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# THE IMPACT OF ECONOMIC INTEGRATION ON FDI AND EXPORTS: A GRAVITY APPROACH

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**Abstract**

This paper uses the gravity-model approach to deal with two issues related to economic integration. The first concern is to analyse the impact on FDI stocks of specific variables denoting the will to integrate, and their relative impact on exports. Variables considered include tariffs, non-tariff barriers and exchange rate variability. The results show that the widespread opinion – and theoretical claim – of 'tariff-jumping' FDI is not supported by the evidence. Moreover, non-tariff barriers have a negative impact on FDI, revealing the greater role of sunk costs for foreign investors as opposed to exporters. In contrast to the impact on exports, exchange rate variability does not have a negative impact on FDI, since it can partially be overcome by directly investing in the host country. The second concern deals with the debate on the complementarity vs. substitutability relationship between exports and FDI. At the aggregate level, the results show that a complementary relationship holds.

**Keywords:** Foreign Direct Investment, Economic integration, Gravity Model.
**JEL classification codes:** F15, F21, F23.

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# THE IMPACT OF ECONOMIC INTEGRATION ON FDI AND EXPORTS:
## A GRAVITY APPROACH

FRANCESCA DI MAURO

**Introduction**

Economic integration between countries has continued to deepen over the past decade. This is especially visible at the regional level, with the escalation of Regional Integration Agreements (RIAs) ranging from Free Trade Areas (FTAs) to Customs Unions (CUs), such as NAFTA, Mercosur or ASEAN. These developments have renewed interest in the economics of regional integration, first raised by Viner (1950). Since trade and Foreign Direct Investment (FDI) are generally recognised as the two main channels of economic integration, the most topical issues in the debate about RIAs relate to trade creation, trade diversion, the 'redirection' of FDI from non-members to members of the RIA and the phenomenon of 'tariff-jumping FDI' (the latter suggesting FDI is only substitute for trade). A typical example of the perceived 'threat' deriving from RIAs is the European Single Market, initially labelled 'Fortress Europe'. The European Union, however, provides also one of the most interesting laboratories to assess the impact of such deep integration. Indeed, several studies have been carried out in order to assess its economic impact, either *ex-ante* - see e.g. Baldwin (1989), Neven and Röller (1991) and Brenton and Winters (1992), or *ex-post* in the years following the implementation of the Single Market Programme (SMP) – Baldwin *et al.* (1995), Sapir (1996) and Brenton (1996). Amongst others, the European Commission study (1996) attempted to include all aspects of potential effects: on trade, on efficiency and competition, on FDI, on income and employment and on the growth and convergence of EU Member States.

In this paper the main concern is not to assess the impact of the Single Market Programme specifically, but the emphasis is rather on the effect of economic integration upon FDI, *relative* to that on exports. Is economic integration more beneficial to FDI or to exports? Which variables reflecting economic integration are more prone to FDI and to exports? Given that FDI is often associated with greater dynamic effects, such as the technology transfer, which in turn may lead to beneficial effects for the recipient country, the impact of economic integration on FDI is potentially more important and deserves close attention.

Economic integration is proxied here through three main variables: exchange rate variability (ERV), tariff barriers and non-tariff barriers (NTBs), and included in gravity-type equations for FDI and for exports in turn. These variables are the most immediate policy instruments available to countries to reveal their will to integrate. The surge of currency boards in emerging countries is an example of what can be called 'monetary integration'. These economies commit to a stable exchange rate in order to gain the trust of investors and to boost their trade. The set-up of the European monetary system (EMS) in the EU pursued the primary objective of stabilising the EU currencies, with an expected benefit for the economies. Similar arguments hold for a reduction in tariffs and even more in NTBs, both measures of 'commercial integration'. I should stress here that this paper does not

seek to reconsider the relationship between exchange rate variability and trade, a topic extensively treated in the literature (see e.g. De Grauwe and Bellefroid (1986), Perée and Steinherr (1989), Gagnon (1993) and Sapir and Sekkat (1995)). In contrast, this relationship has been largely neglected in the FDI literature, even though trade and FDI share very similar characteristics. My purpose is therefore to analyse the relative impact of exchange rate variability on exports as compared to the one on FDI.

Economic integration among countries can also be a concern in terms of employment. An important example was the creation of NAFTA, with American workers perceiving a jobs threat from Mexican 'maquiladoras'. A similar concern arises in the EU, where European firms investing in Central and Eastern Europe are seen as replacing European labour with cheaper labour available in these countries. With either horizontal or vertical FDI, domestic firms investing abroad rather than exporting may leave the export sector at home worse-off. This constitutes the second concern of this paper, and the issue of whether exports and FDI are complements or substitutes will be addressed following Graham's (1996) approach.

It should be stressed at the outset that the focus of the paper is the study of FDI, while the analysis on exports is used as a comparative tool. Thus the review in Section 1 only focuses on the theory of FDI and it is finalised to the derivation of the gravity model used in the empirical part. In Section 2 I discuss the *expected* impact of economic integration on exports and FDI and their potential inter-linkages. The empirical analysis will be presented in Section 3, followed by some concluding remarks in Section 4.

## 1. The theory of FDI

In recent years FDI has received more and more interest from economists and policy-makers. On the one hand, this is probably due to its growing economic importance for both developed and developing countries. According to the 1999 *World Investment Report*, in the past decade both global output and global sales have grown faster than world GDP and world exports. Thus, sales of foreign affiliates are now greater than world total exports of goods, implying that firms use FDI more than they use exports to service foreign markets. Moreover, FDI inward flows represented in 1998 11% of Gross Fixed Capital Formation (UNCTAD (2000)) revealing the importance that these flows can have for economic growth. On the other hand, given the many aspects of FDI, a wide range of economists has become involved in the research: from trade economists, for the close relationship between trade and FDI and development and growth economists, for its effects on the host economy, to regional economists, for its implications for RIAs and industrial economists, for the impact on industrial restructuring. In this section though, I am mainly concerned with the theories that explain the *determinants* of FDI.

### 1.1 The OLI framework

The traditional theory of FDI tries to explain why firms produce abroad instead of simply servicing the markets via exports. After all, multinational companies (MNCs) experience additional costs in producing abroad: higher costs in placing personnel abroad, communication costs (international phone calls, travel expenses for executives or even time costs due to mail delays), language and cultural differences, informational costs on local tax laws and regulations, costs of being outside domestic networks; they also incur higher risks,

such as the risks of exchange rate changes or even of expropriation by the host country. One theoretical approach, introduced by Dunning (1977, 1981), the "OLI framework", considers FDI as determined by Ownership, Location and Internalisation advantages which the MNC holds over the foreign producer; when these advantages outweigh the above costs, FDI arises. The *ownership advantage* includes a product or a production process to which other firms do not have access, such as a patent, blueprint or trade secret, to more intangible advantages such as reputation for quality. The *location advantage* stems directly from the foreign market, such as low factor prices or customer access, together with trade barriers or transport costs that make FDI more profitable than exporting. Finally, the *internalisation advantage* is a more abstract concept to explain why licensing may not be practised; it derives from the firm's interest in maintaining its knowledge assets (such as highly skilled workers who know the firm's technology) internally. This avoids "defection" once the licensee has come to understand the technology and sets up his own firm, in competition with the MNC.[1] Informational asymmetries may also push MNCs to prefer foreign production over licensing, such as better knowledge of the domestic market by the licensee. The fear of being substituted with direct production in the presence of highly selling markets would provide incentive for the licensee to under-declare the potential absorption capacity of a market. Finally, advantages derive from the reduction of transaction costs (for contracting, quality assurance, etc.) that arise in case of licensing.
The main problem of this framework is that although it does explain the existence of MNCs, it has had difficulty explaining the recent trends in FDI, namely their surge among similar countries (horizontal FDI); further, no sound empirical models have been generated in order to compare real data with the theory.

## 1.2 The "New Theory of FDI"

The so-called "New Theory of FDI" refers mainly to the *ownership* and *location* advantage and introduces MNCs in general equilibrium models, where they arise endogenously. Helpman (1984) and Helpman and Krugman (1985) – exponents of the early literature - derive the activity of MNCs when they try to explain intra-firm trade, that is, an additional component of international trade. The models are based on two main assumptions: (1) there is product differentiation and economies of scale, and (2) there are some firm inputs that behave like public goods[2]. Moreover, it is assumed that transport costs are zero and the MNCs will split their production process between a 'headquarter' activity, often skill or capital-intensive, and the plant production abroad. In other terms, the factor proportions in the two activities of the MNE differ, which is the rationale for multinational activity to arise at all. This is recognisable as 'vertical FDI', since firms separate their production process in order to take advantage of factor price differentials across countries. The implications of these models for a potential derivation of the gravity model are that only differences in relative factor endowments across countries (often proxied by GDP per capita) matter for the location of MNCs abroad. This also implies that the 'type' of FDI

[1] Of course, the problem of "moral hazard" can also appear within a subsidiary, but its activity is more subject to the MNC's control.

[2] These are inputs such as management, marketing, R&D, that are specific to the firm and that can be easily transferred from one plant to another, at virtually no cost, hence the denomination of 'public good'.

that can arise from the theory is limited to 'vertical' FDI, also called 'efficiency-seeking' FDI.

