REGIONAL INTEGRATION AND THE LOCATION OF MULTINATIONAL CORPORATIONS

Pontus Brodde Braunerhjelm

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Regional Integration and the Location of Multinational Corporations

Implications for Comparative Advantage and Welfare of Outsiders and Insiders

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"I felt very strongly that it was wrong to view the economy as stationary, as Walras had done, and that there was a source of energy within the economic system which would itself disrupt any equilibrium."

Schumpeter (1937)

"Science is for those people equivalent to positivism, and consequently they can only acknowledge quantified results, i.e. those that originate from a weighing or measuring procedure. Everything else is regarded as the same kind of devastating madness as today's theories were yesterday - that is, before they were proved to them." (Author's translation).

Kandinsky (1911)

FOREWORD

Foreign direct investment has been on the research agenda of the Industrial Institute for Economic and Social Research (IUI) for a long time. In the wake of increasing liberal policy frameworks, and propelled by technological advances, foreign direct investment has during the last decades evolved into a major force in the world economy. Through their international allocation of production, multinational corporations influence the structure of production, the pattern of trade, and the prerequisites for growth across countries.

This thesis, defended in December 1994 at the Graduate Institute for International Studies in Geneva, is the 50th doctoral or licentiate dissertation completed at the Institute. It addresses two major issues. The first relates to home country effects of foreign direct investment. The second concentrates on forces that attract investments to host countries. Particular attention is paid to agglomeration forces, and the extent to which such forces differ between industries.

The analysis draws on recent advances in economic models that incorporate and endogenize the location of multinational corporations. Each of the empirical chapters implement different data sets collected on the firm level, and sometimes pooled with country-level data. Although the empirical analysis is limited to Sweden, the results should have a wider application and contribute to a more general understanding of the interrelationship between multinational corporations and small open economies in a context of regional integration.

Stockholm in February 1996

Ulf Jakobsson

Contents

Acknowledgement

Being trained in the traditional general equilibrium school of economics, foreign direct investment (FDI) never struck me as a particularly interesting area of research, that is, until I took up a position as a researcher with the Industrial Institute for Economic and Social Research (IUI) in 1988/89. Then a partly new world was introduced to me where traditional concepts and assumptions of factor immobility, fixed points and general equilibrium were exchanged for terms like entrepreneurs, footlooseness and creative destruction. In other words, it was my first glimpse into the Schumpeterian world. Even though I have to a large extent retained the traditional general equilibrium model, the Schumpeterian approach has influenced my way of thinking of economics, which of course can be traced in the thesis. For those insights I am indebted to Professor Gunnar Eliasson, former director of the IUI, and also for his never ending enthusiasm and support.

The problems I address in the thesis concern the forces that determine how firms locate production across countries. The IUI has a long tradition in analyzing FDI and constitutes a highly stimulating environment for research in this area. Special thanks to Erik Mellander, Karl-Markus Modén and Sten Nyberg for careful and critical scrutiny of the chapters. Roger Svensson has been my co-author in Chapter 5, a fact which will assure that it contains a sophisticated empirical analysis. I am also grateful to Professor Paul Segerstrom and Associate Professor Thomas Andersson for commenting on different parts of the thesis. Earlier drafts of papers which later were integrated or used in the thesis have benefited from constructive discussions with Associate Professors Lars Lundberg and Per Lundborg, and also from Birgitta Swedenborg.

The thesis was defended in December 1994 at The Graduate Institute of International Studies, Geneva. I would like to express my gratitude to the members of my thesis committee, Professor Richard Blackhurst, The Graduate Institute of International Studies and the General Agreement on Tariffs and Trade, Professor Hans Genberg, The Graduate Institute of International Studies and, finally, Professor Asim Erdilek, Case Western Reserve University. Their knowledgeable comments

substantially improved the content of the thesis. Professor Henryk Kierzkowski, also at The Graduate Institute of International Studies, provided valuable guidance in an initial phase of the thesis work.

Excellent data assistance has been supplied by Jörgen Nilson and Torsten Dahlquist while Cynthia Miller helped to turn the manuscript into a legible product. I would also like to thank Professor Ulf Jakobsson, the present director of IUI, who accompanied me and provided moral support when I defended the thesis in Geneva. Of course, without generous financial support from particularly the Jan Wallander Foundation for Social Science Research, the Sahlén Foundation, Jakob Wallenberg Foundation and the Nordic Economic Research Council, this work would not have been accomplished.

Finally, to my dearest Britt, it took some time, but a man got to do what a man got to do. Thanks for your patience and support.

CHAPTER 1

REGIONAL INTEGRATION AND THE LOCATION OF KNOWLEDGE-INTENSIVE MULTINATIONAL CORPORATIONS

Implications for comparative advantage and welfare of outsiders and insiders

1.1 Introduction

The purpose of this thesis is to study the effects of exogenous shocks originating in the implementation of integration policy on small open economies that are hosts to internationally mobile firms. Current attempts in several parts of the world to integrate regionally (e.g. EU, NAFTA, LAIA) and the increased national importance of the operations of already globally organized multinational corporations (MNCs), make this study highly topical.[1] The original idea, however, grew out of a study in the late 1980s (Braunerhjelm 1990a) in which repeated observations were made that appeared to contradict the predictions of traditional integration theory.

The established theory of integration tells us to expect specialization to increase among member countries of an integrated area (*insiders*) as new trade opportunities are created. In *outsider* countries such effects should be less pronounced, or not present at all. This standard result depends critically on the extent to which integration diverts trade away from outsiders due to the preferential elimination of trade barriers, and the assumption of no, or negligible, factor mobility.

In integration theory factors are generally assumed to be nationally trapped, i.e. there are no transfers of factors between countries. This common assumption dominates the analytical results, a circumstance that frequently is overlooked. Our first task is to modify that assumption. Assuming that factors are internationally mobile, the imposition of trade barriers tends to induce tariff-jumping by firms in order to secure access to protected markets. On the other hand, if integration takes place

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[1] The European Union (EU) is the present name (after November 1993) of the former EC (European Community). These abbreviations will be used interchangeably throughout the presentation. NAFTA is the abbreviation for North American Free Trade Agreement, while LAIA stands for Latin American Integration Association.

among countries without the creation of a common tariff wall against outsiders, the literature gives no reason for factor flows to occur between outsiders and insiders.

The present case focuses on the integration process within Europe, announced as a device to sharpen competition and to promote trade, but not to build a fortress against outsiders (Cecchini 1988). For most of the outsider countries in Western Europe (the EFTA countries), tariffs have already been substantially reduced and market access guaranteed through a series of free trade agreements between the individual EFTA countries and the EC. Consequently, there should be no reason to expect any dramatic change in firm behavior.[2] That things were not so simple, however, became apparent in a detailed survey and interview study of Swedish firms in the manufacturing sector undertaken in 1988 and 1989 (Braunerhjelm 1990a,b).

The objective of the 1988/1989 study was to understand the consequences for firm behavior of different types of associations with the EC, and to link such behavior to the macro level. The main alternatives were either membership in the EC or a status quo relationship. At that time, the uncertainty concerning the Swedish future relationship with the EC was a real issue. Within the manufacturing sector, dominated by approximately 30-40 large, mostly multinational firms, a shift of production or investments towards the EC, originating from such uncertainty, could negatively affect the Swedish economy. The survey covered about 40 percent of employment in the Swedish manufacturing sector. A round of interviews with 40 firms, mainly large, complemented the survey.

The results were as follows: *First,* the surveys and the interviews suggested that if Sweden remained outside the EC a substantial relocation of Swedish manufacturing production into the EC would occur. *Second,* a distinct difference could be observed between firms belonging to technologically advanced industries (for example engineering and pharmaceuticals), and firms in basic industry production (forest and steel industries). Firm executives in the former industries told us they were more inclined to move production into the Common Market in order not to be caught in a disadvantaged position if Sweden remained outside the EC. In the firms belonging to the latter industries, the transaction costs associated with moving huge process-intensive plants abroad and breaking up the infrastructure of existing production systems, were claimed to be prohibitive. On the other hand, it was said

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[2] The former free trade agreements between the EFTA countries and the EC covered mainly manufacturing goods, while the creation of an "internal market" within the European Union (EU) also includes the "freedoms" of services, labor and capital to move across borders. The presence of non-tariff barriers, such as public procurement and anti-dumping threats, could, of course, also induce firms to relocate production.

that new investments, particularly in the later, less process-intensive stages of the value-added chain, would increasingly be located abroad if Sweden alienated itself from the EC.

Judging from the survey results, Sweden would thus become more dependent on the industries that intensively use raw materials, while technologically sophisticated firms would concentrate production abroad. This has indeed occurred (see Andersson -Fredriksson 1993). Such increased specialization of outsiders is not predicted by standard integration theory.

A structural shift towards basic industry production means that countries run the risk of being deprived of their knowledge capital. Three specific qualities are associated with knowledge-intensive production. First, the local knowledge stock influences a country's pattern of growth and production. Second, it generates positive externalities. Third, it stimulates location of firms for which the exploitation of knowledge spillovers (the same externalities) from other firms are important, i.e. agglomeration may occur. Thus, the results from the surveys and interviews may be interpreted as follows: growth will be impeded in the Swedish economy since knowledge-intensive, high value-added production can be more profitably concentrated abroad.

The reason for the apparent contradiction between theory and empirical observations must be sought in the mobility of factors of production through MNCs. This empirical observation should have substantial consequences for the formulation of both trade theory and trade policy. Thus the fruitful confrontation of the theory of the firm and trade theory will be the main theme of this thesis.

1.2 International background

Foreign direct investment (FDI) has become a major force in the global economy during the recent decades. In the latter half of the 1980s the annual growth of FDI averaged a stunning 30 percent. The extent of multinational production is reported in a UN study on world investment as follows: "The stock of foreign direct investment (FDI), a measure of the productive capacity of transnational corporations (TNCs) in foreign countries, reached some $2 trillion in 1992. Over 170,000 foreign affiliates of some 37,000 parent firms generated approximately $5.5 trillion in worldwide sales in 1990. This compares with world exports of goods and non-factor services of $4 trillion, of which one third took the form of intra-firm trade" (UN, 1993).

Furthermore, through their interactions with local suppliers, technology diffusion, etc., the influence of MNCs goes far beyond pure investment figures.

Overseas investments have also been extended to business operations formerly not involved in FDI and they engage an increasing number of countries. As firms have made their business strategies on the regional or global level, their production organization has become increasingly complex and geographically dispersed. Such microeconomic reorganization affects countries by either tying them together in complex networks, or by depriving them of investments (UN 1993).

This evolution has been prompted by two events in particular: (1) the pace of technological progress, with emphasis on information technology, and (2) politically initiated deregulation, notably the dismantling of trade barriers and the removal of capital controls. The latter event has brought a substantial increase in international competition during the last twenty years. Firms have responded by reorganizing to reduce production slack and X-inefficiencies. Flexibility, competence and rapid learning have been key concepts in that process. One aspect of increased flexibility is the ability of firms to relocate production on short notice as the possibilities of profitable production alters in one country, in favor of another. Furthermore, to sustain competitiveness, firms need to continuously upgrade their competence by making investments in R&D, education, and marketing.

The increase in international factor mobility conducted through MNCs makes economies more exposed to the investment decisions by firms. This is particularly obvious for those countries that host a limited number of large multinational firms who dominate the manufacturing sector. Inward investment flows require that a country offer the right set of attractive factors, whether it be the skill level of employees, the accessibility of resources, or the institutional setting, including the country's participation in regional or global agreements concerning fundamental economic or political matters. Furthermore, the investment decisions of MNCs and the ability of MNCs to reallocate competence internationally influence the composition of factors of production across countries. Hence, comparative advantage becomes endogenous. The size of the country, in combination with the size distribution of firms, determine to what extent the pattern of specialization and trade is affected. The Nordic countries (Iceland excluded) on which the empirical analysis in the present study focuses, can all be characterized as small open economies where manufacturing production is generally dominated by a limited number of large MNCs.

1.3 Purpose, limitation, and methodology

As mentioned above, emphasis is on the insider-outsider relationship, i.e. the locational response of firms in countries not participating in an integration process and the derived macroeconomic consequences. More precisely: How are firms' location decisions influenced by exogenous institutional changes (such as integration) and differences in factor compositions (particularly those related to knowledge) across countries? Furthermore, what are the implications of such micro-level (firm) adjustment for a country's specialization, trade pattern and welfare? The macro-economic part of the investigation can also be interpreted as an analysis of the vulnerability of small open economies and the available degrees of freedom in economic policy.

Important in that respect is whether the propensity to relocate differs between firms belonging to different industries and to what extent the structure of the manufacturing sector is affected. In other words, are knowledge-intensive firms more inclined to relocate than firms in the basic capital-intensive industry? In addition, which parts of production are most prone to relocation? Is it the more knowledge-intensive parts or is it the production lines that primarily exploit differences in factor costs? In this particular respect we can talk about internal markets for competence within the MNCs.

Knowledge is generally assumed to contribute positively to the welfare of a country.[3] Before drawing any conclusions with regard to the macro level, however, we have to establish the relationship between a firm's investment in knowledge and its performance with regard to profitability and internationalization. This problem will first be studied at the microeconomic (firm) level in order to build the foundation for some of the assumptions used in the more macro-oriented analysis to follow. The next step is to detect the pattern of foreign investment in different industries. By identifying the country factors that attract investments, particularly the influence of skill factors, we can make inferences on the location of the knowledge stocks of firms. One important variable is whether the relative size of the host country's industry in which the investing firms operate influences the locational decisions. Do firm and country characteristics complement or substitute for each other? Can we observe patterns of agglomeration for different industries or do firms adopt first mover strategies?

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[3] See Grossman-Helpman (1991) for a survey.

Both theoretical and empirical aspects will be considered. Emphasis, however, is on the empirical analysis of the locational patterns of large Nordic firms. The reason is simple: all Nordic countries are small open economies and three of them were outsiders as the EC 1992 program was announced in the mid-1980s. The theoretical analysis is confined to comparative static within a general equilibrium as well as a partial equilibrium context. In the empirical analysis the ordinary least square regression technique is applied in Chapters 3 and 4, while a Tobit analysis is used in Chapter 5. Except for Chapter 2, which is purely theoretical, the tested hypotheses are derived from either explicit models or by drawing on earlier, generally established, theoretical results.

The different data sets used in the regressions contain unique information and are mainly gathered by the Industrial Institute for Economic and Social Research (IUI), Stockholm. The micro-study in Chapter 3 is based on a detailed data set of Swedish firms, covering approximately 40 percent of the employees in the manufacturing sector. In addition to exports, sales, employees, etc., data are also available on the skill structure within the firms and on the educational level, including its costs, for different categories of labor. The firms have also reported their investments in R&D, marketing, education and software. On the basis of these data we can construct knowledge capital stocks.

In Chapter 4 data on the 30 largest firms in Denmark, Finland, Norway and Sweden for the time period 1975-1990 have been collected for the empirical analysis. The data set contains information on foreign and domestic employees in the firms, sales, exports, value-added, profits, age, etc., where firms are classified according to at least the three-digit ISIC level.

The analysis in Chapter 5 builds on an extremely detailed data set of Swedish MNCs for the years 1978, 1986 and 1990. For each of these years the data set covers more than 90 percent of the Swedish MNCs, giving precise information on intra-firm trade, R&D expenditures, assets, investments and acquisitions of companies, etc., for both the parent company and the subsidiaries. For example, the data set contains information on each market to which the subsidiaries export, the distribution between intermediate goods and final goods, re-export back to Sweden, etc. The quality and extent of this data set probably makes it the best available source of information on the operations of MNCs.

The analysis is restricted to large manufacturing firms. The small business and service sectors will be neglected. This is a weakness considering the fact that long term growth has been, and will probably continue to be, concentrated to small

business formation and expansion, and to the service sector in particular (Braunerhjelm 1993). Lack of data on the service sector is the main reason it is not included in the analysis here. Most business related services, however, are based on the production of some good. Yet many of the services provided still take place within the manufacturing firms and are consequently incorporated into the empirical analysis.[4]

There are, of course, also costs associated with the participation in an integration process. The extent of those costs are closely related to the degree of discriminatory measures taken against outsiders. In addition, participation may be conditioned on various participation fees. We will not take such costs into account in the analysis. Furthermore, throughout the analysis we will assume that an integration process among a number of countries does not imply increased barriers towards outsiders, i.e. no protectionistic measures accompany the integration.

1.4 Organization of the thesis

With the exception of Chapter 3, all chapters are devoted to the same problem, namely, the influence of increased firm mobility on a country's specialization and trade pattern. Particular attention is paid to the distribution of knowledge and basic industry firms across countries, and the related effects on comparative advantages. The theoretical approach, however, differs from chapter to chapter, and the empirical analyses use different data sets. Each chapter can therefore be read separately, although for a comprehensive picture of the problems studied, the whole thesis has to be read.

In Chapter 2 the traditional general equilibrium model as outlined by Jones (1965), and its later Edgeworth box version (Dixit-Norman 1980, Helpman-Krugman 1985), are presented. We try to explain and incorporate the observed unorthodox phenomena described above by allowing for factor - or firm - mobility across international borders. An integration process either influences information costs, fosters technological progress, or increases knowledge spillovers, which induce factor flows from outsiders into the integrated area. The traditional two-good, two-factor

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[4] Only external purchases of services in the manufacturing sector that fall outside of the statistics, i.e. if a firm puts its financial services in a separate legal entity, its operations will be registered among private services. The same goes for marketing, transportation, computer and other services (see Braunerhjelm (1992) for details with regard to the Swedish economy or Eliasson (1990) for a redefined industrial sector where industry related services are included in the statistics of manufacturing).

and two-country framework is modified to accommodate one factor called knowledge, used intensively by the firms in the more technologically advanced industry, to move between countries. We can interpret this as a firm's multinational activities. Alternatively, the mobile factor can be viewed as the firms themselves.

The analysis combines the macro-oriented theoretical works of Jones (1965), Cornes-Kierzkowski (1981), Markusen (1983, 1984) and Helpman-Krugman (1985) with the theory of the firm as presented by Coase (1937), Hymer (1960), Caves (1973), Buckley-Casson (1977), to mention a few. It is shown how nonparticipation in an integration process results in an outflow of factors, higher specialization and lower welfare. Furthermore, increased trade intensity between the two countries may coincide with lower welfare for the outsider, an argument forwarded by Graham already in 1923. The mechanism that sets off factor flows at given prices are changes in information costs, technology, or positive externalities in the knowledge-intensive sector emanating from an increased interplay between economic agents as integration occurs (von Hippel 1987, Eliasson 1991, Grossman-Helpman 1991).[5]

Chapter 3 presents a definition of a knowledge production factor, referred to as competence capital. The relationship between investments in competence capital and firm performance is analyzed. The stock of firm-specific competence is incorporated into a production function and it is shown how firm performance is positively correlated with such assets. The returns to such capital is appropriated by firms (owners) and cannot be associated with any particular production factor (McKenzie 1959, Eliasson 1990). Furthermore, the excess or scale-based rents from such dominant knowledge can be shown to appear as total factor productivity shifts in the production function (Eliasson 1992a). Tacitness and imperfect information suffice to make such capital differ between firms and give rise to temporary monopolies and price dispersion among firms. A unique data set containing intangible assets, collected in close collaboration with the firms themselves, is the base of the empirical analysis. The estimations give robust evidence for the significance of such competence capital in explaining the distribution of firm rents.

