically justified was performed, having been carried out in (3) an undertaking equipped for the purpose and (4) resulting in the manufacturing of a new product or representing an important stage of manufacture. In EC practice, the role of the first

criteria has been crucial, while the application of the other criteria has been limited (Vermulst and Waer 1990).

27. According to the Kyoto Customs Convention, processes that are not substantial include, for example, simple assembly operations, operations necessary for preservation of goods during storage and transport, operations to improve the packaging or marketable quality of products and preparations for shipment.

28. The term "Community industry" is interpreted (with two exceptions) as referring to the Community producers as a whole of the like product or to those of them whose collective output of the products constitutes a major proportion of the total Community production (OJ L209/8, EC Regulation 2423/88, Article 4:5).

29. The "related party provision" refers to the situation in which producers are related to the exporters or importers or are themselves importers of the allegedly dumped or subsidized product. In that case, the term "Community industry" may be referring to the rest of the producers (OJ L209/8, EC Regulation 2423/88, Article 4:5).

30. The Community's R&TD policy is based on three general articles in Community Law: Article 4 of the Treaty establishing the European Atomic Energy Community (EURATOM), Article 55 of the Treaty establishing the European Coal and Steel Community (ECSC) and Article 235 of the Treaty establishing the European Economic Community (EEC). The first two Treaties provide for respectively research on nuclear energy, and research on safety and efficiency in the coal and steel industries. Article 235 of the Treaty establishing the European Community gives the Council the opportunity to take the appropriate measures if Community action should prove necessary to obtain Community objectives, and the Treaty has not provided the necessary powers hereto. When the Single European Act (SEA) entered into force in 1987, the Community obtained formal powers in the field of research and technology. As outlined in Article 130:f of the Single European Act: "the Community's aim shall be to strengthen the scientific and technological basis of the European industry and to encourage it to become more competitive at the international level. In order to achieve this, it shall encourage undertakings, including small and medium sized undertakings, research centres and universities in their research and technological development activities; it shall support their efforts to cooperation with one another, aiming in particular, at enabling undertakings to exploit the Community's internal market potential to the full, in particular through the opening-up of national public contracts, the definition of common standards and the removal of legal and fiscal barriers to that cooperation."

31. The frameworks aim at reconciling the Common interest with national and regional interests (EC P-40 May 1983).

32. The programs outline scientific and technical objectives, define their respective priorities, set out the main lines of the activities envisaged, and budget the amount deemed necessary for all the planned activities and its breakdown amongst those activities (SEA Article 130:i; European Documentation 1988,2:19).

33. The first Framework Program, 1984-1987, sought to promote the development of Community research, development and demonstration policy. Within this framework, the Commission allocated approximately 18 percent (i.e. 680 million ECU (MECU)) of the funds available to the activity "New Technologies", which included Information Technology (IT). In the IT program, attention was concentrated on microelectronics in general, and ICs in particular (EC - P-40 May 1983; OJ C 208/1 of August 4, 1983). In the second Framework Program, 1987-1991, the Community budgeted MECU 1600 for promotion of Information Technologies (IT), which accounted for approximately 30 percent of the total financial resources of the framework program. The IT program included projects in microelectronics and peripheral technologies (OJ L302/8 of October 24, 1987).

34. For more information, refer to OJ C208/1 of August 4, 1983 and OJ L302/8 of October 24, 1987.

35. General Electric Company (UK), ICL (UK), Plessey (UK), Thomson (F), CGE (F), Eull (F), Siemens (FRG), AEG (FRG), Nixdorf (FRG), Olivetti (I), STET (I), Philips (NL) (van Tulder and Junne 1988:213).

36. The first phase of ESPRIT covered five areas of concentration, namely advanced microelectronics, software technology, advanced data processing, office information and computer assisted production. The second phase concentrated on microelectronics and peripheral technologies, information processing systems and IT application technologies.

37. On the basis of certain conditions, foreign owned firms are thus able to participate in the R&D projects. However, de facto the number of foreign companies participating in ESPRIT, for example, is limited.

38. Each participant in an ESPRIT project had to share its research results freely, if this was necessary or useful for the work of the others, or for exploitation after the work had ended. The contractors also had to share, on certain conditions, background information if that was needed by the partners. For exploitation, background patents had to be made available on appropriate conditions. In addition, participants had to make available information for R&D, or to grant licenses for

exploitation to other contractors working in the ESPRIT program, if needed.

39. Source: ESPRIT Task Force; European Documentation 2 1988:34); Langlois et al. 1988:138,139; Dunning 1988:3203; CEC 1988:6; van Tulder and Junne 1988:213; European File 15 Nov. 1989.

40. Projects undertaken in the context of EUREKA (the European Research Coordination Agency) are predominantly initiated by individual societies that wish to cooperate. In that respect, EUREKA projects are not strictly "Community" activities (Maillet 1986:547). EUREKA projects concern in general the development of advanced technologies and infrastructure.

41. Sematech seeks to group together in a strategic framework European manufacturers of ICs, research centres and users in order to improve Europe's competitiveness at international level in the field of design, production and application of both mass-produced and custom-built microchips, taking into account the specific needs of the user industries (EC Press release IP(89)478).

42. The overlap between Alvey and ESPRIT is estimated to be 25 to 30 percent (van Tulder and Junne 1988:224).

43. The development and implementation of trade policies at EC instead of national level (CCT, anti-dumping duties and rules of origin) flows logically from the fact that the European Community is a customs union.

APPENDIX A EVOLUTION OF EC ANTI-DUMPING REGULATION

Regulations (R)	Contents
R 459/68 (1968)	Basic EC Anti-Dumping provisions, closely following the GATT 1968 Anti-Dumping Code (Hartley 1979:265).
R 2011/73 (1973)	Amendment of R 459/68 to strengthen the role of the Community Institutions in this area and to streamline the procedures for consultation (Beseler 1986:23).
R 1411/77 (1977)	Second amendment of R 459/68 following the accession of Denmark, Ireland and the United Kingdom to the Community. R 1411/77 provided for the national anti-dumping measures to remain in force pending their review by the Commission, after which the Commission could amend or repeal them (Beseler 1986:23).
R 1681/79 (1979)	Third Amendment of R 459/68, establishing various modifications: clarifications of the rules for dealing with sales made at a loss, establishment of more specific criteria for dumping by state-trading nations, interpretation of the concept of causality, improvement of the rules on the calculation of export prices and in price comparisons, inclusion of provisions for prior disclosure to exporters and importers of the essential facts and considerations on the basis of which it was intended to impose a duty, inclusion of provisions for the collection of provisional duties deposited prior to the acceptance of a price undertaking (Beseler 1986:24).
R 3017/79 (1979)	Replacement of R 459/68, reflecting the Tokyo Round Agreements: adaptation of the EC rules to the provisions of the New Agreement on Implementation of Article VI of the GATT (Bellis 1980:145). According to

Beseler (1986:26), the new legislation reflected the need to avoid situations in which the interpretation of the Code by other signatories offered scope for a greater degree of protection than the Community's interpretation did. As this would have put the Community industry at a disadvantage, R 3017/79 stated that the Community's institutions should take account of the practice of its major trading partners, when applying its own legislation.

R 1580/82 (1982)

Amendment of R 3017/79, revising the provisions for acceptance of undertakings and the administrative review of regulations imposing anti-dumping duties. In order to avoid abuse R 1580/82 required the lapse of a minimum period of one year and the proof of sufficient evidence of changed circumstances, justifying the need for review, before a request of an interested party hereto would be rewarded (de Peuter 1985:358; Beseler 1986:27).

R 2176/84 (1984)

Replacement of R 3017/79 in order to incorporate procedural changes, technical changes and clarification. Procedural changes included the consultation with member states, the stipulation of time limits to the acceptance of price undertakings, the rules for refund of duties on particular shipments, the introduction of the "Sunset" clause, under which anti-dumping duties terminate after a five years period unless it has been proven that there is need for their continued existence. Technical changes included the adjustment of terminology to current customs legislation and common rules for imports from state trading countries. Clarification of the Commission's practice concerned the definition of "costs", "period of investigation", etc. (Beseler 1986:29; de Peuter 1985:358).

The semiconductor policies that the European Community has adopted during the 1980s evoked criticisms from actors in both private and public sectors, abroad and at home. Critics included actors directly related to the EC semiconductor case like foreign governments, foreign firms and domestic semiconductor consumers. In the DRAM anti-dumping case, for example, the EC decision to impose anti-dumping duties and/or conclude a price agreement was heavily criticized by the Japanese exporters which were alleged to have dumped, and by the EC computer industry which were consumers of semiconductors. The criticisms included the argument that the higher DRAM prices, resulting from the duties and/or price agreement, would adversely affect the competitiveness of European computer companies and Japanese subsidiaries in the Community; it was argued, for example, that the cost of anti-dumping duties would be completely disproportionate to any benefit which might result from these policy measures for the complainants. Only non-European producers would benefit from a price agreement. Moreover, the critics argued that European initiatives such as ESPRIT were examples of a more appropriate approach to a resolution of the Community industry's problems (OJ L20/22-23, January 25, 1990).

Academics also criticized the EC policies. In response to the conclusion of the minimum price agreement between the European Community and Japan, Kenneth Flamm, an economist with the Brookings Institution, Washington D.C, stated that "if

APPENDIX B NATIONAL SEMICONDUCTOR POLICIES

West German Semiconductor Policies

West Germany launched in 1984 Informationstechnik, a four year program aimed at the stimulation of various electronics sectors. Approximately 45 percent of the DM 3 billion¹ funding was allocated to semiconductor technology and various specified related technologies. The responsible government department (BMFT) solicited proposals from the semiconductor industry (including foreign owned subsidiaries on certain conditions) and provided funding (generally less than 50 percent) for the projects it accepted. The German government also channelled funds to MEGA (DM 300 million), a joined Philips-Siemens attempt aimed at the creation of a production capability in leading edge memory chips. The two billion dollar project was financed for approximately 10 percent by the Dutch and German governments, and for ninety percent out of private sources. In 1987, the cooperation resulted in the development of the one Megabit DRAM by Siemens and the 4 megabit SRAM by Philips. The German government also co-financed the preparatory phase of JESSI. Few public funds were allocated to military R&D and production, and if so, they were channelled into projects separated from the civilian programs. In general, the German subsidized programs had a predominantly commercial orientation. Public procurement for defense purposes was marginal; however, semiconductors were bought by the public sector for telecommunication applications (Borrus 1988:200,201; The Economist Feb. 18, 1989; Malerba 1985:192; van Tulder and Junne 1988:166,167).

Dutch Semiconductor Policies

Over the period 1984-1988, the Netherlands financially supported its semiconductor industry in the context of the all-embracing Informatica Stimulerings Plan (INSP). The total plan was budgeted for Dfl. 1.7 billion². This plan comprised 5 categories: information (propaganda, etc.), education, research, public and private sector. Nearly 60 percent of the budget was channelled to the private sector. This sum included the Dutch contribution to MEGA (Dfl.200 million), and additional financial support for Philips' semiconductor development. Since 1987, R&D in semiconductors has been stimulated in the context of the Informatie Technology Programma, which in addition to innovation-oriented research, also emphasized education and training, information and demonstration, and standardization. Microelectronics R&D, in particular, was covered by the Micro Electronics Stimulation Program and the Integrated Circuit Technology Innovation Oriented Program. The former program, with a budget of Dfl. 132 million for a five year period (1986-1991), aims to

stimulate research and training at technical universities and colleges, and offers facilities thereto. The latter program was launched in 1985 for seven years and has a budget of Dfl. 27 million. Beneficiaries of these programs were the Technical Universities, colleges and small companies. Indirectly, these policies benefit Philips too due to the fact that many small companies are linked with Philips and many researchers either will or have worked for Philips. In addition, Philips was directly subsidized by the government³. The government also participated in the funding of the preparatory phase of JESSI. Further contribution of the government to JESSI is insecure due to Philips' withdrawal from JESSI, and Philips' inability to commercialize the SRAM-chip, thus wasting large subsidies of the Dutch state. It is unclear what proportion of public funds were allocated to military semiconductor R&D. However, in comparison with France and the United Kingdom, military expenditures probably only marginally affected the Dutch semiconductor industry. (van Tulder and Junne 1988:166-167; Tweede Kamer van de Staten-Generaal 1989-1990; Arnold and Guy 1990:162,163; Delta, September 13, 1990).

French Semiconductor Policies

France supported its semiconductor industry during the years 1982-1986 within the context of Filiere Electronique, a FF 70⁴ billion project aimed at the stimulation of the French electronics industry. The plan was designed to integrate all electronics activities under a common industrial policy, and covered private and national firms, labour, user-groups, research centres, institutes and universities. Under Filiere Electronique the semiconductor industry received FF 3.4 billion for R&D and 2.2 billion for investment subsidies. Funding was channelled to Thomson and Matra-Harris, which were selected as leaders of the French semiconductor industry. The establishment of a leader for each technical area, resulting in a division of labour between the major electronics companies⁵, was part of a comprehensive restructuring of the French electronics industry. This restructuring was enabled by the nationalization of the major electronics firms. In addition, the nationalization proved to be an effective means to channel large forms of public money to these companies (van Tulder and Junne 1988:163). Foreign firms also could benefit from French funds, however, only on certain conditions. France was excluded from MEGA. However, Thomson successfully lobbied the French cabinet for approximately FF 1 billion in support of its own megachip project (van Tulder and Junne 1988:167-172). At present, the French government does contribute to JESSI. Considerable sums of government funds were channelled into military projects. Even proposals of commercial projects were judged on the basis of national interests. Military procurement was substantial (van Tulder and Junne 1988:38,39,167-172; Malerba 1985:195; Langlois et al.

1988:147-153; Nelson 1984:45,46).

British Semiconductor Policies

The United Kingdom launched in 1984 the Micro Electronics Industrial Support Program II (MISP II) to support (collaborative) R&D in the domestic semiconductor industry. In particular, the program sought to develop custom and semicustom ICs. MISP II covered a period of 6 years, and used its funds (120 million) for support up to 25 percent of the R&D costs of projects in microelectronics. In the period 1978-1984, the British government secured a production capability in VLSI memories and microprocessors through its ownership of INMOS. INMOS was privatized and acquired in 1984 by Thorn-EMI (van Tulder and Junne 1988:35). The United Kingdom funded the development of VLSI circuits in the Alvey Program. Over the period 1983-1989, the Alvey program had a budget of 350 million pounds, partly financed by the government (200 million pounds) and partly by the private sector (150 million pounds). Alvey supported up to 100 percent of academic research, up to 90 percent of industrial basic research of wide interest and up to 50 percent of other types. As in ESPRIT, a project approach was used in which companies and universities cooperated. The main participants were the major military contractors Plessey, GEC, Ferranti and STC due to the military orientation of the project. Foreign firms were allowed to participate (for example, IBM and Philips) but only if they had special assets to contribute and only so long as the technological information was unlikely to leak from the United Kingdom (Langlois et al. 1988:134-135, Malerba 1985:198). Although some British projects had an explicit commercial orientation, others were military oriented. As in France, military procurement and funding of R&D was substantial (Nelson 1984:45,46).

Italian Semiconductor Policies

The Italian government approved in 1983 a program supporting R&D in microelectronics; over the period 1984-1988 more than \$ 100 million was allocated to research in VLSI technology and compound semiconductors. The main beneficiary of this program was SGS-ATES. Semiconductor technology was also supported in the context of the program supporting innovation in the industry in general, launched in 1982. It is unclear what proportion of public funds were allocated to military R&D. (Malerba 1985:198-200).

1. DM 1 = \$ 0.7459 (October 3, 1990)
2. Dfl 1 = \$ 0.6515 (October 3, 1990).
3. The total government subsidies in the last few years to PHILIPS are estimated to total Dfl 500 million (Algemeen Dagblad).
4. FF 1 = \$ 0.2225 (October 3, 1990).
5. "One of the most pronounced changes in technical territory was the agreement signed between Thomson and CGE, dubbed the "Yalta of Electronics." CGE exchanged its consumer and component division for Thomson's telecommunications division. In addition, CGE and Thomson sold their computer subsidiaries to Bull, and Thomson acquired the remaining part of Eurotechniques (van Tulder and Junne 1988).

CHAPTER IV

ECONOMIC ANALYSIS OF EC POLICIES ON SEMICONDUCTORS

The semiconductor policies that the European Community has adopted during the 1980s evoked criticisms from actors in both private and public sectors, abroad and at home. Critics included actors directly related to the EC semiconductor case like foreign governments, foreign firms and domestic semiconductor consumers. In the DRAM anti-dumping case, for example, the EC decision to impose anti-dumping duties and/or conclude a price agreement was heavily criticized by the Japanese exporters which were alleged to have dumped, and by the EC computer industry which were consumers of semiconductors. The criticisms included the argument that the higher DRAM prices, resulting from the duties and/or price agreement, would adversely affect the competitiveness of European computer companies and Japanese subsidiaries in the Community; it was argued, for example, that the cost of anti-dumping duties would be completely disproportionate to any benefit which might result from these policy measures for the complainants. Only non-European producers would benefit from a price agreement. Moreover, the critics argued that European initiatives such as ESPRIT were examples of a more appropriate approach to a resolution of the Community industry's problems (OJ L20/22-23, January 25, 1990).

Academics also criticized the EC policies. In response to the conclusion of the minimum price agreement between the European Community and Japan, Kenneth Flamm, an economist with the Brookings Institution, Washington D.C, stated that "if

Europe really wanted to promote its semiconductor industry a better solution would be to subsidise it directly out of the taxpayers' purse rather than impose costs on consumers which are credited directly to Japan" (in Financial Times, July 27 1989). Like the criticisms of Japanese exporters and European computer firms, Flamm's criticism and suggestion are based on the liberal economic notion that any restriction to free trade would generally impose a welfare cost on society, and that subsidies are the least damaging from a welfare perspective. If the EC semiconductor policies indeed impose a welfare cost on society, why would the European Community select such policies?

This chapter starts by focusing on the first part of this question, namely the likely welfare effects of the EC semiconductor policies based on the liberal economic ideology. The liberal economic arguments discussed are the traditional and new case for free trade and their exceptions¹. The second part of the question, namely the reasons underlying the EC choice for policies that impose (at least in theory) a welfare cost on society, will be discussed in Chapters V and VI. However, the distribution of the welfare effects over the various actors involved in the EC semiconductor case (producers, consumers, government), as outlined in the traditional argument, may provide some crucial insights into the interests of the actors mentioned above (I_2 and I_3). The income distributional effects of EC policies for the factors

operating in the European semiconductor industry (capital, labour) as predicted by the Stolper-Samuelson theorem and the Specific Factor Model also contribute significantly to the understanding of the role of interests (I_3) in explaining the EC policy choice.

4.1 THE TRADITIONAL ARGUMENT FOR FREE TRADE AND ITS EXCEPTIONS

The traditional case for free trade, advocated by, for example, Ricardo, Smith and Viner, is that under the assumptions of perfect competition and constant returns to scale, unrestricted inter-industry trade would allow the European Community to specialize in certain industries according to its comparative advantage², and thus to produce and consume efficiently.

As illustrated in figure 4.1, under autarky the economy locates at point A, consuming Y_a units of good Y (say, semiconductors). Under free trade, the economy locates at point F, consuming Y_1 units of good Y. Y_2 units are produced domestically, as for all units up to Y_2 , domestic production of good Y is cheaper than importing good Y. For all units of good Y beyond Y_2 , foreign production is less costly than domestic production. Consequently, $(Y_1 - Y_2)$ units are imported at price p_w^* .

The gains of trade, coming to the benefit of consumers,

Figure 4.1 Domestic Production and Import of Good Y by a Small Actor under Free Trade, an Import Tariff, Voluntary Export Restraints and a Production Subsidy

s_d = Domestic Supply Curve

S_w = World Supply Curve

D_d = Domestic Demand Curve

p_w^* = Equilibrium World Price under Free Trade

p_d^* = Equilibrium Domestic Price under Autarky

t_{AV} = Import Tariff

s = Production Subsidy

Assumes:

1. $p_w^* < p_d^*$

2. Actor is price taker: facing a perfectly elastic world supply curve.

are represented by areas $5+6+7+8+9+10$. The consumers' surplus³ increases from area 1 under autarky to areas $1+2+3+5+6+7+8+9+10$ under free trade. Producers⁴, however, lose; the producers' surplus decreases from areas $2+3+4$ under autarky to area 4 under free trade.

