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International Trade and Organization of Firms

(What Role is Played by Asymmetries in the Helpman-Melitz-Yeaple Model?)

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Preface

The last two decades has been characterized by a progressive disintegration of the production process, in which manufacturing or services goods realized home could be combined with those done abroad. What does this imply? That intermediate goods cross borders several time during the manufacturing process. This explains why intermediate inputs have become the new actors of international trade. In line with this findings we propose an analysis where intermediate inputs play a key role in a contest characterized by different organization of firms.

The structure of the thesis is organized in three papers. In the first paper[1], using data from COMTRADE and WDI, we propose an empirical analysis of the determinants of the choices to fragment production (outsourcing or vertical FDI). We consider four European countries (Italy, Germany, France and United Kingdom) as origin countries, and eleven East and South European countries as potential locations for the foreign productions. We investigate the amount of imports in parts and components of each of these four EU countries, as a function of wage, rule of law and certain indicators of development in the eleven destination countries.We find results consistent with the theory.

In the second paper, we analyse from a theoretical point of view the choice between exports and FDI. Considering an economy with 3 countries, each with a different trade policy, we study the effect of trade on the reallocation of resources, in a contest where firms could engage in domestic production, exports and horizontal FDI activities. In this framework, where we allow for asymmetric trade costs, we analyze the effect of changes in trade policy barriers on different type of firms. The asymmetry introduced gives raise to new interesting insights in terms of preferential trade agreements.

[1]The first paper corresponds to the first chapter, the second paper corresponds to the second chapter and so on.

Building on the previous framework, in the third paper we extend the analysis so that to consider the role of intra-industry trade. In particular, this paper analyses the choice between FDI and Exports in a framework where the existence of intermediate inputs makes MNF activities affected by trade costs. We make the production of the final good variety requires a particular input combination between services and labor manufacture. Hence, when a subsidiary is built abroad this service input has to be imported from the home nation. This makes the total marginal costs of selling via FDI rising with distance. Some asymmetries between countries, in terms of different locations, are assumed. This will make the equilibrium cutoffs related to distance. The existence of intermediate inputs and costs linked to distance leads to a result in which the ratio of MNF firms shrinks when distance becomes important.

Chapter 1

Determinants of International Production of Intermediate Inputs

1.1 Introduction

Beginning from 1990's an increase of outsourcing activities by firms has been observed. One reason that has been suggested in order to explain this change in production has been the decline in transaction costs. The rapid spread of this phenomenon helps explain why it has become such an attractive topic in the economic literature.

There is a large literature that tries to explain the trend of outsourcing. It starts with the seminal paper by Coase (1937), later developed by Williamson (1985), Grossman and Hart (1986), and Grossman and Helpman (2002a,b). More recently, the literatures examine from a theoretical point of view the firm's decision about where locate the sub-contracted activities, by taking into consideration how the contract environment can affect the successful conclusion of the outsourcing relationship. The key element in this literature is the issue of incomplete contracts. One important theoretical study in this field has been done by Grossman-Helpman in "Outsourcing in a Global Economy". This paper will be the focus of the present analysis. After a summary of their theoretical model, we will undertake an empirical investigation based on their economic conclusions, in order to understand what are the main determinants of the decision of where locate the subcontracted activities. It is important to keep in mind that in the present empirical work, only aggregate data are considered. The reason of this choice is

linked to the difficulty of obtaining micro level firm data. However, this choice would have implication on our dependent variable. In fact, the dependent variable can only be considered as an imperfect measure of outsourcing.

We focus the empirical analysis on the amount of imports of parts and components in four European countries: Italy, Germany, France and United Kingdom. On the side, so as potential exporters, and hence as possible places where to locate sub-contracted activities, we have considered eleven East and South European countries. The data used in this paper are taken from different databases, as will be indicated in section 1.5.2.

The rest of the paper is organized as follows. Section 1.2 explains the different ways of realizing the modern offshore assembly processing. Section 1.3 describes the Helpman-Grossman model of outsourcing. Section 1.4 includes some statistical considerations about trade in parts and components. Sections 1.5 and 1.6 presents the econometric work supporting the view that the contract environment plays an important role in explaining the decision of outsourcing. Section 1.7 concludes.

1.2 Defining Outsourcing

Before starting to discuss about outsourcing decisions it could be helpful to explain what generally is meant by this word. According to Price (2001) fragmentation of production can have two different dimensions: the ownership dimension and the outsourcing dimension. The ownership dimension represents a situation in which some activities of the chain of production are realized in different countries, but still under the ownership and control of a single firm (this is the case of multinational firm). However, this represents an old way of sharing production, which was used with the purpose of reducing the transaction costs, whereas, in the outsourcing dimension there is the loss of ownership. In this latter dimension the fragmentation of production, and so the fact that certain activities, such as assembling and processing, are realized by firms in low wage countries, is characterized by the existence of a contract. As Price suggests, outsourcing can be considered as a dimension of fragmentation that lies in between total ownership and complete arm's length transactions. With respect to the outsourcing relationship there are two important elements to consider: the long term nature of this relation and the exchange of

information between the final producer and the input supplier.

1.3 The Grossman-Helpman Model

In "Outsourcing in a Global Economy" (2001), Helpman and Grossman consider two countries, so called North and South, and two industries. They assume North can produce both a homogeneous consumer good, z, and a differentiated good, y. On the contrary, the South can only produce the homogeneous one, because it has not the know-how needed to produce the differentiated one. They further assume that both countries can produce intermediate goods, that are needed for the production of the differentiated good,y.

As we are in the usual intra-industry trade context, consumers consider the differentiated goods y as imperfect substitutes. For this reason the classical CES utility function is adopted in order to describe the typical consumer's maximization problem

$$U = z^{(1-\beta)} \left[\int_0^1 \int_0^{n(l)} y(j,l)^{\alpha} dj dl \right]^{\frac{\beta}{\alpha}}$$

with $0 < \alpha$ and $\beta < 1$. In this equation, z represents the consumption of homogeneous good, and $y(j,l)$ the consumption of the $j-th$ variety located at point l on a unit circle. They associate each good y with a point on the circumference of a unit circle, in such a way that the position of the final good y, represents the characteristics l of the intermediate input needed for its production. Hence, consumers consider the goods at the same location on the circle as different. The elasticity of substitution between any pair of varieties is $\varepsilon = 1/(1-\alpha)$.

Entry

For what concern the production process in differentiated good, Helpman and Grossman (2001) assume the following. North's firms can become producers of a variety of good y after having realized a certain investment in product design. This latter is the cost of entry by the final good producer in the North, and can be represented as the amount of labor needed to produce good y times the Northern wage rate, $f_n w^N$. However, the production of the final differentiated good requires an intermediate input, which North's firms cannot realized by themselves. For

this reason they need to outsource the production of this input to some other firms which can be located in the North or in the South. This gives raise to the main problem this model: since the characteristics of the input supplier are completely random, the search and eventually the recognition of an appropriate input supplier partner involves some difficulties.

The input suppliers can be located in both countries. Following Helpman and Grossman, in order to become a supplier of intermediate goods it is necessary that the input supplier makes a certain investment in expertise (or investment in the realization of a prototype). This expertise can be represented by a point on a unit circle. Helpman and Grossman assume that this investment in expertise represents a cost that is higher than the cost of "designing a single final product". This would imply that the number of final producers is greater than the number of intermediate producers. They indicate the entry cost by $w^i f_m^i$, where $i = S, N$. f_m^i represents the amount of labor needed to produce the input by the intermediate producers, that can be located both in the North, and in the South.

Search

Once firms enter into the intermediate sector, a second step takes place: final producers of differentiated goods have to look for appropriate input suppliers, in the sense that input suppliers' expertise is strictly closed to the input characteristics that the final producers need. The search and associated research activities require f_s units of northern labour at a cost of $w^N f_s$. In their working paper, Grossman and Helpman (2002), they considered the following search cost : $c_s = w^n \eta^i x^2$ with $i = S, N$. Where, x represents the search intensity in market i; $\eta^i x^2$, represents the amount of units of labor in order to realize a search of intensity x, and w represents the wage in the North, since they assume search is realized by Northern workers. Here they assumed that final producers are not guaranteed to find all suppliers in a given market, unless their search efforts are sufficiently intense. However, in the recent version of the paper[1], they decided to simplify the analysis by considering only a fixed cost of search, $w^N f_s$. In this framework, it is crucial to find an input supplier with an expertise linked with the final producer's needs. In fact, if the latter fails in the choice of input supplier's location, it must exit the industry.

[1] Review of Economic Studies (2005)

As we have explained above, the realization of the customized inputs by the input supplier requires an investment in a prototype. This investment can be considered as a cost in order to obtain the customized input, so it depends on the distance between the supplier's expertise and the final producer's need. The larger is this distance the higher will be the customization cost. The fixed cost of providing a particular component to a final producer whose needs in term of inputs are at a distance x from the supplier's expertise, is given by $c_p = w^i \mu^i x$. This represents the supplier's cost of developing the prototype.

Bargaining and Contracting

After the final producer has found an appropriate input supplier, the two firms start the negotiation considering the characteristics of the local legal environment. The negotiation process is divided into two steps. In the first step, the two parts have to negotiate on the input supplier's investment in customization, and on the payment for the development of the prototype. This is also called the "investment contract". In the second step the parties negotiate on the price and quantity of the input to be sold. In this second part the contract is usually called the "order contract".

In this relationship, the input supplier's investment, even if it is perfectly observable, it is not fully verifiable to outside parties. The imperfect verifiability of investment in a prototype constraints the contracting possibilities. In order to deal with this incompleteness they use elements of the theory of contract is necessary. Before continuing, could be interesting spending few words on this theory. The theory of contracts has emerged as a consequence of the failures in general equilibrium theory. These failures came from the fact that the real world is characterized by asymmetries of information that strongly affect economic relations, making it necessary to develop some other tools capable of taking them into account. In order to do this has been necessary to turn away temporarily from general equilibrium models. One of the main feature of contract theory has been to put in evidence that the impossibility of writing a so called complete contract. The reason is because there could exist some contingencies which are so unpredictable to make impossible take them into account when writing the contract. This could be the result of opportunity costs consideration: the cost of considering these contingencies is higher than the benefit. Another explanation could be that parties are not able to verify ex

post the value of certain observed variables.

In this incomplete context, the possibility to renegotiate the contract assumes a different meaning with respect to a situation in which contracts are complete. In fact, in the former case, the possibility for the parties to renegotiate the contract in order to react to unforeseen contingencies, can be seen rather than an efficiency loss, as a socially useful reaction. The problem in incomplete contracts is not only related to asymmetric information. In fact, in this model the information is symmetric, in the sense that all the variables are observed by all the parties, but some other variables cannot be included, because they are observable but non-verifiable. The theory of incomplete contracts can be considered as a development of the transaction cost theory (Coase 1937 and Williamson 1985). In this theory it is assumed that, as agents are boundedly rational, contracts cannot be complete. As many investments in relationship-specific assets, as in the Helpman-Grossman (H-G) model, are non-verifiable, firms[2] fear to lose the surplus created by their investment, so they can be induced to under-invest. This is the so called hold up problem.

In Helpman-Grossamn model the incomplete contract argument is used as a possible determinant in the choice of outsourcing decisions. They consider two different contexts. In the first one, the supplier's investment in the prototype is completely unverifiable. In this case, since the input supplier cannot engage in undertaking any initial investment, the first stage negotiations are completely useless. In the second context, the investment decisions of the input supplier are partially verifiable, so that there is a role for contracts, even if incomplete.

1.4 Outsourcing: The Evidence from Trade in Components

In order to understand the proportion and the trend of international fragmentation of production[3] we can consider real data. Before starting, we should highlight that international trade data for a long time have not been distinguished between assembled products and components. For this reason, it was impossible to establish the location where parts and components were realized, the magnitude of this production and so on. This until when a revision to the Standard International Trade Classification (SITC-Rev 2 and 3) has permitted to easily obtain

[2] The input suppliers, in the contest of the Helpman-Grossman model

[3] Also called "Global Production Sharing" by Yeaple.

SITC - Revision 3 - Code	Description
7119	Parts of steam boilers and auxiliary plants
7139	Internal combustion engine parts
7149	Parts of engines and motors, nes
7169	Parts of rotating eletric motors
72119	Parts of cultivating equipment
72129	Parts of harvesting machinery
72139	Parts of dairy machinery
72198	Parts of wine making machinery
72199	Parts of other agricultural machinery, nes
7239	Parts of construction machinery
72449	Parts of spinning and extruding machinery
72469	Parts of looms and knitting machinery
72479	Parts of textile machinery, nes
7259	Parts of paper mill and paper making mach.
72689	Parts of bookbinding machinery
7269	Parts of printing and typesetting machinery
72719	Parts of grain milling machinery
72729	Parts of food processing machinery
72819	Parts of machine tools for special industries
72839	Parts of mineral working machinery
72849	Parts of machines for special industries, nes
7369	Parts of machine tools for metal working
73719	Parts of foundry equipment
7373	Welding, brazing etc. mach
7429	Parts of pumps for liquids
7439	Parts of centrifuges and filters
74419	Parts of fork lift trucks
7449	Parts of lifting and loading machines
74519	Parts of power hand tools
74999	Parts of non-eletric machinery, nes
759	Parts of office and adding machinery
764	Parts of telecommunications equipment
77129	Parts of eletric power machinery
772	Parts of switchgear
77579	Parts of domestic eletrical equipment
77829	Parts of eletric lamps and bulbs
77889	Parts of eletrical machinery, nes
784	Parts of motor vehicles and accessories
78539	Parts of carriages and cycles
78689	Parts of trailers and non-motor vehicles
79199	Parts of railroad equipment and vehicles
7929	Parts of aircraft and helicopters

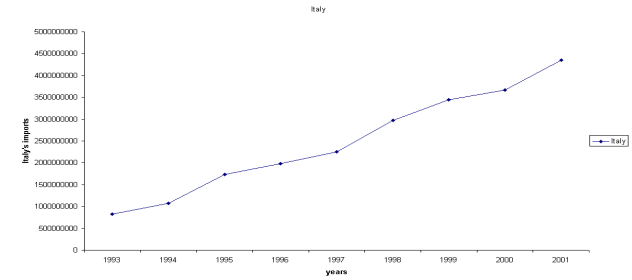
intra-industry trade in parts and components. Hence, it is only in the late 1970s that, thanks to the shift to the SITC Revision 2 system, the number of products groups composed only of components started to increase. In particular, the most detailed and complete group is the one of machinery and transport (SITC 7). For this reason, we decided to built our dependent variable, value of imports of parts and components, on SITC-Rev 3. Following the classification by Yeats (2001), this is the list of parts and components that has been taken into consideration for the construction of the dependent variable.

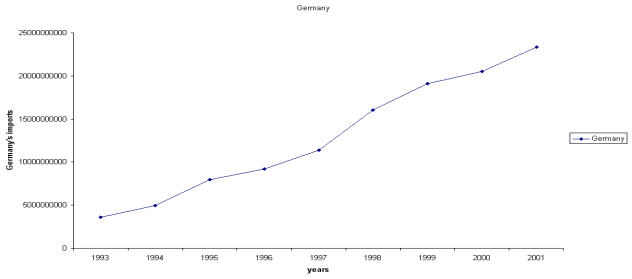
How great is the relative importance of trade in parts and components among the four European countries that we are considering? The following table provides some evidence in relation to the value of imports of parts and components within the transport and machinery sector (SITC 7), for what concern the four EU countries with respect to the eleven partners.

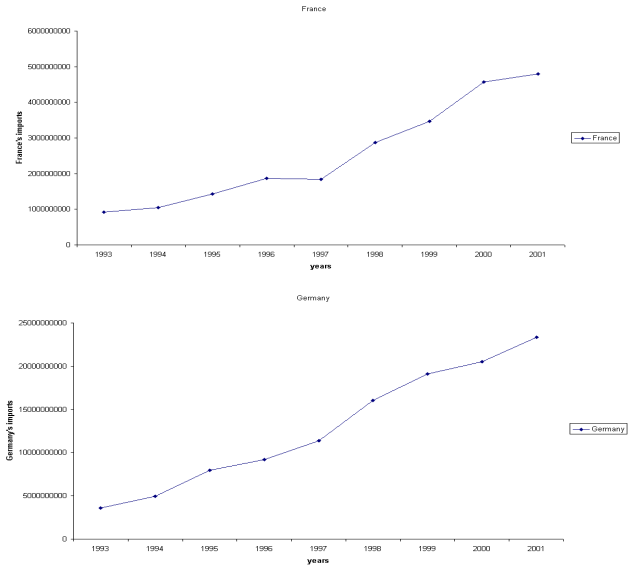
In order to understand the role of the European economic area in promoting the international

	Partners	Value of imports (in $) in 2000
Italy	Bulgaria	55887224
	Croatia	33817908
	Cyprus	5618942
	Czech Rep.	373977888
	Greece	45126140
	Hungary	477184800
	Poland	1081546240
	Romania	211029088
	Slovakia	533861760
	Slovenia	403851648
	Turkey	444719264
Germany	Bulgaria	102220312
	Croatia	109553912
	Cyprus	135076208
	Czech Rep.	5767663104
	Greece	75471808
	Hungary	6874668032
	Poland	3339293952
	Romania	418428448
	Slovakia	1733964800
	Slovenia	952288256
	Turkey	1013970624
France	Bulgaria	29203236
	Croatia	33500148
	Cyprus	1993141
	Czech Rep.	699475712
	Greece	32327476
	Hungary	1325819264
	Poland	677575232
	Romania	240145280
	Slovakia	336709376
	Slovenia	469584640
	Turkey	728815424
United Kingdom	Bulgaria	10088911
	Croatia	15987397
	Cyprus	189622848
	Czech Rep.	800285312
	Greece	85199256
	Hungary	720353280
	Poland	510725312
	Romania	61895536
	Slovakia	91718832
	Slovenia	68347840
	Turkey	432121216

fragmentation of production, we decided to consider the relationship between four main EU countries and eleven relevant partners in South-Eastern Europe. It could be easily anticipated that the reduction of trade barriers in regional arrangements, like EU or EFTA, has affected in a positive way the growth of trade in parts and components. Comparing the magnitude of trade in regional arrangements with trade with third countries, we observe that the former has increased at a faster rate. Consequently, we could expect that this trend will continue with respect to the new arrivals in EU. However, this reduction in trade barriers in regional arrangements is not the only reason for explaining this trend. In relation to the Helpman Grossman model, we should in fact consider the that regional arrangements can guarantee a more secure way of trading. In this environment the existence of a well defined and stable legal system creates an incentive for production sharing. The following figures represent the trend of imports in parts and components in each EU country. In particular, the trend of the total amount of imports of parts and components in transport and machinery sector of Italy, Germany, France and UK respectively:







Using the as a benchmark the Grossman-Helpman model, we can analyze those factors which seem to contribute the most in the development of North-South contracting activity, and so in the expansion of trade in components. As suggested by Grossman-Helpman, wage differences between developed and developing countries play an extremely important role in explaining the bid up of international fragmentation of production. According to Yeats (2001), in order to remain competitive in international markets, many firms in high labor cost EU countries have decided to move part of their labor intensive activities (assembling, processing and repairing), to those countries with lower wages (Eastern and Central Europe). However, as pointed out by Helpman-Grossman, other factors, like human capital, R&D, contractual environment, transportation and telecommunication technologies, seem to play a key role in explaining the dimension and the direction of this global production sharing. Another important element is represented by distance: gravity equation could help explaining the size of this fragmentation. In fact, higher transport costs, cultural differences affect in negatively the choice of fragment production. More precisely, there could be a trade off between distance and wage advantages. In order to explain this argument let's consider the sub-Saharan Africa case. Sub-Saharan Africa has not become a relevant partner in offshoring assembly processing activity, in spite of very low labor costs. The reason is probably linked to its own geographical position. This finding suggests that in our empirical study, country like Cyprus, will play not a less relevant role in explaining the ongoing fragmentation of production.

Also tariffs schedule plays an important role in determining the location of part of the production process. The "outward processing relief arrangements", that are provisions contained in the European Community tariff schedules, permits to parts and components to be exported for further assembly or processing. When these products are re-imported, they can be totally or partially exempted from duties. These provisions are applied to European Community countries. This last element highlights the importance of being part of an economic area. Let's consider the EU as an example. The advantages that the EU countries get from being members could act as an incentive explaining why a big part of the disintegration of production takes place among the countries member of that area. Even if, from a geographical point of view, there are other countries with a more convenient position; for example Ukraine, Belarus, are from a geographical point of view nearer to the core of Europe.

1.5 Empirical Investigation

In this part of the paper we take a closer look at the main determinants of the localization of part of the production process. Since we are interested in analyzing the two main activities through which fragmentation is taking place, outsourcing and vertical integration, we will analyze both of them. Let's start with outsourcing. Following Helpman-Grossman, the main elements that characterize the input supplier as a suitable partner in a sub-contracted activity are the cost of investment in the prototype, the thickness of the market, the wage rate and the legal environment in the country where the input supplier is located.

