Industriens Utredningsinstitut
THE INDUSTRIAL INSTITUTE FOR ECONOMIC AND SOCIAL RESEARCH

A list of Working Papers on the last pages

Revised version published in IUI Dissertation Series, IUI, Stockholm, 1995.

No. 404, 1993

REGIONAL INTEGRATION AND THE LOCATION OF KNOWLEDGE-INTENSIVE MULTINATIONAL FIRMS: Implications for comparative advantage and welfare of outsiders and insiders

by
Pontus Braunerhjelm

December 1993
Revised, September 1994

Postadress
Box 5501
114 85 Stockholm

Gatuadress
Industrihuset
Storgatan 19

Telefon
08-783 80 00
Telefax
08-661 79 69

Bankgiro
446-9995

Postgiro
19 15 92-5

10.92 10.000

Preliminary!

REGIONAL INTEGRATION AND THE LOCATION OF KNOWLEDGE INTENSIVE MULTINATIONAL FIRMS

IMPLICATIONS FOR COMPARATIVE ADVANTAGE AND WELFARE OF OUTSIDERS AND INSIDERS

by

Pontus Braunerhjelm

The Industrial Institute for Economic and Social Research
Box 5501, 114 85 Stockholm, SWEDEN

CHAPTER 1

REGIONAL INTEGRATION AND THE ALLOCATION OF COMPETENCE IN MULTINATIONAL FIRMS

Implications for comparative advantage and welfare of outsiders and insiders

1.1 Introduction

The purpose of this thesis is to study the macro-economic effects on small open economies, hosting internationally mobile firms, as they are exposed to an exogenous shock originating in the implementation of integration policy. Current attempts in several parts of the world to integrate regionally (EU, NAFTA, LAFTA etc.), and the increased national importance of the operations of already globally organized multinaltional firms (MNFs), makes this study highly topical.[1] The original idea, however, grew out of repeated observations from a study in the late 1980s (Braunerhjelm 1990) that appeared to contradict the predictions of traditional integration theory.

The established theory of integration tells us to expect specialization to increase between members of an integrated area (the *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

[1] The European Union (EU) is the present name (after November 1993) of former EC (European Community). NAFTA is the abbreviation of North American Free Trade Association, while LAFTA stands for Latin American Free Trade Association.

raising 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 assumption of course 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 tend to induce tariff-jumping by firms in order to secure access to protected markets. On the other hand, if integration takes place among countries without the creation of a common tariff wall against outsiders, the literaure gives no reason for factors 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 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 substiantially reduced and market access guaranteed through the free trade agreement between the EFTA and the EC. Consequently, there should be no reason to expect any dramatic change in firm behaviour.[2] That things were not that simple, however, became apparent in a detailed survey and interview study of Swedish firms in the manufacturing sector undertaken in 1988 and 1989 (Braunerhjelm 1990).

The objective of the 1988/1989 study was to understand the consequences for firm behaviour of different types of associations with the EC, and to link such behaviour to the macro-economy. The main alternatives were either membership with the EC or a status quo relation. At that time the uncertainty

---

[2] The free trade agreement between EFTA and EC covers only goods, while the creation of an "internal market" within the Eropean Union (EU) also include the "freedoms" of services, labour and capital to move across borders. The presence of non-tariff barriers, as public procurement, anti-dumping threats etc., could of course also induce firms to relocate production.

concerning future Swedish relationships 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 would negatively affect the Swedish firms economy. The survey of covered about 40 percent of employment in the Swedish manufacturing sector. In addition 40 firms, mainly large ones, were interviewed.

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 pharmaceuptical firms), 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, basic, industries, the transaction cost associated with moving huge process-intensive plants abroad and breaking up the infrastructure of existing production systems, were claimed prohibitive to such relocation. On the other hand it was said 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 industries intensively using raw materials, while technologically sophisticated firms would concentrate production abroad. Recent development also shows that this has occurred (Andersson et. al., 1993). Such increased specialization of outsiders is not predicted by standard integration theory.

Such structural shift towards basic industry production runs the risk of depriving countries of their knowledge capital, as new investments are concentrated abroad. Three specific qualities are associated with knowledge

intensive production. First, knowledge strength influences the growth and production patterns of countries. Second, it generates positive externalities. Third, it is important for firms to locate in areas where they can exploit knowledge spill-overs (the same externalities) from other firms, i.e. clustering may occur. Thus, the result from the survey and interview may be read 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 of theory and empirical observations must be looked for in the mobility of factors of production through MNFs. 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 (Eliasson 1991), 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 last decades. In the 1980s the annual growth of FDI averaged a stunning 30 percent. The extent of multi-national production is reported in the last 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 170000 foreign affiliates of some 37000 parent firms generated approximately $5.5 trillion in world-wide sales 1990. This compare 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 MNFs goes much beyond pure investments figures.

Overseas investments have also been extended to business operations formerly

not involved in FDI and engage an increasing number of countries. As firms have made their business strategies regional, or global, their production organization has become increasingly complex and geographically dispersed. Such micro-economic 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 barries and the removal of capital controls. The latter evolution has brought a substantial increase in international competition during the last twenty years. Firms have responded by re-organizing 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 firms' ability to relocate production on short notice as the possibilities of profitable production alters between countries. Furthermore, to sustain competitiveness, firms need to continously upgrade their competence by investments in R&D, marketing etc.

The increase in international factor mobility, conducted through MNFs, makes small open economies more exposed to the investment decisions by firms. This is particularly obvious for those countries hosting a limited number of large, already multinaltional, firms. Inward investment flows require that countries offer the right set of attractive factors, whether it be the skill level of employees, the accessability of resources, the institutional setting, including the participation in regional or global agreements concerning fundamental economic or political matters. Furthermore, the investment decisions of MNFs, and their ability to reallocate competence internationally, influence the composition of factors of production across countries. Hence comparative advantages are being endogenized. 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 - in most of them - manufacturing production is dominated by a limited number of large MNFs.

1.3 Purpose, limitation and methodology

As already mentioned, emphasis is on the insider-outsider relation, i.e. the locational response of firms in countries not participating in an integration process and the derived macro-economic consequences. Hence, how is firms' location influenced by exogenous institutional changes (as integration) and differences in factor compositions (particularly those related to knowledge) between countries? Furthermore, which are the implications of such micro-level (firm) adjustment on countries specialization, trade patterns and welfare? The macro-economic part can also be interpreted as an analysis of the vulnerability of small open economies and the degrees of freedom that are available for 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. More precisely, 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 change location? Is it the more knowledge intensive parts or is it production lines that primarily exploit differences in factor costs? In this particular respect we can talk about internal markets for competence within the MNFs.

Knowledge is generally assumed to contribute positively to the welfare of countries.[3] Before drawing any conclusions with regard to the macro-level, however, we have to establish the relation between firms´ investment in knowledge and their performance with regard to profitability an

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

internationalization.[4] This problem will first be studied at the micro-economic firm level to build the foundation for some of the assumptions used in the macro-oriented analysis to follow. The next step is to detect the pattern of foreign investment in different industries. By identifying country factors that attract investments, particularly the influence of skill-factors, we can make inferences on the location of firms knowledge stocks. 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 clustering for different industries or do firms adopt first mover strategies?

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 of course that all Nordic countries are small open economies and that three of them were outsiders as the EC 1992 program was announced in the mid 1980s. The theoretical analysis is confined to comparative statics within a general - as well as partial - equilibrium context. In the empirical analysis ordinary least square regression technique will be 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,

---

[4]The difference between knowledge and competence have been described in the following way: Knowledge is present all over, competence is the ability to take advantage of that knowledge and turn it into a profitable activity (Eliasson 1991).

employees etc., data are also available on the skill-structure within the firms and on the educational level - and 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 MNFs for the years 1978, 1986 and 1990.[5] For each of these years the data set covers more than 90 percent of the Swedish MNFs, giving precise information on intra-firm trade, R&D, 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 that the subsidiaries have exported to, 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 on the operations of MNFs.

The analysis is restricted to large manufacturing firms. The small business sector, and service production, will be neglected. This is a weakness considering the fact that long term growth have been - and will probably continue to be (Braunerhjelm 1993) - concentrated to small business formation and expansion, and to the service sector in particular. Lack of data on the service sector is the main reason. 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

[5] Data are also available for 1960, 1965, 1970, and 1974, however, not the ones we use in our particular analysis.

incorporated into the empirical analysis.[6]

1.4 Organization of the thesis

All chapters in one way or another are devoted to the same problem, namely, the influence of increased firm mobility on the macro-economic performance. Particular attention is being paid to the distribution of knowledge and basic industry firms across countries, and the related effects on comparative advantages. The theoretical approach, however, differs between chapters and the empirical analyses uses different data-sets. Each chapter can therefore be read separately, although for a comprehensive picture of the problems studied, the whole book has to be read.

In Chapter 2 the traditional general equilibrium model as outlined by Jones (1965), and its later Edgeworth box version (Helpman-krugman 1985), is presented. We try to explain and incorprate the observed, unorthodox phenomena described above, by allowing for factor - or firm - mobility across nations. An integration process either influences expectations, fosters technological progress or increases knowledge spillovers which induces factor flows from outsiders into the integrated area. The traditional two goods, two factors and two countries framework is retained but modified to accomodate one factor - called knowledge which is used intensively by the firms in the more technologically advanced industry - to move between countries. We can interpret this as multinational activities by firms. Alternatively the mobile factor can be viewed as firms themselves.

The analysis combines the macro-oriented theoretical works of Jones (1965),

---

[6] Only external purchases of services in the manufacturing sector that falls 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).

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 non-participation in an integration process results in an outflow of factors, higher specialization and lower welfare. Furthermore, increased trade intensity between the two countries 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 expectations, technology, or positive externalities in the knowledge intensive sector emanating from an increased interplay and communications between economic agents as integration occurs (von Hippel 1987, Eliasson 1987, 1991, Grossman-Helpman 1991).[7]

Chapter 3 presents a definition of a knowledge production factor, referred to as competence capital. The relation between investments in competence capital and firm performance, notably profitability and internationalization, is analyzed. The stock of firm-specific competence is incorporated into a production function and it is shown how and that firm performance is positively correlated with such assets. The returns to such capital is appropriated by firms and cannot be associated with any particular, measured, production factor (McKenzie 1959, Eliasson 1990). The excess, or scale based rents from such dominant knowledge can furthermore be shown to appear as total factor productivity shifts in the production function (Eliasson 1992). 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 collaberation with firms themselves, is the base of the empirical analysis. The

[7]The two sector, two factors and two goods 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 examplified by integration and advances in information technology), leads to spontanous creation of markets for competence implying that firms reallocate proprietary knowledge within the firm to markets that yield the highest return.

estimations give robust evidence for the significance of such competence capital in explaining the distribution of firm rents. The same capital is also shown to positively affect the degree of internationalization.

Chapter 4 takes us back to macro again. Building on recent contributions in locational theory, Venables (1993)[8] 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 - assumed to derive economies of scale at the plant level - or a high-tech sector where scale economies appear at the firm level. The firm specific economies of scale emanate from inputs of non-rivalry production factor, interpreted as competence capital which is the source of product-differentiation. As firms, formerly protected by trade barriers are exposed to international competition, differences in the size of markets and in fixed costs induce firms to re-locate production. The empirical results show that countries specialized in high-tech production are more likely to experience substantial relocation if production conditions alter between countries. 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 characteristica on the location of the firm is investigated. Previous empirical work has focused on the size of markets, openness, proximity, factor costs, etc. (see Lipsey-Kravis 1982, Culem 1988, Swedenborg 1979). Few attempts have, however, been made to understand the influence of manufacturing structure (in host countries) itself on firms' FDI. Particularly, do firms prefer to invest in countries with large similar production, or does a pattern of "opposite attract" (Kravis-Lipsey 1982) prevail? The former implies clustering tendencies, similar to the theoretical explanations in the "new" theories of

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

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 strengthened, the structure and size of such attracting factors are decisive for investments. By combining a data set on practically all Swedish multinational firms and approximately 20 countries reciving investment by Swedish firms between 1978-1990, it is shown that clustering occurs among firms in high-tech industry while other factors, for instance the size of the market, 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 also presented. For instance, the analysis should be extended to include dynamics. Some preliminary simulations are therefore presented, using the IUI's micro-based macro-model of the Swedish economy, to assess the macro-economic effects of being a member of the European Union as compared to the EEA agreement or a status quo relation.

References

Braunerhjelm, P, 1990, Effekter på den svenska industristrukturen av EG 1992, *Ekonomisk Debatt*, No. 8, pp. 713-720

Braunerhjelm, 1993, Globalization and the Future Role of Small and Medium-Sized Firms, in Oxelheim, L, (ed.), *The Global Race for Foreign Direct Investment*, Springer-Verlag, Berlin

Buckley, P, Casson, M, 1976, *The Future of Multinational Enterprises*, MacMillan, London

Caves, 1971, International Corporations: The Industrial Economics of Foreign Investment, *Economica*, Vol. 38, pp. 1-27

Cecchini, P, 1988, *The European Challenge 1992*, Wildwood House, Aldershot

Chandler, A, 1990, *Scale and Scope*, Harvard University Press, Cambridge

Coase, R, 1937, The Nature of the Firm, *Economica*, Vol. 13, pp. 169-182

Cornes, R, Kierzkowski, H, 1981, Inter- and Intra-Industry Factor Specificity in an Open Economy, *mimeo*, IUHEI, Geneva

Culem, C, 1988, The Locational Determinats of Direct Investments among Industialized Countries, *European Economic Review*, Vol. 32, pp. 885-904

Dunning, J, 1977, Trade, Location of Economic Activities and the MNE: A Search for an Eclectic Appraoch, in Ohlin, B, Hesselborn, P-O, Wijkman, P-M, (eds.), *The Allocation of International Production*, Proceedings of a Nobel Symposium at Stockholm, MacMillan, London

Eliasson, G, 1990, The Firm as a Competent Team, *Journal of Economic Behaviour and Organization*, Vol. 13, pp. 275-298

Eliassin, G, 1991, Financial Institutions in a European Market for Executive Comepetence, in Wihlborg, C, Fratianni, M, and Willet, T, (eds.), *Financial Regulation and Monetary Arrangements after 1992*, Elseviers Science Publishers B.V.

Eliasson, G, 1992, Business Competence, Organizational Learning, and Economic Growth: Establishing the Smith-Schumpeter-Wicksell (SSW) Connection, in Scherer, F, Perlman, M, (eds.), *Entrepreneurship, Technological Innivation, and Economic Growth*, The University of Michigan Press, Ann

Arbor

Graham, F, 1923, Some Aspects of Protection Furher Considered, *Quarterly Journal of Economics*, Vol. 37, pp. 199-227

Grossman, G, Helpman, E, 1991, *Innovation and Growth in a Global Economy*, MIT Press, Cambridge

Helpman, E, Krugman, P, 1985, *Market Structure and Foreign Trade*, MIT Press, Cambridge

von Hippel, E, *The Source of Innovation*, Oxford University Press, New York

Hymer, S, 1960, *The International Operations of National Firms: A Study of Direct Foreign Investments*, MIT Press, Cambridge

Jones, R, A Simple General Equilibrium Model, *Journal of Political Economy*, Vol. 73, pp. 557-572

Knight, F, 1944, Diminishing Returns from Investment, *Journal of Political Economy*, Vol. 52, pp. 26-47

Kravis, I, Lipsey, R, 1982, The Location of Overseas Production and Production for Export by US Multinational Firms, *Journal of International Economics*, Vol. 12, pp, 201-223

Krugman, P, 1991a, Increasing Returns and Economic Geography, *Journal of Political Economy*, Vol. 99, pp. 483-500

Krugman, P, 1991b, *Geography and Trade*, MIT Press, Cambridge

Markusen, J, 1983, Factor Movements in International Trade, *Journal of International Economics*, Vol. 14, pp. 340-356

Markusen, J, 1984, Multinationals, Multi-Plant Economies, and the Gains from Trade, *Journal of International Economics*, Vol. 16, pp. 205-224

McKenzie, L, 1959, On the Existence of General Equilibrium for a Competitive Market, *Econometrica*, Vol. 27, pp. 54-71

Muller, D, 1990, *The Dynamics of Company Profits*, Cambridge University Press, Cambridge

Swedenborg, B, 1979, *The Multinational Operations of Swedish Firms. An Analysis of Determinants and Effects*, IUI, Stockholm

Teece, D, 1983, Technological and Organizational factors in the Multinational Enterprise, in Casson, M, (ed.), *The Growth of International Business*, Allen &

Unwin, London

United Nations, 1993, *World Investment Report 1993*, United Nations, New York

Venables, A, 1993, Equilibrium Locations of Vertically Linked Industries, *CPER Discussion Paper*, Nb. 82

Wheeler, D. and A. Mody, 1992, International Investment Locational Decisions - The Case of U.S. Firms, *Journal of International Economics*, Vol. 33, pp. 57-76.