Assuming that the EC seeks to maximize "common" welfare⁵, and not just the performance of a specific industry, the imposition of restrictions to free trade would be at a net cost to European society. An ad-valorem tariff on imports, such as the Common Customs Tariff (CCT), would impose a welfare loss on society due to inefficiently high production and inefficiently low consumption (Yarbrough and Yarbrough 1988:189). As illustrated in figure 4.1, the imposition of an import tariff at Pt_{AV} dollars per import unit, increases domestic production of good Y from Y_2 to Y_4 , but decreases domestic consumption of good Y from Y_1 to Y_3 . The consumers' surplus decreases from areas $1+2+3+5+6+7+8+9+10$ under free trade to areas $1+2+9+10$ under import protection, while the producers' surplus increases from area 4 under free trade to areas $3+4$. In other words, part of the consumers' surplus (area 4) is transferred to the producers (redistribution effect). The government benefits also from the imposition of the tariff. Areas $6+7$ of the consumers' surplus are transferred to the government that collects the tariff revenue (revenue effect). Areas 5 and 8, however, represent the deadweight losses due to production and consumption

inefficiencies, generated by the tariff.

The anti-dumping duties imposed in the DRAM anti-dumping case are, in effect, also comparable to the levying of an ad-valorem tariff on the imported semiconductors since the duties imposed are a percentage of the net free-at-Community-border price before duty⁶.

The imposition of the minimum price agreement, comparable to the imposition of voluntary export restraints, leads to even higher welfare costs than imposition of anti-dumping duties or the Common Customs Tariff do. This agreement has the same effects as the CCT (see figure 4.1); however, the part of the consumers' surplus which is transferred to the government in the case of a tariff (area 6+7), comes in the case of the minimum price agreement to the benefit of the foreign producers. The higher price for exported products increases the profits for the foreign producers.

When tariffs, duties and price agreements are designed to protect domestic producers from foreign competition, these restrictions to free trade are seen as a second best solution to the ESPRIT and JESSI subsidies, which are in their welfare effects comparable with production subsidies⁷. The latter subsidies allow domestic production to increase at a lower welfare cost than the tariff, duties or price agreement. As figure 4.1 shows, the production subsidy increases domestic production of semiconductors from Y_2 to Y_4 , while leaving consumption unaffected. The cost to society is therefore

limited to the deadweight loss caused by inefficiently high production (area 5). Although these subsidies are therefore seen as preferential to the Common Customs Tariff, anti-dumping duties or the price agreement, according to the traditional argument for free trade, the European Community would still be better off under free trade.

Only in two cases does the traditional argument "prescribe" trade barriers, namely in the case of monopoly power and in the case of a new industry that is temporarily unable to compete with experienced rivals in other countries. In the first case, the optimum tariff argument for protection states that when a single country forms a large enough share of the world market to obtain some market power, it may be able to gain at the expense of its trading partners by imposing a tariff (Yarbrough and Yarbrough 1988:251). In the second case, the infant industry argument for protection is justified on the basis of the existence of market imperfections such as the problem of appropriability of knowledge, and imperfections in the capital market (Stegemann 1989:85-86; Krugman and Obstfeld 1988:232).

The first best argument for tariffs, namely the optimum tariff, does not apply to the European semiconductor case since the European Community does not have a sufficiently large share of the world market in semiconductors to obtain market power. The second argument, the infant industry argument, does not apply since the Community semiconductor

industry can hardly be called an infant industry. Therefore, advocates of the traditional argument for free trade would argue that in the European semiconductor case tariffs should be eliminated and that, if any intervention, subsidies should be used.

4.2 THE NEW ARGUMENT FOR FREE TRADE AND ITS EXCEPTIONS

The world market for semiconductors is not characterized by perfect competition and constant returns to scale. In imperfect markets, what is the validity of the free trade prescription? Can government intervention in such markets be justified from a welfare perspective?

The new case for free trade, advocated for example by Krugman and Richardson⁸, states that even in imperfect markets unrestricted trade would be beneficial to both the European Community and the rest of the world. Free trade would allow the European Community to specialize in certain segments within industries according to its engineered comparative advantage⁹, thus creating intra-industry trade. The gains of trade thus obtained may even raise world welfare beyond the world welfare under perfect competition due to economies of scale gains and dynamic technological gains¹⁰.

There are, however, some arguments for EC intervention which could be justified from a welfare perspective, namely the optimum tariff argument, strategic trade policies aimed

at industries generating excess profits due to (temporary) market power or generating (technological) spillovers to the rest of the economy, and the strategic infant industry argument. The limited applicability of the optimum tariff argument and the infant industry argument to the EC semiconductor case has already been discussed in the previous section. This section therefore focuses on strategic trade policies.

The basic idea underlying strategic trade policies is that governments can enhance national welfare by actively promoting domestic development of industries that create substantial economic rents (excess profits) or external benefits (Stegemann 1989:81; Richardson 1990:114-16). In an economy characterized by imperfect competition, some industries may be able to generate excess profits, i.e. higher rates of profits than are earned in other industries of equivalent riskiness (Krugman 1986:13). In principle, these rents are temporary, since their size forms an incentive for competitors to enter the market. However, entry barriers may inhibit the entry of rivals; and ongoing technological innovation may "re-new" these profits (Richardson 1990:115). If a government can secure for its country a larger share of these rent-yielding industries, national welfare will be raised, at the expense of other countries' welfare (beggar-thy-neighbor policy).

Some industries indirectly yield high returns per unit

of input because they generate technological spillovers to the rest of the economy (Krugman 1987:230). These externalities comprise benefits from large scale production, benefits from learning by doing (especially for new processes and products), benefits from promoting technological progress and protecting it from uncompensated copying, and benefits from promoting and protecting sectors and occupations that are alleged to encourage technological progress intrinsically (Richardson 1990:114-15). By promoting these externalities-generating industries, countries could, in principle, raise their income (Krugman 1987:139; Krugman 1986:13). In contrast to policies aimed at the promotion of rent-yielding industries, policies to promote industries that generate externalities need not be detrimental to other countries (1987:138). If the technological externalities created by these industries spill over to other countries and/or consumer prices (and thus import prices) fall, the latter countries also gain.

The cutting-edge semiconductor industry offers scope for high economic growth (rents) and positive spillover effects (externalities) to other sectors of the economy (Borrus, Tyson and Zysman 1986). The strategic trade policy argument states thus that governments should protect and promote their respective industries on the basis of the gain that intervention might yield to the home country.

In a setting of imperfect competition and increasing returns to scale, government action may alter the strategic

game played by foreign and domestic firms, as is illustrated in figure 4.2. The Brander-Spencer model (Stegemann 1989:81-84; Brander 1986:26-31) illustrated here assumes an international duopoly in which each firm only exports to a third market. Both firms are assumed to act as Cournot duopolists, i.e. each firm maximizes its profits to the export market on the assumption that the other producer's sales are given.

In the absence of any government intervention, the equilibrium sales would be respectively Q_H^* and Q_F^* , defined by the intersection (point C) between the reaction curves¹¹ of the two firms, R_H and R_F . Expansion of production above the equilibrium output, for example by firm H, would push the competitor, firm F, down its reaction function, ideally to point S where firm H's profits are maximal¹². However, firm H may not have the ability (the lower cost production, etc.) to make such a commitment for longer term on its own. In that case, the threat of expansion of firm H is not credible to firm F; the expansion is likely to be temporary because such an aggressive threat would hurt firm H in the longer term. Backed up by government subsidies, firm H can, however, make a credible threat. In that case the reaction curve of firm H shifts from R_H to R_H' ; H's equilibrium output shifts from Q_H^* to Q_H' and F's output declines from Q_F^* to Q_F' .

Strategic trade policy arguments, as discussed above, indicate that government subsidies or government protection

Figure 4.2 Brander-Spencer Model (profit shifting)

R_F = Reaction curve firm F

R_H = Reaction curve firm H

Q_F^* = Equilibrium Output firm F

Q_H^* = Equilibrium Output firm H

π_H = Profit curve firm H

targeted at a particular industry may result in a domestic gain under certain conditions (Grossman 1986:62; Richardson 1990). The realization of these gains is, however, dependent on a set of assumptions. It is assumed that there exist full information, net benefits, no pressure from interest groups, and no retaliation.

In terms of availability of information, uncertainty exists about the behaviour of firms, the existence and the size of rents and externalities, etc. Insufficient information thwarts the decision as to which industries to target and how. Which industries and which firms within industries could generate excess rents or spillovers? What are the appropriate policies to be employed? (Krugman 1987:129; Yarbrough and Yarbrough 1988:249; The Economist Feb. 24, 1990:71; Grossman 1986:53-55, 58-59).

Concerning net benefits, it is doubtful whether government policies can indeed generate net benefits or rents. Are there any benefits of targeting and if so, will those benefits be larger than the opportunity cost of not targeting another industry? Finally, will those benefits be larger than the costs imposed on other sectors of the economy?¹³ (Krugman 1987:140; Dixit 1986:290; Grossman 1986:50-61; Yarbrough and Yarbrough 1988:249; The Economist Feb. 24, 1990:71)

Harris (1989:767) argues that the net welfare effects of strategic subsidy and tariff policies are small. However, the redistributive effects may be large: the individual welfare

of various producer and consumer groups or other domestic actors in the industry such as labour may be seriously affected by these policies. In that case, the political leverage of the various groups may be the determining factor in the policy making process¹⁴. Krugman (1987:140) argues that even if rents exist in industries that make intervention worthwhile, governments may still not be able to raise national income. Two reasons underlie this statement: profits may be dissipated by the entry of additional firms¹⁵ and excess returns gained in the targeted industry may be offset (at least to some extent) by returns lost elsewhere, as a consequence of the higher price of domestic resources to buyer firms.

As to the pressure groups, effective interest group pressures may result in excessive or wrongly allocated government intervention. For example, protection of industries, originally meant to be temporary, may be continued under pressure of interest groups, even after its economic justification has disappeared (Yarbrough and Yarbrough 1988:249). Socio-political factors such as job creation may "cloud" allocation decisions (The Economist Feb. 24, 1990:71). Consequently, the welfare of small groups in society can be increased by large amounts, while costs are imposed on larger, more diffuse groups. (Krugman 1987:141; Grossman 1986:62-64)

Finally, a targeted industry cannot be seen in isolation from its international context. Industrial policies on behalf

of the European producers affect the Japanese and American semiconductor industry and may provoke governmental counteractions¹⁶. When retaliation occurs, each country can be left worse off than it was before the policies were implemented¹⁷ (Grossman 1986:62, 64-65; The Economist Feb. 24, 1990:71); Bhagwati, 1988:36; Krugman 1987:142; Yarbrough and Yarbrough 1988:249). In addition, EC semiconductor policies provoke reactions of individual firms that might offset all potential gains from the initial intervention. For example, is the European Community better off with foreign direct investment in semiconductors induced by the external tariff (Sharp 1988:243,244), than it would have been under free trade?

In sum, these criticisms arouse doubts concerning the validity and applicability of the strategic trade policy argument in real world. Based on the discussion, one might conclude that the potential net benefits from strategic trade policies are minimal or at least highly uncertain. In that case, there are grounds to believe that the EC policies of subsidies and protection of the semiconductor industry do impose a welfare cost on the European Community. This leads Krugman (1987:143) to conclude:

This is not the old argument that free trade is optimal because markets are efficient. Instead, it is a sadder but wiser argument for free trade as a rule of thumb in a world whose politics are as imperfect as its markets.

Thus, (unilateral) free trade, although based on unrealistic assumptions, is nevertheless the right policy according to the new international trade theory.

4.3 THE INCOME DISTRIBUTIONAL IMPACT OF TRADE POLICIES

Not only the distribution of welfare effects over consumers, producers and the government, as outlined above, but also the income distributional effects of EC policies for the factors operating in the European semiconductor industry (capital and labour) provide some crucial insights into the interests of workers and the owners of capital. As stated by Krugman and Obstfeld (1988:61), "groups that lose from trade are likely to lobby their governments to restrict trade and protect their incomes". This section focuses on the question what the income distributional effects of EC semiconductor policies are in both the short and long term.

The Specific Factor Model (Ethier 1988:203-205) predicts that in the short run, both capital (the specific factor¹⁸) and labour in the European semiconductor industry would gain from the imposition of a tariff on semiconductor products, the conclusion of a price agreement, or the subsidization of production.

The imposition of a tariff on semiconductors, for example, would raise the price of these products relative to other products in the European market. A rise in the

semiconductor price would proportionally increase the value of the marginal product of labour in semiconductor production (VMP_L). As a consequence, the semiconductor firm would hire new labour until the VMP_L equals the costs of hiring an additional worker¹⁹. Assuming that the total labour force is constant and that labour is mobile, the number of workers employed in the semiconductor industry would thus grow at the cost of the number of workers employed in other industries. At the same time, the nominal wage of labour would rise but not as much as the price of semiconductors did. Consequently, the real wage would decrease relative to the price of semiconductors, but increase relative to the unchanged price of other products. The return to capital, the immobile factor in the semiconductor industry, would increase in real terms since, due to the growth of the number of workers in the semiconductor industry, the fixed stock of semiconductor capital has more labour with which to work. The marginal product of capital in the semiconductor industry increases, and accordingly the price of capital rises relative to both the price of semiconductors as well as other products. Since the labour/capital ratio in other industries would become smaller, the price of capital in other industries would decline in real terms. In the semiconductor industry, therefore, both capital and labour gain in the short run from the imposition of a tariff.

In the longer term, however, both capital and labour are

mobile. In that case, the Stolper-Samuelson theorem could give insight in the income distributional effects of EC policies. Applying the Stolper-Samuelson theorem to the EC semiconductor case, the rise in the relative price of semiconductors (for example, due to the imposition of a tariff) would raise the price of the factor used intensively in the production (namely capital) relative to the price of both semiconductors and other, labour-intensive goods. The real income of capital would thus increase. In contrast, the rise in the relative price of semiconductors would bring about a real reduction in income of the factor used intensively in the production of other goods, namely labour.

While in the short run, the interests of capital-owners and workers in trade restricting policies thus coincide, in the long term these interests therefore diverge.

4.4 CONCLUSIONS

Both the traditional and new liberal economic ideologies advocate "free trade" as the optimum strategy for small actors in world markets, such as the European Community with regard to semiconductors. Since policies of protection and financial support impose a welfare cost on the Community, economic liberals regard the EC policies thus as inferior to free trade. In spite of these costs, and thus in spite of what economic liberals argue and predict, the European Community

has opted for protection and financial support. This triggers the question as to why the Community did so. Why did the European Community select policies that each standard economic textbook would reject on the basis of the associated welfare costs? What political economy factors underlay the European policy choice?

In this chapter, some insights have been obtained with respect to the latter question. We may assume that actors that gain from trade restriction are likely to lobby for government intervention. This chapter showed that the welfare distributional effects of EC semiconductor policies are to the benefit of semiconductor producers but detrimental to semiconductor consuming firms. Semiconductor producers are thus likely to lobby for governmental support and protection and semiconductor consumers to lobby against such measures. The income distributional effects of EC policies are such that in the short run both labour and capital-owners gain from protection, while in the long run only capital-owners benefit. In the short run, EC policies are thus likely to be supported by both labour and capital-owners, while in the long run only the capital-owners are expected to lobby for government intervention. The following chapter incorporates the interest-shaping impact of welfare and income distributional effects of EC policies into a broader explanatory framework for the European semiconductor policy response.

ENDNOTES

1. Note that the authors cited in the following two sections are not necessarily advocates of the ideologies discussed because in the various cases reference books on international political economy ideologies were used such as Frieden, J.A and D.A. Lake (1987) International Political Economy: Perspectives on Global Power and Wealth, Gilpin, R. (1987) The Political Economy of International Relations, and McKinlay, R.D. and Little (1986) Global Problems and World Order.

2. Traditional comparative advantage is based on factor endowments, demand patterns and assumed constant technology levels.

3. Consumers' surplus is defined as the value of the satisfaction received from consumption of a good over and above the amount consumers must pay to obtain it. Graphically, the consumer surplus is represented as the area under the demand curve and above the good's effective price (Yarbrough and Yarbrough 1988:186,187).

4. Producers' surplus is defined as the revenue received by producers over and above the minimum revenue required to induce producers to supply the good. Graphically, the producers' surplus is represented as the area above the supply curve and below the good's market price (Yarbrough and Yarbrough 1988:186,187).

5. "Common" welfare is defined as the standard of living of the European Community as a whole, which is greater than the sum of the welfare of the individual member states. The argument runs as follows: regional integration allows member states to specialize according to their comparative advantage. The resulting higher level of efficiency generates a (net) gain in welfare to the Community as a whole. Individual countries may, however, lose. In line with compensatory liberal theory (McKinlay and Little, 1986: 107), it is assumed that, under pressure by these states, the countries will be compensated for their losses. In other words, not only efficiency, but also equity, objectives guide EC policies.

6. That is, the price of the product when it enters the Community.

7. The reason is that the ESPRIT and JESSI subsidies aim at research cooperation efforts between groups of companies where results are only available to the participants and not to the semiconductor industry in general. The research outcomes are thus appropriated by the participating firms.

8. The new case for free trade can be seen as a response to the new developments in international trade and the failure of the traditional theories to explain these new trends and to take account of these developments in their policy "prescriptions". See, for example, Krugman (1987) and Richardson (in The Economist, June 24, 1989).

9. Engineered comparative advantage is based on product differentiation, economies of scale and/or rapidly changing technology.

10. In that respect it is interesting to note the outcomes of empirical studies on trade liberalization with imperfect competition, such as performed by Richardson for the OECD (The Economist June 24, 1989). Richardson (1989) concludes that the effects of free trade under imperfect competition yield gains that usually outweigh the losses (the surrender of profits to foreigners).

11. The reaction curve of a firm in a duopolistic market shows what the best strategy for that firm is, for each conceivable strategy of its rival (Ethier 1988:55).

12. Point S is defined by the tangency point of the profit curve of firm H (π_H) to R_F .

13. For example, protection of semiconductors may benefit in-house producers, but may simultaneously harm semiconductor consumers due to the higher price of the devices.

14. For example, labour may capture rents if the labour unions successfully press for higher wages.

15. This is the case when the market can actually support four or five firms instead of only one (Krugman 1987:140).

16. In contrast to the average "small actor", the European semiconductor industry is able to impose a "credible threat" if it is supported by the European Community. However, its opponents (Japan, USA) have at least equal economic and political leverage. Strategic trade policies that seek to confer domestic gains at the expense of trade partners may therefore provoke foreign retaliation.

17. Beggar-thy-neighbour game.

18. Specific factors are those that cannot be transferred from one industry to another; they are suitable for a specific use (Ethier 1988:128).

19. The value of the marginal product of labour in the semiconductor industry is the amount by which any semiconductor producer can increase its revenue by hiring an additional worker. As long as that amount exceeds the cost of hiring that worker (the wage) the firm will do so.

CHAPTER V

EXPLAINING POLICY CHOICES: THE IIII-APPROACH

This chapter outlines an explanatory framework for analysis of economic policy choices in general, and the European semiconductor policy response in particular. Through applying this framework to the European semiconductor case, insight may be obtained into the political economy factors underlying the EC policy response to import penetration and foreign direct investment in the European semiconductor industry.

Explanatory frameworks of economic policy choices vary according to their underlying perspective on political economy. The selection of a perspective affects one's choice of determinants of state action, perception of the role and the nature of these determinants, and vision of the interaction among these determinants. As illustrated by Hall (1986:5): "Several important lines of analysis have been developed to explain national economic policies, and each of them contains an implicit model of the polity."

This thesis argues, in line with Cohen (1990:269), that a framework explaining economic policy choices should consider both domestic and system-level variables simultaneously. The domestic-level variables identified for purposes of analysis in this thesis are Ideology (I_1), Interests (I_2) and Institutions (I_3), while the International System (I_4) refers to system-level variables. These four interacting variables should be seen as the independent variables explaining EC policy choices in the EC semiconductor case (although

government policies in their turn may affect the four variables noted). Figure 5.1 gives an overview of how these variables may be related.