Instead, what is observed among developed countries is mainly horizontal FDI, because similar types of production activities, owned by MNCs, take place in different countries, as for example in the car industry. Brainard's (1993) and Markusen and Venables' (1998) models account for this type of FDI and they arrive at empirically testable hypothesis about the activity of MNCs. Their work starts from the observation that indeed most FDI is motivated by "market-access" reasons, rather than by differences in factor prices; this is confirmed for example by the fact that in 1999 over 90% of FDI is between North-North countries (UNCTAD (2000)) rather than North-South, as the Helpman-Krugman theory of MNCs would predict. The main idea is that the firm faces a trade-off between advantages of proximity (to the foreign market) vs. advantages of concentration (of the plant), given the presence of firm-level economies of scale (again, special inputs such as R&D, management, etc.) as well as the usual plant-level economies of scale. With transport costs, whenever the former advantage outweighs the latter, a firm will go multinational and replace exports with FDI.

In Brainard's model (1993) three types of equilibria can arise: a pure multinational equilibrium, when proximity advantages are greater than concentration ones, a pure trade equilibrium, when the opposite is true, and a 'mixed equilibrium' when the two advantages are equal and MNCs coexist with single-plant, single-country firms. It is important to note at this stage that the model assumes symmetry of factor endowments, which is the reason why 'vertical MNCs' cannot arise, in contrast to the Helpman-Krugman model. The empirical hypotheses are derived from the costs structure of the firms, who face additional variable costs in exporting and additional fixed costs of opening up a plant abroad. For example, the number of firms that will export increases with the fixed plant cost (because then they can benefit from economies of scale by concentrating production) and decreases with the level of transport costs and trade barriers. Strictly speaking, from the theoretical model can be derived only those variables that are linked to plant-level vs. firm-level economies of scale, plus the 'trade costs' variables. This implies for example the presence of distance (a proxy for transport costs) or trade costs (tariffs). However, Brainard's empirical work (Brainard (1997)), in addition to these mentioned variables, introduces the 'income per-worker differential', justified as a control variable for factor-proportions differences and the host country GDP, because, in her words, this variable is more likely to be an important determinant of the presence of MNCs.
In the model of Markusen and Venables (1998) MNCs arise endogenously in a general equilibrium framework, even though their focus is only on horizontal direct investment. The model includes two countries, two homogenous goods and two factors. Firms in each country can be of two types: national or multinational, which gives four firm-types in total. From the firms' different cost structures and with the assumption of Cournot competition and free entry, the model can explicitly solve for 'production regimes', i.e. the combination of firm types that operate in equilibrium. Again, the key variables for determining the presence of MNCs are transport costs, plant and firm-level economies of scale and market size. Asymmetry of countries in terms of relative factor endowments does not lead to vertical MNCs, since they are excluded by assumption. In contrast, the general result is that MNCs become more and more important as countries become more similar in size, relative endowments and as world income grows.

In Markusen (1997) the model is refined even further, with the formal introduction of both types of MNCs: horizontal and vertical, plus the usual national single-plant firms. There are therefore six firm-types: single-plant NE in each country, two-plant horizontal MNCs and single-plant vertical MNCs[3]. We are still in a theoretical setting and empirical representations of the theory are always conducted via numerical simulations. One of the messages of the paper is that MNCs benefit from (or produce) some sort of 'knowledge-capital', that allows headquarter services to provide a crucial input for production abroad. It is only with a series of papers in late 1998 and 1999 that an empirical test of the theory is carried out (Carr, Markusen and Maskus (1998), Markusen and Maskus (1999a) and Markusen and Maskus (1999b)), as well as a synthesis of past theoretical advances. In the last of these papers, three models are tested simultaneously: the knowledge-capital model (KK), the horizontal MNCs model (HOR) and the vertical MNCs one (VER). A simulation analysis is used to identify the impact on each model of the recurrent variables: the size of the economy (measured by GDP), world GDP (the sum of each country's GDP) and the relative factor endowments (measured by the difference in the ratio of skilled workers over total employment), as well as some interaction term between them. Their results give strong support to the HOR model, while both the VER and KK do poorly.

### 1.3 From theory to practice: the Gravity Model

When I get to the empirical analysis, and I want to be able to compare 'attractiveness' across countries and explain the geographic distribution of FDI, I need a model that can pick up its common determinants. In order to synthesise the two approaches discussed above, i.e. Helpman and Krugman's treatment of vertical FDI and Brainard's horizontal one, I will include in the model the following variables[4]: relative factor endowments, an index of countries' similarity in size, geographic distance between the partner countries and a measure of the 'economic space' between the two countries, given by the sum of the two GDPs. The last variable is included to catch the 'market-seeking' aspect of FDI, i.e. when investors produce abroad to sell in the host market and increase their market shares there. Additional variables, such as a common language, a common border, or preferential trade agreements, that may reduce the costs of locating abroad, can be introduced via dummy variables.

This simple specification can easily be recognised as the 'gravity model', which I will use throughout the empirical analysis. In contrast to the common view among economists, the gravity model rests on a sound theoretical basis. Maurel (1998) carries out a thorough investigation on its origins, and shows its evolution across the trade theories of Linnemann (1966), Helpman and Krugman (1985) and the empirical studies by Helpman (1987) and Brainard (1997). She also shows how the gravity model applied to trade can be compatible with both the traditional Heckscher-Ohlin and the Helpman and Krugman framework,

[3] This set of firm-types is still not complete, as there may be two-plant vertical MNCs, where only a part of the production chain is carried out abroad and the re-imported goods are intermediary. The cost structure in this case may be different.

[4] A similar version of this model specification was first introduced by Helpman (1987) for a trade equation; more recently, Egger (2000) has applied a refined version of it to both exports and FDI data.

without becoming a meaningless black box. Given the similarity between trade and FDI in terms of trends, it has also been employed to estimate bilateral FDI flows (see Brenton (1996), Eaton and Tamura (1996), and Brenton and Di Mauro (1999)). The general form of the gravity equation that I estimate is the following:

$$\ln Y_{ij} = \alpha + \beta_1 SUMGDP_{ij} + \beta_2 SIMSIZE_{ij} + \beta_3 RELENDOW_{ij} + \beta_4 DIST_{ij} + \sum \gamma_k D_{kij} + \varepsilon_{ij} \quad (1)$$

with the following variable definitions: $Y_{ij}$ is the value of FDI or exports from country *i* (home country) to country *j* (host country);

$$SUMGDP_{ij} = \ln\left(GDP_i + GDP_j\right) \quad (2)$$

$$SIMSIZE_{ij} = \ln\left[1 - \left(\frac{GDP_i}{GDP_i + GDP_j}\right)^2 - \left(\frac{GDP_j}{GDP_i + GDP_j}\right)^2\right] \quad (3)$$

$$RELENDOW_{ij} = \left(\ln\frac{GDP_i}{Pop_i} - \ln\frac{GDP_j}{Pop_j}\right) \quad (4)$$

$DIST_{ij}$ is the relative distance between countries *i* and *j*. Following the advice of Polak (1996), I use here a measure of relative distance rather than absolute, i.e. the logarithm of actual distance divided by the average distance of the investing country from its partners, weighted by the shares of the latter in world GDP. This correction prevents the gravity model from producing biased results: a downward bias for far-away countries and an upward one for close-in countries.

$D_{kij}$ are dummy variables (mostly country dummies) used when appropriate and $\varepsilon_{ij}$ is the usual error term.

A precision needs to be made at this point concerning the dependent variable FDI. In fact, the models à la Brainard and Markusen are mainly concerned with MNC activity, as opposed to that of the national exporter. With this respect, they correctly identify as the principal variable of interest - especially for the empirical analysis - the level of affiliate production abroad. This requires availability of such data, which in practice is limited - in a consistent way - to Sweden and the USA, typical case-studies of the literature (see e.g. Blomstrom *et al.* (1997), Brainard and Riker (1997), Markusen and Maskus (1999b) and Svensson (1996)). As my variable of interest is FDI, at least I make use of FDI *stock*, with the justification that these are used in the production process abroad, and hence constitute a good proxy for foreign affiliate production[5]. I now briefly discuss the impact of what I will call the 'gravity variables'.

The 'economic space' variable (SUMGDP) is expected to have a positive impact in both the FDI and exports equation. The index of size similarity (SIMSIZE) takes values between -∞ (i.e. the log of a number near zero) in case of perfect dissimilarity and -0.69 (the log of 0.5) for perfect similarity. Similarity in size should have a positive effect on exports:

[5] A strong correlation certainly exists between FDI stock and foreign affiliates production, and I am implicitly assuming here that the relationship is linear, but it may not be. Further inquiry in this direction could prove useful and I envisage it for the future.

countries similar in size will trade more, as the Helpman and Krugman theory of increasing returns predicts, trade is of intra-industry nature. I also expect a positive coefficient in the FDI equation, if the New FDI Theory holds true, as those models were motivated by the observation that FDI arises more among similar countries.

Differences in relative endowments (RELENDOW) are measured here by the simple difference in GDP per capita[6]; one could question the validity of this proxy, since, as noted in Helpman (1987), this method is accurate when there are only two factors of production (capital and labour) and all goods are freely traded. Better measures would be: GDP per worker, the ratio of capital (gross fixed capital formation) over working population, or that of skilled workers in total employment, as advocated by Wood (1994) for assessing the factor content of trade. However, given the poor reliability in employment and capital stocks data, especially for developing countries, I decided to stick with this definition of factor endowments. As far as the impact is concerned, a negative coefficient in the exports equation is a sign that Helpman and Krugman's theory of intra-industry trade (IIT) prevails: trade is not determined by differences in factor composition, as foreseen by traditional Heckscher-Ohlin inter-industry type trade models. For FDI, the story is similar: vertical FDI (equivalent to inter-industry trade) emerges as countries greatly differ in their factor composition – hence showing a positive coefficient, while horizontal FDI (comparable to IIT) is determined by similarity in factor composition, therefore displaying a negative coefficient. One cannot know a-priori which type prevails and the answer is an empirical one.