The supplier's *investment cost in the prototype* is characterized by the quality of the inputs required by the specific final producer. This customization costs is increasing with the distance in expertise between the two parties: the greater is the distance between the supplier's expertise and the final producer's needs the larger is the customization cost. This distance in expertise can be approximated by the level of human capital (h), R&D, or success in innovation (I). The function representing the customization costs is the following: $\mu^i = f(H, R\&D, I)$, where μ is the customization cost. The justification for human capital, as an element for representing customization cost, it is linked to recent findings where is confirmed that firms reveal preference for high skilled employees, even if this implies higher costs in term of wage. The significance

of human capital in production is presented in several theoretical studies such as Grossman-Helpman (1991), with clear implications for the final producer's choice in the search for partner. This model studied the link between the quality of education and the rate of innovation,putting in evidence that the increase in the aggregate stock of human capital has the effect of increasing the R&D activities. The firms will favor human capital in the production process because the costs between skilled and unskilled workers are diminishing due to higher availability of skilled employees. This could also imply that the contracting environment with a high distance in R&D expertise between partners will become unsatisfactory for the final producer. As the customization of the components implies the development of a prototype with characteristics that fully satisfy the final producer's needs, we can consider this quality as affected by R&D. The R&D resources are dependent on the R&D expenditures in each country and the increase in the R&D resources inside a firm or between parties means a higher probability for a successful innovation. Based on this we assume that the demand for intermediate inputs is strictly related to their own quality.

In what follow we consider the role of *Contract enforcement.* In fact, the other element that seems to play a relevant role in explaining the choice of where to outsource is represented by the quality of the institutional system. Protection of property rights and the quality of the government represent reliable measures of quality of institutions. Empirical tests on these measures confirm their positive and significant effect on the economic performance of the country considered. It is straightforward to understand that good quality of these institutions will promote the credibility of government's commitment. What has been used in the present paper in order to represent the quality of the institutions is an index intended to measure the extent of the rule of law in each of the eleven countries. This index, so called rule of law, can assume values from 0 to 6, where the higher scale indicates the better quality of institutions. This measure comes from the International Country Risk Guide. Unfortunately, this index is not available for two countries, Croatia and Slovenia.

For what concerns wage, a higher wage level in the destination country is expected to discourage the choice of outsourcing there.

The last element that seems to affect the choice of where to locate the outsource partner is represented by the search costs. In fact, since firms need to find a supplier for their components,

the greater is the number of input suppliers in a country, the more profitable it is for final producer to search for partners there. This because a search of a given intensity is more likely to find a potential supplier when there are more input suppliers are available. For this reason we will use, as a variable that can reduce the search costs, the thickness of the destination market. In this paper the thickness of the market is represented by the number of suppliers present in each country that we consider. The thickness of the market will be called (th). To summarize, in the following equation we indicate the variables that play an important role in the decision of implementing outsourcing: $out = f(\mu^i, th^i, w^i, \gamma^i)$.

Very similar aspects characterize vertical integration.

1.5.1 Hypothesis for Empirical Testing

The outsourcing is modeled as an activity that requires first of all searching for partners, and later on a relation specific investment which will be characterized by incomplete contracts. In this empirical analysis there are key element to focus on, and these are represented by the investment in the prototype, the wage, the nature of the contracting environment and the thickness of the destination market. Based on the previous theoretical background we can formulate the following hypothesis:

- the investment in R&D as well as the educational level in the destination country is expected to lower the customization costs, and so increase the attractiveness of outsourcing;
- the thicker is the market, the more easy is to find a partner for the final producer. In fact the thickness by increasing the level of competition, should reduce search cost of the final producer;
- a higher wage level in the destination country is expected to affect in a negative way the incentives to outsource to that country. In their paper, Grossman and Helpman find that wage can be considered as endogenously determined by the level of outsourcing in those countries[4];

[4] We will see that the empirical results are not confirming this finding.

- the quality of the legal system, or the contract environment, is expected to affect in a positive way the choice of outsourcing, as a consequence of the fact that the higher is the quality if the legal system (γ), the greater is the profitability of the searching activity.

1.5.2 Data Definition and Variables

In this paper we deal with eleven East and South European countries as possible partners in the outsourcing relationships. The final producers are located in four European countries, Italy, Germany, France and UK. We will consider the bilateral trade between each of the four EU countries with respect to the 11 East and South European countries. These 11 countries are Bulgaria, Croatia, Cyprus, Czech Republic, Greece, Hungary, Poland, Romania, Slovakia, Slovenia and Turkey. The aim of this paper is to investigate the amount of imports in parts and components of each of these four EU countries, as a function of wage, rule of law and certain indicators of development in the eleven destination countries.

Before choosing for pooling, since we suspect the existence of some heterogeneity among these eleven destination countries (and so problems of heteroskedasticity will arise) we undertake the test for the validity of pooling. This test, which uses the F-statistic, suggests the possibility to pool the data. In particular this happens when we consider heterogeneity by years. Whereas, if we construct a panel by considering heterogeneity by countries, the F-test, does not allow us to use pool estimation. As a consequence of the fact that the estimation results obtained by considering heterogeneity by countries are not robust, we will only consider heterogeneity by years. It is important to note that the dependent variables that have been used cannot distinguish between the parts and components that represent intra-firm trade and the parts and components that are in fact outsourced. This implies that what is estimated in the following regressions is a combination between outsourcing and intra-firm trade.

Empirical findings suggest that outsourcing is more likely in industries where the R&D expenditures are at the intermediate level. For this reason, we collect data from transport and machinery industry (non electrical machinery, electrical machinery and transport equipment). We will consider the amount of imports in parts and components of each EU countries from the eleven destination countries during the time period 1993-2001. We will test two possible proxy of outsourcing. With the first proxy, we analyze the main determinants of imports of

parts and components in machinery with respect to their value added (IMVA). While with the second proxy, we represent the dependent variable as the country's market share of parts and components (SHAI). These imports of parts and components as well as the total imports of machinery and transport equipment (SITC 7) are taken from the UN COMTRADE database. The data for the value added derives from the UN Industrial Statistic and WDI database. Thus, the dependent variable used as a proxy for outsourcing, could be represented by one of the following variables:

- IMVA = Ratio of imported parts and components to value added in transport and machinery
- SHAI = Market share of imports in parts and components

As we have seen in the theoretical part, we will consider the customization costs as explained by the level of education and technology. We chose to represent the customization costs by using the following variables: human capital and R&D. In relation to human capital we tried different proxies such as "public spending on education", "school enrollment at the country level" (secondary and tertiary). Finally, we decided for school enrollment at the secondary level (SESG), because it gives the better results. As a proxy for R&D we chose "scientists and engineers in R&D". All these data come from the World Development Indicators database. The wage data comes from the ILO Statistic database. The statistic of wages are in general average earning per workers. Earning data from payrolls of establishment usually refers to cash payments received from employers before deduction of taxes and social security. The wages considered are: wages in manufacturing. The thickness of the market was described as the amount of listed companies in each countries. This variable was found in WDI database. Finally, as a measure of the rule of law and corruption we used the index of the International Country Risk Guide. The list of the independent variables is the following:

- Wage = Yearly wage per employee in manufacturing
- Pse = Public spending on education at the country level, total (%GDP), as a proxy for human capital

- Sesg = School enrolment at the country level, secondary (% gross), as a proxy for human capital
- Scrd = Scientists and engineers in R&D at the country level (per million people), as a proxy for R&D
- Thick = Total amount of firms in each east European country
- Rule of Law = The quality of the legal system in each east European country

To summarize, our log-log estimation is:

$out_{i,t} = \alpha + \beta_1 w_{i,t} + \beta_2 pse_{i,t} + \beta_3 sesg_{i,t} + \beta_4 set_{i,t} + \beta_5 scrd_{i,t} + \beta_6 thick_{i,t} + \beta_7 rule_{i,t} + \varepsilon_{i,t}$,

where i stands for the $i-th$ cross sectional unit (number of countries considered as partners) and t for the time period.

1.5.3 Estimation Method

The regression model that we have used is a panel data regression model. We have decided to use a panel data because we suspect heterogeneity in the different countries over time. But also because by combining time series of cross section observations a panel data regression can permit to have more information data, less collinearity among the independent variables and more degrees of freedom.

We would like to see if imports in parts and components depends on R&D, education, wage, rule of law and thick of the market, in the expected way. We have 9 cross sectional units (in fact the time period is 1993-2001) and 11 countries, which means that we should have 99 observations. Unfortunately, as a consequence of the fact that some data are not available (rule of law) we will work with 77 observations.

We estimate two possible proxies for outsourcing, each of them in relation to the four different European countries that we take into consideration: Italy, Germany, France, UK. The estimation that we take into consideration is SUR. For what concern the estimation technique we have decided to consider the pooled regression. In this regression all coefficients are restricted to be the same across all cross-sections, so this is equivalent to estimating a model on the stacked data, ignoring all cross-sectional information. The estimated model assumes not only that the

intercept value of each of the four country, Italy, Germany, France and UK, is the same among the different years, but also that the slope coefficients of the independent variables is identical for all the nine years. As a consequence of these restricted hypothesis, we will prefer to test for pooling, in order to make sure that this kind of estimation is reasonable. The test that we use is based on the F-statistic It consists in comparing the sum of squared residuals from the restricted model with the one obtained from the unrestricted one. As the critical f is higher than the f-statistic we cannot reject the null that slopes and intercepts are equal across the nine years, so the restrictions seem to be appropriate. This also implies that we should pool the data together.

Before moving to the estimation results, we have to check for heteroskedasticity. This problem can arise as a consequence of the fact that we consider a large number of countries. This heteroskedasticity problem is a result of the different sizes of the countries. In fact we can expect to observe higher variation in the imports of parts and components coming from large countries than in those coming from the small ones. And even if we consider countries of similar sizes, the problem of heteroskedasticity can always exist as a consequence of the fact that the amount of imports in parts and components also varies as a consequence of research and development expenditure, spending in education. Nevertheless, if we implement the test for groupwise heteroskedastic on the pooled regression, that is a test of equality of variance among the different years, we will see that the test statistic cannot reject the null hypothesis of equal variance of the residuals across years, so there is no evidence of the presence of groupwise heteroskedasticity.

In conclusion, the type of estimation that we have chosen is a pool regression with SUR. The characteristics of this estimation are the following. By selecting Seemingly Unrelated Regression, we estimate a feasible GLS specification correcting for both cross-section heteroskedasticity and contemporaneous correlation. In the initial estimation, we considered all the indicated regressors, but a problem of multicollinearity appeared. The reason is because the set of exogenous variables chosen is highly correlated. For this reason, we restricted the number of regressors, keeping only the more significant one. Hence the reduced form regression corrected for multicollinearity is: $out_{i,t} = \alpha + \beta_1 w_{i,t} + \beta_2 sesg_{i,t} + \beta_3 scrd_{i,t} + \beta_4 thick_{i,t} + \beta_5 rule_{i,t} + \varepsilon_{i,t}$. Moreover, we did an Hausmann test of endogeneity. The choice to implement a test statistic

for endogeneity is because we are concerned in trying to understand if wage is endogenously determined by the outsourcing. The reason of this test comes from the fact that one of the result found by Grossman and Helpman is that the relative wage can be solved as a function of the number of input supplier in each country. So it is endogenously determined by the amount of outsourcing activities. If this were the case then OLS estimates will be biased and inconsistent. To test this hypothesis, we have used a set of instrumental variables correlated with the "suspect" variable wage but not with the error term of the outsourcing equation. As instrumental variables of the wage we have decided to consider pse, sesg and scrd. We run two OLS regressions. In the first regression, we regress the suspect variable, wage, on all exogenous variables and instruments. Subsequently, after having taken the residuals from this first regression, we create a second regression, in which we re-estimate the usual dependent variable including the residuals from the first regression as additional regressors. However, since the coefficient on the first stage residuals is not significantly different from zero, we can conclude that OLS estimates are consistent. Hence, there is no endogeneity problem. However, this results could not be considered completely reliable. In fact, it could be that in implementing this test we have not used all the possible variables supposed to explain wages.

1.5.4 Purpose of the Econometric Work

We are trying to study firms' decisions about where to outsource. Since the availability of firm level data is restricted, we based our analysis on aggregate data. We are conscious that this choice makes the dependent variable an imperfect measure of outsourcing. The econometric results should put in evidence the determinants of the location of part of the production process in the eleven destination countries. We considered the time period 1993-2001, because the empirical findings in term of vertical disintegration start after 1990. Since we are not interested in observing which of the eleven East and South European countries seems to become more likely a partner of one of the four EU countries, we considered these eleven countries as an aggregate area with which Italy, Germany, France and UK could start new trade relationships.

The question to which we are trying to answer is "the East and South European countries have become partners of an outsourcing relationship during 1993-2001?". Since the main European countries trade most of the time among each others, it could be interesting to understand

whether the enlargement of the Europe would increase the incentive to find outsourcing partners in the new arrivals. The new European area will become a possible place in which firms in countries such as Italy, UK, France and Germany, will decide to outsource a particular activity? In trying to analyze this problem, we will adopt the theoretical results of the H-G model of outsourcing.

The econometric results confirm the existence of a role played by the eleven destination countries in supplying parts and components to the four EU countries. Nevertheless, this role seems to be quite small, at least during the period 1993-2001.

1.6 Econometric Results

1.6.1 Econometric Results with IMVA

We will start by taking into consideration the estimation results for the ratio of import in parts and components to value added in manufacturing. This dependent variable gives us the amount of parts and components that explains the value added in manufacturing in each of the four countries. We should remember that this amount of parts and components can be considered a combination of outsourcing and intra-firm trade, as a consequence of the fact that it is not possible to have data on outsourcing from an aggregate point of view. We are estimating the relationship between the intensity of imports of parts and components in manufacturing production and all the set of explanatory variables (customization costs, rule of law and thickness of the market). The estimation results for each EU country are provided in table 1, table 2, table 3 and table 4 in the Appendix. The estimation technique used is pooling with SUR. In fact, after having implemented a test on pooling for each proxy of the dependent variable and for each of the four countries, we can conclude that it is possible to pool. The consequence of this choice is that all the coefficients are restricted to be the same across all cross-sections, and this is equivalent to estimate a model in which we ignore the cross-section information. We have decided to use a pool estimation with SUR because this kind of estimation corrects for both cross-section heteroskedasticity and contemporaneous correlation. And even if from the group-wise heteroskedasticity test there is no evidence of heteroskedasticity, there could be some problems of autocorrelation.

For what concern Italy, in the first regression we consider the following explanatory variables: wage, sesg, scrd, thick, rule of law. From the R^2 we can say that the explanatory variables explain around 26% of the total incentive to import parts and components from the eleven east and south european countries. If we look to the sign of the estimated coefficients we can see that wage is significant and negatively related to IMVA, as expected . The coefficient of sesg, that represents a proxy for human capital, contradicts our expectation, because it is negatively related to the amount of imports, and it is statistical significant. Whereas, the coefficient of scrd, that is a proxy for R&D, is positive and statistical significant. The coefficient associated to the thickness of the market is significant and positively related to the dependent variable. Finally, the coefficient of the quality of the legal system is positive and statistically significative. To summarize, all the coefficients of the independent variables have the expected sign, except for sesg.

If we consider the other three countries, Germany, France and UK we can see that we obtain similar results. More precisely, the estimations results related to Germany in terms of sign and significance are more satisfactory with respect the one obtained for Italy. From the R^2 we can say that the explanatory variables explain around 50% of the total incentive to import parts and components from the eleven east and south European countries. However, the coefficient of sesg is negative and statistically significant. Whereas, all the other coefficients are significant and they have the expected sign.

France's estimation differ from the one of Germany only in terms of R^2. For what concern the sign and the statistical significance of the coefficients we obtain exactly the same results as the one obtained for Italy and Germany. For what concern UK the results little more changes. In fact, the coefficient of wage changes sign passing from negative to positive, even if it is not statistically significant. Moreover, the coefficient of scrd becomes negative but it is not statistical significant.

For all the four countries the coefficients associated to rule of law and thickness of the market are significant and with the expected sign. This confirms the theoretical expectation. In particular, holding all the other exogenous variables constant, an improvement by 1% in the contracting environment in the eastern and southern economic area, raises the profitability to final producers of searching there by 1.4%, 6.5%, 5% and 4% respectively for Italy, Germany,

France and United Kingdom.

If we compare the magnitude of the coefficients among the four countries, we can conclude that Germany and France have the highest value for the coefficients associated to rule of law, thickness of the market and wage. Italy follows for what concern wage, and UK for the coefficient associated to rule of law. Germany and France seem to be the countries for which we obtain the better results in term of correspondence with the theory suggested by H-G. Also the results for Italy are robust, even if not so big in term of magnitude. Whereas, for UK we have some contradictory results. The fact that Germany seems to be the country for which we have the better results, could be explained by the fact that in Germany one of the most important industry is the car industry. The latter has started in recent year to subcontracting an ever expanding range of activities, so we were expecting to obtain no contradictory results for Germany.

What can appear not reasonable is the sign that we obtain for the coefficient of sesg with respect to each country. In fact, we expected a positive sign, as a consequence of the fact that an increase in the school enrollment should decrease the customization costs of producing good quality intermediate goods. What could be the reason? One justification could come from the following consideration. The school enrollment (sesg) is strictly linked to the wage rate, in the sense that an higher level of education will imply an higher wage rate. As we know, the wage rate is expected to be negatively linked to the choice of outsourcing, so for the same reason we could understand why the coefficient of sesg has a negative sign.

1.6.2 Econometric Results with SHAI

Now we take into consideration the estimation results for the market share of import in parts a components. This dependent variable gives us the amount of import of parts and components from each of the eleven countries in relation to the overall amount of imports of parts and components for every year. We are estimating the amount of import from one of the eleven country with respect the total amount imported from all the eleven. Again we are interested in the relationship between SHAI and all the set of explanatory variables (customization costs, rule of law and thickness of the market). The estimation results are provided in table 5, table 6, table 7 and table 8 in the Appendix, the estimation technique is pool with SUR.

For what concern Italy, in the first regression we consider the following explanatory variables: wage, sesg, scrd, thick, rule of law. From the R^2 we can say that the explanatory variables explain around 29% of the total incentive to import parts and components from the eleven east and south European countries. If we look to the sign of the estimated coefficients we can see that wage is significant and negatively related to SHAI, as expected . Again the sesg, that represents a proxy for human capital, is negatively related to the amount of imports, and it is also statistical significant. Whereas the other coefficients have the expected sign, exactly as in the previous estimation.

By considering the other three countries, Germany, France and UK we obtain similar results to the one obtained with the previous dependent variable, IMVA. The main changes concern the R^2. For what concern UK the results have more changes. In fact, not only the wage is positively related to IMVA, even if not statistically significant, but here also scrd is negative and statistical significant. Again for all the four countries the coefficients associated to rule of law and thickness of the market are significant and with the expected sign.

By comparing the magnitude of the coefficients among the four countries, we can conclude exactly what we have concluded before. Germany and France have the highest value for the coefficients associated to rule of law, thickness of the market and wage. Italy follows for what concern wage, and UK for the coefficient associated to rule of law. Germany seems to be the country for which we obtain the better results in term of correspondence with the theory suggested by H-G. Also the results for Italy are robust, even if not so big in term of magnitude. Whereas, for UK we have some contradictory results. The fact that Germany continues to be the country for which we have the better results, seems to confirm the empirical evidence.

It is important to point out that by considering two different and imperfect measures of outsourcing we have obtained approximately the same results, both in terms of magnitude that in terms of sign, for each of the four EU countries. This could be considered an important results

1.7 Conclusions

The rise of outsourcing as a new method of production raises important issues about the political consequences of the on going fragmentation of the production, and about what drives this process of fragmentation. We have discussed the model developed by Grossman-Helpman for studying outsourcing decisions in a global economy. We have considered the final producer's problem of obtaining the essential component from a possible partner.

In the econometric part of the present paper we have tried to estimate the relationship between the imported parts and components and several country characteristics: the wage level in the manufacturing sector, investment in human capital and R&D, the quality of the legal system and the thickness of the market. Finally, after having tested the choice of where to outsource by considering different possible elements that seem to affect outsourcing, our main conclusion is that the quality of the legal system can be considered a relevant variable, that can increase the country's ability to take part to the international outsourcing process. In general, we can say that from the estimated regressions we obtain results consistent with the theory.

In order to have a full understanding of the nature and determinants of outsourcing, or more generally of production sharing, it seems necessary move the attention away from data at aggregate level. The reason is the bias that characterizes the work at the aggregate level: it is impossible to distinguish between outsourcing and FDI. Consequently, a further step in trying to analyze the empirical nature of the outsourcing phenomenon is using data at firm-specific levels. Moreover, we can also try to extend the range of possible countries, by including a larger set of transition economies.

Finally, since the present empirical research has paid a special attention to the influence of the roles of institutions on outsourcing decisions, one possible further step is try to consider other proxies of the quality of institutions, in such a way to avoid some problems, such as endogeneity[5]. In fact, most studies that employ institutional indicators try to consider indicators from more than one data source, in order to test the robustness of the results. In our case, another possible index that can be included is the Corruption Perception Index. However, it can be very difficult obtain these institutional data for certain countries, that have been characterized by political

[5]The ratings of rule of law and corruption indicators follow economic changes. This implies that, when a country is characterized by a rapid economic growth this will determine a rapid increase of these indices.

instability.