In the following chapter, the roles of Ideology, Interests, Institutions, and the International System in the decision-making process are discussed in both general terms, as well as in terms specific to the EC semiconductor case.

5.1 IDEOLOGY

The policy response of the European Community may be explained in terms of "ideas" and "examples". Ideas (or ideologies) are defined as "systems of thought and belief by which [decision-makers] explain how their social system operates", and from which decision-makers derive a course of economic and political action (Gilpin 1987:25; Hall 1986:19,278). By shaping the understanding of decision-makers of the economic and political reality in which they operate and by "guiding" their actions, ideologies influence economic policy choices.

Ideologies can be used to justify interests (Bhagwati 1988:70; Cohen 1990:268¹); they legitimate the objectives pursued and the actions undertaken by domestic (and foreign) governmental and non-governmental actors (see figure 5.1). In turn, interests reinforce ideas (Bhagwati 1988:18). As illustrated by Goldstein (1989:71) in her analysis of the

Figure 5.1 IIII-Determinants of Policy Choices

impact on policy change of new political coalitions and the ideas they carry: "Ideas influence policy only when they are carried out by individuals or groups with political clout." In addition, Goldstein (1989:71) points to the constraints that political structures² impose on the alternative ideas that new coalitions successfully can implement. New ideas have to "fit" into the existing structures. Only in times of crisis, the structural environment becomes less constraining.

Learning about the past or of other countries' experiences affects economic policy choices too. These "examples" shape economic postures through their demonstration effect (Bhagwati 1988:17,20-37). Moreover, successful experiences establish the legitimacy of a policy: "policies become institutionalized because they work" (Goldstein 1989:71).

Focusing on the EC semiconductor case, what ideas and what examples have influenced the European semiconductor policy response? Since the government policies that are central to this thesis were directed towards the semiconductor industry and the government thus intervened in economic operations, the economic variants of three major International Political Economy perspectives³ might have been seen as determining the EC policy choice. However, as has been shown in the previous chapter, economic liberalism apparently had little impact on the EC semiconductor policy choice. Nor is it likely that Marxism and related ideologies have influenced

the policy formulation, since in none of the European countries, Marxists or advocates of related political ideologies were part of the mainstream political scene⁴. The following section therefore focuses on the economic argument derived from realism, namely the economic nationalist argument in favour of government intervention in the semiconductor industry⁵.

5.1.1. The Economic Nationalist Argument in Favour of Government Intervention

In contrast to economic liberalism, economic nationalists such as Cohen and Zysman (1987), raise questions about the case for free trade in imperfect markets. Economic nationalists accept the concept of an anarchical international system in which states seek to maximize their national interest to safeguard their security and to ensure their survival. Since a gain for one state will be at the expense of another (zero sum game), international relations are inevitably conflictual. Consequently, the nature of the international system is such that primacy should be put on the state and its interests. Economic nationalists, therefore, regard comprehensive government intervention to strengthen the state and its interests as justified.

Gilpin (1987:32) describes the national interests in terms of two inextricably linked ends, namely wealth and power. With respect to the importance of the interest in power

relative to the interest in wealth, and the relation and interaction of these ends, economic nationalists perceive wealth as an essential means to power and power as an essential means to wealth. A long run harmony is assumed to exist between these objectives of national policy, although in some particular circumstances it may be necessary to make temporary economic sacrifices in the interest of military security [or other non-economic ends] and therefore also of long run prosperity (quoted in Viner 1987:72).

Nationalists emphasize the importance of a national industrial base, and in particular basic industries (steel, etc.) and high tech industries, for the following economic and non-economic reasons (Shull 1986:37; Dosi 1983:223; Gilpin 1987:33):

1. Manufacturing yields major externalities and linkages which benefit the economy as a whole;
2. Manufacturing is the basis of military power, and thus central to national security. Linked to this proposition is the importance of the national industrial base for economic and technological self-sufficiency, and political autonomy;
3. Manufacturing, and in particular high technology industries such as the semiconductor industry, contribute to national prestige.

The national industrial base and, more specifically, certain key industries, are regarded as vital to the overall

development of the economy. The main reason for their importance is the linkages, such as the generation of employment in other sectors of the economy (Cohen and Zysman 1987:3-28), and the generation of externalities, including basic technological skills and innovations whose applicability goes beyond the scope of the sector of origin (Chaikin 1985:170).

The semiconductor industry is deemed "strategic" in this respect. There exists a synergy between technological progress in microelectronics and technological development in industries in which microelectronic devices are used as inputs, such as the telecommunications and computer industry. A loss of production capability, a lag in technology, or a flight into the niches of the market, often caused by loss in competitiveness, could undermine the "success" of these downstream producers (Dosi 1983:223)⁶.

A relatively weak position of the semiconductor industry would be aggravated by the fact that technological progress in microelectronics is embedded in existing production technology, i.e. the successive generations of semiconductors are linked. Missing a generation, by either stepping out of production, lagging behind in technological development or by excessive specialization, could limit the industry's future prospects.

Evidence⁷ shows that firms, which have sufficient financial resources, may return to semiconductor production

after having missed one generation; as outlined in section 2.1, the design and basic technology of manufacturing involved in a new generation of chips are relatively easy to acquire (Baldwin and Krugman 1988:176). However, by missing one generation, firms also risk losing the specific knowledge associated with production (Conklin and St. Hilaire 1988:xviii). Since this type of knowledge is relatively hard to acquire (see section 2.1.2), these firms may lose valuable time and money "learning". As a consequence, these firms are likely to be relatively slow in commercializing the basic technology, and are thus not as able as the "first movers" to earn the profits that are necessary for developing the following generation of devices (see section 2.1.2). In the eyes of economic nationalists, government intervention in the national semiconductor industry is thus justified on the basis of the recognition that inadequate national production could lead to a decline in domestic economic growth (Welfens 1987:168).

The level of development of the industrial base and changes therein, are considered by economic nationalists as determinants of military power⁸. The termination of industrial production or operation at inadequate levels (Srinivasan 1987:337), often caused by loss in competitiveness, could increase reliance on foreign producers (Moran 1990:5). Therefore, nationalists attach great importance to the viability of certain key national industries such as

electronics (Intriligator 1987:360). Nationalists also emphasize the need to have stockpiles of certain critical materials, minerals or other items. The absence or inadequacy of availability of national industries that extract and produce these items could, again, increase dependence on foreign sources of supply (Kostecki 1989:19). The latter would be especially important if the critical items were classified by the foreign supplier as "sensitive"⁹ and/or the foreign supplier was perceived as an opponent (Intriligator 1987:366). In addition, nationalists stress the need to have access to advanced technology, partly for military purposes (Intriligator 1987:366; Kostecki 1989:19). An inadequate national capability in high technology production could therefore increase the reliance on foreign sources of technology.

The reliance of the state on foreign suppliers increases the threat of manipulation by foreign governments (Moran 1990:5), and thus the potential loss of political sovereignty. In other words, closely related to the concept of national defense is the issue of economic and technological self-sufficiency, i.e. the need for a national production and technology-generating capability.

The semiconductor industry is perceived as "strategic" in this respect. Not only are semiconductors used as components for military purposes¹⁰, but also the semiconductor industry "produces" advanced technology (Dosi 1983:223; Udis

1987:143). Economic nationalists thus argue that government intervention to promote and protect the national semiconductor industry is justified for national security considerations¹¹. It is argued that inadequate national production could endanger national safety, while the protection and promotion of the industry fosters these non-economic interests.

Considering the point that industry and in particular high tech industry may contribute to national prestige (Shull 1986:37; Dosi 1983:223), economic nationalists argue that the possession of a national semiconductor capability increases a country's prestige since it seems to imply that the country through its technological capabilities belongs to the most advanced countries.

On the basis of the economic and non-economic reasons discussed above, nationalists consider a national industrial base as indispensable. As outlined above, importation of the key manufactured products is unacceptable from an economic, political, military and prestige point of view. Furthermore, according to economic nationalists, domestic production through foreign direct investment can hardly be considered a better solution. Admittedly, foreign direct investment has the advantage that the foreign companies that a country depends upon, and the technology it needs are situated within the sovereign jurisdiction of the home state. For example, as Flamm (1990:288) explains, the manufacturing of a complete product within Community borders, as stimulated by the changed

rules of origin and the lower tariff for wafers, would give the Community more control:

It makes it more difficult for foreign-based companies to coordinate their actions since it is much easier to observe what is going on inside those factories [...and...] national security concerns are eased. If [...] one nation might simply withhold vital chips to exert leverage on another region's foreign policy, the militia can be called in to occupy the local factory.

However, domestic production does not rule out foreign interference. Foreign governments may, for example, place extraterritorial constraints on the activities of these foreign-owned subsidiaries (Moran 1990:8,9).

Due to the particular importance attached to a national industrial base, economic nationalists support and justify industrial policies seeking to protect and improve this industrial base. This is especially the case when the industrial base is threatened due to, for example, loss in competitiveness.

Economic nationalists argue that government intervention to promote and protect the national industrial base should focus on the following priorities¹²:

1. The promotion of industrial adjustment in case of loss of international competitiveness. This concerns both managing decline as well as managing expansion.
2. The prevention of loss of international competitiveness of economic and politically "strategic" industries, caused by causes inherent to the market and/or foreign industrial policies.

3. The promotion of industries that are economically and politically desirable: high rents, high externalities, prestigious, etc.

Instruments include policies aimed directly at altering trade and investment flows; both import penetration as well as Foreign Direct Investment (FDI) are disliked. Other policy instruments include policies to encourage particular industries (such as the semiconductor industry), or particular activities (such as R&D).

Moran (1990:14) also stresses the importance of diversification and multiplication of suppliers, as long as the upstream industry is characterized by an oligopolist or monopolist structure. In this context, Moran (1990:6,14) argues that the threat of foreign control is a function of the degree of external concentration in the industries upon which the defense effort depends; even a national capability provides no protection against foreign manipulation when monopoly or oligopoly concentration in the upstream industry allows foreign governments to dictate how the firms must operate.

Implicitly, the economic nationalist perspective assumes that government policies are effective in playing a positive role in industrial development. In that respect, the Japanese "example" has played an important role. The success of Japanese government intervention in certain industries in the 1970s set a precedent for government intervention in general,

and for methods of intervention in particular (stimulation of interfirm cooperation, funding basic R&D, etc.) (Lauber 1986:37).

The economic nationalist argument in favour of government intervention, which could justify all policies employed by the European Community on behalf of the European semiconductor industry, is, however, subject to criticism.

The main argument against government intervention follows from the assumption of complementarity of wealth and power. Kennedy (1987:539) argues that ideally complementarity of these ends may exist, but that in reality the pursuit of power and wealth should be seen as a trade-off¹³. The expenditures on behalf of non-economic objectives (autonomy, national security, prestige, etc.) decrease the vulnerability of a state to the actions of other states. Yet, keeping such expenses often burdens the national economy¹⁴. National production may relieve the threats associated with dependency on foreign sources of supply. However, national production may also impose a cost on society in terms of higher costs, lower output, delayed deployment and unacceptable quality. Additionally, national firms may pursue their own interests rather than those of the national government.

Furthermore, government intervention, justified on the basis of economic and non-economic reasons, is not necessarily sufficient to bring about a national industrial base. As Gilpin (1987:49) indicates: "A strong and interventionist

state does not guarantee economic development; indeed, it might retard it." In this context, it is important to note that the Japanese record on targeting is mixed at best (Brander 1987:35). Tyson (1987:69) argues, in contrast, that Japanese intervention has had an enduring effect in the semiconductor industry. Yamamura (in Krugman 1986:201) also recognizes the impact of MITI on the evolution of the Japanese semiconductor industry. In his conclusion, however, Yamamura adopts a middle course: "My view on Japanese industrial policy is that it has been more effective than many economists would admit but substantially less so than maintained by the Americans urging adoption of industrial policy à la Japanese."

Finally, under conditions of secured supply, it may well be that the net benefits of imported, cheap supply outweigh the net benefits of a domestic capability as is argued by Starbatty and Vetterlein (1988:115). This notion refers to questions concerning the existence and size of externalities, and the costs of government intervention.

Nevertheless, the economic nationalist argument in favour of government intervention may have influenced the EC policy response to foreign direct investment and import penetration in the European semiconductor industry. Economic nationalist ideas may have not only have justified government intervention in the European industry, but also have made intervention crucial. In addition to this cognitive explanation of economic policy choices, other explanations also exist. Economic policy

choices, such as the European semiconductor response to import penetration and foreign direct investment, may be explained by interests and institutions, constituting together the so-called (domestic) "unit level analysis"¹⁵, and by the international system. Interests, Institutions and the International System are discussed in the following sections.

5.2 INTERESTS

The European policy response to the situation in the European semiconductor industry may be explained by the influence of interests of domestic non-governmental actors (see figure 5.1). Domestic non-governmental actors are made up of societal actors and their representative associations. Societal actors include non-organized, non-governmental actors, such as business, labour, etc. It is assumed that societal actors act in accordance with their self-interest. Under this approach an actor favours or opposes a particular economic policy depending on whether the policy contributes to or harms the actor's interests¹⁶.

Interests are shaped by both "economics" as well as "politics" (Bhagwati 1988:17,18,37-40; Gourevitch 1987:54,55). "Economics" refers to the (domestic and international) economic situation that the societal actors face; for example, pressures for protectionism might increase significantly with economic distress (Bhagwati 1988:38). Economic conditions also

include the welfare and income impacts of policies on the individual actors; the interests of societal actors are affected by whether they gain or lose from the policies chosen (see Chapter IV). "Politics" refers to non-economic conditions, such as the international political-military setting. For example, demands for policies contributing to economic self-sufficiency might grow with increased political rivalries.

Interests are not only affected by the shaping force of the political and economic conditions facing the societal actors but also by the political and economic organizations within which the actors operate (Hall 1986:233). Economically, this latter notion implies that the organizational arrangement of production matters for the shaping of interests. Milner (1987), for example, finds that, in contrast to domestically oriented firms, companies with international linkages (exporting and importing, producing in various countries, trading on an intrafirm basis) have little interest in protectionism even in times of severe economic distress. Politically, this implies that the way actors are organized and represented by intermediate associations matters. For example, the representation of both semiconductor producers and consumers in one employers' association might affect their posture towards economic policy.

Representative (or intermediate) associations, such as labour unions, employers' organizations, consumers'

of/de

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MICROCOPY RESOLUTION TEST CHART
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STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No. 2)

associations and political parties are organizations designed to link the interests of societal actors to the government. These associations constrain and enable the pursuit of interests by societal actors in two ways. First, the organization of structures within which particular interests are brought forward determines the facility with which the interests can be articulated and the force with which they can be expressed (Hall 1986:232-233). However, the political clout of societal actors is determined by more than their organization. Other determining factors (as illustrated here for industry) are size, concentration, number of employees and geographical spread (Milner 1988:259). Second, societal interests are channelled through these associations to the EC level. The aggregation of these interests affects the nature of the preferences. As stated by Hall (1986:233): "Organization does more than transmit the preferences of particular groups; it combines and ultimately alters them."

Moreover, intermediate associations express interests independent of societal demands. The autonomous interests may derive merely from the fact that the intermediate associations "exist" : "...[intermediate associations] acquire, in mediating the preferences of societal actors, their own identity; their own existence, interests, perspectives and concerns" (Gourevitch 1986:60). Thus, not only do intermediate organizations impact on policy choices through channelling the interests of societal actors, also they affect decision-making

through the expression of their own, autonomous interests.

Focusing on the EC semiconductor case, then, what domestic non-governmental actors may have affected the European policy choice? The following listing of actors, based on the author's empirical research, appear to possibly have influenced EC policy choices: suppliers to semiconductor manufacturers, semiconductor producers, semiconductor consumers, industrial fora for discussion and policy formulation (the so-called "groups" or "round tables" of the larger European firms), manufacturers' associations that represent semiconductor producers, labour, share-holders, political parties and taxpayers.

Suppliers of inputs to semiconductor manufacturers, labour, taxpayers and political parties will be largely ignored in this study. Suppliers of inputs to the European semiconductor industry may be interested in the preservation of this industry as a consumer of their products. For example, silicon suppliers may have an interest in the continued existence of the European semiconductor industry since this industry consumes silicon. However, it seems that the impact of silicon suppliers on EC decision-making in the 1980s was limited. A potential explanation is that the suppliers' interest in a viable Community semiconductor industry was marginal; the fate of the European semiconductor industry was of little importance to the silicon suppliers due to its small size. Another explanation is that silicon suppliers had only

little "political clout" to impact on EC policy choices due to the abundance of silicon.

Labour is related to the EC semiconductor case through its interest in the preservation and growth of employment and the level of wages. As has been shown by the labour response to the recent lay-offs at Philips, unions are vocal in representing the interests of labour¹⁷. However, while in the 1970s trade unions were involved in policy decisions, their impact on policy outcomes has gradually declined. The prime reason is that under the economic conditions of lack of, or very limited, growth which characterized Europe in the early 1980s, the political power of labour and its representatives was limited.

Taxpayers are related to the EC semiconductor case through their (indirect) financial contributions for EC policy intervention. However, it seems that their impact was limited for the following reasons: taxpayers were not organized and proved incapable of standing effectively for their interests. Their lack of organization was partly due to the method of payment (indirect), and partly due to the fact that the costs of intervention on behalf of the semiconductor industry were spread over a large number of taxpayers, resulting in a relatively small individual burden. This thesis focuses instead on the impact of semiconductor producers (and their share-holders), consuming firms, and intermediate associations on the EC decision-making process.

European political parties seem to have had little impact on EC decision-making. This is not surprising considering the limited say of the European Parliament in the EC decision-making process, particularly prior to the Single European Act.

5.3 INSTITUTIONS

The European policy response may also be explained by the role of institutions in the decision-making process (see figure 5.1). "Institutions" refer in this paper solely to domestic governmental actors. Institutions provide the mechanisms and the momentum interests need to influence policy (Bhagwati 1988:4). Institutions mould the behaviour and preferences of societal actors through their rules, norms and regulations. Institutions shape the organizations through which societal actors channel their interests. In the process of channelling (Hall 1985:232,233) and aggregation (Gourevitch 1986:61,62) of interests, institutions also alter preferences.

Institutions not only affect interests but also express preferences themselves. On the one hand, the interests of institutions may take the form of the specific pursuits of certain groups within the governmental organizations, such as the bureaucracy and politicians. Their interests may include, respectively, the strive for budget maximization to increase power and prestige and secure employment (Boadway and Wildasin 1984:158), and the need to secure re-election (Hall 1986:273).

It is assumed that politicians and bureaucrats act in accordance with these interests¹⁸. On the other hand, the interests of institutions may take the form of preferences that go beyond the sum of the interests of parts within the structure.

Institutional actors thus have an impact on the outcomes of decision-making processes, on the one hand through influencing those interests which are channelled through their institutions (societal interests), and on the other hand through exercising interests.

Focusing on the EC semiconductor case, what domestic institutional actors may have affected the European policy choice and how? In the EC semiconductor case two institutions could be discerned: the national and EC governments (two-tiers governmental system) (see figure 5.1). National governments channelled and aggregated societal interests and exercise national interests, whether truly national or specific. The preferences expressed by a national government with respect to EC policy issues, to be called "member state" interests, thus reflected both societal and national interests. The European Community, in its turn, channelled societal and member state interests and exercised European interests, whether truly European or particular.

5.4 INTERNATIONAL SYSTEM

Finally, the European policy response to import penetration may be explained through the international system explanation: what constraints and incentives for government behaviour were derived from the broader structure of the external environment? (Cohen 1990:268) (see figure 5.1). It is argued that the nature of the system and the position of the decision maker within the system are essential to policy outcomes (Frieden and Lake 1987:12-14).

In this paper, the international system is defined as the framework in which both institutions (national and supra-national) and non-governmental (domestic and foreign) actors operate. Countries are perceived to pursue their own interest. The primacy of a nation's "own" interest vis-à-vis other actors' interests creates the so-called "prisoners' dilemma". Although it would be beneficial for all actors involved if no country intervened, each country alone is better off intervening than being the only country not to intervene. Repeated games of the Prisoners' dilemma type, performed by Axelrod¹⁹, point to the value of a "tit-for-tat" approach: in the subsidy and protection game, any actor should subsidize if other countries support their industries; any actor should protect if other countries erect barriers to imports; any actor should opt for free trade, if other actors do so, etc. (Harris 1985:122; Brander 1986:39,40). According to Milner

(1987), for example, multinational enterprises may only request protection for home markets if foreign markets are protected as well.