Veugelers, R, 1991, Locational Determinats and Ranking of Host Countries: An Empirical Assessment, *Kyklos*, Vol. 44, pp. 363-382

Yamawaki, H, 1991, Locational Decisions of Japanese Multinational Firms in European Manufacturing Industries, *mimeo*, Catholic University of Louvain, Louvain-la-Neuve

REGIONAL INTEGRATION, THE INTERNATIONAL FIRM, AND THE PATTERN OF TRADE AND PRODUCTION OF INSIDERS AND OUTSIDERS*

Pontus Braunerhjelm, September 1994
The Industrial Institute for Economic and Social Research (IUI)
Box 5501, 11485 Stockholm, Sweden

Abstract

An institutional change, like an integration policy, drives a wedge between insiders and outsiders. Such discrepancies create incentives for outsider firms to relocate production into the integrated area. Mainstream contemporary general equilibrium models, however, only allow for factor mobility within countries. This paper shows how regional integration among a limited number of countries induce international factor flows between insiders and outsiders due to differences in, (1) information costs, (2) technological progress and (3) in knowledge based externalities. The effects of such international transfers of factors are shown to be either *trade–augmenting* or *trade–depressing.*

1. Introduction

This paper 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 diminish. 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 sector – that employs the mobile factors most intensively, determine the impact on outsiders. Specialization in production could hence be reinforced even if a country chooses, or is forced, to stay outside an integration process.

The neglect of firms in traditional integration theory implies that the most influential respondents to integration are disregarded. Consequently the micro–foundation of that model is, to say the least, poor.[1] International firms are the dominant actors in international economics with regard to trade, investments and technology transfer.[2] The options faced by international 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, firms do respond to such institutional changes (Dunning 1989).[3] The result was a massive inward foreign direct investment into the EC, resulting in structural adjustment and altered factor compositions within and between countries. Hence, empirical findings suggest that institutional changes may shift comparative advantages across countries, or regions, through induced firm

behavior.

This paper is organized as follows. Section 2 gives a brief background of earlier research relevant to factor movements in the standard general equilibrium model, defined to incorporate international firms. In section 3, three possible reasons for a reshuffle of factors across countries in response to international trade policy changes, are elaborated. First, the effect of an institutional change – in the forthcoming represented by an integration process – on information costs of outsiders (firms) is considered. Second, the assumption that such institutional change yield cost advantages (technological progress) to insider firms is investigated. Within this setting the analysis is extended to the effects of increasing returns to scale in the production of one of the goods, i.e. policy induced externalities. Section 4 summarizes the main findings.

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 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 its 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 goods prices between outsiders and insiders is a far too narrow perspective. At the micro–level, firms do not solely act in response to changes in relative prices, as in the vertical integration model (Brainard 1993). Furthermore, from a country's view, 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. That would serve to widen the industrial base, strengthen the R&D base of production and/or increase competition, i.e. to acquire comparative advantage through institutional change (Helpman 1988). Particularly since concentration of knowledge factors, like skilled labor, R&D departments, etc., have 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 points of

equilibria. This paper focuses on the adjustment process of firms exposed to an exogenous policy shock as they are free to to locate production across countries

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.[4] As an example consider the huge investments – mostly greenfield – undertaken by japanese car manufactures in the US during the 1950s.[5]

3. The Models

Consider a subset of the world consisting of three small, open economies trading with each other where, 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 where in each region (or country) firms produce two goods, either a relatively high–tech manufacture (Y) or a low–tech basic industry good (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. A general quasiconcave production

function combines the factors of production into Y– and X–goods. Although both factors of production are mobile between sectors within each country, international mobility is restricted to factor h. In equilibrium marginal productivities and factor rewards are equalized across regions for given prices, i.e. firms' profitability is independent of the location of production. Since factor endowments are given, inter–country changes only reflects a redistribution of the given stock of factors.

Transfers of factors of production (or of firms) across countries are however associated with costs – contractual, organizational and those involved in moving factors geographically – that deter relocation. We will refer to these as transaction costs. The relation between costs of employing the mobile factor (w) of outsider and insider firms can be described as,

$$w^o - w^i \equiv \Delta w = c_m^o \qquad (3.1)$$

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 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 allow for differences in factor rewards between countries. The immobility of v could also be explained by such transactions costs.

Finally, demand is assumed identical in the countries. In order to emphasize that changes in relative prices are not the prime issue considered here, the integrated area is assumed to be too small to influence world market prices.[6]

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, equations A1–A5).

3.1. Information costs, Factor Flows and Specialization

One of real firms major costs items consists of the gathering and evaluation of different kinds of information. By allowing (instantaneous) information costs to appear as an economy move between two points of equilibria – although agents are assumed to be perfectly informed at each point of equilibrium – we retain the general framework of the traditional model.

Institutional policy changes is one example of information that have to be processed and evaluated by firms. If all firms in the two economies are exposed to exactly the same changes, information costs are also 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, technological improvements, etc. – which renders additional information costs, outsider firms would be disadvantaged as compared to insider firms. For purpose of illustration, assume that – ceteris paribus – insiders have zero information costs while outsiders have to evaluate the effect of "outsideness". We can regard that as an additional fixed cost (F) which only pertains to outsider firms. At given prices and where goods are homogeneous, a disequilibrium solution will emerge since,

$$c^{o}(w,r,F,y) > c^{i}(w,r,y) = p_{y} \tag{3.1}$$

As long as transaction costs (c_m^o) of moving the internationally mobile factor (h) into the integrated area falls below the differences in costs of production, 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, see Figure 1).[7]

Proposition 1: Exogenous policy changes that create information cost wedges between outsider and insiders firms will induce profit–maximizing firms to transfer their mobile factor into the integrated area. If the mobile factor is concentrated to the outsiders 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 outsiders 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 3.1 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,

$$Y'^{i} = h'^{i}\lambda_{vx}/|\lambda| \qquad > 0 \qquad (3.2)$$

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

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

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.[8] For example, consider it as a reduction in unskilled factor (v) engaged in firms' administration related to border crossings, including the gathering of documentation demanded by the authorities concerning the origin of goods, etc., i.e. activities that was 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 in several countries.

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

$$z'^{i}_{vy} = (1/a_{vy})(da_{vy}/dI) \tag{3.3}$$

which substituted into equation A3b in the appendix yields

$$a'^{i}_{vy} = \theta_{hy}\sigma\,(w' - r') - z'_{vy} \tag{3.4}$$

where changes in input of v is a function of the elasticity of substitution (σ), factor prices, and technological change. The latter, originating from the exogenous shift in 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 not gaining from integration should expand. There are also

cases – as shown below – 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–goods. 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–augmenting 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 profits induces 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 process stops when marginal productivity of insider h has fallen to neutralize the initial effect of reducing the input requirement of v in Y, i.e. factor rewards are equalized

between outsiders and insiders and profits return to zero.

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 experience 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 less v is employed by each h–firm and unemployment of v increases. Without inter–country factor flows through international firms a disequilibrium solution is permanented.

Proposition 2: If the integration process is accompanied by a shift in technology exclusively available for insiders, implying a lower input requirement of v in the production of Y, outsider firms will transfer their mobile factors into the integrated area. That 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,

$$w'^{i} = z'_{vy}\theta_{vx}/\,|\theta| \qquad >0 \qquad (3.5)$$

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

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

and, consequently, z'_{vy} acts like a subsidy on the factor used intensively in industry Y. If firms can appropriate whatever minor part of the technologically induced subsidy, outsider firms will locate their h into the integrated area. 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),

$$Y'^{i} = (\delta_h \lambda_{vx} - (-\delta_v \lambda_{hx}))\, w'/\,|\lambda| \qquad (3.6)$$

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 that employs the mobile factor most intensively (Figure 1).

3.3 Differentiated Products and Mobile Knowledge Capital

Finally we elaborate the case where multinational firms (MNFs) are explicitly introduced into a simple general equilibrium framework. The existence of MNFs 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. The firm–specificity of knowledge capital, obstruct arm's length contracts since that would either risk to erode the proprietary knowledge of firm's upstream activities, or lead to excessive Coasian transaction costs (Coase 1937, Hymer 1960, Williamson 1975, 1985).

Knowledge capital, h, is produced by capital and labor and, as revealed by the factor proportion rays in Figure 2, utilizes the most capital intensive technique (i–H). The capital–intensity of downstream production (H–Y) ranks between upstream production and the manufacturing 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) in knowledge capital production, due to enhanced interplay and communication within a wider and more heterogeneous macro–base (von Hippel 1988, Eliasson 1988, Grossman–Helpman 1991). It is assumed non–communicative between outsiders and insiders, or to affect outsiders with a lag. Within upstream production of knowledge the externality acts as a public good that lowers the amount of inputs needed to produce a given amount of knowledge. Thus,

$$c_h^i(w,\epsilon) < c_h^o(w)$$

and consequently comparative advantages are affected by the size of ϵ.

Assume now, in contrast to the Helpman–Krugman model, that primary factors (K,L) engaged in the production of firm specific knowledge, are internationally mobile. Since it is only in the production of the knowledge good the externalities prevail, and it is here that the firm–specific features appear, there are at given prices no incentives for firms to move factors involved in downstream production. Since knowledge production employs most capital, proportionally more of capital than labor is shifted into the integrating area, resulting in a Rybczynski induced increase in the production of H from ($i–h_2$) to (i–H'). Due to the beneficial effects of the externality, less knowledge (H' as compared to H) can support a given amount of production of Y when firms concentrate their knowledge departments in one country.[9] This implies a release of predominantly capital, resulting in an expansion of downstream production in the Y–sector, (H'–Y). Hence, if preferences are characterized by "love for variety" (Spence 1976, Dixit–Stiglitz 1977), the new equilibrium also contains more varieties of Y–goods, implying that a higher level of welfare is attained.

The new equilibrium is characterized by increased internationalization of firms since all knowledge producing units (i–H') are located in the integrated area (Figure 3). The accentuated divergence in factor endowments increase the number of multinational firms, thereby increasing the number of subsidiaries from (y–u) to (y–u') and fostering more of intra–firm trade. Furthermore, since prices are assumed constant, which leaves the angle of the ray through the C'–point unaffected (Figure 3), 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 locate 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: The integrated area specializes in Y–production. The relationship between ϵ and the stock of capital in the integrated area can be defined in the following way,

$$K^i = k^{i,d} + k^{i,h}(\epsilon^i(I)) \tag{3.7}$$

where $k^{i,d}$ denotes capital employed in downstream production while $k^{i,h}$ represents capital in upstream production by insiders. Likewise for labor. The distribution of factors between the two countries is affected by by the size of the externality (ϵ), assumed to emanate from integration (I). Substitute these expressions into the full employment conditions for the integrated area,

$$a_{ly}(n + u)D^i + a_{lh}(H)^i = l^{i,d} + l^{i,h}(\epsilon^i(I)) \tag{3.8}$$

$$a_{ky}(n + u)D^i + a_{kh}(H)^i = k^{i,d} + k^{i,h}(\epsilon^i(I)) \tag{3.9}$$

where n denote the number of firms, u represent the subsidiaries abroad, and production of the differentiated goods is separated in downstream (D) and upstream (H) activities. Then, from the equations of change (corresponding to equations A4a,b in the appendix), the externality induced relative change in the endowments of factors of production in the integrating region can be derived. Under the assumption made above, i.e. $\epsilon^i > \epsilon^o = 0$, costs of producing h must be lower in the integrated area. To remain competitive at average cost pricing, outsiders have to locate their knowledge producing departments into the integrated area. The Rybczynski effect implies that production of (capital–intensive) H increases in the integrated area,

$$H'^i = (\lambda_{ly}(k^i_\epsilon \epsilon_I dI) - \lambda_{ky}(l^i_\epsilon \epsilon_I dI))/|\lambda| > 0 \tag{3.10}$$ 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 in that area.[10]

4. Final Remarks

Contemporary research has shown that technological know–how is mainly created and diffused by multi–national firms (Kokko 1992, Dunning 1993), strongly suggesting that comparative advantage of nations is influenced by factor flows, i.e. the interregional investment decisions by MNFs. 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).

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. Uncertainty 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 by profit–maximizing firms in outsider countries. In that case a small open economy could turn more specialized by abstaining from participation in an integration process, even at constant terms of trade,

accompanied by a decrease in welfare for outsiders. Hence, the short–run response carries important long–run growth implications.

The normative conclusions of the model are hence quite strong. If the outsider country had participated 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 have vanished, as would the incentive for factor moves. An alternative interpretation of the above model is that all firms produce upstream and downstream production, divided between the two sectors Y and X. With the assumption implemented in the above model, the result of outsiders would then be increased specialization in downstream, less technologically advanced X–products as firms locate their more sophisticated parts, intensively employing internationally mobile high–skill factors, abroad.

Furthermore, integration is shown to have either *trade–augmenting* or *trade–depressing* effects as factor mobility through firms is allowed, implying that the traditional conclusions of integration theory could well be reversed. 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.