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A.1 Appendix

Estimation results with IparImva

ITALY (with sesg and scrd)
Dependent Variable: LOG(IPARMVA)
Method: Seemingly Unrelated Regression
Sample: 1 11
Included observations: 9
Number of cross-sections used: 9
Total panel (balanced) observations: 81
One-step weighting matrix

Variable	Coefficient
C	1,3421***
	(0,1172)
LOG(WAGE)	-0,1174***
	(0,0084)
LOG(SESG)	-3,1555***
	(0,0311)
LOG(SCRD)	0,7557***
	(0,0072)
LOG(THICK)	0,2727***
	(0,0025)
LOG(RULEOFLAW)	1,4301***
	(0,0266)
Unweighted Statistics	
R-squared	0.2641
Adjusted R-squared	0.2151
S.E. of regression	1.2099
Durbin-Watson stat	1.5199

Standard errors are in parenthesis. In each table *, ** and *** mean significance at the 10, 5 and 1% level respectively.

FRANCE (with sesg)
Dependent Variable: LOG(IPARMVA)
Method: Seemingly Unrelated Regression
Sample: 1 11
Included observations: 9
Number of cross-sections used: 9
Total panel (balanced) observations: 81
One-step weighting matrix

Variable	Coefficient
C	0.5731
	(1,9126)
LOG(WAGE)	-0,4471***
	(0,0885)
LOG(SESG)	-3,8875***
	(0,3766)
LOG(SCRD)	0,5798***
	(0,0751)
LOG(THICK)	0,7144***
	(0,0279)
LOG(RULEOFLAW)	5,0944***
	(0,3496)
Weighted Statistics	
Unweighted Statistics	
R-squared	0.3453
Adjusted R-squared	0.3017
S.E. of regression	1.7759
Durbin-Watson stat	1.4825

GERMANY (with sesg and scrd)
Dependent Variable: LOG(IPARMVA)
Method: Seemingly Unrelated Regressio
Date: 08/26/04 Time: 19:22
Sample: 1 11
Included observations: 9
Number of cross-sections used: 9
Total panel (balanced) observations: 81
One-step weighting matrix

Variable	Coefficient
C	-2.0251
	(1,2630)
LOG(WAGE)	-0,4736***
	(0,0874)
LOG(SESG)	-3,9017***
	(0,3549)
LOG(SCRD)	0,9160***
	(0,0718)
LOG(THICK)	0,6748***
	(0,0394)
LOG(RULEOFLAW)	6,5240***
	(0,5719)
Unweighted Statistics	
R-squared	0.5079
Adjusted R-squared	0.4751
S.E. of regression	1.6474
Durbin-Watson stat	1.9365

UK (with sesg)
Dependent Variable: LOG(IPARMVA)
Method: Seemingly Unrelated Regression
Date: 08/26/04 Time: 20:00
Sample: 1 11
Included observations: 9
Number of cross-sections used: 9
Total panel (balanced) observations: 81
One-step weighting matrix

Variable	Coefficient
C	1.0099
	(3,3503)
LOG(WAGE)	0.2118
	(0,1665)
LOG(SESG)	-3,5752***
	(0,7122)
LOG(SCRD)	-0.1296
	(0,1784)
LOG(THICK)	0,4488***
	(0,04967)
LOG(RULEOFLAW)	3,8688***
	(0,4172)
Unweighted Statistics	
R-squared	0.2057
Adjusted R-squared	0.1527
S.E. of regression	1.6398
Durbin-Watson stat	1.5489

Estimation results with Shae:

ITALY (with sesg and scrd)
Dependent Variable: LOG(SHAI)
Method: Seemingly Unrelated Regression
Date: 08/26/04 Time: 19:11
Sample: 1 11
Included observations: 9
Number of cross-sections used: 9
Total panel (balanced) observations: 81
One-step weighting matrix

Variable	Coefficient
C	3,7656**
	(1,7017)
LOG(WAGE)	-0,3181***
	(0,0864)
LOG(SESG)	-2,6686***
	(0,3795)
LOG(SCRD)	0,3565***
	(0,0682)
LOG(THICK)	0,2004***
	(0,0216)
LOG(RULEOFLAW)	2,7419***
	(0,3157)
Unweighted Statistics	
R-squared	0.2952
Adjusted R-squared	0.2482
S.E. of regression	1.139
Durbin-Watson stat	1.5566

GERMANY (with sesg and scrd)
Dependent Variable: LOG(SHAE)
Method: Seemingly Unrelated Regression
Sample: 1 11
Included observations: 9
Number of cross-sections used: 9
Total panel (balanced) observations: 81
One-step weighting matrix

Variable	Coefficient
C	-2.1556
	(2,3167)
LOG(WAGE)	-0,3722**
	(0,1417)
LOG(SESG)	-3,4973***
	(0,6229)
LOG(SCRD)	0,6874***
	(0,1176)
LOG(THICK)	0,4443***
	(0,0559)
LOG(RULEOFLAW)	6,7152***
	(0,8307)
Unweighted Statistics	
R-squared	0.4123
Adjusted R-squared	0.3732
S.E. of regression	1.7635
Durbin-Watson stat	1.9314

FRANCE (with sesg)
Dependent Variable: LOG(SHAE)
Method: Seemingly Unrelated Regression
Sample: 1 11
Included observations: 9
Number of cross-sections used: 9
Total panel (balanced) observations: 81
One-step weighting matrix

Variable	Coefficient
C	10,391***
	(1,2926)
LOG(WAGE)	-0,7841***
	(0,0908)
LOG(SESG)	-5,4652***
	(0,4586)
LOG(SCRD)	0,3224***
	(0,1219)
LOG(THICK)	0,4928***
	(0,0317)
LOG(RULEOFLAW)	7,7533***
	(0,2929)
Unweighted Statistics	
R-squared	0.4042
Adjusted R-squared	0.3645
S.E. of regression	1.5226
Durbin-Watson stat	1.491

UK (with sesg)
Dependent Variable: LOG(SHAE)
Method: Seemingly Unrelated Regression
Sample: 1 11
Included observations: 9
Number of cross-sections used: 9
Total panel (balanced) observations: 81
One-step weighting matrix

Variable	Coefficient
C	8,0298***
	(2,5587)
LOG(WAGE)	-0.0954
	(0,1326)
LOG(SESG)	-3,6291***
	(0,4015)
LOG(SCRD)	-0,4155***
	(0,1169)
LOG(THICK)	0,3681***
	(0,0446)
LOG(RULEOFLAW)	4,3678***
	(0,4710)
Unweighted Statistics	
R-squared	0.1914
Adjusted R-squared	0.1374
S.E. of regression	1.5567
Durbin-Watson stat	1.5631

Chapter 2

FDI versus Exports: What Role is Played by Asymmetric Liberalization?

2.1 Introduction

MNEs together with their subsidiaries are responsible for 75 percent of the world's trade commodity. This trend is confirmed by UNCTAD's report (2000) where is estimated that one third of world trade is intra-firm trade (trade between headquarters of MNEs and subsidiaries, or simply among subsidiaries). Given the importance of understanding the functioning of MNEs, the recent literature is not only interested in studying the determinants of firms' choice to become multinational; but also in observing the different integration strategies of MNEs; and put them in comparison with other type of firms that can serve foreign markets. More precisely, recent researches are oriented towards the different ways of foreign market access.

Many empirical micro based studies, that observe production and trade at the firm level, have demonstrated the existence of different type of firms even within industries. This "heterogeneity" plays a peculiar role in the recent trade literature. If on one side, the "new" trade theory predicted either that all firms export or that none do depending upon the level of trade costs, on the other side the so called "new new" trade theory gives rise to a more differentiated

framework, in which each firm that enters the market has innate ability. This ability would determine whether the firm becomes a pure domestic firm, an exporter or a MNF. The decision to engage in exporting or in FDI activities is highly connected with firm characteristics, like dimension, productivity, factor intensity. This confirm the existence of a link between trade and firms heterogeneity.

In the present study we consider an economy with 3 countries, each with a different trade policy. Following the seminal paper of Melitz, we study the effect of trade on the reallocation of resources, in a contest where firms could also engage in horizontal FDI activities. In this framework, where we allow for asymmetric trade costs, we analyze the effect of changes in trade policy barriers on different type of firms. The new asymmetry introduced gives raise to new interesting insights in terms of preferential trade agreements. Moreover, the existence of a third type of firms implies a modification of the concept of producers and sellers in an open economy situation.

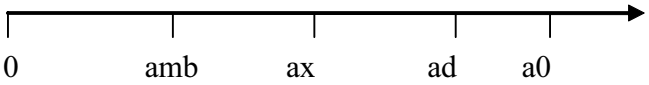
In this work the claim is that the choice of becoming an exporter or engaging in FDI is linked to different countries' locations, and so to different transport costs. These new elements could permit to analyze a richer set of possible results. In this paper, Melitz adds two essential elements to the new trade theory. The first is the fixed market entry costs, that is what a potential entrant has to pay. The second is heterogeneity in firms productivity. By introducing firms heterogeneity in the 1980's Krugman model, he observed how an increase in the exposure to trade lead to reallocation towards the more efficient firms, without necessarily inducing an increase in the productive efficiency of individual firms[1]. Its findings are supported by several micro-econometric studies.

After this paper, the study of the implications of firm level productivity differences has become an important field of interest in international economics. In fact, the shift from the representative firm framework to the heterogeneous firms framework allowed to model some aspects of international commerce that until now have been studied only empirically. We are referring to the different production strategies that a firm can undertake. Which firm serves foreign market? Which firm chooses to export, which to serve the foreign market through FDI?

[1]This result is partially contradicted by Baldwin et all (2004), where they pointed out that "although freer trade improves industry productivity in a level sense, it harms it in a growth sense"

And finally, what are the circumstances under which it outsources? These questions can be addressed because of this new heterogeneity element inserted. The novelty in this contest, is that only a fraction of firms will become exporters or engage in FDI. Hence, allowing firms level productivity to differ has generated a new area of research where trade is combined with the different organizational choices of firms. In this contest, the different production strategies can be analyzed in a general equilibrium setting.

In line with this new research area is the paper by Helpman, Melitz and Yeaple (2004), "Exports vs FDI". Here, the authors built a multi-country, multi-sectoral general equilibrium model where their intent is to analyze the decision of heterogeneous firms to serve foreign market either through exports or local sales (FDI). Similar to Melitz (2003), they work with identical nations, a single factor, L, but with H+1 sectors. They find that firm level heterogeneity plays a relevant role in explaining the choice between export and FDI flows. Their theoretical framework takes as a starting point the classical Melitz's model where another type of firm, MNEs, is added. They studied the Brainard's proximity concentration hypothesis[2] in a firms heterogeneity environment. Essentially, what they find is that the least productive firms (with a very high marginal cost, a is in between a_D and a_0) leave the market, as they are not able to obtain positive operating profit. The low productivity firms, $a_X < a < a_D$, enter but serve exclusively the domestic market. The firms with a marginal cost such that $a_M < a < a_X$ decide to export. And finally the more productive firms, $0 < a < a_M$, choose to serve the foreign market through FDI.



They assume that the different modes of market access involve different kind of costs. For example, some entry costs, that are considered sunk; then transport costs, that vary with sales; and fixed organizational costs which vary with organizational form. The main result of

[2] the proximity concentration trade-off predicts that "firms are more likely to expand their production horizontally across borders the higher are the transport costs and trade barriers and the lower are investment barriers and the size of scale economies at the level at the plant level relative to the firm level" (Brainard, 1997).

their paper derives from the assumption of firms heterogeneity: by making firms characteristics endogenous they avoid the classical result where either all the firms invest abroad or none does. On the contrary, here there will be a range of firms that do export and another that engage in FDI. Nonetheless, their results rely on the assumption of perfectly symmetric countries and on the absence of asymmetries in transport costs or in fixed costs. As a consequence of this a firm that does export toward a country will do export towards every other country. This could limit our comprehension about the reality, where usually a firm chooses a mixture of organizational forms.

Up until now we considered studies that explained the different modes of foreign market access by considering only final goods. Nevertheless, the last two decades has been characterized by a progressive disintegration of the production process, in which manufacturing or services goods realized home could be combined with those done abroad. What does this imply? That intermediate goods cross borders several time during the manufacturing process. This explains why they have become the new actors of international trade. There are many examples that can highlight this trend. The most quoted is the Barbie doll example cited by Feenstra (1998): "Of the $2 export value for the dolls when they leave Hong Kong for the United States, about 35 cents covers Chinese labor, 65 cents covers the cost of materials, and the remainder covers transportation and overhead, including profits earned in Hong Kong". However, the empirical evidence quantifying this phenomenon is not so developed. One reason relies on the way in which data on intermediate goods are collected. In fact, the classification of goods into intermediate and final is quite arbitrary. In order to turn aside from this arbitrariness, Hummels, Ishii and Yi (2001) used a narrower concept of fragmentation of production: imported goods used as inputs to produce a country's export goods. They found that international trade in intermediate rose faster than in final goods. Despite the interest for the empirical analysis of the different form of production processes, we choose to leave that aside for the moment and continue to focus on the theoretical aspects of this new new trade.

If we want to understand the nature of trade in intermediate goods, we should spend some words in describing the ways in which this trade can happen. On one hand, a firm can decide to produce an intermediate input within its boundaries; in this case it engages in what the literature calls vertical FDI. On the other hand, a firm can decide to outsource the production of

the intermediate input. This would imply that some sectors could have only vertical integrated firms and others have only disintegrated firms. These two ways of international procurement of intermediate goods could be better explained by adding to the trade theory some elements of contract theory. In relation to this could be useful to consider the large literature on the organizational forms of the firm. It starts with the seminal paper by Coase (1937), later developed by Williamson (1985), Grossman and Hart (1986), and Grossman and Helpman. The latter paper considers the choice between integration and outsourcing in a framework where all the firms are equally productive. Instead, the recent paper by Antras and Helpman (2004) studies the problem of choosing different ownership structure by introducing in the G-H model different productivity levels. These studies make contract theory very important for analyzing situations in which firms heterogeneity is linked with ownership structure.

Building on this literature, we would like to develop a theoretical model where we study the effects of within sectoral heterogeneity on the decision of firms to engage in foreign market access, in a framework where distance plays a role. Following HMY, we would like to add to this model intra-firm trade: each good sold requires a component that is shipped from the mother nation and a component that is produced locally. This would imply that the total marginal cost of selling via FDI will rise with distance, as a consequence of the fact that the transfer of this component incurs in transport costs. In this contest, distance will not only discourage exports but eventually also FDI, permitting us to obtain mixed results. For example a firm can decide to do FDI until a point and then when transport costs become to high (in relation to the fact that the marginal cost of being engaged in FDI is already higher than the cost of doing export), it switches to export strategies. Moreover, we could also analyze this framework from a different perspective. In particular, we can ask: what is the profit maximizing way for firms to organize their activities? Do firms prefer internally produce the intermediate inputs or to outsource to some local supplier? In order to deal with this issue we will make use of some elements of some contract theory. This idea is developed in more details in section three .

This paper condenses different research interests, and it is organized in the following way. In section 2.2 we develop the model of trade with asymmetric trade costs. In section 2.3 we characterize its equilibrium of this economy. In section 2.4 we investigate the impact asymmetric liberalization. In the last section we conclude.

2.2 A model of trade with asymmetric trade costs

The present model builds on Helpman, Melitz, Yeaple (2004) (HMY hereafter),which in turn builds on Melitz (2003)[3]. We consider three countries, A, B and C that use labor to produce goods. The distance between A and B is sufficiently small. C represents the remote country, also in terms of culture. In every country there is a homogeneous and a differentiated sector that produces respectively good z and x. As in Helpman et al (2004) we assume that a fraction of income, β, is spent on the differentiated good, and a fraction $(1-\beta)$ is spent on the homogeneous good, z. The latter is taken as numeraire. In every country there are L^i units of labor. As the labor-input coefficient for the homogeneous sector is 1 and given the fact that the homogeneous good is produced in every countries, the wage is equalized across countries. In particular, the common wage rate is equal one. For what concerns the differentiated sector, as usual we assume increasing return to scale in the production of each variety (monopolistic competition environment). As there are no costs of product differentiation, each firm will produce only one variety.

To enter in an industry firms bear the fixed cost f_E (measured in units of labor), that is sunk. Subsequently, the entrant draws a productivity parameter (or labor per unit output coefficient, called a) from a common cumulative density function G(a)[4]. However, the truncated distribution, $G(a/a_{Di})$, is different for each country. Upon drawing its own productivity parameter, a firm can immediately decide to exit and not to produce (this happens if it has a low productivity draw). Otherwise, a firm can choose to produce; this will imply additional fixed costs linked to the type of organizational form chosen. If it chooses to produce for its own domestic market it pays the additional fixed market entry cost f_D. If the firm chooses to export, it bears the additional costs f_X of meeting different market specific standards (for example, the cost of creating a distribution network in a new country). Finally, if the firm chooses to serve through FDI, the additional costs it has to face are f_M. The latter fixed cost is due to creating a distribution network in a new country as well as to the building up of new capacities in the foreign country. This implies that f_M is composed by f_D and f_X[5]. More precisely, in order

[3] In order to preserve consistency, we will follow the Helpman et al notations.

[4] The support of the continuous random variable a is $0 \leq a \leq a_0$

[5] f_D ,f_X , f_M can be considered as variety development costs or fixed organizational costs.

to obtain this partition is essential that $f_D < \tau^{\varepsilon-1} f_X < f_M$; otherwise we lose the relationship between productivity level and type of market access. Following Melitz we assume that a firm who wishes to export or engage in FDI should make an initial investment. This latter occurs when the firm's productivity is already revealed.

As it is clear from the inequality above, the exporting sector is characterized by iceberg transport costs: selling one unit in the export market, would require the shipment of $\tau \geq 1$ units. In relation to the country's location we will observe the following iceberg costs:

$$\begin{aligned} \tau^{AB} &< \tau^{AC} \\ \tau^{CB} &< \tau^{CA} \end{aligned}$$

These assumptions would have an implication on the productivity level that we should observe. As τ affects only exporting sector, the productivity required for becoming an exporter is increasing with distance. This implies that the number of exporters will be decreasing with distance. After entry the market environment is characterized by monopolistic competition. Last element: all firms face a constant probability of death. This event is described by a Poisson distribution with an hazard rate δ[6] : in every period the firm can be hit by this bad event and forced to exit. Hence, each firm's value profit is:

$$v(a) = \sum_{t=0}^{\infty} (1-\delta)^t \pi(a) = \frac{1}{\delta} \pi(a)$$

hence, the actual value of profits does not depend upon δ. For simplicity, we assume that there is no time discounting.

Preferences

Preferences are described by the utility function :

$$U = z^{(1-\beta)} \left[\int_{v \in V} x(v)^{\alpha} \right]^{\frac{\beta}{\alpha}} dv$$

[6] As Melitz pointed out, the probability of exit δ introduces an effect similar to time discounting.

Consumers have identical, homothetic preferences over the two classes of goods. Furthermore, consumers have identical preferences among varieties. Preferences across varieties have the classical CES form. Hence, if we take the log the sub-utility function over all varieties of good x is:

$$u = \frac{\beta}{\alpha} \log \left[\int_{v \in V} x(v)^{\alpha} \right] dv$$

where α represent the elasticity of substitution, $\alpha = \frac{\varepsilon - 1}{\varepsilon}$. The solution to the utility maximization problem[7] gives us the usual demand for each variety:

$$\begin{aligned} x &= \frac{\beta E^i}{\int_0^{n^i} p_i(v)^{1-\varepsilon} dv} p_i^{-\varepsilon} \\ &= A^i p_i^{-\varepsilon} \end{aligned}$$

where $A^i = \frac{\beta E^i}{\int_0^n p^i(v)^{1-\varepsilon} dv}$.

Production and Trade

On the firm side, there is a continuum of firms, each will choose to produce its own varieties. The partial derivative of the profit equation gives the price at which the differentiated good is sold. More precisely:

$$\frac{\partial}{\partial q}(pq - aqw - fw) = 0$$

this gives a consumer price of $p_i = \frac{aw}{\alpha}$, where $i = A$, B or C . The term $\frac{1}{\alpha}$ in the price expression, represents the mark up factor[8]. This is the price offered by a domestic producer or by a foreign subsidiary. Whereas, the consumer price for the imported goods is $p_j = \frac{wa\tau^{ij}}{\alpha}$ where $j = A, B, C$. In what follow we will set w equals to 1. Firms technology is characterized by a constant marginal cost with a fixed specific cost. The cost function is: $l_i = f + aq$.