International organizations, rules and agreements try to regulate these relations. These rules and agreements help contain conflict and promote cooperation (Cohen 1990:278). Non-governmental actors (multinational enterprises in particular) can either comply with or undermine governmental strategies, depending on whether these policies are in accordance with their own interests or not²⁰.

In addition to the nature of the system discussed above, the position of the decision-maker in this system is considered crucial to policy outcomes. The position of the decision-maker, in turn, is determined by the relative size of the actors and consequently any asymmetry in relations that may result from the differences in size (Cohen 1990:276; Harris 1985:123). What is the political and economic leverage of the various actors playing the game? Do domestic actors have to consider external conditions as "given", or are they able to affect these conditions?

The international system affects economic policy choices through the impact that it has on domestic actors (Gourevitch 1986:65). As is illustrated by Milner (1988:292): "The consequences of interdependence are internal to states: they affect domestic societal actors' policy preferences, not states' policy instruments." These pressures include both

international political and economic conditions, as well as the more particularistic pressures imposed by external actors such as foreign governments, foreign multinational enterprises, and international organizations.

Focusing on the EC semiconductor case, what may have been the impact of the international system? Two factors can be discerned to guide the analysis of the impact of the international system on the EC policy response, namely the nature of the international system incorporating foreign firms, governments and international organizations such as the GATT, and the relations of these external actors vis-à-vis domestic actors.

5.5 CONCLUSIONS

The European policy response to import penetration and foreign direct investment in the European semiconductor industry can be explained by four interrelated variables, namely Ideology (I_1), Interests (I_2), Institutions (I_3), and the International System (I_4) (summarized here as the IIII-approach).

Ideology refers to the ideas and examples that may have influenced the European policy response. The economic nationalist argument in favour of government intervention, which probably has impacted on the EC decision-making, was discussed. It was also assumed that ideas and examples justify

the interests of domestic and foreign societal and institutional actors. These actors, in their turn, reinforce ideas (see figure 5.1).

Interests refer to the non-governmental actors that may have impacted on European policy formulation, either directly or indirectly through national governments and/or intermediate organizations. The thesis focuses on semiconductor producers, semiconductor consumers and their respective representative associations as interest groups. The assumption was made that the interests of these groups are shaped and reinforced by the economic and political conditions that these groups face, their economic and political organization, and their political clout (see figure 5.1).

Institutions refer to the impact of the two-tiers European government system. Their impact on policy choices is of two-fold. First, it was assumed that the Community and the national governments alter the interests that are channelled through their institutions, and second, that the Community and the national governments express respectively European and national interests (see figure 5.1).

The International System refers to the impact of the international context in which the European Community operates on policy choices. It was assumed that both the nature of the system as well as the position of the decision-maker within the system would affect policies through their impact on domestic variables (see figure 5.1).

The policy outcome that results, the EC policy response, impacts, in its turn, the four variables described above, thus initiating the cycle as shown in figure 5.1 once again. The EC semiconductor policies, as have been described in Chapter III, should be seen as the dependent variable in the semiconductor case which these four "I" variables, as independent factors, try to explain. Using the IIII-framework, the following chapter will explain the EC policy response to import penetration and foreign direct investment in the semiconductor industry.

ENDNOTES

1. Cohen (1990:268) describes the level of analysis which focuses on the legitimizing base of consensual knowledge or economic culture in order to explain and analyze policy choices, the cognitive level of analysis.

2. Goldstein (1989) defines the "structural environment" in terms of many immutable parts: the separation of powers, the level of penetration by powerful societal groups, the re-election cycle, etc.

3. The distinction between three main International Political Economy approaches, namely liberalism, economic nationalism and marxism, is based on Gilpin (1987:25-64).

4. Even in countries like Italy and France where the Communists do have relatively more political power, the impact of Marxist and related ideologies are limited. These political parties do not necessarily act according to Marxist ideas as their names might suggest.

5. Note that the authors cited in the following section are not necessarily advocates of the ideology discussed because in the various cases reference books on international political economy ideologies were used such as Frieden, J.A and D.A. Lake (1987) International Political Economy: Perspectives on Global Power and Wealth, Gilpin, R. (1987) The Political Economy of International Relations, and McKinlay, R.D. and Little (1986) Global Problems and World Order.

6. "Understanding components is vital for designing the boxes into which they are slotted. Many Europeans echo American fears that, without the capacity to make semiconductors, such understanding will be lost" (The Economist, Aug. 6, 1988:54).

7. For example: Intel.

8. This is in line with Kennedy (1987: 43), who concludes that: "[...] all major shifts in the world's military power balances have followed alterations in the productive balances".

9. "Sensitive" implies that the item could be used for military purposes.

10. The "defense industry" used to be one of the largest consumers of semiconductors (see Chapter II).

11. This is illustrated, for example, in the Fairchild case. In 1986, Schlumberger announced it would sell 80% of Fairchild to Fujitsu Ltd, Japan's largest computer company. The deal was opposed by American companies and by the US government, the latter on the basis of security considerations (New York Times Sept.1 1987:D1).

12. Sources used: Geroski 1987:59; Kostecki 1989:19; Lipsey 1987:121-24; Brander 1987:33; Lawrence 1987:60; Intriligator 1987:366; and Tyson 1987:71.

13. This proposition is in line with liberal theorists (Gilpin 1987:32).

14. Kennedy (1987:539) illustrates this in the case of military expenditures: "War or the very possibility of war makes the establishment of a manufacturing power an indispensable requirement for a nation of the first rank. Yet by going to war, or by devoting a large share of the nation's manufacturing power to expenditures upon "unproductive" armaments, one runs the risk of eroding the national economic base, especially vis-à-vis states which are concentrating a greater share of their income upon productive investment for long term growth."

15. "[The unit level analysis focuses] on the strategic interactions among all domestic actors, inside or outside the government, with actual or potential influence on a state's foreign actions - in short, the political and institutional basis at home for economic policy preferences abroad" (Cohen 1990:268).

16. This assumption is a broader interpretation of Baldwin's (1989:2) economic self-interest approach, under which an actor favours or opposes a particular trade policy depending on whether the policy increases or decreases the actor's real income.

17. Labour unions from nine European countries stated that there should be no forced lay-offs. Internationally, the unions would make their presence felt in the interest of the employees of Philips (NRC Handelsblad July 3, 1990:11).

18. This is in line with the "voting" models such as the Bowen-Black majority voting model, the Roman-Rosenthal model and the Downs model (Boadway and Wildasin 1984:139-169).

19. In Brander 1986:39,40.

20. Multinational enterprises are understood in this thesis to have no particular loyalty to any national government. They act according to what is most advantageous to them, not to what national governments would like them to do.

CHAPTER VI

EXPLAINING THE EC SEMICONDUCTOR POLICY RESPONSE

During the DRAM anti-dumping investigation, DRAM consumers such as the Community computer industry argued that no measures should be taken, given the protection already afforded to the Community DRAM producing industry by high customs tariffs. Additional protective measures, leading to even higher DRAM prices, would further hamper the competitiveness of the DRAM consuming industry. Moreover, the opponents of protective measures in the DRAM anti-dumping case argued that the costs of such measures to consumers would outweigh the benefits to producers (OJ L20/23 of January 25, 1990). In spite of such costs to the DRAM consumers, the Community opted for protection of the Community DRAM producers. This triggers the question as to why the Community did so.

This question not only applies to the DRAM anti-dumping case, but also to other EC policies on semiconductors. To reformulate the question in more general terms: why did the Community opt for protection and financial support of the semiconductor industry (as we have seen in Chapter III), when these policies would (at least in theory) impose welfare costs on the European Community (see Chapter IV)? This chapter attempts to explain the EC policy response to import penetration and foreign direct investment in the semiconductor industry. By using the IIII-framework, developed in the Chapter V, this chapter seeks to answer the second research question of this thesis, namely what political economy factors

underlay the chosen EC policy response in the 1980s. Thereto, the four "I" variables will be discussed in the context of the EC semiconductor case. Figure 6.1 gives an overview of how Ideology, Interests, Institutions, and the International System variables impact on the EC decision-making in this case.

6.1 IDEOLOGY

In Chapter V, it was argued that ideologies and examples justify interests; ideas and precedents legitimate the objectives pursued and actions undertaken by firms, national governments, and the European Community¹. Through analysis of the arguments that firms, national and European institutions employ to justify their policy choice, insight may be obtained in the ideas and examples that affected these responses. It was expected that the economic nationalist ideology, in particular, might have played an important role.

The large European electronics firms, which produce semiconductors, emphasized the importance of an in-house semiconductor capability to avoid becoming dependent on foreign (i.e. Japanese and American) suppliers, in contrast to purely semiconductor consuming firms who argued that they would benefit more from free trade in semiconductors². The large electronics firms argued that dependence would hinder their economic growth, since semiconductor technology and

Figure 6.1 IIII-Determinants of Policy Choices
in the EC Semiconductor Case

knowledge feed into other high tech operations, and costs of inputs affect the prices of the final products. Dependency on outside suppliers of semiconductors could threaten their competitiveness in downstream activities. In the second part of the 1980s the dependency problem became acute due to the concentration of market power in the hands of a few Japanese suppliers of "commodity" semiconductors. According to Flamm (1990:257-260), the exercise of monopoly power by these Japanese producers (for example in the form of restrictions on supply and production capacity) led, along with other factors such as the recovery in demand, to higher DRAM prices. Higher prices increased the profitability of the Japanese DRAM suppliers, while decreasing those of European semiconductor consumers³. Additionally, dependence on foreign suppliers was perceived as undermining the ability of European firms to obtain military contracts.⁴

Thomson, for example, regarded dependence on US components as unsatisfactory due to its close links with the French military⁵. Siemens argued that DRAM technology was the key to being competitive in most other kinds of chips that go into the variety of products the company sells, and should therefore be produced by the company itself⁶. Philips emphasized during the 1980s the strategic importance of keeping the computer, consumer electronics, and component division together, although recently, "forced" by financial difficulties, the firm decided to halt production of a key

computer chip (NRC Handelsblad June 30, 1990:17; Financial Times, Sept. 5, 1990:7).

For these economic reasons, the large European electronics companies justified the continuation of divisions that were often suffering heavy losses, and pointed to the necessity of government support at both national and EC level.

National governments argued that a domestic semiconductor production capability served economic and/or national security purposes. A competitive domestic semiconductor industry was seen as a precondition for healthy national economic growth, and, in particular in the countries with a major defense interest, namely France and the United Kingdom, essential for military purposes (Dosi 1983; van Tulder and Junne 1988; Borrus 1988; Malerba 1985; Langlois et al. 1988). The United Kingdom, for example, established INMOS on the grounds that an indigenous standard chip producer would have important spinoff effects for the whole British electronics industry (van Tulder and Junne, 1988:35). The Netherlands subsidized its semiconductor industry on the basis that technological progress in the semiconductor industry was an important source of economic growth; by strengthening the country's technological base, the government would contribute toward sustained economic growth and thriving social development (Tweede Kamer van de Staten Generaal 1989-1990).

For these reasons, member state governments justified the

large subsidies channelled to the domestic semiconductor industry. The national governments also supported EC semiconductor programs, although their autonomy might be compromised. The reason was that there was more to be gained than lost from collaboration; through European programs national objectives could be reached (see 3.2).

The European Community considered a "European" capability in semiconductors to be vital. From an economic perspective, the Community argued that, because semiconductors are technology drivers, a loss of production capability in semiconductors would hinder the development of future generations of devices, and thus seal the fate of the European semiconductor industry. Furthermore, as semiconductors are increasingly used as key components in downstream sectors, developments in the semiconductor industry would not only affect the industry itself but also semiconductor consumers. Loss of capability would hamper the economic and industrial development of the European economy. As the Community argued:

The importance of these new technologies extend beyond their own particular industry and its relative weight within the economy; whoever possesses them also dominates the other industries, because they, as components or ingredients, make possible the development of new classes of products and processes that could not otherwise be developed; the new technologies are the key to future prosperity" (Council of European Communities 1986:15).

From a political perspective, the Community claimed that economic dependency on foreign semiconductor suppliers would threaten political sovereignty, i.e. its autonomy in making

political decisions. As stated in an EC memo (EC P-40 May 20, 1983):

[...] technological dependence in a few specialized areas is now threatening to become industrial and economic dependence plain and simple. In these conditions, the cultural identity of Europe and eventually its political independence will be seriously at stake.

The threat of losing political autonomy was aggravated by the erosion of the EC's political leverage due to increasing economic dependency, which was in itself a blow to Europe's prestige'. Moreover, the European Community argued that it would no longer control the factors that determine the electronics evolution or its economic, social and cultural effects. Consequently, loss of capability would hinder the Community's control over its own future. As the Community stated:

The effects of the electronics revolution that is now taking place will impact directly on Europe's social and economic structure regardless of whether it has an active or passive role in it. Changes offer new possibilities, but bring about alterations that are not always without problems. Only those who can control the determining factors can hope to minimize the problems. Europe must therefore assume a positive role to be master of its future (EC P-40 of May 20, 1983).

The limited control (politically and economically) of the European Community over a vital component such as semiconductors fuelled economic nationalist ideas: the only way to regain control was to strengthen the European semiconductor industry relative to Japan and the United States. Thus, for the political and economic reasons⁸ described above, the Community rationalized its decision to

improve and protect the performance of the European semiconductor industry. The European Community (European News May 20, 1983) argued that it could not afford to remain an observer at a time when, on the one hand the United States and Japan were taking new initiatives and increasing their investments to improve their technological, industrial and commercial prominence, and on the other hand the emerging economies in Asia and the Americas were taking over more and more traditional manufacturing activities (the so-called "small country squeeze", see Walsh 1987). Acquisition of foreign technology and joint ventures with foreign firms might hold benefits for those involved, but would not offer any long term solutions. Instead, the Community argued that a long term strategy should be established seeking to make the industry as competitive as the Japanese and American counterparts (Europe, November 8/9 1982).

Semiconductor producers, national governments and the European Community all emphasized the necessity to strengthen their position vis-à-vis foreign actors, in particular Japan and the United States. The semiconductor producers' arguments for an in-house production capability, the member states' motivations for a domestic semiconductor industry, and the Community's reasoning on behalf of an EC capability in order to justify government intervention, all point to the employment of the "economic nationalist argument" for government support and protection of high tech industries (see

figure 6.1) As has been outlined in 5.1.1, economic nationalism justifies government promotion and protection of high tech industries such as the semiconductor industry, on the basis of the argument that an indigenous production capability in these industries is indispensable to the wealth (through linkages and externalities), national security, political sovereignty and national prestige of the state vis-à-vis other states.

The economic argument that firms, national governments and the Community used to justify government intervention, namely that high tech industries generate externalities and yield linkages that increase wealth, may also be derived from strategic trade policy (STP) ideas. As outlined in Chapter IV, strategic trade policy justifies government intervention on behalf of high tech industries on the basis of the argument that such industries generate externalities and/or excess rents, and thus may benefit the country under certain conditions.

The impact of strategic trade policy ideas on decision-makers is not incompatible with the impact that economic nationalism has on these actors. While in strategic trade policy the country's increased welfare is an end in itself, in economic nationalism the growth in wealth is also a means to the objective of political autonomy and security. Strategic trade policies thus may serve the objectives of economic nationalism quite well.

Judging by the arguments used to justify government intervention in the semiconductor industry (or in the case of firms, to ask for government support and protection), semiconductor policy choices, made by the large electronics firms, national governments and the Community, have been affected by economic nationalist ideas, and, to a certain extent, strategic trade policy arguments.

No reference was made in the justification of government intervention in the European semiconductor industry to the demonstration effect of examples. However, it is common knowledge that, as Lauber (1986:37) states, in the 1980s the Japanese "MITI" approach came to be regarded as the most promising policy for the Community as well. The MITI approach is defined as the strategy of picking strategic, capital and knowledge intensive industries with high value added and rapidly growing markets. This approach derives its prestige value from the effect it is said to have had on the Japanese semiconductor industry which is regarded to be "the semiconductor industry's biggest success-story" (The Economist, Feb.18, 1989:74).

Judging by practice, economic nationalist ideas have been executed only to a certain degree. In contrast to the nationalist policy "recommendations", member state governments supported conditionally foreign investments, particularly in depressed regions, and advanced R&D programs of foreign subsidiaries (see 3.3). Nor did the Community block foreign

direct investment, although the Community adhered to other aspects of the economic nationalist (and STF) policy "prescriptions". The Community impeded semiconductor imports through barriers and subsidized the semiconductor industry. The Community appeared to aim at a competent, European-located rather than European-owned semiconductor capability (see 3.2.6). Community policies thus seemed to be affected not only by ideas and examples, but also by other factors. The following section focuses on the impact of European (owned) semiconductor producers and consumers and their representative organizations on the EC policy response as possible other factors influencing policy choices.

6.2 INTERESTS: NATIONAL FIRMS AND REPRESENTATIVE ASSOCIATIONS

In Chapter V, it was argued that the interests expressed by national firms may have affected European policy choices (see figure 5.1). As has been shown in Chapter III, Philips, Thomson, SGS and Siemens, the larger European-owned semiconductor producers, advocated the need for certain forms of protection and stimulation to improve their competitiveness vis-à-vis Japan and the United States⁹. Semiconductor consumers, in contrast, opposed any protectionist policy for the same reason¹⁰.

6.2.1 Interests of Semiconductor Consumers and Producers

The diverging attitudes of the main semiconductor producers and (independent) chip consumers, as has been seen in the DRAM case¹¹, can be explained by the different economic conditions that these firms faced. European semiconductor consumers had an interest in the lowest price as possible for their semiconductor inputs. Policies, that restricted the imports of cheap semiconductor devices and/or raised their price, imposed a welfare cost on the total group of consumers that outweighed the benefits to all producers¹². If the number of consumers would have been far larger than the number of producers, the per capita cost to consumers of the EC policies would have been smaller than the per capita benefit to producers. In that case, consumers would gain little from lobbying against these policies; the benefit of lobbying would be smaller than the cost of doing so. However, in the EC semiconductor case, the closest downstream consumers of semiconductors were relatively concentrated. The cost of the EC policies was thus not spread over a large group, but over a small number of firms. As a consequence, the per capita cost of the EC policies to these semiconductor consuming companies was high enough to economically justify lobbying against these policies. These downstream semiconductor consumers thus appealed to the Community not to impose any price-raising policies on semiconductors.

During the 1980s, the main semiconductor producers

Philips, Thomson, Siemens and SGS all operated in the increasingly competitive mainstream commodity semiconductor markets, competing directly with American and Japanese producers (see Chapter 2). The European producers were relatively uncompetitive¹³ and faced various competitive disadvantages such as a fragmented regional market, insufficient resources for each "national champion" to independently develop its own cutting-edge technology, and a backlog in R&D relative to Japan and the United States (Pavel and Patell (1989); Smith (1986)).

These conditions, aggravated by other factors such as downturns in demand (and consequently overcapacity and pressure on prices) and investments that had not yielded any returns as yet, made these firms increasingly unable to finance growing investments in semiconductor equipment and R&D on their own (van Tulder and Junne, 1988:267). Even in a good year, argued the Financial Times (May 29, 1990), no company earned enough from chipmaking to fund those enormous investments on its own.

The profitability of the semiconductor operations of Philips, Siemens and Thomson, for example, was minimal, thus yielding no or very limited resources for re-investment. In the mid-1980s, Thomson Semiconducteur, the most important producer of semiconductors within the components group Thomson's Composants¹⁴, suffered substantial losses¹⁵. Siemens' components group, producing predominantly semiconductors¹⁶,

incurred losses over the timespan 1986-1989. In 1988 alone, Siemens' losses in chips were estimated at \$350 million. Philips' income from components operations was positive in the second half of the 1980s; however, in 1989, Philips incurred a negative income on its components division due to losses on its chip production¹⁷ (Annual Reports of Philips 1985-1989, Siemens 1985-1989, Thomson 1982, 1985-6; NRC Handelsblad May 4, 1990).