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[5] The two-sector, two-factor and two-good model is, of course, not the best specification to capture dynamic micro phenomena operating across national borders between, and within, firms. Particularly, as discussed in Chapter 3 and 5, although not explicitly modelled, if exogenous changes (here exemplified by integration and advances in information technology), lead to spontaneous creation of markets for competence, implying that firms reallocate proprietary knowledge within the firm to markets that yield the highest return.

Chapter 4 takes us back to the macro level. Building on recent contributions in locational theory, Venables (1993)[6] has shown in a two-industry model how the location of firms depends on the interaction of costs of market access, differences in the size of markets (core-periphery) and production costs. In a slightly modified model, firms are grouped into either a basic industry that is assumed to derive economies of scale at the plant level, or a high-tech sector where scale economies are assumed to appear at the firm level. The firm-specific economies of scale emanate from inputs of a non-rivalry production factor, interpreted as competence capital which is the source of product differentiation. As firms that were formerly protected by trade barriers are exposed to international competition, differences in the size of markets and in costs induce firms to relocate production. The empirical results show that countries specialized in high-tech production are more likely to experience substantial relocation if production conditions alter there. The hypotheses derived from the model are empirically tested on a firm data set for the Nordic countries.

In Chapter 5 the same problem is analyzed from the point of view of the countries receiving investments. In other words, the impact of foreign country characteristics on the location of firms is investigated. Previous empirical work has focused on the size of markets, the degree of openness, market proximity and factor costs, among other things (see Lipsey-Kravis 1982, Culem 1988, Swedenborg 1979). Yet few attempts have been made to understand the influence of the host country's manufacturing structure itself on firms' FDI. In particular, do firms prefer to invest in countries with similar production, or does a pattern of "opposites attract" (Kravis-Lipsey 1982) prevail? The former implies agglomeration tendencies similar to the theoretical explanations in the "new" theories of growth and economic geography. The latter indicates that firms try to reap first mover advantages (Chandler 1990, Mueller 1990). In an integration context, where markets are opened up and competition is strengthened, the structure and size of such attracting factors are decisive for investments. By combining a data set on practically all Swedish multinational corporations and approximately 20 foreign countries receiving investment by Swedish firms between 1978-1990, it is shown that agglomeration occurs among firms in the high-tech industry while other factors are more important for basic industry firms.

The concluding chapter summarizes the main results and discusses the policy implications of the analysis. Possible avenues for future research within this area are

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[6] See also Krugman (1991 a,b).

also presented. For instance, if the conclusions of the new growth theory holds, the distribution of knowledge intensive production should result in divergent growth rates among countries.

CHAPTER 2

REGIONAL INTEGRATION, FOOTLOOSE FIRMS, AND THE PATTERN OF TRADE AND PRODUCTION OF INSIDERS AND OUTSIDERS[7]

2.1 Introduction

This chapter raises a few questions concerning the robustness of traditional integration theory as internationally mobile firms are incorporated into the analysis. According to mainstream integration theory, the inter–industry specialization of the participating countries is strengthened whereas outsiders are likely to become less specialized as trade with insiders diminishes. Allowing for international transfers of factors through mobile firms, however, leads to more ambiguous results. The incidence of mobility on different factors and which sector – import or export – that employs the mobile factors most intensively, determine the impact for outsiders. Specialization in production could hence be reinforced even if a country chooses, or is forced, to stay outside an integration process.

In neglecting to include firms in traditional integration theory the most influential respondents to integration have been disregarded. Consequently, the micro–foundation of that model is, to say the least, poor.[8] International firms are the dominant actors in international economics with

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[7] This chapter has benefited from valuable comments from Professor Paul Segerstrom and Ph.D. Karl–Markus Moden.

[8] Helpman–Krugman (1985) have introduced the multinational firm into the general equilibrium trade model. The firm is modeled in a way such that its existence is due to large differences in factor endowments between countries. Hence, it deals predominantly with vertical integration of firms in developed and developing countries.

regard to trade, investment and technology transfer.[9] The options available to international footloose firms differ completely from those assumed in most trade models where firms are tied to one country. As is evident from the strategies of international firms prior to the formation of the European Community (EC) in the 1950s, as well as during its extension in the 1970s and the 1990s, firms seem to respond to such institutional changes (Dunning 1991, Baldwin, Haaland & Forslid 1994).[10] There was a massive inward foreign direct investment into the EC, resulting in structural adjustment and altered factor compositions within and between countries (Cantwell 1988). Hence, empirical findings suggest that institutional changes may shift comparative advantages across countries or regions through induced firm behavior.

This chapter is organized as follows: Section 2.2 gives a brief background of earlier research relevant to factor movement in the standard general equilibrium model, defined to incorporate international firms. In section 2.3, three possible reasons for a reshuffling of factors across countries in response to international trade policy changes are elaborated. First, the effect of an institutional change – represented by an integration process – on the information costs of outsiders (firms) is considered. Second, the assumption that such institutional change affects the production technology of insider firms is investigated. Within this setting the analysis is extended to the effects of policy induced externalities. Section 2.4 summarizes the main findings.

2.2 Background

According to traditional trade theory, the effects of integration can be divided into the effects of trade creation and trade diversion (Viner 1950, Meade 1955, Lipsey 1960). The former is welfare enhancing, while trade diversion

[9] The term international firm is used to stress that firms need not have production abroad, i.e. rather than being multinational they are footloose and have the option to locate in different countries.

[10] Such firm behavior is also supported in empirical investigations for the Nordic countries (Braunerhjelm 1990a, Karlsen 1990). For a US perspective, see for instance Henderson (1989) or Zieburn (1983). More generally, see Leban–Lesbourne (1983) for adaptive strategic behavior by firms.

reduces welfare. Trade creation occurring within the integrated area is likely to coincide with external trade diversion, i.e. exchange of goods with outsiders decreases, and it is not a trivial task to derive the net effect. Subsequent contributions to integration theory have focused on game theoretical aspects and the role of dynamic effects such as economies of scale, technological progress and innovations. Factor flows, or investments between outsiders and insiders, and their impact upon the general equilibrium solution have, however, been ignored.

One explanation is the neglect of the firm. The theory of the firm, first developed by Coase (1937), explains international production, or transfers of factors of production, through internalization theory, transaction costs arguments and locational advantages (Mundell 1957, Hymer 1960, Kindleberger 1969, Aliber 1970, Caves 1971, Buckley–Casson 1976, Dunning 1977, Williamson 1975, 1985, Teece 1983 and others). Price differentials between markets may induce such transfers, although other explanations, especially the appropriability problem and resource seeking, are more frequently forwarded.

Introducing the firm into standard integration theory therefore suggests that the traditional approach of comparing relative prices of goods between outsiders and insiders is a far too narrow perspective. At the micro–level firms do not solely act as arbitragers to exploit differences in relative prices, as first pointed out in the seminal work by Hymer (1960).[11] Furthermore, from the point of view of countries, the purpose of an institutional change could be to stimulate an inflow or reallocation of factors between countries, rather then a change in relative prices. The inflows would serve to widen the industrial base, strengthen the R&D base of production and/or increase competition, i.e. comparative advantage would be acquired through institutional change (Helpman 1988). Particularly since concentration of knowledge factors, like skilled labor, R&D departments, etc., has been argued to generate dynamic long–run growth effects, both in terms of an increased stock of production factors and positive externalities (Baldwin 1989, Grossman–Helpman 1991).

Yet, also the static short–run effects – which will be considered here – are of interest. To comprehend the static solution it is necessary to elucidate the (instantaneous) underlying process guiding an economy between two

[11] Empirically there is also very little evidence supporting that firms undertake foreign production in order to exploit arbitrage gains (Brainard 1993a, Caves 1995).

points of equilibria. A major issue in this chapter is the adjustment process of internationally footloose firms, as they are exposed to an exogenous policy shock.

Hence, there are ample theoretical and empirical reasons why international trade theory should take into account at least one crucial characteristic of international firms: their ability to locate production in different countries, thereby influencing the international distribution of comparative advantage and welfare.[12] As an example, consider the huge investments – mostly greenfield – undertaken by Japanese car manufacturers in the US during the 1980s.[13]

2.3 The models

Consider a subset of the world consisting of three small, open economies that engage in trade with each other. At a given point in time, two of them integrate into a single market. In what follows, the non–participating country will be referred to as the outsider. Hence, the analysis can be carried out in a manner analogous to the competitive two–nation, two–factor and two–goods model. In each country (or region) manufacturing is divided into production of either a high–tech good (Y) or a low–tech basic industry commodity (X).

The outsider is assumed to specialize in production of X–goods, which intensively uses a factor v consisting of a bundle of unskilled labor, natural resources and fixed capital. The dominant input of the high–tech industry is a knowledge factor (h), defined as a composite of skilled labor and mobile capital (Hufbauer 1970, Romer 1990). Factor v receives a reward r while payments to factor h is denoted w. Although both factors of production are mobile between sectors within each country, we postulate that international mobility is restricted to factor h. In equilibrium marginal

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[12] How exogenous accumulation of factors of production affects specialization in production, and the importance of differences in production technologies, has been analyzed in a number of studies (Rybczynski 1955, Mundell 1957, Johnson 1958, Kemp 1966, Jones 1967, Cornes–Kierzkowski 1981, Markusen 1983, 1984 and several others). Less attention is however devoted to the impact of integration on the distribution of production by profit–maximizing firms.

[13] The common belief that Japan's competitive edge in producing cars was a country–specific comparative advantage proved to be wrong. Furthermore, it implies that the US may regain its position as the world leading car exporter, although the cars will be Japanese. In fact, Japanese cars have for some time been exported from the US to Japan. This illustrates the point made above and the importance of economic policies in attracting production.

productivities and factor rewards are equalized across countries for given prices, i.e. a firm's profitability is independent of the location of production. Since factor endowments are given, inter–country changes only reflect a redistribution of the given stock of factors.

Mobility of factors of production (or of firms) across countries can be expected to generate costs – contractual, organizational and those involved in physically relocating factors – which will deter relocation. We will refer to these as transaction costs. The relationship between costs of employing the mobile factor (w) of outsider and insider firms can be described as

$$w^o - w^i \equiv \Delta w = c_m^o \qquad (2.1)$$

where c_m^o represents the costs of moving production abroad and the superscripts o and i refer to outsiders and insiders, respectively. Then, assuming $c_m^o > 0$, profit–maximizing firms will transfer factor h until the difference in the marginal profitability of employing (investing) factor h abroad equals the marginal costs of establishing production in another country. Large costs in moving production abroad would then be mirrored in large differences in factor rewards between countries. The immobility of v could also be explained by such transactions costs.

A general quasiconcave production function combines the factors of production into Y– and X–goods which are demanded by consumers having identical and homothetic preferences. Finally, in order to emphasize Hymer's findings, i.e. that price differentials are not sufficient grounds for firms to embark on overseas production, the integrated area is assumed to be too small to influence world market prices which remain at the pre–integration level.[14]

Three highly simplified cases, where each deviates in some respect from the standard model, will be elaborated; the effect of an exogenous policy shock (integration) on information costs, technological change, and technological spillovers. As a departing point we take the simplest general equilibrium model (see appendix to this chapter, equations A1–A5).

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[14] Admittedly this is a strong assumption. See Dixit–Norman (1980, chapter 6) for a similar case.

2.3.1 Information costs, factor flows and specialization

One major cost real firms face relates to the gathering and evaluation of different kinds of information. By allowing (instantaneous) information costs to appear as an economy moves between two points of equilibria – while still keepeing agents perfectly informed at each point of equilibrium – we retain the general framework of the traditional model.

Institutional policy changes is one example of new information that has to be processed and evaluated by firms. If all firms in the two economies are exposed to exactly the same changes, information costs are identical. However, if being an "outsider" to an integration process constitutes an additional aspect of a policy change – for instance due to uncertainty concerning market access or technological improvements – which renders additional information costs, outsider firms would be disadvantaged as compared to insider firms. For purpose of illustration, assume that ceteris paribus firms embraced by the policy shock have zero information costs while outsiders have to evaluate the effect of "outsideness." We can regard that as an additional fixed cost (F) which will be inserted into outsider firms cost functions (c).[15] At given prices and where goods are homogeneous, a disequilibrium solution will emerge at given prices since,

$$c^{o}(w,r,F,y) > c^{i}(w,r,y) = p_{y} \qquad (2.2)$$

If the transaction costs (c_{m}^{o}) of moving the internationally mobile factor (h) into the integrated area are zero, inter–country transfers of factor h will take place. Such transfers will proceed until the marginal productivity of outsider h has increased enough to compensate for the expected regional differences. Alternatively complete specialization will be attained. The redistribution of factor h between countries implies that the production of Y increases in the integrated area and decreases for outsiders (Rybczynski 1955, Figure 2.1).[16]

Proposition 1: Exogenous policy changes that create information cost wedges between outsiders and insiders will induce profit–maximizing firms to transfer their mobile factor into the integrated area. If this mobile factor is

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[15] The properties of the cost–function are described in the appendix.

[16] All income adhering to the moved factors is consumed within the host country. The income of the economy is defined in terms of GDP, not GNI, to emphasize that the focus is on specialization in production (see Brecher–Bhagwati 1981).

concentrated to the outsider's import–competing sector, specialization and trade will increase in a two country setting, here referred to as the *trade–augmenting* effects of integration. If the mobile factor is primarily used in the outsider's export–competing sector the opposite effect will occur, which we denote as *trade–depressing* effects of integration.

Proof: The proof is trivial since, from equation 2.2 and the application of the Rybczynski theorem (Rybczynski 1955), we know that production of Y must increase in the integrated area as the endowment of h increases. By applying Cramer's rule to equations A4 a,b in the appendix,

$$Y'^{i} = h'^{i}\lambda_{vx}/|\lambda| \qquad > 0 \qquad (2.3)$$

since the determinant of λ is positive if Y is intensively using factor h,

$$|\lambda| = \lambda_{hy} - \lambda_{vy} \qquad \text{Q.E.D.}$$

2.3.2 Institutional change and technology

Suppose now that integration (I) exclusively affects technology in the integrated area, where technological progress is defined as a reduction of the amount of v required in the production of Y. For example, consider it as a reduction in unskilled factors engaged in the firm's administration of matters related to border crossings, including the gathering of documentation demanded by the authorities concerning the origin of goods, i.e. activities that were necessary before the integration. Both insider and outsider firms are assumed to be perfectly informed of such cost reducing effects. Clearly, local presence is required in order to profit from the alleged improvements. Again, the extent of the relocation is restricted by the increased costs of having production taking place in several countries (c_m^o).

Following Jones (1965, 1968), we define such technological change (z'_{vy}) as

$$z'^{i}_{vy} = (1/a_{vy})(da_{vy}/dI) \qquad (2.4)$$

which substituted into equation A3b in the appendix yields

$$a'^{i}_{vy} = \theta_{hy}\sigma\,(w' - r') - z'_{vy} \qquad (2.5)$$

implying that changes in the input requirement of v are a function of the elasticity of substitution (σ), factor prices, and technological change. The latter, originating from the exogenous shift in integration (I), is zero for outsiders. As v is released from the Y–sector in the integrated area, i.e. overall endowments of v increases, the normal response at given prices would be a Rybczynski induced expansion of the X–sector in the integrated area. Intuitively, however, it is far from obvious why the sector being disadvantaged by integration should expand. There are also cases – as shown below – which are perhaps more likely to occur, when the result will be an expansion of the Y–sector.

First, note that the decrease in the required input of v will at given prices also act as a subsidy to insider producers of Y. From the Stolper–Samuelson theorem (Stolper–Samuelson 1941), the reward to the intensively employed factor then increases at the expense of the other factor's return. Consider now the process that emerges in the standard framework where "invisible" firms provide the production technology that turns h and v into goods. The immediate effect of a v–saving technological change in the Y–industry is a tendency towards positive profits for Y–firms and increased demand for factor h, which put upward pressure on the reward to factor h. We can think of the – instantaneous – adjustment process in the following way: Firms in the Y–sector offer h employed in the X–sector a marginally higher reward than before, although not high enough to exhaust the gains accruing from the technological change. As Y–firms employ h in the proportions given by the technological change, h flows from the X–sector and the Y–sector starts to expand. When the last unit of h in the X–sector has been employed in the Y–sector, the reward to factor h tends to increase even more and h is substituted for v. Production then swings back towards the X–industry, as predicted by the Rybczynski theorem.

In the presence of international mobility of h, however, the difference in the reward to Y–prouducers induces profit–maximizing "invisble" firms in the outsider country to transfer factor h, i.e. to undertake foreign investment, into the integrated region in order to gain access to the *region–specific* technological advantage. The inflows of foreign h goes on until the marginal productivity of insider h has fallen enough to neutralize the initial effect of reducing the input requirement of v in Y. At that point factor rewards are equalized between outsiders and insiders.

Consider now the case when each h can be defined as a firm. As h–firms hire v–factors (which also could be regarded as firms), there is no incentive for h to substitute "itself" for more v as it experiences a higher reward. In that case the mechanism to start the inter–sector factor flows necessary to absorb the extra amount of factor v released in the integrated does not exist. Instead the Y–sector would expand as h–firms, formerly engaged in X–production, start to produce Y–goods. Furthermore, after the technological change has ocurred, less of internationally immobile v is employed by each h–firm, which shows up in unemployment. Without inter–country factor flows through international firms a constant disequilibrium solution is established. Note that in both cases above it is the region–specific character of the technological change, as opposed to an "athmospheric" change embracing all countries, that induces the factor flows between countries.

Proposition 2: If the integration process is accompanied by a shift in technology exclusively available to insiders, implying a lower input requirement of v in the production of Y, outsider firms will transfer their mobile factors into the integrated area. This will result in a *trade–augmenting* effect if the internationally mobile factor is intensively employed in the outsider's import–competing sector and a *trade–depressing* effect if it is employed the export–sector sector.

Proof: Holding all other variables constant, the impact of technological change on factor reward can be deduced from equations A2 a,b in the appendix as,

$$w'^{i} = z'_{vy}\theta_{vx}/\,|\theta| \qquad >0 \qquad (2.6)$$

which is unambiguously positive since the given factor–intensities implies that,

$$|\theta| = \theta_{hy} - \theta_{hx} \qquad >0$$

Consequently, z'_{vy} acts like a subsidy on the factor used intensively in industry Y. Since Y must be increasing in its own price, outsider firms will locate their h into the integrated area if they can appropriate whatever minor part of the technologically induced subsidy. Substituting the effect of z'_{vy} (= $w>0$) into equations A4 a–b and applying Cramer's rule gives the production effect (where h' refer to exogenous addition in the total stock of h which is zero),

$$Y'^{i} = (\delta_h\,\lambda_{vx} - (-\,\delta_v\,\lambda_{hx}))\,w'/\,|\lambda| \qquad (2.7)$$

which is unambiguously positive since the determinant is positive. Q.E.D

Hence, as Ricardian effects of international trade are added to a basic Heckscher–Ohlin structure, trade and factor movements may turn out to be complements rather then substitutes. Whether complementarity or substitutability prevails depends on which sector employs the mobile factor most intensively (Figure 2.1).