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[11]

(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,

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

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

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

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

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

REFERENCES

Aliber, R. (1970), A Theory of Direct Foreign Investment, in C.Kindleberger *The International Corporation: A Symposium,* Cambridge, Massachusetts

Arrow, K. (1971), The Firm in General Equilibrium Theory, in Marris, R, Wood, A, *The Corporate Economy: Growth, Competition, and Innovative Potential,* Harvard University Press and MacMillan, London

Baldwin, R. (1989), The Growth Effects of 1992, *Economic Policy* 4, 249–281

Brecher, R. and Bhagwati, J. (1981), Foreign Ownership and the Theory of Trade and Welfare, *Journal of Political Economy* 89, 497–512

Brainard, S. (1993), An Empirical Assessment of the Proximity–Concentration Tradeoff between Multinational Sales and Trade, *NBER WP*, No. 4580

Braunerhjelm, P. (1990), *Svenska industriföretag inför EG 1992*, IUI, Stockholm

Buckley, P. and Casson, M. (1976), *The Future of the Multinational Enterprise,* MacMillan, London

Caves, R. (1971), International Corporations: The Industrial Economics of Foreign Investment, *Economica* 38, 1–27

Coase, R. (1937), The Nature of the Firm, *Economica* 13, 169–182

Cornes, R. and Kierzkowski, H. (1981), Intra– and Inter–Industry Factor Specificity in an Open Economy, *mimeo,* IUHEI, Geneva

Dixit, A. and Stiglitz, J. (1977), Monopolistic Competition and Optimum Product Diversity, *American Economic Review* 67, 297–308

Dixit, A. and Norman, V. (1980), *The Theory of International Trade,* Cambridge University Press and James Nisbet & Co Ltd, Massachusetts

Dunning, J. (1977), Trade, Location of Economic Activity and the MNE: A Search for an Eclectic Approach, in B. Ohlin, P.O. Hesselborn and P.M. Wijkman, *The International Allocation of Economic Activity: Proceedings of a Nobel Symposium at Stockholm,* MacMillan, London

Dunning, J. (1991), European Integration and Transatlantic Foreign Direct Investment: The Record Assessed, *WP 3–91*, Business and Economic Studies on European Integration, Copenhagen

Dunning, J. (1993), International Direct Investment Patterns, in L. Oxelheim, *The Global Race of Foreign Direct Investment*, Springer Verlag, Berlin

EC Commission (1988), The Economics of 1992, *European Economy No. 35*, Bruxelles

Eliasson, G. (1988), The International Firm: A Vehicle for Overcoming Barriers to Trade and a Global Intelligence Organization Diffusing the Notion of a Nation, *IUI Working Paper 201*, IUI

Findlay, R. and Kierzkowski, H. (1983), International Trade and Human Capital: A Simple General Equilibrium Model, *Journal of Political Economy* 91, 957–978

Graham, F. (1923), Some Aspects of Protection Further Considered, *Quarterly Journal of Economics* 37, 199–227

Grossman, G. and Helpman, E. (1991), *Innovation and Growth in a Global Economy*, MIT Press, Cambridge

Helpman, E. (1988), Growth, Technical Progress and Trade, *NBER WP*, No 2592

Helpman, E. and Krugman, P. (1985), *Market Structure and Foreign Trade*, MIT Press, Cambridge

Henderson, D. (1989), *1992: The External Dimension,* Group of 30, New York and London

von Hippel, E. (1987), *The Source of Innovation*, Oxford University Press, New York

Hufbauer, G. (1970), The Impact of National Characteristics and Technology on the Commodity Composition of Trade in Manufactured Goods, in R.Vernon, *The Technology Factor in International Trade*, Columbia University Press, New York

Hymer, S. (1960), *The International Operations of National Firms: A Study of Direct Foreign Investment*, MIT, Cambridge MA, MIT Press

Jones, R. (1965), A Simple General Equilibrium Model, *Journal of Political Economy* 73, 557–572

Jones, R. (1967), International Capital Movements and the Theory of Tariffs and Trade, *Quarterly Journal of Economics* 81, 1–38

Jones, R. (1968), Variable Returns to Scale, *International Economic Review* 3, 261–272

Karlsen, J. (1990), Business Strategy and National Policy Concerning Integration: Nordic Direct Foreign Investment in the European Community, *Notat*, No 25/90, NÖI, Bergen

Kindleberger, C. (1969), *American Business Abroad: Six Lectures on Direct Investment*, Yale University Press, New Haven

Kokko, A. (1992), *Foreign Direct Investments, Host Country Characteristics, and Spill–Overs*, EFI, Stockholm

Krugman, P. (1979), A Model of Innovation, Technological Change and the World Distribution of Income, *Journal of Political Economy* 87, 253–66

Leban, R. and Lesourne, J. (1983), Adaptive Strategies of the Firm Through a Business Cycle, *Journal of Economic Dynamics and Control* 5, 201–234

Lipsey, R. (1960), The Theory of Customs Unions: A General Survey, *Economic Journal* 70, 496–513

Markusen, J. (1983), Factor Movements and International Trade, *Journal of International Economics* 14, 340–56

Markusen, J. (1984), Multinationals, Multi–Plant Economies, and the Gains from Trade, *Journal of International Economics* 16, 205–224

Meade, J. (1955), *The Theory of Customs Unions,* North Holland, Amsterdam

Mundell, R. (1957), International Trade and Factor Mobility, *American Economic Review* 47, 321–35

Romer, P. (1986), Increasing Returns and Long–Run Growth, *Journal of Political Economy*, 94, 1002–1037

Romer, P. (1990), Trade, Politics and Growth in a Small, Less Developed Economy, *Paper at the CEPR/IIES conference*, Stockholm

Rybczynski, T. (1955), Factor Endowment and Relative Commodity Prices, *Economica* 22, 336–41

Spence, M. (1976), Product Selection, Fixed Costs, and Monopolistic Competition, *Review of Economic Studies* 43, 217–36

Stolper, W. and Samuelson, P. (1941), Protection and Real Wage, *The Review of Economic Studies*, 9, 333–357

Teece, D. (1986), *A Transaction Cost Theory of Multinational Enterprises, Economic Structures and International Competitiveness*, Wiley/IRM, Chichester

Viner, J. (1950), *The Customs Union Issue*, Carnegie Endowment for International Peace, New York

Villiamson, O. (1975), *Market and Hierarchies: Analysis and Antitrust Implications*, Free Press, New York

Villiamson, O. (1985), *The Economic Institutions of Capitalism*, Free Press, New York

Zieburn, G. (1983), Internationalization of Capital, International Division of Labor and the Role of the European Community, in Tsoukalis and Loukas eds., *The European Community: Past, Present and Future*, Basil Blackwell, London

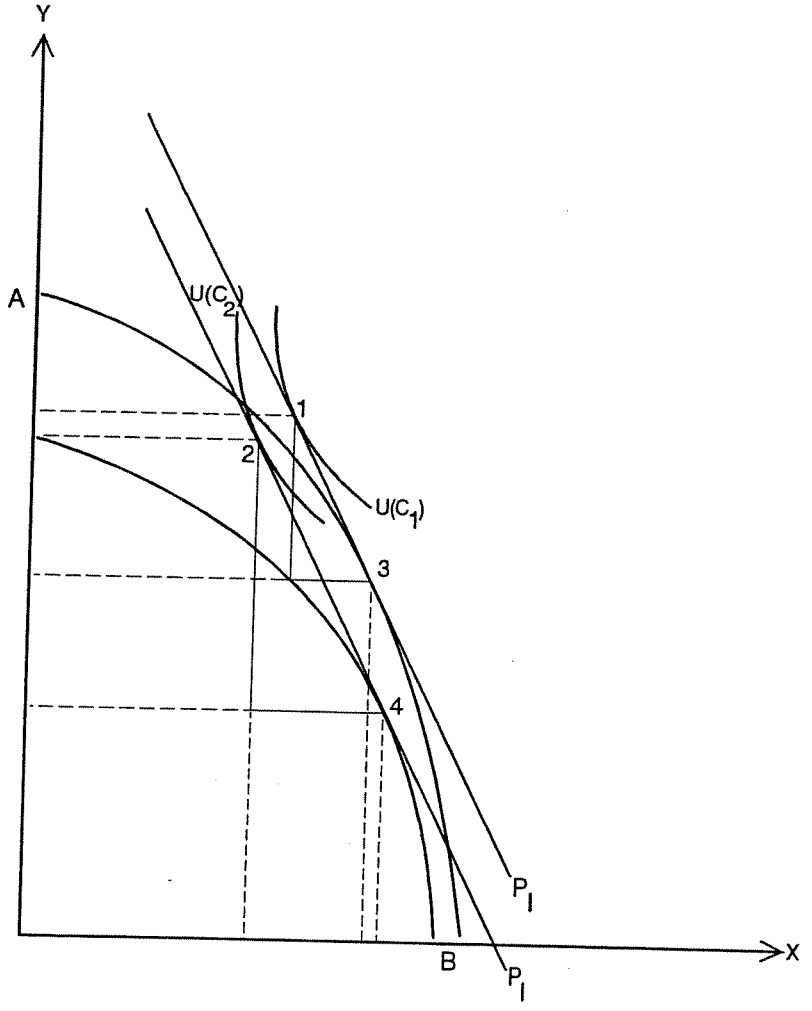


Figure 1. Factor Flows and Specialization in the Outsider Country

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, Q_1

4. = Production level after integration, Q_2

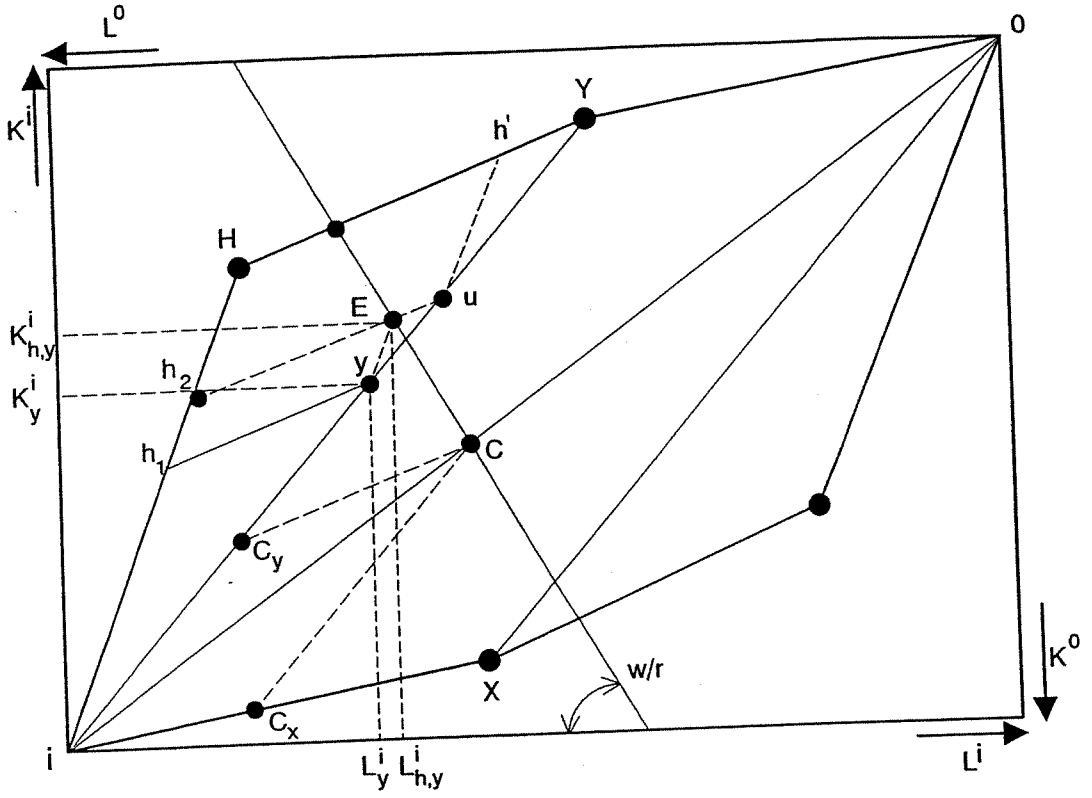


Figure 2. General Equilibrium with MNFs

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 outsiders' 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.

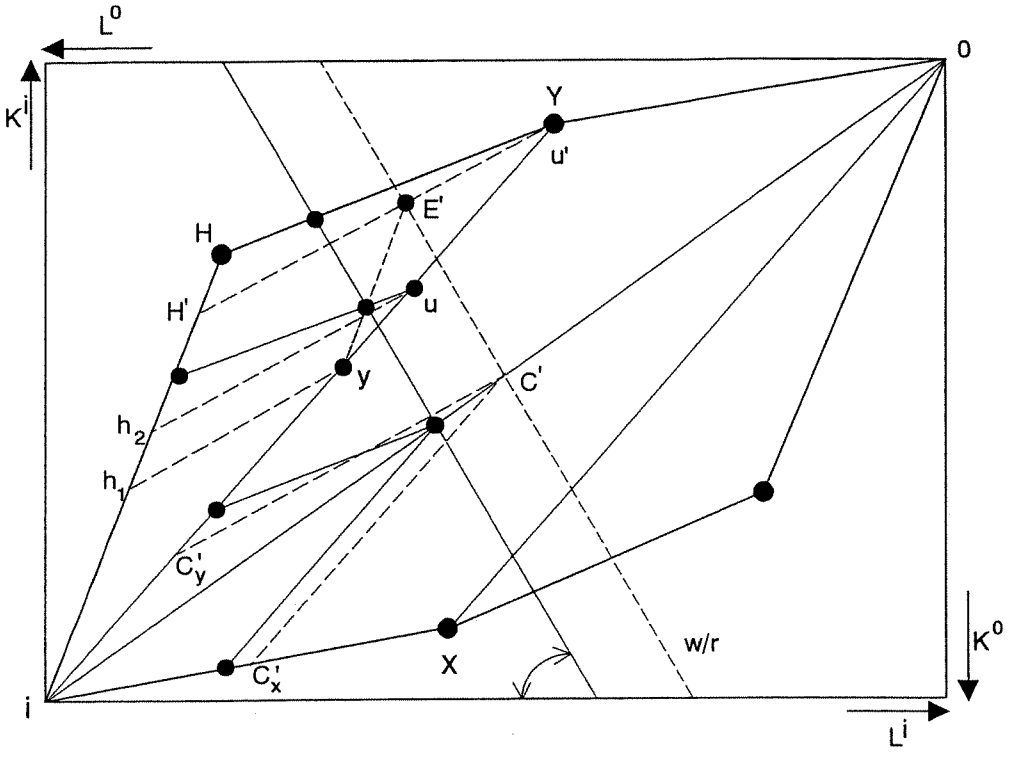


Figure 3. General Equilibrium and Factor Mobility

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 good by outsiders located in the integrating area, $y-u'$ = subsidiaries in downstream production in outsider countries employing knowledge produced by insiders.

*Prof. P.Segerstrom and K.M.Modén have contributed with valuable comments.

[1]Helpman–Krugman (1985) have introduced the multinational firm into the general equilibrium trade model. The firm is modeled in a way where 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.

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

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

[4]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 factor flows.

[5]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, there has already been some exports of Japanese cars from the US to Japan. This illustrates the point made above and the importance of economic policies in attracting production.

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

for a similar case.

[7]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).

[8]See also Krugman (1979) for exogenous technology shifts.

[9]This is identical to a shift of the h–isoquant closer to the origin.

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

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

On the Role of Competence Capital in Firm Performance

Pontus Braunerhjelm

The Industrial Institute for Social and Economic Research (IUI)
Box 5501, 114 85 Stockholm, Sweden

May 1994

Abstract

Industrial Organization literature has long been concerned about the discrepancy between the theoretical assumptions of equalization of profits among firms and the lack of empirical support. To sort out this contradiction, this paper defines and introduces the concept of competence capital. It is modeled as an additional production factor. Based on a few standard assumptions, intangible competence capital is shown to have a positive impact on firms' profitability. A unique IUI firm data set is used to demonstrate that differences in firms' competence capital explains much of the distribution of profits across firms.

JEL classification: L2

1. Introduction[1]

The role of knowledge, or competence, in firm performance has - although recognized long ago - recently been rediscovered as a key to economic prosperity.[2] That recognition 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 firms', or countries', knowledge stock (Spencer-Valla 1989, Porter 1990).

Technological progress in the postwar era has enabled transmission of commodities and information in unprecedented ways. To maintain competitiveness, firms have to organize such that swift and continuous adjustment to, as well as 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 Cantwell (1989) and Eliasson (1987), such upgrading of firms' knowledge bases 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 since it introduces a stock variable that more closely corresponds to the theoretically derived concept of firm-specific assets. In addition to R&D-

---

[1]Financial support from The Nordic Economic Research Counsel and The Jacob Wallenberg Foundation is gratefully acknowledged. Special thanks to Erik Mellander, IUI, for valuable comments.

[2] Already Marshall (1879) stated that "knowledge is the most prominent engine of growth". Hayek (1945) also stressed the importance of knowledge and the measurement difficulties.

investments it also comprises investments in marketing, education and software. The empirical analysis is based on a unique firm data set 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, including competence capital, is developed in section 3, followed by empirical tests of the hypotheses specified in section 4. Finally, the main results are summarized and some normative implications discussed (section 5).