Although during the 1980s the net income of Philips, Siemens and Thomson was positive (except in 1981-1983 for Thomson) (see table 6.1), it was only to a certain extent feasible to finance the unprofitable semiconductor operations out of the profits on other operations. Investing the companies' retained earnings in the unprofitable semiconductor operations placed a burden on other divisions within the company¹⁸ and/or on the firms' share-holders¹⁹.

Increasingly, these producers (supported by their share-holders) therefore turned to their respective national governments and to the European Community for funding of R&D and equipment in order to reduce the costs of production, and for protection against cheap imports, in order to increase the value of sales. As shown in Chapter 4, policies of protection and support would benefit both semiconductor producers as well as their share-holders (owners of capital).

The requests for protection against semiconductor imports and foreign direct investment were, however, moderated by

Table 6.1 Net Income (NetInc) in Millions of the Domestic Currency (resp. Dutch Guilders, German Marks, and French Francs) of Philips, Siemens and Thomson, Percentage of Growth (% gr) over Previous Year and Net Income as Percentage of Sales (% sl), 1980-1989. (pos = positive, neg = negative)

Year	Philips				Siemens				Thomson			
	NetInc	% gr	% sl		NetInc	% gr	% sl		NetInc	% gr	% sl	
1989	1,374	+ 30	2.4		1,577	+ 13	2.6		n.a	n.a	n.a	
1988	1,056	+ 29	1.9		1,391	+ 9	2.3		US\$ 2.2		n.a	
1987	818	- 19	1.6		1,275	- 13	2.5		n.a	n.a	n.a	
1986	1,015	+ 10	1.8		1,474	- 4	3.1		882	pos	1.4	
1985	919	- 17	1.5		1,528	+ 43	2.8		126	pos	0.2	
1984	1,113	+ 67	2.1		1,066	+ 33	2.3		- 21	pos	n.a	
1983	647	+ 49	1.4		802	+ 9	2.0		-1,073	neg	n.a	
1982	433	+ 21	1.0		738	+ 45	1.8		- 168	neg	n.a	
1981	357	+ 3	0.8		509	- 20	1.5		502	n.a	1.2	
1980	328	- 42	0.9		633	- 7	2.0		n.a	n.a	n.a	

Sources: Annual Reports Philips 1985-1989, Siemens 1985-1989, and Thomson 1982,1985,1986.

various economic and political organizational factors (see 5.2; Milner 1987). Siemens, Thomson, SGS and Philips were multinational enterprises with internationalized operations. All had subsidiaries in various countries around the world in the 1980s, as is indicated in tables 6.2 and 6.3 by the share of international sales and employees related to the domestic sales and employees²⁰. Moreover, their operations in the various countries were not independent but related to each other. It was estimated that in 1988 more than 60 percent of the integrated circuits sold within the European Community were assembled and tested outside the European Community and were thus intra-firm traded (Flamm 1990:267). Consequently, in contrast to companies solely operating in the domestic market, Siemens, Thomson, SGS and Philips would likely be affected negatively by excessive trade and investment barriers²¹.

Furthermore, the internationalization of these MNE operations was also expressed in the number of international agreements concluded with other independent semiconductor producers. Siemens, for example, cooperated in the period 1984-1987 in the area of semiconductors with Philips (NL), GEC (UK), Plessey (UK) and Thomson (F) (UNCTC 1988:58). Philips had established partnerships in 1986 with Intel (US), Siemens (FRG) and Advanced Semiconductor Materials International (NL). For purposes of complementary R&D, technology transfer, et cetera, the European-owned semiconductor producers appeared

Table 6.2 Sales (in Millions of the Domestic Currency) of Philips, Siemens and Thomson, Percentage of Growth over Previous Year, and Geographical Distribution (in %) of Sales (international and domestic (resp. Europe, West Germany and France), 1980-1989.

Year	Net Sales	PHILIPS		
		% gr	Internat. (%)	European (%)
1989	57,224	+ 2	n.a	n.a
1988	56,079	+ 6	38.7	61.3
1987	52,715	- 4	38.6	61.4
1986	55,037	- 8	40.8	59.2
1985	60,045	+ 12	47.4	52.6 (NL 6.4)
1984	53,804	+ 16	n.a	n.a
1983	46,183	+ 7	n.a	n.a
1982	42,991	+ 1	n.a	n.a
1981	42,411	+ 16	n.a	n.a
1980	36,536	+ 10	n.a	n.a

Year	Sales	SIEMENS		
		% gr	Internat. (%)	Domestic (%)
1989	61,126	+ 3	53.5	46.5
1988	59,374	+ 15	48.2	51.8
1987	51,431	+ 9	51.4	48.6
1986	47,023	- 14	53.0	47.0
1985	54,616	+ 19	46.8	53.2
1984	45,819	+ 16	50.9	49.1
1983	39,471	- 2	56.2	43.8
1982	40,106	+ 16	55.1	44.9
1981	34,561	+ 8	55.7	44.3
1980	31,960	+ 14	54.1	45.9

Year	Sales	THOMSON		
		% gr	Internat. (%)	Domestic (%)
1989	n.a	n.a	n.a	n.a
1988	US\$ 1200	n.a	> US\$ 400	n.a
1987	n.a	n.a	n.a	n.a
1986	62,650	+ 5	61	39
1985	59,880	+ 4	60	40
1984	57,885	+ 13	61	39
1983	51,320	+ 9	56	44
1982	47,050	+ 8	n.a	n.a
1981	43,650	-	n.a	n.a
1980	43,657	+ 20	n.a	n.a

Sources: Annual Reports Philips 1985-1989, Siemens 1985-1989, Thomson 1982, 1985, 1986, and Electronics 1988.

Table 6.3 Total Number of Employees (in thousands) of Philips, Siemens and Thomson and Percentage of Employees Working in Home Country (resp. the Netherlands (NL), West Germany (FRG) and France (F)), 1980-1989.

Year	Philips		Siemens		Thomson	
	Employ.	% NL.	Employ.	% FRG.	Employ.	% F.
1989	305	n.a	365	62	n.a	n.a
1988	310	21	353	63	n.a	n.a
1987	337	21	359	64	n.a	n.a
1986	344	20	359	64	104.5	77
1985	346	21	329	68	107.	70
1984	344	20	310	67	111.9	n.a
1983	343	n.a	305	67	107.3	n.a
1982	336	n.a	324	68	128.8	n.a
1981	348	n.a	338	68	129.	n.a
1980	373	n.a	334	68	n.a	n.a

Sources: Annual Reports Philips 1985-1989, Siemens 1985-1989, and Thomson 1982,1985,1986.

to perceive the presence of higher value added, foreign-owned subsidiaries within the Common market as beneficial²². Consequently, in contrast to the economic nationalist policy prescriptions, foreign direct investments were not blocked (see 3.2.4).

Third, Siemens, Thomson, SGS and Philips were large electronics companies, both producing and consuming semiconductors. High semiconductor prices would hurt these companies as much as prices that were too low, since these firms not only produced semiconductors, but also used imported devices as inputs. (This is illustrated by the monitoring of semiconductor prices, following the 1986 Japanese-American Semiconductor Agreement (see 3.1)).

Finally, the political organization of these firms included indirect representation through lobby groups and industrial fora. Both producer/consumers of semiconductors such as Siemens and Philips, and pure consumers of semiconductors such as Nixdorf (FRG)²³, were represented in these fora and organizations. The mutual representation contributed to a policy stance incorporating more than the narrow interests of semiconductor producers.

In sum, semiconductor consumers opposed protection of the semiconductor industry since such policies would increase the prices of their inputs and thus threaten their profitability and competitiveness. Semiconductor producers also sought to improve their profitability and competitiveness, however, with

the help of the government. Government support was necessary to fund the increasing costs of R&D for which the uncompetitive companies did not have sufficient resources. Government protection was necessary to shield the companies against cheap imports, thus increasing the value of their sales. The companies' demands for protection were, however, moderated by their internationalized production, their economic linkages with foreign semiconductor producers, their own needs for cheap imported semiconductors, and their linkages with semiconductor consumers. Undue protectionism would hurt these companies more than it would benefit them.

Both semiconductor consumers as well as semiconductor producers lobbied the European Commission to act in accordance to their respective interests. However, as the DRAM anti-dumping case illustrates (see section 3.2.3), the Commission adopted policies in line with the producers' interests, indicative for the larger political power of these firms. Other policies (such as ESPRIT) also show how the producer demands have been "translated" into policies without much modifications.

The scope of impact that producers appeared to have had on the EC decision-making process is to a certain degree surprising. Ostry (1990:31), for example, has recently argued that, in general, private groups have little influence on the final outcome at the Commission level. The institutions representing societal interests within the EC decision-making

mechanism were only consultative bodies. "Insofar as private sector political pressures feed into policymaking", Ostry therefore stated, "they operate more via the member states than through ongoing consultative arrangements with the Community". However, Ostry also indicated that on sensitive technical and bureaucratic issues, close cooperation exists between the Commission and the representatives of Community-wide, product-based industrial groups. The next section looks into the question why semiconductor producers were effective in lobbying the Community and why they were more effective than semiconductor consumers.

6.2.2 Political Influence of Semiconductor Consumers and Producers

The effectiveness of the large European-owned semiconductor producers in lobbying for national and EC funding and protection is due to the size of these companies, their type of business operations and their political organization (see section 5.2).

In the 1980s, Philips, Siemens, SGS and Thomson could be classified as large companies, in terms of overall sales and employment. In particular, the fact that a substantial part of their total sales and total employment was located in their respective home countries added to the political importance of these firms (see tables 6.2 and 6.3)²⁴.

The component groups (including semiconductors) of each

company, by themselves, did not yield much "political clout" in terms of sales or employment. The sales of components accounted for approximately 13 percent of Philips' total sales, 8 percent of Thomson's total sales, and 3 percent of Siemens' total sales (Annual Reports of Philips, Thomson, and Siemens). In comparison to the United States and Japan, only a small number of number of jobs were available in the European semiconductor industry due to its weak position (van Tulder and Junne 1988:105). Only 11 percent of the total employment in Philips' components division, for example, was located in the Netherlands.

However, semiconductor manufacturing added to the political clout of the producers to the extent that semiconductors were considered strategically important for economic and political reasons (see previous section). This was particularly the case when the semiconductor manufacturer was a supplier of military semiconductors, such as Thomson, INMOS, Plessey and Ferranti²⁵.

The strategic importance of the semiconductor industry has created a relatively powerful position for semiconductor producers within Europe. As illustrated by van Tulder and Junne (1988:166), once Siemens and Philips threatened to move their research and production facilities abroad, financial support from the German and Dutch governments for the development of the megachip technology was almost mandatory, since a transfer of research and production facilities would

imply the loss of the only remaining relative successful European semiconductor facilities.

Additionally, closer linkages between the large electronics companies and governments have resulted in selective subsidy policies in microelectronics at both national and EC level, largely created in response to specific requests by large producers. As the DRAM anti-dumping case and ESPRIT show, rather than through ongoing consultative and institutionalized arrangements with the Community, semiconductor producers operate through informal channels. Requests were brought forward either directly or indirectly through the political organization of these firms (van Tulder and Junne 1988:67).

The main semiconductor producers had established direct representatives and sometimes offices in both the national capitals and in Brussels (Philip 1987:282). At national level, these firms had access to the member state governments for the following reasons as suggested by van Tulder and Junne (1988:184,196,227): (1) many government departments had a long history of support for large firms; (2) sometimes government officials came from large companies or eventually hoped to find a job with these firms; (3) large companies could afford tax and subsidy specialists and lobby activities; and (4) large companies were represented in commissions of experts that prepared government programs. Moreover, the increasing technological sophistication and the shortening of the product

life cycle resulted in a growing dependency of governments on large companies to formulate their governments' own innovation policies. These arguments, in particular the latter, were also applicable at EC level.

Indirectly, Philips, Siemens, Thomson and SGS made representations to the national governments and the European Community through intermediate associations. The representative organizations at national level included employers' organizations and sectoral organizations²⁶. The representative organizations at EC level included industrial fora and the Eurogroup EECA. The industrial fora referred to the alliances between the larger European-owned firms, established on the basis of a shared interest in the development of core technology, such as the "Round Table" group of the twelve main European electronics companies, the "Round Table of European Industrialists" and the "Standard Promotion and Application Group" (SPAG) (van Tulder and Junne 1988:213-216). These alliances served as fora for discussion and formulation of common political action at the European level. Through alliances firms could exert considerable pressure on the EC government. As has been described in section 3.2.5.1, in the case of ESPRIT, the Community planned and prepared policies in close cooperation with the twelve largest European electronics firms, and implemented these policies with their assistance. P.H. Roberts, technical director at the General Electric Company (quoted in van Tulder

and Junne 1988:214) therefore concluded:

I find it very difficult as a member of GEC or any other of the IT companies to say that we do not think the shape of the program as defined was sensible because we had excellent opportunity to influence it and in many areas I think we did.. it is not a program dreamt up by Brussels bureaucrats and forced on us, it is our program.

Additionally, the European semiconductor industry made representations to the European Commission through the Eurogroup EECA, the European Electronic Component Manufacturers' Association²⁷. According to Flamm (1990:249), EECA was established in 1986 by the European semiconductor industry in order to bring dumping cases against Japanese chip imports, as such following the example of the American Semiconductor Industry Association (SIA)²⁸. EECA worked with the Commission on anti-dumping complaints, on matters of tariffs, rules of origin and on trade policy issues. Through EECA the European firms impacted on the European Community's policies²⁹.

An interesting insight illustrating the functioning of a Eurogroup (and other interest groups) within the European Community, was given by A. Philip (1987:283-284). He indicated that the scope for Eurogroups which sought to influence the Community policies was large because generally the decisions taken by the European Community were the result of long discussions in a multitude of national and European governmental institutions. Some of these institutions, such as the EC Economic and Social Committee, specifically

represented societal interests.

Even after the Community had decided on a particular issue, there would be ways to either recall the decision or influence its policy development and implementation. Council Decisions could be challenged in the European Court of Justice. Policy planning and execution could be influenced through active participation in EC advisory committees. In addition, day-to-day decisions of the EC's Management Committees could be influenced through representations to the Commission and national governments dealing with the substance of those decisions. As A.Philip (1987:283) described it:

At every stage in the journey that proposals have to make through the Community institutions, there are possibilities for affected interests to press their case before those who are still in judgement on those proposals (Philip 1987:283).

The relations between the Eurogroups and the European Community were not limited to lobbying the Community in order to influence the policy-making process. In particular, close relations existed between these lobby groups and the European Commission. Eurogroups sought information from the European Commission about the current EC policies and operations and the future EC plans. In addition, these groups sought access to the Commission to increase their legitimacy. The European Commission, in its turn, needed Eurogroups to acquire information about the various interests and positions needed to create a sufficiently large base of support for its decisions. These lobby groups also assisted the Commission in

implementation of the EC decisions. Finally, Eurogroups informed the Commission on infringements of Community policies (Philip 1987:284).

The Commission preferred to cooperate with Eurogroups rather than with various national pressure groups since it saved the Commission the time of discussing the issue with various lobby groups and the trouble of reconciling the different national interests. Moreover, the European Commission needs these European lobby groups to further European integration from within the Community (Philip 1987:284)³⁰

EECA was, just like industrial fora, a channel through which the European semiconductor producers lobbied the European Community. During the 1980s, the producers effectively pressed for support at both EC and national level due to their political clout. The latter was based predominantly on the large size of the companies in terms of total sales and employment, the economically and politically (militarily) strategic type of business operations, and the direct and indirect network through which requests were channelled.

Semiconductor consumers (for example Nixdorf and Olivetti) were also important in terms of sales and employment. In addition, semiconductor consumers channelled their requests through similar organizations. Semiconductor consumers were represented by the Eurogroup EUROBIT,

participated in the Round Table group of the twelve main European electronics companies, et cetera.

National governments and the European Community, however, adopted policies that were in accordance to the interests of semiconductor producers rather than in line with the requests of consumers. The fear that the performance of the domestic semiconductor producers would negatively affect the domestic "downstream" semiconductor consuming industry probably explains this phenomenon; the semiconductors appeared to be of greater strategic importance to the decision-makers than the final products that incorporated these devices. Flamm concludes (1990:257) therefore, that the EC trade policy apparatus largely deals with the interests of producers, not consumers, even when the consumer is itself an important industry.

As shown in figure 6.1, both the interests of semiconductor producers and consumers impacted on national and EC policy choices. However, the requests of producers and consumers were weighted differently in the decision-making of national governments and the European Community. As a consequence, the leading semiconductor producers have been able to influence public decision-making in such a way that large amounts of money were allocated in their favour³¹. This triggers the question whether the national governments and the European Community reflected in their policy choices predominantly the interests of the semiconductor producers,

or that the policy choices were also in their own interests (see 5.3). The following section will discuss the relations between firm interests on the one hand and national and Community interests on the other, as well as the impact that the national governments and the European Community have had on the EC semiconductor policy choice.

6.3 INSTITUTIONS: NATIONAL GOVERNMENTS AND THE EUROPEAN COMMUNITY

The interests expressed by semiconductor producers were in line with those verbalized by the national governments and the European Community. National governments seeking to improve the performance of the domestic semiconductor industries, and the European Community geared at the establishment of a competitive European semiconductor capability, perceived the producers' request to protect and strengthen their in-house semiconductor capabilities as contributing to the realization of their own interests (see section 6.1). The large semiconductor producers were considered to be of crucial importance to a healthy domestic capability (see section 6.2). Both national governments as well as the European Community thus channelled and reinforced the interests of semiconductor producers (see figure 6.1).

However, the member state interests and the EC interests were not necessarily in accordance with each other; policies

that would benefit the Community as a whole would not necessarily serve each individual member state. The national governments therefore feared, as has been expressed in the ESPRIT negotiations, that the European semiconductor policies would supplant their policies. The complementarity of European and national policies (see section 3.3), indicates that the member states have been able to avert this. National interests thus appeared to have a strong impact on the EC semiconductor policies. The following section discusses the impact of national interests on the EC policy response vis-à-vis European interests.

6.3.1 The EC Decision-making Mechanism: the Relative Importance of Member State Interests versus Societal and EC interests

The traditional relationship between the European Community and the national governments gave predominance to the member states, which was underscored by the fact that only national governments could delegate constitutional powers³² to the European Community. In other words, all powers that the Community possessed in the 1980s were originally within the authority of the national governments and have been transferred to the EC level on their initiative and with their approval.

The Treaty establishing the European Economic Community provides for common policies in agriculture, trade and

competition, and for coordination in the field of economic and monetary policy. In 1987, the Single European Act extended Community activities into new areas such as environment and research (The Economist, Dec. 9, 1989:52). Not surprisingly, in the EC semiconductor case, the European Community employed those instruments that were within its authority: trade policies and R&TD policies.

The specific EC semiconductor policies (namely the regulations on the level of tariffs on semiconductors, ESPRIT, and anti-dumping duties, or the directive on the protection of semiconductor topographies) were proposed by the European Commission³³, representing European interests, in close consultation with national representatives, national experts, and representatives of trade unions, employers' federations, traders' organizations, et cetera. The Commission also had to consult Advisory, Regulatory and Management Committees, which had been established by the Council to represent national and societal interests. In the preparatory phase of ESPRIT, for example, the Commission cooperated with the twelve largest electronics companies, their experts, smaller companies, research institutes and universities. The Commission proposals were subsequently presented to the Council³⁴, representing the member states, for approval. In the last years of the 1980s, these Council decisions were made in cooperation with the European Parliament³⁵, and after consultation with the Economic and Social Committee³⁶. The Parliament and the Economic and

Social Committee were representing societal interests.

Not only national but also European and societal interests were thus represented in the decision-making process. It has been argued that the member state interests prevailed over European and societal preferences. One reason for the prevalence of national interests was that these preferences impacted on the formulation of Commission proposals; national interests were represented in the bodies that the Commission had to consult prior to proposing a decision to the Council. The main reason, however, was that the Council, the platform of national interests, was the final decision-making body.

Under the unanimity rule, one member state could block the acceptance of a Community proposal. Under majority rule, the impact of individual member states was reduced; a proposal could be accepted even if two large states opposed it. However, the political leverage of large states made it de facto unlikely that other (smaller) states would use their veto. Rather, the decision-making process would be delayed. The delaying impact that member states have on the final decision-making was shown in the case of ESPRIT I and II (see section 3.2.5.1).