After entry, a firm will know its own productivity. Subsequently, it will decide whether

[7] The budget constraint is: $E^i = \int_{v \in V_h} p(v)x(v)dv$

[8] Giving the relationship between α and ε, we have that: $\frac{1}{\alpha} = \frac{\varepsilon}{\varepsilon - 1}$.

serve exclusively the domestic market, or if engaging also in foreign market access. In this latter case firm can choose two channels: exports or local sales via affiliate production (FDI). This choice is affected by the proximity concentration trade-off: FDI requires higher fixed costs (for building up new capacities), but it saves transport costs. Let's have a look to the different operating profits. Please note that $i \neq j$.

The *operating profits from producing for domestic market* are

$$\pi_D^i = pq - aq - f_D$$

and then,

$$a_{Di}^{1-\varepsilon} \frac{(1-\alpha)\beta E^i}{\alpha^{1-\varepsilon} \int_0^{n^i} p^i(v)^{1-\varepsilon} dv} = f_D$$

where a_{Di} is the cut-off marginal cost for entering the domestic market; βE^i is the expenditure on the differentiated good; δ is the probability of death of each firm; $\int_0^{n^i} p^i(v)^{1-\varepsilon} dv$ is the price integral over all the competing varieties. In autarky, this term can be rewritten as $n_i^E \int_0^{a_{Di}} \left(\frac{a}{\alpha}\right)^{1-\varepsilon} dG(a_i)$. Later on, the $\alpha^{1-\varepsilon}$ will be put outside the integral, so as to get rid off it. Using previously mentioned simplification, the above expression can be written as:

$$a_{Di}^{1-\varepsilon} \frac{(1-\alpha)A^i}{\alpha^{1-\varepsilon}} = f_D$$

moreover, by setting $\frac{(1-\alpha)A^i}{\alpha^{1-\varepsilon}} = B^i$, we obtain

$$a_{Di}^{1-\varepsilon} B^i = f_D \tag{2.1}$$

Let's consider the *operating profit from exporting* in country j (here the quantity supplied differs from above because of E^j):

$$\pi_X^{ij} = p_j q_j - a q_j - f_X$$

and then,

$$\phi_{ij} a_{Xij}^{1-\varepsilon} \frac{(1-\alpha)\beta E^j}{\alpha^{1-\varepsilon} \int_0^n p^j(v)^{1-\varepsilon} dv} = f_X$$

where a_{Xij} is the cut-off marginal cost for entering the export market[9]; ϕ_{ij} represents the "freeness" of trade, $\phi_{ij} \equiv \tau_{ij}^{1-\varepsilon}$[10]. As ϕ_{ij} will be different for each pair of countries, there will exists three type of trade openness. The above equation can be rewritten as[11],

$$\phi_{ij} a_{Xij}^{1-\varepsilon} B^j = f_X \tag{2.2}$$

Finally the *operating profits from doing FDI* in country j are:

$$\pi_M^{ij} = p^j q_j - a q_j - f_M$$

and then,

$$a_{Mij}^{1-\varepsilon} \frac{(1-\alpha)\beta E^j}{\alpha^{1-\varepsilon} \int_0^n p^j(v)^{1-\varepsilon} dv} = f_M$$

where a_{Mij} represents the cut-off marginal cost for engaging in FDI activities in market j. As only horizontal FDI are taken into consideration, FDI activities do not incur in transport costs. Hence,

$$a_{Mij}^{1-\varepsilon} B^j = f_M \tag{2.3}$$

However, for what concern the firms engaged in FDI, the operating profit taken into consideration involves the comparison between the operating profits form FDI activities and export activities. This because a firm will choose to engage in FDI in country j if only if

[9] i and j represent the origin and the destination country respectively.

[10] It goes from 0 (autarky, $\tau = \infty$) to one (trade is perfectly free, $\tau = 1$).

[11] where $A^j = \frac{\beta E^j}{\int_0^n p^j(v)^{1-\varepsilon} dv}$ and $B^j = \frac{(1-\alpha)A^j}{\delta \alpha^{1-\varepsilon}}$.

$\pi_{Mij} - \pi_{Xij} \geq f_M - f_X$. It follows that the operating profits would be

$$a_{Mij}^{1-\varepsilon} B^j (1 - \phi_{ij}) \geq f_M - f_X$$

Note that E^i and E^j represent the income level in the origin and in the destination country respectively. Since the only source of income is labor income, $E = wL$, and as we set $w = 1$, $E = L$. As mentioned above, a_{Di}, a_{Xij} and a_{Mij} represent the cut-off marginal costs for entering the domestic market, the foreign market as exporter or as subsidiary. In particular, as we are dealing with three asymmetric countries we will have fifteen cutoffs. As we are allowing for countries asymmetries, the minimum level of productivity in order to produce the differentiated good, $\frac{1}{a_{Di}}$, is different in every country; as well as the productivity level required for becoming an exporter or for engaging in horizontal FDI. Since $\frac{1}{a}$ represents the labor productivity and ε is set to be strictly greater than 1, $a^{1-\varepsilon}$ could be considered a productivity index. All the profits described above are increasing function of $\frac{1}{a}$. Independently on the type of activity, the more productive is a firm, the more profits it will make. A firm with a productivity index below $\frac{1}{a_{Di}}$ will exit the industry because its operating profits are less than 0. $a^{1-\varepsilon}$ represents the cut-off productivity level at which a particular type of firm just break even.

From the operating profits above we can derive the cut-off coefficients:

$$a_{Di} = \left(\frac{f_D}{B^i} \right)^{\frac{1}{1-\varepsilon}}$$

$$a_{Xij} = \left(\frac{f_X}{B^j \phi_{ij}} \right)^{\frac{1}{1-\varepsilon}}$$

$$a_{Mij} = \left(\frac{(f_M - f_X)}{B^j (1 - \phi_{ij})} \right)^{\frac{1}{1-\varepsilon}}$$

N-types, D-types, X-types and M-types

As it is clear from above, firms are distinguished into four groups. Firms that do not produce at all, $a > a_D$; firms that sell domestically, $a_D \geq a > 0$; firms that sell domestically and also export, $a_X \geq a > a_M$; finally firms that sell domestically and build subsidiary in foreign country, $a_M \geq a > 0$. These types are determined by the existence of three different fixed

organizational costs, discussed previously. This explain the three cutoff levels, i.e. thresholds for marginal costs: a_D, a_X and a_M. Figure a) can be useful.

Firms draw from the marginal cost distribution $G(a)$, where a is the marginal costs, considered as the continuos random variable; n represents the mass of firms with any given level of "a". Hence $nG(a)$ represents the steady state distribution of a. Through n we can calculate the mass of firms existing in each category.

2.2.1 Characteristic of the Open Economy

Price Index

The price index differs from the one in a symmetric world. Here, it is affected by difference in productivity between firms and thus by their different prices and quantities. The price index in country i is determined by combining the consumer price of the varieties produced by the domestic country, plus the consumer price of the varieties that reach country i through foreign subsidiaries or through export[12]. Hence:

$$\int_0^n p^i(v)^{1-\varepsilon} dv = n_i^E \int_0^{a_{Di}} \left(\frac{a}{\alpha}\right)^{1-\varepsilon} dG(a/a_{Di}) +$$

$$+ \sum_{j \neq i} n_j^E \left[\int_0^{a_{Mji}} \left(\frac{a}{\alpha}\right)^{1-\varepsilon} dG(a/a_{Dj}) + \int_{a_{Mji}}^{a_{Xji}} \phi_{ij} \left(\frac{a}{\alpha}\right)^{1-\varepsilon} dG(a/a_{Dj}) \right]$$

As previously said, it could be convenient to put the $\alpha^{1-\varepsilon}$ outside the integral; this will allow us to do some simplifications. Hence,

$$\int_0^n p^i(v)^{1-\varepsilon} dv = \underbrace{\frac{n_i^E}{\alpha^{1-\varepsilon}} \int_0^{a_{Di}} (a)^{1-\varepsilon} dG(a/a_{Di}) +}$$

[12] The price index is multiplied by n, because it is necessary to consider all the possible type of firms that can enter in the economy given the probability of succesfull entrance.

$$\frac{1}{\alpha^{1-\varepsilon}} \sum_{j \neq i} n_j^E \left[\int_0^{a_{Mji}} (a)^{1-\varepsilon} \, dG(a/a_{Dj}) + \int_{a_{Mji}}^{a_{Xji}} \phi_{ij} \, (a)^{1-\varepsilon} \, dG(a/a_{Dj}) \right]$$

where $dG(a/a_{Di})$ represents the probability of being a particular type of firm (domestic, exporter or subsidiary) conditional on the probability of successful entry. Note that the first integral includes all the varieties produced in the domestic market, the second and the third integral represent all varieties sold by foreign subsidiaries and imported from the other markets. Thus, the price index could be thought as a weighted average of the marginal costs of all firms active as sellers in country i. n_i^E is the mass of varieties produced in country i.

The Free Entry Conditions

Every firm has to pay f_E to enter in the market. It can happen that some firms after having paid f_E draw a marginal cost higher than the maximum marginal cost necessary for break even in the domestic market, $a > a_D$. Such firms will immediately exit form the market, loosing their f_E. In the other case, when $a < a_D$, the potential entrant will survive and eventually serve other markets as exporter or subsidiary. The reward obtained after a successful entry increases as the mass of active firms decreases. This result is similar to the Dixit-Stiglitz model. However, here the equilibrium number of firms is more complicated than in the homogeneous case, because of the different type of firms that can enter.

The free entry condition ensures equality between the expected firm profits of a potential entrant and the entry cost f_E. If this profit is negative no firms would enter the sector. Despite the fact that we are in a framework of monopolistic competition, among the firms that enter there will be some that loose with respect to the average profits: when their pure profits are exactly equal to their fixed organizational costs, they cannot repay f_E. Whereas, firms that have a pure profits strictly greater than the fixed cost, they can repay the initial sunk cost. These last firms earn pure profits: their revenues exceeds their costs by more than what would be necessary to cover the sunk costs. the unrestricted entry condition will imply that the expected profit is driven to zero. Using the initial operating profits, the equilibrium free entry condition

in country i of a potential entrant is:

$$\int_0^{a_{Di}} (a^{1-\varepsilon} \frac{(1-\alpha)\beta E^i}{\alpha^{1-\varepsilon} \int_0^{n} p^i(v)^{1-\varepsilon} dv} - f_D) dG(a) + \sum_{j \neq i} [\int_{a_{Mij}}^{a_{ij}} (\phi_{ij} a^{1-\varepsilon} \frac{(1-\alpha)\beta E^j}{\alpha^{1-\varepsilon} \int_0^{n^j} p^j(v)^{1-\varepsilon} dv} - f_X) dG(a) +$$

$$+ \int_0^{a_{Mij}} (a^{1-\varepsilon} \frac{(1-\alpha)\beta E^j}{\alpha^{1-\varepsilon} \int_0^{n^j} p^j(v)^{1-\varepsilon} dv} - f_M) dG(a)] = f_E$$

We can rewrite the equation above in order to have a more tractable expression.

$$\int_0^{a_{Di}} (a^{1-\varepsilon} B^i - f_D) dG(a) + \sum_{j \neq i} n_j^E [\int_{a_{Mij}}^{a_{Xij}} (a^{1-\varepsilon} (\phi_{ij} B^j) - f_X) dG(a) +$$

$$\int_0^{a_{Mij}} (a^{1-\varepsilon} (B^j) - f_M) dG(a)] = f_E \tag{2.4}$$

Parametrization: Pareto Distribution

The free entry condition and the price index depend upon probability distribution. This implies that if we want an explicit solution for them we need to assume a particular functional form for G(a). Following the empirical literature on firms size distribution it seems reasonable to use as an approximation the Pareto distribution with lower productivity bound $\frac{1}{a_{Di}}$. The cumulative distribution function of a Pareto random variable a is:

$$G(a) = \left(\frac{a}{a_0}\right)^k \tag{2.5}$$

where k and a_0 are the shape and scale parameter, respectively. Note that k=1 implies a uniform distribution on $[0, a_0]$. The shape parameter k represents the dispersion of cost draws. An increase in k would imply an increase in the number of high cost firms (the shape of the cumulative distribution becomes more convex). The support of the distribution, 0....a_0, is identical for every country. a_0 represents the upper bound of this distribution. In order

to avoid infinite variance we should consider an upper bound on the highest possible level of productivity, or a minimum value for the marginal cost. Figure 1 in the Appendix describe the marginal cost that is induced by G(a). The productivity distribution of surviving firms will also be Pareto with shape k; and the truncated cost distribution is given by:

$$G(a/a_D) = \left(\frac{a}{a_D}\right)^k$$

with $a \in [0, a_D]$.

Price Index with Pareto distribution

The price index in country i is characterized by all the brands offered in that country. More precisely, the brands offered by domestic firms and foreign subsidiaries have a consumer price of a/α, and brands offered by foreign exporters have a consumer price of $a\tau_{ij}/\alpha$. As firms will start producing only if they have at least a productivity of $\frac{1}{a_{Di}}$, the probability distribution of being an exporter (or FDI) is conditioned on the probability of successful entry: $G(a/a_{Di})$ [13]. Please note that the upper bound of the cost distribution so that firms survive, a_{Di}, is different for every country. We describe the price index for each country. Hence, the price index in A is:

$$\int_0^n p^A(v)^{1-\varepsilon} dv = \frac{n_A^E}{\alpha^{1-\varepsilon}} \int_0^{a_{DA}} (a)^{1-\varepsilon} \, dG(a/a_{DA}) + \frac{n_B^E}{\alpha^{1-\varepsilon}} \left[\int_0^{a_{MBA}} (a)^{1-\varepsilon} \, dG(a/a_{DB}) + \int_{a_{MBA}}^{a_{XBA}} \phi_{AB} \, (a)^{1-\varepsilon} \, dG(a/a_{DB}) \right] +$$

$$\frac{n_C^E}{\alpha^{1-\varepsilon}} \left[\int_0^{a_{MCA}} (a)^{1-\varepsilon} \, dG(a/a_{DC}) + \int_{a_{MCA}}^{a_{XCA}} \phi_{AC} \, (a)^{1-\varepsilon} \, dG(a/a_{DC}) \right]$$

where we use $dG(a/a_{Di}) = \frac{a^{k-1}}{(a_{Di})^k}$ [14], where we exploit the fractal nature of the Pareto distribution. Then solving the integral we obtain,

$$\int_0^n p^A(v)^{1-\varepsilon} dv = \frac{n_A}{\alpha^{1-\varepsilon} a_{DA}^k} \frac{k}{k-\varepsilon+1} a_{DA}^{k-\varepsilon+1} + \frac{n_B}{\alpha^{1-\varepsilon} a_{DB}^k} \frac{k}{k-\varepsilon+1} \left[a_{MBA}^{k-\varepsilon+1} + \phi_{AB} \left(a_{XBA}^{k-\varepsilon+1} - a_{MBA}^{k-\varepsilon+1} \right) \right]$$

[13] It is exploited the fractal nature of the Pareto.

[14] $G(a/a_{Di}) = \frac{G(a)}{G(a_D)} = \frac{\left(\frac{a}{a_0}\right)^k}{\left(\frac{a}{a_{Di}}\right)^k} = \left(\frac{a}{a_{Di}}\right)^k$

$$+\frac{n_C}{\alpha^{1-\varepsilon}a_{DC}^k}\frac{k}{k-\varepsilon+1}\left[a_{MCA}^{k-\varepsilon+1}+\phi_{AC}\left(a_{XCA}^{k-\varepsilon+1}-a_{MCA}^{k-\varepsilon+1}\right)\right]\equiv\Delta_A$$

where $\phi_{ij}=(\tau^{ij})^{1-\varepsilon}$. Whereas in country B the price index is:

$$\int_0^n p^B(v)^{1-\varepsilon}dv = n_B^E\int_0^{a_{DB}}\left(\frac{a}{\alpha}\right)^{1-\varepsilon}dG(a/a_{DB})+n_A\left[\int_0^{a_{MBA}}\left(\frac{a}{\alpha}\right)^{1-\varepsilon}dG(a/a_{DA})+\int_{a_{MBA}}^{a_{XBA}}\phi_{AB}\left(\frac{a}{\alpha}\right)^{1-\varepsilon}dG(a/a_{DA})\right] \tag{2.6}$$

$$+n_C^E\left[\int_0^{a_{MBC}}\left(\frac{a}{\alpha}\right)^{1-\varepsilon}dG(a/a_{DC})+\int_{a_{MBC}}^{a_{XBC}}\phi_{BC}\left(\frac{a}{\alpha}\right)^{1-\varepsilon}dG(a/a_{DC})\right]$$

solving the integral,

$$\int_0^n p^B(v)^{1-\varepsilon}dv=\frac{n_B}{\alpha^{1-\varepsilon}}\frac{k}{k-\varepsilon+1}a_{DB}^{1-\varepsilon}+\frac{n_A}{\alpha^{1-\varepsilon}a_{DA}^k}\frac{k}{k-\varepsilon+1}\left[a_{MAB}^{k-\varepsilon+1}+\phi_{AB}\left(a_{XAB}^{k-\varepsilon+1}-a_{MAB}^{k-\varepsilon+1}\right)\right]$$

$$+\frac{n_C}{\alpha^{1-\varepsilon}a_{DC}^k}\frac{k}{k-\varepsilon+1}\left[a_{MCB}^{k-\varepsilon+1}+\phi_{BC}\left(a_{XCB}^{k-\varepsilon+1}-a_{MCB}^{k-\varepsilon+1}\right)\right]\equiv\Delta_B$$

Finally, the price index in country C is:

$$\begin{aligned}\int_0^n p^C(v)^{1-\varepsilon}dv &= \frac{n_C}{\alpha^{1-\varepsilon}}\frac{k}{k-\varepsilon+1}a_{DC}^{1-\varepsilon}+\frac{n_A}{\alpha^{1-\varepsilon}a_{DA}^k}\frac{k}{k-\varepsilon+1}\left[a_{MAC}^{k-\varepsilon+1}+\phi_{AC}\left(a_{XAC}^{k-\varepsilon+1}-a_{MAC}^{k-\varepsilon+1}\right)\right]\\ &+\frac{n_B}{\alpha^{1-\varepsilon}a_{DB}^k}\frac{k}{k-\varepsilon+1}\left[a_{MBC}^{k-\varepsilon+1}+\phi_{BC}\left(a_{XBC}^{k-\varepsilon+1}-a_{MBC}^{k-\varepsilon+1}\right)\right]\equiv\Delta_C\end{aligned} \tag{2.7}$$

Free entry condition using the Pareto distribution:

Also the free entry is rewritten in order to consider the Pareto parametrization assumed above. We should keep in mind that the free entry condition includes all types of firms. This implies that the cumulative density function is $G(a)=\left(\frac{a}{a_0}\right)^k$; hence the support is: 0.... a_0, where for simplicity we can set $a_0=1$. The free entry condition in country A would be:

$$\int_0^{a_{MAB}}\left(a^{1-\varepsilon}\frac{E^B}{\varepsilon\Delta_B}-f_M\right)dG(a)+\int_{a_{MAB}}^{a_{XAB}}\left(a^{1-\varepsilon}\frac{E^B}{\varepsilon\Delta_B}\phi_{BA}-f_X\right)dG(a)+\int_0^{a_{MAC}}\left(a^{1-\varepsilon}\frac{E^C}{\varepsilon\Delta_C}-f_M\right)dG(a)$$

$$+\int_{a_{MAC}}^{a_{XAC}}\left(a^{1-\varepsilon}\frac{E^C}{\varepsilon\Delta_C}\phi_{CA}-f_X\right)dG(a)+\int_0^{a_D}\left(a^{1-\varepsilon}\frac{E^A}{\varepsilon\Delta_A}-f_D\right)dG(a)=f_E$$

As we can see two elements that compose the free entry are: (1) the ex ante expected fixed costs and (2) the expected benefits. In general terms,

$$\sum_{j\neq i}[\int_0^{a_{Mij}}\left(a^{1-\varepsilon}\frac{E^j}{\varepsilon\Delta_j}-f_M\right)dG(a)+\int_{a_{Mij}}^{a_{Xij}}\left(a^{1-\varepsilon}\frac{E^j}{\varepsilon\Delta_j}\phi_{BA}-f_X\right)dG(a)+$$

$$\int_0^{a_{Di}}\left(a^{1-\varepsilon}\frac{E^i}{\varepsilon\Delta_i}-f_D\right)dG(a)=f_E$$

where i is the index for the home country, whereas j indexes the two foreign countries. Δ_i is the price index in the home country and Δ_j is the price index in the foreign countries.

2.3 General Equilibrium with Asymmetric Trade Costs

We now examine the equilibrium in this special asymmetric model. More precisely, we observe the impact of a gradual trade openness in this special trade bloc composed by three countries, previously described. In absence of trade barriers, every country will replicate the outcome of the integrated world economy. In fact, firms act as if they were selling their variety to the integrated world economy; and consumers in every country can buy the same goods at the same aggregate price index. In this contest trade will have the same effect as an increase in country size in a closed economy. This implies that the firm level outcome is not affected. As precised by Melitz 2003, the transition to trade does not affect the firm level variables (productivity, profits). Hence, Krugman 1980 is confirmed.