2. Competence capital

The importance of knowledge has been acknowledged 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, knowledge has frustrated most attempts of explicit incorporation as a factor of production into the production function. Despite the impressive theoretical achievements, empirical evidence remain quite scarce.

To assess the influence of knowledge on firms' performance, a stock concept of such assets has to be developed. Investments related to knowledge assets are however - in accordance with the existing legislation and conventions - booked directly on firms' expense accounts. 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).[3] In addition to a brief literature review, this section will therefore elaborate at some length on the difficulties encountered in defining and capitalizing intangibles.

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, while the second maintains that the rate of return is identical across firms, or even industries, for each implemented unit of R&D. Although the estimated productivity effects varies, most studies report effects of R&D on productivity to be around 30 percent.[4]

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 in this literature 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 cannot simply be referred to 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

---

[3] SCB (The Swedish Bureau of Statistics) 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 during 1988-1992 from 53 to 61 percent (SBC F13 SM 9102, 9201).

[4] Both Griliches (1973) and Terleckyj (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.

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 - at least partly - be based on misspecified models since most studies only consider surviving firms, i.e. they do not account for sample selection bias. Those firms that fail and exit does not show up in the data sets.

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

Competence capital of firms is defined as assets in R&D, marketing, software and education, where the returns are appropriated by the firms themselves.[5]

This definition is operationalized by accumulating costs earlier charged on the current cost account. The firm-specific aspect of knowledge is stressed, which contrast with the mainstream approach where knowledge is assumed homogenous across firms, or even industries.[6] 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 their relevance as new technology emerges.

---

[5] Becker (1994) refute 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.

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

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. 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 is warranted. Firms are assumed to be profit-maximizing and employing regular production technologies. Their competitiveness is based on product differentiation, emanating from the respective firm's competence capital. The market structure is thus characterized by imperfect competition.

In 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,[7] profits - defined as the residual after factor payments to labor and capital - are equalized in 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.[8]

Since we can observe that profits differ between firms, even over long periods of time (Chandler 1990), the (static) general equilibrium 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 empirical analysis will

---

[7] See also Williamson (1981). It implies that the input is tied to the entrepreneurial unit.

[8] 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.

focus on whether such incidence in profits can be explained by differences in the respective firm's stock of competence, a hypothesis forwarded several years ago (Knight 1944, McKenzie 1959).

3.1. Profit maximization with competence capital

Models incorporating intangibles are generally based on either the assumption that investment in intangible capital shift the firms´ 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, and from which profits - defined as residual revenues not distributed to labor and fixed capital - will be derived.

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.[9]

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

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

subject to[10]

---

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

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

$0 < \alpha,\gamma < 1$

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. No indivisibilities exist and consequently the scale of operations is indeterminate, i.e. firms may be small or large.

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,

$$\Pi_i = P(V_i H_i^{\gamma}) - R_i V_i - W_i^h H_i \qquad \geq 0 \qquad (2)$$

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. If H were a well-defined production factor within the firm, all residual profits (W^h) would be appropriated by that factor. 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 2 subject to the restrictions in equation 1. Hence, differentiating profits with respect to H_i, yields the first order condition

$$\gamma H_i^{\gamma-1} = W_i^h/(PV_i) \qquad (3)$$

or, by (1) and the definition of V_i,

$$\gamma(Q/H_i) = W_i^h/P \qquad (4)$$

implying that competence capital is employed until the marginal contribution of additional H equals the marginal (real) return demanded by the firms' owners. From equation 3 and 4, the employment of competence capital, H, is decreasing in prices and in downstream production.[11] This suggests that inflationary pressures tend to reduce investments in competence capital, as do specialization in downstream, low value production, where product differentiation is less pronounced.[12]

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

$$\Pi_{i,hh} = (1-(1/\gamma))P_iV_i H^{\gamma-2} < 0 \qquad (5)$$

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

---

[11] The closer to perfect competition, the more sensitive will H be to inflationary impulses. Parts of basic industry production and simple component production, are examples of price-sensitive and products with little content of competence capital (Braunerhjelm 1991, 1992b). That competence capital leads to productivity gains in downstream production due to better quality of inputs and processes has been shown by Terleckyj (1974) and Scherer (1982).

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

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

and 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,

$P_{2,i,I}=C_{2,i,I}$ (=) $r=(\Delta P/P_1)100=\delta$

The more differentiated, or qualitative, the good, the higher the price that can be charged. If prices increase due to inflationary policies there is no incentive for firms to undertake investment in competence capital.

4. Data, hypotheses and empirical results

Previous empirical analyses, referred to in section 2, have to some extent managed to explain the spread in 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 are that a strong, and rather immediate relationship existed 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 evidence is ambiguous. For instance, Megna-Mueller (1991) receive weak support for R&D as an explanatory variable of profits.

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.[13] Secondly, a relation between inputs and outputs could 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, etc.

---

[13] 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 assumptions 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.

Finally, the stock of competence capital could be calculated by, or in close collaboration with, the firms themselves. This is the approach taken here.[14]

This method has some obvious advantages. First, we can disregard the lag-problem. At present, there is no unanimousity concerning the lag structure. For instance, Terleckyj (1982) used a three year lag, while Pakes-Schankerman (1984) and Griliches-Lichtenberg (1984) implemented a 2 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 deflating R&D, 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.[15]

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 hypotheses to be empirically tested are 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, where firms´ ability to differentiate

---

[14] The survey data are complemented with interviews with each firm. For a description of these surveys, see Braunerhjelm (1992). Information gathered through interviews have 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."

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

depends on their former and present skills and know-how, i.e. their competence stock. Since there is no well defined factor to appropriate the return to H, it will show up as residual profits or Schumpeterian rent.

In addition a few control variables, where previous research has established a relation to profits, will be included into the empirical analysis. First, since it is argued that investment in competence capital needs some scale to be profitable, 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 a size weighted relation 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. From the simple model in section 3.1, a negative relation between costs of labor (W) and profitability is expected. Finally, the impact of labor productivity (LP) is hypothesized to be positive.

4.2. Econometric specification and results

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

The endogenous variable is firms' real rate of return (ε_i) on total capital, defined as the return exceeding the interest rate on long-term government bonds, deflated for the inflation rate. In accordance with the theoretical model in section 3, as well as previous research referred to above, the following general functional relationship is postulated,

$\varepsilon^* = f(H,S,X,XL,POWER,LP,W)$

and the hypotheses formulated above will be tested by OLS estimation of a logarithmic form of the profit-function,

$$\varepsilon_i^* = a + b_1 h_i + b_3 s_i + b_4 (xl)_i + b_5 x_i + b_6 power_i + b_7 (lp)_i - b_8 w_i + \eta \qquad (7)$$

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.[16] Among these, SOFT1 refers to the stock of competence capital - as defined above - within 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.[17] Several tests with flow variables failed to show any significance, as expected. 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.[18]

Size measured as numbers of employees, sales, or different capital-labor ratios, were also included. In all cases they were found to be insignificantly

---

[16] Some overlapping is inevitable of current costs and capitalized items. 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).

[17] 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 1992a).

[18] Can we reject the possibility that causality runs from profits to the knowledge stock? Since data are cross-section with a single year´s flow value of profits, while the competence stock has been accumulated during the firm´s entire existence, we can quite safely infer that causality runs from the competence stock to profits.

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,

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 firms' 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.[19] The expected signs of the explanatory variables are summarized in Table 1.

All variables have been divided by total capital to avoid problems of heteroscedasticity and to isolate from effects of firm size. From correlation matrices there is no sign of multicollinearity. The different competence capital items were also exposed to a principal component analysis with no improved results.

The results are shown in Table 2. 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

[19]Value-added could of course also be used as a measure of firms' competence. The drawbacks are, however, that such values also incorporate effects of protectionism, market dominance, etc. Furthermore, a cross-section 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.

insignificant. Exports by large firms have the expected positive sign and is significant while "pure" exports display a negative impact on profits. This could be interpreted as if 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.[20]

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

The strong support for a positive relation between the rate of return and, on one hand, the stock of competence capital within firms and, on the other hand, exports for large firms, is particularly noteworthy. The competence stock, SOFT1, seems to be the best knowledge variable in explaining firms' profitability.

5. Conclusions

Using the unique IUI firm data base, the relevance of competence capital for firms' performance in industries competing with differentiated goods, receives strong support. This contrasts with the findings of for instance Megna-Mueller (1991). The unique data set captures firm specific assets in a more direct way then traditionally used data on R&D, marketing, etc.

---

[20] This conforms 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).

Considering the positive impact of competence on firms' performance, the normative conclusion must be that economic policy should be geared towards competence enhancing activities. Such policies can only lay down the basic prerequisites for firms by providing advanced and qualitative education, competitive infrastructures and communication systems, etc. 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. As shown in the theoretical model, inflationary policies tend to reduce investments in competence capital.

The results also highlight the strong dependence of large firms on foreign markets to sustain their profit levels. Smaller firms display the opposite relation; exports tend to lower their 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 surplus production. No statistical significance was found between size and profitability.

The importance of access to the export markets also indicates that if domestic firms are exposed to - or suspect future - discriminatory measures that threaten their exports, they are forced to either relocate production or become smaller, i.e. release 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 uncertainess connected with being an outsider to a process that involves the main markets for a majority of exporting Swedish firms.

Table 1 **Definition and expected signs of explanatory variables.**
(Dependent variable = the real rate of return)

Explanatory variables	sign
SOFT1, amount of competence 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 2.5 Rate of return and competence capital, 1989

	Dependent variable, real rate of return, (ε)	
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	59	59

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

References

Arrow, K, 1962., The Economic Implications of Learning by Doing, *Review of Economics and Statistics*, Vol. 80, pp. 155-173.

Ayanian, R., 1975, Advertising and Rate of Return, *Journal of Law and Economics*, Vol. 18, pp. 479-506.

Bain, J., 1955, *Barriers to New Competition*, Harvard University Press, Cambridge.

Baldwin, R., 1989, Growth Effects of 1992, *Economic Policy*, Vol. 4, pp. 247-282.

Becker, G., 1994, *Human Capital*, 4th edition, Columbia University Press, New York.

Block, H., 1974, Advertising and Profitability: A Reappraisal, *Review of Economics and Statistics*, Vol. 55, pp. 541-548.

Boyer, K., 1974, Informative and Goodwill Advertising, *Review of Economics and Statistics*, Vol. 56, pp. 541-548.

Branch, B., 1974, Research and Development Activities and Profitability: A Distributed Lag Analysis, *Journal of Political Economy*, Vol. 82, pp. 999-1013.

Braunerhjelm, P., 1991, Svenska underleverantörer och småföretag i det nya Europa, *Research Report 38*, IUI, Stockholm.

Braunerhjelm, P., 1992a, Competence, Capacity and Competence; A Description of Complementary IUI Firm Survey of Small and Large Firms and of Subcontractors, in Albrecht, J, Moses Database, *Research Report No 40*, IUI, Stockholm.

Braunerhjelm, P., 1992b, Globalization and the Future Role of Small and Medium-Sized Enterprises, in Oxelheim, L, (ed.), *The Global Race for Foreign Direct Investment*, Springer Verlag, Berlin.

Bryer, R., 1990, Economic Income is Dead! Long Live Economic Income? Accounting for the Controversy Over the Good-Will in the UK, *Research Paper 30*, Warwick Business School, England.

Burns, P., Dewhurst, J., 1986, *Small Business in Europe*, MacMillan, London.

Cantwell, J., 1989, *Technological Innovation and Multinational Corporations*, Basil Blackwell, Oxford and Cambridge.

Carter, J., 1978, Collusion, Efficiency, and Antitrust, *Journal of Law and Economics*, Vol. 21, pp. 435-444.

Chandler, A., 1990, *Scale and Scope*, Harvard University Press, Cambridge, Ma.

Clarke, D., 1976, Econometric Measurement of the Duration of Advertising Effects on Sales, *Journal of Marketing Research*, Vol. 13, pp. 345-357.

Clarke, K., Griliches, Z., 1984, Productivity Growth and R&D at the Business Level: Results from PIMS Data Base, in Griliches, Z., (ed.), *R&D, Patents and Productivity*, University of Chicago Press, Chicago.

Coase, R., 1937, The Nature of the Firm, *Economica*, Vol. 13, pp. 169-182.

Collins, N., Preston, L., 1968, *Concentration and Price-Cost Margins in Manufacturing Industries*, University of California Press, Berkely.

Comanor, W., Wilson, T., 1979, The Effect of Advertising on Competition: A Survey, *Journal of Economic Literature*, Vol. 17, pp. 453-476.

Demsetz, H., 1973, Industry Structure, Market Rivalry, and Public Policy, *Journal of Law and Economics*, Vol. 16, pp. 1-9.

Eliasson, G., 1987, Technological Competition and Trade in the Experimentally Organized Economy, *Research Report No. 32*, IUI, Stockholm.

Eliasson, G., 1990, The Firm as a Competent Team, *Journal of Economic Behavior and Organization*, Vol.13, pp. 275-298.

Eliasson, G., 1992, The Moses Model - Database and Applications, in Albrecht, J., et al, Moses Database, *Research Report 40*, IUI, Stockholm

Grant, R., 1991, *Contemporary Strategy Analysis*, Basil Blackwell, Oxford.

Griliches, Z., 1973, Research Expenditure and Growth Accounting, in Williams, B., (ed.), *Science and Technology in Economic Growth*, John Wiley & Sons, New York.

Griliches, Z., 1979, Issues in Assessing the Contribution of Research and Development to Productivity Growth, *The Bell Journal of Economics*, Vol. 10, pp. 92-116.

Griliches, Z., 1980, Returns to Research and Developments Expenditures in the Private Sector, in Kendrick, J., Vaccara, B., (eds.), *New Developments in Productivity Measurement and Analysis*, University of Chicago Press, Chicago.

Griliches, Z., 1986, Productivity, R&D and Basic Research at the Firm Level in the 1970´s, *American Economic Review*, Vol. 76, pp. 141-155.

Griliches, Z., Lichtenberg, F., 1984, R&D and Productivity and the Industry Level: Is There Still a Relationship?, in Griliches, Z., (ed.), *R&D, Patents and Productivity*, University of Chicago Press, Chicago.

Grossman, G., Helpman, E., 1991, *Innovation and Growth in a Global Economy*, MIT University Press, Cambridge.

Hayek, J., 1945, The Use of Knowledge in Society, *American Economic Review*, Vol. 35, pp, 520-30.

Helpman, E., Krugman, P., 1985, *Market Structures and Foreign Trade*, MIT Press, Cambridge.

Hägg, I., 1992, On Investment and Accounting with a Focus on Immaterial Investments, in Hägg, I., and Segelod, E., (eds.), *Issues in Empirical Investment Research*, North-Holland, Amsterdam.

Kendrick, J., 1976, *The Formation and Stock of Total Capital*, Columbia University Press, New York.

Knight, F., 1921, *Risk, Uncertainty, and Profit*, Houghton Mifflin, Boston.

Knight, F., 1944, Diminishing Returns from Investment, *Journal of Political Economy*, Vol. 52, pp. 26-47.

Lambin, J., 1976, *Advertising, Competition, and Market Conduct in Oligopoly Over Time*, North-Holland, Amsterdam.

Mainsfield, E., 1980, Basic Research and Productivity Increase in Manufacturing, *American Economic Review*, Vol. 70, pp. 863-873.

Marshall, A., 1879, *Principles of Economics*, MacMillan, London.

McKenzie, L., 1959, On the Existence of General Equilibrium for a Competitive Market, *Econometrica*, Vol. 27, pp. 54-71.