2.3.3 Differentiated products and mobile knowledge capital

Finally we elaborate the case where multinational corporations (MNCs) are explicitly introduced into a simple general equilibrium framework. The existence of MNCs in models of international trade is explained by factor endowments being so disparate across countries that factor price equalization cannot be attained. In essence, it is the traditional vertical integration structure, where international factor price equalization is attained through intra–firm transfers of intangible production factors, or knowledge capital (Helpman–Krugman 1985).

Knowledge capital, h, defined to conform with headquarters services in the Helpman–Krugman model, relates to input of marketing, R&D, education, management activities etc. These are upstream activities, produced under increasing returns to scale and with firm–specific features that can be employed in downstream activities, domestically as well as in subsidiaries abroad (see the appendix). The firm–specificity of knowledge capital obstructs arm's length contracts since that would either risk eroding the proprietary knowledge of a firm's upstream activities, or lead to excessive Coasian transaction costs (Coase 1937, Hymer 1960, Williamson 1975, 1985). Wherever the production of the knowledge input is located, it can – according to mainstream economic models – costlessly serve as "blueprints" inputs in downstream production at other plants.

As revealed by the factor proportion rays in Figure 2.2, production of the knowledge input utilizes the most capital intensive technology (i–H). The capital–intensity of downstream production (H–Y) ranks between upstream production and manufacture of the basic industry goods (Y–O). The overall structure of trade is determined by factor proportions as in the traditional Heckscher–Ohlin model, i.e. the integrating area is specialized in and a net exporter of Y while the outsider is a net importer of Y and the sole supplier of X.

Suppose that integration yields Marshallian externalities (ϵ), exclusively affecting the production of knowledge capital as the two countries form a single market. Such knowledge externalities are usually attributed to an enhanced interplay and communication between knowledge producing units (von Hippel 1987, Grossman–Helpman 1991). Here we assume that externalities are non–communicative between outsiders and insiders and act as a public good for insiders that lowers the amount of inputs needed to produce a given amount of knowledge. Thus, $c_h^i(w,\epsilon) < c_h^o(w)$, suggesting that comparative advantages are affected by the size of ϵ.

In contrast to the Helpman–Krugman model, primary factors engaged in the production of proprietary firm–specific knowledge, h(K,L), are assumed to be internationally mobile. Since knowledge production is highly capital intensive, a transfer of knowledge producing units between insiders and outsiders will involve a proportionally larger share of capital than labor. Consider a situation where an externality gap has emerged between insiders an outsiders, $\epsilon^i > \epsilon^o = 0$. As illustrated in Figure 2.3, this would lead to a shift in the endowment point from E to E' (parallell to O–H) as outsiders locate their h–producing units in the integrated area. The result is a Rybczynski induced increase in the production of insider H from (i–h_2) to (i–H').

Due to the externality, less factors of production are required in the production of h to support a given level of downstream production.[17] Thus, some of the capital and labor flowing into the integrated area can be employed in downstream production of differentiated goods. Hence, in the new equilibrium overall downstream production will expand while overall production of knowledge inputs will decrease (H–H').

In the post–integration equilibrium, all knowledge producing units (i–H') will be located in the integrated area (Figure 2.3). The accentuated divergence in factor endowments increases the number of multinational firms, as reflected by the increasing number of subsidiaries from (y–u) to (y–u') which fosters more of intra–firm trade. Furthermore, since prices are assumed

[17] This is identical to a shift of the h–isoquant closer to the origin. Alternatively, consider the case when the same amount of capital and labor is employed in producing the knowledge input. Due to the externality, location in the integrated area would lower production costs, enabling a smaller scale of production. At given prices, and with preferences characterized by "love for variety" (Spence 1976, Dixit– Stiglitz 1977), this means that the new equilibrium will contain more varieties of the Y – good, implying welfare gains.

constant, which leaves the angle of the ray through the C'–point unaffected, the widened distance between consumption and production of Y in the integrated area, i.e. $C'_y - y$, implies that also inter–industry trade increases.

Proposition 3: Assuming that integration yields an industry– and country–specific Marshallian externality related to the production of knowledge capital, then all knowledge producing units will be located in the integrated area. As firms relocate, specialization in production increases which shifts the distribution of comparative advantage between insiders and outsiders, leading to a *trade–augmenting* effect of integration.

Proof: Assume that the production function is weakly separable in the production of differentiated goods (d) and the knowledge good (h),

$$Y = F(d(K,L,h),h(K,L,\epsilon))$$

where downstream production is linearly homogenous in d = f(K,L,h) while economies of scale prevails in the production of knowledge inputs. The externality enters as an unpaid intermediate production factor in the production of the knowledge input (h). The size of the externality depend on the overall level of the production of knowledge in the economy (H)

$$\epsilon^{j,h} = g(H), \quad \epsilon^{j,h}_H > 0, \quad j = \text{country}$$

such that $(\epsilon^{j,h} + \epsilon^{s,h}) > \epsilon^{j,h}$, j and s being two separate countries. An integration policy that merges the h–sectors in two countries will consequently increase the externality, i.e. $H^i = f(I)$. Hence, ceteris paribus

$$h(K,L) = f(\epsilon^{i,h}(I)), \quad h_I = f_\epsilon \epsilon_I > 0$$

Think of h as a bundle of factors of production tied to knowledge production that can freely float over international borders. If h represents the distribution of the production of knowledge inputs between outsiders and outsiders, h^i/h^o, clearly an integration policy will shift h–production into the integrated area,since $h_I > 0$. Q.E.D.

Thus, trade policies affect the composition of factors between countries and make outsiders more exposed to international trade. Comparative advantage is transferred to the integrated region (already abundant in h) through the transfer of knowledge, or skill, by firms' locating their knowledge producing units in that area.[18]

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[18] See Findlay–Kierzkowski (1983) and Grossman–Helpman (1991) for similar results.

2.4. Final remarks

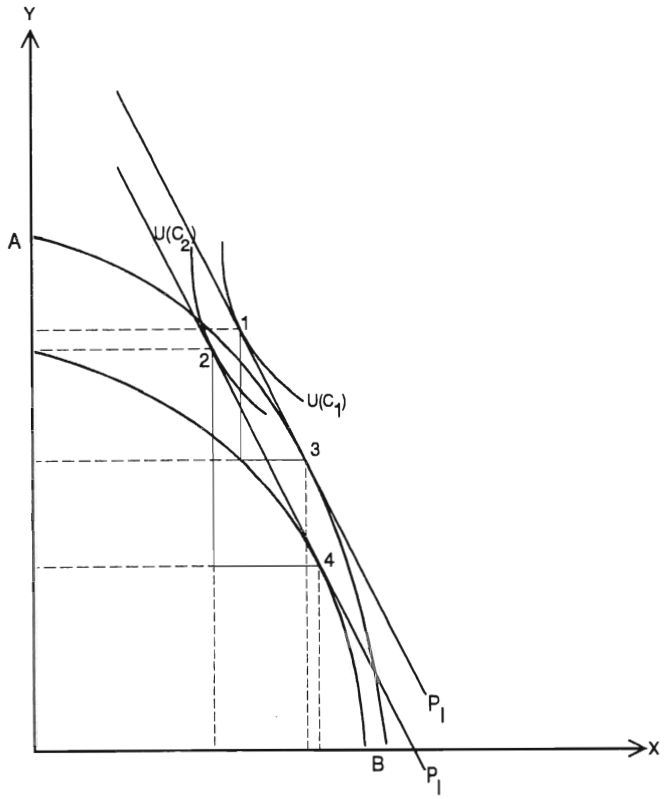
By incorporating factor mobility, or firms, into a general equilibrium context, it is shown how sensitive the traditional trade models are to even minor alterations in the basic assumptions. If firms are allowed to shift production between countries, a different and more complex picture emerges as compared to the traditional integration model. This holds irrespective of whether technologies are characterized by constant or increasing returns to scale. Additional information costs related to the effects of integration, or specific production advantages confined to insider producers due to increased spillovers from an enlarged knowledge base, technological progress, etc., will induce an outflow of factors, or firms, from outsider countries.

A small open economy could become more specialized by abstaining from participation in an integration process, even at constant terms of trade, accompanied by a decrease in welfare for outsiders. If the internationally mobile factor is intensively used in the outsider's import sector, specialization will increase, while the opposite result prevails if mobile factors are predominantly used in the export sector. Thus, integration is shown to have either *trade–augmenting* or *trade–depressing* effects as factor mobility through firms is allowed, implying that the traditional conclusions about the effects of integration on outsiders could well be reversed.

The normative conclusions of the model are hence quite strong. If the outsider country participates in the integration process it would automatically have gained from the effects derived from the institutional change. The base for a discriminatory situation towards its producers of h–intensive goods would never have arisen, and consequently the incentives for factor moves would also vanish.

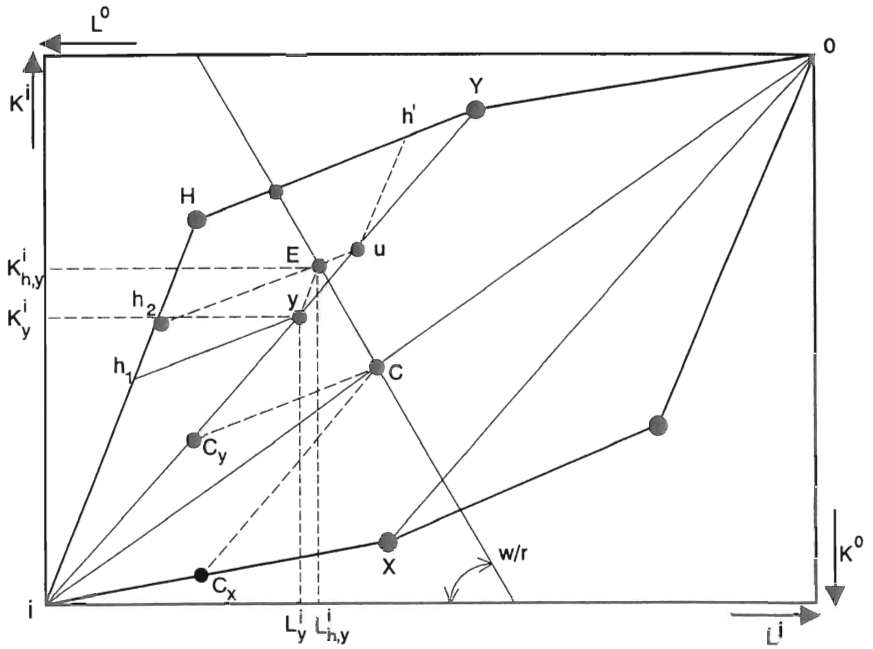
Contemporary research claims that international firms are the main diffusers of technological know–how (Kokko 1992, Dunning 1993), strongly suggesting that comparative advantage of nations is influenced by factor flows, i.e. the interregional investment decisions by firms. The long–run effects would be to insert an element of path dependency through such knowledge accumulation, where the size of the knowledge sector itself plays a crucial role in attracting investments by technologically advanced firm (Grossman–Helpman 1991).

Figure 2.1. Factor flows and specialization in the outsider country



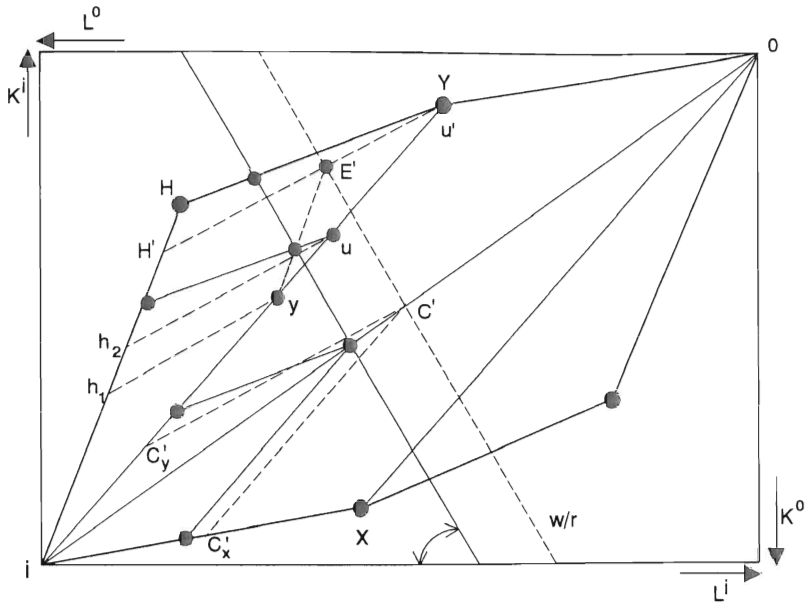
Note: The following notation is used:
1 = Consumption level before integration, welfare level $U(C_1)$
2. = Consumption level after integration, welfare level $U(C_2)$
3. = Production level before integration
4. = Production level after integration

Figure 2.2. General equilibrium with MNCs



Note: The following notation is used:
i = insider, o = outsider, E = endowment point outside the diversification cone, h_1 = knowledge production by insiders employed in domestic downstream production, h_1–h_2 = knowledge production transferred by insiders to subsidiaries abroad, h_2–H = knowledge production by outsiders employed in downstream production in outsider plants, u–y = production by insiders of Y–goods in subsidiaries abroad, C_y = consumption of Y–goods in the integrated area, C_x = consumption of X–goods in the integrated area, y–C_y = net export of Y–goods from the integrated area, K^i_y and L^i_y = factors used in production of Y in the integrated area, ($K^i_{h,y}$–K^i_y) and ($L^i_{h,y}$–L^i_y) = factors employed in knowledge production in the integrated area transferred to subsidiaries abroad.

Figure 2.3. General equilibrium and factor mobility



Note: The following notation is used, where dotted lines refer to equilibrium after the transfer of factors:
i = insider, o = outsider, E'= new endowment point after factor movements, H'—h_2 = the production of knowledge goods by outsiders located in the integrating area, y—u' = subsidiaries in downstream production in outsider countries employing knowledge produced by insiders.

Appendix

Consider the cost function for a firm using factor i in production of good j,

$c(q,j) = \min (qi:f(i)< S)$

where S is the feasible set and q is the reward to factor i. The input coefficient (a) is derived by applying Shephard's lemma,

$c_q(q,j) = a_{ij} \qquad c_{qq} < 0$

The technology employed is summarized in the input coefficient (see for instance Dixit–Norman 1980).

The structure of both the foreign and domestic economy is given by the traditional trade model, where the equation of change are[19]

(full employment)

$$\lambda_{hy}Y' + \lambda_{hx}X' = h' - (\lambda_{hy}a'_{hy} + \lambda_{hx}a'_{hx}) \qquad \text{(A1a)}$$

$$\lambda_{vy}Y' + \lambda_{vx}X' = v' - (\lambda_{vy}a'_{vy} + \lambda_{vx}a'_{vx}) \qquad \text{(A1b)}$$

(non–profit)

$$\theta_{hy}w' + \theta_{vy}r' = P'_y - (\theta_{hy}a'_{hy} + \theta_{vy}a'_{vy}) \qquad \text{(A2a)}$$

$$\theta_{hx}w' + \theta_{vx}r' = P'_x - (\theta_{hx}a'_{hx} + \theta_{vx}a'_{vx}) \qquad \text{(A2b)}$$

where λ represents the factor intensity, θ the cost share and a dot equals the relative change. The elasticity of substitution along an isoquant is,

$$\sigma = (a'_{hj} - a'_{vj})/(w' - r') \qquad j = Y,X$$

and the condition of cost minimization along an isoquant,

$$\theta_{vj}a'_{vj} + \theta_{hj}a'_{hj} = 0$$

implying that the respective change in the input coefficients is given by,

$$a'_{hj} = -\theta_{vj}\sigma_j(w' - r') \qquad \text{(A3a)}$$

$$a'_{vj} = \theta_{hj}\sigma_j(w' - r') \qquad \text{(A3b)}$$

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[19] See Jones (1965,1968) for a more detailed version.

which upon substitution into equations A 1,2 yields

$$\lambda_{hy}Y' + \lambda_{hx}X' = h' + \delta_h(w' - r') \tag{A4a}$$

$$\lambda_{vy}Y' + \lambda_{vx}X' = v' - \delta_v(w' - r') \tag{A4b}$$

$$\theta_{hy}w' + \theta_{vy}r' = P'_y \tag{A5a}$$

$$\theta_{hx}w' + \theta_{vx}r' = P'_x \tag{A5b}$$

where

$$\delta_h = (\lambda_{hy}\theta_{vy}\sigma_y + \lambda_{hx}\theta_{vx}\sigma_x)$$

$$\delta_v = (\lambda_{vy}\theta_{hy}\sigma_y + \lambda_{vx}\theta_{hx}\sigma_x) .$$

CHAPTER 3

THE ROLE OF COMPETENCE CAPITAL IN FIRM PERFORMANCE

3.1 Introduction

Although its importance was first recognized long ago, the role of knowledge, or competence, in firm performance has recently been rediscovered as a key to economic prosperity.[20] That goes for the micro level (Eliasson 1990, Grant 1991) as well as the macro level (Romer 1986, Grossman-Helpman 1991). Still, most economic models tend to ignore knowledge factors or classify them as residual effects. If knowledge is incorporated at all, it is generally restricted to R&D investments, although activities like organizational routines, education, networks, marketing, supporting systems, etc., all form the base of the knowledge stock of a firm or country (Spencer-Valla 1989, Porter 1990).

Technological progress in the postwar era has enabled the movement of commodities and information in unprecedented ways. To maintain competitiveness, firms have to organize such that swift and continuous adjustment to and incorporation of relevant new technology is emphasized. This evolution affects all firms, irrespective of whether they are domestically or internationally active, small or large. As shown by, for instance, Eliasson (1987) and Cantwell (1989), such upgrading of a firm's knowledge base is a dominant and resource consuming activity.

The purpose of this paper is to conceptualize knowledge capital and to incorporate it into a simple model of the firm, from which hypotheses concerning the relation between profitability and knowledge capital will be derived and empirically tested. The analysis differs from previous research in that it introduces a stock variable that more closely corresponds to the theoretically derived concept of firm-specific assets. In addition to R&D-investments, it also comprises investments in marketing, education and software. The empirical analysis is based on a unique firm data set

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[20] Marshall wrote already in 1879 that "knowledge is the most prominent engine of growth." Hayek (1945) also stressed the importance of knowledge and the measurement difficulties.

emanating from extensive surveys collected directly from the firms by The Industrial Institute for Social and Economic Research (IUI), Stockholm.

The remainder of this paper is organized in the following way: The definition of knowledge, or competence, capital is presented in the next section. A simple theoretical model of the firm which includes competence capital is developed in section 3.3, followed by empirical tests of the hypotheses specified in section 3.4. Finally, the main results are summarized and some normative implications discussed (section 3.5).

3.2 Competence capital

The importance of knowledge has been recognized in several fields of economic research, e.g. the theory of human capital, the impact of public goods, and the recent contributions to growth theory (Knight 1921, 1944, McKenzie 1959, Arrow 1962, Kendrick 1976, Griliches 1979, Sala-i-Martin 1990, Becker 1994, to mention a few). Yet, being an intangible good, most attempts to incorporate it explicitly into the production function as a factor of production have been frustrated. Despite the impressive theoretical achievements, empirical evidence remains quite scarce.