It seems more plausible that firms wishing to export or to engage in FDI activities are not only affected by per unit costs (such as transport costs), but also by some fixed costs, that are not linked with export or FDI volumes. These additional specific fixed costs could explain the partition among domestic, exporting and FDI firms. In relation to the exporting sector, Tybout and Roberts (1997) provided evidence about fixed costs associated with entry into export markets: a firm should learn about the host market, and provide information about the

product characteristics to consumers in that market (we will denote these costs of distribution and servicing network, f_X). Similar costs could be thought for FDI sector. However, these costs include not only the previously mentioned costs of distribution and servicing network, but also the cost of building up new capacities (subsidiaries) and the cost of duplicating overhead production (these costs are denoted f_M); hence $f_M > f_X$. Both types of costs could be modelled as independent of quantity decisions. Regardless of the organizational type of firm, a firm incurs in the same sunk cost of entry, f_E. As we assume that the variation in country size is small enough (at the beginning we consider identical countries), the homogeneous good is produced in every country so that FPE across country is ensured.

Firms who decide to export have to realize the initial fixed investment of f_X; however this fixed investment occurs only after the firm's productivity is known. Moreover, exporting firms should face the standard per-unit trade costs: $\tau > 1$ units of a good must be shipped in order for one unit to arrive at destination. In this special case, the trade costs, even if they are the same for every pair of countries, i.e. $\tau^{AB} = \tau^{BA}$, they could differ between pair of countries, i.e. $\tau^{AB} \neq \tau^{AC}$. The model is solved considering that country C has the highest barriers to trade. For this reason is possible to use the following relationship:

$$\phi_{AC} \leq \phi_{BC} < \phi_{AB}$$

We could think to country A and B as two closed areas, like European and Eastern European countries. Country C could represent another important economic area with which A and B are trading.

Even if the countries are not perfectly symmetric, as trade costs differ between pair of countries, these differences are small enough to preserve FPE: the wage rate is the same in every country; and it is normalized to one. The existence of different openness to trade however, would imply different price index in every country. In fact, the price index is determined by the aggregate number of goods available in every country, that in turn depends upon the trade costs. In the domestic market, the firm pricing rule is given by $p_d = \frac{aw}{\alpha} = \frac{a}{\alpha}$. Firms who export will use another pricing rule: they set higher prices in the host economy that reflects the increased marginal costs of serving this market, $p_x = \frac{a\tau}{\alpha} = \tau p_d$. On the contrary the price

sets by subsidiary is always a domestic price (however the cutoff productivity level is different in every country). Each firm's profit could be a combination of portions earned from domestic sales, export sales and affiliate sales. Precisely, the combined revenue of a firm is:

$$r(a) = \begin{cases} r_d(a) & \text{if the firm serves only the domestic market} \\ r_d(a) + \sum_{j \neq i} r_{xj}(a) & \text{if the firm exports to all countries} \\ r_d(a) + \sum_{j \neq i} r_{mj}(a) & \text{if the firm engages in FDI in all countries} \end{cases}$$

In order to obtain the special partition that we want it is necessary and sufficient that $f_D < \tau^{\varepsilon-1} f_X < f_M$: the FDI costs must be higher than the trade costs, and these latter have to be bigger than the domestic costs. Without this relationship, no level of trade costs τ, can induce this partitioning. All the fixed costs coefficients are assumed to be the same across countries;

Even if the cumulative distribution is the same in every country, the equilibrium cutoffs will be different in every country. To be precise, the existence of asymmetries implies the existence of fifteen operating profits conditions and three free entry conditions. The highly non linearity of this system derives from the following term: $k - \varepsilon + 1$. As mentioned in HMY, $k > \varepsilon + 1$, so that finite variance of the distribution is ensured. However, since we have to simplify the system in order to obtain an analytical solution, the values chosen for these parameters cannot respect this condition. This gives raise to the following question: could it be possible to justify the existence of heavy tailed distribution with infinite variance? The answer is yes, so long as an upper bound on the highest possible level of productivity is assumed. If not, then the firms with those unbounded (high) productivity levels take over the entire market (hence the infinite variance). $1/a_{\min}$ plays the role of upper bound. Hence, in terms of marginal costs a should belong to the following interval: $a \in [a_{\min}, a_0]$, where $a_{\min} < a_0$.

The equilibrium cutoffs and number of firms are found solving a system of eighteen equations, where we consider different degrees of trade openness.

2.3.1 Transition from Autarky to Trade

In the autarky situation the number of firms in every country can be simply obtained by using the price index inside the operating profit of the domestic firm, this gives:

$$n_i = \frac{(1-\alpha)\,\beta E^i}{k f_D}\,(k-\varepsilon+1)$$

Subsequently, substituting the equilibrium number of firms into the free entry condition, we can find an expression for the equilibrium level of domestic cutoff. The export and FDI activities do not exist in this situation. Respecting the previous assumptions, if trade is allowed, new types of firms will emerge: in relation to their productivity drawn, each firm could give birth to a different organizational scenario.

In the Melitz model the FE condition is identical in both closed and open economy[15]. In the present framework, we start with the analysis of the symmetric case, in which every country open to trade. The FE conditions are equal to the same f_E. Again, these FE are left unaffected by trade: regardless of profit differences across firms (relative to export or FDI status), the expected value of future profits, in equilibrium, must equal the fixed investment cost f_E (sunk cost). Hence, as in Melitz 2003, the transition from autarky to open economy, will move up the ZCP curve: the exposure to trade induces an increase in the cutoff productivity level ($\left(\frac{1}{a_D}\right)^T > \left(\frac{1}{a_D}\right)^A$)[16]. This will modify the productivity level of the least productive firms. In an open economy situation, a firm with a productivity level between $\left(\frac{1}{a_D}\right)^A$ and $\left(\frac{1}{a_D}\right)^T$ cannot earn positive profits and so will exit from the market. Moreover, as pointed out by Melitz, another selection process acts: firms with productivity level above $\left(\frac{1}{a_X}\right)$ or above and $\left(\frac{1}{a_M}\right)$ enter respectively as exporters or as subsidiary. These three effects are called *domestic market selection effect*, *export market selection effect* and *FDI market selection effect*. These effects reallocate market shares towards more efficient firms, and generate an increase in the overall productivity.

The transition toward the open economy situation generates a reduction in the number of firms operating in every country[17]. The equilibrium number of firms in each country will

[15] Melitz 2003 considers perfectly symmetric countries with identical trade costs.
[16] Recall that the ZPC are downward sloping and the FE conditions are upward sloping.
[17] As in Melitz, $M < M_A$, where M_A represents the number of firms in autarky.

represent the total number of firms selling in that country: total number of domestics firms, foreign exporters and multinationals. The number of firms decrease as a consequence of the domestic market selection effect ($a_D \downarrow$). However, as the entrance of new foreign firms more than compensate this reduction, consumers typically enjoy a larger amount of varieties.

2.4 Effect of Asymmetric Liberalization

Partial Integration between A and C

As in this work we enlarge the analysis to three countries, we could exploit the rich set of insights deriving from the analysis of an asymmetric liberalization. In fact, when all countries are symmetric is not possible to consider the effect of a country's position within the trade network considered. On the contrary, if we allow trade barriers to differ across countries, so that they are pair-wise symmetric, it is possible to consider the effect of preferential trade liberalization. These asymmetries induces important changes in the steady state equilibrium.

We solve the system for a certain level of integration between A and B and B and C. Whereas, A and C represent two symmetric regions with an undefined level of integration; ϕ_{AC} is left undefined so that it is possible to analyze the effect of a gradual liberalization between A and C. B represents the asymmetric region. In fact, as very few country can operate in an autarky environment, it seems more interesting to observe whether an increase in the exposure to trade, or an increase in the level of integration, will generate similar effects as the one previously discovered for the transition from autarky to free trade. In what follows is assumed that the increase in the level of integration is the result of a reduction in trade costs, τ (or $\uparrow \phi$), generated from a bilateral agreement between A and C to decrease barriers to trade.

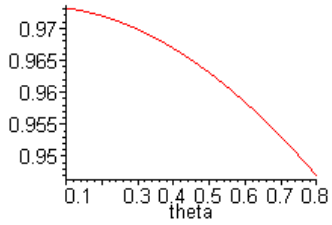
As described in the section above the result of the transition from autarky to trade was an increase in the aggregate productivity and in welfare as a consequence of a market selection effect. Below it will be shown how preferential trade liberalization, occurring through reduction in trade costs, could generate interesting changes in the equilibrium results: the equilibrium cutoff (in terms of marginal costs) is decreasing in the liberalizing countries, whereas is increasing in the third countries. In the liberalizing countries, the least productive firms will exit from the market, and the market share is reallocated from the less productive to the more produc-

tive. The asymmetric liberalization considered would permit to observe changes in extensive and intensive margins.

The model is calibrated so that to respect the different assumptions made in the theoretical part, and keeping only the parameter ϕ_{AC} undefined. In this section we examine the effects of a transition from very low integration to a partially integrated situation between country A and C. The analyses is meant to observe the impact of a progressive integration between A and C on the cutoffs equilibrium levels and on the number of firms in each country (so on the initial steady state). In this situation the price index in A and C will be exactly the same, as well as the FE condition and the cutoff operating profits. The system in 18 equations reveals the existence of multiple equilibria. We decide to consider the first solution because is the more plausible: it is highly stable with respect to the others. This equilibrium determines fifteen cutoffs and three equilibrium number of firms. However as A and C are identical, they share the same cutoffs and the same number of firms, so it is sufficient to compare A to B. The introduction of asymmetries at the country level permits the emergence of new insights. What are the effects of gradual integration between A and C on firm's productivity levels? Do all firms benefit from partial integration or the impact depend on firm's productivity? How the number of entrants, producers and exporters is affected? How is aggregate productivity and welfare affected?

Optimal Cutoff Levels

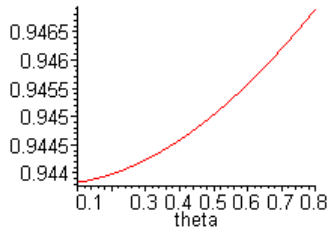
The increase in ϕ_{AC}[18] induces a decrease in the domestic marginal cost of A=C (see graph below), indicating an increase in the cutoff productivity level of domestic firm, $\left(\frac{1}{a_D}\right)' > \left(\frac{1}{a_D}\right)$:



(2.8)

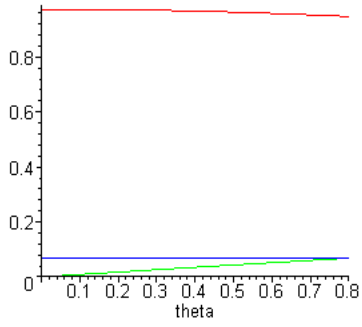
[18] This relation is respected: $\phi_{AC} \leq \phi_{BC} < \phi_{AB}$

This is what Melitz defines the *domestic market selection effect*: the increasing liberalization between A and C increase the cutoff productivity level of domestic firms in these countries. On the other hand, the domestic marginal cost of B is slightly increasing with ϕ_{AC}. The increase in the level of integration between A and C reduces the level of competition in B, so that the productivity required to survive in this market is lower:



(2.9)

As we can observe from the graphs, the initial level of marginal cost is higher in A and C than in B, indicating that in countries A and C the cutoff productivity level is lower. The reason of this lower level of productivity derives from the smaller level of competition existing in these two markets, A and C, before liberalization. The export cutoff productivity levels, $\frac{1}{a_{XAB}}$ and $\frac{1}{a_{XAC}}$, are decreasing with ϕ_{AC}, as expected:

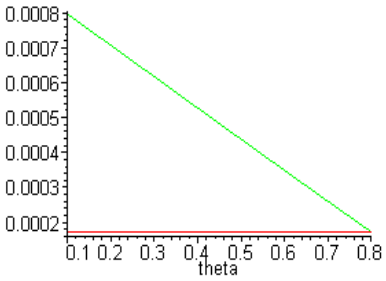


(2.10)

The graph above tells us that an increase in ϕ_{AC} determines an increase in the marginal cost of exporting toward B and C. The partial integration between A and C reduces the level of productivity required to become exporter in C. This happens because on one side the increased exposure to trade forces the least productive firms to exit, but it will also generate the entry of new firms into the export market (that did not export with a lower level of ϕ_{AC}). For the same reason there is a decrease in the level of productivity required to become exporter in B.

Again from the graph we notice that the marginal costs for being exporter in C is lower than for country B: since trade costs are higher toward C than B the productivity required for reaching country C as exporter should be higher.

What about the cutoffs equilibrium level for firms engaged in FDI? The marginal cost of doing FDI is higher in country C than in country B, indicating that the level of productivity required to reach country B is higher than to reach C, $\frac{1}{a_{MAB}} > \frac{1}{a_{MAC}}$. This result depends upon the fact that as FDI activity is not affected by trade costs, it became easier to engage in FDI activity the more distant is the country[19]. Let observe the graphical representation of $a_{MAB} < a_{MAC}$:

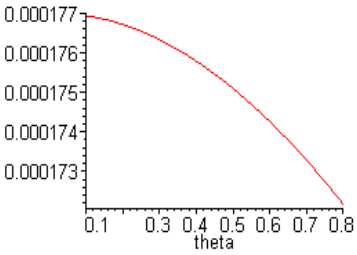


How can we explain these behaviors? Simply by considering the evolution of ϕ_{AC}. In fact, the increase in ϕ_{AC} makes $\frac{1}{a_{MAC}}$ increasing because now is easier to reach market C through exports (as the transport costs have decreased). This will increase the productivity level required for being a subsidiary in C so that this condition is respected: $\pi_{MAC} - \pi_{XAC} \geq f_M - f_X$ (selection effect: as a consequence of liberalization only the more productive firms will survive as subsidiaries in C). On the other side, there is a slight increase in the marginal cost a_{MAB}; what does kit represent? The effect of an increase in the level of integration between A and C reduces competition in the country unaffected by trade liberalization. Hence, as the subsidiary firms are in some sense domestic, the productivity required to be subsidiary in B decrease slightly. This could be also a reflect of what is happening in the FDI sector from A toward C.

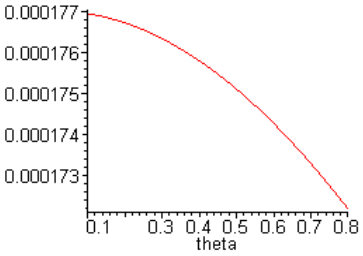
In country B the marginal cost of exporting, a_{XBA}, is slightly decreasing as a consequence of an increase in ϕ_{AC} (and as a consequence of the symmetry between A and C, $a_{XBA} = a_{XBC}$.

[19]Recall that the choice of engaging in FDI activity is determined by: $\pi_{Mij} - \pi_{Xij} \geq f_M - f_X$

So the productivity is decreasing with integration, $\uparrow \frac{1}{a_{XBA}} = \frac{1}{a_{XBC}}$.



This happens because some firms from A and C will enter as exporters in the new markets A or C. Firms that from country B wants to become exporters in A or C should face this new competition: as a consequence of increase in ϕ_{AC}, more firms are entering in markets A and C as exporters, and the country excluded form the integration, B, will pay in terms of a required productivity level. There is a market selection effect on the exporter firms that form B enter in A or C. The same is true for the productivity level required to engage in FDI activity for country B's firms. As a consequence of partial liberalization between A and C there is an increase in the equilibrium productivity level (these are the same in A and C, so $\frac{1}{a_{MBA}} = \frac{1}{a_{MBC}}$):



The decrease in trade costs makes harder to do FDI for country B, because export is become more accessible as a consequence of $\tau \downarrow$. The increase in the productivity level makes entrance more attractive.

Hence, for what concern A and C, the gradual liberalization between them forces the least productive firms to exit (effect on the marginal cost of domestic firms), but it also generate the entry of new firms into the export market (who were unable to export with a lower ϕ_{AC}). The opposite happens in country B: the reduction in trade costs between A and C induces an

increase in the productivity level required to become an exporter from country B; the marginal costs of domestic firms increases slightly. All the changes lead to a symmetric world.

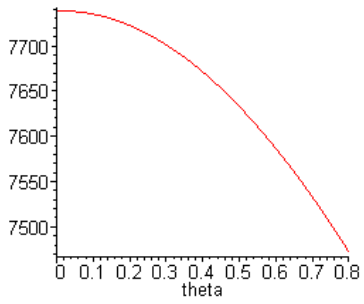
For firms in country A (C), the increase in ϕ_{AC} makes easier to become exporter in country B and C (A). The higher integration between A and C, due to a reduction of trade costs, generates an increase in the domestic cutoff productivity, but a decrease in the export cutoff productivity. As in Melitz the increased exposure to trade forces the least productive firms to exit, but the decrease in τ permit the entry of new firms into the export market. On the other side, it makes easier to become MNF in B and more difficult in C. The condition on the operating profits of MNFs is more restrictive as τ_{AB} is decreasing. Whereas, as country B does not experiment an increase in trade openness, in the MNFs sector there is not an increase in competition. For firms in B, the increase in ϕ_{AC} makes more difficult to become an exporter or a MNF in countries A and C. In fact, with respect to a situation in which B was the only trading with both A and C, the partial integration between A and C increase the level of competition that B's firms should face when they reach the foreign countries. In countries A and C there is a domestic market selection effect induced by openness to trade; whereas in country B the effect of increase in ϕ_{AC} reduces the overall profits in this economy, so the zero cutoff profit condition moves up generating a reduction in the productivity required for entering successfully.

Number of Entrants, Producers and Exporters

As it is clear from above, firms are distinguished into four groups. Firms that do not produce at all, $a > a_D$; firms that sell domestically, $a_D \geq a > 0$; firms that sell domestically and also export, $a_X \geq a > a_M$; finally firms that sell domestically and build subsidiary in foreign country, $a_M \geq a > 0$. These types are determined by the existence of three different fixed organizational costs, discussed previously. This explain the three cutoff levels in each country, i.e. thresholds for marginal costs: a_D, a_X and a_M. Figure a) can be useful. Firms draw from the marginal cost distribution $G(a)$, where a is the marginal costs, considered as the continuos random variable; n represents the mass of firms with any given level of "a". Hence $nG(a)$ represents the steady state distribution of a. Through n[20] we can calculate the mass of firms existing in each category.

[20] n is a primitive number that indicates every type of firm entering in the market.

In a contest of heterogeneous firms, preferential trade agreement would have a richer impact on the number of firms in each country. The partial integration between countries A and C induces a reduction in the number of firms with any given a, this means that $\frac{\partial n_i^E}{\partial \phi_{AC}} < 0$ in each country. Thus the overall amount of entrants in the trade bloc decreases:



This means that preferential trade agreements reduces the number of patterns which have been drawn in every country. As we described above, from n_i^E we could derive the different type of firms existing in each country. In the excluded country, B, the preferential trade liberalization between A and C, is increasing the number of active firm, and reducing the number of entrants as exporters and MNFs. On the contrary, in the liberalizing countries, there is a reduction in the number of active firm. This effect is combined with an increase in the number of entrants as exporters and MNFs towards B, and with a reduction with respect to country C. The number of active firms in each country is given by

$$n_i^{\text{Active}} = n_i \left(\frac{a_{Di}}{a_0} \right)^k$$

where a_0 is set to be equal 1. In the liberalizing countries the number of active firms is decreasing, $\frac{\partial n_i^{\text{Active}}}{\partial \phi_{AC}} < 0$, and so the number of domestic varieties; this is due to the so called *domestic market selection effect*: the increase in competition between A and C reduces the number of active firms. On the other side the partial liberalization increases the number of firms that are entering as N-type firms[21]. This latter effect could be due to the increased competition. In the excluded country, B, it is observed a slight increase in the number of active

[21] Firms that enters but do not produce.

firms, $\frac{\partial n_i^{\text{Active}}}{\partial \phi_{AC}} > 0$, associated with a decrease in the number of N-type firms. This last effect could be explained by the reduction in the level of competition.

The number of sellers in county i includes domestic producers, exporters from $j \neq i$ and foreign subsidiaries. From the mass of potential entrants n_i^E, we could obtain the amount of domestic producers, $n_i^E G(a_{Di})$, exporters selling in i, $n_j^E G(a_{Xji})$ and subsidiaries selling in i, $n_j^E G(a_{Mji})$. So that $n_i^E G(a_{Di}) + \sum_{j \neq i} n_j^E G(a_{Xji}) + \sum_{j \neq i} n_j^E G(a_{Mji}) = n_i^s$, total amount of firms selling in country i. On the other side the number of producers in country i is given by $n_i^E G(a_{Di}) + \sum_{j \neq i} n_j^E G(a_{Mji})$. As a consequence of PTA, the number of sellers is decreasing in countries A and C, whereas it is increasing in country B. The same is happening to the number of producers.

Is it possible to interpret the behavior of the equilibrium number of entrants, n_i^E, in terms of the "home market effect"? Krugman (1980) identified in the home market effect the peculiar distinction between traditional trade and new economic geography. He showed that in a two industry economy with one factor of production, each country will tend to export those products for which it has a relative large domestic demand. In our case the preferential trade liberalization is decreasing the domestic marginal costs of production in the liberalizing countries, implying an increase in demand of domestically produced varieties. In line with the home market effect, this generates an increase in the number of firms engaged in foreign market activities. On the contrary, since the excluded country is facing a decrease in the domestic demand, as a consequence of the increased domestic marginal costs, the number of firms engaged in foreign market activities is reduced.