Megna, P., Mueller, D., 1991, Profit Rates and Intangible Capital, *Review of Economics and Statistics*, Vol. 73, pp. 632-642.

Mueller, D., 1986, *Profits in the Long Run*, Cambridge University Press, Cambridge.

Mueller, D., 1990, *The Dynamics of Company Profits*, Cambridge University Press, Cambridge.

Pakes, A., Schankerman, M., 1984, The Rate of Obsolence of Patents, Research Gestation Lags and the Private Rate of Return to Research Resources, in Griliches, Z., (ed.), *Patents and Productivity*, Chicago University Press, Chicago.

Porter, M., 1974, Consumer Behavior, Retailer Power, and Market Performance in Consumer Good, *Review of Economics and Statistics*, Vol. 56, pp. 419-436.

Porter, M., 1990, *The Competitive Advantage of Nations*, MacMillan, London.

Ravenscraft, D., 1983, Structure-Profit Relationship at the Line of Business and Industry Level, *Review of Economics and Statistics*, Vol. 65, pp. 22-31.

Ravenscraft, D., Scherer, F., 1982, The Lag Structure of Returns to Research and Development, *Applied Economics*, December, pp. 603-620.

Romer, P., 1986, Increasing Returns and Economic Growth, *American Economic Review*, Vol. 94, pp. 1002-1037.

Sala-i-Martin, X., 1990, Lecture Notes on Economic Growth, *WP 3563 and 3564*, NBER, Cambridge.

SCB 1991-1992, *F13 SM* 9102, 9201

Scherer, F., 1982, Interindustry Technology Flows and Productivity Growth, *Review of Economics and Statistics*, Vol. 64, pp. 627-634.

Scherer, F., 1986, On the Current State of Knowledge in Industrial Organization, in de Jong, H., Shephard, W., (eds.), *Mainstreams in Industrial Organization*, Martinus Nijhoff Publishers, Dordrecht.

Schumpeter, J., 1942, *Capitalism, Socialism, and Democracy*, Harper and Row, New York.

Shepherd, W., 1972, The Elements of Market Structure, *Review of Economic and Statistics*, Vol. 54, pp. 23-57.

Shepherd, W., 1975, *The Treatment of Market Power*, Columbia University Press, New York.

Spencer, R., Valla, J.-P., 1989, The Internationalization of the Industrial Firm: An International Development Network Approach, in Luostarainen, R., (ed.), *Dynamics of International Business*, Proceedings of the XV Conference of the European Business Association, Helsinki.

Terleckyj, N., 1974, *Effects of R&D on the Productivity Growth of Industries: An Exploratory Study*, National Planning Association, Washington, D.C.

Terleckyj, N., 1982, R&D and US Industrial Productivity in the 1970´s, in Sahel, D., (ed.), *The Transfer and Utilization of Technical Knowledge*, Lexington Books, Lexington.

US Department of Labor, 1989, The Impact of Research and Development on Productivity Growth, Bureau of Labor Statistics, *Bulletin 2331*, Washington, D.C.

Weiss, L., 1974, The Concentration-Profit Relationship and Antitrust, in Goldschmid, H., Mann, H., Weston, J., (eds.), *Industrial Concentration: The New Learning*, Little & Brown, Boston.

Williamson, O., 1975, *Market and Hierarchies: Analysis and Antitrust Implications*, Free Press, New York.

Williamson, O., 1981, The Modern Corporation: Origin, Evolution, Attributes, *Journal of Economic Literature*, Vol. 19, pp. 1537-1568.

INDUSTRIAL STRUCTURE, REGIONAL DEREGULATION, AND THE LOCATIONAL RESPONSE OF LARGE NORDIC FIRMS[1]

by

Pontus Braunerhjelm, June 1994
The Industrial Institute for Economic and Social Research, IUI
Box 5501, 114 85 Stockholm, Sweden

Abstract

Contemporary theoretical advances in economic geography emphasize how that the location of firms depends on the interaction of trade costs and regional differences in market size and production costs. Specialization, i.e. the structure of industrial production, is an additional factor introduced in this paper that influences location. It is argued that technologically advanced production exhibit a higher degree of geographical "footlooseness" as compared to basic production, being dependent on natural resources often tied to a particular country. The model is empirically tested by implementing a unique data-base on Nordic firms spanning the years 1975-1990.

[1]Financial support from the Nordic Economic Research Counsel is gratefully acknowledged.

1. Introduction

The unprecedented growth in foreign direct investments in the 1980s has spurred a revival of research in economic geography. The "new" location theory has focused on the influence of the interaction of production and trade costs, i.e. costs of market access, on firms' locational decisions. The objective of this is paper is to include structural aspects into a simple model of economic geography. The manufacturing sector is divided between high-tech, internationally footloose manufacturing production and basic, country-locked, industries. In the former type of production competitive advantage is based on firm-specific competencies, while firms in basic industries exploit country-specific resources. Hence, if firms are exposed to regional differences with regard to production costs, market size, etc., the initial industrial structure could be expected to influence the extent, pace and pattern of the following adjustment process. 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 their industrial structure.

The following model relies heavily on the work presented by particularly 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 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 for other firms, there is a tendency for such centripetal forces to reinforce themselves.

In addition of offering high levels of demand, large markets also have the advantage of supplying highly specialized and non-traded factors or services.[2]

---

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

On the other hand, high trade costs and low economies of scale implies 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 the vertical link between industries affects 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 data-base covering the 30-40 largest firms in Finland, Norway and Sweden in the period 1975-1990. For Denmark the data are not as complete and does not allow a statistical analysis. The firms in the respective countries will be divided into a high-tech and a low-tech industry in each country. Together they cover most of the manufacturing production in the investigated countries. Consequently, the allocation of these firms' production 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 part is outlined in section 2. Section 3 presents the hypotheses derived from the theoretical model, the empirical model and the data base. The results of the empirical analysis are presented in section 4 while a summary of the main findings concludes the chapter.

2. The Model

The structure of the following model differs from previous research in two aspects; First, in contrast to Krugman's (1991a,b) model containing one

manufacturing and one agricultural sector, the present model focuses on the structure of manufacturing sector. This is similar to Venables' (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 industrial structure and locational behavior by firms belonging to different industries, affects countries' specialization in manufacturing if they are exposed to inter-country differences with respect to production costs, trade costs, ans size. Secondly, "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 factor of productions where economies of scale predominantly occur on plant level. Such division conform well with observed differences across industries (cf. Braunerhjelm 1990).

The basic structure of the model can be desribed as follows. Within each of two regions, or countries, two goods are produced; high-tech Y goods, and low-tech basic industry goods, denoted X (forestry, ore etc.) Firms in each industry produce differentiated goods and consumers' preferences are characterized by "love for variety" (Spence 1976, Dixit-Stiglitz 1977). One country, the core, dominates with respect to marker size. Inflows of firms from the smaller country are assumed to be to small to influence factor markets in the core country.

2.1 The Single Industry Case

As firms are able to exercise some monopoly power, the demand elasticities facing firms must exceed one. Assuming concave and symmetric CES utility functions, utility-maximizing consumers will chose to consume exactly the same

proportions of all varieties, irrespective of the expenditure level.[3] Demand for variety i is then a function of the number and prices - including trade costs - of close substitutes and the level of expenditure (e),

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

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

where y_{hh} equals home country demand of y produced in the home country, 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 price indexes for the home country (h) and the foreign country (f). These are defined in the following way,

$$(P_h)^{1-\alpha} = (p_h{}^y)^{1-\alpha} n_h + (p_f t)^{1-\alpha} n_f \qquad (2a)$$

$$(P_f)^{1-\alpha} = (p_h t)^{1-\alpha} n_h + (p_f)^{1-\alpha} n_f \qquad (2b)$$

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). Trade costs are defined as costs associated with exports (imports) of goods, composed of a mixture of tariffs and non-tariff barriers, transports, etc. 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,

$$\kappa_j = (p_j)^{\alpha} (P_j)^{1-\alpha} \qquad j=h,f \qquad (3)$$

---

[3] 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.

implying that the demand equations can be expressed as

$$y_{i,hh} = e_h/\kappa_h \tag{4a}$$

$$y_{i,hf} = (e_f/\kappa_f)(t/p_f)^{-\alpha} \tag{4b}$$

where p_f denotes relative prices (p_f/p_h).

On the supply-side, fixed costs in production generate economies of scale to firms. The number of firms consequently depends on the level of fixed costs. 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,

$$\pi_h = (p_h - c_h)(y_{hh} + y_{hf}) - c_h F_h \tag{5}$$

where c represent marginal variable costs while the last term is fixed costs incurred by firms in the home country's Y-industry. The first order condition is satisfied when marginal revenue equals marginal costs, $p_h(1-(1/\alpha)) = c_h$.[4] By substituting for c_h, and using the zero profit condition in equation 5, this can be expressed as,

$$(y_{hh} + y_{hf}) = F_h(\alpha - 1) \tag{6}$$

implying that the size of the firm is given by the level of fixed costs and the elasticity of demand. Thus, the essence of Venables´ model (equations 1-6) rests on standard assumptions of utility maximizing consumers and profit maximizing producers, where optimization requires the traditional marginal

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

conditions to be fulfilled.

To derive the locations of firms 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 1a and 1b into the profit-maximizing equation (6). Hence, each industry (or firm) is in equilibrium when

$$(e_h/\kappa_h) + (e_f/\kappa_f)(t/p_f)^{-\alpha} = \psi_h \qquad (7a)$$

and similarly for the other country

$$(e_h/\kappa_h)(tp_f)^{-\alpha} + (e_f/\kappa_f) = \psi_f \qquad (7b)$$

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

Using κ, equations 2a and 2b can be solved for the number of firms in each country,[5]

$$n_h = (\kappa_h - (\kappa_f/p_f^{\alpha})t^{1-\alpha})/1-t^{2(1-\alpha)} \qquad (8a)$$

$$p_f n_f^y = (\kappa_f - \kappa_h p_f^{\alpha} t^{1-\alpha})/1-t^{2(1-\alpha)} \qquad (8b)$$

By substituting for the values of κ_f and κ_h - derived from equation 7a and 7b - and dividing equation 8b with 8a, the distribution of firms between the two countries is given by,[6]

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

---

[5] 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.

[6] See appendix for the derivation of equations 8a,b and 9.

which, by multiplying and dividing the numerator and the denominator with p^{α} and $t^{-\alpha}$, simplifies to,

$$Y_{f,h} = [(\sigma t^{\alpha} + t^{1-\alpha}) - p^{\alpha}(\sigma + t)\Psi]/[(t\alpha + \sigma t^{1-\alpha})\Psi - p^{-\alpha}(1 + \sigma t)] \qquad (9)$$

where $Y_{f,h}$ denotes the geographical distribution of firms in the Y-industry. Thus, the number of firms in each region 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 variable 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.

Proposition 1. Higher relative costs will unambiguously result in an outflow of firms from the foreign country.

Proof:[7] Assume that initially there is no trade between the countries, i.e. $t>p$. Since the home country is defined as the smaller country, σ will always exceed one. Then, differentiating equation 9 with respect to marginal costs yields,

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

i.e.,higher marginal costs abroad unambiguously results in an outflow of firms.

With regard to fixed costs, an increase in the ψ-ratio also negatively affects the foreign location of firms since,

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

---

[7] 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.

Trade costs can only be disregarded when expenditure levels and production costs are identical within the countries. 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,

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

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 to σ^y yields,

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

which is unambiguously positive as long as production costs are equal or if $t^{\alpha} > c^{\alpha}\Psi$, i.e. costs the foreign country are not high enough to mitigate the effect of an increase in expenditure. Q.E.D.

2.2 The Two Industry Case

We now introduce a basic goods industry, into the model. Similarly to the Y-industry, X-producing firms are initially distributed between the countries in given proportions. The allocation of firms across the two countries can be derived in exactly the same way as for the Y-industry (equation 9). Although the basic characteristics are identical between the two industries, they are assumed to differ in one critical way; production factors used in the X-industry are tied to a particular region, or country. Such factors could be viewed as natural resources (for instance forests, oil and mineral ore). Fixed costs within the X-production emanate from the availability of resources and the costs of extracting them. Thus, a Heckscher-Ohlin feature is introduced into the model.

The differences between the Y- and the X-industries could also be interpreted 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, on the other hand, economies of scale in the high-tech Y-industry appears 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 activities, and can comparatively easily be transferred to production plants abroad (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 could consequently increase their sales by moving closer to the market, since total expenditure would then comprise only of goods, not transport costs.[8]

---

[8] 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 $p_h=1$), $e(t,u)=ty_{hf}$, and consumption is derived by applying Shepherd's Lemma (see Varian 1992),

Analogously to equation 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- and the X-firms in the two countries,

$$M = (Y_{f,h}/X_{f,h}) \tag{10}$$

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

The more of interaction, the more complex is the analysis. 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. Analogously to the results in the one industry case, increases in production costs restricted to the Y-sector in the foreign country, it will shift the foreign production structure towards basic X-industry goods. Higher expenditure level and trade costs will on the other hand expand foreign Y-production.

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.

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

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

Several types of interaction between the variables are however conceivable. Whenever such interactions occurs, the calculations get extremely complex and hard to interpret from a qualitative point of view. We will restrict this part to a discussion of one particularly interesting interaction effect, namely how deregulation in conjunction with production cost determine 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 into the area or country that exhibit the lowest production costs. Since firms-specific assets quickly can be transferred to other regions, firms in the more technologically advanced Y-sector are more apt to relocate to countries with the lowest production costs. Thus we would expect the effect to be concentrated to the Y-industry. Of course there are a multifold 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, structural adjustment - in terms of firms' location - due 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.

3. Hypotheses, the Data Base and the Empirical Model

The empirical model focuses on the locational behavior of firms in the Nordic countries, having small domestic markets and depending heavily on exports to the EC. During the last 20 years, trade and transportation costs have been radically reduced between the Nordic countries and the EU.

Previous empirical research in this area has focused on host country

characteristics that attracts 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 openness have a positive impact on FDI, supporting the conclusions of locational theory. The evidence is however mixed, and Wheeler-Moody (1992) found that the opposite relation. In addition, they found that agglomeration effects seemed to 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 is more or less non-existent. Some studies have however been conducted on Japanese foreign direct investments, where the results suggest that firms locate in accordance with countries´ comparative advantages (Micossi-Viesti 1991, Yamawaki 1991). For the Swedish manufacturing sector Braunerhjelm-Oxelheim (1992) have shown, using industry data, how knowledge intensive industry has been the dominant foreign investor, although firms in the basic industries have catched up during later years. They also conclude that a substitutionary relationship prevails between domestic and foreign investment in more technologically advanced industries, while a complementary investment pattern exist in the basic industry.

Based on the propositions presented in section 2.1 and 2.2, four major hypotheses will be tested. First, we expect foreign investment by Nordic firms to be concentrated to the relatively foot-loose, high-tech firms.[9] The Nordic countries are abundantly endowed - as compared to their main trading partner, i.e. the EC - with notably forest, but also oil and to some extent

[9] Admittedly there are other forces, as well as strategic considerations, that affects the location of firms. Still, costs and market access constitute major reasons to relocate.

minerals, and in the case of Denmark, fertile land.[10] Consequently, there is no reason to expect that the Nordic countries suffer from a competitive disadvantage in their basic industry production, and we hypothesize that the impact of reduced trade barriers is less pronounced in those industries.

Secondly, such investment flows should be more distinct in the latter half of the 1980s, being characterized by movements towards regional integration in several parts of the world although most pronounced within the EC. For the same reason, differences between regions with regard to production costs should also have a more distinct effect in the latter half of the 1980s, which will be tested by implementing an interaction dummy. Finally, the fourth hypothesis holds that larger markets - where size is measured as differences in GNP-growth rates - will stimulate an inflow of firms into the high-growth areas.