To assess the influence of knowledge on firm performance, a stock concept of such assets has to be developed. But investments related to knowledge assets are, in accordance with the existing legislation and conventions, booked directly onto a firm's expense account. This means that empirical analyses run into considerable computational, definitional, and methodological problems since knowledge stocks have to be constructed. Furthermore, knowledge will always contain elements of tacitness related to entrepreneurial skill, luck and other non-measurable factors. Still, as argued by, for instance, Hägg (1992) and Eliasson (1992), much of the same difficulties arise when investments in real capital are undertaken. Moreover, the growth of knowledge assets within firms strongly suggests that such assets cannot be omitted from economic analysis (Bryer 1990).[21] In addition to a brief review of the literature, this section will therefore elaborate at some length on the difficulties encountered in defining and capitalizing intangibles.

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[21] SCB (Statistics Sweden) has collected data on knowledge capital since 1988, defined as investments in R&D, marketing and software. As a percentage of total investments, including machinery and buildings, investment in knowledge capital increased from 53 to 61 percent in 1988-92 (SBC F13 SM 9102, 9201).

One strand of economic literature closely linked to the topic of this paper concerns the effects of R&D stocks on the growth of total factor productivity, normally referred to as the rate of return on R&D. Two basic approaches have emerged in the literature. The first postulates that the share of R&D is a constant proportion of output (Griliches 1980), while the second maintains that the rate of return is identical across firms, or even industries, for each implemented unit of R&D (Terlecky 1974, Griliches-Lichtenberg 1984). Although the estimated productivity effects varies, most studies report effects of R&D on productivity to be around 30 percent.[22]

Related to this is the micro-oriented industrial organization literature on proprietary goods, or firm-specific assets, and the internalization of such knowledge assets within firms (Coase 1937, Schumpeter 1942, Williamson 1975). One question addressed concerns the differences in profits between firms, even within narrowly defined industries, despite the standard assumption of equalization of profits. Such differences have been shown to persist over long periods of time, and one cannot simply refer to them as temporary divergences from equilibrium (Shepherd 1975, Chandler 1990, Mueller 1990). Scherer (1986) argues that firms that manage to build up a "reputational capital" can charge a premium due to such capital, or expand their customer base at a lower price compared to their competitors, while other studies confer the main explanations to entry barriers, particularly tariffs and market dominance (Bain 1955, Collins-Preston 1968, Shepherd 1972, Demsetz 1973, Porter 1974, Weiss 1974, Carter 1978, Ravenscraft 1983, Mueller 1986). The persistent profit argument seems, however, to be at least partly based on wrongly specified models since most studies only consider surviving firms, i.e. they do not account for sample selection bias. Those firms that fail and exit do not show up in the data sets.

Turning to the definitional problem, there is at present no generally accepted definition of intangible capital, nor means of denominating it. In the literature it is referred to as "intangibles", "knowledge capital", "soft capital," to name a few. Since such assets really allude to competencies within the firm, both organizational and collective, as well as individual, in what follows it will be denoted competence capital, defined as:

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[22] Both Griliches (1973) and Terlecky (1974) conclude that the productivity effects are 30 percent. Griliches (1980) and Mansfield (1980) report similar results while Clark-Griliches (1984) find considerably lower effects, 18-20 percent, in a study based on divisional data. In a later study, although not fully comparable, Griliches' (1986) estimations indicate that the effects are up to three times as high. Scherer (1982) separates infirm R&D and R&D from other sources and concludes that the effect is in the range of 29-74 percent, where the upper limit relates to infirm R&D.

Competence capital of firms is defined as assets in R&D, marketing, software and education, where the returns are appropriated by the firms themselves.[23]

This definition is operationalized by accumulating costs earlier charged on the current cost account. The firm-specific aspect of knowledge is stressed, in contrast to the mainstream approach whereby knowledge is assumed homogenous across firms, or even across industries.[24] Costs with short-run effects (less than one year) are not activated as asset values, and all assets are expressed at reproduction value. The chosen competence variables are consistent with the definitions of intangible assets most thoroughly analyzed in other economic fields. Another reason to pick the specific variables enumerated in the definition are their intuitive close links with skills and new technology.

To some extent, the definition overlaps with the concept of human capital. The important difference concerns the appropriability of the returns that, according to the firms, cannot be tied to any specific inputs. Hence, competence capital should show up as (temporary) monopoly rents to the firm.

3.3 A simple model of the competence-based firm

Although the analysis in this paper concentrates on the firm, a few words on the market structure are warranted. Firms are assumed to be profit-maximizing and employing regular production technologies. A firm's competitiveness is based on product differentiation, which emanates from its competence capital. The market structure is thus characterized by imperfect competition.

In the traditional monopolistic model profits are pushed to zero due to entrance by firms. In the competence model considered here, newly established firms have to possess or acquire the necessary competence on which the ability to differentiate their products from those of others rests. If we assume that competence can be acquired in the market, or, imposing the Helpman-Krugman (1985) assumptions, if factors become firm-specific as soon as they are employed,[25] profits - defined as the residual after factor payments to labor and capital - are equalized in

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[23] Becker (1994) refutes the idea that firms underinvest in training due to the risk that their employees may leave the firm. Instead, workers accept lower wages for training.

[24] Compare the concepts of specific technological information and general technological information (Grossman-Helpman 1991),

[25] See also Williamson (1981), arguing that the knowledge input is tied to the entrepreneurial unit.

equilibrium. Imitative behavior, dispersion of knowledge and free entry are the means to achieve this end. However, the equilibrium level of profits need not necessarily be zero.[26]

Since we can observe that profits differ between firms, even over long periods of time (Chandler 1990), the (static) general equilibrium model may not be the best analytical tool. Rather, firms will be distributed in a profit space at each given point in time. Temporary Schumpeterian rents will erode due to entrepreneurial entry, as well as imitation, by firms. The following empirical analysis will have an explicit microeconomic focus in order to examine whether the incidence in profits among firms can be explained by differences in their stock of competence, a hypothesis forwarded several years ago (Knight 1944, McKenzie 1959).

3.3.1 Profit maximization with competence capital

Models incorporating intangibles are generally based on either the assumption that investment in intangible capital shifts a firm's demand function (Clarke 1976, Megna-Mueller 1991), or that intangibles act as a shift factor in the production function (Griliches 1979, Romer 1986). It is the latter approach that is adopted here. Profits, defined as residual revenues not distributed to labor and fixed capital, will also be derived from this approach.

Consider the following basic structure of production of a representative firm (i). All firms employ three factors of production, labor (L), capital (K) and competence capital (H). Perfect competition prevails on the factor markets for capital and labor, while H is firm-specific, heterogenous, and contained within the firms. Production is organized such that upstream, firm-specific competence capital (H) shapes and adds value to downstream production by differentiating it from other close varieties. Homogeneous capital (K) and labor (L) are employed in downstream manufacturing, on which competence capital acts as a shift-factor.[27]

Assume that all firms employ the above factors of production, organized by means of identical Cobb-Douglas technologies,

$$Q_i = AK_i^{1-\alpha}L_i^{\alpha}H_i^{\gamma} \qquad (3.1)$$

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[26] For instance, Grossman-Helpman (1991, Chapter 5) show how profits only have to be equalized in present value terms, but may diverge among firms at any particular point of time.

[27] Already Knight (1921) objected to the idea that increasing returns to scale were external in all respects to firms.

subject to[28]

$0 < \alpha, \gamma < 1$

The restriction on γ is imposed to assert that firms cannot handle unlimited amounts of H, i.e. decreasing returns to H is postulated (Romer 1986). The production function Q is hence assumed to be linearly homogenous in capital and labor, but to exhibit limited increasing returns to scale with regard to all factors.

As modeled, the production function is strongly separable, implying that it can be divided into a constant returns to scale part ($V_i=AK_i^{1-\alpha}L_i^{\alpha}$) and an increasing returns to scale part H_i^{γ}. Profit (Π) is then defined as

$$\Pi_i = P(V_iH_i^{\gamma}) - R_iV_i - W_i^hH_i \quad \geq 0 \tag{3.2}$$

where the costs of the linearly homogenous input aggregate (V) is R while W_i^h represents the reward to each firm's competence capital H.[29] If H were a well-defined production factor within the firm, all residual profits (W_i^h) would be appropriated by that factor. Here it could be interpreted as the returns to owners or to entrepreneurial skill, frequently disregarded in economic models. It must be non-negative since firms cannot operate at negative profits.

Profit maximizing can be viewed as a two-step procedure. First, the optimal quantities of capital and labor are determined for given prices and a given stock of H, where profit is known to be zero (or infinite). Thereafter, profits are maximized with respect to H, which is the step we focus on here. The equilibrium stock of competence capital for firm i is calculated by maximizing equation 3.2 subject to the restrictions in equation 3.1. Hence, differentiating profits with respect to H_i, yields the first order condition

$$\gamma H_i^{\gamma-1} = W_i^h/(PV_i) \tag{3.3}$$

---

[28] Subscripts denote partial derivatives, except for numbers (or t) that refer to periods, or i, which refers to firm i.

[29] In general, if a constant return to scale technology prevails, the cost function can be written as c(w,y)=yc(w,1) which is utilized in equation 3.2.

or, by 3.1 and the definition of V_i

$$\gamma Q = w_i^h H_i \tag{3.4}$$

implying that competence capital is employed until the marginal contribution of additional H equals the marginal (real) return demanded by the firms' owners.[30]

The second order condition implies falling returns to H after some optimum stock of competence capital is reached,

$$\Pi_{i,hh} = (1-(1/\gamma))P_i V_i H^{\gamma-2} \quad < 0 \tag{3.5}$$

which is unambiguously negative since $0<\gamma<1$. Consequently, the marginal effect of competence investment peters out and at some stage goes to zero.

3.4 Data, hypotheses, and empirical results

Previous empirical analyses, referred to in section 3.2, have, to some extent, managed to explain the spread in firm profit by differences in market power and efficiency, collusion and entry barriers. Less attention has been paid to the effects of investment in intangibles on profit rates. The relatively few studies undertaken are predominantly based on industry data, where the applied lag distributions frequently are assumed identical across firms, and even industries. The conclusion from most of these studies is that a strong and rather immediate relationship exists between marketing and profitability (Boyer 1974, Ayanian 1975, Lambin 1976, Comanor-Wilson 1979). Block (1974) and Weiss (1974), however, report opposite findings. For R&D expenses, a positive effect has been found in most empirical studies, although it appears with a considerable lag (Scherer 1965, Branch 1974, Ravenscraft-Scherer 1982). But also here the evidence is ambiguous. For instance, Megna-Mueller (1991) finds weak support for R&D as an explanatory variable of profits.

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[30] If competence is assumed to be a function of past experiences such that competence investment (I) in period 1 influences the quality or sharpens the differentiation of the respective firm's product in period 2, then

$P_{2,i}=g(I_{1,i})$ $P_{2,i,I}>0$

In a two-period world, the first order condition requires that the marginal value of competence investment equals the marginal cost, or interest rate (r), which in turn depends on the rate of time preferences (δ). Hence, $P_{2,i,I}=C_{2,i,I}$ (=) $r=(\Delta P/P_1)100=\delta$.

To acquire data on competence capital, normally not reported in the firm's annual reports, several methods are available. First, growth accounting can be utilized to isolate the impact of R&D on outputs.[31] Second, a relationship between inputs and outputs can be specified to calculate the stock of competence capital. This method has the disadvantage of being unable to discriminate gains associated with, for instance, protectionistic barriers. Finally, the stock of competence capital can be calculated by, or in close collaboration with, the firms themselves. This is the approach taken here.[32]

This method has some obvious advantages. First, we can disregard the lag-problem. At present, there is no consensus concerning the lag structure. For instance, Terleckyj (1982) used a three-year lag, while Pakes-Schankerman (1984) and Griliches-Lichtenberg (1984) implemented a two-year lag. Several other lag structures are also used. Furthermore, we avoid the difficulties stemming from different assumptions with regard to the depreciation rate of R&D. Also here opinions differ. Terleckyj (1982) argues that the most reasonable results are obtained if no depreciation at all is assumed, while others claim that yearly depreciation is more likely to be around 20-30 percent (Pakes-Schankerman 1984). Related to this is the problem of obtaining an estimate of the R&D-stock in real terms, where again there are numerous recommendations. In essence, what this tells us is that the calculations of R&D stocks are plagued by a number of difficulties which will, to varying degrees, insert errors into the estimates.[33]

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[31] Growth accounting implies that the growth of inputs (k and l) is subtracted from the growth of output which yields the multifactor productivity growth. It can be used to isolate the effect of R&D. Consider the following Cobb-Douglas production function (q), where all variables are expressed as percentage rate of change,

$$q - \alpha_1 k - \alpha_2 l = a + \alpha_3 r$$

Productivity growth is decomposed into a constant and the effect of R&D(=r). The underlying assumption is that each factor's contribution to output can be determined by multiplying its income share by its rate of growth, i.e. each input is taken to be paid exactly its marginal product.

[32] The survey data are complemented with interviews with each firm. For a description of these surveys, see Braunerhjelm (1992). Information gathered through interviews has sometimes been claimed to be unscientific. Commenting on that controversy, Scherer (1986) makes an analogy to the difficulties that astronomists encountered in the 17th century in determining the shape of the planetary orbits. Kepler, unable to observe the planetary motions, assumed that they were circular. However, when he visited Tycho Brahe he could actually observe that the orbits were elliptical, which impelled Scherer to make the following remark; "If Kepler could have interviewed God about what laws of planetary motion He ordained, would he have refrained because it was unscientific? One doubts it."

[33] For a survey of these problems, see the study by the US Department of Labor (1989).

3.4.1 Hypotheses

The empirical application will be based on the simple model outlined above. Rather then subjecting the model itself to a rigorous test, the basic hypothesis to be empirically tested is derived from the theoretical model. In particular, we expect a positive connection between the stock of competence capital (H) and firm profits. The intuitive explanation is the following: firms engage in product differentiation to maximize profits, whereby a firm's ability to differentiate depends on its accumulated skills and know-how, i.e. its competence stock. Since there is no well-defined factor to appropriate the return to such skill, returns will show up as residual profits or Schumpeterian rent. From the model in section 3.3.1, a negative relationship between costs of labor (W) and profitability is also expected.

A few control variables, where previous research has established a relation to profits, will also be included into the empirical analysis. First, since a large scale is generally regarded as necessary in order to invest in competence capital, the role of size (S) - measured in terms of labor or sales - is asserted to be positively related to profits. Furthermore, in small countries, large firms can be expected to be dependent on the international market to sustain profits. Therefore, in addition to exports, a size-weighted relationship between profits and exports (XL) will also be incorporated into the analysis.

Market power (POWER) is also included as an explanatory factor. High profits have frequently been explained by the size distribution of firms. Large firms are claimed to discourage or impede entry by other firms, thereby making monopoly pricing possible. Therefore we expect market power to be positively connected with profits. Finally, the impact of labor productivity (LP) is hypothesized to be positive.

3.4.2 Econometric specification and results

The empirical analysis will be based on a data set covering 138 firms in the engineering industry in 1989, gathered mainly from extensive IUI surveys and, to some extent, public sources.

The endogenous variable is the firm's real profit margin (Π_i), defined as sales revenue minus total costs. In accordance with the theoretical model in section 3.3.1, as well as with the previous research referred to above, the following general functional relationship is postulated:

$\Pi_i = f(H,S,X,XL,POWER,LP,W)$.

All variables have been deflated by the consumer price index and divided by total capital to avoid problems of heteroscedasticity and to isolate them from effects of firm size. This implies that the dependent variable also can be interpreted as the real rate of return on total capital (ε_i). From correlation matrices there is no sign of multicollinearity. The hypotheses formulated above will be tested by OLS estimation of a logarithmic form of the profit-function,

$$\varepsilon_i^* = a + b_1 h_i + b_3 s_i + b_4 (xl)_i + b_5 x_i + b_6 power_i + b_7 (lp)_i - b_8 w_i + \eta \ , \qquad (3.6)$$

where ε_i^* denotes the rate of return inclusive of the hidden unknown return to competence capital. The error term is expected to exhibit the standard properties, $\eta \sim N(0,\sigma^2)$ and $E(\eta_i \eta_j)=0$ for $i \neq j$.

The effect of competence (h) is tested by implementing predominantly stock variables.[34] Among these, SOFT1 refers to the stock of competence capital - as defined above - of firms, while the variable GR&D, defined as current R&D expenditure divided by the R&D-stock, denotes the growth in the R&D stock. A second stock variable is also included, SKILL, which captures the share of qualified labor among total employees.[35] As expected, several tests with flow variables failed to show any significance. Stock variables are preferred since the effects of building up current competencies through, for instance, R&D appear with a significant lag and only a fraction of current expenditure will eventually add to the stock of competence.

Size measured as numbers of employees, sales, or different capital-labor ratios, were also included. In all cases they were found to be insignificantly connected to the rate of return. Although evidence is somewhat mixed, this is consistent with a number of other studies (Burns-Dewhurst 1986, Braunerhjelm 1991). Instead, size was used as a weight to test whether foreign sales increase in importance for profits as firms become larger,

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[34] Some overlapping of current costs and capitalized items is inevitable. As noted by Griliches (1973), since the inputs of capital and labor includes the factors of production used in R&D, the social rate of return is beyond the private rate of return (see also Griliches-Lichtenberg 1984).

[35] The employees of the firms have been divided into five different skill categories. The variable SKILL refers to the second and the third category, i.e. specialists, technicians and employees in other service-oriented activities within the firm (see Braunerhjelm 1992).

$b_x x$, where $b_x=(b_6 + b_7 l)$

where l and x refer to employees and exports, respectively. If the hypothesis is supported, the parameter of the size weighted exports (b_7) should be significant, while it is more difficult to attach any sign to b_6 a priori. Market power (POWER), measured as the firm's percentage of total sales in the engineering industry, i.e. market share, was also included since previous studies claim it to be an important explanatory variable of high profits.

The costs of homogenous factors were approximated by the firm's labor costs (including social costs). Labor productivity, defined as value added per employee, could also be interpreted as a proxy for the type of production.[36] The expected signs of the explanatory variables are summarized in Table 3.1.

The results are shown in Table 3.2.[37] In the first model all variables are significant at the 1 percent level, with the exception of the growth of the R&D stock (significant at the 5 percent level) and market power which is insignificant. Hence, there is strong support for a positive relationship between the rate of return and the stock of competence capital within firms.

Exports by large firms have the expected positive sign and are significant while "pure" exports display a negative impact on profits. This could be interpreted as follows: large firms are dependent on exports to sustain profits, while small firms, experiencing lower profits as they engage in export activities, do not possess the competence required to operate on the international markets.[38]

In the second model the competence stock has been replaced by the variable SKILL, capturing the share of highly educated employees within the firms. It is also significant, albeit at a lower level. This is not surprising, considering that it is a less encompassing concept of competence, as compared to the variable SOFT1.

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[36] Value added could, of course, also be used as a measure of a firm's competence. The drawbacks are, however, that such values also incorporate effects of protectionism, regulations, etc. Furthermore, a cross-sectional study only includes data for one year. To be able to interpret value added as a competence variable, data would be required over the whole business cycle in order to adjust for peak values. The same problem does not arise with stock values which are more stable over time.