First we calculate the number of exporters and MNFs with a low level of integration: $\phi_{AC} = 0.3$.Subsequently, we observe what happens for further increase in liberalization, $\phi_{AC} = 0.6$. This would permit to obtain variations in the total level of export. As we know, these changes will derive from changes in the extensive and intensive margin (new products exported and increased exports in products already traded, respectively). In country B, the increase in ϕ_{AC} implies an augment in the number of pure domestic firms (a_{DB} has increased), and an increase the number of foreign subsidiaries. As a consequence, the number of pure domestic varieties decreases, because the labor resources has to be shared among different type of producers. As in Melitz, the increases liberalization between A and C, reducing $a_{DA} = a_{DC}$, reduces the

number of domestic varieties. However, the reduction in trade costs generates an increase in the exported varieties that reach country A. Finally, on one side we assist to an increase in the varieties sold by subsidiaries from country B, but on the other side we observe a decrease for what concerns C. To conclude, the overall amount of varieties exported has increased as effect of integration, and the overall number of varieties produced by MNFs decreased. Intuitively this happens because integration, as implies the reduction in trade costs, encourages the exporting sector.

Effects of PTA

The effects of preferential liberalization in a model with three asymmetric countries, in terms of trade barriers, are important in terms of new patterns of entry across countries. In the liberalizing countries, A and C, where the domestic cutoffs reduction implies higher productivity, is more difficult to enter as local supplier; although becomes easier for the successful entrants firms to engage in foreign market activities. In these countries there will be a decline in the average price and costs. On the contrary, the excluded country, B, experiments an increase in the cutoff, which makes entrance in the local market easier. However, PTA is discouraging firms decisions to sell abroad, both as exporters than subsidiaries.

The liberalizing countries get better access as exporters to each other's market and also to the excluded one. For what concern the FDI sector, the liberalizing countries, A and C, become more selective in terms of respective MNFs' entry, as a consequence of increase in trade openness. However, it becomes easier for them to enter as a subsidiary in the third country. The excluded country will experiment a reduction in market access to A and C, both in terms of exporting and subsiadiaries firms. Hence, preferential trade liberalization generate a welfare gains in the liberalizing countries, A and C, along with a reduction in welfare for the excluded country, C.

2.4.1 PTA and Change in Total Export

International trade evolves along two major margins: intensive and extensive margins. The intensive margin represents a movement of world trade determined by variations in trade volume among pre-existing firms. On the other hand, the extensive margin refers to movement of world

trade due to new trade relationships being established or existing ones abandoned. These two aspects of trade represent an interesting novelty in the empirical literature. The analysis of extensive and intensive margin permits to consider the action of time. This represents an important change with respect to the typical approach used in gravity studies, where the attention was circumscribed to those country pairs with strictly positive trade flows.

Since many findings confirm that trade relationships are influenced by extensive-margin adjustments both in terms of the number of new exported products and the number of exported products, in the present work we examine the effects of preferential trade liberalization on these two margins. Our results seem to confirm the empirical findings related to the greater reaction of the extensive margin to distance (expressed as trade barriers) with respect to the intensive margin. In what follow we derive the expression of these two measures of trade. The value of export of a i's exporting firm is given by:

$$\frac{a^{1-\varepsilon}\phi_{ij}\beta E_B}{\varepsilon\Delta_j} \tag{2.11}$$

but we should remember that the export cutoff condition is

$$\begin{aligned} \phi_{ij}a_{Xij}^{1-\varepsilon}\frac{\beta E^j}{\varepsilon\Delta_j} &= f_X \\ \frac{\phi_{ij}\beta E^j}{\Delta_j} &= \frac{\varepsilon f_X}{a_{Xij}^{1-\varepsilon}} \end{aligned} \tag{2.12}$$

substituting equation(2) inside equation(1) we obtain the per firm level of export

$$v(a) = \left(\frac{a}{a_{Xij}}\right)^{1-\varepsilon} f_X$$

If we integrate over all the exporting firms we obtain the total value of export:

$$n_i \int_{a_{Mij}}^{a_{Xij}} \left[\left(\frac{a}{a_{Xij}}\right)^{1-\varepsilon} f_X\right] dG(a)$$

The *intensive margin* of trade refers to increased exports of products already being exported,

hence:

$$\text{Int. Marg.}= \left[\int_{a^0_{Mij}}^{a^0_{Xij}} \left\{ V[a;\theta',n'] - V[a;\phi^0,n^0 \right\} dG(a) \right]$$

where a^0_{Xij} and a^0_{Mij} represent the cutoff equilibrium level at $\phi_{ij} = 0.3$. Since n_i changes as a consequence of increased level of integration, in the intensive margin formula n_i is not taken into consideration. In fact, n_i represents the number of entrants, which will be lower as a consequence of the market selection effect, even if it includes new exported varieties (the number of exporters has increased). Since we want a measure of differences in volume of already exported varieties we do not consider n_i.

The *extensive margin* refers to exports of products that have been not exported before, as a consequence of the entry of new firms. In order to calculate this measure we evaluate a in the per firm level of export considering the two different level of integrations: $\phi_{ij} = 0.3$ and $\phi'_{ij} = 0.5$:

$$\text{Ext. Marg.}= \int_{a^0_{Xij}}^{a'_{Xij}} V[a;\theta',n']dG(a)$$

Change in Total Export from country A to B and C

Let's consider the changes in total export for the liberalizing countries, A and C. Both the *intensive* than the *extensive margin* are positive. As expected the extensive margin is higher with respect to both partners. As consequence of partial trade liberalization, the change in total export between A and C is positive and again the extensive margin plays a more significant role.

Change in Total Export from country B to A

As consequence of partial trade liberalization between A and C, the change in total export between B and A is negative. Here the negative role played by the extensive margin is bigger than the role played by intensive margin. The same is true with respect to country C.

The overall change in total export of the entire economy is positive.

2.4.2 PTA and Change in Total FDI

$$\Delta \text{ Tot Exp} = \int_{a^0_{Mij}}^{a^0_{Xij}} \left\{ V[a;\theta',n'] - V[a;\phi^0,n^0] \right\} dG(a) + (n^{0.5}_{\text{exp}} - n^{0.3}_{\text{exp}}) \int_{a^0_{Xij}}^{a'_{Xij}} V[a;\theta',n'] dG(a)$$

2.5 Conclusions

In this paper we developed a model of international trade with asymmetries in terms of trade costs. We consider one differentiated sector, x, characterized by firms with different productivities. The existence of different fixed costs generates the possibility of observing different organizational forms. Moreover, the existence of different trade costs allows a more detailed analyses of the impact of trade, in particular with respect to preferential trade agreement.

The effects of preferential liberalization is such that in the liberalizing countries, A and C, is more difficult to enter as local supplier; although becomes easier for the successful entrants firms to engage in foreign market activities. In these countries there will be a decline in the average price and costs. On the contrary, the excluded country, B, experiments an increase in the cutoff, which makes entrance in the local market easier. However, PTA is discouraging firms decisions to sell abroad, both as exporters than subsidiaries. Moreover, the liberalizing countries get better access as exporters to each other's market and also to the excluded one. For what concern the FDI sector, the liberalizing countries, A and C, become more selective in terms of respective MNFs' entry, as a consequence of increase in trade openness.

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Chapter 3

FDI and Exports with Intermediate goods and coordination costs

3.1 Introduction

In 1993 Brainard proposed what has become the standard approach for explaining horizontal multinational firms, the so called proximity versus concentration hypothesis. This hypothesis put in evidence the trade-off between the advantages from locating near to customers and from concentrating production in only one location (that gives rise to scale economies at the plant level). This model obviously implies that it is more likely to be engaged in FDI activities when trade costs are particularly high. Hence, foreign subsidiaries' sales will be raising with distance. For the same reason, horizontal FDI are not encouraged by reduction in transport costs. On the contrary, when trade costs fall, scale economies advantages can outweight the gain from locating near to customers. In this case export activities could become more profitable. If we compare this theory with what the empirical evidence on FDI tells us, we would immediately discover some discrepancies.

Since 1986, despite the drastic reduction in transport costs across different countries, there has been a consistent growth of multinational sales, in particular of FDI inflows. As Dunning 1993 showed, a large part of international trade is conducted by MNEs. He estimated that MNEs together with their subsidiaries are responsible for 75 percent of the world's trade commodity. Confirming this trend, UNCTAD (2000) estimated that one third of world trade

is intra-firm trade (trade between headquarters of MNEs and subsidiaries, or simply among subsidiaries). These empirical findings seem to contradict our expectations based on proximity versus concentration hypothesis. Following the theory, the fall in trade costs should reduce FDI and encourage exports. However, what the reality indicates is exactly the opposite: the reduction in trade costs coincided with FDI growth[1].

How could be possible to reconcile the MNFs theory with these findings? An important element that could be introduced is the existence of vertical linkages between the home and the foreign nations. These linkages could be taken into account allowing intermediate inputs to play a role. In what follows we argue that these inputs are supplied by two type of workers: l_i and h_i (i indicates the country). L^i represents the amount of low skill workers and H_i the amount of high skill workers. If on one side low skill labor is perfectly substitutable, on the other side, high skill is assumed to be firm specific. These input characteristics will make the foreign affiliates' sales affected by changes in distance trade costs.

The analysis focuses on the choice between FDI and Exports in a framework which includes intermediate inputs. For this purpose, Helpman, Melitz, Yeaple (2004) and Antras-Helpman (2004) will be intensively used. However, an interesting distinction is introduced: we allow for asymmetries across countries. These asymmetries are expressed in terms of different country location and so different trade costs (this would imply that productivities will be not only firms specific, but also country specific). This element introduces a new level of heterogeneity, not only among firms, but also among countries. On one side, this higher level of heterogeneity contributes in keeping the analysis nearer to reality. In fact, conversely to the symmetric assumption in HMY, which yields an equilibrium where if a firm can engage in foreign market activity it will be active in every foreign market[2] independently of the distance, the introduction of spatial distribution of firms gives a role to distance in determining the organizational form of firms. This is in line with the recent empirical findings that seem to confirm that the number of firms is decreasing with distance. In fact, spatial distribution of affiliates seems to be much richer than the scale-vs-proximity models predict.

Letting the production of the final good variety requires a particular input combination

[1] This seems to be confirmed in EU, where under the single market situation a reduction in the trade costs have been achieved.

[2] In relation to its own productivity, it will be active as an exporters or as a subsisdiary.

between high skill and low skill workers, will play an interesting role in an open economy situation, when we analyze the organizational choices in the differentiated sector. In particular, when we consider the FDI strategies. In this contest, a subsidiary built abroad has to import from the home nation the high skill service. This vertical linkage makes a portion of the total marginal costs of selling via FDI rising with distance. Moreover, we argue that the relationship between home and foreign nations gives rise to communication issues. In fact, in order to realize the final good, the subsidiary needs also the knowledge of the high skill workers in the home nation. The transfer of this know how generates what could be called communication costs ($f(dist)$). In this framework with intermediate inputs and communication costs, firms prefer to engage in exporting rather than FDI strategies when distance becomes important.

As it was briefly mentioned above a crucial paper in this respect is "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity" by Melitz (2002). This paper adds two crucial elements to the new trade theory. The first is the fixed market entry costs, that is what a potential entrant has to pay. The second is heterogeneity in firms productivity. By introducing firms heterogeneity in the 1980's Krugman model, he observed how an increase in the exposure to trade lead to reallocation towards the more efficient firms, without necessarily inducing an increase in the productive efficiency of individual firms[3]. Its findings are supported by several micro-econometric studies.

After this paper, the study of the implications of firm level productivity differences has become an important field of interest in international economics. In fact, the shift from the representative firm framework to the heterogeneous firms framework allowed to model some aspects of international commerce that until now have been studied only empirically. We are referring to the different production strategies that a firm can undertake. Which firm serves foreign market? Which firm chooses to export, which to serve the foreign market through FDI? And finally, what are the circumstances under which it outsources? These questions can be addressed because of this new heterogeneity element inserted. The novelty in this contest, is that only a fraction of firms will become exporters or engage in FDI. Hence, allowing firms level productivity to differ has generated a new area of research where trade is combined with the

[3]This result is partially contradicted by Baldwin et all (2004), where they pointed out that "although freer trade improves industry productivity in a level sense, it harms it in a growth sense"

different organizational choices of firms. In this contest, the different production strategies can be analyzed in a general equilibrium setting.

In line with this new research area is the paper by Helpman, Melitz and Yeaple (2004), "Exports vs FDI". Here, the authors built a multi-country, multi-sectoral general equilibrium model where their intent is to analyze the decision of heterogeneous firms to serve foreign market either through exports or local sales (FDI). Similar to Melitz (2002), they work with identical nations, a single factor, L, but with H+1 sectors. They find that firm level heterogeneity plays a relevant role in explaining the choice between export and FDI flows. Their theoretical framework takes as a starting point the classical Melitz's model where another type of firm, MNEs, is added. They studied the Brainard's proximity concentration hypothesis[4] in a firms heterogeneity environment. Essentially, what they find is that the least productive firms (with a very high marginal cost, $a_D < a < a_0$) leave the market, as they are not able to obtain positive operating profit. The low productivity firms, $a_X < a < a_D$, enter but serve exclusively the domestic market. The firms with a marginal cost such that $a_M < a < a_X$ decide to export. And finally the more productive firms, $0 < a < a_M$, choose to serve the foreign market through FDI. They assume that the different modes of market access involve different kind of costs. For example, some entry costs, that are considered sunk; then transport costs, that vary with sales; and fixed organizational costs which vary with organizational form. The main result of their paper derives from the assumption of firms heterogeneity: by making firms characteristics endogenous they avoid the classical result where either all the firms invest abroad or none does. On the contrary, here there will be a range of firms that do export and another that engage in FDI. Nonetheless, their results rely on the assumption of perfectly symmetric countries and on the absence of asymmetries in transport costs or in fixed costs. As a consequence of this a firm that does export toward a country will do export towards every other country. This could limit our comprehension about the reality, where usually a firm chooses a mixture of organizational forms.

Up until now we considered studies that explained the different modes of foreign market access by considering only final goods. Nevertheless, the last two decades have been characterized

[4] the proximity concentration trade-off predicts that "firms are more likely to expand their production horizontally across borders the higher are the transport costs and trade barriers and the lower are investment barriers and the size of scale economies at the level at the plant level relative to the firm level" (Brainard, 1997).

by a progressive disintegration of the production process, in which manufacturing or services goods realized home could be combined with those done abroad. What does this imply? That intermediate goods cross borders several time during the manufacturing process. This explains why they have become the new actors of international trade. There are many examples that can highlight this trend. The most quoted is the Barbie doll example cited by Feenstra (1998): "Of the $2 export value for the dolls when they leave Hong Kong for the United States, about 35 cents covers Chinese labor, 65 cents covers the cost of materials, and the remainder covers transportation and overhead, including profits earned in Hong Kong". However, the empirical evidence quantifying this phenomenon is not so developed. One reason relies on the way in which data on intermediate goods are collected. In fact, the classification of goods into intermediate and final is quite arbitrary. In order to turn aside from this arbitrariness, Hummels, Ishii and Yi (2001) used a narrower concept of fragmentation of production: imported goods used as inputs to produce a country's export goods. They found that international trade in intermediate rose faster than in final goods. Despite the interest for the empirical analysis of the different form of production processes, we choose to leave that aside for the moment and continue to focus on the theoretical aspects of this new new trade.

If we want to understand the nature of trade in intermediate goods, we should spend some words in describing the ways in which this trade can happen. On one hand, a firm can decide to produce an intermediate input within its boundaries; in this case it engages in what the literature calls vertical FDI. On the other hand, a firm can decide to outsource the production of the intermediate input. This would imply that some sectors could have only vertical integrated firms and others have only disintegrated firms. These two ways of international procurement of intermediate goods could be better explained by adding to the trade theory some elements of contract theory. In relation to this could be useful to consider the large literature on the organizational forms of the firm. It starts with the seminal paper by Coase (1937), later developed by Williamson (1985), Grossman and Hart (1986), and Grossman and Helpman. The latter paper considers the choice between integration and outsourcing in a framework where all the firms are equally productive. Instead, the recent paper by Antras and Helpman (2004) studies the problem of choosing different ownership structure by introducing in the G-H model different productivity levels. These studies make contract theory very important for

analyzing situations in which firms heterogeneity is linked with ownership structure.

Building on this literature, our purpose is to develop a theoretical model where we study the effects of within sectoral heterogeneity on the decision of firms to engage in foreign market access, in a framework where distance plays a role. Starting from Helpman, Melitz and Yeaple (2004) we propose to add to this model intra-firm trade: each good sold requires a component that is shipped from the mother nation and a component that is produced locally. This would imply that the total marginal cost of selling via FDI will rise with distance, as a consequence of the fact that the transfer of this component incurs in transport costs. In this contest, distance will not only discourage exports but eventually also FDI, permitting us to obtain mixed results. For example, a firm can decide to do FDI until a point and then when transport costs become to high (in relation to the fact that the marginal cost of being engaged in FDI is already higher than the cost of doing export), it switches to export strategies. Moreover, we could also analyze this framework from a different perspective. In particular, we can ask: what is the profit maximizing way for firms to organize their activities? Do firms prefer internally produce the intermediate inputs or to outsource to some local supplier? A further extension of the present work could be to introduce some elements of contract theory in the contest of outsouring relationships. This idea will be developed in more details in another paper.

This paper condenses different research interests, and it is organized in the following way. In section 3.2 we elaborate the model and characterize its equilibrium. Section 3.3 investigates the impact of trade. In section 3.4 we consider the effects of progressive liberalization. In the last section we conclude.

3.2 Theoretical Framework

We consider N[5] symmetric countries, that use two inputs to produce goods. Consumers in each country share the same preferences. Each country's location is represented by a point on a circle; along this circle, each country would have a clone. Trade costs among countries increase with distance by a proportion λ. This would permit us to consider the role of asymmetric transport costs, which are assumed to be pair wise symmetric, in the trade bloc (the circle). These

[5] Where N is assumed to be an odd number.

transport costs are broadly defined, so as to include different kind of impediments: distance, trade barriers, cultural differences. In every country there is a homogeneous and a differentiated sector that produces respectively good z and x. As in Helpman et al (2004) we assume that a fraction of income, β, is spent on the differentiated good, x, and a fraction $(1-\beta)$ is spent on the homogeneous good, z.

For what concern the way in which the production is structured, we adopt the ad hoc division of labor proposed by Antràs et al. (2006). Each country is endowed with two type of inputs, L_i and H_i, each supplying one unit of their corresponding factor inelastically. These inputs are supplied by two type of workers: l_i and h_i (the index i indicates the country). L^i represents the amount of low skill workers and H_i the amount of high skill workers. On one side, some low skill workers (simply called workers) are responsible for routine tasks, l_i, like data entry, data processing, and database management, financial and accounting services etc. And on the other side high skill workers (managers) specialize in knowledge-intensive tasks, h_i. Both factors are perfectly mobile between sectors.

The fact that the production function requires the combination of these two types of *inputs* will play an interesting role in an open economy situation, when we analyze the organizational choices in the differentiated sector. More specifically, in relation to the FDI strategy our claim is that the inputs realized by foreign managers in the host country cannot be considered perfect substitute of inputs realized by managers in the home economy. For this reason the specific knowledge-intensive tasks, h_i, should be imported from the home nation. This assumption will expose this imported inputs to trade costs. However, this is not the only cost that emerges in this situation. We assume that managers in the home economy should "teach" foreign workers how to realize an efficient outcome (reputation matters). This transfer of knowledge generates costs linked to communication problems. The aspect of communication depends on how communication technologies are developed in the countries.

The communication costs affect the relationship between managers in the home country and workers in the host country. As we mentioned above, only a particular firm's organization strategy will be affected by these costs: market access through FDI. In this case, managers in the home country should travel to the host country in order to give orders to the foreign workers. As a consequence of the improvements in communication technologies, the managers

could also give orders and guidance over the phone and the internet, using emails, and others to workers in the host economy. When the level of communication in the host economy is not well developed, these costs could discourage the choice in favor of FDI. Instead, when they are not outrageously high, there could be a reason for choosing FDI. Also distance can affect the level of development of communication. For this reason, in what follow, we consider these communication costs, $f_c(dist)$, as positively related with distance. It is convenient to observe, that the existence of "adequate manager skills" in the host country plus the availability of sufficiently developed communication technologies, will change completely the situation. In fact, MNFs could become really interested in offshoring parts of the production process to foreign countries. The presence of "manager skills" allows a more efficient (time-saving) transmission of knowledge across countries, permitting to the MNFs to avoid communication costs. However, at least in this paper, our interest is limited to the case in which FDI strategies is more convenient. We leave the analysis of offshoring strategies for another paper.