3.2. The Data Base

The data base 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.[11] 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 data base covers information on sales, exports, value-added, R&D, number of employees divided on foreign and domestic production, age and some other, less frequently reported, variables. Based on R&D intensities and the ISIC classification, firms are divided into a technologically more advanced industry, referred to as high-tech, a basic industry, and a third group denoted

---

[10]Furthermore, trade in basic industry goods have been comparatively free. Compared to trade in for example cars, telecommunication, pharmaceupticals, etc., trade in forest industry goods, oil and also ore, has been less regulated in the EC (see Cecchini 1988).

[11] In each year the 30 largest firms are included, i.e. the data-set it 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 subindustries, i.e. in order to save degrees of freedom firm-specific dummies have not been implemented.

OTHER, containing firms that neither could be classified as basic or high-tech. Basic industry firms are the reference group.

All four Nordic countries have firms that doubtlessly fall into the high-tech industry. Among these are firms in the pharmaceutical, transport, instrument and electronic industries, to mention a few. There are also firms involved in typical base-industry production, although here the differences among the Nordic countries are more distinct. For instance, Denmark still has a substantial part of its industry rooted in the agricultural sector, whereas particularly Finland, but also Sweden, have a large forest and mining sector. In Norway the extraction of oil is the dominant basic industry.

Data on which country that host the firms' foreign production units are not available and therefore the empirical analysis cannot include country specific features that influence location.[12]

3.3 The econometric model

The dependent variable consists of the share of foreign employees out of total employees in the largest firms in Norway, Finland and Sweden, since we do not have data on the numbers of firms.[13] 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 EC.[14] It is hypothesized that Nordic (except for Denmark)

---

[12] Aggregate shows that the EC-countries have been the main recipients of Swedish FDI.

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

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

firms, facing a situation in the late 1980s of being outsiders to the European integration process, combined with political ambivalence concerning the future association to the Community, stepped up their investments to the EC. The time period 1975-1990 has therefore been divided into three groups, 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. They are expected to exert a positive and increasing effect on foreign production of Nordic firms over time.

Two variables reflecting the effect of larger foreign markets and differences in production costs are also included. First, the difference between a three year moving average in GNP growth between the OECD-countries and each Nordic country is calculated (DIFGNP). A higher foreign growth is hypothesized to have a positive effect on location abroad. Secondly, to account for production costs, the differences in 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 differs. Higher foreign unit-labor costs should have a dampening effect on production abroad.[15]

The exposure of firms to differences in production costs between regions as trade and investment barriers are dismantled have 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 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 regional deregulation taking place within

[15] The data are collected from OECD-statistics (see the references).

the EC in that period, being the Nordic firms most important markets in the 1980s.

It is known that the basic industry derive economies of scale on the plant level, while economies of scale are more pronounced at the firm level for technologically advanced production (Braunerhjelm 1990). Therefore the high-tech industry dummy (HIT) is expected to be positively connected with foreign production. Firms belonging to the basic industry, where the Nordic countries have their main comparative advantage (Lundberg 1992), is the reference group. 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. 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,

$$FEMP = \gamma + \gamma_1 HIT + \gamma_2 OTHER + \gamma_3 T80 + \gamma_4 T86 + \gamma_5 TC80 + \gamma_6 TC86 + \gamma_7 DFGNP + \gamma_8 DIFULC + \gamma_9 Z + \varepsilon$$

where the endogenous variable FEMP refers to the firms' share of foreign employees. 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 $E(\sigma_i \sigma_j) = 0$.

4. Empirical Results

The regressions will be undertaken by implementing OLS, where all variables are deflated by the consumer price index and expressed in logarithms. Furthermore, to avoid heteroscedasticity and to correct for firm size, the variables are expressed in units per employee. The data base covers the period

1975-1990. The results are shown in Table 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, size has in several other studies (Swedenborg 1979) been confirmed as a significant variable for firms´ 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 domes/tic 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, secondly, 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). Value-added per employee, i.e. labor productivity, is highly correlated with profits and therefore not included into the regression analysis.

As shown in Table 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 within the EC, is highly significant. After 1985, Swedish firms in predominantly the high-tech sector, stepped up their investment abroad. 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. It could be interpreted in two ways; first, it suggests that the risks

involved in setting up production units abroad requires a high internal cash flow, and secondly, a comparatively high profits reflect some unique firm-specific asset, or competence, on which the firms base their 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 influenced location of production during the whole 1980s.

Turning to Finland, the regression contains the same variables as for Sweden. Obviously the results conform well with those reported for the large Swedish firms. The dummies representing the time period 1980-85, the differences in unit labor costs during that period, are however insignificant. Hence, the period 1980-1985 as such did not exter any positive influence on the internationalization of Finnish firms, neither did differences in production costs. That contrast markedly with the effects in 1985-1990, where both these varaiables turn highly significant. It reflects the decision to establish the internal market within the EC and, for the same reason, that Finnish firms became more exposed to international competition simultanously as their export markets in former Soviet Union began to collapse. Also profits, as well as differences between Finland and the OECD-area with respect to GNP-growth and unit labor costs, are insignificant. 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. The overall explanatory power of the regression is somewhat lower as compared to the Swedish case, yet it explain approximately 52 percent of the share of foreign employment.

Finally, the results of the Norwegian data are shown in Table 1. The Norwegian data do not contain any information on profits and instead value-added per employee is included into 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 of course are expected to be positively connected to foreign employment. In the beginning of the period foreign sales match very closely to exports, making it an acceptable proxy for exports, while in the late 1980s the discrepancy between the two gets wider.

The picture that emerges is considerably less clear-cut than for the other countries and 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 the firms´ operations abroad, as is higher GNP-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 difference between 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.

Table 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

5. Conclusion

To a large extent the empirical analyses support the hypotheses derived from the theoretical analysis in section 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 or huge investments in process- and capital-intensive plants, have retained more of their production in their respective home countries. Internationalization of production occurred under a period characterized by trade liberalization and diminishing regulations on capital flows, ownership and foreign investment.

Differences in GNP-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 EC 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, while foreign sales display the expected opposite relation. 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 1990, Braunerhjelm-Svensson 1993).

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

Appendix

The demand equations 1a and 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, $u_i(y_{i1},y_{i2}\ldots y_{in})\equiv(\sum y^{\beta})^{1/\beta}$,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, $\sum p_i y_i=E_i$. Define the Lagrangian function,

$$L = (\sum y^{\beta})^{1/\beta} - \lambda(\sum p_i y_i - E_i) \qquad \text{A1}$$

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

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

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 the budget constraint the y_i´s are eliminated. Then solve for $(\lambda/u_i)^{-\sigma}$,

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

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

$$y_i=(p^{-\sigma}/\sum p^{1-\sigma})E_i \qquad \text{A3}$$

i.e., the same expression as in equation 1a and 1b. The denominator can be interpreted as a price index.

Equation 8a and 8b are derived in the following way. First, equations 2a and 2b can be expressed in terms of domestic and foreign firms,

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

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

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 $p_h = 1$,

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

and similarly for the number of foreign firms,

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

Equations A6 and A7 are identical to equations 8a and 8b. From the zero profit conditions in equation 7a and 7b, expressions for κ_h and κ_f can be obtained. By substituting these expressions into A6 and A7, and dividing the two equations with each other, equation 9 is attained which gives the distribution of firms as a function of trade costs, production costs, and expenditure levels.

References

Braunerhjelm, P, 1990, Effekter på den svenska industristrukturen av EG 1992, *Ekonomisk Debatt*, Nb. 8, pp. 713-720

Braunerhjelm, P, 1993, On the Role of Competence Capital in Firms Internationalization, *mimeo*, IUI, Stockholm

Braunerhjelm, P, Oxelheim, L, 1992, Heckscher-Ohlin and Schumpeter Industries: The Response by Swedish Multinational Firms to the EC 1992 Program, *IUI WP 352*, IUI, Stockholm

Braunerhjelm, P, Svensson, R, 1993, Multinational Firms, Country Characteristics, and the Pattern of Foreign Direct Investment, *mimeo*, Industriens Utredningsinstitut, Stockholm

Caves, 1971, International Corporations: The Industrial Economics of Foreign Investment, *Economica*, Vol. 38, pp. 1-27

Cecchini, P, 1988, *The European Challenge 1992*, Wildwood House, Aldershot

Culem, C, 1988, The Locational Determinants of Direct Investments among Industrialized Countries, *European Economic Review*, Vol. 32, pp. 885-904

Dixit, A, Stiglitz, J, 1977, Monopolistic Competition and Optimal Product Diversity, *American Economic Review*, Vol. 67, pp. 297-308

Grossman, G, Helpman, E, 1991, *Innovation and Growth in a Global Economy*, MIT Press, Cambridge

Heum, P, Ylä-Antilla, P, Braunerhjelm, P, Thomsen, S, 1992, Firm Dynamics in a Nordic Perspective. Large Corporations and Industrial Transformation, *ETLA Discussion Paper No. 423*, ETLA, Helsinki

Horst, T, 1972, The Industrial Composition of US exports and Subsidiary Sales to the Canadian Market, *American Economic Review*, Vol. 62, pp. 37-45

Hymer, S, 1960, *The International Operations of International Firms: A Study of Direct Foreign Investments*, MIT Press, Cambridge

Kravis, I, Lipsey, R, 1982, The Location of Overseas Production and Production for Export by US Multinational Firms, *Journal of International Economics*, Vol. 12, pp, 201-223

Krugman, P, 1991a, Increasing Returns and Economic Geography, *Journal of Political Economy*, Vol. 99, pp. 483-500

Krugman, P, 1991b, *Geography and Trade*, MIT Press, Cambridge

Lundberg, L, 1992, European Economic Integration and the Nordic Countries Trade, *Journal of Common Market Studies*, Vol. 30, pp. 157-173

Magee, S, 1977, Information and the Multinational Corporation: An Appropriability Theory of Foreign Direct Investment, in Bhagwati, J, (ed.), *The New International Economic Order: The North-South Debate*, MIT Press, New York and London

Micossi, S, Viesti, G, Japanese Direct Manufacturing Investment in Europe, in Oxelheim, L, 19993, *The Global Race for Foreign Direct Investment*, forthcoming, Springer-Verlag

OECD, Historical Statistics 1960-1991

OECD, Main Indicators, 1991

OECD, OECD Economic Outlook 1990-91

Spence, M, 1976,Product Selection, Fixed Costs, and Monopolistic Competition, *Review of Economic Studies*, Vol. 43, pp. 217-36.

Spence, M, 1984, Cost-Reduction, Competition, and Industry Performance, *Econometrica*, Vol. 52, pp. 101-124

Svensson, R., 1993, *Evidence on Declining Exports Due to Overseas Production*, IUI Working Paper No. 369, Stockholm.

Swedenborg, B, 1979, *The Multinational Operations of Swedish Firms. An Analysis of Determinants and Effects*, IUI, Stockholm

Teece, D, 1983, Technological and Organizational factors in the Multinational Enterprise, in Casson, M, (ed.), *The Growth of International Business*, Allen&Unwin, London

Varian, H, 1992, *Microeconomic Analysis*, WW Norton&Co, New York and London

Venables, A, 1993, Equilibrium Locations of Vertically Linked Industries, *CEPR Discussion Paper*, No. 82.

Wheeler, D. and A. Moody, 1992, International Investment Locational Decisions - The Case of U.S. Firms, *Journal of International Economics*, 33, pp. 57-76.

Veugelers, R, 1991, Locational Determinants and Ranking of Host Countries: An Empirical Assessment, *Kyklos*, Vol. 44, pp. 363-382

Yamawaki, H, 1991, Locational Decisions of Japanese Multinational Firms in European Manufacturing Industry, *mimeo*, Catholic University of Louvain

Multinational Corporations, Country Characteristics, and Clustering in Foreign Direct Investment

Pontus Braunerhjelm and Roger Svensson*

The Industrial Institute for Economic and Social Research (IUI),
Box 5501, S-114 85 Stockholm, Sweden

May 1994

Abstract

Recent achievements in economic theory stress how technological spill-overs, accessibility to markets, and economies of scale, influence the location of firms and may induce clustering patterns in industrial production. By combining a unique data set on Swedish multinationals with industry data for 18 countries, it is shown how such agglomeration can be detected in the pattern of foreign direct investment. The clustering effect is statistically supported in more technologically advanced industries as engineering and chemicals, while it is insignificant in the basic industry.

---

* The authors would like to thank participants at the IUI-seminar for valuable comments.

I. Introduction

During the 1980s foreign direct investment (FDI) increased to become a major force in the global economy, reaching an - as compared to other economic variables - unparalleled annual growth rate of approximately 30 percent. This increase in firms' foreign operations 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; Venables 1993). In these models, agglomeration is spurred by the presence of externalities arising from firms' inability to fully appropriate the return to R&D investments, increased competition and interaction between firms, and enhanced access to specific skills and capabilities. If such factors gain in importance for firms' 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- and country-specific characteristics on the pattern of FDI. More precisely; are similarities between firm characteristics in home countries and industry characteristics in host countries promoting FDI, i.e. can we observe clustering, or agglomeration, patterns in FDI? The analysis focuses on differences across industries, in particular basic (iron & steel, paper & pulp) and more advanced, knowledge intensive industries (chemicals, engineering).

The OLI-theory, extended to account for clustering effects, constitutes the theoretical base for the model. The empirical analysis utilizes a unique IUI data set on Swedish multinational corporations (MNCs). Firm data will be combined with country data for most OECD countries as well as the most important Latin-American countries. Furthermore, our methodological approach is refined compared to previous work in this area, since countries where firms have no affiliate production are included into the analysis (Svensson 1993).

The paper is organized as follows. Section II reviews the theoretical framework of FDI as well as earlier empirical results. The data base is described in section III. In section IV, the econometric method and the hypotheses are presented. The results are provided in section V, and the final section concludes.

II. Foreign direct investment in economic analysis

II(i). Theoretical background

The 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, and I represents internalization of production within the firm through FDI. 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 induce firms to internalize production. The theoretical platform builds on works by Coase (1937), Hymer (1960) and Williamson (1975, 1979). With regard to the locational factors, the eclectic approach maintain that in order to attract FDI the recipient country has to offer some particular, country-specific, advantage. Such advantages are for instance sizable markets, skills or costs of factors of production, policy designed incentives.

A recent explanation of factor accumulation not accounted for in the eclectic approach, is the possibility to capture 'spill-overs' 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, implying that an externality is created and diffused to other firms, thereby reducing their costs (Griliches 1979). The spill-over literature is closely linked to the earlier research on public goods. 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 spill-overs are abundant would therefore constitute 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 advantages accruing to the pooling of factors with specific skills, the

possibility to support production of non-traded inputs, and information spill-overs.[1] The 'new' location theory, however, puts more emphasis on 'pecuniary' externalities, defined to be associated with demand and supply linkages rather than technological spill-over 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.[2] 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, are also in focus in a model recently presented by Venables (1993). Within a traditional monopolistic competition framework, he argues that low trade costs will make firms highly sensitive to differences in production costs, thereby making them more internationally 'footloose'. 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.[3]

II(ii). Previous empirical results

To what extent have the hypotheses of agglomeration effects been confirmed in empirical research? Although evidence has been forwarded concerning the existence

---

[1] 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).