Both the Council and the Commission were supported and guided by the European Council. The latter consisted of the EC Heads of State, assisted by their Foreign Affairs Ministers and Commissioners. Although the European Council was not a

formal decision-making body, it could reach politically important understandings and agreements. Its relevance for the decision-making process has, for example, been shown in the case of ESPRIT where, on the one hand, the European Council expressed its political support for ESPRIT while, on the other hand, the failure of the European Council to come to a conclusion on the EC budget reforms delayed the process of decision-making (see section 3.2.5.1).

In sum, the EC decision-making process was such that the member states' interests were expressed in various ways and on crucial points, which gave them significant opportunities to impact on the EC decisions. However, the role of European interests, as brought forward by the Commission, should not be underestimated. The power of the Council relative to the Commission was to a certain extent limited by the interdependence of the Commission and Council in the decision-making process. As Noel (1988) explained, the Council could only on rare occasions proceed without a proposal from the Commission. This implied that if the Commission did not initiate any action, the Council would be paralysed.

Moreover, the acknowledged danger of abuse by certain member states of the unanimity rule in the Council voting procedure, had gradually led to an increased use of majority voting for Council decisions, even on very important matters. In the Single European Act, the Council's scope for taking majority decisions had formally been extended to include, for

example, decisions on the completion of the internal market, and research and technology. Since 1987, Commission proposals could be approved by 54 out of 76 votes. The Council could only depart from a Commission proposal under unanimity. If the Council was neither unanimously against, or in majority in favour of a proposal, there would be a deadlock. In other words, the threat to stall the integration of the European market was a bargaining chip in hands of the Commission. European interests, as expressed by the Commission, were thus not only exercised in the policy preparation phase, but also impacted on the final decision-making.

Finally, once a decision had been made by the Council, the European Commission (if thereto entitled), implemented this decision. The implementation of most EC semiconductor policies thus did not require the cooperation and/or assistance of the national governments³⁷. All EC semiconductor decisions (except the topography regulation) were implemented at Community level and not by the national government. The Commission managed, for example, the funds and common policies for the promotion of scientific research (Framework Programs, ESPRIT). The Commission initiated and investigated anti-dumping complaints, imposed provisional anti-dumping duties³⁸ and accepted undertakings, in implementation of the Council Regulation on dumping and subsidies. The regulation on the determination of integrated circuits was also issued by the European Commission. (See Treaty establishing the European

Economic Community; European File 16 1989; Kelly 1988:88; Noel 1988).

The member state governments thus channelled the interests of semiconductor producers and expressed their national interests in various ways and on crucial points in the EC decision-making process, which gave them a large impact on the EC decisions. The European Commission, representing the European interest, also channelled the interests of producers and exercised its own interest, but was less influential in the decision-making process than the Council. However, the Commission did play a dominant role in the preparation and the implementation of semiconductor policies.

We have seen so far how semiconductor producers, national governments and the European Commission had important impacts on the EC semiconductor policy response. We have discussed the role of the economic nationalist ideology which has justified the interests of firms, the national governments and the Community. However, we have not paid particular attention to the impact of the international system on these actors (see figure 6.1). The following section will discuss the constraints and incentives for firms, national governments and the Community derived from the broader structure of the external environment.

6.4 THE INTERNATIONAL SYSTEM

Semiconductor producers (and consumers), member state governments, and the European Community operated in the 1980s in an international trading system which was under considerable pressure. The GATT regime, and the multilateral, rules-based approach to trade it stood for, appeared to lose its effectiveness as a "guardian" of liberalized trade (The Economist, September 22, 1990:6; Cohen 1990:278). Instead, the GATT regime seemed to give way to regionalization and politicization of trade relations; separate trading blocs seemed to develop, while managed trade and protectionism increased.

In the 1980s, these trends were clearly expressed in the world semiconductor industry. As in the European Community, the United States and Japan attached, in accordance with economic nationalist ideas, great importance to a viable domestic semiconductor industry. C.W.M. Koot, managing director of the IC business with Philips, illustrated the attitude of the three largest semiconductor producers and consumers:

[...] each region needs a viable IC industry to further its culture. Each region, therefore, needs to be substantially self-supporting. Being self-supporting means that all the elements of the so-called "industrial foodchain" must be available domestically: everything from manufacturing equipment, and chip design and fabrication, to making the end product for the consumer.

(quoted in Flamm 1990:288)

Thereto, the Community, Japan and the United States all

financially supported their semiconductor industries and protected their markets through less transparent measures than tariffs. The increasing political involvement in the semiconductor industry, the best example being the 1986 Japanese-American Semiconductor Agreement (section 3.1.2), augmented the frictions between the respective trading blocs. For example, it was unacceptable to the European Community that Japan and the United States determined in the 1986 Semiconductor Agreement the economic conditions that European semiconductor producers and consumers would face. Similarly, Japan and the United States considered it inadmissible that the Community changed the interpretation of the criteria of origin to suit its own needs, at the costs of foreign producers.

The GATT regime provided for a dispute settlement mechanism. With respect to the 1986 Semiconductor Agreement, the mechanism proved effective (see section 3.1.2); Japan adhered to the GATT's panel report. However, cases are also known in which the country in question blocked the adoption of the report and/or reserved the acceptance of the implementation of the report depending on the outcomes of the Uruguay Round (for example, the EC Screwdriver Amendment case).

Within this changing regime, with respect to semiconductors the European Community was a small actor. The Community was not only a price taker of market prices, but

also of politically determined prices, as the Community discovered after the conclusion of the 1986 Semiconductor Agreement between Japan and the United States. According to Flamm (1990:248), the 1986 Agreement contained the implicit message that Europe (its firms and governments) had ceased to be an important player in the international semiconductor industry and could safely be ignored by the two top semiconductor producers in "managing" their trade relations.

The nature of the changing trading regime, and the position of the European Community therein, have affected the interests of EC firms, member state governments and the Community, and consequently the EC semiconductor policy response (see figure 6.1). In addition, the international system impacted on ideology.

While within the semiconductor industry the pressures to globalize semiconductor operations increased, the individual EC firms faced markets that were either protected or subject to conditional entry. In addition, they faced competitors that were supported by their respective governments. Moreover, semiconductor producers (and consumers) had to accept the prices that were established through trade negotiations between the United States and Japan. All these factors adversely affected the competitive position of the European semiconductor producing (and consuming) firms, threatened their position in the domestic market and limited their export opportunities³⁹. Consequently, these firms put pressure on the

national governments and the European Community to protect and support the EC semiconductor industry in similar ways, and to counter managed trade practices.

The member state governments were also affected by the changes in the international system. The decreasing role of GATT, as a guardian of peace and stimulator of cooperation, increased the threats to their survival and autonomy; the member states were individually, as small actors with respect to semiconductors, not able to counter any managed trade decisions made by foreign governments. The member states could, however, strengthen their ties with other countries through integration into regional schemes, as a second best solution. The member states thus allowed increased EC intervention in the semiconductor industry to serve their nationalist interests evoked by external developments.

In addition, the European Community was affected by the changing international system. In particular, in the second half of the 1980s, Japanese and American governments engaged in managed trade practices to which the European Community, due to its "smallness" in semiconductors, could not respond in other than reactive ways. ESPRIT, for example, was the Community response to the Japanese plans for the Fifth Generation Computer (EC Background Report ISEC/B1/83 of January 27, 1983). The EC protection of semiconductor topographies followed the introduction of similar measures in Japan and the United States. Simultaneously, these managed

trade practices made the Community realize that the domestic semiconductor industry had to be strengthened in order to require greater control over its own future.

Finally, the disintegration of the world-wide liberal GATT regime into trading blocs, the revival of protectionism, and the rise of managed trade have impacted on ideology; these developments strengthened the economic nationalist perception of how the international system operates.

The GATT trade regime and the recent changes therein have affected the EC policy response through their impact on EC firms (threat to EC position in domestic and international markets), national governments (threat to survival and autonomy), and the European Community itself (threat to self-control). The international system also strengthened the economic nationalist ideology.

6.5 CONCLUSIONS

During the 1980s, the European Community protected and supported its semiconductor industry, although these policies imposed (at least in theory) a welfare cost on society. The EC policy response to import penetration and foreign direct investment in the semiconductor industry can be explained by four, interrelated variables, namely Ideology, Interests, Institutions and the International system.

Judging by the arguments used to justify government

intervention in the semiconductor industry, the EC semiconductor policy choices have been affected by economic nationalist ideas, and, to a certain extent, strategic trade policy arguments. National semiconductor policies and the requests of firms for government support and protection were also affected by economic nationalist ideas. The Community, however, did not adhere to all economic nationalist policy prescriptions. In line with economic nationalist policy rules, the Community impeded semiconductor imports through barriers and subsidized the semiconductor industry. However, in contrast to economic nationalist prescriptions, the Community was open to foreign direct investment. Neither did the member states adhere to the anti-FDI prescription. The Community considered its objective of a competitive European semiconductor industry for political, strategic and economic reasons to be better served through upgrading rather than blocking of foreign direct investment. Clearly, foreign direct investment appeared to be (perceived as) beneficial to the Community by the European Commission, the member states and EC firms.

Both semiconductor producers as well as semiconductor consumers lobbied the European Commission to act in accordance to their respective interests. In the anti-dumping case, producers would gain considerably from government intervention (as would their share-holders), while consumers would lose. However, the Commission adopted a policy line that benefitted

the producers, indicative for the larger political power of these firms. The semiconductor producers were so effective in lobbying for EC funding and protection due to their company size, their type of business operations and their political organization. Semiconductor consumers were far less effective in their lobby activities due to the fact that their products would be dependent on semiconductors as inputs. It was feared that the performance of the domestic semiconductor producers would negatively affect the domestic "downstream" semiconductor consuming industry. Semiconductors were thus considered to be of a greater strategic importance than, for example, computers. Semiconductor producers also effectively lobbied the national governments.

The interests expressed by semiconductor producers were channelled and reinforced by the national governments and the European Community. National governments which sought to improve the performance of the domestic semiconductor industry, and the European Community which geared at the establishment of a competitive European semiconductor capability, perceived the producers' request to protect and strengthen their in-house semiconductor capabilities as contributing to the realization of their own interests. The large semiconductor producers were considered to be of crucial importance to a healthy domestic capability.

However, the European and national interests were not necessarily compatible. In particular, the national

governments feared that the European semiconductor policies would supplant their policies. The complementarity of European and national policies indicates that the member states had a strong impact on the EC semiconductor policy choice. Their impact can be explained by the fact that the member states could express their interests in various ways and on crucial points in the EC decision-making process. However, the power of the Council relative to the Commission was to a certain extent limited by the interdependence of the Commission and Council in the decision-making process. The Commission also played a dominant role in the initiation and implementation of Council decisions. In particular, the Commission played a crucial role in the initiation of ESPRIT.

Finally, the nature of the international system and the position of the EC within this system affected the EC policy choice through the impact of this external variable on semiconductor firms, national governments and the European Community. The disintegration of the world-wide liberal GATT regime into trading blocs, the revival of protectionism, and the rise of managed trade threatened the position of EC firms in domestic and international markets, the autonomy of member states and the European Community. The international system also impacted on ideology; the recent developments strengthened the economic nationalist perception of the way in which the international system operates.

Evoked by the developments in the international system

and justified by the economic nationalist ideology, the European Community thus opted for the policies it did in response to the interests of semiconductor producers, which were channelled and strengthened by the national governments, acting on behalf of the national interests, and the European Commission, aiming to maximally support the European interest.

ENDNOTES

1. The impact of ideology on foreign firms, governments, et cetera is not discussed in any detail, since it was assumed (for purposes of analysis) that ideology was a domestic cognitive variable.

2. As illustrated in Chapter III, semiconductor consumers strongly disputed the governmental reasoning that an indigenous semiconductor capability was necessary; the semiconductor consumers insisted that they could meet all their needs satisfactorily on world markets. Semiconductor consumers also argued that the anti-dumping actions and price arrangements, intended to shield semiconductor producers from Japanese competition, would penalize the consumers.

3. However, a greater threat facing chip users would be, according to Flamm (1990:260), the integration of these Japanese suppliers forward into the downstream industry, enabling these firms to maximize their returns while undermining the competitiveness of semiconductor consumers that are lacking their own "leading edge" chip making capability.

4. Sources: OJ L20/23 of January 25, 1990; Financial Times, May 25, 1990; van Tulder and Junne 1988:38-39; Prof.Dr.P.Balk in Algemeen Dagblad Sept. 6, 1990:3; Delta, Sept. 9: 1990:6; De Volkskrant May 5, 1990; Businessweek, May 28, 1990:38.

5. According to Mr. Gomez, chairman of Thomson, "Thomson could not afford not to control its semiconductor technology" (quoted in van Tulder and Junne 1988:38-39).

6. As stated by Siemens in its annual report (1984): "We intend to make ourselves less and less dependent on outside suppliers [...]".

7. See Flamm (1990:248), who argues that the 1986 Semiconductor Agreement has caused "psychological injury" to the European Community.

8. Source: CEC Task Force; European File 15/89 Nov. 1989; OJ L67/54 March 9, 1984; Europe Nov. 8/9, 1982; ECC Background Report ISEC/B1/83 Jan.27, 1983; EC P-40 May 1983; European News May 20, 1983; EC IP(89)478 June 21, 1989; OJ L302/8 Oct. 24, 1987; OJ L20/21 Jan.25, 1990; Bulletin EC 2 1984; Jessi - a European Challenge; Europe June 22, 1989.

9. As has been outlined in Chapter III, these firms were the complainants inter alia in the DRAM and EPROM anti-dumping cases. They requested the levying of anti-dumping duties or the establishment of an undertaking to protect the an DRAM and EPROM industry against "unfair" price competition. These semiconductor

producers also lobbied for the change in rules of origin. Siemens, Thomson, SGS, Philips, and other European owned semiconductor producers such as Bull (F), Plessey (UK) and GEC (UK) belong to the Round Table group of the 12 largest an electronics companies which initiated the European Strategic Program for Research and Development in Information Technology (ESPRIT) aimed at the stimulation of the an semiconductor industry. Philips and Siemens, later joined by Thomson, were also the initiators of the Eureka project JESSI.

10. In the DRAM anti-dumping case, for example, semiconductor consumers were heavily opposed to the imposition of duties and the conclusion of a minimum price agreement.

11. In the case of ESPRIT, for example, the dichotomy between the interests of semiconductor producers and consumers is blurred.

12. See Figure 4.1. The cost to consumers of a tariff, for example, would be represented by areas 3+5+6+7+8, while the gain to producers would be represented by area 3. Clearly $3+5+6+7+8 > 3$.

13. This is expressed, for example, in the declining share of European semiconductor production in world production (see table 3.1), and in the declining position of the major European producers on the world ranking list. Philips' international ranking declined from the 4th position in 1974 to the 9th position in 1980 and the 10th position in 1983. Siemens stayed in the world top ten in the 1970s, but disappeared out of it in the 1980s. By 1989, Siemens occupied the 15th position. SGS' ranking declined from the 16th position in 1974 to the 18th in 1980. Thomson's position remained stable over the 1970s (approx. 18th), but fell in the 1980s (UNCTC 1986). By 1989, however, the merger SGS-Thomson was ranked 12th.

14. In 1985 Thomson Semiconducteur accounted for approximately 50 percent of the sales in components and for 74 percent of the sales in semiconductors.

15. Net income (in thousands of FF) 1985:- 79,638, 1986:- 371,561 (Annual Report Thomson 1986).

16. Semiconductors accounted for more than 60 percent of the total components sales of Siemens.

17. Philips' components division lost Dfl 125 million (\$80.6 million) in 1989 (Financial Times, September 5, 1990:7).

18. The transfer of resources from the more to the less profitable divisions decreases the share of the most profitable divisions in retained income. As a consequence, less money is available to make the necessary re-investments.

19. Enlarging the share of retained earnings in net income decreases the size of dividends to be paid to the shareholders. Since shareholders do have a say in the company's policies due to their ownership of equity, neglected shareholders may give the company problems with respect to the approval of certain decisions. However, more important are the consequences of the lower quotations of shares on the stock exchange which are based on the size of the dividends. A low quotation limits the company's possibilities to finance new investments, acquisitions, et cetera through issuing shares. The company's "own currency" can be considered "weak" (NRC Handelsblad July 3, 1990:11). A low quotation makes the company a potential target for hostile takeovers, unless precautions have been taken.

20. Semiconductor operations were not restricted to the domestic market. Thomson Semiconducteur, for example, sold in 1985 45 percent of its semiconductors in markets other than the French one. However, these foreign markets may have been predominantly European markets.

21. For example, excessive barriers would impede intra-firm trade.

22. Foreign direct investment may be (perceived as) beneficial to host countries for various reasons such as transfer of management skills and technology, creation of direct and indirect employment, increased domestic competition due to the entry of foreign companies (lower prices for the consumer), and positive effects on the balance of payments, namely (short term) inflow of capital and increased exports. On the other hand, foreign direct investment may be (perceived as) disadvantageous to host countries for various reasons such as loss of sovereignty (fiscal, monetary and trade policies may be undermined), promotion of inaccessible and unsuitable consumption patterns, little benefits in the form of employment, transfer of technology, etc., decreased domestic competition as the foreign subsidiary outcompetes domestic firms, crowding out of domestic investments due to use of domestic capital by foreign subsidiaries and negative effects on the balance of payments, namely long term outflow of royalties, dividends, etc. and increased imports.

23. Siemens recently acquired Nixdorf.

24. Arnold and Guy (1986:162), for example, write that "Philips' role as a major employers gives the company enormous political influence in many European countries, but in none is this more so than in Holland". This influence may be direct as well as indirect. Especially in fields related to electronics, Arnold and Guy find, it is often difficult to find an experienced and competent Dutch person who does not work, or who has not in the past worked, for Philips.

25. Thomson had close links with the military; van Tulder and Junne (1988:38-39) indicate that in the early 1980s about 35 percent of Thomson's total R&D on components was financed by the French defense sector. Also the British semiconductor industry had a distinctly military orientation: INMOS, Plessey, and Ferranti were military producers.

26. The relevant electronic component manufacturers associations, operating at national level, were ZVEI-FV23, ANIE/GR29, FAPEL, ECIF and SYCEP-SITELESC.

27. The Commission recognizes an official "repertoire" of Eurogroups. These groups represent agriculture and food, industrial employer interests, and a variety of commercial, service industry, trade unions, consumers and environmental interests. Other Eurogroups are, for example, EUROBIT (computer industry), COPA (agriculture), CECOM (photocopier industry), and Eurofer (steel) (Philip 1987).

28. Sematech was also established with the objective of pursuing anti-dumping investigations.

29. In addition, EECA represents the semiconductor industry vis-à-vis other trade associations such as SIA. In these inter-trade associations trade policy issues and conditions of fair semiconductor trade are discussed; especially with SIA, EECA has been working on the improvement of the GATT code to prevent dumping and industrial targeting (quoted Eckhard Runge, Secretary-General EECA).

30. See also Ostry (1990:31): "The Commission has encouraged the formation of these Community-wide sectoral groups to facilitate a Community rather than a national point of view."

31. "In spite of all the internationalization, the relationship between national governments and MNEs, especially in the field of electronics, turns out to be still very close" (van Tulder and Junne 1988:158).

32. The European Community can extend its "own" powers to implement one of the objectives of the Community through a Council Decision, made unanimously on a proposal of the Commission and after consultation with the European Parliament (Article 235 of the Treaty establishing the European Community).

33. The European Commission, subject to the European Parliament, is composed out of at least one citizen from each member state appointed by mutual agreement of the national governments. (In 1989, the Commission counted 17 members: 2 Germans, 2 French, 2 Italian, 2 Spanish, 2 British, and one from each of the other countries). The Commission members may only act in the interest of

the Community; they must remain independent of the national governments.

34. The Council consists of the ministers from the member states. It depends on the agenda which ministers participate in the Council meetings. For example, the Ministers of Research of the member states met over ESPRIT. In total the Council holds 76 votes. The distribution according to nationality is the following: West Germany, France, Italy and the United Kingdom 10 votes each, Spain 8 votes, Belgium, Greece, the Netherlands and Portugal 5 votes each, Denmark and Ireland 3 votes each, Luxembourg 2 votes.