Nowadays, the role played by these vertical linkages is extremely important. The reduction in spatial frictions, in particular, thanks to the introduction of new technologies, has contributed enormously to the decrease in the costs of communication between managers in the home country and workers in the host country. However, the relationship between home and host nation is also affected by the level of international barriers. The higher are international barriers, the more difficult will be the contact between them and so the smaller will be the vertical linkages, because they become too costly. In the special framework considered, the specific knowledge needed (the high skill input), generates a situation in which the input realized by managers in home nation have to be exported to the host economy. Obviously, in a situation of partial free trade, the transfer of these inputs will be hit by trade costs. In the specific case of FDI mode of market access, two different type of costs will affect the behavior of the MNF: the transport costs that hits the intermediate input imported, and the communication costs between managers in the home and workers in the host country. Physical and cultural distances will have a positive impact on the communication costs. For this reason, the communication costs could be considered a particular type of distance related fixed cost.

3.2.1 Preferences

Preferences are described by the utility function :

$$U = z^{(1-\beta)} \left[\int_{v \in V} x(v)^{\alpha} \right]^{\frac{\beta}{\alpha}} dv$$

Consumers have identical, homothetic preferences over the two classes of goods. Furthermore, consumers have identical preferences among varieties (V is the set of all possible varieties). So preferences across varieties have the classical CES form. Hence, if we consider the sub-utility function over all varieties of good x:

$$u = \left[\int_{v \in V} x(v)^{\alpha} \right]^{\frac{\beta}{\alpha}} dv$$

if we take log

$$u = \frac{\beta}{\alpha} \log \left[\int_{v \in V} x(v)^{\alpha} \right] dv$$

where α represent the elasticity of substitution, $\alpha = \frac{\varepsilon - 1}{\varepsilon}$. The solution to the utility maximization problem[6] gives us the usual demand for each variety:

$$\begin{aligned} x &= \frac{\beta E}{\int_0^{n^i} p_i(v)^{1-\varepsilon} dv} p_i^{-\varepsilon} \\ &= A^i p_i^{-\varepsilon} \end{aligned} \tag{3.1}$$

where $A^i = \frac{\beta E^i}{\int_0^n p^i(v)^{1-\varepsilon} dv}$. The inverse demand function is given by

$$p(v) = A^{\frac{1}{\varepsilon}} x^{-\frac{1}{\varepsilon}} = A^{1-\alpha} x^{\alpha - 1} \tag{3.2}$$

The demand parameter α is the same in every country. This would permit to give attention to differences in organizational costs.

[6] The budget constraint is: $E^i = \int_{v \in V_h} p(v) x(v) dv$

3.2.2 Production

The homogeneous sector, z, produces a homogeneous good with constant returns to scale and perfect competition. This good is freely traded on international markets. One unit of z requires one unit of only one factor: l_i. The unit cost function is $c_z(w_l)$, where w_l is the wages rate for low skill workers. This unit cost function represents marginal and average costs. In the homogeneous sector, competition determines price equals marginal costs. Since this sector is characterized by costlessy trade and perfect competition $p_z = c_z(w_l) = w_l$. It is convenient to choose good z as the numeraire, so that $p_z = 1$. The pricing condition will become: $1 = w_l^*$. As long as the homogeneous good is produced in every countries, the cost of producing the homogenous good is equal in every country.

The differentiated sector, x, produces a continuum of horizontally differentiated varieties. Each variety is produced with an increasing return to scale (at the firm level) production function. As preferences are Spence-Dixit-Stiglitz type, a single producer competes equally with every other producer and the same profit is obtained for each variety. As there are no costs of product differentiation, each firm will produce a different type of variety. Moreover, since consumers' preferences are characterized by "love of variety", any firm could obtain a higher share of the market by producing a different variety, than by reproducing an existing one. In this model with monopolistic competition, a continuum of productivity is introduced, so that some firms are making pure profits: the firms that are not on the cutoff level.

To enter in the differentiated sector, firms should bear the fixed cost f_E (measured in units of low skill labors), that is sunk. Subsequently, each entrant draws a productivity parameter (or labor per unit output coefficient, called a) from a common cumulative density function G(a)[7]. Upon drawing its own productivity parameter, a firm can immediately decide to exit and not to produce (this happens if it has a low productivity draw). Otherwise, a firm can choose to produce; this will imply additional fixed costs linked to the type of organizational form chosen. If it chooses to produce for its own domestic market it pays the additional fixed market entry cost f_D. If the firm chooses to export, it bears the additional costs f_X of meeting different market specific standards (for example, the cost of creating a distribution network in a new

[7] The support of the continuous random variable a is $0 \leq a \leq a_0$. The cumulative densitiy function is the same in every country; but the equilibrium cutoff change in every country.

country). Finally, if the firm chooses to serve through FDI, the additional costs it has to face are f_M. The latter fixed cost is due to creating a distribution network in a new country as well as to the building up of new capacities in the foreign country. This implies that f_M is composed by f_D and f_X. So: $f_D < f_X < f_M$[8]. More precisely, in order to obtain this partition is essential that $f_D < \tau^{\varepsilon-1} f_X < f_M$; otherwise we lose the relationship between productivity level and type of market access. All the fixed costs are evaluated at the low skill workers' wage. Why? As it is clear from the inequality above, the exporting sector is characterized by iceberg transport costs: selling one unit in the export market, would require the shipment of $\tau \geq 1$ units. In relation to the country's location we will observe the exporting price increasing with distance from the home country.

Despite the fact that we are dealing with symmetric countries, the fact that they are located differently makes distance playing a role. The role played by distance gives rise to interesting insights. The exporting price from country 1 to country $(N-1)/2$ is defined as:

$$\begin{aligned} p_2 &= \tau_1 \frac{a p_h^{\eta}}{\alpha} \\ &\dots \\ p_{\frac{(N-1)}{2}} &= \tau_1 \lambda^{\frac{(N-1)}{2}} \frac{a p_h^{\eta}}{\alpha} \end{aligned}$$

where τ_1 represents the trade costs with the nearest country. As we saw the index is set to go from 1 to $\frac{N-1}{2}$, because we locate countries on a circle. For what concern the price of the subsidiary:

$$\begin{aligned} p_2 &= (p_h \tau_1)^{\eta} \frac{a}{\alpha} \\ &\dots \\ p_{\frac{(N-1)}{2}} &= \left(p_h \tau_1 \lambda^{\frac{(N-1)}{2}} \right)^{\eta} \frac{a}{\alpha} \end{aligned}$$

because it incurs in transport cost only in relation to the intensity of high skill labor in the production of the final good. The trade costs is constructed in the following way: between country 1 and country 2 is τ_1; between country 1 and country 3 is $\tau_2 = \tau_1 \lambda$; between country 1

[8] f_D ,f_X , f_M can be considered as variety development costs or fixed organizational costs.

and country 4 is $\tau_3 = \tau_1\lambda^2$ and so on until country N-1 is reached, here $\tau_{(N-1)/2} = \tau_1\lambda^{(N-1)/2}$.

All the previous assumptions would have an implication on the productivity level that we should observe. In particular, later will be possible to analyze how trade affects the (endogenous) range of productivity levels, the profits associated to those and the distribution of the market shares. We expect to observe that the productivity required for becoming an exporter or for engaging in FDI will be increasing with distance, as trade costs affect in a negative way both organizational forms. This implies that the ex ante probability of entrants as an exporter or as a subsidiary will be decreasing with distance. After entry the market environment is characterized by monopolistic competition. Last element: all firms face a constant probability of death. This event is described by a Poisson distribution with an hazard rate δ : in every period the firm can be hit by this bad event and forced to exit. Hence, each firm's value profit is:

$$v(a) = \sum_{t=0}^{\infty}(1-\delta)^t\pi(a) = \frac{1}{\delta}\pi(a)$$

hence, the actual value of profits does not depend upon δ. For simplicity, we assume that there is no time discounting.

How does the differentiated sector works? As anticipated, the production of any variety involves two specific inputs: l_i, and h_i. The tasks performed by low skill workers are interchangeable among countries (these are not firm specific, they are standardized). On the contrary, even if knowledge-intensive tasks, h_i are performed in every country, these are highly firm specific. The knowledge-intensive tasks cannot be considered as perfect substitutes across countries; i.e. the one existing in country A is strictly correlated with firms in country A. For this reason, firms that engage in FDI prefer to import the input realized by managers from home nation. We could claim that these inputs are firms specific in the sense that every firm in order to realize the *specific* variety needs some expertise and knowledge that has been developed in the contest of its specific production. For this reason is not easy to substitute this knowledge service (that could be considered as "endemic" to a particular firm)[9]. These vertical linkages

[9] In a further step we could analyze under which conditions it seems reasonable to outsource the production of this service (by saving in transport costs, but loosing the esclusivity of the specific know how and incurring in higher communication costs) instead of exporting that input (from home to abroad; this will permit to the firm to keep internally its know how).

between mother and foreign nation give rise to communication costs: managers and technicians have to travel from home to the foreign country (or to guide over the phone or others) to teach some specific procedures linked to the production of the specific variety (export of knowledge related to high skill workers).

Thus the exporting sector, as well as the FDI sector, are characterized by iceberg transport costs: selling one unit in the export market j, would require shipment from country i of $\tau \geq 1$ units for the exporting sector and τ^{η} for the FDI sector. This would imply that the marginal costs in exporting sector is higher than the one in the FDI sector (at least until when the communication costs are not too high, and so until when distance does not play a big role).

In every country, the producers of differentiated goods face an inelastic supply of low skill labor (l) and high skill labor (h). The high skill workers are endowed with higher abilities than low skill workers (being high or low type is exogenous). Let's assume that the inputs combination needed to realize any variety could be well captured by a Cobb-Douglas production function:

$$x(v) = \frac{1}{a}\left(\frac{h}{\eta}\right)^{\eta}\left(\frac{l}{1-\eta}\right)^{1-\eta}, 0 < \eta < 1 \tag{3.3}$$

where $\frac{1}{a}$ is the firm specific productivity parameter. η and $(1-\eta)$ represent how relevant are inputs from low and high skill workers for the production of each variety. η and $(1-\eta)$ are identical in every country[10]. As we explain above, these two tasks are qualitatively different. When trade is open, firms in every country could decide to start export or FDI strategies. This will depend upon their own productivity. The potential gain from sales of the final good is:

$$R(v) \equiv p(v)\,x(v) = A^{1-\alpha}\left(\frac{1}{a_p}\right)^{\alpha}\left(\frac{h}{\eta}\right)^{\alpha\eta}\left(\frac{l}{1-\eta}\right)^{\alpha(1-\eta)}$$

where we use the inverse demand function from (2) and (3). The profits for domestic firms is given by

$$\Pi_D = px(v) - lw - hp_h - wf_D$$

where we assumed that $x(v)$ units of variety v needs a fixed amount f of low skill workers. The

[10] The parameters η and $(1-\eta)$ are sector specific. Since we consider only one secor, they will have no subscript.

profit form exporting is

$$\Pi_{XJ} = px\left(v\right) - \left(lw + hp_h\right)\tau_{ij} - wf_X$$

where j is the destination country and i is the origin country. The profit for a subsidiary located in j is

$$\Pi_{MJ} = px\left(v\right) - wl - h\tau_{ij}p_h - wf_c(dist) - wf_M$$

where $f_c(dist)$ represents the fixed communication costs and $h\tau_{ij}p_h$ is the trade costs associated to the subsidiary's imported input. A subsidiary located in the host country j, has to face both the communication costs, which rise with distance, and the trade costs that hit the imported inputs. In order to find the operating profits, we solve the minimization problem of the firm. We start by considering the subsidiary.

$$\min_{l,h,\lambda} L = wl + h\tau_{ij}p_h + \lambda\left[x\left(v\right) - \frac{1}{a_M}\left(\frac{h}{\eta}\right)^{\eta}\left(\frac{l}{1-\eta}\right)^{1-\eta}\right]$$

the hicksian factor demands are

$$h^* = x\left(v\right)a_M\eta\left[\frac{w}{p_h}\right]^{1-\eta}$$

$$l^* = x\left(v\right)a_M\left(1-\eta\right)\left[\frac{p_h}{w}\right]^{\eta}$$

Using the hicksian demands, we can write the total cost of a subsidiary as a function of the final output:

$$TC_{MNF} = wl^* + h^*\tau_{ij}p_h - f_c(dist) - wf_M$$

$$= x\left(v\right)a_M\left(\tau_{ij}p_h\right)^{\eta}w^{1-\eta} - f_c(dist) - wf_M$$

Combining the result obtained above for the total cost with the potential gain, it is possible to derive an expression for the profits, which depends only upon the final output:

$$\Pi_{MJ}(a, A, \eta) = A^{1-\alpha}x\left(v\right)^{\alpha} - x\left(v\right)a_M\left(\tau_{ij}p_h\right)^{\eta}w^{1-\eta} - f_c(dist) - wf_M$$

hence the optimal output,

$$x\left(v\right)^{*}=\frac{\alpha^{\frac{1}{1-\alpha}}A}{\left(a_{M}\left(\tau_{ij}p_{h}\right)^{\eta}w^{1-\eta}\right)^{\frac{1}{1-\alpha}}}$$

thus we can write the expression for the *equilibrium profit of the multinational firm*:

$$\Pi_{MJ}^{*}(a,A,\eta)=A\left(\frac{1}{a_{M}}\right)^{\frac{\alpha}{1-\alpha}}\frac{1-\alpha}{\left[\frac{1}{\alpha}\left(\tau_{ij}p_{h}\right)^{\eta}w^{1-\eta}\right]^{\frac{\alpha}{1-\alpha}}}-f_{c}(dist)-wf_{M}$$

then if we use the relationship between α and ε, $\frac{\alpha}{1-\alpha}=\varepsilon-1$ we get

$$\Pi_{MJ}^{*}(a,A,\eta)=Aa_{M}^{1-\varepsilon}\frac{(1-\alpha)}{\alpha^{1-\varepsilon}}\left[\left(\tau_{ij}p_{h}\right)^{\eta}w^{1-\eta}\right]^{1-\varepsilon}-f_{c}(dist)-wf_{M} \tag{3.4}$$

Note that the parameter a_M is firm specific, while A and η are industry (and so country) specific. Remember that η measures the intensity of knowledge-intensive tasks in the production of the final good, and A represents the amount of income spent relative to the differentiated product (so it is endogenous to the industry and exogenous to the producer of a specific variety).

In the same way it is possible to derive the total operative profits for the other organizational forms. The *profits from producing for domestic market* are

$$\Pi_{D}^{*}(a,A,\eta)=A_{i}a_{D}^{1-\varepsilon}\frac{(1-\alpha)}{\alpha^{1-\varepsilon}}\left[p_{h}^{\eta}w^{1-\eta}\right]^{1-\varepsilon}-wf_{D} \tag{3.5}$$

Finally, the *profit from exporting* in country j (here the quantity supplied differs from above because of E^{j}):

$$\Pi_{XJ}^{*}(a,A,\eta)=A_{j}\left(\tau_{ij}a_{X}\right)^{1-\varepsilon}\frac{(1-\alpha)}{\alpha^{1-\varepsilon}}\left[p_{h}^{\eta}w^{1-\eta}\right]^{1-\varepsilon}-wf_{X} \tag{3.6}$$

The final good producer will choose the type of organizational form that maximizes $\Pi_{K}^{*}(a,A,\eta)$ where $k=M,X$ or D. For this reason, final good producers organize the production so as to minimize both variable and fixed costs. In what follows we will set $w=1$. Since we are dealing with symmetric countries which differ only in terms of their spatial location (so there is a role for intra-industry trade), factor prices will be the same in every countries. From the equilibrium operating profit of producing for domestic market, $\Pi_{D}^{*}(a,A,\eta)$,

$$A_i a_{Di}^{1-\varepsilon} \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left[p_h^{\eta}\right]^{1-\varepsilon} = f_D \tag{3.7}$$

we can derive the equilibrium cutoff condition. Setting $B^i = \frac{(1-\alpha)A^i}{\alpha^{1-\varepsilon}}$, we obtain

$$a_{Di}^{1-\varepsilon} = \frac{f_D}{B^i \left[p_h^{\eta}\right]^{1-\varepsilon}}$$

From the equilibrium operating profit of exporting in country j (here the quantity supplied differs from above because of E^j), $\Pi_{XJ}^*(a, A, \eta)$:

$$A_j \left(\lambda^i \tau_{ij} a_{Xj}\right)^{1-\varepsilon} \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left[p_h^{\eta}\right]^{1-\varepsilon} = f_X \tag{3.8}$$

and using $B^j = \frac{(1-\alpha)A^j}{\alpha^{1-\varepsilon}}$ and $\tau_{ij}^{1-\varepsilon} \equiv \phi$, we derive the following equilibrium cutoff

$$a_{Xj}^{1-\varepsilon} = \frac{f_X}{B^j \left(\lambda^i \tau_{ij}\right)^{1-\varepsilon} \left[p_h^{\eta}\right]^{1-\varepsilon}}$$

In order to find the cutoff for firms engaged in FDI, we should compare the operating profits from doing FDI with the operating profit from doing export. This because by construction, a firm will choose to do FDI in country j if only if the production abroad is more profitable than exports, i.e. if this holds $\pi_{Mij} - \pi_{Xij} \geq f_c(dist) + (w + \tau_{ij} p_h) f_M - (w + p_h) f_X$. Thus the operating profit of doing FDI in country j, $\Pi_{MJ}^*(a, A, \eta)$ is

$$A_j a_{Mj}^{1-\varepsilon} \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left[\left(\lambda^i \tau_{ij}\right)^{\eta(1-\varepsilon)} - \left(\lambda^i \tau_{ij}\right)^{1-\varepsilon}\right] p_h^{\eta(1-\varepsilon)} = f_c(dist) + f_M - f_X \tag{3.9}$$

which gives the following equilibrium cutoff

$$a_{Mj}^{1-\varepsilon} = \frac{f_c(dist) + f_M - f_X}{B^j \left[\left(\lambda^i \tau_{ij}\right)^{\eta(1-\varepsilon)} - \left(\lambda^i \tau_{ij}\right)^{1-\varepsilon}\right] p_h^{\eta(1-\varepsilon)}}$$

a_{Di}, a_{Xj} and a_{Mj} represent the cutoff marginal costs from entering the domestic market, the foreign market as exporter or as subsidiary. $\phi \equiv \tau^{1-\varepsilon}$ is the freeness of trade. Since $\frac{1}{a}$ represents the labor productivity and ε is set to be strictly greater that 1, $a^{1-\varepsilon}$ could be considered a productivity index. All the profits described above are increasing function of

$a^{1-\varepsilon}$. Independently on the type of activity, the more productive is a firm, the more profits it will make. Upon observing its productivity level, the differentiated good producer chooses the ownership structure that maximizes its profits, or exits the market. This latter outcome will happen whenever the productivity level, $\frac{1}{a}$, is below a threshold level, $\frac{1}{a_{Di}}$. We can also talk in terms of marginal cost: if the marginal cost is above a certain threshold level, a_{Di}, the firm exits form the market and forfeits the fixed cost of entry. This threshold depends on the consumption index, A.

It is straightforward to see that $\Pi^*_{KJ}(a, A, \eta)$ is decreasing in variable and fixed costs; for this reason the firm prefer to organize production so as to minimize these costs. f_D, f_X and f_M represent respectively the component of the fixed cost that domestic, exporting and subsidiary firms have to bear.

Free Entry

Free entry ensures equality between the expected operating profits of a potential entrant and the entry cost, f_E. This condition holds for all type of firms. This implies that the cumulative density function is $G(a) = \left(\frac{a}{a_0}\right)^k$; hence the support is: 0.... a_0, where for simplicity we can set $a_0 = 1$.This condition can be expressed as

$$\int_0^{a_D} [\frac{Ea^{1-\varepsilon}\left[p_h^\eta\right]^{1-\varepsilon}}{n\Delta\varepsilon} - f_D]dG(a) + 2\sum_{i=0}^{\frac{N-1}{2}} \{\int_{a_M}^{a_X} [\frac{\phi\gamma^i a^{1-\varepsilon} E\left[p_h^\eta\right]^{1-\varepsilon}}{n\Delta\varepsilon} - f_X]dG(a) +$$

$$\int_0^{a_M} [\frac{\left[\phi\gamma^i\right]^\eta Ea^{1-\varepsilon}\left[p_h^\eta\right]^{1-\varepsilon}}{n\Delta\varepsilon} - f_c(dist) - f_M]dG(a)\} = f_E \tag{3.10}$$

where $\gamma^i = \left(\lambda^i\right)^{1-\varepsilon}$ and ϕ is the well known freeness of trade. λ^i is the parameter that takes into consideration the different country locations. Using equations (7)-(10) plus the price index we can find implicit solutions for the cutoff coefficients. As long as the change in country size is not too large, incomplete specialization is preserved in every country, along with FPE.