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

[3] See also Braunerhjelm (1991) where it is shown how sensitive Swedish upstream firms are to the location of downstream firms. Braunerhjelm (1993) argues that industrial characteristics, i.e. whether production is specialized towards basic industries or more high-tech industries, is an important explanatory variable of countries' vulnerability to such parametric changes.

of R&D externalities (Levin and Reiss 1988; Bernstein 1988; Bernstein and Mohen 1994), most empirical analyses of location still emanate from the traditional OLI-framework. For instance, Kravis and Lipsey (1982) and Veugelers (1991) conclude that size and geographical proximity exert a positive impact on the distribution of investments. With regard to openness, evidence is more scattered. Kravis and Lipsey (1982) and Culem (1988) find that it has a positive influence on FDI, supporting the 'new' locational theory, while Wheeler and Mody (1992) report opposite results and Veugelers (1991) fails to detect any significant impact. Factor costs seem to have very limited influence on FDI, at least among industrialized countries. In fact, Kravis and Lipsey (1982) report a pattern of 'opposite 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, i.e. 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 and Mody (1992) contended that US investors regard such agglomeration factors as the major determinant of FDI. Some further evidence of agglomeration is also found in pattern of Japanese FDIs which seem to have strengthen the specialization of countries and regions (Micossi and Viesti 1991).

Wheeler and Moody (1992) also raise the question how economies which lack such attracting factors could overcome this drawback, since agglomeration - after a certain stage has been reached - seems to be a self perpetuating process. As shown by Arthur (1986), a minor regional advantage could turn into a substantial clustering of a specialized industrial activity.

II(iii). 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 IV. As shown above, theoretical models focus on R&D spill-overs 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, the skill level among employees, etc. Some of these factors have been emphasized in recent contributions to economic geography. Hence, in order to understand the distribution of production across countries such local forces, related to country- and industry-specific features, must be included in 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 of 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 include one such country variable that captures the relative abundance of skilled labor across countries. In this extended version of the OLI-model, both variables can be traced directly to recent contributions in economic theory.

III. The data base

The data on Swedish MNCs has been collected by the Industrial Institute for Economic and Social Research (IUI) in Stockholm at six different occasions since the mid-1960s. It contains detailed information about R&D, production, employment 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 to which we have export statistics of 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.[4] This is, however, not a cause of great concern since more than 95 percent of the foreign production of Swedish MNCs is undertaken in the countries included in the model.

(Table 1)

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 1, firms frequently establish manufacturing affiliates in markets to which they have previously exported. This suggests that firms' export markets are strong candidates for FDI. Exceptions in this pattern relates to industries where different barriers to trade have made exports impossible, as in the gas (chemicals), concrete, food and textile (others) industries. In the empirical analysis one observation is, therefore, generated every time a firm has had previous exports to a foreign market. Note that this is irrespective of whether the firm has any affiliates in the particular country or not. 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.

IV. 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}).[5] It is divided with 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%), since we want to compare host countries where affiliates are established with

[4] 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.

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

ones where the firms have no affiliate production. The appropriate statistical method for estimating such a model is the Tobit method (Tobin 1958):

$$\frac{NS_{ijt}^{*}}{TS_{it}} = \beta_0 + \beta_1 CLUST_{kjt} + Z'\beta + \epsilon_{ijt}, \qquad \text{(1a)}$$

$$\frac{NS_{ijt}}{TS_{it}} = \begin{cases} \dfrac{NS_{ijt}^{*}}{TS_{it}} & \text{if } \dfrac{NS_{ijt}^{*}}{TS_{it}} > 0 \\ 0 & \text{if } \dfrac{NS_{ijt}^{*}}{TS_{it}} \leq 0 \end{cases} \qquad \text{(1b)}$$

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 intensity to produce in a specific host country.[6] The parameter estimates, which are consistent, may, however, not be interpreted as marginal effects.[7] This specification contrasts with previous studies that have investigated the locational determinants of affiliate production. More precisely, earlier models have limited the analysis to host countries where each firm already has production. The weakness of such 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 FDI. The principal, and most interesting determinant of FDI is the variable measuring country 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*. For two reasons, this variable is divided with a weighted mean of the

---

[6] 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.

[7] 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).

share of employees in industry *k* for all countries; First, some industries may be large in almost all countries and, secondly, some industries are more labor-intensive than others. Such industries would then receive a lower value if we instead had chosen the share of output. Thus, if the coefficient of CLUST turns out to be significantly positive, it suggests a presence of clustering effects.[8] Insignificant or negative parameter estimates 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}, are supposed to capture demand and scale effects, and have received support in previous empirical studies. GDP is 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 1000s of the population ($RSET_{jt}$) based on UN (1992) statistics. Host countries with a high RSET value are expected to promote FDI, especially by R&D intensive firms. A modified version of the Wheeler and Mody (1992) index measuring trade policy has also been included ($OPEN_j$).[9] This index takes 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 MNCs 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 earlier stage are expected to have a positive

---

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

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

influence on the location of production, as predicted by Aharoni (1966) and Johansson and Vahlne (1977).[10]

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 capture the technological 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 intensity to produce abroad.

By including additive dummy variables, we examine whether any shifts in the level of the dependent variable occur over time or across regions.[11] The analysis also considers whether there are any industry- 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.[12]

Since we want to examine if the variables - especially the clustering 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.

---

[10] In Svensson (1993) it is discussed and shown how foreign production and exports are simultaneously related to each other.

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

[12] 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.

Unrestricted model: The parameters are unrestricted across the main industries.[13] 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.

V. Results of the estimations

As seen in Table 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 at the 5%-level. The more important the industry of the firm is in the host country, the more production in the affiliates in that country, and the higher is the probability that the firm has established any affiliate there. This result supports the view that clustering, or agglomeration, partly determines the location of manufacturing affiliates. The previous trade patterns 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 other 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 other factors than tariffs and trade barriers, in the first place, affect the distribution of Swedish FDI.

(Table 2)

Turning to the firm-specific variables, the R&D intensity, RD, exerts a confusing, negative impact, while the labor skill variable, LS, displays the expected, positive connection to foreign production in model (I). Not surprisingly, the

[13] 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 great heterogenity.

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 seems to be important both in the receiver country and in the investing firm when explaining the distribution of FDIs.

Table 3 shows the results of the unrestricted model, where the parameters are allowed to shift across industries In model (III), the clustering variable, CLUST, has a positive, and significant influence on foreign production at the 5%-level in engineering and chemicals, but not in the basic industry. When all parameters are industry-specific (model IV), the effect is significant at the 10%-level only in engineering. More interesting is, however, that the parameter estimates for the clustering variable are almost identical in models (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, has some influence in chemicals, but is 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 main host country variables that attract MNCs to establish affiliate production. Finally, in addition to the clustering effect, previous exports and market size seem to be the major determinants of foreign production in engineering.

(Table 3)

VI. Concluding remarks

The statistical analysis clearly supports that agglomeration, or clustering, governs Swedish MNCs as they locate production abroad. The clustering variable - the relative size of the respective industry in each country - captures the support system of an industry, i.e. a larger share indicates relative abundance of suppliers of

components and other complementary production. Furthermore, a larger size of the industry should improve the possibilities to profit from knowledge spill-overs. Disaggregated to the industry level, the clustering variable displays strong significance for engineering and some significance for chemicals, while it is insignificant for the basic industry.

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 localization of production. Firms endowed with human capital seem to be more inclined to undertake foreign operations, while the influence of the technology level within the firm is uncertain.

The policy implications are obvious. If externalities, or economies of agglomeration, turn out to be increasingly important in firms' investment decisions, this could set off 'locational tournaments' among countries (David 1984; Oxelheim 1993). Particularly if the conclusions of the 'new' growth theory hold, i.e. if macro-economic growth is predominantly related to investment in knowledge.

Our results suggest that one important factor in attracting investments of knowledge intensive firms is the amount of skilled labor in the economy. The crucial factor seems, however, to be the relative size of knowledge intensive industries, implying that larger industries tend to attract more investment to that particular industry. As discussed by Venables (1993), low trade costs, paired with high economies of scale, facilitates substantial relocation of firms which may threaten the entire industrial base of a country. Hence, the empirical analysis suggest that a multiple equilibrium situation is possible, where countries, or regions, are trapped in either virtuous or vicious growth cycles. Although the results are based on Swedish MNCs, we believe they have a general application to the investment pattern of other MNCs.

References

Aharoni, Y. (1966) *The Foreign Investment Process* (Division of Research, Graduate School of Business Research, Harvard University).

Arthur, B. (1986) 'Industry Location Pattern and the Importance of History.' CEPR Paper No. 84, Stanford University

Bernstein, J. (1988) 'Cost of Production, Intra- and Interindustry Spillovers: Canadian Evidence.' *Canadian Journal of Economics* 21, 324-347

Bernstein, J. and P. Mohen (1994) 'International R&D Spillovers Between US and Japanese Intensive Sectors.' NBER WP No. 4682, Cambridge, Ma

Braunerhjelm, P. (1991) 'Svenska småföretag och underleverantörer i det nya Europa.' Reserach Report No. 38, IUI, Stockholm

Braunerhjelm, P. (1993) 'Regional Integration and the Location of Knowledge-Intensive Multinational Firms.' IUI WP No. 404, IUI, Stockholm

Coase, R. (1937) 'The Nature of the Firm.' *Economica* 4, 13-16

Dahmén, E. (1950) *Svensk industriell företagarverksamhet. Kausalanalys av den industriella utvecklingen 1919-1939* (Dissertation, IUI, Stockholm)

David, P. (1984) 'High Technology Centers and the Economics of Locational Tournaments.' *mimeo*, Stanford University

Dunning, J. (1977) 'Trade, Location of Economic Activities and the MNE: A Search for an Eclectic Appraoch.' In *The Allocation of International Production*, eds. B. Ohlin, P-O. Hesselborn and P-M. Wijkman, Proceedings of a Nobel Symposium at Stockholm, (London: MacMillan).

Griliches, Z. (1979) 'Issues in Assessing the Contribution of Research and Development to Productivity Growth.' *Bell Journal of Economics* 10, 92-116

Henderson, J. (1974) 'A Note on Economics of Public Intermediate Goods.' *Economica* 41, 322-327

Hymer, S. (1961) *The International Operations of National Firms: A Study of Direct Foreign Investments* (Cambridge, Ma: MIT Press)

Johansson, J. and J.E. Vahlne (1977) 'The Internationalization Process of the Firm: A Model of Knowledge Development and Increasing Foreign Direct Commitments.' *Journal of International Business Studies* 8, 23-32

Kravis, I. and R.E. Lipsey (1982) 'The Location of Overseas Production and Production for Export by US Multinational Firms.' *Journal of International Economics* 12, 201-223

Krugman, P. (1991a) 'Increasing Returns and Economic Geography.' *Journal of Political Economy* 99, 483-500

Krugman, P. (1991b) *Geography and Trade* (Cambridge, Ma: MIT Press)

Leamer, E. (1990) 'The Structure and Effects of Tariffs and Nontariff Barriers in 1983.' In *The Political Economy of International Trade*, ed. R. Jones and A. Krueger (Oxford: Basil Blackwell)

Levin, R. and P. Reiss (1988) 'Cost-Reducing and Demand Creating R&D with Spillovers.' *Rand Journal of Economics* 19, 538-556

McDonald, J.F. and R.A. Moffitt (1980) 'The Uses of Tobit Analysis.' *The Review of Economics and Statistics* 62, 318-321

Meade, J. (1955) *The Theory of International Economic Policy. Trade and Welfare* (London: Oxford University Press)

Micossi, S. and G. Viesti, 'Japanese Direct Manufacturing Investment in Europe.' In *European Integration: Trade and Structure*, ed. A. Winters and A. Venables (New York: Cambridge University Press)

Oxelheim, L. (1993) *The Global Race for Foreign Direct Investment* (Berlin: Springer-Verlag)

Porter, M. (1990) *The Competitive Advantage of Nations* (New York: The Free Press)

Romer, P. (1986) 'Increasing Returns to Scale and Long-Run Growth.' *Journal of Political Economy* 94, 1002-1037

Sala-i-Martin, X. (1990) 'Lecture Notes on Economic Growth.' NBER WP No. 3563 and 3564, Cambridge, Ma

Svensson, R. (1993) *Production in Foreign Affiliates: Effects on home country exports and modes of entry* (Stockholm: IUI)

Tobin, J. (1958) 'Estimations of Relationships for Limited Dependent Variables.' *Econometrica* 26, 24-36

United Nations (1992) *Statistical Yearbook 1988/89* 37 (New York: United Nations)

Venables, A. (1993) 'Equilibrium Locations of Vertically Linked Industries.' CPER Discussion Paper 82, London School of Economics

Wheeler, D. and A. Mody (1992) 'International Investment Locational Decisions - The Case of U.S. Firms.' *Journal of International Economics* 33, 57-76

Veugelers, R. (1991) 'Locational Determinants and Ranking of Host Countries: An Empirical Assessment.' *Kyklos* 44, 363-382

Williamson, O. (1975) *Market and Hierarchies: Analysis and Antitrust Implications* (New York: The Free Press)

Williamson, O. (1979) 'Transaction Costs Economics: Origin, Evolution, Attributes.' *Journal of Economic Literature* 19, 1537-1568

Table 1. ***Comparison between establishment of manufacturing affiliates and earlier trade pattern of firms across industries for 1978, 1986 and 1990.***

Industry	No. of establishments	No. of obs. to which the firms had previous exports	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	84
All industries	418	392	94

Note: Every time a firm has established an affiliate in a host country, one observations is generated. Only firms which are included in two succeeding surveys are analyzed 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] 'Other' industries include the food, textile, paper products, wood products and concrete industries.

Table 2. ***Estimation results of the restricted model.***

Method = Tobit	Dependent variable = NS/TS	
Explanatory variables	Model (I)	Model (II)
CLUST	0.0195 ** (0.0087)	0.022 ** (8.66 E-3)
$(XF/TS)_{t-1}$	0.755 *** (0.116)	1.057 *** (0.120)
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	-0.396 *** (0.113)	0.575 ** (0.282)
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 firms in model (II) are not shown, but are available from the authors on request.

Table 3. ***Estimation results for different industries in the unrestricted model.***

Method = Tobit	Dependent variable = NS/TS					
Explanatory variables	Model (III)			Model (IV)		
	Basic	Chemicals	Engineering	Basic	Chemicals	Engineering
CLUST	0.0122 (0.0114)	0.0318 ** (0.0154)	0.0219 ** (0.0101)	0.0127 (0.0151)	0.0343 (0.0249)	0.0233 * (0.0132)
$(XF/TS)_{t-1}$	1.048 *** (0.120)			1.068 *** (0.240)	0.947 *** (0.341)	1.059 *** (0.173)
GDP	2.71 E-6 *** (7.35 E-7)			1.14 E-6 (1.32E-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)	0.023 *** (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	0.587 ** (0.299)			0.780 (0.770)	0.274 (0.436)	0.536 (0.462)
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	1192.8			1234.8		
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 and dummies for time, regions and firms, as well as estimates for the group of 'other industries' are not shown, but are available from the authors on request.

CHAPTER SIX

SUMMARY

1. Main results

In the preceeding chapters we have studied various aspects of the expanding international operations of MNFs. 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 adressed 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. Costs differentials have traditionally been forwarded as the main explanation for firms to internationalize production. In the last decade externalities, spill-overs and size have been empasized 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, which has emerged as one of the dominant features of todays economic life. Within an integration context a thorough understanding of the adjustment at the micro-level is required before any normative policy conclusions can be drawn. Traditional analytical methods are simply too blunt.