[37] The different items composing competence capital (see definition) were also exposed to a principal component analysis with no improved result. A Houseman test, undertaken to control for the causality between profits and competence capital, showed no significance for the opposite causality.

[38] This is in accordance with interview results from smaller firms where it was claimed that the export market was used as a dumping market for production surpluses (Braunerhjelm 1991).

Furthermore, the growth in the R&D stock loses its significance. For both models the adjusted R^2 values, as well as the F-values, are quite satisfactory.

3.5 Conclusions

Using the unique IUI firm data base, there is noteworthy and strong support for a positive relationship between the rate of return and the stock of competence capital on one hand, and the rate of return and exports in large firms on the other. This contrasts with the findings of, for instance, Megna-Mueller (1991). The unique data set captures firm-specific assets in a more direct way than traditional data on R&D and marketing.

If we believe that high profit will be transformed into positive welfare effects through e.g. wealth accumulation, higher investments and wages, then one conclusion seems to be that economic policy should be designed to encourage competence enhancing activities. Such policies could only lay down the basic prerequisites for firms by providing, for example, advanced high-quality education, and competitive infrastructures and communication systems. The firms themselves, through their acquired competence and in competition with other firms, have to determine the exact allocation and composition of their firm-specific capital.

The results highlight the heavy dependence of large firms on foreign markets to sustain profit levels. For smaller firms an opposite relation is indicated; exports tend to lower profits. This illustrates that small firms do not possess the competence required to penetrate foreign markets successfully, or that exports may be seen as a way to dispose of surplus production. No statistical significance was found for a relationship between size and profitability.

The importance of access to the export markets also indicates that if firms are exposed to, or suspect future, discriminatory measures that threaten their ability to export, they may be forced to either relocate production or downsize by shedding factors of production, with obvious welfare implications. This has clear policy implications with regard to international institutional changes, as exemplified by the European integration, and the uncertainty connected with being an outsider to a process that involves the main export markets for a majority of exporting Swedish firms.

Table 3.1 Definition and expected signs of explanatory variables

Explanatory variables	sign
SOFT1, amount of knowledge capital per labor unit	+
SKILL, percentage of skilled employees	+
GR&D, current R&D expenses divided by the R&D stock	+
X, absolute value of exports	+/-
XL, absolute value of exports weighted by labor	+
W, total labor costs	-
LP, labor productivity defined as value-added per employee	+
POWER, percentage sale of total domestic sale	+

Table 3.2 Rate of return and knowledge capital, 1989

	Dependent variable, profitability	
Independent variables	Model 1	Model 2
Intercept	.37 (.15)	.35 (.13)
SKILL		.21* (1.67)
SOFT1	.16*** (2.61)	
GR&D	.09** (2.12)	.02 (.64)
EXP	-2.84*** (-8.99)	-2.86*** (-8.79)
EXPL	2.82*** (8.80)	2.87*** (8.70)
LCOSTS	-2.32*** (-8.50)	-2.42*** (-8.21)
LP	2.77*** (8.77)	2.88*** (8.91)
POWER	.21 (.99)	.23 (.96)
Adj.R^2	.70	.68
F-value	23.3	21.4
DF DW	59 2.3	59 2.4

Note: The statistics are within brackets. * = 10 percent significance level, ** = 5 percent significance level, *** = 1 percent significance level.

CHAPTER 4

INDUSTRIAL STRUCTURE, REGIONAL DEREGULATION, AND THE LOCATIONAL RESPONSE OF LARGE NORDIC FIRMS

4.1 Introduction

The observed increase in the mobility of factors of production, as revealed by the unprecedented growth in foreign direct investment during the 1980s, has spurred a revival of research in economic geography. The "new" location theory focuses on the influence of the interaction of production and trade costs - i.e. costs of market access - on the locational decisions by firms. The objective of this chapter is to include structural aspects into a simple model of economic geography. The manufacturing sector is divided into two industries: a high-tech and internationally footloose manufacturing production industry and a basic, country-locked industry. In the former type of production, competitive advantage is based on firm-specific competencies, while firms in basic industries are assumed to exploit country-specific resources. Hence, if firms are exposed to regional differences with regard to e.g. production cost or market size, the initial industrial structure could be expected to influence the extent, pace and pattern of the ensuing adjustment process. A country's sensitivity or vulnerability to exogenous shocks that shift the economic prerequisites for industrial production to other parts of the world is therefore also linked to its industrial structure.

The following model relies heavily on the work presented by Venables (1993), and to some extent Krugman (1991a,b). The basic presumption is that firms are subject to increasing returns to scale, since otherwise all production could be replicated at each location. The economic geography literature claims that economies of scale and low trade costs make the location of production highly sensitive to differences in production costs, implying that firms will locate where demand is large. Since inflows of firms will further enlarge markets, making them even more attractive to other firms, there is a tendency for such centripetal forces to automatically reinforce each other.

In addition to offering high levels of demand, large markets also have the advantage of supplying highly specialized and non-traded factors or services.[39] On the other hand, high trade costs and low economies of scale imply that production will be decentralized into several local markets. Furthermore, as emphasized by Krugman (1991a), the "pecuniary" links, i.e. externalities arising from market interactions, are at least as important as technological spillovers. Venables (1993) pursues this line by stressing how vertical links between industries affect the locational pattern. He argues that, depending on such links and the structure of the economy, relatively modest changes in strategic economic variables may result in substantial relocation and the demise of the entire industrial base of a country.

Hypotheses will be derived from the theoretical model and submitted to empirical tests by utilizing a database covering the 30 largest firms in Finland, Norway and Sweden in the period 1975-1990. For Denmark the data are not as complete and do not allow a statistical analysis. The firms are divided into a high-tech and a low-tech industry for each country. Together they cover most of the manufacturing production in the countries under investigation here. Consequently, the allocation of the production of these firms between domestic and foreign units should have important implications for production specialization, trade pattern, and welfare in each country.

The rest of this chapter is organized as follows: The theoretical discussion is presented in section 4.2. Section 4.3 presents the hypotheses derived from the theoretical model, the empirical model and the database. The results of the empirical analysis are presented in section 4.4, and a summary of the main findings concludes the chapter.

4.2 The Model

The structure of the following model differs from the one used in previous research in two ways. First, in contrast to Krugman's (1991a,b) model, which contains one manufacturing and one agricultural sector, the present model focuses on the structure of the manufacturing sector. This is similar to Venables's (1993) model. Unlike Venables, however, we do not consider the vertical links between industries. Rather, our purpose is to shed light on how the interaction of the industrial structure and the locational behavior of firms belonging to different industries, affects a countrys'

[39] See Krugman (1991b) for a discussion of the significance of size in this respect.

specialization in manufacturing if it is exposed to inter-country differences with respect to production costs, trade costs, and size. Second, "footlooseness" of firms is claimed to depend on the source of the economies of scale, which is assumed to differ between industries. In high-tech firms it originates from non-rivalry *firm*-specific inputs, implying that plants can be established at several locations, while basic industry firms exploit country-specific factors of production, where economies of scale predominantly occur on the *plant* level. Such a division conforms well to observed differences across industries (cf. Braunerhjelm 1990a).

The basic structure of the model can be described as follows: Consider a world consisting of two countries of unequal size. The two countries share the same technology and have identical, homothetic preferences in consumption. Within each country, two goods are produced; high-tech Y goods, and low-tech basic industry X goods (e.g. timber, ore). Firms in each industry produce differentiated goods and consumer preferences are characterized by "love for variety" (Spence 1976, Dixit-Stiglitz 1977). Then we introduce exogenous differences between countries related to size and trade costs, and let firms locate in either of the two countries; however, inflows of firms from the smaller country are assumed too small to influence factor markets in the larger (core) country.

4.2.1 The single-industry case

Assuming that goods markets are characterized by Chamberlinean monopolistic competition, the demand elasticities facing firms must be less than infinitely elastic since all firms are able to exercise some monopoly power. Standard CES utility functions, i.e. concave and symmetric, guarantee that utility-maximizing consumers will choose to consume exactly the same proportions of all varieties, irrespective of the expenditure level.[40] Demand for variety i is then a function of the number (n) and prices (p) - including trade costs (t) - of close substitutes, and the level of expenditure (e),

$$y_{i,hh} = (p_{i,h})^{-\alpha}(P_h)^{\alpha-1}\, e_h \qquad (4.1a)$$

and

$$y_{i,hf} = (p_{i,h}t)^{-\alpha}(P_f)^{\alpha-1}\, e_f \qquad (4.1b)$$

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[40] See the appendix for derivation of the demand-functions. To simplify the presentation, the analysis will for the moment be limited to the Y-sector. The X-sector can be analyzed in exactly the same way, since the two sectors only differ with respect to the character and size of fixed costs.

where y_{hh} equals home-country demand of domestic y, while y_{hf} represents foreign demand for domestically produced y goods, i.e. exports. The elasticity of demand is represented by α, and p is the price of variety i, while P can be interpreted as the price indexes for the home country (h) and the foreign country (f), respectively. These are defined in the following way,

$$(P_h)^{1-\alpha} = (p_h^{y})^{1-\alpha} n_h + (p_f t)^{1-\alpha} n_f \qquad (4.2a)$$

and

$$(P_f)^{1-\alpha} = (p_h t)^{1-\alpha} n_h + (p_f)^{1-\alpha} n_f \qquad (4.2b)$$

where, due to the assumption of symmetric utility functions, the indexation of varieties can be dropped. Thus, the price level is determined by foreign and domestic prices (p), the number (n) - or location - of firms, and trade costs (t). If the number of varieties increases, costs must decrease, since prices must equal average cost in equilibrium. Trade costs are defined as costs associated with exports (imports) of goods and are composed of a mixture of tariffs, non-tariff barriers and transportation costs. They are assumed to be of the iceberg type, implying that $t \geq 1$.

To facilitate computations, Venables (1993) introduces a variable κ defined as

$$\kappa_j = (p_j)^{\alpha}(P_j)^{1-\alpha} \qquad j=h,f \qquad (4.3)$$

implying that the demand equations can be expressed as

$$y_{i,hh} = e_h/\kappa_h \qquad (4.4a)$$

and

$$y_{i,hf} = (e_f/\kappa_f)(t/p_f)^{-\alpha} \qquad (4.4b)$$

where p_f denotes relative prices (p_f/p_h).

On the supply side, fixed costs in production generate economies of scale to firms and determine the number of firms. Assuming free entry, equilibrium will be characterized by zero profits. This is all the information about the production technology that is required. Consider a representative profit (π) maximizing firm in the home country's Y-industry,

$$\pi_h = (p_h - c_h)(y_{hh} + y_{hf}) - c_h F_h \qquad (4.5)$$

where c represents marginal variable costs while the last term is fixed costs incurred as a firm engages in activities to differentiate its products, i.e. develops firm-specific assets. The first order condition is satisfied when marginal revenue equals marginal costs, $p_h(1-(1/\alpha))=c_h$.[41] By substituting for c_h, and using the zero profit condition in equation 4.5, this can be expressed as

$$(y_{hh} + y_{hf}) = F_h(\alpha - 1) \tag{4.6}$$

implying that the size of the firm is given by the level of fixed costs and the elasticity of demand. Thus, the essence of the Venables model (equations 4.1-4.6) rests on standard assumptions of utility-maximizing consumers and profit-maximizing producers, where optimization requires the traditional marginal conditions to be fulfilled.

To derive the locations of a firm between the two countries as a function of costs and expenditure levels, a few additional calculations are needed. First, substitute the demand expressions in equations 4.1a and 4.1b into the profit-maximizing equation (4.6). Thus, each industry (or firm) is in equilibrium when

$$(e_h/\kappa_h) + (e_f/\kappa_f)(t/p_f)^{-\alpha} = \psi_h \tag{4.7a}$$

at home, and

$$(e_h/\kappa_h)(tp_f)^{-\alpha} + (e_f/\kappa_f) = \psi_f \tag{4.7b}$$

abroad, where $\psi=F(\alpha - 1)$ and (e/κ) denotes demand per unit expenditure.

Using κ, equations 4.2a and 4.2b can be solved for the number of firms in each country,

$$n_h= (\kappa_h - (\kappa_f/p_f^{\alpha})t^{1-\alpha})/1-t^{2(1-\alpha)} \tag{4.8a}$$

and

$$p_f n_f^{y}= (\kappa_f - \kappa_h p_f^{\alpha} t^{1-\alpha})/1-t^{2(1-\alpha)} \tag{4.8b}$$

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[41] From the expression within parenthesis, the second derivative must be negative and hence the optimality conditions are fulfilled. If costs (c) fall, then production expands until elasticity of demand has decreased enough to stop the process.

By substituting for the values of κ_f and κ_h - derived from equation 4.7a and 4.7b - and dividing equation 4.8b by 4.8a, the distribution of firms between the two countries is given by[42]

$$Y_{f,h} = p_f^{\alpha}[(\sigma + t^{1-2\alpha}) - \psi(\sigma + t)(p_f/t)^{\alpha}]/p_f^{\alpha}\psi(1 + \sigma t^{1-2\alpha}) - (1 + \sigma t)t^{-\alpha}$$

By multiplying the numerator and the denominator with t^{α}, and dividing by p^{α}, it simplifies to

$$Y_{f,h} = [(\sigma t^{\alpha} + t^{1-\alpha}) - p^{\alpha}(\sigma + t)\Psi]/[(t^{\alpha} + \sigma t^{1-\alpha})\Psi - p^{-\alpha}(1 + \sigma t)] \qquad (4.9)$$

where $Y_{f,h}$ denotes the distribution of firms in the Y-industry between the foreign country (f) and the home country (h), (Y_f/Y_h).

Thus, the number of firms in each country is expressed as a function of the following exogenous variables: the relative expenditure level in the two countries on Y products, σ $(=e_f/e_h)$, the relative size of fixed costs, ψ $(=\psi_f/\psi_h)$, differences in prices p $(=p_f/p_h)$ (which also equals differences in marginal costs, $c=c_f/c_h$), and, finally, trade costs (t). The impact of changes in these variables on the location of firms is shown in propositions 1-3 below.[43]

Proposition 1. Higher relative costs will unambiguously result in an outflow of firms.

Proof: Assume that initially there are no trade costs between the countries, i.e. t=1. Since the home country is defined as the smaller country, σ will always exceed one. Then, differentiating equation 4.9 with respect to marginal costs (c) yields[44]

$$(Y_{f,h})_c = [-\alpha c^{\alpha-1}(\sigma+1)\Psi(DEN) - (-\alpha c^{-\alpha-1}(1+\sigma)(NUM)]/DEN^2 =$$
$$= -\alpha c^{\alpha-1}(\sigma+1)[\Psi DEN - NUM)]/DEN^2 < 0$$

i.e. higher marginal costs abroad, if they are not offset by lower foreign fixed costs, unambiguously result in an outflow of firms.

With regard to fixed costs, an increase in the ψ-ratio also negatively affects

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[42] See appendix for the derivation of equations 4.8a,b and 4.9.

[43] In the full model developed by Venables, expenditure and costs in the respective country are endogenous. Firms in a small country would, however, regard these variables as exoegenous, which is the case at hand here.

[44] To simplify the notation we have used the notation DEN for the denominator and NUM for numerator. Since the distribution of firms cannot be negative, both the numerator and the denominator are positive. Assume that numerical restrictions are imposed on the DEN and NUM such that they have roughly the same value, i.e. the size difference is not extreme.

the foreign location of firms since[45]

$(Y_{f,h})_{\psi}=[-(c^{\alpha})(\sigma+t)(DEN) - (t^{\alpha}+\sigma^{y}t^{1-\alpha})(NUM)]/DEN^2 < 0$ Q.E.D.

Trade costs can only be disregarded when expenditure levels and production costs are identical within each country. In all other cases, trade costs influence the distribution of firms between countries.

Proposition 2. If the foreign country imposes measures that increase the costs of market accessibility (t), it will induce an inflow of firms from the home country.

Proof. Assuming equal production costs in the two countries, the effect of increased trade costs on the location of firms is

$(Y_{f,h})_{t}= [(\sigma\alpha t^{\alpha-1}+(1-\alpha)t^{-\alpha}-1)(DEN) - (\alpha t^{\alpha-1}+(1-\alpha)t^{\alpha}\sigma-\sigma)(NUM)]/DEN^2 > 0$

which must be positive for σ larger than one. Q.E.D.

If the level of trade costs is so high that no exchange of goods takes place between countries, the number of firms in the respective country depends on the expenditure level. In general, firms will respond positively to increased expenditure levels in the respective country.

Proposition 3. An increase in expenditure level on Y-goods will stimulate an inflow of firms, if not counteracted by extreme differences in fixed costs between the countries.

Proof. Assume that initially there is no trade between the countries, i.e. t>p. Differentiating equation 9 with respect toσ yields

$(Y_{f,h})_{\sigma}= [(t^{\alpha}-\Psi c^{\alpha})(DEN) - (t^{1-\alpha}\Psi-c^{-\alpha}t)(NUM)]/DEN^2 > 0$

which is unambiguously positive as long as fixed costs in the foreign country are not high enough to mitigate the effect of an increase in expenditure. Q.E.D.

4.2.2 The two-industry case

We now introduce a basic goods industry into the model. As with firms in the Y industry, X-producing firms are initially distributed between the countries in given proportions. The allocation of firms between the two countries can be derived in exactly the same way as for the Y industry (equation 4.9). Although the basic characteristics are identical for the two industries, they are assumed to differ in one critical way: production factors used in the X industry are tied to a particular country. Such factors could be viewed as natural resources (e.g. forests, oil and mineral ore).

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[45] In a Chamberlinian monopolistic equilibrium fixed costs will be identical across firms. We will initially allow for differences between countries in fixed costs due to trade costs. For example, consider the case when trade costs are so high that autarchy prevails.

Fixed costs associated with the production of X-goods emanate from the availability of resources and the costs of extracting them. Thus, a Heckscher-Ohlin feature is explicitly introduced into the model.

The differences between the Y industry and the X industry could also be viewed as if firms in the X industry derive economies of scale on the plant level. The extraction of country-based resources consequently requires relatively large plants, while economies of scale in the high-tech Y industry appear at the firm level. The latter type of scale economies are normally assumed to originate from the creation of non-rivalry knowledge or competence capital, for instance R&D and marketing assets, and can be transferred to production plants abroad with comparative ease (Grossman-Helpman 1991). Hence, firms in the Y industry display a much higher degree of "footlooseness."

Note that expenditure abroad on domestically produced Y products also includes costs of transportation, even if all trade costs have disappeared. As long as $t>1$ firms can consequently increase their sales by moving closer to the market, since total expenditure would then be comprised only of goods, not transport costs.[46]

Analogously to equation 4.9, the distribution of X firms between countries can be shown to depend on market size in addition to production and trade costs. By dividing the expression for the distribution of Y firms with the distribution of X firms, the influence of a change in one of the exogenous variables on the structure of the manufacturing sector can be derived in the respective country. Let M represent the distribution of Y-firms and X-firms in manufacturing in the two countries,

$$M = (Y_{f,h}/X_{f,h}) \quad . \tag{4.10}$$

An increase in M means that the foreign country becomes more specialized in high-tech production of Y goods, while a decrease in M implies that Y production is concentrated to the home country. A change in the structure of the manufacturing sector then depends on which exogenous factors that shift - and how - and on the interaction between these variables.