As for distance, the effect on exports is clearly negative, being it a proxy for transport costs. On the other hand, FDI theory suggests that firms will invest abroad rather than export provided that trade costs are high. However, this variable may also have a negative coefficient in the FDI equation since the costs of operating overseas affiliates are still likely to rise the further they are from the MNCs headquarters. Overall though, I expect the coefficient in the exports equation to be higher than that in the FDI equation.

Having defined the general gravity equation, I can now turn more specifically to the objective of the paper, i.e. assessing the impact that economic integration has on FDI and on exports. The possible misspecifications in the gravity equation identified by Polak (1996) and Matyas (1997), especially when preferential trading blocs hypotheses are tested among a group of countries, are directly tackled here. By introducing some specific factors that characterise economic integration, rather than by just using dummy variables for countries belonging to the same regional integration area, I precisely try to avoid the problems identified by these authors. If a proper specification of the model is ensured then, it looks like the gravity equation represents a good way to proceed empirically.

[6] Measuring this difference in absolute terms - as done by Helpman (1987) or Egger (2000) equates in practice to restricting the impact of this variable only to *positive* differences, while in fact the rationale for it is just that *any* large difference in factor endowments causes vertical FDI or inter-industry trade.

## 2. Expected impact of economic integration

Typically economic integration will be characterised by a few important changes affecting integrating countries, at various degrees, and they can be stylised as follows:

1. Reduction of tariffs (abolition of tariffs and adoption of a common external tariff, in the customs union case);
2. Reduction of Non-Tariff Barriers (NTBs) – e.g. this was the aim of the Single Market Programme (SMP);
3. Potential greater exchange rate stability, as witnessed in the European Monetary System (EMS);
4. Greater efficiency in the allocation of resources, due to increased competition;

The first two effects can be called 'commercial changes', since they are directly connected with trade policy. The third is related to 'monetary integration', while the last can be called 'market integration'. My focus will be on the first three, mainly because quantitative measures are readily available for these three effects and also because I have not investigated yet an aggregated measure of market integration. Nevertheless, reduction of NTBs can also be viewed as a general reduction of 'regulatory barriers', which in turn increases competition. The effect of market integration is therefore indirectly picked up, and what remains is the role of competition policy.

### 2.1 Impact of commercial changes

Let's put ourselves in the case of a Regional Integration Area (RIA), as an extreme exemplification of what happens when countries deeply integrate among themselves. When analysing the impact of commercial changes, a main distinction should be made between members and non-members of the RIA. On the one hand we have the fact that a reduction of trade costs will directly benefit exports. If we assume that the 'tariff-jumping' argument holds (which in fact should be tested first) we would expect a *reduction* in FDI from the members of the RIA, relative to exports. That is, exports should become more profitable as a means of servicing the foreign market *within* the RIA. On the other hand though, but only in the case of a customs union, the opposite may become true for non-members. The trade diversion effect of the RIA creation leads previous exporters to directly invest in the RIA, in order to both avoid the tariff *and* access a larger market that is then free of tariffs.

Smith (1987) analyses the effect on FDI of trade policy adjustments within a game-theoretical approach. MNCs act in a strategic way in concentrated markets, and may decide to invest rather than export into a country in order to avoid entry of domestic firms, in the presence of sunk costs. In his model, the impact of a reduction in tariffs is not clear a priori, and depending on the initial equilibrium, it may also increase FDI, thereby reversing the 'tariff-jumping' argument[7].

Blonigen and Feenstra (1996) look at the dynamic impact of a creation of a RIA, where it may act as a protectionist 'threat' against non-members and push MNCs to anticipate establishment into the bloc in order to avoid potential higher tariffs when exporting into it. A similar result is reached by Donnenfeld (1998), who constructs a model based on non-cooperative games, where the existence of MNCs may modify the optimal trade policy of

[7] See Motta (1992) for an extension of Smith's model.

competing RIAs. He finds that at fixed tariffs, the only way to integrate between two regional blocs is through FDI, which leads to full trade diversion and investment creation. The effect of FDI on the tariff level is also analysed. Given that high tariffs would encourage FDI more than they encourage exports, MNCs exert a pressure upon the bloc's capacity to set high tariffs and prevent tariff wars internationally. Nevertheless, it looks to us that if the purpose of the bloc is to protect itself from both FDI and exports from non-members (for which a justification has also to be found), then setting lower tariffs may indeed increase the opportunity-cost of MNCs to invest in the bloc, but it also reduces the cost of exports! Moreover, as highlighted by Motta and Norman (1996), regional blocs will benefit more in terms of welfare if they concentrate on reducing internal barriers rather than coordinate on tougher external trade policy. The explanation is that since FDI is beneficial for the host country, each member of the RIA has an incentive in encouraging it, but non-bloc MNCs will flow in only under the condition of 'market-accessibility', which is ensured by minimising the level of intra-bloc trade barriers. Finally, whatever is the assumed relationship between exports and FDI (complements or substitutes) or the nature of FDI (horizontal or vertical) a tariff reduction will always benefit imports of intermediary goods in the host country or imports of the final good in the home country, hence favouring both exports and FDI.

The net result on FDI in a RIA of these tariffs adjustments therefore depends on which effects will prevail, the pro-FDI or the anti-FDI one. Since it is not clear from the theoretical point of view, it becomes an empirical issue, as pointed out by Winters (1997). Of course I am not considering other tools to protect members of a bloc from non-bloc investors here, as for example the rules of origin set up by the EU. By imposing a 'local-content requirement', the EU can protect itself from imports of Korean goods produced in Eastern Europe, that benefit from free-trade under the Europe Agreements. The effect is to discourage such investment by non-members and it would not be picked up only by looking at the level of the tariffs.

I would just like to point out here that in the theoretical literature the implicit (crucial) assumption is that barriers to trade are a good incentive for FDI. But if this were to be true, real-world data should show that most FDI arises between developed and developing countries (or blocs), where the average MFN tariffs are higher. Nevertheless in 1998 over 90% of FDI flows were within developed countries. In my empirical analysis I explicitly introduce the tariffs variable into the FDI equation.

Similar arguments apply to NTBs' reduction. There is a straightforward positive effect on exports, given that their reduction diminishes trade costs, but the impact appears less clear for FDI. On the one hand, exports become more profitable compared to FDI, when a firm decides how to service the foreign market; on the other hand, and especially for non-members of the RIA, their reduction transforms investment in a member country into a good export-platform to reach all the other member countries (the market access argument) and hence we should observe an increase from non-members. The net effect is again uncertain theoretically and justifies the direct inclusion of this variable in the gravity equations.

## 2.2 Impact of monetary integration

The issue of exchange rate variability and its effect on trade has been debated at length. Many empirical studies have been produced since the collapse of the dollar exchange standard in 1971, and the passage from a fixed to a flexible exchange rate regime. The studies either compare different exchange rates regimes (De Grauwe and Bellefroid (1986)) or model explicitly exchange rate variability and trade flows (see Perée and Steinherr (1989), Dell'Ariccia (1998)). The purpose here is not to find a better measure of it, but to look at the relative impact on exports and FDI.

The economics behind a supposed (negative) relationship between exchange rate variability and trade flows stems from the fact that the exporter incurs some production costs in his own currency, while the future revenues are expressed in a foreign one[8]. Any change in the exchange rate during the period before payment is therefore a potential loss or benefit for the exporter. Of course, forward currency markets exist and can be used, but generally they are unavailable for periods longer than one year and are practically non-existent in developing countries. Moreover, the presence of long-term commitments to the export activity, as for example to obtain export licenses, may act as sunk costs not 'hedgeable' in the forward market. These factors all lead to assume a certain risk-aversion against exchange rate variability and hence that trade would be favoured by stable exchange rates. Previous empirical studies have not arrived at a clear-cut conclusion on the issue, with the results ranging from no effect of exchange rate variability (Gagnon (1993)) to some findings of a negative effect (De Grauwe and Bellefroid (1986), Dell'Ariccia (1998), Perée and Steinherr (1989)).
As far as FDI is concerned, it has been very much neglected by the previous empirical analysis, even though it shares many characteristics with trade and therefore one would expect economists to investigate its relationship with exchange rate variability as well. The first step of the reasoning is that if exchange rate variability is really bad for trade, we may expect that it will induce FDI, because then by directly localising the production abroad firms would eliminate part of the exchange rate risk. Secondly, if a RIA does reduce exchange rate variability among its members, then there is a strong case to observe a reduction in FDI from non-members, *ceteris paribus*, and hence an increase in exports as the preferred channel of integration, given the reduced exchange rate risk. But contrary arguments could also apply, if exchange rate variability is intrinsically bad for FDI too. For example repatriated profits are worth less in case of a revaluation of the domestic currency, exported inputs may be worth less in case of a devaluation or imported final goods may be more expensive in case of a devaluation. Again, even a priori the net effect on FDI is not clear from a theoretical point of view and needs to be evaluated empirically. In my analysis I will consider two medium-term measures of exchange rate variability, following De Grauwe and Perée and Steinherr. This is especially appropriate for FDI, whereby foreign investors look at the long-term stability of a currency when deciding where to invest, rather than the short one, given the greater sunk costs that they incur.