35. The European Parliament is elected by universal suffrage. In 1989, the division according to nationality was the following: Germany, France, Italy and the United Kingdom each 81 seats, Spain 60, The Netherlands 25, Belgium, Greece and Portugal each 24 seats, Denmark 16, Ireland 15, and Luxembourg 6. The division according to political party was the following: Socialist Group 180 seats, Christen-Democratic Group 120, Liberal Democratic and Reformist Group 49, The Green Group 30, Group of the United Left 28, Group of the European Democratic Alliance 22, Technical Group of the European Right 17, Left Unity 14, Rainbow Group 14, and non-attached 10.

36. The Economic and Social Committee is a consultative body with 189 members who represent employers, trade unions and other interested groups such as consumers.

37. Due to pressure from domestic interests, the prevalence of national objectives over European ones and/or due to administrative problems, inefficiency and ignorance at the national level, member states often disregarded Community law and regulations (Bronckers 1989; The Economist Jan. 20, 1990:69-70). The implementation record of Community law and regulations in the 1980s showed that the national governments were often slow in ratifying Community decisions. Even if the member states introduced laws and procedures, they often appeared to ignore them. Moreover, some member states even failed to carry out EC Court rulings, the Community's ultimate way to enforce Community acts (The Economist Jan. 20, 1990:69-70; Philip 1987:284).

38. Definitive anti-dumping duties are imposed by the Council on proposal of the Commission.

39. Both semiconductor producers and consumers are adversely affected. (Note that many producers are simultaneously consumers). For example, foreign government subsidies to foreign semiconductor producers, resulting in lower priced semiconductor, do not only increase competition to domestic producers, but also to domestic consumers. Even if the domestic consumer incorporates foreign, cheaper priced semiconductors in its final product instead of the higher priced domestic semiconductors, the price of the domestic

final product is likely to be more expensive than the foreign final product which can incorporate devices at cost price.

CHAPTER VII

CONCLUSIONS

In the 1980s, the European semiconductor industry was characterized by a relatively small share in world production, a comparatively high emphasis on the more mature devices, and relatively high rates of import penetration and foreign direct investment. Arguing that a domestic semiconductor capability was vital for economic and political reasons, the European Community was concerned about the poor performance of the European semiconductor industry. This thesis discussed how the Community responded to import penetration and foreign direct investment in the semiconductor industry, and why the Community selected instead policies that according to liberal economics should be rejected on the basis of the associated welfare costs.

This study first described the semiconductor industry worldwide. The discussion of the industry was included in the thesis to give the reader the necessary background information, and to help understand the grounds for government intervention and the form of government interference in the semiconductor industry. Chapter II outlined the technological dimension of the semiconductor industry, its historical evolution, and the current patterns of supply and demand.

Based on the conclusion of Chapter II that the European semiconductor industry was a small actor in the world industry, Chapter III focused on the first research question of the thesis, namely what the Community did to improve the weak performance of the European semiconductor industry. The

EC policies were discussed in comparison with the Japanese and American policies, and with the member state policies.

The EC policies appeared to be beneficial to European-owned semiconductor producing firms and their share-holders. However, the EC policies were to the disadvantage of other actors such as semiconductor consumers, foreign exporters and, in certain cases, foreign-owned subsidiaries located in the Community. Chapter IV outlined the welfare and income distributional effects of the European semiconductor policies for the various actors involved in the EC semiconductor case, and for the Community as a whole. According to the economic liberal perspective, the EC policies adversely affected certain groups and imposed a welfare cost on the Community.

Chapter V and VI subsequently addressed the question why the Community selected policies that (at least in theory) were injurious to certain groups within society and to society as a whole. Chapter V outlined an explanatory framework for the European semiconductor policy response, namely the IIII-approach; the IIII-approach would give insight in the political economy factors that conditioned the European policy choice. Chapter VI applied the IIII-approach to the EC semiconductor case, thus answering the second research question of this thesis.

The first research question, namely "what was the EC policy response to import penetration and foreign direct investment in the European semiconductor industry", was

answered on the basis of a review of the primary sources and the existing literature in this area. It was expected that the European Community would support and protect the EC-owned semiconductor producers in order to establish a competent European-owned production capability.

The Community did protect and support the EC semiconductor industry to a large degree. The Community, however, did not block foreign direct investment into the Community, nor formally excluded foreign-owned producers from the benefits of government protection and funding. The objective of the EC policies in the 1980s appeared to be the establishment of a competent and high value European-located semiconductor industry, rather than an exclusively European-owned production capability.

The European Community protected its semiconductor industry against an influx of cheap imports through the Common Customs Tariff, the imposition of anti-dumping duties and the conclusion of price undertakings. Additionally, the Community sought to strengthen the European (owned) semiconductor producers and increase their international competitiveness through funding of cooperative R&D projects such as ESPRIT and JESSI. The Community also protected the design of semiconductor topographies to improve the legal environment of R&D and production. Finally, the Community allowed foreign direct investment in the semiconductor industry.

Community policies, however, had the intended or

unintended effect of upgrading inward investment through various incentives and constraints. Through the lower tariff on wafers, the Community stimulated investment in manufacturing operations in the Community instead of (exporting or) point-of-sales investments. Anti-dumping suits or threat thereof indirectly had the same effect, stimulating manufacturing in the Community to obtain European "origin" status, thus avoiding any anti-dumping charges. The change in rules of origin indirectly stimulated foreign direct investment in diffusion operations instead of assembly. Since diffusion generally accounts for most of the value of the completed chip and involves higher capital and R&D investments, this policy change also contributed to the upgrading of inward investment in the Community industry.

In terms of outward policies, the Community tried to protect the European semiconductor industry from the constraining effects of foreign semiconductor policies. In relation to member state policies, the EC policies as described above complemented and coordinated the national policies rather than supplanting them.

The second research question, namely, "why did the Community select policies which from an economic liberal point of view imposed welfare costs on society", was answered by applying the IIII-approach mentioned above. It was argued that policy choices might be explained by four interacting variables. The first "I", Ideology, referred to the ideas and

examples that influenced the European policy response. The second "I", Interests, pointed to the impact of non-state actors on European policy formulation, either directly or indirectly through national governments and/or intermediate organizations. Institutions, the third "I", referred to the impact of the two-tiered European government system. Finally, the fourth "I" referred to the impact of the international system on EC decision-making. The policy outcome that resulted impacted in its turn on the four variables described above through a feedback loop.

It was expected that the European semiconductor policy response could be explained by the impact of the economic nationalist ideology, lobbying of firms, national governments seeking to maximize their interests, and the impact of external factors.

Judging by the arguments used to justify government intervention in the semiconductor industry, the EC semiconductor policy choices have been affected by economic nationalist ideas, and, to a certain extent, strategic trade policy arguments. The Community, however, did not adhere to all economic nationalist policy prescriptions. In line with economic nationalist policy prescriptions, the Community impeded semiconductor imports through barriers and subsidized the semiconductor industry. However, in contrast to economic nationalist prescriptions, the Community was open to foreign direct investment. Neither did the member states adhere to

the anti-FDI prescription. The Community considered its objective of a competitive European semiconductor industry for political, strategic and economic reasons to be better served through upgrading rather than blocking of foreign direct investment.

Both semiconductor consumers as well as semiconductor producers lobbied the European Commission to act in accordance to their respective interests. In the DRAM anti-dumping case, producers would gain considerably from government intervention as would their share-holders, while consumers would lose substantially. However, the Commission adopted a policy line that benefitted the producers, indicative for the larger political power of these firms. The semiconductor producers were so effective in lobbying for EC funding and protection, due to their company size, their type of business operations and their political organization. Although the semiconductor consuming industry was also an important industry, semiconductor consumers were far less effective in their lobby activities due to the smaller strategic importance of final products over key inputs. Semiconductor producers also effectively lobbied the national governments.

The interests expressed by semiconductor producers were channelled and reinforced by the national governments and the European Community. National governments which sought to improve the performance of the domestic semiconductor industry, and the European Community which geared at the

establishment of a competitive European semiconductor capability, perceived the producers' request to protect and strengthen their in-house semiconductor capabilities as contributing to the realization of their own interests.

The member state interests and the EC interests were not necessarily in accordance; national governments feared, in particular, that the European semiconductor policies would supplant their policies. However, European policies appeared to be complementary to the member state ones, indicative for the impact of the member states on the EC semiconductor policy choice. The impact of member states on EC policy choices was explained by the fact that the member states could express their interests in various ways and on crucial points in the EC decision-making process. However, the power of the Council (platform for national interests) relative to the Commission (representing Community interests) was to a certain extent limited by the interdependence of the Commission and Council in the decision-making process. The Commission also played a dominant role in the initiation and implementation of Council decisions.

Finally, the nature of the international system and the position of the EC within this system influenced the EC policy choice through the impact of this external variable on semiconductor firms, national governments and the European Community. The disintegration of the world-wide liberal GATT regime into trading blocs, the revival of protectionism, and

the rise of managed trade threatened the position of EC firms in domestic and international markets, the autonomy of member states and the European Community. The international system also impacted on ideology; the recent developments strengthened the economic nationalist perception of the way in which the international system operated.

Evoked by the developments in the international system and justified by the economic nationalist ideology, the European Community thus chose its policies in response to the interests of semiconductor producers, which were channelled and strengthened by the member state governments, acting on behalf of national interests, and the European Commission, aiming at maximally supporting the European interest.

This thesis has discussed and analyzed the Community response to import penetration and foreign direct investment in the European semiconductor industry. As such, the study has contributed to the literature on EC semiconductor policies. Additionally, this thesis offered a case study on explaining economic policy choices. The IIII-model proved useful in this case, although due to the interaction between the four variables, and the feedback impacts of EC policies on these variables, the distinction between independent and dependent variables, and between exogenous and endogenous variables was not always clear-cut. The model made clear, however, that the EC semiconductor policy response was the outcome of a complex process in which various variables played a less or more

important role.

Some authors have questioned why the European semiconductor industry should be subsidized at all; would not we all be better off under free trade? Others have criticized the government for spending too little on an industry as vital for the Community's economy and autonomy as the semiconductor industry. Whether the Community has found the right response to foreign direct investment and import penetration, and thus to its "small country"-problem in semiconductors, remains a topic for future research.

Evaluation of policies inherently triggers the question as to what the government optimally should have done. Application of Porter's "diamond" of national competitive advantage constituting of four interacting determinants, namely factor conditions, demand conditions, related and supporting industries and firm strategy, structure and rivalry (Porter 1990:77), could give interesting insights in the competitive weaknesses of the European semiconductor industry, and could thus constitute a guideline to the formation of EC semiconductor policies. In that case, the core question would not be why the Community selected certain policies, but what the Community should select in order to increase its competitiveness in semiconductors.

BIBLIOGRAPHY

Aggarwal, V. (1987). "The Strategic Challenge of the Evolving Global Economy". Business Horizons, July-August, vol.30, no.4:38-45.

Algemeen Dagblad (1990). "Angst voor het Verolme-Effect." Algemeen Dagblad, September 6:3.

Andriessen, J.E. (1982). Economie in Theorie en Praktijk. Amsterdam: Elsevier.

Arnold, E. and K. Guy (1986). Parallel Convergence National Strategies in Information Technologies. London: Pinter:147-176.

Baldwin, R.E. (1989). "The Political Economy of Trade Policy". The Journal of Economic Perspectives, vol.3, no.4. Fall, 119-136.

Baldwin, R.E. and P.R. Krugman (1988). "Market Access and International Competition: a Simulation Study of 16K Random Access Memories". R.C. Feenstra, Empirical Methods for International Trade. Cambridge, Massachusetts:MIT:171-202.

Bellis, J. (1980). "New Community Protection against Dumping and Subsidies". European Law Review, vol.5:145-147.

Beseler, J.F. and A.N. Williams (1986). Anti-Dumping and Anti-Subsidy Law. The European Communities. London: Sweet and Maxwell.

Bhagwati, J. (1988). Protectionism. Cambridge, Massachusetts: MIT Press.

Boadway, R.W. and D.F. Wildasin (1984). Public Sector Economics. Boston: Little, Brown and Company.

Borrus, M.G. (1988). Competing for Control. America's Stake in Microelectronics. Cambridge, Massachusetts: Balinger Publishing Company.

Borrus, M., L. Tyson and J. Zysman (1986). "Creating Advantage: How Government Policies Shape International Trade in the Semiconductor Industry." P.R. Krugman (ed), Strategic Trade Policy and the New International Economics. Cambridge, Massachusetts: MIT Press:47-69.

Brander, J.A. (1986). "Rationales for Strategic Trade and Industrial Policy. P.R. Krugman (ed), Strategic Trade Policy and the New International Economics. Cambridge, Massachusetts: MIT Press:23-47.

Brander, J.A. (1987). "Shaping Comparative Advantage: Trade Policy, Industrial Policy and Economic Performance." R.G. Lipsey and W. Dobson (eds). Shaping Comparative Advantage. Policy Study, no.2. Montreal: C.D. Howe Institute:1-56.

Braun, E. and S. MacDonald (1982). Revolution in Miniature. Cambridge: Cambridge University Press.

Bronckers, M.C.E.J. (1989). "Private Enforcement of 1992: Do Trade and Industry Stand a Chance against the Member States?" Common Market Law Review, no.26:513-533.

Business Korea (1987). "World-Class Hopes". Business Korea, August:84.

Business Week (1990). "Semiconductors: Chips Are Down, but Not for Long." Business Week, January 8:100 and May 28:38.

Chaikin, S.C. (1985). "Trade, Investment, and Deindustrialization." T.H. Moran (ed). Multinational Corporations. The Political Economy of Foreign Direct Investment. Lexington, Massachusetts: Lexington Books:159-172.

Cohen, B.J. (1990). "The Political Economy of International Trade". International Organization, vol.44, no.2:261-281.

Cohen, B.J. and J. Zysman (1987). Manufacturing Matters. The Myth of the Post Industrial Economy. New York: Basic Books.

Conklin, D.W. and F.St. Hilaire (1988). Canadian High-Tech in a New World Economy: a Case Study of Information Technology. Canada: Institute for Research on Public Policy.

CEC (Council of European Communities) (1986). Esprit. European Strategic Program for R&D in Information Technology. Luxembourg: Office des Publications Officielles des Communautés Européennes.

CEC (1988). European Strategic Programme for R&D in Information Technology. Luxembourg: Office des Publications Officielles des Communautés Européennes.

De Peuter, S. (1985). "Developments in EEC Anti-Dumping Procedure." European Law Review, vol.10:358-362.

De Volkskrant (1990). "Een Beetje Verrast". De Volkskrant, May 5.

De Volkskrant (1990). "De Reddende Engel van Philips?" De Volkskrant, May 19:37.

De Volkskrant (1990). "Open EG-Markt Zet Ondernemer onder Druk." De Volkskrant, May 29:37.

Delta (1990). "Er Is nog Hoop voor Dutch Chips". Delta, September 13:6.

Directorate-General (D-G) XIII, Telecommunications, Information Services and Innovation (1989). The Review of ESPRIT 1984-1988. The Report of the ESPRIT Review Board.

Dixit, A.K. (1986). "Trade Policy: an Agenda for Research". P.R. Krugman (ed), Strategic Trade Policy and the New International Economics. Cambridge, Massachusetts: MIT Press:283-304.

Dosi, G. (1983). "Semiconductors: Europe's Precarious Survival in High Technology". G. Shepherd, F. Duchene, Ch. Saunders (eds) (1983). Europe's Industries. Public and Private Strategies for Change. London: Pinter:209-235.

Dunning, J.H. (1988). Explaining International Production. London: Unwin Hyman.

Durande, B. (1988). "Europe de la Technologie: du Defi aux Ambiguites". Chroniques d'Actualite de la S.E.D.E.I.S., no. 6, 15 Juin:237-245.

EC - P-40 (1983). Esprit: a Technological Push to Make European Industry Catch Up with its American and Japanese Competitors within Ten Years. Memo. May.

EC - Memo (1983). High Technology. Memo. May, 20.

EC - 10063 e/83 (Presse 176) (1983). First R&D Program on Information Technology-ESPRIT. Memo. June, 2.

EC Bulletin (1984). "The Adoption of the First Phase of the ESPRIT Program. Bulletin, no.2, July 27.

EC Memo 112/86 (1986). Commission Challenges in GATT the US-Japan Agreement on Semiconductors. Memo. October 8.

EC Memo 6734 en/87 (1987). Relations with Japan. Memo. May 25/26.

EC Memo 79/87 (1987). High Level Consultation between Commission and Japan. Memo. July, 7.

EC Presse 1054 en/87 (1987). Second Phase of the ESPRIT Programme. Memo. December.

EC Memo 32/89 (1989). GATT Panel Report on Semiconductors. Memo. June 2.

EC Press release IP (89) 478 (1989). Japan to Implement these Recommendations. Memo.

ECC Background Report ISEC/B1/83 (1983). Esprit: a New Venture in Co-operation. Report. January, 27.

Electronic Engineering Times (1988). "Recession Forecast". Electronic Engineering Times, September 5:20.

Electronic Engineering Times (1989). "SGS Thomson Projects Semiconductor Sales Downturn". Electronic Engineering Times, December 4:20.

Electronics (1985). Excerpts from Market Report. Electronics, January 1:67/68.

Electronics (1986). Excerpts from Market Report. Electronics, January 6:53 and January 13:39,43,47,50.

Electronics (1987). Excerpts from Market Report. Electronics, January 8:55 and January 22:79,81,85,88.

Electronics (1987). "Plessey Buys Ferranti Semiconductor Division". Electronics, December 17:152.

Electronics (1988). Excerpts from Market Report. Electronics, January 21:69,73,77.

Electronics (1989). Excerpts from Market Report. Electronics, January:55,57,121,125,130,138.
106.

Electronics (1989). "An Eleventh-Hour Twist in Plessey Take Over Bid. Electronics, March:56B.

Electronics (1989). "Losing the Edge in Production Equipment". Electronics, August:61-64.

Electronics (1990). Excerpts from Market Report. Electronics, January:53-55,94,98,101,103.

Electronic World News (1990). "European Market Sees Modest Growth in 1989." Electronic World News, January 15:25.

Electronic World News (1990). "Siemens Hits Top Two." Electronic World News, February 5:E1.

Ethier, W.J. (1988). Modern International Economics. New York: W.W. Norton and Company.

Europe (1982). "Research: Ten's Agreement on Pilot Phase of ESPRIT Programme Enables Launching of Community Long Term Strategy in field of Information Technology." Europe, Nov. 8/9:12.

Europe (1983). "New Technologies: the Parliament Approves the First Information Technologies Programme ESPRIT". Europe, Oct. 15.

Europe (1983). "Research Council: Ten Give Go Ahead to ESPRIT Program Subject to Two Financial Reservations Linked to Future Financing of Community under Stuttgart Mandate". Europe, Nov. 7/8.

Europe (1984). "Data-Processing: Council of 23-24 January to Seek Agreement on Financing of ESPRIT Program." Europe, Jan. 19.

Europe (1984). "ESPRIT Programme". Europe, Feb. 10.

Europe (1989). "EEC-Japan: Debates on the Quantitative Restrictions Practice by Several Commodity Counts". Europe, Jan. 13/14.

Europe (1989). "EEC-Japan: the Last "Screwdriver" Anti-Dumping Duty on Photocopies Is Eliminated." Europe, February 15.

Europe (1989). "EEC-Japan: Japanese Authorities Will No Longer Control Conditions on the Part of the Commission, which Is Presently Seeking Price Commitments." Europe, June 22.

Europe (1990). "EEC-Japan: European DRAM Manufacturers Welcome the Price Undertakings Offered by Japanese Producers and Consider that They Will Also Have Positive Effects for User Industries." Europe, Jan 31.

European Documentation (1988). "Research and Technological Development Policy." European Documentation, no.2.

European Documentation (1989). "Europe Without Frontiers - Completing the Internal Market." European Documentation, no.2.

European File (1989). "ESPRIT: Key to the Technological Awakening of Europe." European File, no.15.

European File (1989). "Europe, Our Future. The Institutions of the Community." European File, no.16.