The problem, i.e. increased firm mobility and the derived macro-economic consequences, was introduced and formulated in Chapter 1. Chapter 2 concluded that 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 contradicts traditional wisdom of

integration economics where specialization is predicted among the integrating countries. It originates in the assumed factor mobility which is absent in standard integration models. The outcome depends on whether it is the import- or 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 expectations, 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 focuses on the macro-economic outcome as firms are incorporated into the traditional analysis. In particular, the allocation of production between insiders and outsiders of the integration process, the trade patterns, and the distribution of welfare, is shown to depend on the strategies chosen 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 introduces a "knowledge" factor assumed - and observed - to be mobile between countries. A pure micro-economic view is 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 returns are appropriated by the firm itself. By using a unique IUI data set, the analysis verifies and supports the assumption in the other chapters that such capital plays a crucial role in firms' profitability and internationalization. The strategic role of such capital suggests that MNFs allocate their internal competence to markets where the highest returns can be obtained.

Chapter 4 builds 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 EC and the EFTA as well as between the blocks – it affects the location of firms.

By implementing a firm data-set on the 30 largest firms in each Nordic country (excluding Iceland) during 1975-1990, it was shown that high-tech firms have dominated outward investment in particularly Finland and Sweden, and to some extent also in Denmark 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 Internal Market considerably increased investments by Nordic firms into the EC.

While Chapter 4 studied which type of firms that predominantly engaged in foreign production, Chapter 5 investigates the country variables that attract investments. One objective is to study whether any clustering tendencies can be observed in the pattern of Swedish foreign direct investments. By combining an IUI data set on all Swedish MNFs investments abroad in 1978, 1986 and 1990, with country variables for most OECD countries and the largest Latin-American countries (altogether 21 countries), it was concluded that skill factors, like the number of engineers etc., 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 in industry j invested in countries where industry j was comparatively large, it would support the hypotheses of clustering 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. In the latter case, market size and proximity were more relvant explanatory factors.

A few words on the issues not addressed in this study is also warranted. The theoretical approach has predominantly been 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 have to be traded against the lack of dynamics.

Furthermore, knowledge intesive operations are argued 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, risking political tournaments between countries to attract foreign investments (David 1984, Oxelheim 1993). Such strategic investment policies have also been neglected in this boook.

2. Economic Policy

The analysis have some obvious normative implications. First, the increased competition created by the deregulation of trade barriers and capital control, puts pressure on firms in a changing environment to continously adjust to sustain profitability and survive. The new deregulated situation will therefore induce relocation of different parts of firms' value chain to countries that offer the best opportunities for industrial production. Todays sophisticated information technology makes effective monitoring of geographically dispersed production possible. There are numerous example. The accounting unit of Swissair is located in Bombay, ITT has its procurement department in Belgium, etc., (UN 1993).

Countries must be able to offer the right, competitive environment to attract investments from foreign as well as domestic firms. In addition, from a growth and welfare point of view, what matters is the type of investments that a country receives. MNFs are the main source of creation and diffusion of technological know-how.[1] Since knowledge should not be subject to decreasing returns to scale, it carries important growth implications. Policies should therefore be geared at supplying skillness 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 these country characteristic to form a country´s comparative advantage.

Only then will the productive interactions with, and feed-backs to, local firms get started. Receiver competence is a necessary condition to create virtuos 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 is doomed in todays 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 however gives a larger 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 counties. Hence, to promote sustainable growth, the key is to provide the right, attractive, investment climate. The long-run consequences of a failure may be quite dramatic since technological competition insert an element of path dependence where initially small differences between countries may grow over

[1]In the Swedish manufacturing sector, R&D expenditure of MNFs amounted to 19 billion SEK in 1990 as compared to 24.3 billion for the whole manufacturing sector (Fors-Svensson 1993).

time to substantial technological and growth gaps. Countries, or more accurately, the firms of a country, partly form their competitive strength by participating at high-competitive markets. Experimentally organized markets requires the interaction of firms where spill-overs from other firms, firm-specific knowledge, and the characteristics of the country combines into new knowledge (Eliasson 1991).

In such setting a small open economy can only be superior in a limited range of production, i.e. several centers of "excellence" in different countries may evolve (Arthur 1986, Krugman 1991). In order to develop such islands of excellence the underlying necessary skill has however 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 - and normally the more advanced firms - have the financial means, the knowledge and the entrepreneurship to embark on an internationalization process, the lack of such "attractiveness" may trap countries in a visciuos circle of declining investment and growth.

3. Future research

The analysis in the previous chapters have been of the static, general or partial, equilibrium type. Although valuable insights can be gained from the static apppproach, an extension into dynamics is preferrable. At the IUI, a micro to macro based model (MOSES) has been developed for simulation purposes.[2] It can briefly be described as a four sector, two country model where firms are the decision making units. More precisely, manufacturing is divided into the following sectors; natural resources, intermediate goods, investment goods and consumption goods. In addition there is a public and a household sector. The country trade with the rest of the world.

---

[2] MOSES= Model for Simulating the Economy of Sweden. For a detailed description of the model, see Albrecht et al 1993.

The firms in the model are partly real, partly modelled on a detailed information on 150 large and medium-sized firms. Firms take decisions on prices, wages and form expectations concerning sales and profits marginal, which is used in the production planning. Aggregate output is determined in cooperation with the other sectors.

This is the basic structure of the MOSES model. It is not a CGE model, striving towards a static equilibrium point, since firms are continously exposed to changes in the economic environment. Still, in the long-run it converges towards equilibrium. At the moment it is being updated to include firm data up to 1990.

Simulations have been undertaken to estimate the implications for the Swedish economy of an EC membership, an EES agreement and a status quo relation (Andersson-Fredriksson 1993, Trofimov-Antonov 1993). In those simulations the following "bench-mark" assumptions were made concerning the initial state of the economy:

1. Unemployment is 10% of the labor force.
2. The budget desicions is 11 percent of GNP.
3. The interest rate is 10 percent.
4. The trade balance is positively up to 1 percent of GNP with a positive trend.
5. Inflation is approximately 2,5 percent.
6. GNP growth is minus 1 percent.

Based on extensive IUI-surveys Andersson-Fredriksson (1993) then assume that particularly investment, but also a number of other variables (Table 1), will evolve differently depending on which type of association with EU that Sweden chooses.

Table 1. Assumption on the effects of EU-membership, EEA-agreement, and a status quo situation on investments, small firms operations, budget deficit, and fees to the EU.

Variables	Status quo	EEA	EU
Investment	-5%	0	+ 15% for investment goods, + 7,5% in other sectors
Efficiency of investments in the investment goods sector	0	0	+ 10 %
Demand on small firm product	0	+10%	+10%
Entry barriers	0	-5%	-10%
Probability of exits	+	0	0
Budget effects	0	-0,1% of GNP	-1.5%, membership fees -1.5% decreases in indrect taxes
Refunding from EU	0	0	+ 0,7% of GNP

Source: Andersson-Fredriksson 1993

The simulation are designed to capture the additional effects of an EU-membership, or an EEA-agreement, as compared to a stats quo situation. The results over a 10 year period are shown in Table 2 and Figure 1 and 2.

Table 2. Macro-economic results of the simulations, 1994-2004

	Status quo	EEA	EU
GNP growth	0	0.37	0.82
Inflation	0	-0.11	-0.34
Unemployment	0	-0.13	-0.17
Tradebalance/GNP	0	-0.37	0.94
Budget deficit year 2004 as % of GNP	0	-1.10	0.30

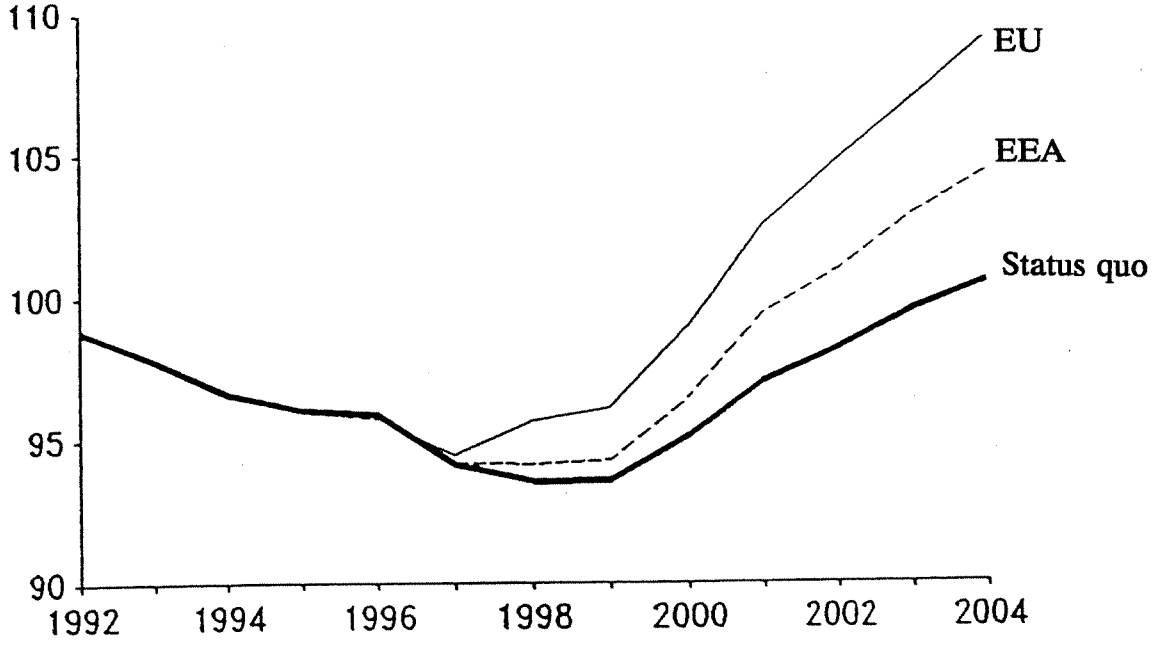
Source: Andersson-Fredriksson

Thus, under the above stated assumption the simulation clearly shows that membership results in the best macroeconomic performance. The budget deficit initially increases, but in the latter five years the consolidation is more rapid with EU-membership. This example is just an illustration of the dynamics as capture by IUI's simulation model. Of course the results must be interpreted with utmost care, as is the case for all simulated results. According to Andersson-Fredriksson (1993) the results are however satisfactorily robust.

At present the effects of an increase in entry rate on macro economic performance is studied using the MOSES model. Within a coming project the macro-economic effects of increased location of knowledge-intensive, both due to entry of newly established small firms and an inflow of foreign direct investment, firms will be analysed. Economic policy does of course affect the solution. Consider for example example the effects of a devaluation, or depreciation, on the expansion of the knowledge and the basic industries. What are the implications of such exogenous policy shocks on long-term growth? In a coming study we hope to have som answers on that and related questions.

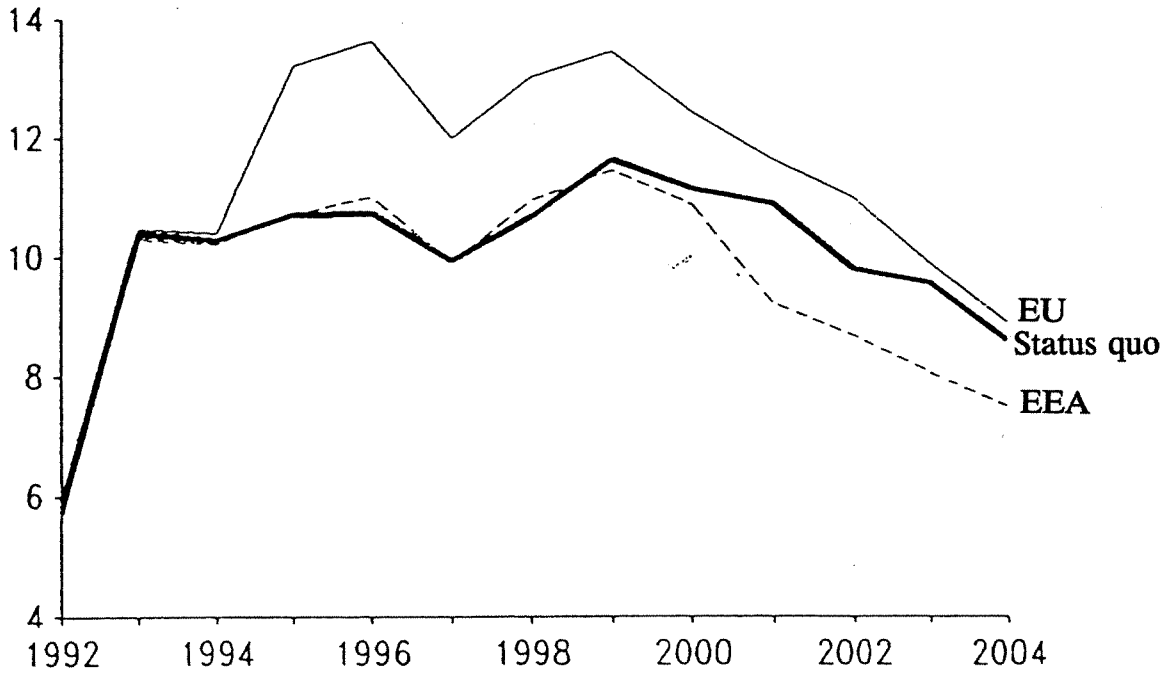
To sum up, the results of this book show how investments in competence pays off at the micro (firm) level, and how the sensitivity of the location of firms has increased due to increased international competition fostered by deregulation of capital markets and dismantling of trade barriers. Paired with the advances within technology, particularly information technology, the ability of firms to locate - and to relocate - to countries offering the best production prerequisites, puts pressures on countries to supply the adequate investment "climate". This is particularly relevant for the high-tech, knowledge intensive firms. According to the new growth theory, such knowledge intensive activities 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 clustering 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.

Figure 1. GNP growth as Sweden chooses EU-membership, an EEA-agreemen, or a staus quo relation.



Source: Andersson-Fredriksson 1993

Figure 2. Budget deficit as Sweden chooses EU-membership, EEA-agreement, or a status quo relation



Source: Andersson-Fredriksson 1993

References

Albrecht, J, Braunerhjelm, P, Eliasson, G, Nilsson, J, Nordström, T, Taymaz, E, 1992, *Moses Databas*, Research Report No. 40, IUI, Stockholm

Andersson, T, Fredriksson, T, 1993, *Sveriges val, EG och direktinvesteringar* (Sweden´s Choice, EC, and Foreign Direct Investment), Report for the Ministry of Finance, Allmänna förlaget, Stockholm

Arthur, B, 1986, Industry Location Pattern and the Importance of History, Stanford University, CEPR, *Paper No. 84*

Graham, F, 1923, Some Aspects of Protection Further Considered, *Quarterly Journal of Economics*, Vol. 37, pp. 199-227

David, P, 1984, High Technology Centers and the Economics of Locational Tournaments, *mimeo*, Stanford University

Dosi, G, 1988, Sources, Procedures and Microeconomic Effects of Innovation, *Journal of Economic Literature*, Vol. 26, pp.1120-1171

Eliasson, G, 1991, Modelling the Experimantally Organized Economy - Complex Dynamics in an Empirical Micro-Macro Model of Endogenous Economic Growth, *Journal of Economic Behaviour and Organization*, Vol. 16, pp. 153-182

Fors, G, Svensson, R, 1993, R&D in Swedish MNCs, *mimeo*, IUI

Grossman, G, Helpman, E, 1991, *Innovation and Growth in a Global Economy*, MIT Press, Cambridge

Krugman, P, 1991, *Geography and Trade*, MIT Press, Cambridge

Oxelheim, L, 1993, *The Global Race for Foreign Direct Investment: Prospects for the Future*, Springer-Verlag, Berlin

Schmookler, J, 1966, *Invention and Economic Growth*, Harvard University Press, Cambridge

Schumpeter, J, 1942, *Capitalism, Socialism, and Democracy*, Harper, New York

UN 1993, *World Investment Report*, United Nationd Publication, New York