[8] A similar argument can be made for the importer, whereby his buying contract is in foreign currency, while the selling price is set in domestic value and is therefore subject to unexpected variations.

## 2.3 FDI and exports: complements or substitutes?

One of the major concerns of the home country when discussing MNCs activity is related to the labour market, either in terms of employment or wages. A major example was the outcry upon the creation of NAFTA, with American workers perceiving a jobs threat from Mexican 'maquiladoras'. In terms of employment, the channel through which the labour market can be affected is two-fold. On the one hand, when a firm establishes a plant abroad and produces directly in the host market rather than exporting, the export sector at home may be left worse-off, with some domestic plants closing down and unemployment rising. This would be the case with horizontal FDI. On the other hand, when a firm produces abroad in order to take advantage of cheaper labour and export back home, as in the case of vertical FDI, domestic workers may again be left worse-off, especially the unskilled ones. In both cases though we have to take into account the effect of intra-firm trade, e.g. in capital or intermediate goods, from the parent firm to the affiliate, since this can fuel demand for labour in the home economy, and therefore offset the negative impact on the final good sector. The net effect is uncertain though, and at the theoretical level any outcome is possible, depending on specific parametrisation. The issue then becomes an empirical matter, as often pointed out in the literature (see Baldwin (1995b)).

In the empirical literature, two approaches have been followed until now to tackle this issue: a direct approach and an indirect one. The former usually consists in estimating simple regressions equations of the demand for labour of home-country parent firms, as a function of affiliates net sales (which proxy their production). This implies to be able to use data on activities of foreign affiliates, which – again - can be done in a consistent way only for the U.S. and Sweden, two countries with such figures (see for example Blomström et al. (1997), Brainard and Riker (1997) and Svensson (1996)). The results usually show a very low substitution between employment at home and in the affiliates.

The indirect way to empirically test the impact of FDI on employment is to look at the relationship between exports and FDI. Here the objective is to see whether FDI substitutes for exports, and therefore indirectly harms the exporting sector's employment at home. The methodology that I adopt takes inspiration from the work of Graham (1996) and has already been employed in Brenton and Di Mauro (1999). Two gravity equations are estimated, one for exports and one for FDI, and then the residuals of the estimation are regressed against each other. The presumption of this method is to remove the influence of the common factors on FDI and on exports, by using gravity equations. A positive correlation between the two residuals is therefore interpreted as a sign of complementarity, since high residuals in exports are associated with high residuals in FDI, and vice-versa. This method is intended only to give a first indication about the relationship between exports and FDI, and should be viewed as a starting point for further analysis.

Graham's empirical study focuses on the US and Japan, for both of which he finds a complementarity relationship. Brenton and Di Mauro extend the empirical analysis to include the FDI outflows of European countries, France, Germany and the UK, in addition to the US. The results show a statistically significant positive coefficient for all regressions between FDI and exports, strongly suggesting a complementary relationship.

The novelty here is that I directly introduce some variables linked to economic integration (the three discussed above), which therefore 'clean' even further the remaining information

in the residuals. This analysis can in fact be viewed as a supplementary way of testing the complementarity vs. substitutability issue. The *prima facie* evidence is represented by the observation of the tariff coefficient in the FDI gravity equation. In fact, the 'tariff-jumping' argument - i.e. a synonym for exports and FDI being substitutes - holds if we find a positive coefficient attached to the tariff variable. This would mean that greater tariffs induce FDI and reduce exports. Therefore a coherent result would be to get a positive coefficient in the tariff variable in the FDI equation, *and* a negative coefficient in the complementarity vs. substitutability test. This would reveal that FDI is jumping the tariff *and* that exports and FDI are substitutes. And vice versa. As a caveat, I would like to emphasise here that even though a complementarity relationship may hold between FDI and exports at an *aggregate* level, sectoral analysis may not confirm this conclusion. Future research will therefore investigate this issue more closely.

## 3. Empirical analysis

I now get to empirically analyse my first concern, the impact on exports and FDI of the three variables of economic integration identified in Section 2, once the 'gravity variables' are taken into account. Previous analyses have made wide use of dummy variables to catch the effect of economic integration, as for example the analysis of a 'domino effect' in Europe by Sapir (1997). Here I directly tackle the issue by including in the gravity-model equations the specific variables that are meant to play an important role in economic integration: tariffs, NTBs and exchange rate variability (ERV). Moreover, once I have taken into account the various factors determining both FDI and exports, I can attack my second concern and test the complementarity vs. substitutability relationship between exports and FDI, following the methodology proposed by Graham (1996).

Countries considered include France, Germany, Italy, UK, Japan, South Korea, US and Canada, who together account for nearly 70% of world outward FDI stock (1998), and constitute my set of 'home countries' (i.e. investing or exporting countries). The set of 'host countries' for either exports or FDI stocks is constituted by both OECD and non-OECD members. My sample of home countries includes the four big countries in the EU and its three main trading partners. South Korea has been included since it represents well the situation of some emerging economies, which from net recipient of FDI are slowly becoming net investors. In 1997 its ratio of outward to inward FDI flows was above 1.8, while the same ratio for the stocks showed a value of 1.2 (UNCTAD (1998)). For the eight home countries, I estimate three gravity-type equations for exports and FDI in 1988, 1993 and 1996, under various specifications. The years available are constrained by the sources of tariffs and NTBs data - i.e. OECD (1997), UNCTAD (1997) and UNCTAD (1994), which include data on tariffs and NTBs for non-OECD countries. Fortunately, these years also correspond to a greater effort of integration within the EU, with the implementation of the Internal Market. They are therefore appropriate for a measure of the impact of economic integration. The Annex contains precise sources of variables, summary statistics, correlation matrices and the list of recipient countries.

The estimated gravity equation is therefore constructed for each year as follows:

$$\ln Y_{ij} = \alpha + \beta_1 SUMGDP_{ij} + \beta_2 SIMSIZE_{ij} + \beta_3 RELENDOW_{ij} + \beta_4 DIST_{ij} + \beta_5 TAR_{ij} + \beta_6 NTB_{ij} + \beta_7 ERV_{ij} + \\ + \delta_i + CI + \varepsilon_{ij} \qquad (5)$$

Where $Y_{ij}$ is the value of FDI or export from country *i* (home country) to country *j* (host country). I then include on the RHS the 'gravity variables' previously discussed: *SUMGDP*, *SIMSIZE*, *RELENDOW* and $DIST_{ij}$, as well as *TAR*, the level of the tariff, *NTB*, the non-tariff barriers, and *ERV*, a measure of exchange rate variability. I also include a measure of 'political' integration, the Corruption Index (CI), which is meant to catch the impact of a hostile environment on business, together with home countries fixed effects ($\delta_i$) - see below. Variable definitions are now discussed in more detail.

**Tariffs**

My measure of tariffs is the simple average of MFN (Most Favoured Nation) at an aggregate level. The trade-weighted MFN average (i.e. weighted with imports) suffers in fact from a downward bias, since the most protected goods also have a nearly zero weight; on the contrary, the production-weighted MFN average suffers from an upward bias from the fact that highly protected goods enter with a greater weight. Therefore I decided to use the simple average. It could be considered a little limited to consider only the MFN tariff, especially in the case of EU countries, for which a complex system of concessions to ACP countries, preferential trade arrangements or GSP (generalised system of preferences) exists. However, although the share of countries receiving mostly MFN treatment is only 42%, for various reasons the overall importance of this regime reaches 70% of imports entering the EU[9]. Moreover, by only considering this regime I am indirectly deriving an upper bound of the impact of trade barriers, at least for the EU. Lastly, since for each pair of EU countries the MFN takes value zero, the variable is expressed as ln(1+MFN%).

**NTBs**

The measure of NTBs considered here is a 'frequency ratio'. It is an approximation of the share of tariff lines affected by any type of NTB. The calculation runs as follows (UNCTAD (1994)): the frequency ratio is equal to 0% if no NTB applies to a certain tariff line; it is 50% if an NTB applies to some of the products of the tariff line and goes up to 100% if an NTB applies to all products. In the case of more than one NTB per tariff line, the incidence is still 100%. Usually NTBs are classified into 'price measures' and 'quantitative restrictions'. The former includes voluntary restrictions in export prices, variable duties and anti-dumping measures. The latter includes non-automatic licensing regimes, voluntary exports restrictions and other quantitative restrictions. Again, as this type of NTBs are not allowed within the EU, the variable takes zero value for each pair of EU Member States, and I consequently express the variable as ln(1+NTB%).

**ERV**

I consider two different measures of exchange rate variability. They are both based on the nominal bilateral exchange rate between country *i* and *j*. The first measure, ERV1, is a deviation from Perée and Steinherr (1989). It is calculated over the medium term, according to the following formula:

$$ERV1 = \frac{\max(\ln ER_{t-k}) - \min(\ln ER_{t-k})}{\min(\ln ER_{t-k})}$$

[9] For more details, see Commission of the European Communities (1993).