European File (1989). "Patents, Trade Marks and Copyrights in the European Community." European File, no.17.

European News (1983). "ESPRIT. Europe's Technological Push." European News, May 20.

European News (1990). "EC Anti-Dumping Proceeding on Japanese DRAMs." European News, Jan. 23.

Financial Post (1989). "US Semiconductor Makers Fear New European Trade Restrictions." Financial Post, April 11, v.2(39):11.

Financial Post (1988). Calls on EC to block Take-Over Bid." Financial Post, December 13:12.

Financial Times (1989). "Brussels Chip Pricing Plan Angers Computer Makers". Financial Times London, July 27:3.

Financial Times (1990). "New Pressure to Reshape the Mould." Financial Times, May 25:17.

Financial Times (1990). "Europe's Chip Dilemma". Financial Times London, May 29.

Financial Times (1990). "European Chip Makers Limber up for Battle." Financial Times London, June 18:6.

Financial Times (1990). "Philips Lays off 4,000 in Computer Cutbacks". Financial Times London. September 5, 1990:7.

Flamm, K. (1990). "Semiconductors". G. Hufbauer, Europe 1992. An American Perspective. Washington, D.C.: The Brookings Institution:225-292.

Frieden, J.A. and D.A. Lake (eds) (1987). International Political Economy: Perspectives on Global Power and Wealth. New York: St.Martin's Press.

Geroski, P. (1987). "Brander's 'Shaping Comparative Advantage': Some Comments". R.G. Lipsey and W. Dobson (eds). Shaping Comparative Advantage. Policy Study, no.2. Montreal: C.D. Howe Institute:57-64.

Gilpin, R. (1987). The Political Economy of International Relations. Princeton: Princeton University Press.

Goldstein, J. (1989). "The Impact of Ideas on Trade Policy: the Origins of US Agricultural and Manufacturing Policies". International Organization, vol.43, no.1, Winter:31-73.

Gourevitch, P. (1986). Politics in Hard Times. Ithaca, N.Y.: Cornell University Press.

Grossman, G.M. (1986). "Strategic Export Promotion". P.R. Krugman (ed). Strategic Trade Policy and the New International Economics. Cambridge, Massachusetts: MIT Press:47-69.

Grunwald, J. and K. Flamm (1985). Global Factory: Foreign Assembly in International Trade. Washington D.C.: The Brookings Institution.

Hall, P.A. (1986). Governing the Economy. The Politics of State Intervention in Britain and France. Cambridge: Polity Press.

Harris, R. (1985). Trade, Industrial Policy and International Competition. Toronto: University of Toronto Press.

Harris, R.G. (1989). "New Protectionism Revisited". Canadian Journal of Economics, vol.22, no.4, November.751-778.

Hartley, T. (1979). "Locus Standi under Article 173: the Japanese Ballbearing Cases". European Law Review, vol.4:265-268.

Hill, S.R. (1989). Finding High Tech Policies that Work: Firms and Competitiveness in the Semiconductor Industry. Dissertation. University of Maryland College Park. Ann Arbor, Michigan: UMI Dissertation Information Service.

Howell, T.R., S.F. Benz and A.W.M. Wolff (1986). "International Competition in the Information Technologies: Foreign Government Intervention and the U.S. Response". Stanford Journal of International Law, vol.22, Fall:215-262.

Internal Market (1984). "Research Council, Member States Finally Approve ESPRIT Programme." Internal Market, no.1023:15.

Intriligator, M.D.(1987). "Comments" to T.N. Srinivasan, "The National Defense Argument for Government Intervention in Foreign Trade". R.M. Stern (ed), US Trade Policies in a Changing World Economy. Cambridge, Massachusetts: MIT Press:363-369.

Jenkins,B. (1986). "Reexamining the "Obsolescing Bargain": a Study of Canada's National Energy Program". International Organization, vol.40, no.1, Winter:139-165.

Jessi. A European Challenge. Brochure.

Junne (1987). "Automation in the North: Consequences for Developing Countries' Exports." J.A. Caporaso (ed). A Changing International Division of Labour. Boulder: Lynne Rienner Publishers: 71-90.

- Kelly, M. et al. (1988). Issues and Developments in International Trade Policy. IMF:88-105.
- Kennedy, P.M. (1987) The Rise and Fall of the Great Powers. New York: Random House.
- Koopmann, G. and H.E. Scharrer (1989). "EC Trade Policy beyond 1992. Intereconomics, Sept/Oct.:207-215.
- Kostecki, M.M. (1989). "Electronics Trade Policies in the 1980s." Journal of World Trade, vol.23, no.1, February:17-73.
- Krugman, P.R. (ed) (1986). Strategic Trade Policy and the New International Economics. Cambridge, Massachusetts: MIT Press.
- Krugman, P.R. (1987). "Strategic Sectors and International Competition." R.M. Stern (ed). US Trade Policies in a Changing World Economy. Cambridge, Massachusetts: MIT Press: 207-231.
- Krugman, P.R. (1987). "Is Free Trade Passé?". The Journal of Economic Perspectives, vol.1, no.2, Fall:131-142.
- Krugman, P.R. and M. Obstfeld (1988). International Economics. Boston: Scott, Foresman & Company.
- Krugman, P.R. and R.E. Baldwin (1988). "Market Access and International Competition: a Simulation Study of 16K Random Access Memories". R.C. Feenstra (ed). Empirical Methods for International Trade. MIT Press: 171-202.
- Langlois et al (1988). Microelectronics: an Industry in Transition. World Industry Studies 8. Boston: Unwin Hyman.
- Lauber, V. (1986). "The Political Economy of Industrial Policy in Western Europe." S.A. Hull and J.F. Cohen (eds), Economics and Politics of Industrial Policy. London: Westview Press:27-45.
- Lawrence, R.Z. and R.E. Litan (1987). "Why Protectionism Doesn't Pay." Harvard Business Review, May/June:60-67.
- Lipsey, R.G. (1987). "Report on Workshop." R.G. Lipsey and W. Dobson (eds). Shaping Comparative Advantage. Policy Study, no.2. Montreal: C.D. Howe Institute:109-155.
- Main, J. (1989). "How to Go Global and Why?" Fortune, August 28, 1989:70-79.
- Malerba, F. (1985). The Semiconductor Business. The Economics of Rapid Growth and Decline. London: Frances Pinter.

McKinlay R.D. and Little (1986). Global Problems and World Order. London: Frances Pinter.

Milner, H.V. and D.B. Yoffie (1989). "Between Free Trade and Protectionism: Strategic Trade Policy and a Theory of Corporate Trade Demands". International Organization, vol. 43, no.2, Spring:239-272.

Milner, H.V. (1987). "Resisting the Protectionist Temptation: Industry and the Making of Trade Policy in France and the United States during the 1970s". International Organization vol.41, no.4, Autumn:639-665.

Milner, H.V. (1988). Resisting Protectionism. Global Industries and the Politics of International Trade. Princeton, New Jersey: Princeton University Press.

Molina, R. (1989). The Social Basis of the Microelectronics Revolution. Edinburgh: Edinburgh University Press.

Moran, T.H. (1990). The Globalization of America's Defense Industries. Managing the Threat of Foreign Dependence. Mimeo. School of Foreign Service, Georgetown University. (Published also in International Security, Summer 1990, vol.15, no.1:57-99).

Mytelka, L. (1987). The Political Economy of Strategic Partnering. Ottawa:Investment Canada.

Mytelka, L. (1990). "Strategic Partnering Activity by European Firms through the Esprit Programme". Mimeo. Korea Institute for International Economic Policy.

Nelson, R.N.(1984). High-Technology Policies. A Five Nation Comparison. Washington D.C.: American Enterprise Institute for Public Policy Research.

New York Times (1987). "Fairchild Being Sold to National". New York Times, September 1:D1.

Noel, E. (1988). The Institutions of the European Community. Luxembourg: Office des Publications Officielles des Communautés Européennes.

Norall, C. (1989). "The New Amendments to the EC's Basic Anti-Dumping Regulation." Common Market Law Review, no.26:83-101.

NRC Handelsblad (1990). "Einde Moeilijkheden Philips Is Nog Niet in Zicht". NRC Handelsblad, May 4.

NRC Handelsblad (1990). "Timmer Zal bij Philips Snijden, Niet als een Slager, maar als een Chirurg". NRC Handelsblad, June 30:17.

NRC Handelsblad (1990). "Philips Kan Niet Blijven Werken met Zwakke Valuta", "Analisis Sceptisch over Reorganisatie". NRC Handelsblad, July 3:11.

OJ Official Journal C208/1, 1983. Council Resolution of 25 July 1983 on Framework Programmes for Community Research, Development and Demonstration Activities and a First Framework Programme 1984-1987.

OJ Official Journal C181/3, 1989. Notice of Initiation of an Anti-Dumping Proceeding concerning Imports of Certain Types of Electronic Micro-circuits Known as DRAMS Originating in Japan.

OJ Official Journal L342 of December 31, 1979. Council Regulation (EEC) No. 3000/79 of Dec. 20, 1979, Amending Regulation (EEC) No. 950/68 on the Common Customs Tariff.

OJ Official Journal L315 of Oct. 28, 1980. Council Regulation (EEC) No. 3000/80 of Oct. 28, 1980, Amending Regulation (EEC) No. 950/68 on the Common Customs Tariff.

OJ Official Journal L335 of Nov. 23, 1981. Council Regulation (EEC) No. 3300/81 of Nov. 16, 1981 Amending Regulation (EEC) No. 950/68 on the Common Customs Tariff.

OJ Official Journal L318 of Nov. 15, 1982. Council Regulation (EEC) No. 3000/82 of Oct. 19, 1982 Amending Regulation (EEC) No. 950/68 on the Common Customs Tariff.

OJ Official Journal L313 of Nov. 14, 1983. Council Regulation (EEC) No. 3333/83 of Nov. 4, 1983 Amending Regulation (EEC) No. 950/68 on the Common Customs Tariff.

OJ Official Journal L67/54 of March 9, 1984. Council Decision of 28 February 1984 Concerning a European Programme for Research and Development in Information Technologies (ESPRIT).

OJ Official Journal L320 of Dec. 10, 1984. Council Regulation (EEC) No. 3400/84 of Nov. 27 1984, Amending Regulation (EEC) No. 950/68 on the Common Customs Tariff.

OJ Official Journal L331 Dec. 9, 1985. Council Regulation (EEC) No. 3331/85 of Dec. 5 1985, Amending Regulation (EEC) No. 950/68 on the Common Customs Tariff.

OJ Official Journal L345 Dec. 8, 1986. Council Regulation (EEC) No. 3616/86 of Nov. 24, 1986 Amending Regulation (EEC)

No. 3331/86, amending Regulation (EEC) No. 950/68 on the Common Customs Tariff: 85.21.

OJ Official Journal L24/37 of Jan. 27, 1987. Council Directive of 16 December 1986 on Judicial Protection of the Topographies of Semiconductor Products.

OJ Official Journal L256 Sept. 7, 1987. Council Regulation (EEC) No. 2658/87 of July 23, 1987 on the Tariff and Statistical Nomenclature and the Common Customs Tariff: 8541, 8542.

OJ Official Journal L302/8 of Oct. 24. Council Decision of 28 September Concerning the Framework Program for Community Activities in the Field of Research and Technological Development.

OJ Official Journal L209/4 of August 2, 1988. Council Regulation (EEC) No. 2423/88 of 11 July 1988 on Protection against Dumped or Subsidized Imports from Countries not members of the European Economic Community.

OJ Official Journal L298 of Oct. 31, 1988. Commission Regulation (EEC) No. 3174/88 of Sept. 21, 1988 Amending Annex 1 to Council Regulation (EEC) No. 2658/87 on the Tariff and Statistical Nomenclature and the Common Customs Tariff: 8541, 8542.

OJ Official Journal L33/24 of Febr. 4, 1989. Commission Regulation (EEC) No. 288/89 of February 3, 1989 on Determining the Origin of Integrated Circuits.

OJ Official Journal L282 of Oct. 2, 1989. Commission Regulation (EEC) No. 2886/89 of Aug. 2, 1989 Amending Annex I to Council Regulation (EEC) No. 2658/87 on the Tariff and Statistical Nomenclature and the Common Customs Tariff: 8541, 8542.

OJ Official Journal L20/21 of Jan. 25, 1990. Commission Regulation (EEC) No. 165/90 of January 23, 1990 Imposing a Provisional Anti-Dumping Duty on Imports of Certain Types of Electronic Microcircuits Known as DRAMS Originating in Japan, and Accepting undertakings Offered by Certain Exporters in Connection with the Anti-Dumping Proceeding Concerning Imports of These Products and Terminating the Investigation in their respect.

OJ Official Journal L193/1 July 27, 1990. Council Regulation (EEC) No. 2112/90 of July 23, 1990 Imposing a Definitive Anti-Dumping Duty on Imports of Certain Types of Electronic Microcircuits Known as DRAMS Originating in Japan and Collecting Definitively the Provisional Duty.

Okimoto, D. a.o. (eds). (1984). Competitive Edge: the Semiconductor Industry in the US and Japan. Stanford, California: University Press.

Ostry, S. (1990). Governments and Corporations in a Shrinking World. Trade and Innovation Policies in the United States, Europe and Japan. New York: Council on Foreign Relations Press.

Patel, P. and K. Pavitt (1989). "European Technological Performance: Results and Prospects." European Affairs, no.2, Summer:56-63.

Philip, A.B. (1987). "Pressure Group Power in the European Community". Intereconomics, Nov/Dec:282-289.

Philips N.V. (1985,1986,1987,1988,1989). Annual Report of N.V. Philip's Gloeilampen Fabrieken. Eindhoven, the Netherlands.

Porter, M.E. (1986). Competition in Global Industries. Boston: Harvard Business School Press.

Porter, M.E. (1990). "The Competitive Advantage of Nations". Harvard Business Review, March-April, no.2: 73-93.

Richardson, D. (1990). "The Political Economy of Strategic Trade Policy". International Organization, vol.44, no.1:107-135.

Santo, B. and K. Wollard (1988). "The World of Silicon: It's Dog Eat Dog". IEEE Spectrum, September:29,32-39.

Sayer (1986). "Industrial Location on a World Scale: the Case of the Semiconductor Industry. A.J. Scott and M. Stolper. Production, Work and Territory. The Geographical Anatomy of Industrial Capitalism. Boston: Allen and Unwin: 107-123.

Sharp, M. (1988). "Inward Investment and Industrial Competitiveness." Intereconomics, September/October:241-250.

Shull, P. and J.F. Cohen (eds). Economics and Politics of Industrial Policy. The United States and Western Europe. London: Westview Press.

Siemens (1985,1986,1987,1988,1989). Annual Report of Siemens. West Germany.

Smith, B. (1986). "A New Technology Gap in Europe". SAIS Review, Winter/Spring, 6:219-236.

Srinivasan, T.N. (1987). "The National Defense Argument for Government Intervention in Foreign Trade". R.M. Stern. US Trade Policies in a Changing World Economy. Cambridge, Massachusetts: MIT Press:337-362.

Starbatty, J. and U. Vetterlein (1988). "Must The Semiconductor Industry be Subsidised?" Intereconomics, May/June:109-115.

Stegemann, K. (1989). "Policy Rivalry among Industrial States: What Can We Learn from Models of Strategic Trade Policy". International Organization, vol.43, no.1, Winter:73-100.

Stone, F. (1987). Canada, the Gatt and the International System. Ottawa: The Institute for Research on Public Policy.

Stone, N. (1989). "The Globalization of Europe: an Interview with Wisse Dekker". Harvard Business Review, May/June:90-95.

The Economist (1988). "European Electronics. Breaking a Vicious Circle". The Economist, August 1:54.

The Economist (1988). "The Anti-Dumping Dodge". The Economist, September 10:77-78.

The Economist (1989). "Who Turned out the Lights?" The Economist, vol.313, February 2:74.

The Economist (1989). "Silicon Ballet." The Economist, February 18:74.

The Economist (1989). "Testing Strategic Trade". The Economist, June 24, February 24:65.

The Economist (1989). "Europe's Trade Policy. A Gun that Needs to Get Knotted." The Economist, September 9:82-83.

The Economist (1989). "European Commission Dictionary Time". The Economist, December 9:52.

The Economist (1989). "The Headless Superpower". The Economist, December 16:17-18.

The Economist (1989). "LSI Logic Tiny Terror". The Economist, vol.313, December 23:80-83.

The Economist (1989). "Tinkerers versus Dreamers", The Economist, December 23:73-74.

The Economist (1990). "Policing Europe's Single Market." The Economist, January 20:69-70.

The Economist (1990). "Welcome the Cheap-Chip Lobby." The Economist, February 3:16-17.

The Economist (1990). "Memory Chips. One World." The Economist, February 3:149.

The Economist (1990). "From the Sublime to the Subsidy". The Economist, February 24:71.

The Economist (1990). "Nothing to Lose but Its Chains". Survey. The Economist, September 22:6.

The Globe and Mail (1989). "Britain, EC Launch Monopoly Inquiries into Hostile Take-Over Bid for Plessey." The Globe and Mail, January 13:B15.

The Globe and Mail (1989). "Once Sleepy Siemens, Now Active, Ambitious." The Globe and Mail, January 30:B1,B4.

The Globe and Mail (1989). "Plessey Results Bolster Fight after Takeover" The Globe and Mail, May 23: B17.

The Globe and Mail (1989). "GEC, Siemens Win Battle to Capture Britain's Plessey." The Globe and Mail, September 9:B5.

The Globe and Mail (1990). "Japanese Investing in the EC" and "European Firms Targeted." The Globe and Mail, August 2:B2.

Thomson (1982,1985-86). Annual Report of Thomson. France.

Treaties Establishing the European Community. Luxembourg: Office for Official Publications of the European Communities.

Tweede Kamer van de Staten Generaal (1989). Technologie Beleid 1989-1990, 21311. Den Haag: Ministerie van Economische Zaken.

Tyson, L. (1987). "Comments on Brander's 'Shaping Comparative Advantage': Creating Advantage, An Industrial Policy Perspective":65-82.

Udis, B. (1987). The Challenge to European Industrial Policy. Impacts of Redirected Military Spending. Westview Special Studies in International Economics. London: Westview Press.

UNCTC (1986). Transnational Corporations in the International Semiconductor Industry. New York: United Nations.

UNCTC (1988). Transnational Corporations in World Development. New York: United Nations.

United Nations (1987). International Trade Statistics Yearbook. Trade by Commodity. New York: United Nations.

Van Tulder, R. and G. Junne (1988). European Multinationals in Core Technologies. New York: J. Wiley and Sons.

Vermulst E., and P. Waer (1990). "European Community Rules of Origin as Commercial Policy Instruments." Journal of World Trade, June:55-99.

Vernon, R. (1966). "International Investments and International Trade in the Product Cycle". Quarterly Journal of Economics and Statistics, vol.41:255-267.

Viner, J. (1987). "Power versus Plenty as Objectives of Foreign Policy in the Seventeenth and Eighteenth Centuries." J.A. Frieden and D.A. Lake. International Political Economy: Perspectives on Global Power and Wealth. New York: St.Martin's Press:71-84.

Wall Street Journal (1988). "Technology Fosters More Corporate 'Togetherness'". Wall Street Journal, January 5th:25.

Wall Street Journal (1989). "Disagreement in US Electronics Industry". Wall Street Journal, January 10:B5;3.

Wall Street Journal (1989). "US is Asking for Japanese Assurances about Suppliers of Computer Memories" Wall Street Journal, August 22.

Walsh, V. (1987). "Technology, Competitiveness and the Special Problems of Small Countries". STI-Review, no.2:81-133.

Welfens, P.J.J. (1987). "Growth, Innovation and International Competitiveness". Intereconomics, July/August:168-174.

Wyatt, S. (1987). The Changing Technology Scene: the Case of the OECD Countries. Technology Trend Series no. 7. New York: United Nations Industrial Development Organization.

Yarbrough, B.V. and R.M. Yarbrough (1988). The World Economy: Trade and Finance. New York: Dryden Press.

Yoffie, D.B. (1988). "How an Industry Builds Political Advantage". Harvard Business Review. May-June 1988:82-89.

Young, G. (1985). Venture Capital in High-Tech Companies. The Electronics Industry in Perspective. London: Frances Pinter.

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