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[46] Expenditure in the foreign country on Y-goods produced in the home country is determined by agents minimizing their expenditure on Y for a given level of utility (u). From the properties of the expenditure function (and assuming $p_h=1$), $e(t,u)=ty_{hf}$,consumption is derived by applying Shepherd's Lemma (see Varian 1992)

$e_t=y_{hf}$, and $e_{tt}<0$

From the second order derivative it is obvious that decreasing t would increase demand abroad and enable larger sales volumes.

The more interaction, the more complex the analysis becomes. Consider first the simplest case, where all interaction is assumed absent. If the exogenous changes are restricted to the Y industry, then the results will be identical to the ones obtained for the single industry case.

Proposition 4. Analogous to the results in the single-industry case, increases in production costs restricted to the Y sector in the foreign country will shift the foreign production structure towards basic X-industry goods. A higher expenditure level and a rise in trade costs will, on the other hand, cause foreign Y production to expand.

Proof: The proof is identical to the proofs of proposition 1-3 since the denominator, i.e. the distribution of X firms between the countries, remains unaltered.

Yet, several types of interaction between the variables are conceivable. Whenever such interaction occurs, the calculations become extremely complex and therefore hard to interpret from a qualitative point of view. We will restrict this part of the discussion to one particularly interesting interaction effect, namely how deregulation, i.e. the lowering of trade costs, in conjunction with production costs, influence the location of firms.

Consider the case where at a given point in time the dismantling of trade barriers substantially reduces transportation expenses and confront firms with differences in production costs. In order to sustain competitiveness firms have to relocate to the country that exhibits the lowest production costs. Firm-specific assets such as knowledge can be transferred across countries relatively quickly, and hence the Y sector – where competitiveness is based on such assets – will be more apt to relocate. Of course, there is a multitude of other conceivable interaction effects. However, since regional deregulation has been a conspicuous event in several parts of the world, we have chosen to concentrate on the interaction of differences in production costs and deregulation.

To conclude this part of the discussion, structural adjustment in terms of the relocation of firms as they are exposed to some exogenous shock depends on the initial size of industries in the respective country, the type of distortion, the level of trade costs, and the interactions between variables.

4.3 Hypotheses, the database and the empirical model

The empirical model focuses on the locational behavior of firms in the Nordic countries, all having small domestic markets and depending heavily on exports to the

EU. During the last 20 years, the trade and transportation costs of exporting from the Nordic countries to the EU have been radically reduced.

Previous empirical research in this area has focused on the host-country characteristics that attract foreign direct investment. The size of the market, geographic proximity, and growth frequently turn up as the significant variables (Kravis-Lipsey 1982, Culem 1988, Veugelers 1991). Several studies report that the degree of openness has a positive impact on FDI, supporting the conclusions of locational theory. Yet, the evidence is mixed, and Wheeler-Moody (1992) found that the opposite relationship prevailed. In addition, they found that agglomeration effects seemed to be a crucial determinant of the location of foreign direct investment.

Attempts to estimate differences in the locational pattern of high-tech and low-tech industries are more or less non-existent. There have been some studies conducted on Japanese foreign direct investments, where the results suggest that firms locate in accordance with a country's comparative advantage (Yamawaki 1991). For the Swedish manufacturing sector Braunerhjelm-Oxelheim (1995) have shown, using industry data, how the knowledge-intensive industrial sector has been the dominant foreign investor, although firms in the basic industries have caught up in recent years. They also conclude that a substitutionary relationship prevails between domestic and foreign investment in more technologically advanced industries, while a complementary investment pattern exists in the basic industry.

Based on the propositions presented in sections 4.2.1 and 4.2.2, three major hypotheses will be tested. First, since firm-specific assets are more swiftly transferred between countries, we expect foreign investment by Nordic firms to be concentrated to the relatively footloose high-tech firms.[47] The Nordic countries are abundantly endowed, in contrast to their main trading partner the EU, with natural resources, notably forests, but also oil and to some extent minerals, and in the case of Denmark, fertile land. Hence, there is no reason to expect that the Nordic countries should relocate production due to competitive disadvantages in their basic industry production (Lundberg 1992).[48]

Second, the Nordic countries have a history of having relatively high production costs. Consequently, according to the theoretical model, reduced trade

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[47] Admittedly there are other forces, as well as strategic considerations, that affect the location of firms.

[48] Furthermore, trade in basic industry goods has been relatively free as compared to trade in, for example, cars, telecommunications, and pharmaceuticals (see Cecchini 1988).

barriers that expose firms to such differences should induce firms to relocate to countries with lower costs in this regard. Furthermore, since the liberalization has been spread out over a number years, this effect should be more pronounced towards the latter part of the estimated time period, i.e. the late 1980s. This will be tested by implementing an interaction dummy variable.

Finally, it was shown in the model above how differences in size influence the distribution of firms. Over time, market size changes with the rate of growth in the different countries. We therefore expect that differences in the growth of GDP, corresponding to expenditures differences in the theoretical model, will stimulate an inflow of firms into the high-growth areas.

4.3.1 The database

The database consists of data on the 30-40 largest industrial firms in Denmark, Finland, Norway and Sweden for the time period 1975-1990, ranked by the number of employees.[49] All firms belong to the ISIC class 2 or 3, and they are categorized according to the ISIC 3-digit, sometimes 4-digit, level. The database covers information on sales, exports, value added, R&D, number of employees divided between foreign and domestic production, age and some other less frequently reported variables. Based on R&D intensities, firms are divided into a technologically more advanced industry, referred to as high-tech, a basic industry, and a third group denoted OTHER, containing firms that could neither be classified as basic or high-tech. Basic industry firms are the reference group.[50]

All four Nordic countries have firms that doubtlessly fall into the high-tech industry category. Among these are firms in the pharmaceutical, transport, instrument and electronic industries, to mention a few. There are also firms involved in typical basic-industry production, although here the differences among the Nordic countries are more distinct. For instance, Denmark still has a substantial part of its industry

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49 In each year the 30 largest firms are included, i.e. the data set is an unbalanced panel. For the earlier years, data are not always available, implying that the regressions are based on a somewhat lower number of firms. Firms are assumed to be homogenous within the three sub-industries, i.e. in order to save degrees of freedom firm-specific dummies have not been implemented.

50 It is only in the case of Norway and Sweden where it was possible to use R&D spending as a "high-tech" indicator, and for Sweden only for 1978, 1986 and 1990. According to these intensities firms are categorized in each country for each year. High-tech industries consist of the following ISIC classes: 351, 352,and 380-385. Basic industries are the following: 210, 220, 310, 311, 331, 340, 341, 370-372. The rest of the manufacturing industries are classified as "Other."

rooted in the agricultural sector, whereas particularly Finland, but also Sweden, has a large forest and mining sector. In Norway the extraction of oil is the dominant basic industry.

It is not possible to determine the host country of each firm's foreign production units. Therefore, the empirical analysis cannot include host-country specific features that influence location.[51]

4.3.2 The econometric model

In the theoretical model, the overall number of firms were fixed and shifted across countries as we exposed the economies to different shocks. Since we do not have data on the numbers of firms, the dependent variable is defined as the share of foreign employees out of total employees in the largest firms in Norway, Finland and Sweden.[52] Admittedly, this is not the best way of modelling the shift of firms between different countries. For instance, we have to assume that there are no other sources of entry for firms. Still, it gives an understanding for why firms embark on foreign production. For each country one can then either estimate each industry separately or aggregate the industries and insert dummies for firms of the respective industries. The latter approach will be adopted here.

Two dummy variables are designed to capture the creation of the internal market within the EU.[53] It is hypothesized that Nordic (except for Danish) firms, facing a situation in the late 1980s of being outsiders to the European integration process combined with political ambivalence concerning the future association with the Community, stepped up their investment in the EU. The time period 1975-1990 has therefore been divided into three segments, each containing five years. The reference period is 1975-1980. The dummy variable T80 takes on a value of one in the period 1980-1985, while T85 is the equivalent dummy for the period 1985-1990. Otherwise the dummies are assigned a value of zero. These dummies are expected to capture a positive and increasing effect on the foreign production of Nordic firms over time.

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[51] On an aggregate level, the EC-countries have been the main recipients of Swedish FDI.

[52] In the case of Denmark, data are too scarce to allow a statistical analysis.

[53] The White Paper and the Single Act, the two most important documents to realize the internal market, were approved in 1985 and 1986.

Two variables reflecting the effect of differences in growth and production costs between foreign and domestic markets are also included. First, the difference between a three year moving average in GDP growth between the OECD-countries and each Nordic country is calculated (DIFGDP). A higher foreign growth is hypothesized to have a positive effect on location abroad. Second, the differences in unit labor costs calculated as two year moving averages in the OECD-area and the Nordic countries respectively, have also been constructed (DIFULC). The shorter time period is based on the assumption that firms can redirect production quite quickly between their foreign and domestic units if production costs differ. Higher foreign unit-labor costs should have a dampening effect on production abroad.[54]

The increased exposure of firms to differences in production costs between regions as trade and investment barriers are dismantled has been incorporated through two interaction dummies. They consist of the multiplicative effect of the time periods referred to above and differences in unit-labor costs for each of the Nordic countries and the rest of the world, defined as the OECD-area. These variables are denoted TC80 and TC86, and we expect both to be positively related to the firms expansion abroad. Again, the effect in the latter period is expected to be more pronounced due to the accelerated regional deregulation taking place within Europe, being the Nordic firms' most important markets in the 1980s.

It has been shown that the basic industry firms derive economies of scale on the plant level, while economies of scale are more pronounced at the firm level for technologically advanced production (Braunerhjelm 1990a). Therefore the high-tech industry dummy (HIT) is expected to be positively related to foreign production. The reference group consists of firms belonging to the basic industry, where the Nordic countries have their main comparative advantage. It is harder to a priori assign any value to the third group (OTHER), representing quite heterogenous production.

Finally, as data availability varies between countries, so does also the independent variables utilized in the regressions for the respective Nordic country. Based on earlier research in this area referred to above, the following control variables are included in the empirical analysis and contained in the variable Z; value added, exports, size, R&D, age and profits. Thus, the general structure of the model is the following:

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[54] The data are collected from OECD-statistics.

$$FEMP_{it} = \gamma + \gamma_1 HIT_{it} + \gamma_2 OTHER_{it} + \gamma_3 T80_{it} + \gamma_4 T86_{it} + \gamma_5 TC80_{it} + \gamma_6 TC86_{it} + \gamma_7 DFGNP_{it} + \gamma_8 DIFULC_{it} + \gamma_9 Z_{it} + \varepsilon$$

where the endogenous variable FEMP refers to the firm's share of foreign employees. The subscripts refer to firms (i) and the time period (t). Finally, ε is the error term assumed to have zero expected mean and to be non-correlated, i.e. $\varepsilon \sim (0, \sigma^2)$ and $E(\varepsilon_i \varepsilon_j) = 0$.[55]

4.4 Empirical results

The regressions will be undertaken by implementing OLS. All variables referring to values have been deflated by the consumer price index for the respective country. To avoid heteroscedasticity and to correct for firm size, the variables are expressed in units per employee. Finally, logarithmic values are used in the estimation. The database covers the period 1975-1990 and the results are shown in Table 4.1.

Starting with Sweden, the explanatory variables in addition to the ones described above, i.e. those summarized in variable Z, are the following. First, scale effects, i.e. the size of firms, has in several other studies (e.g. Swedenborg 1979) been confirmed as a significant variable for a firm's foreign operations, and here it is measured as the numbers of employees (size). Recent findings have also established a negative relationship between foreign production and exports from the domestic units in the 1980s (Svensson 1993). Exports are consequently expected to be negatively connected with the share of foreign employment.

Profits, defined as operating profits divided by total sales, are also included as an explanatory variable. This is justified for two reasons: First, internationalization is costly, and second, high profits should capture some kind of firm-specific asset yielding temporary monopoly profits, which according to economic theory has a positive influence on internationalization (Hymer 1960, Dunning 1977). Since we do not have any profit data for Norway, value added per employee, i.e. labor productivity is used instead.

As shown in Table 4.1 most variables are significant at the 1 percent level and have the expected signs. A strong positive relationship between high-tech firms and foreign production is established, as compared to basic industry firms. In addition, the time variable capturing Swedish FDI after the decision to establish the internal market

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[55] Note that $E(\varepsilon_{it}\varepsilon_{jt})=0$, for $i \neq j$, while $E(\varepsilon_{it}\varepsilon_{it}) \neq 0$ for $s \neq t$. However, this will not yield inconsistent parameter estimates.

within the EU, is highly significant. Confirming previous results (Braunerhjelm 1993, Svensson 1993), exports and foreign production display a negative relationship. Only size fails to attain statistical significance.

Profits also turns out to be strongly positively related with the share of foreign employment. This could be interpreted in two ways. First, it suggests that the risk involved in setting up production units abroad requires a high internal cash flow, and second, a comparatively high level of profits reflects some unique firm-specific asset, or competence, on which a firm bases its competitiveness. Higher growth abroad, i.e. an expansion of the market, and lower foreign production costs, display the expected positive impact on foreign production. As shown by the interaction dummies, TC80 and TC85, differences in production costs have increasingly influenced the location of production during the whole 1980s.

Turning to Finland, the regression contains the same variables as for Sweden. The results conform well to those reported for the large Swedish firms. The dummies representing the time period 1980-85, and the differences in unit labor costs during that period, are, however, insignificant. Hence, the period 1980-1985 as such did not exert any positive influence on the internationalization of Finnish firms. Neither did differences in production costs. That contrasts markedly with the effects in 1985-1990, where both these variables become highly significant. It reflects the decision to establish the internal market within the EU and, for the same reason, that Finnish firms became more exposed to international competition simultaneously as their export markets in former Soviet Union began to collapse.

The high-tech dummy is strongly significant suggesting that primarily technologically advanced firms have established production abroad, particularly after 1985. As in the Swedish case, a negative relationship between foreign production and exports is established while profits and differences between Finland and the OECD-area with respect to GDP-growth are insignificant. The overall explanatory power of the regression is somewhat lower as compared to the Swedish case, yet it explains approximately 52 percent of the share of foreign employment.

Finally, the results of the Norwegian data are shown in Table 4.1. The Norwegian data do not contain any information on profits. In its place, value added per employee is included in the analysis. On the other hand, data on R&D and age are available. The R&D variable, being a proxy for firm-specific assets, is lagged by three periods. Previous studies confer a positive relationship between R&D and foreign production (Horst 1972, Caves 1971, Magee 1977, Teece 1983). Age reflects that it takes time to grow, and to learn about foreign markets, and previous research has

contended a positive connection to foreign operations (Swedenborg 1979).

A severe restriction is the lack of data on exports. Instead, we have to use foreign sales which naturally are expected to be positively connected to foreign employment. In the beginning of the period foreign sales match very closely exports, making it an acceptable proxy for exports, while in the late 1980s the discrepancy between the two becomes wider.

The picture that emerges is considerably less clear-cut than for the other countries and thus much harder to interpret. The dummies for the different sub-industries are significant and the high-tech dummy has the expected positive sign. Likewise, the time dummies have the expected sign and are highly significant while, somewhat surprising, only the interaction dummy for the period 1980-1985 is significant, which is probably linked to the expansion of the Norwegian oil industry in 1985-1990. Also foreign sales are strongly positively related to firms' operations abroad, as is higher GDP-growth in the OECD-area. On the other hand, size is negatively connected with the internationalization of Norwegian firms, which could be explained by the large corporations in the Norwegian oil industry and in other basic industries. It is, however, more difficult to explain the highly negative significance of labor productivity on foreign production. Again it is tempting to attribute the explanation to influences from the Norwegian oil-sector. R&D, age and differences in production costs in Norway and OECD, fail to show any significance. Overall the explanatory power is substantially lowered compared to the results for Sweden and Finland.

4.5 Conclusions

To a large extent the empirical analyses support the hypotheses derived from the theoretical analysis in section 4.2. All Nordic industries display a distinct pattern of high-tech firms being the leaders in the internationalization process. Firms in the basic industries, often tied to country-specific factors and huge investments in process- and capital-intensive plants, have retained more of their production in their respective home countries. Internationalization of production occurred in a period characterized by trade liberalization and diminishing regulations on capital flows, ownership, and foreign investment.

Differences in GDP growth turned out to have a positive impact on foreign production for two of the three countries. The decision to enlarge the market within the EU is likely to have had an influence in the latter part of the 1980s, implying a

considerable reduction in trade and transportation costs within the common market. This is also suggested by the time dummies, being significant for all the three countries in the period 1986-1990. A similar result applies to the interaction between the time dummy and differences in production costs for Sweden and Finland. The empirical analysis also shows how exports vary negatively with foreign production. This result further underpins the existence of substitution between exports and foreign production. A definite understanding of these matters, however, requires that the analysis takes into account sub-industry differences (Braunerhjelm 1990b).

Small open economies with a large share of high-tech firms in the manufacturing sector have been shown to be more likely to experience relocation abroad of their firms if the economic prerequisites for industrial production shift across countrie, or regions. For countries that have a relatively small industrial base, or are dependent on relatively few firms, the implications could be quite drastic. A clear example of a country with such a setting is Sweden, being dependent on relatively few large international firms. Many of these firms are involved in high-tech production. According to the new growth theory, a decrease in knowledge intensive-production could show up in long-term irreversible patterns of low growth rate.

Table 4.1 OLS estimation of the share of foreign production in large, industrial, Nordic firms, 1975–1990

Explanatory variables	Sweden	Finland	Norway
Intercept	.34*** (4.70)	-.70*** (-6.35)	.28*** (3.56)
High-tech	.10*** (7.24)	.06*** (2.84)	.10*** (7.16)
Other	-.05** (-2.53)	-.06** (-1.98)	.14*** (8.99)
T80	.08*** (4.81)	.05 (1.24)	.05** (2.34)
T86	.10*** (2.89)	.15*** (4.77)	.13*** (5.72)
TC80	.009** (2.03)	.01 (1.18)	.03*** (2.89)
TC86	0.013** (2.38)	.02*** (4.77)	.003 (.92)
Size	-.003 (-.47)	.09*** (7.16)	-.03*** (-3.42)
Exports	-1.26*** (-14.74)	-.1.04*** (-6.52)	
Foreign sales			.63*** (11.95)
Profit	1.11*** (4.51)	.37 (.79)	
VA			-.66*** (-10.70)
Age			-0.01 (-1.27)
R&D3			.34 (.73)
DIFBNP	.007** (1.97)	-.003 (-.63)	.009** (2.39)
DIFULC	-.006*** (-3.84)	-.002 (-.66)	-.002 (-1.03)
Adjusted R^2	.61	.52	.45
F-value	60.35	20.16	22.31
DF	409	220	320

Note: * = 10 percent significance level, ** = 5 percent significance level, *** = 1 percent significance level.