Where ER is the nominal bilateral exchange rate; k<t is the period over which the maximum and the minimum are taken (I consider 5 years). Their original measure also included an indicator of the short-term variability, based on the difference between the actual and the "equilibrium" exchange rate. My reduced version only captures what they name "accumulated experience" of exchange rate variability in a country, i.e. a sort of 'memory' of what the exchange rate has been, not just in the past year, but over a longer period. It is somehow a 'rough' version of ERV, since I only look here at the *range* of the exchange rate. In fact, if the maximum and the minimum reach very extreme values in two points of the period considered, but if over the same period the exchange rate does not vary very much, my measure would over-estimate the concept of variability. Of course, agents may also be interested in knowing what is the magnitude of their exchange rate risk, hence the magnitude of their potential losses, and with these limits in mind, I keep this 'rough' measure.

The second, more 'sophisticated' measure ERV2, is a variation from De Grauwe and Bellefroid (1986). They consider a long-run measure of ERV, by taking the standard deviation of the yearly percentage changes of bilateral exchange rates over a period of ten years. In fact their purpose is to test for a difference in the exchange rate regime, by looking at data before and after 1973. My measure is again more over the medium-term, since I calculate the standard deviation of the yearly percentage changes of bilateral exchange rates (in logarithms) in the previous five years.

Finally, I include in equation (5) a more 'political' measure of economic integration, given by the 'Corruption perceptions Index' (CI)[10]. The index is a composite measure of corruption across countries, derived from surveys by various institutions, each giving a ranking of nations. Because of the way it is constructed, a higher index means less corruption, so we should observe positive coefficients if we think that FDI and exports flow less into corrupt countries.

A final (important) point before showing the results of the estimation deals with the 'fixed effects' issue. Matyas (1997) has shown that the correct econometric specification of the gravity model should: *a)* be estimated as a fixed effect model rather than a random effect one (claim also made by Egger (2000)), and *b)* that being a 'two-way fixed effects panel data model', it should include fixed effects for the *home* country, for the *host* country and for *time*, when applicable.

In my case, the first correction surely applies, as the home countries considered are not randomly sampled over all investors, but in fact they constitute almost my entire population[11]. As far as the second correction is concerned, I can only include *home* country fixed effects, as the *host* country ones are collinear with the tariff variable: in each year the same tariff rate applies to each host country, hence it cannot be compatible with a host country dummy. However, Matyas' paper is concerned with the statistical significance of

[10] The index is elaborated each year by Transparency International and Göttingen University for a series of countries; it is available at http://www.gwdg.de/~uwvw.

[11] See Greene (1997) p. 633 and Matyàs and Sevestre (1992) chap. 2 for a discussion on *fixed effects* vs. *random effects* models in panel data estimations.

trading blocs and potential economic areas, those that empiricists usually try to catch with 'bloc dummies'; in this paper I specifically try to avoid this, by explicitly introducing real variables of economic integration (such as tariffs, ERV, etc.). In other words, what was before caught by dummies ("a sign of our ignorance") were a series of variables, specific to the host country, without specifying them, while I now do so. Hence I can omit Matyas' suggestion of including *host* country fixed effects, without mis-specifying the gravity equation. Finally, as I estimate each equation for one year, I do not have a time dimension.

In each year, therefore, I have a stacked matrix with eight home countries, for which there are between 20 and 33 host countries. This explains why I have 232 observations, instead of 264 (8x33) as would be the case with a full sample. Moreover, because of the presence of heteroskedasticity, the GLS estimator was used, together with home country fixed effects. The results of the estimations are shown in tables 1 to 4. Tables 1 and 2 show the results when using ERV1 and tables 3 and 4 with ERV2. The interpretation can address either changes over time in the coefficients, or their relative magnitudes for exports and FDI.

**Table 1: Gravity equation on exports flows: France, Germany, Italy, UK, Japan, US, Korea, Canada, using ERV1**

| | 1988 | | | 1993 | | | 1996 | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Coefficient* | *Std. Error* | *z* | *Coefficient* | *Std. Error* | *z* | *Coefficient* | *Std. Error* | *z* |
| SUMGDP | 1.6121 | 0.1248 | 12.9190 | 1.5364 | 0.1070 | 14.3610 | 1.7836 | 0.1051 | 16.9730 |
| SIMSIZE | 0.5939 | 0.0736 | 8.0740 | 0.5422 | 0.0721 | 7.5170 | 0.6889 | 0.0788 | 8.7380 |
| RELENDOW | 0.2447 | 0.0929 | 2.6330 | 0.0617 | 0.1007 | 0.6130 | 0.3466 | 0.0957 | 3.6210 |
| DIST | -0.6524 | 0.0450 | -14.5040 | -0.6706 | 0.0434 | -15.4640 | -0.5779 | 0.0414 | -13.9720 |
| LMFN | -2.3266 | 0.7738 | -3.0070 | 0.1133 | 1.1503 | 0.0990 | -3.0349 | 1.3800 | -2.1990 |
| LNTB | -0.8630 | 0.3240 | -2.6640 | -1.8535 | 0.4651 | -3.9860 | -3.8959 | 0.7249 | -5.3740 |
| ERV1 | 0.0053 | 0.0262 | 0.2030 | -0.0001 | 0.0002 | -0.8740 | -0.0001 | 0.0001 | -0.6930 |
| CI | 0.0875 | 0.0360 | 2.4330 | 0.0211 | 0.0310 | 0.6810 | 0.0732 | 0.0317 | 2.3080 |
| ger | 0.7270 | 0.1303 | 5.5800 | 0.3626 | 0.1390 | 2.6080 | 0.4001 | 0.1752 | 2.2830 |
| ita | -0.1897 | 0.1532 | -1.2380 | -0.1146 | 0.1461 | -0.7840 | -0.0479 | 0.1242 | -0.3860 |
| uk | 0.3468 | 0.1695 | 2.0450 | 0.3826 | 0.1644 | 2.3270 | 0.3174 | 0.1603 | 1.9800 |
| jap | -0.2076 | 0.2151 | -0.9650 | -0.3025 | 0.2311 | -1.3090 | -0.5252 | 0.1934 | -2.7160 |
| us | -0.2359 | 0.2818 | -0.8370 | -0.1651 | 0.2516 | -0.6560 | -0.2839 | 0.2177 | -1.3040 |
| kor | 0.6336 | 0.3839 | 1.6510 | 0.5405 | 0.2478 | 2.1810 | 0.9604 | 0.2279 | 4.2140 |
| can | -0.0634 | 0.1937 | -0.3270 | -0.3286 | 0.1921 | -1.7100 | 0.0100 | 0.1978 | 0.0500 |
| _cons | -13.0645 | 1.7989 | -7.2630 | -11.7086 | 1.6072 | -7.2850 | -15.5859 | 1.6232 | -9.6020 |
| $R^2$ | 0.7622 | | | 0.7784 | | | 0.7721 | | |
| Adj. $R^2$ | 0.7457 | | | 0.7630 | | | 0.7562 | | |
| S.E. of regression | 1.4246 | | | 1.2948 | | | 1.2486 | | |
| Log likelihood | -140.9852 | | | -122.0659 | | | -109.0665 | | |

**Table 2: Gravity equation on FDI flows: France, Germany, Italy, UK, Japan, US, Korea, Canada, using ERV1**

| | 1988 | | | 1993 | | | 1996 | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Coefficient* | *Std. Error* | *z* | *Coefficient* | *Std. Error* | *z* | *Coefficient* | *Std. Error* | *z* |
| SUMGDP | 1.7926 | 0.3388 | 5.2910 | 1.6622 | 0.2442 | 6.8080 | 1.9318 | 0.2381 | 8.1140 |
| SIMSIZE | 0.7343 | 0.1484 | 4.9490 | 0.8333 | 0.1286 | 6.4820 | 0.9553 | 0.1371 | 6.9680 |
| RELENDOW | 0.1045 | 0.1999 | 0.5230 | 0.0319 | 0.1866 | 0.1710 | 0.2869 | 0.1829 | 1.5690 |
| DIST | -0.4220 | 0.1042 | -4.0510 | -0.4493 | 0.0845 | -5.3160 | -0.4193 | 0.0799 | -5.2500 |
| LMFN | -2.2138 | 1.6823 | -1.3160 | -2.1495 | 2.1407 | -1.0040 | -2.3941 | 2.5415 | -0.9420 |
| LNTB | -3.2961 | 0.7225 | -4.5620 | -2.7837 | 0.8767 | -3.1750 | -4.2284 | 1.2426 | -3.4030 |
| ERV1 | -0.0333 | 0.0586 | -0.5670 | -0.0001 | 0.0002 | -0.6970 | 0.0000 | 0.0001 | 0.2070 |
| CI | 0.1155 | 0.0775 | 1.4890 | 0.0924 | 0.0576 | 1.6050 | 0.1760 | 0.0612 | 2.8770 |
| ger | 1.0359 | 0.2935 | 3.5290 | 0.3250 | 0.2703 | 1.2020 | 0.3226 | 0.3335 | 0.9680 |
| ita | -0.0704 | 0.4804 | -0.1470 | -0.3955 | 0.3931 | -1.0060 | -0.2967 | 0.3397 | -0.8740 |
| uk | 1.0680 | 0.4935 | 2.1640 | 0.7716 | 0.3058 | 2.5230 | 0.6040 | 0.2949 | 2.0480 |
| jap | 0.6550 | 0.5366 | 1.2210 | 0.4676 | 0.4537 | 1.0310 | 0.3624 | 0.3312 | 1.0940 |
| us | 1.3482 | 0.6289 | 2.1440 | 1.0422 | 0.4800 | 2.1710 | 0.8216 | 0.3851 | 2.1330 |
| kor | -4.5223 | 0.9949 | -4.5460 | -2.1725 | 0.6164 | -3.5250 | -0.9777 | 0.4591 | -2.1290 |
| can | 0.5263 | 0.6450 | 0.8160 | 0.4543 | 0.4121 | 1.1020 | 0.3111 | 0.6392 | 0.4870 |
| _cons | -17.5402 | 4.8377 | -3.6260 | -14.7721 | 3.6186 | -4.0820 | -19.2634 | 3.6381 | -5.2950 |
| $R^2$ | 0.6111 | | | 0.6380 | | | 0.5717 | | |
| Adj. $R^2$ | 0.5841 | | | 0.6129 | | | 0.5419 | | |
| S.E. of regression | 2.8683 | | | 1.9212 | | | 1.6874 | | |
| Log likelihood | -358.0871 | | | -289.6838 | | | -280.9808 | | |