Price Index

The price index in country i is characterized by all the brands offered in that country. More precisely, the brands offered by domestic firms have a consumer price of a/α, brands offered by foreign exporters have a consumer price of $a\tau\lambda^i/\alpha$ and $a\tau\left(\lambda^i\right)^\eta/\alpha$ for foreign subsidiaries. As firms will start producing only if they have at least a productivity of $\frac{1}{a_D}$, the probability distribution of being an exporter (or FDI) is conditioned on the probability of successful entry: $G(a/a_D)$ [11]. Please note that the upper bound of the cost distribution so that firms survive, a_D, is identical for every country.

$$\int_0^n p^i(v)^{1-\varepsilon}dv = \frac{1}{\alpha^{1-\varepsilon}}\int_0^{a_D}\left[ap_h^\eta\right]^{1-\varepsilon}dG(a/a_D)+\frac{1}{\alpha^{1-\varepsilon}}2\sum_{i=0}^{\frac{N-1}{2}}\left[\int_0^{a_M}\left[\phi\gamma^i\right]^\eta\left[ap_h^\eta\right]^{1-\varepsilon}dG(a/a_D)+\int_{a_B}^{a_X}\phi\gamma^i\left(ap_h^\eta\right)^{1-\varepsilon}dG(a\right.$$

3.2.3 Parametrization: Pareto Distribution

The fact that the free entry condition and the price index depend upon probability distribution implies that if we want an explicit solution for them we need to assume a particular functional form for G(a). Following the empirical literature on firms size distribution it seems reasonable to use as an approximation the Pareto distribution. The cumulative distribution function of a Pareto random variable a with the shape parameter k is:

$$G(a) = \left(\frac{a}{a_0}\right)^k \tag{3.11}$$

where k and a_0 are the shape and scale parameter, respectively. Note that k=1 implies a uniform distribution on $[0, a_0]$. The shape parameter k represents the dispersion of cost draws. An increase in k would imply an increase in the number of high cost firms (the shape of the cumulative distribution becomes more convex). The support of the distribution, 0....a_0, is identical for every country. a_0 represents the upper bound of this distribution. In order to avoid infinite variance we should consider an upper bound on the highest possible level of productivity, or a minimum value for the marginal cost. Figure 1 in the Appendix describe the marginal cost that is induced by G(a). The productivity distribution of surviving firms will

[11] It is exploited the fractal nature of the Pareto.

also be Pareto with shape k; and the truncated cost distribution is given by:

$$G(a/a_D) = \left(\frac{a}{a_D}\right)^k$$

with $a \in [0, a_D]$.

Price Index with Pareto distribution

As firms will offer a price only if they have at least a productivity of $\frac{1}{a_D}$, the cumulative distribution is defined on a support 0.....a_D, so it is: $G(a) = \left(\frac{a}{a_D}\right)^k$. Solving the price index we will obtain:

$$\Delta = \frac{1}{1-\frac{1}{\beta}} a_D^{1-\varepsilon}[1 + 2T^{1-\beta}\sum_{i=0}^{\frac{N-1}{2}}\left(\phi\gamma^i\right)^\beta + 2V^{1-\beta}\sum_{i=0}^{\frac{N-1}{2}}\left[\left(\phi\gamma^i\right)^\eta - \phi\gamma^i\right]^\beta \tag{3.12}$$

where $\beta = \frac{k}{\varepsilon-1}$; $\tau^{1-\varepsilon} = \phi$; $\left(\lambda^i\right)^{1-\varepsilon} = \gamma^i$; $f_X/f_D = T$ and $(f_c(dist) + f_M - f_X)/f_D = V$.

Free entry condition using the Pareto distribution:

Also the free entry could be rewritten considering the parametrization assumed. However, here the support is 0.... a_0, because every type of firm can enter. For simplicity we can set $a_0 = 1$.

$$\frac{E\left[p_h^\eta\right]^{1-\varepsilon}}{n\varepsilon\Delta}[\int_0^{a_D}(a^{1-\varepsilon} - f_D)dG(a) + 2\sum_{i=0}^{\frac{N-1}{2}}\int_0^{a_M}(a^{1-\varepsilon}\left(\phi\gamma^i\right)^\eta - (f_c(dist) + f_M)dG(a) +$$

$$+2\sum_{i=0}^{\frac{N-1}{2}}\int_{a_M}^{a_X}(a^{1-\varepsilon}\left(\phi\gamma^i\right) - f_X)dG(a)] = f_E \tag{3.13}$$

where Δ is the price index.

3.3 General Equilibrium with N countries

In order to analyze the main implications of this model, we exploit the fact that all fixed coefficients are the same in every country and that the distribution function is the same. However,

the existence of N countries located along a circle introduces a role for distance in determining the different organizational forms. Using the price index found in (12) inside the domestic cutoff conditions (7), we find the equilibrium number of varieties (and so of existing firms) consumed in a typical nation:

$$n^* = \frac{(\beta-1)\left[p_h^{\eta}\right]^{1-\varepsilon} E}{\varepsilon\beta f_D[1+2T^{1-\beta}\sum_{i=0}^{\frac{N-1}{2}}(\phi\gamma^i)^{\beta}+2V^{1-\beta}\sum_{i=0}^{\frac{N-1}{2}}[(\phi\gamma^i)^{\eta}-\phi\gamma^i]^{\beta}]}$$

Following Baldwin's notation, we define $2T^{1-\beta}\sum_{i=0}^{\frac{N-1}{2}}\left(\phi\gamma^i\right)^{\beta} = \Omega$, and, on the other hand, $2V^{1-\beta}\sum_{i=0}^{\frac{N-1}{2}}\left[\left(\phi\gamma^i\right)^{\eta}-\phi\gamma^i\right]^{\beta} = \Psi$. Where Ψ and Ω could be consider as parameters that summarizes the impact of trade costs on exports and on FDI. Then, the expression for n could be simplified to:

$$n^* = \frac{(\beta-1)\left[p_h^{\eta}\right]^{1-\varepsilon} E}{\varepsilon\beta f_D\left[1+\Omega+\Psi\right]} \tag{3.14}$$

the number of entrants is decreasing in Ψ and Ω which represent a measure of higher fixed and variable trade costs in export and FDI sectors respectively.Using the free entry condition in (13), and the cutoff conditions in (7)-(9), we could get explicit closed form solutions for a_D, a_X, and a_M.

$$a_D^* = a_0\left[\frac{(\beta-1)\left[p_h^{\eta}\right]^{1-\varepsilon} f_E}{\left(\beta-(\beta-1)p_h^{\eta(1-\varepsilon)}f_D(1+\Psi+\Omega)\right)}\right]^{\frac{1}{k}} \tag{3.15}$$

Using (15) inside the ratio between (8) and (7) we find

$$a_X^* = a_0\left[\frac{(\beta-1)\left[p_h^{\eta}\right]^{1-\varepsilon} f_E}{\left[\beta-(\beta-1)p_h^{\eta(1-\varepsilon)}\right]f_X(1+\Psi+\Omega)}\left(\phi\gamma^i\right)^{\beta}T^{1-\beta}\right]^{\frac{1}{k}} \tag{3.16}$$

Finally, using (15) inside the ratio between (9) and (7) we obtain the equilibrium cutoff if MNF

$$a_M^* = a_0\left[\frac{(\beta-1)\left[p_h^{\eta}\right]^{1-\varepsilon} f_E}{\left[\beta-(\beta-1)p_h^{\eta(1-\varepsilon)}\right](1+\Psi+\Omega)}\left[\left(\phi\gamma^i\right)^{\eta}-\left(\phi\gamma^i\right)\right]^{\beta}\frac{V^{1-\beta}}{f_c(dist)+f_M-f_X}\right]^{\frac{1}{k}} \tag{3.17}$$

Conversely to Helpman *et al.* (2004), the cutoffs differ in relation to the geographical location of the destination country. In fact, equations (14)-(17) change in relation to how many countries belong to this trade bloc. Since countries are equally spaced along the circle, the above equations are the same for every country. This imply that countries are perfectly symmetric among each other, but the existence of different spatial distributions determines distance dependent cutoffs.

3.3.1 Number of Entrants, Producers, Exporters and MNFs

As it is clear from above, firms are distinguished into four groups. Firms that do not produce at all, $a > a_D$; firms that sell domestically, $a_D \geq a > 0$; firms that sell domestically and also export, $a_X \geq a > a_M$; finally firms that sell domestically and build subsidiary in foreign country, $a_M \geq a > 0$. These types are determined by the existence of three different fixed organizational costs, discussed previously. This explain the three cutoff levels in each country, i.e. thresholds for marginal costs: a_D, a_X and a_M. Firms draw from the marginal cost distribution $G(a)$, where a is the marginal costs, considered as the continuos random variable; n^* represents the mass of firms with any given level of "a". Hence $n^*G(a)$ represents the steady state distribution of a. Through n^*[12] we can calculate the mass of firms existing in each category. From equation (14) we can see that a rise in the trade costs, f_X, f_M, $f_c(dist)$ and $\phi\gamma^i$ reduces the the number of existing firms.

3.3.2 The Role of Distance

Since empirical finding is much richer than the scale-vs-proximity models predict, we created a model with N countries located along a circle so that to analyze the spatial distribution of affiliates. Since distance play an important role in determining organizational form of firms, we could analyse how distance interacts with the existence of MNF. There are two way through which distance enters in the firm's profits. First, through the communication costs, $f_c(dist)$, which reflects the communication needs between managers in the home country and workers in the host country. Secondly, through the part of intermediate inputs that incur in trade costs because imported. Comparing the profits from doing FDI and from exporting, we could

[12] n is a primitive number that indicates every type of firm entering in the market.

ask under which conditions, the profits from doing FDI is bigger than the profits from doing exports,

$$\Pi^*_{MJ}(a, A, \eta) \overset{?}{\gtrless} \Pi^*_{XJ}(a, A, \eta) \tag{3.18}$$

Considering the same level of productivity we can solve the above inequality so as to put in evidence the role played by the communication costs. In particular, we want to observe for which value of the communication costs (18) is true. Thus we can rewrite the equation above in the following way

$$A_j a^{1-\varepsilon} \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left[\left(\lambda^i \tau_{ij} p_h \right)^{\eta} \right]^{1-\varepsilon} - f_c(dist\gamma^i) - f_M > A \left(\lambda^i \tau_{ij} a \right)^{1-\varepsilon} \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left[p_h^{\eta} \right]^{1-\varepsilon} - f_X$$

hence,

$$A_j a^{1-\varepsilon} \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left[p_h^{\eta} \right]^{1-\varepsilon} \left[\left(\phi\gamma^i \right)^{\eta} - \left(\phi\gamma^i \right) \right] - f_M - f_X > f_c(dist\gamma^i)$$

When distance is small enough this inequality holds. However, when distance becomes important, the condition above is more likely to be satisfied when ϕ increases, so when there is an improvement in trade openness, since the term $\left[\left(\phi\gamma^i \right)^{\eta} - \left(\phi\gamma^i \right) \right]$ is decreasing with liberalization. This would imply that engaging in FDI activity is more likely in a contest of free trade.

What is the role of distance on the affiliate sales? First of all, let's define the aggregate affiliate sales in the case of two countries:

$$\begin{aligned} S_A &= \int_0^{a_M} A_j a^{1-\varepsilon} \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left(p_h^{\eta} \right)^{1-\varepsilon} \left(\phi\gamma^i \right)^{\eta} g(a) da \\ &= \left(\frac{a_M}{a_D} \right)^k a_M^{1-\varepsilon} \frac{k}{k-\varepsilon+1} A_j \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left(p_h^{\eta} \right)^{1-\varepsilon} \left(\phi\gamma^i \right)^{\eta} \end{aligned}$$

The first term, $(a_M/a_D)^k$, represents the cumulative probability of firms from the origin country to own an affiliate in the destination country. As we said before, if we multiply this term with the total mass of firms from the origin country, $n^* G(a_M)$, we obtain the number of affiliate in the destination country. The remaining part of that expression represents average sales. Since

we are dealing with N symmetric countries, the overall aggregate sales are:

$$S_A = \sum_{i=0}^{\frac{N-1}{2}} \left(\frac{a_M}{a_D}\right)^k a_M^{1-\varepsilon} \frac{k}{k-\varepsilon+1} A_j \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left(p_h^{\eta}\right)^{1-\varepsilon} \left(\phi\gamma^i\right)^{\eta} \tag{3.19}$$

From the expression above, we see that a_M is positively related to the number of affiliates producing in foreign countries, while it is negatively related with the average size of foreign affiliates. Differentiating (19) with respect to a_M

$$\frac{\partial S_A}{\partial a_M} = \left(\frac{a_M}{a_D}\right)^k a_M^{-\varepsilon} k A_j \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left(p_h^{\eta}\right)^{1-\varepsilon} \left(\phi\gamma^i\right)^{\eta} > 0$$

we see that a_M, the threshold marginal cost of being a MNF, is positively related to aggregate affiliate sales. Hence, we can conclude that, as long as $k \geq \varepsilon$, the aggregate sales are positively affected by a change in the threshold marginal cost.

What can be said about the relationship between aggregate sales of affiliates and distance? First of all, we will use the zero-profits condition to derive the effect of distance on the threshold marginal cost, a_M

$$\Pi^*_{MJ}(a, A, \eta) = A_j a_{Mj}^{1-\varepsilon} \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left[\left(\phi\gamma^i\right)^{\eta} - \left(\phi\gamma^i\right)\right] p_h^{\eta(1-\varepsilon)} - f_c(dist\gamma^i) - f_M + f_X$$

where do not assume any particular functional form for $f_c(dist)$. Moreover, we should be careful because in the expression above distance is not directly observable, since: $\gamma^i \equiv \left(\lambda^i\right)^{1-\varepsilon}$. Hence, when distance is high (so when λ^i is large), γ^i will be small. Solving the expression above for a_M

$$a_M = \left(\frac{f_c(dist\gamma^i) + f_M - f_X}{B^j \left[(\phi\gamma^i)^{\eta} - (\phi\gamma^i)\right] p_h^{\eta(1-\varepsilon)}}\right)^{\frac{1}{1-\varepsilon}}$$

where B^j was defined before. Deriving this expression with respect to γ^i we find

$$\frac{\partial a_M}{\partial \gamma^i} = \frac{1}{1-\varepsilon} \left(\frac{f_c(dist\gamma^i) + f_M - f_X}{B^j \left[(\phi\gamma^i)^{\eta} - (\phi\gamma^i)\right] p_h^{\eta(1-\varepsilon)}}\right)^{\frac{1}{1-\varepsilon}-1}$$

$$* \left[\frac{f'(\gamma^i)}{B^j \left[(\phi\gamma^i)^\eta - (\phi\gamma^i) \right] p_h^{\eta(1-\varepsilon)}} - \frac{\left(f_c(dist\gamma^i) + f_M - f_X \right) \left(\eta \frac{(\phi\gamma^i)^\eta}{\gamma^i} - \phi \right)}{B^j \left[\left[(\phi\gamma^i)^\eta - (\phi\gamma^i) \right] p_h^{\eta(1-\varepsilon)} \right]^2} \right]$$

Since $\varepsilon > 1$, the first term is negative; the second term is more difficult to interpret because is not easy to know what is the sign of $\eta \frac{(\phi\gamma^i)^\eta}{\gamma^i} - \phi$. If this term is positive, then for values of γ^i sufficiently small[13], the term inside the square bracket would be negative. This would imply a positive sign of the derivative,

$$\frac{\partial a_M}{\partial \gamma^i} > 0$$

Hence, when distance is not too small the effect of distance on the cutoff marginal cost is always negative[14]. Therefore, since overall aggregate sales are positively related to the threshold marginal cost, it is immediate to conclude that when distance is sufficiently high, aggregate sales are decreasing in distance. This results is in line with recent empirical findings.

Since λ^i represents an increase in the trade costs due to different location of firms, we could interpret the increase in λ^i as an increase in the initial trade bloc, so as an increase in the circle dimension. Thus, given the above findings we can predict that an increase in the dimension of the trade bloc, induces a reduction on a_M, that implies a decrease a reduction in the affiliates' aggregate sales.

What is the role of distance on export? It could be interesting to compare the effect of distance on MNF's activities vs. export activities. For this purpose, in what follow we consider the effect of distance on export sales. Let's define the aggregate export sales in the case of two countries:

$$\begin{aligned} S_X &= \int_{a_M}^{a_X} A_j \left(\phi\gamma^i \right) a^{1-\varepsilon} \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left[p_h^\eta \right]^{1-\varepsilon} \\ &= A_j \left(\phi\gamma^i \right) \frac{(1-\alpha)}{\alpha^{1-\varepsilon}} \left[p_h^\eta \right]^{1-\varepsilon} \frac{k}{a_D^k} \frac{\left(a_X^{k-\varepsilon+1} - a_M^{k-\varepsilon+1} \right)}{k-\varepsilon+1} \end{aligned}$$

[13] Small values of γ^i would imply that the communication cost, $f_c(dist\gamma^i)$, is high.
[14] high values of λ imply a small γ, and so given the sign of the derivative a small a_M.

Deriving this expression with respect to a_X and a_M we find that

$$\frac{\partial S_X}{\partial a_M} = -\frac{\left(\phi\gamma^i\right)\frac{1}{a_D^k}a_M^{k-\varepsilon+1}k}{a_M}A_j\frac{(1-\alpha)}{\alpha^{1-\varepsilon}}\left[p_h^\eta\right]^{1-\varepsilon} < 0$$

and

$$\frac{\partial S_X}{\partial a_X} = \frac{\left(\phi\gamma^i\right)\frac{1}{a_D^k}a_X^{k-\varepsilon+1}k}{a_X}A_j\frac{(1-\alpha)}{\alpha^{1-\varepsilon}}\left[p_h^\eta\right]^{1-\varepsilon} > 0$$

As expected, export sales are increasing in a_X, the threshold marginal cost of being an exporter, and decreasing in a_M. In order to analyse the relationship between aggregate export sales and distance, we will use the zero-profits condition to derive the effect of distance on both the threshold a_M and a_X. We already know from the analysis above that $\partial a_M/\partial\gamma^i > 0$, which means: as long as distance is not too small the cutoff marginal cost a_M is negatively affected by distance. On the other side for what concern a_X

$$a_{Xj} = \left(\frac{f_X}{B^j\left(\phi\gamma^i\right)\left[p_h^\eta\right]^{1-\varepsilon}}\right)^{\frac{1}{1-\varepsilon}}$$

hence

$$\frac{\partial a_{Xj}}{\partial\gamma^i} = -\frac{\left(\frac{f_X}{B^j\left(\phi\gamma^i\right)\left[p_h^\eta\right]^{1-\varepsilon}}\right)^{\frac{1}{1-\varepsilon}}}{(1-\varepsilon)\gamma^i} > 0$$

the effect of distance on the cutoff marginal cost a_X is unambiguously positive.

3.4 The Impact of Trade

In the present framework, with N symmetric countries, we observe the effect of opening to trade. Since f_E does not change in the transition from autarky to trade, the FE conditions are left unaffected by trade: regardless of profit differences across firms (relative to export or FDI status), the expected value of future profits, in equilibrium, must equal the fixed investment cost f_E (sunk cost). Hence, as in Melitz 2003, the transition from autarky to open economy, will move up the ZCP curve: the exposure to trade induces an increase in the cutoff productivity

level ($\left(\frac{1}{a_D}\right)^T > \left(\frac{1}{a_D}\right)^A$)[15]. This will modify the productivity level of the least productive firms. In an open economy situation, a firm with a productivity level between $\left(\frac{1}{a_D}\right)^A$ and $\left(\frac{1}{a_D}\right)^T$ cannot earn positive profits and so will exit from the market. Moreover, as pointed out by Melitz, another selection process acts: firms with productivity level above $\left(\frac{1}{a_X}\right)$ or above and $\left(\frac{1}{a_M}\right)$ enter respectively as exporters or as subsidiary. These three effects are called *domestic market selection effect*, *export market selection effect* and *FDI market selection effect*. These effects reallocate market shares towards more efficient firms, and generate an increase in the overall productivity.

The transition toward the open economy situation generates a reduction in the number of firms operating in every country[16]. The equilibrium number of firms in each country will represent the total number of firms selling in that country: total number of domestics firms, foreign exporters and multinationals. The number of firms decreases as a consequence of the domestic market selection effect ($a_D \downarrow$). However, as the entrance of new foreign firms more than compensate this reduction, consumers typically enjoy a larger amount of varieties.

3.5 Conclusions

The paper analyses the choice between FDI and Exports in a framework where the existence of intermediate inputs makes MNF activities affected by trade costs. Some asymmetries between countries, in terms of different country locations, are assumed. The production of the final good variety requires a particular input combination between services and labor manufacture. Hence, when a subsidiary is built abroad this service input has to be imported from the home nation. This makes the total marginal costs of selling via FDI rising with distance. The relationship between home and foreign nations gives rise to communication costs. The existence of intermediate inputs and communication costs leads to a result in which the ratio of MNF firms shrinks. We found that under certain condition the aggregate affiliate sales are decreasing with distance. While the amount of exports is increasing with distance. This result is consistend with the recent empirical findings.

[15] Recall that the ZPC are downward sloping and the FE conditions are upward sloping.
[16] As in Melitz, $M < M_A$, where M_A represents the number of firms in autarky.

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