Appendix

The demand equations 4.1a and 4.1b are derived as follows. First, we impose the love of variety structure on preferences (Spence 1976, Dixit-Stiglitz 1977) implying that utility is increasing in the number of varieties (n) consumed for each product group (i). Assume that the utility function is weakly separable between product groups and that each sub-utility function (u_i) is characterized by symmetric constant elasticity of substitution, $u_i(y_{i1},y_{i2}\ldots y_{in})=(\Sigma y^{\beta})^{1/\beta}$, where $\beta=(1-1/\sigma)$ and σ equals the elasticity of substitution. For each product-group, consumers maximize utility (u_i) subject to a given budget constraint, $\Sigma p_i y_i=E_i$. Define the Lagrangian function,

$$L = (\Sigma y^{\beta})^{1/\beta} - \lambda(\Sigma p_i y_i - E_i) \quad . \tag{A1}$$

The Lagrangian multiplier is denoted by λ. The first order condition is obtained by differentiating the Lagrangian with respect to y,

$$y^{-1/\sigma}(u_i)=\lambda p_i \text{ or } y=(\lambda/u_i)^{-\sigma}p_i^{-\sigma} \quad . \tag{A2}$$

From the first order condition it is clear that the second order derivative with respect to consumption of y must be negative. Hence the conditions for a maximum is fulfilled. By substituting the expression in A2 into the budget constraint the y_i's are eliminated. Then solve for $(\lambda/u_i)^{-\sigma}$,

$(\lambda/u)^{-\sigma}=E_i/\Sigma p_i^{1-\sigma}$,

which, substituted back into the first-order conditions, yields

$$y_i=(p^{-\sigma}/\Sigma p^{1-\sigma})E_i \quad , \tag{A3}$$

i.e. the same expression as in equation 4.1a and 4.1b. The denominator can be interpreted as a price index.

Equation 4.8a and 4.8b are derived in the following way. First, equations 4.2a and 4.2b can be expressed in terms of domestic and foreign firms,

$$n_h=P_h^{1-\alpha}p_h^{\alpha}/p_h-(p_f t/p_h)^{1-\alpha}n_f=\kappa_h/p_h-(p_f t/p_h)^{1-\alpha}n_f \tag{A4}$$

$$n_f=P_f^{1-\alpha}p_f^{\alpha}/p_f-(p_h t/p_f)^{1-\alpha}n_h=\kappa_f/p_f-(p_h t/p_f)^{1-\alpha}n_h \quad , \tag{A5}$$

where $\kappa_j=P_j^{1-\alpha}p_j^{\alpha}$ (j=h,f) is used to simplify the notation. Substitute for n_f into A4,

$n_h=\kappa_h/p_h-(p_f t/p_h)^{1-\alpha}[\kappa_f/p_f-(p_h t/p_f)^{1-\alpha}n_h]$

rearrange and set $p_h=1$,

$$n_h=[\kappa_h-(\kappa_f/p_f t^{\alpha})t^{1-\alpha}/](1-t^{2(1-\alpha)}) \tag{A6}$$

and similarly for the number of foreign firms,

$$n_f p_f=[\kappa_f-(\kappa_h p_f^{\alpha}t^{1-\alpha})](1-t^{2(1-\alpha)}) \quad . \tag{A7}$$

Equations A6 and A7 are identical to equations 4.8a and 4.8b. From the zero profit conditions in equation 4.7a and 4.7b, expressions for κ_h and κ_f can be obtained.

By substituting these expressions into A6 and A7, and dividing the two equations by each other, equation 4.9 is attained, which gives the distribution of firms as a function of trade costs, production costs, and expenditure levels.

CHAPTER 5

MULTINATIONAL CORPORATIONS, COUNTRY CHARACTERISTICS, AND AGGLOMERATION IN FOREIGN DIRECT INVESTMENT[56]

5.1 Introduction

During the 1980s foreign direct investment (FDI) increased to become a major force in the global economy. Compared to other economic variables, it reached an unparalleled annual growth rate of approximately 30 percent. This increase in the foreign operations of firms has finally begun to be incorporated in economic theory, particularly in growth theory and locational economics (Romer 1986, Sala-i-Martin 1990, Krugman 1991a,b,2 Venables 1993). In these models agglomeration is spurred by the presence of externalities arising from a firm's inability to fully appropriate the return to R&D investments, increased competition and interaction with other firms, and enhanced access to specific skills and capabilities. If such factors gain in importance for firm competitiveness, they will promote investments in regions with similar production, i.e., firms will act to exploit economies of agglomeration.

This paper focuses on the empirical underpinning of the alleged interaction between firm-specific and country-specific characteristics on the pattern of foreign investment. More precisely, do home-country firms invest in foreign countries that have a large share of similar production? If so, will production specialization across countries be reinforced through clustering or agglomeration as firms undertake FDI? The analysis presented below focuses on differences in the pattern of FDI across industries, in particular basic industries (ore, forestry) and more advanced, knowledge intensive production.

The OLI (ownership advantage, location, internalization) approach to FDI, extended to account for clustering effects, constitutes the theoretical base for the analysis. The empirical analysis utilizes an unique IUI firm data set containing detailed

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[56] This chapter is written together with Roger Svensson, The Industrial Institute for Economic and Social Research, Stockholm.

information on approximately 90 percent of the Swedish multinational corporations (MNCs). Firm data are combined with country data for most OECD countries as well as most important Latin American countries. Drawing on recent contributions in economic theory we emphasize the agglomeration effects in the location of firms. The hypotheses will be tested through Tobit analysis. Furthermore, our methodological approach is refined compared to previous work in this area, since countries where no affiliate production occur are included in the analysis (Svensson 1993).

The paper is organized as follows. Section 5.2 reviews the theoretical framework of FDI as well as earlier empirical results. Then, a detailed description of the database is forwarded. Sections 5.4 and 5.5 present the hypotheses and the statistical analysis. Finally, the paper concludes with a summary of the main findings and a policy discussion.

5.2 Foreign direct investment in economic analysis

5.2.1 Theoretical background

The general theoretical framework, known as the eclectic approach (Dunning 1977), stresses the interaction between firm-specific factors and country variables as the main determinants of FDI. It is also referred to as the OLI theory, where O stands for ownership advantages, i.e. firm-specific assets, L denotes country-specific factors, while I represents internalization. The lack of markets for firm-specific assets tends to make transaction costs - or the risk of being exposed to "opportunistic behavior" (Williamson 1975) - excessively high for arm's length contracts and similar arrangements, which induces internalization by firms through FDI. The theoretical platform builds on works by Coase (1937), Hymer (1960) and Williamson (1975, 1979), to mention a few. With regard to the locational factors, the eclectic approach maintains that in order to attract FDI, the recipient country has to offer some particular, country-specific, advantage. Examples of such an advantage are sizable markets, skilled or low-cost factors of production, or policy designed incentives.

A recent explanation of factor accumulation not accounted for in the eclectic approach is the possibility to capture spillovers from other firms or industries, as suggested by the new growth theory (Romer 1986). It is argued that knowledge-enhancing activities can only partly be appropriated by firms, which create an externality that is diffused to other firms, thereby reducing their costs (Griliches

1979). The "spillover" literature is closely linked to the earlier research on public goods, assumed to be supplied by the government. Already Henderson (1974) argued that the rent firms derive from public goods, which enter their production functions as unpaid intermediate goods, induces entrance by firms. Regions where such spillovers are abundant would therefore have a locational advantage.

The literature on economic geography also uses the concept of external effects. More precisely, the issue addressed in locational theory concerns why firms concentrate into certain geographically well-defined areas, despite the fact that costs tend to be higher in those areas. The rationale for such behavior is traditionally ascribed to the advantages accruing to the pooling of factors with specific skills, the possibility to support production of non-traded inputs, and information spillovers. The "new" location theory, however, puts more emphasis on "pecuniary" externalities, defined to be associated with demand and supply linkages rather than technological spillover effects (Krugman 1991a,b). Economies characterized by high transportation costs, limited manufacturing production and weak economies of scale are shown to have a dispersed manufacturing sector. On the other hand, low transportation costs, coupled with a large manufacturing sector and economies of scale, foster concentration of production.[57] The analysis is frequently limited to the location of firms *within* countries although, and more appropriate for our purpose, the same line of reasoning can, of course, be applied to the location of firms *between* countries.

Locational aspects, however from a somewhat different angle, is also at focus in a model recently presented by Venables (1993). Within a traditional monopolistic competition framework, Venables argues that low trade costs will make firms highly sensitive to differences in production costs, thereby making them more internationally "footloose."[58] Venables also shows that in the case of vertically linked industries, parametric changes may result in "catastrophic" effects, implying that extensive relocation of firms may more or less wipe out the industrial base in regions or countries. Consequently, there are inherent instabilities in the system and several equilibria may prevail simultaneously in different countries.[59]

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[57] The idea is not new, already Dahmén (1950) stressed the importance of clustering, or in Dahmén's terminology, development blocks, in creating competitive advantages, a tradition pursued at the macro level by for instance Porter (1990).

[58] If factor mobility is low, such clustering could be halted by increases in factor rewards.

[59] See also Braunerhjelm (1991) where it is shown how sensitive Swedish upstream firms are to the location of downstream firms.

5.2.2 Previous empirical results

To what extent has the theory of FDI, particularly the part of it concerned with agglomeration effects, been confirmed in empirical research? Although evidence has been forwarded concerning the existence of R&D externalities (Levin-Reiss 1988, Bernstein 1988, Bernstein-Mohen 1994), most empirical analyses of location still emanate from the traditional OLI framework. For instance, Kravis-Lipsey (1982) and Veugelers (1991) reach the conclusion that size and proximity exert a positive impact on the distribution of investments. With regard to openness, evidence is more scattered. Kravis-Lipsey (1982) and Culem (1988) conclude that it has a positive influence on FDI, supporting the "new" locational theory, while Wheeler-Mody (1992) report opposite results and Veugelers (1991) fails to detect any significant influence. Factor costs seem to have very limited influence on FDI, at least among industrialized countries. In fact, Kravis-Lipsey (1982) report a pattern of "opposites attract," i.e. firms in low wage industries invested in high wage markets, which was interpreted as high wages reflecting high productivity and not necessarily high costs. It could, however, also be hypothesized that firms invest in high wage, high cost, areas in order to exploit price differentials between countries, reflecting a first mover strategy.

From the above cited studies a number of variables can be distinguished that influence the locational choice of firms, although less light is shed on the tendencies towards clustering. By incorporating country "agglomeration" factors, defined as the quality of infrastructure, the degree of industrialization and the level of inward FDI into the respective market, Wheeler-Mody (1992) contended that US investors regard such agglomeration factors as a major determinant of foreign investment. Some further evidence of agglomeration is also found in the pattern of Japanese foreign direct investments which seem to have strengthened the specialization of countries and regions (Micossi-Viesti 1991).

Wheeler and Mody also raise the question how economies lacking such attracting factors could overcome this drawback, since agglomeration seems to be a self perpetuating process beyond a certain stage. As shown by Arthur (1986), a minor regional advantage could turn into a substantial clustering of a specialized industrial activity.

5.2.3 Introducing agglomeration factors into the OLI model

The OLI framework - extended to incorporate agglomeration factors - constitutes the theoretical base for the empirical model in section 5.4. As noted above, theoretical models focus on R&D spillovers as the main force in creating clusters. This is somewhat misleading since a number of other factors also influence the locational attractiveness of different regions, e.g. the industrial structure, the characteristics of local networks and suppliers, and the skill level of employees. Hence, in order to understand the distribution of production across countries such local forces, related to country-specific and industry-specific features, must be included into the empirical models.

In our view, the most relevant agglomeration variable is the industry's share of the manufacturing sector in the respective host country. The compelling feature with this variable, as we measure it, is that it captures the support systems within industries, without becoming too general to invalidate an economic interpretation. Earlier attempts to include agglomeration variables suffer from the weakness that they have been confined to aggregated country variables, hardly allowing any meaningful interpretation as far as industrial clustering is concerned. We have however included one such country variable which captures the relative abundance of skilled labor across countries. In this extended version of the OLI model, the added variables can be traced directly to recent contributions in economic theory.

5.3 The database

The database on Swedish MNCs was completed at the Industrial Institute for Economic and Social Research (IUI) in Stockholm and covers six years with approximately a five year interval (1965, 1970, 1974, 1978, 1986, 1990). The data set contains detailed information about R&D, production, employees and the distribution between foreign and domestic units, as well as the extent and direction of external and internal trade flows. In the empirical analysis, only the last three surveys (1978, 1986 and 1990) are used, since emphasis is on the location by Swedish MNCs in the 1980s. Only countries on which we have export statistics for the individual firms are included in the analysis, i.e. the OECD countries in Europe and North

America, and the major countries in Latin America.[60] This is, however, not a cause of great concern since more than 95 percent of the foreign production of Swedish MNCs is directed to the countries included in the model.

As mentioned above, countries which host no Swedish-owned manufacturing affiliates must be compared with countries that do, in order to adequately test for the determinants of localization. As illustrated in Table 5.1, firms frequently locate manufacturing affiliates in markets to which they have previously exported. This suggests that export markets are strong candidates for a firm's FDI. Exceptions to this pattern relate to industries where different barriers to trade have made exports impossible, as in the gas (chemicals), concrete (others), food and textile industries. In the empirical analysis one observation is therefore generated each time a firm has had previous exports to a foreign market, irrespective of whether the firm has any affiliates in the particular country. Due to the export variable, only MNCs which are included in two succeeding surveys are tested in the model, i.e. observations for 1990 (1986, 1978) are only included when a firm appears in the 1986 (1978, 1974) survey as well.

5.4 Econometric specification and hypotheses for empirical testing

The dependent variable is net sales of firm *i's* affiliates located in country *j* in period *t* (NS_{ijt}).[61] It is divided by total sales of the firm (TS_{it}), since one should expect foreign production to be increasing in firm size. This is also a way to avoid heteroscedasticity. NS/TS is characterized by a large share of zeroes (more than 60%). One objective is to compare countries where Swedish affiliates are established with those lacking such Swedish presence. The appropriate statistical method for estimating such a model is the Tobit method (Tobin [1958]):

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[60] EC countries: Germany, the Netherlands, Belgium, France, Italy, Great Britain, Denmark, Spain and Portugal; EFTA countries: Norway, Finland, Switzerland and Austria; North America: USA and Canada; Latin America: Argentina, Brazil and Mexico.

[61] Net sales = Gross sales - Imports from the parent.

$$\frac{NS_{ijt}^{*}}{TS_{it}} = \beta_0 + \beta_1 CLUST_{kjt} + Z'\beta + \epsilon_{ijt}, \tag{5.1a}$$

$$\frac{NS_{ijt}}{TS_{it}} = \begin{cases} \frac{NS_{ijt}^{*}}{TS_{it}} & if \ \frac{NS_{ijt}^{*}}{TS_{it}} > 0 \\ 0 & if \ \frac{NS_{ijt}^{*}}{TS_{it}} \leq 0 \end{cases} \tag{5.1b}$$

CLUST is the agglomeration variable and the Z corresponds to either attributes of the MNC or attributes of the host country. The latent variable $(NS/TS)^{*}$, can be interpreted as an index of the propensity to produce in a specific host country.[62] The parameter estimates, which are consistent, may, however, not be interpreted as marginal effects.[63] This specification contrasts with previous studies that have investigated the locational determinants of affiliate production. More precisely, earlier models have restricted the analysis to host countries where the firms already have production. The weakness of such an approach is that the location of production is given, and consequently one only tests whether the firm produces more or less in the existing affiliates in a host country.

The explanatory variables included in the model are primarily derived from the OLI theory, extended to incorporate country-specific agglomeration factors. The focus is on the interaction between firm-specific and country-specific determinants of FDIs. The principal and most interesting variable is the one measuring clustering effects ($CLUST_{kjt}$). It is defined as the share of employees in industry *k* of all employees in the manufacturing sector in host country *j* at time t. This variable is divided with a weighted mean for industry *k* for all countries for two reasons. First, some industries may be large in almost all countries. Second, some industries are more labor-intensive than others. Such industries would then receive a higher value if we had chosen the share of output instead. If the coefficient of (CLUST) turns out

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[62] The residuals are assumed to have the desired properties $\epsilon \sim N(0, \sigma_\epsilon^2)$, $E(\epsilon_{hjt}\epsilon_{ijt})=0$ for $h \neq i$ and $E(\epsilon_{ijt}\epsilon_{ikt})=0$ for $j \neq k$. It should be noted that $E(\epsilon_{ijs}\epsilon_{ijt}) \neq 0$ for $s \neq t$, since a firm which has a high production in country *j* at time *s*, is also expected to have a high production at time *t*. This will, however, not yield inconsistent parameter estimates.

[63] The β's can be decomposed into two parts: changes in the probability of being above the limit and changes in the value of the dependent variable if it is already above the limit (McDonald and Moffitt [1980]).

to be significantly positive, it suggests the presence of clustering effects.[64] Significant parameter estimates that are low, or negative, imply that firms primarily invest in countries which have limited production of similar products, indicating that other reasons to invest abroad are more important.

The other country variables included in the model are the following. Large markets, measured by GDP_{jt}, have received support in most other empirical analysis and are expected to have a positive influence on host country production. Furthermore, a variable measuring the relative factor endowment of skilled labor in the host country is included. This is defined as the number of Research Scientists, Engineers and Technicians per 1,000s of the population ($RSET_{jt}$) and is taken from UN [1992] statistics. Host countries with high RSET are expected to promote FDI, especially by R&D intensive firms. A modified version of the Wheeler and Mody [1992] index measuring the host countries openness policy has also been included ($OPEN_j$).[65] This index will take on a higher value the more open the host country economy is. Here we apply the traditional tariff jumping argument and hypothesize that low openness encourages foreign firms to locate production in the host country. Finally, the historical trade pattern of the firm is represented by the exports of finished goods by firm *i* to country *j* in period *t-1* ($XF_{ij,t-1}$). It is assumed that exports increase with firm size. XF_{t-1} is therefore weighted with the inverse total sales of the firm in period *t-1*. By using the lagged value of exports, we avoid simultaneity problems. Exports at an early stage are expected to have a positive influence on location of production, as predicted by Aharoni (1966) and Johansson-Vahlne (1977).[66]

Firm-specific advantages are expected to create absolute advantages vis-à-vis competitors. We use R&D intensity (RD_{it}) - defined as total R&D expenditures divided by total sales of the firm - and the average wage (LS_{it}) in the home country part of the MNC, to capture such firm-specific advantages. The former is argued to

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[64] One may argue that there should be a simultaneous relationship between NS/TS and CLUST, e.g. if firms in transport allocate more FDIs to Germany, then this industry will get a larger share of total manufacturing employees in Germany. But this is not a problem of great concern, since our model analyzes location of affiliate production for individual firms. It must be regarded as quite farfetched to believe that an individual firm would affect a characteristic aggregated on industry and country level.

[65] This index includes (1), limits on foreign ownership and, (2), government requirements that a certain percentage of a specific type of local component must be used when setting up manufacturing operations. This variable takes on values from 1 to 10, where 10 means high openness. The Wheeler-Mody index was constructed for the US and it has been modified to conform better to the Swedish situation by utilizing the data on trade barriers in Leamer (1990).

[66] In Svensson (1993) it was shown how foreign production of Swedish MNCs in the 1980s substitutes for exports.

capture the technological, or knowledge, intensity of the firm, while the latter should be correlated with the human capital within the company. In accordance with the OLI theory, both RD and LS should exert a positive impact on the propensity to produce abroad.