**Table 3: Gravity equation on exports flows: France, Germany, Italy, UK, Japan, US, Korea, Canada, using ERV2**

| | 1988 | | | 1993 | | | 1996 | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Coefficient* | *Std. Error* | *z* | *Coefficient* | *Std. Error* | *z* | *Coefficient* | *Std. Error* | *z* |
| SUMGDP | 1.5991 | 0.1231 | 12.9920 | 1.5428 | 0.1037 | 14.8770 | 1.8009 | 0.1044 | 17.2510 |
| SIMSIZE | 0.6136 | 0.0730 | 8.4020 | 0.6055 | 0.0716 | 8.4550 | 0.6943 | 0.0782 | 8.8750 |
| RELENDOW | 0.2722 | 0.0925 | 2.9440 | 0.1039 | 0.0979 | 1.0610 | 0.3363 | 0.0950 | 3.5390 |
| DIST | -0.6070 | 0.0468 | -12.9610 | -0.6394 | 0.0426 | -15.0200 | -0.5779 | 0.0410 | -14.0950 |
| LMFN | -2.5416 | 0.7682 | -3.3090 | -0.3499 | 1.1167 | -0.3130 | -2.7741 | 1.3764 | -2.0150 |
| LNTB | -0.5585 | 0.3393 | -1.6460 | -1.9990 | 0.4507 | -4.4360 | -4.1180 | 0.7279 | -5.6570 |
| ERV2 | -1.0780 | 0.3622 | -2.9760 | -0.1014 | 0.0241 | -4.2020 | -0.1273 | 0.0636 | -2.0010 |
| CI | 0.0724 | 0.0359 | 2.0180 | 0.0130 | 0.0301 | 0.4320 | 0.0661 | 0.0316 | 2.0910 |
| ger | 0.7431 | 0.1306 | 5.6920 | 0.3745 | 0.1345 | 2.7850 | 0.3971 | 0.1735 | 2.2880 |
| ita | -0.1471 | 0.1554 | -0.9470 | -0.0652 | 0.1415 | -0.4610 | -0.0376 | 0.1232 | -0.3050 |
| uk | 0.3398 | 0.1650 | 2.0600 | 0.3838 | 0.1572 | 2.4410 | 0.3191 | 0.1596 | 1.9990 |
| jap | -0.1925 | 0.2137 | -0.9010 | -0.2536 | 0.2216 | -1.1450 | -0.5139 | 0.1922 | -2.6740 |
| us | -0.2113 | 0.2784 | -0.7590 | -0.1192 | 0.2411 | -0.4940 | -0.3037 | 0.2140 | -1.4190 |
| Kor | 0.6446 | 0.3772 | 1.7090 | 0.5784 | 0.2378 | 2.4330 | 0.9732 | 0.2264 | 4.2990 |
| Can | -0.1091 | 0.1897 | -0.5750 | -0.3274 | 0.1846 | -1.7730 | 0.0802 | 0.1981 | 0.4050 |
| _cons | -12.7739 | 1.7761 | -7.1920 | -11.6834 | 1.5578 | -7.5000 | -15.7713 | 1.6100 | -9.7960 |
| $R^2$ | 0.7587 | | | 0.7867 | | | 0.7767 | | |
| Adj. $R^2$ | 0.7420 | | | 0.7719 | | | 0.7612 | | |
| S.E. of regression | 1.4214 | | | 1.3017 | | | 1.2524 | | |
| Log likelihood | -136.7381 | | | -114.0664 | | | -107.1213 | | |

**Table 4: Pooled Gravity equation on FDI flows: France, Germany, Italy, UK, Japan, US, Korea, Canada, using ERV2**

| | 1988 | | | 1993 | | | 1996 | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Coefficient* | *Std. Error* | *z* | *Coefficient* | *Std. Error* | *z* | *Coefficient* | *Std. Error* | *z* |
| SUMGDP | 1.8617 | 0.3222 | 5.7780 | 1.6635 | 0.2440 | 6.8180 | 1.9260 | 0.2382 | 8.0860 |
| SIMSIZE | 0.6745 | 0.1440 | 4.6840 | 0.7959 | 0.1319 | 6.0340 | 0.9489 | 0.1370 | 6.9260 |
| RELENDOW | 0.0452 | 0.1921 | 0.2350 | 0.0120 | 0.1876 | 0.0640 | 0.2917 | 0.1831 | 1.5930 |
| DIST | -0.5472 | 0.1042 | -5.2500 | -0.4617 | 0.0852 | -5.4220 | -0.4225 | 0.0798 | -5.2930 |
| LMFN | -1.4366 | 1.6212 | -0.8860 | -1.9874 | 2.1492 | -0.9250 | -2.4972 | 2.5441 | -0.9820 |
| LNTB | -4.2600 | 0.7355 | -5.7920 | -2.6123 | 0.8766 | -2.9800 | -4.1388 | 1.2417 | -3.3330 |
| ERV2 | 3.1646 | 0.7838 | 4.0380 | 0.0615 | 0.0492 | 1.2510 | 0.1521 | 0.2279 | 0.6680 |
| CI | 0.1633 | 0.0747 | 2.1850 | 0.0959 | 0.0577 | 1.6610 | 0.1805 | 0.0617 | 2.9280 |
| ger | 0.9890 | 0.2769 | 3.5710 | 0.3157 | 0.2696 | 1.1710 | 0.3249 | 0.3322 | 0.9780 |
| ita | -0.1733 | 0.4209 | -0.4120 | -0.4197 | 0.3930 | -1.0680 | -0.3069 | 0.3396 | -0.9040 |
| uk | 1.0985 | 0.4790 | 2.2930 | 0.7730 | 0.3054 | 2.5310 | 0.6050 | 0.2943 | 2.0560 |
| jap | 0.5702 | 0.5158 | 1.1050 | 0.4279 | 0.4544 | 0.9420 | 0.3488 | 0.3319 | 1.0510 |
| us | 1.2261 | 0.6002 | 2.0430 | 0.9674 | 0.4803 | 2.0140 | 0.8236 | 0.3822 | 2.1550 |
| kor | -4.4757 | 0.9887 | -4.5270 | -2.1894 | 0.6171 | -3.5480 | -0.9792 | 0.4597 | -2.1300 |
| can | 0.6845 | 0.6393 | 1.0710 | 0.4493 | 0.4120 | 1.0910 | 0.2503 | 0.6443 | 0.3880 |
| _cons | -18.9017 | 4.6035 | -4.1060 | -14.8704 | 3.6171 | -4.1110 | -19.2271 | 3.6383 | -5.2850 |
| $R^2$ | 0.6270 | | | 0.6401 | | | 0.5751 | | |
| Adj. $R^2$ | 0.6010 | | | 0.6152 | | | 0.5456 | | |
| S.E. of regression | 2.9053 | | | 1.9244 | | | 1.6926 | | |
| Log likelihood | -349.4756 | | | -289.0445 | | | -280.8073 | | |

As a general comment, the equation performs slightly better with exports than with FDI, with higher adjusted R squared[12] and lower standard errors. In both the export and the FDI equation, and with either ERV1 or ERV2, the variables SUMGDP, SIMSIZE and DIST are always significant and with the expected sign. Exports are positively affected by size similarity, a sign that the Helpman and Krugman theory of intra-industry trade (IIT) is at work. For distance, as expected I observe a greater negative impact on exports than on FDI. Moreover, the inclusion of two different measures of exchange rate variability does not dramatically change the magnitude of the coefficients for the other variables. As far as RELENDOW is concerned, in the exports equation (see Tables 1 and 3) it usually shows a positive coefficient (except in 1993); however, the magnitude is smaller than the one for SIMSIZE. I interpret this as evidence that both IIT (size similarity matters) and inter-industry trade (differences in relative factor endowments matter) co-exist, but the former prevails.

In the FDI equation, the variable on differences in factor endowments provides an interesting insight into the nature of FDI itself (see Tables 2 and 4). The coefficient is never significantly different from zero. The 'efficiency-seeking' argument does not seem to be an important determinant of FDI, while the SIMISZE variable has an even greater positive impact on FDI than on exports (compare for example the coefficients in table 1 and 2). In other words, FDI is not driven by differences in factor endowments (hence prices), but by countries similarity. As predicted by the "New Theory of FDI", *horizontal* FDI will arise between countries at similar level of development, and my results confirm this prediction.