By including additive dummy variables, we examine whether any shifts in the level of the dependent variable occurr over time or across regions.[67] The analysis also considers whether there are any industry-specific or firm-specific fixed effects to explain the variation in foreign production. This is done by alternatively assigning additive dummies for different industries or firms.[68]

Since we want to examine if these variables, especially the agglomeration variable, exert different impacts on the localization of production across industries, two main versions of the model are estimated.

Restricted model: All parameters to the explanatory variables are restricted, i.e. β_1, β_2, etc., are assumed to have the same value for all industries. Two variants of this model are estimated, one with industry (I) and one with firm-specific (II) additive dummies.

Unrestricted model: The parameters are unrestricted across the main industries.[69] This is accomplished by assigning interaction dummies for different industries. In model (III), only β_1 is allowed to vary across industries, but in model (IV), all parameters of the explanatory variables are specific for each industry. Furthermore, firm-specific additive dummies are always used in the unrestricted model.

5.5 Results of the estimations

As seen in Table 5.2, the log-likelihood ratios are satisfactorily high in both runs in the restricted model. The parameter to our main variable, CLUST, is always significant

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[67] When using time dummies, 1990 will always be the reference period. The regions are the EC, EFTA, North America (Nam), Latin America (Lam). The EC is always the reference region.

[68] The industries, which are assigned dummies are: food, textiles, basic, chemicals, metal products, machinery, electronics and transports. The metal industry will always be the reference industry. When controlling for firm-specific effects, MNCs included in at least two of the three surveys are given an additive dummy. This means that we control for 27 different firms, which cover more than 75 percent of the observations. There is no use to assign dummies to MNCs which only appear in one survey, since then there is little variation left between firms.

[69] The main industry groups are the basic, chemical, engineering and "other" industries. The last group includes food, textiles, wood products, etc, but is not shown in the result part of this paper due to the greater heterogeneity.

at the 5% level. The larger the host country industry to which the investing firm belongs, the larger affiliate production in that country, and the higher is the probability that the firm has established an affiliate there. This result supports the view that agglomeration influences the location of manufacturing affiliates. The previous trade pattern of firms, XF/TS, have an even stronger influence on the location of production. The parameter is significant at the 1% level in both runs.

Considering the host-country variables, both market size, GDP, and the endowment of skilled labor, RSET, exert a positive and clearly significant impact on affiliate production. This is in accordance with the hypotheses above. The openness of the host country, OPEN, has the expected negative impact on affiliate production, but the parameter is never significant. This indicates that the location of FDI is primarily affected by other factors than openness.

Turning to the firm-specific variables, the R&D intensity, RD, exerts an unexpected, negative impact, while the labor skill variable, LS, display the expected, positive connection to foreign production in model (I). Not surprisingly, the coefficients of the firm variables are strongly affected by the inclusion of firm-specific effects in model (II). RD then exerts a positive impact on FDI, which means that the influence of RD on the whole is uncertain. The coefficient of LS is not significant, but is still positive. Thus, there is some evidence that firms with skilled labor are more inclined to undertake FDIs. Human capital in the host country (as represented by RSET) and within the investing firm (LS), seem to be important in explaining the distribution of FDIs.

Table 5.3 shows the results of the unrestricted model, where the parameters are allowed to shift across industries. In model (III) the agglomeration variable, CLUST, has a positive and significant influence on foreign production at the 5%-level in the engineering and chemicals industries, but not in basic industry. When all parameters are industry-specific (model IV), the effect is significant at the 10%-level only in engineering. Even more interesting is that the parameter estimates for the clustering variable are almost identical in model (III) and (IV). Only the standard errors increase, which can be explained by the inclusion of 18 more variables in model (IV), and that some sort of multicollinearity arises. Thus we conclude that agglomeration effects are strongly prevalent in engineering, have some influence in chemicals, but are absent in the basic industry.

In model (III) the results for the other explanatory variables are analogous to those in model (II). In model (IV), however, the previous trade pattern of the firm is the main determinant of FDI in the basic industry. In chemicals, it seems obvious

that previous exports, market size and skilled labor are the most important host country variables to attract MNCs to establish affiliate production. Finally, in addition to the agglomeration variable, previous export and market size seem to be the major determinants of foreign production in engineering

5.6 Concluding remarks

The statistical analysis supports that agglomeration has a positive impact on Swedish MNCs as they locate production abroad. The agglomeration variable - the relative size of the respective industry in each country to which the investing firm belongs - captures the support system of an industry, i.e. a larger share indicates a relative abundance of suppliers of components and services related to that industry, and access to labor skills they require. Furthermore, a larger size of the industry should also improve the possibilities to profit from knowledge spillovers. Disaggregated to the industry level, the agglomeration variable displays strong significance for the engineering industry, some for the chemical industry, while it is insignificant for the basic industries.

Among the host-country variables, market size and the quality of the labor force attract MNCs to establish manufacturing affiliates. Openness fails to show any significance. It is also verified that the previous trade pattern of the firm exerts a significant influence on the location of production. Firms endowed with human capital seem to be more inclined to undertake foreign operations, while the influence of the firm's level of technology is uncertain.

A normative conclusion seems to be that if such externalities or economies of agglomeration strongly affect the location of FDI, it is important to be among the first to attract such investments. Particularly if agglomeration is dominated by more technologically advanced firms (e.g. engineering, chemicals) and the conclusions of the "new" growth theory hold, i.e. macroeconomic growth is predominantly related to investment in knowledge. Agglomeration, combined with lower trade costs and high economies of scale, could result in substantial relocation of firms, a process which may threaten the entire industrial base of a country. Hence, the empirical analysis suggest that a multiple equilibrium situation is possible in which countries, or regions, are trapped in either virtuous or vicious growth cycles. Although the results here are based on the behavior of Swedish MNCs, we believe they have a general application with regard to the investment pattern of other MNCs.

Table 5.1 Comparison between establishment of manufacturing affiliates and earlier trade pattern of firms across industries for 1978, 1986 and 1990

Industry	Number of foreign subsidiaries	Exports have preceded the establishment of subsidiaries	
		Number of times	Percent
Paper & pulp	44	43	99
Chemicals	73	62	85
Iron & steel	15	15	100
Metal products	35	31	89
Machinery	77	76	99
Electronics	108	107	99
Transports	16	16	100
Others[a]	86	78	91
All industries	454	428	94

Note: Every time a firm has established an affiliate in a host country, one observation is generated. Only firms which are included in two succeeding surveys are represented in the table, i.e. observations for 1990 (1986, 1978) are only included when a firm appears in the 1986 (1978, 1974) survey as well.

[a] "Others" include food, textile, paper products, wood products, and concrete industries.

Table 5.2 Estimation results of the restricted model

Method = Tobit	Dependent variable = NS/TS	
Explanatory variables	Model (I)	Model (II)
CLUST	.0195 ** (.0087)	.022 ** (8.66 E-3)
$(XF/TS)_{t-1}$	.755 *** (.116)	1.057 *** (.120)
GDP	2.87 E-6 *** (7.42 E-7)	2.69 E-6 *** (7.36 E-7)
RSET	8.19 E-3 *** (2.89 E-3)	8.34 E-3 *** (2.89 E-3)
OPEN	-2.27 E-4 (3.44 E-3)	-9.06 E-4 (3.42 E-3)
RD	-.396 *** (.113)	.575 ** (.282)
LS	3.55 E-4 *** (1.15 E-4)	8.11 E-5 (1.49 E-4)
Log likelihood ratio	1068.9	1187.4
No. of observations	1278	1278
Left censored obs.	736	736

Note: Standard errors in parentheses. ***, ** and * indicate significance at 1, 5 and 10 percent respectively. Intercepts, dummies for time and regions in both models, for industries in model (I) and for frims in model (II) are not shown, but are available from the authors on request.

Table 5.3 Estimation results for different industries in the unrestricted model

Method = Tobit	Dependent variable = NS/NT					
Explanatory variables	Model (III)			Model (IV)		
	Basic	Chemicals	Engineering	Basic	Chemicals	Engineering
CLUST	.0122 (.0114)	.0318** (.0154)	.0219** (.0101)	.0127 (.0151)	.0343 (.0249)	.0233* (.0132)
$(XF/TS)_{t-1}$	1.048*** (.120)			1.068*** (.240)	.947*** (.341)	.1.059*** (.173)
GDP	2.71 E-6*** (7.35 E-7)			1.14 E-6 (1.32 E-6)	3.42 E-6*** (1.15 E-6)	2.94 E-6*** (8.44 E-7)
RSET	8.58 E-3*** (2.87 E-3)			9.36 E-3 (5.92 E-3)	.023*** (6.12 E-3)	3.25 E-3 (3.51 E-3)
OPEN	-8.71 E-4 (3.42 E-3)			2.19 E-3 (5.26 E-3)	-4.31 E-3 (4.85 E-3)	7.27 E-4 (3.69 E-3)
RD	.587** (.299)			.78 (.77)	.274 (.436)	.536 (.462)
LS	1.05 E-4 (1.49 E-4)			7.04 E-5 (2.30 E-4)	1.10 E-6 (2.17 E-4)	1.12 E-4 (1.18 E-4)
Log likelihood ratio No. of observations Left censored obs.	1192.8 1278 736			1234.8 1278 736		

Note: Standard errors in parentheses. ***, ** and * indicate significance at 1, 5 and 10 percent respectively. Intercepts and dummies for time, regions and firms are not shown, but are available from the authors on request.

CHAPTER 6

SUMMARY

6.1 Main results

In the preceeding chapters we have studied various aspects of the expanding international operations of MNCs. Since existing theory does not satisfactorily explain some observed phenomena, notably the endogenization of comparative advantages through internal firm transfers of know-how, emphasis in the analysis has been on quantitative and empirical results. Contemporary theoretical advances have just recently addressed the welfare effects of knowledge accumulation and the related normative issues. Economic science, however, still has a lot to learn about the forces that induce firms to relocate parts, or all, of their operations to certain regions or countries. Cost differentials have traditionally been forwarded as the main explanation for why firms internationalize production. In the last decade externalities, spillovers and size have been emphasized as more important reasons to move production.

Here it is argued that a micro to macro approach is necessary in order to comprehend the dynamics originating from the increased mobility of firms, one of the dominant features of today's economic life. Within an integration context a thorough understanding of the adjustment at the micro level is required before any normative conclusions can be drawn. Traditional analytical methods are simply too blunt.

The problem, the macroeconomic consequences of increased firm mobility, was introduced and formulated in Chapter 1. Chapter 2 concluded that under certain circumstances, small open economies would become more specialized and dependent on trade if they decided, or were forced, to isolate themselves from an ongoing integration process. This result, which stems from the assumption of international capital mobility, contradicts traditional wisdom of integration economics where specialization is predicted primarily among the integrating countries. The outcome depends on whether it is the import-competing or the export-competing sector that utilizes the mobile factor most intensively. Three possible reasons for factors to move from outsider countries into the integrated area were presented: altered information costs, technical progress and externalities. It was also shown that pro-trade biased

adjustment is compatible with decreasing welfare, which relates to an argument forwarded already by Graham (1923).

The analysis in Chapter 2 focused on the macroeconomic outcome as firms are incorporated into the traditional analysis. In particular, the allocation of production between insiders and outsiders of the integration process, trade patterns, and the distribution of welfare, were shown to depend on the response by internationally mobile firms. The main objective was to illustrate how sensitive traditional analysis is to even minor alterations in the underlying assumptions, which also demonstrates the complexity of the effects of integration. Consequently, generalized normative prescriptions based on such models should be interpreted very carefully.

Chapter 3 then explicitly introduced a "knowledge" production factor. A pure microeconomic view was taken in this chapter. The ambition was to define such knowledge, or competence capital, at the firm level and to quantify its effects on firm performance. Competence capital consists of capitalized items of R&D, marketing, education and software, where the returns are appropriated by the firm itself. By using a unique IUI data set, the analysis verified and supported the assumption in the other chapters that such capital plays a crucial role in firm profitability and internationalization. The strategic role of such capital suggests that MNCs allocate their internal competence to markets where the highest returns can be obtained.

Chapter 4 was built directly on recent advances in locational theory, claiming that costs of production and market access, together with market size, determine the location of firms. By introducing two industries within the manufacturing sector exhibiting different degrees of "footlooseness," it was demonstrated that relocation of firms influences - and is influenced by - the structure of industrial production. High-tech firms in particular derive economies of scale from a non-rivalry input supplied at the firm level, which allows rapid relocation as production conditions change between countries or regions. On the other hand, basic industry firms exploit economies of scale at the plant level and are often tied to some country-specific resource, limiting their mobility. As firms are exposed to decreasing trade costs, which have characterized, for instance, the European market – within the EU and the EFTA as well as between the blocks – the location of firms is affected.

By using a data set on the 30-40 largest firms in each Nordic country (excluding Denmark) during 1975-1990, it was shown that high-tech firms have dominated outward investment, particularly in Finland, Sweden and Norway. Basic industry firms have experienced a considerably lower pace in their internationalization

in all countries. Another important result is that the decision to create the European Internal Market seems to have increased investments by Nordic firms into the EU.

While Chapter 4 studied the type of firm that predominantly engages in foreign production, Chapter 5 investigated the country variables that attract investments. One objective was to study whether any agglomeration tendencies could be observed in the pattern of Swedish foreign direct investments. By combining an IUI data set on all Swedish MNCs investments abroad in 1978, 1986 and 1990, with country variables for most OECD countries and the largest Latin-American countries (altogether 18 countries), it was concluded that skill factors, such as the number of engineers, were important determinants of inflows of FDI. Furthermore, a variable describing the relative size of the industry in the foreign country to which the investing firm belonged was included. Thus, if firms belonging to industry j invested in countries where industry j was comparatively large, it would support the hypotheses of agglomeration tendencies. The results show that this was the case for the high-tech industry, while no such pattern could be detected for firms in the basic industry.

A few words on the issues not addressed in this study are also warranted. The theoretical approach has been predominantly static which of course is a drawback. As seen in some of the chapters, however, even static models become quite complex. The transparency gained from more simple models has to be traded against the loss of dynamics.

Furthermore, knowledge-intensive operations have been claimed to generate positive externalities in terms of diffusion of knowledge due to interaction with local firms, employment effects etc., which promotes growth. Therefore politicians may be tempted to embark on industrial policies and risk political tournaments between countries to attract foreign investments (David 1984, Oxelheim 1993). Such strategic investment policies have also been neglected in this thesis.

6.2 Economic policy

The analysis has some obvious normative implications. First, the increased competition created by the deregulation of trade barriers and capital controls puts pressure on firms to continuously adjust to sustain profitability and survive. The new deregulated situation will therefore induce relocation of different parts of a firm's value chain to countries that offer the best opportunities for industrial production. Today's sophisticated information technology makes effective monitoring of

geographically dispersed production possible. There are numerous examples. The accounting unit of Swissair, for example, is located in Bombay, and ITT has its procurement department in Belgium (UN 1993).

Countries therefore must be able to offer the right competitive environment to attract investments from foreign as well as domestic firms - but not just any kind of investment. From a growth and welfare point of view, what matters is the type of investments a country receives. MNCs have been shown to be the main source of the creation and diffusion of technological know-how.[70] Since knowledge is not subject to decreasing returns to scale, it carries important growth implications. Policies should therefore be geared at supplying skills in a broad sense. That includes a highly educated labor force, a competitive research environment, top qualified scientists and engineers and, in addition, a well-developed infrastructure. Firms contribute with their competence capital which interacts with different country characteristics to form a country's comparative advantage.

Only then will the productive interactions with local firms get started. Receiver competence is a necessary condition to create virtuous cycles of advanced, high value-added production, generating positive externalities between the interacting parties, as well as to other sectors of the economy. This also indicates the limitations of national economic policies. Industrial policies aimed at creating national champions are doomed in today's highly internationalized world. As shown by Schmookler (1966, see also Grossman-Helpman 1991), and also claimed much earlier by Schumpeter (1942), costs and expected profits are the prime sources of inventions and innovations and the main engines of the "creative destruction" process. Later research also gives a role to academic research (Dosi 1988).

The increased mobility implies that firms will relocate, bringing with them technological know-how and skill, if conditions change between countries. Hence, to promote sustainable growth, it is crucial to provide the right attractive investment climate. The long-run consequences of a failure may be quite dramatic since technological competition inserts an element of path dependence, where initially small differences between countries may grow over time to substantial technological and growth gaps. Countries, or more accurately, the firms of a country, partly form their competitive strength by participating in highly-competitive markets. Experimentally organized markets (Schumpeter 1942) requires the interaction of firms where

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[70] In the Swedish manufacturing sector, R&D expenditure of MNCs amounted to 19 billion SEK in 1990 as compared 24.3 billion for the whole sector (Fors-Svensson 1994).

spillovers from other firms' specific knowledge, and the characteristics of the country, combine into new knowledge (Eliasson 1991).

In such a setting a small open economy can be superior only in a limited range of production, i.e. several "centers of excellence" in different countries may evolve (Arthur 1986, Krugman 1991). Yet, in order for such islands of excellence to develop, the underlying necessary skill has to be there. Countries with small domestic markets and no specific country advantages are particularly dependent on local business competence to attract and retain investments and firms. Since only a fraction of firms, normally the more advanced ones, has the financial means, the knowledge and the entrepreneurship to embark on an internationalization process, the lack of such "attractiveness" may trap countries in a vicious circle of declining investment and declining growth.

To sum up, the results of this thesis show how investments in knowledge pay off at the micro (firm) level, and how the sensitivity of the location of firms has increased due to increased international competition, fostered by deregulation of capital markets and dismantling of trade barriers. Paired with the advances within technology, particularly information technology, the increased ability of firms to locate - and to relocate - to countries offering the best production prerequisites, puts pressure on countries to supply a competitive investment "climate" and to provide the required institutional setting. This is particularly relevant for the high-tech, knowledge-intensive firms. According to the new growth theory, such knowledge-intensive activity is the prime engine of growth. Adjustment on the micro level in terms of a change in the stock of a country's knowledge-producing firms, bearing in mind the presence of agglomeration tendencies in such production, will therefore induce long-term effects on the specialization in production, the trade pattern, and the distribution of welfare across nations.

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Regional Integration and the Location of Multinational Corporations

Doctoral thesis for the degree of Doctor of Philosophy by Pontus Brodde Braunerhjelm

The massive increase in global foreign direct investment (FDI) during the past decades has brought back international mobility of factors of production and economic geography to the academic agenda. Two forces have spearheaded the increase in global FDI: First, production technology has been adapted to fit smaller units, thereby allowing a greater geographical dispersion of production. In addition, and perhaps more important are the advances in information technology, thus making effective monitoring and communication of geographically dispersed units possible. Second, the dismantling of trade barriers and capital controls have made the location of production much more sensitive to differences in skills, costs, institutional settings, etc., across countries.

The issues addressed in this thesis concern the implications of factor mobility on a country's specialization and comparative advantage. Special attention is directed towards integration and the response by insider and outsider firms. Although focus is on the empirical analysis, the theoretical side is not neglected and both general equilibrium and partial equilibrium effects of FDI are considered in the thesis.

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