As far as exchange rate variability is concerned, while ERV1 is never significant, ERV2 always has a negative impact on exports (compare tables 1 and 3), with a significantly smaller coefficient after 1988. If exchange rate variability is genuinely bad for exports, my analysis shows that a more sophisticated measure such as ERV2 seems more appropriate to pick up this effect. In contrast, exchange rate variability never has an impact on FDI, whatever measure is used (Tables 2 and 4), except in 1988 with ERV2. The '80s can certainly be viewed as a period of high turbulence in exchange rates, and in this period it was plausible for investors to avoid such variability by locating production in the country considered, in so far as other conditions were fulfilled.

The 'commercial' variables (MFN and NTBs) both have the expected negative impact upon exports (see Tables 1 and 3) whichever measure of ERV is used, with the exception of 1993, when the MFN coefficient is not significant. This could be indirectly explained by the effects of the 'Single Market Programme' re-launched after 1992, and with the abolition of customs in 1993. Exports in those subsequent years have increased among EU countries, where the MFN variable takes value zero, hence reducing the negative impact of tariffs on exports.

The impact of the MFN variable on FDI is quite interesting too - and identical for both ERV1 and ERV2. In the three years considered, the MFN coefficient is not significantly different from zero (see Tables 2 and 4). This implies that FDI does not respond to

[12] These are own calculations, as the GLS estimator does not provide a ready measure of the fit; see Greene (1997) for a discussion on the alternatives.

changes in tariffs, which in turn suggests that the 'tariff-jumping' argument is not supported by the evidence. In other terms, an increase in the tariff level has no impact on FDI, it does not harm it, but it does not induce it either. In a very simplified way, as mentioned previously, this is a first *direct* sign of FDI and exports being complementary. Moreover, the coefficient of the NTB variable on FDI always displays a negative sign; this could be explained via the argument of 'market-accessibility' and the existence of sunk costs. When foreign firms invest in a host country, they incur sunk costs in setting up the affiliates; if they then cannot access a larger market, not because of tariffs, but because of NTBs, their losses can be even greater than for the exporters. This supports the Motta and Norman (1992) argument, whereby regional blocs will benefit more in terms of welfare if they concentrate on reducing internal barriers rather than co-ordinating on tougher external trade policy.
Finally, the Corruption Index variable CI mostly displays a positive coefficient in both the export and FDI equation, showing that corruption may be perceived as an obstacle by investors and exporters.

As far as the 'trend' in the coefficients is concerned, I observe that the impact of size similarity (SIMSIZE) grows over time, and this is true for both exports and FDI. The results show that more and more, the main channels of economic integration - exports and FDI - flow among similar countries, which in a way confirms the 'convergence hypothesis' predicted in Markusen and Venables (1995).

I now get to the complementarity vs. substitutability relationship between exports and FDI. As already said, the method proposed by Graham is to regress against each other the residuals from each gravity estimation, the one on exports and the one on FDI, the presumption being that if the gravity equations have indeed removed the influence of the common factors, the residual correlation may show other causal relationship between exports and FDI, not explained by the usual gravity factors. I present in table 5 the results of the complementarity vs. substitutability analysis. I decided to run the regressions only with the ERV2 measure. The residuals from the FDI equation play the role of the dependent variable, regressed against those of the export equation. As can be seen, for all three years considered the coefficients are positive and highly significant. The relationship of exports and FDI is practically always close to one-to-one for 1988, 1993, and 1996.

**Table 5: Complementarity vs. substitutability: regression on exports residuals**

| *Dep. Var.:* | **1988** | | **1993** | | **1996** | |
|---|---|---|---|---|---|---|
| *Residual FDI* | *coefficient* | *t statistics* | *coefficient* | *t statistics* | *Coefficient* | *t statistics* |
| Residual exports | 1.0446 | 6.4190 | 1.2021 | 9.9480 | 0.9765 | 0.1271 |
| Adj. $R^2$ | 0.1482 | | 0.2978 | | 0.2007 | |
| N.of observations | 232 | | 232 | | 232 | |

As already mentioned, this method can only account for a complementarity or substitutability relationship between exports and FDI at an *aggregate* level. Sectoral studies may instead show different results in the different sectors.

## 4. Concluding remarks

In this paper I have used the gravity approach to directly analyse the impact on exports and FDI of several variables which are recognised as being the means of economic integration: commercial barriers (tariffs, NTBs) and monetary variables (exchange rate variability). As predicted by the "New Theory of FDI", my results show that FDI is mainly of a horizontal nature, in the sense that foreign investors mainly invest abroad in order to sell in the host market; in my case this is indicated by the positive impact of the variable 'size similarity', while differences in factor endowments never matter. Moreover, the empirical analysis shows that exchange rate variability does not seem to have an impact on the decision to invest abroad, except during the turbulent 1980s, when FDI represented a means of reducing exchange rate risk. For exports, in contrast, I find a negative impact of exchange rate variability when using the more sophisticated measure ERV2, confirming results from the empirical literature that uses more long-term measures of variability.

Another interesting result concerns the impact on FDI of the commercial variables. Tariffs consistently have no impact on FDI, implying that the 'tariff-jumping' argument is not supported by the empirical analysis. This conclusion certainly needs to be tested by other scholars, and eventually should have repercussions on the theory of FDI itself, as it is generally assumed that high trade costs are a good incentive for FDI to arise in the first place. Similarly, NTBs seem to have a large negative impact on FDI, which I explain by the existence of sunk costs for foreign investors and supports the 'market-accessibility' argument. FDI will flow into a RIA only if internal barriers are reduced. Finally, my analysis on the complementarity vs. substitutability issue of exports and FDI shows that, on aggregate, FDI and exports are complementary: a 10% increase in exports will lead – most of the time - to an increase in FDI exceeding 10%.

Sectoral analysis may not confirm this finding, hence my future research will look at the disaggregate aspect of exports and FDI, for example by using the few available databases at a sectoral level (e.g. for Germany, France and the UK). Future refinements of the paper will also consider better measures of the differences in factor endowments, e.g. by restricting the analysis to OECD countries, hence augmenting the reliability of employment and capital stocks data.

## REFERENCES


Alessandrini S. (1997) "EU Foreign Direct Investments in Central and Eastern Europe" research project for DG III.

Baldwin R.E. (1989) "The growth effects of 1992" *Economic Policy*, N. 2, pp. 247-281.

Baldwin R.E. (1995a) "A domino theory of regionalism" in Baldwin R.E., Haaparanta P., Kiander J. (eds.) *Expanding Membership in the European Union*, Cambridge University Press.

Baldwin R.E (1995b) "The Effects of Trade and Foreign Direct Investment on Employment and Relative Wages" NBER Working Paper N. 5037, February.

Baldwin R.E., Forslid R. and Haaland J. (1995) "Investment creation and investment diversion: simulation analysis of the single market programme" CEPR Discussion Paper N. 1308, December.

Blomström M., Fors G. and Lipsey R.E. (1997) "Foreign Direct Investment and Employment: Home Country Experience in the US and Sweden" *The Economic Journal* November.

Blonigen B.A. and Feenstra R.C. (1996) "Protectionist Threats and Foreign Direct Investment" NBER Working Paper Series, N. 5475, March.

Brainard S. L. (1993) "A Simple Theory of Multinational Corporations and Trade with a Trade-off between Proximity and Concentration" NBER Working Paper N. 4269, February.

Brainard S.L. (1997) "An Empirical Assessment of the proximity-concentration Tradeoff between Multinational Sales and Trade" *American Economic Review* Vol. 87, N. 4.

Brainard S. L. and Riker D.A. (1997) "Are U.S. multinationals exporting U.S. jobs?" NBER Working Paper N. 5958, March.

Brenton P. (1996) "The Impact of the Single Market on Foreign Direct Investment in the EU" Report for DG II, *mimeo*, (1996).

Brenton, P. and Di Mauro, F. (1999) "The Potential Magnitude and Impact of FDI flows to CEECs", *Journal of Economic Integration*, Vol. 14 N. 1, March, pp. 59-74.

Brenton P. and Winters A. (1992) "Estimating the international trade effects of 1992: West Germany" *Journal of Common Market Studies*, N. 30, pp. 143-156.

Buigues P. and Ilzkovitz F. (1990) "The impact of the internal market by industrial sector: the challenge for Member States" *European Economy*.

Carr D., Markusen J. R. and Maskus K. (1998) "Estimating the Knowledge-Capital model of the multinational enterprise" NBER Working Paper N. 6773, October.

Commission of the European Communities (1988) "The Economics of 1992" *European Economy*, N. 35, March.

Commission of the European Communities (1993) "The European Community as a world trade partner" *European Economy* N. 52.

Commission of the European Communities (1996) "Economic Evaluation of the Internal Market" *European Economy* Reports and Studies N. 4.

Dell'Ariccia G. (1998) "Exchange Rate Fluctuations and Trade Flows: Evidence from the European Union" IMF Working Paper, WP/98/107, August.

De Grauwe P. and Bellefroid B. (1986) "Long-run exchange rate variability and international trade" International Economics Research Paper N. 50, KUL.

Donnenfeld S. (1998) "Regional Blocs and Foreign Direct Investment" FEEM Nota di Lavoro N. 30.98.

Dunning J. (1977) "Trade, Location of Economic Activity and MNE: A Search for an Eclectic Approach" in Ohlin B., Hesselborn P. And Wijkman P/M/ eds. *The International Allocation of Economic Activity*, Macmillan, London.

Dunning (1981) International Production and the Multinational Enterprise, George Allen and Unwin, London.

Eaton J. and Tamura A. (1996) "Japanese and US exports and investment as conduit of growth" NBER Working Paper N. 5457, February.

Gagnon J. (1993) "Exchange rate variability and the level of international trade" *Journal of International Economics* Vol. 34, pp. 269-287.

Graham E. M. (1996) "On the Relationship Among FDI and International Trade in the Manufacturing Sector: Empirical Results for the United States and Japan" WTO - Staff Working Paper RD-96-008, July.

Greene W.H. (1997) *Econometric Analysis* Third Edition, Prentice Hall.

Helpman E. (1984) "A Simple Theory of International Trade with Multinational Corporations" *Journal of Political Economy*, Vol. 92, N. 31.

Helpman E. (1987) " Imperfect Competition and International Trade: Evidence from Fourteen Economies" *Journal of the Japanese and International Economies*, 1.

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

Linnemann H. (1966) "An Econometric Study of International Trade Flows", Amsterdam: North-Holland.

Markusen J. R. (1997) "Trade Versus Investment Liberalisation" FEEM Nota di Lavoro N. 75.97 September.

Markusen J.R and Maskus K. (1999a) "Multinational firms: Reconciling Theory and Evidence" NBER Working Paper N. 7163, June.

Markusen J.R and Maskus K. (1999b) "Discriminating among alternative theories of the multinational enterprise" NBER Working Paper N. 7164, June.

Markusen J.R. and Venables A.J. (1995) "Multinational Firms and the New Trade Theory" NBER Working Paper N. 5036, Feb.

Markusen J.R. and Venables A.J. (1998) "Multinational Firms and the New Trade Theory" *Journal of International Economics* Vol. 46, 183-203.

Matyàs L. (1997) "Proper Econometric Specification of the Gravity Model" *The World Economy* Vol. 20.

Matyàs L. and Sevestre P. *eds.* (1992) *The Econometrics of Panel Data*, Kluwer Academic Publishers, The Netherlands.

Maurel M. (1998) *Régionalisme et désintégration en Europe centrale et orientale – Une approche gravitationnelle*, CNRS Economie, Paris.

Motta M. (1992) "Multinational firms and the tariff-jumping argument" *European Economic Review* Vol. 32, pp. 1557-1571.

Motta M. and Norman G. (1996) "Does economic integration cause foreign direct investment?" *International Economic Review* Vol. 37, N. 4, November.

Neven and Röller (1991) "European integration and trade flows" *European Economic Review* Vol. 35, pp. 1295-1309.

OECD (1997) 'Indicators of tariffs and non-tariff measures' CD-ROM.

OECD (1998) 'International direct Investment Statistics Yearbook', Paris.

Perée E. and Steinherr A. (1989) "Exchange rate uncertainty and foreign trade" *European Economic Review* Vol. 33, pp. 1241-1264.

Polak J.J. (1996) "Is APEC a Natural Regional Trading Bloc? A Critique of the 'Gravity Model' of International Trade" *The World Economy* Vol. 19, N. 5, September.

Sapir A. (1996) "The effects of Europe's internal market programme on production and trade: a first assessment" *Weltwirstchaftliches Archiv*, Vol. 132, N. 3.

Sapir A. (1997) "Domino effects in West European Trade, 1960-92" CEPR Discussion Paper N. 1576, February.

Sapir A. (1998) "The political economy of EC regionalism" *European Economic Review*, Vol. 42, pp. 717-732.

Sapir A. and Sekkat K. (1995) "Exchange rate regimes and trade prices: Does the EMS matter?" *Journal of International Economics* Vol. 38, pp. 75-94.

Smith A. (1987) "Strategic Investment, Multinational Corporations and Trade Policy" *European Economic Review* Vol. 31, pp. 89-96.

Svensson R. (1996) "Effects of Overseas production on Home Country Exports: Evidence Based on Swedish Multinationals" *Weltwirtschaftliches Archiv* Vol. 132 (2).

UNCTAD (1994) 'Répertoire des Régimes d'importations', Geneva.

UNCTAD (1997) Trade Analysis and Information System (TRAINS) CD-ROM, Version 5.0, Autumn.

UNCTAD (1998) *World Investment Report*, Geneva.

UNCTAD (1999) *World Investment Report*, Geneva.

UNCTAD (2000) *World Investment Report*, Geneva.

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

Winters L. A. (1997) "Assessing Regional Integration Arrangements" *mimeo* June.

# ANNEX

**Data definitions and sources:**

| | |
|---|---|
| FDI: | stocks in current million dollars, from OECD (1998) |
| Exports: | flows in current million dollars, from Direction of Trade Statistics Yearbook (DOTSY), IMF, various years |
| GDP: | current million dollars, International Financial Statistics (IFS), IMF, various years |
| Population: | millions, IFS, IMF, various years |
| Distance: | own calculation: calculated as the distance in km. between the two capital cities and divided by the average distance from host countries, weighted with the share in world GDP of the latter |
| MFN: | (1+MFN rate in percentage points), from OECD (1997) and UNCTAD (1994, 1997) |
| NTBs: | 'frequency ratio', see p. 19 for exact definition, from OECD (1997) and UNCTAD (1994, 1997) |
| Exchange rate: | nominal bilateral exchange rate, own calculation from IFS CD-ROM, 1996 |
| CPI: | country ranking, from http://www.gwdg.de/~uwvw |

**Host countries**

Home countries do not have among themselves the same sample of host countries; I only present here the maximum number of available countries. However, for each home country, the same sample of host countries is kept over time.

Argentina, Australia, Austria, Belgium-Luxembourg, Brazil, Canada, Chile, China, Denmark, Finland, France, Germany, Greece, Hong Kong, India, Indonesia, Ireland, Italy, Japan, Korea, Malaysia, Mexico, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States.

## SUMMARY STATISTICS

| **1988** | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| LEXPS | 232 | 7.4506 | 1.6318 | 0.0000 | 11.4100 |
| LFDIST | 232 | 5.6500 | 3.6692 | -6.9100 | 11.1800 |
| SUMGDP | 232 | 14.2189 | 0.8403 | 12.2364 | 15.8635 |
| SIMSIZE | 232 | -1.7458 | 0.9099 | -4.6200 | -0.6931 |
| RELENDOW | 232 | 0.7549 | 1.3275 | -1.8425 | 4.5002 |
| DIST | 232 | 2.8911 | 1.1003 | 0.3347 | 4.7720 |
| LMFN | 232 | 0.1094 | 0.1203 | 0.0000 | 0.5800 |
| LNTB | 232 | 0.1473 | 0.1600 | 0.0000 | 0.6700 |
| ERV1 | 232 | -0.2129 | 2.5141 | -33.4354 | 7.0300 |
| ERV2 | 232 | 0.1423 | 0.1451 | 0.0000 | 0.6700 |
| CI | 232 | 6.4997 | 2.2542 | 0.2000 | 8.4100 |

| **1993** | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| LEXPS | 232 | 7.8114 | 1.4676 | 4.2200 | 11.6500 |
| LFDIST | 232 | 6.9232 | 2.4052 | -6.9100 | 12.0800 |
| SUMGDP | 232 | 14.5169 | 0.8313 | 12.8334 | 16.1622 |
| SIMSIZE | 232 | -1.6864 | 0.8680 | -4.2854 | -0.6938 |
| RELENDOW | 232 | 0.7083 | 1.2688 | -1.5020 | 4.7925 |
| DIST | 232 | 2.8850 | 1.0976 | 0.3098 | 4.7851 |
| LMFN | 232 | 0.0883 | 0.0925 | 0.0000 | 0.4253 |
| LNTB | 232 | 0.0995 | 0.1261 | 0.0000 | 0.4861 |
| ERV1 | 232 | 21.5281 | 330.8363 | -48.1577 | 5038.5880 |
| ERV2 | 232 | 0.4988 | 1.7960 | 0.0005 | 10.1846 |
| CI | 232 | 6.4056 | 2.4140 | 0.5700 | 9.3000 |

| **1996** | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| LEXPS | 232 | 8.1781 | 1.4211 | 4.3000 | 12.0100 |
| LFDIST | 232 | 7.4167 | 2.2318 | -6.9100 | 12.3900 |
| SUMGDP | 232 | 14.7170 | 0.7996 | 13.2185 | 16.3195 |
| SIMSIZE | 232 | -1.6143 | 0.8099 | -4.0768 | -0.6935 |
| RELENDOW | 232 | 0.6539 | 1.2277 | -1.3669 | 4.6885 |
| DIST | 232 | 2.8651 | 1.1040 | 0.3208 | 4.7598 |
| LMFN | 232 | 0.0679 | 0.0687 | 0.0000 | 0.3016 |
| LNTB | 232 | 0.0686 | 0.0864 | 0.0000 | 0.2654 |
| ERV1 | 232 | 33.0072 | 499.3264 | -21.3508 | 7605.4690 |
| ERV2 | 232 | 0.1725 | 0.6897 | 0.0004 | 10.0653 |
| CI | 232 | 6.4414 | 2.3959 | 2.4300 | 9.4300 |

## CORRELATION MATRICES

| **1988** | LEXPS | LFDIST | SUMGDP | SIMSIZE | RELENDOW | DIST | LMFN | LNTB | ERV1 | ERV2 | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LEXPS | 1 | | | | | | | | | | |
| LFDIST | 0.6198 | 1 | | | | | | | | | |
| SUMGDP | 0.595 | 0.5962 | 1 | | | | | | | | |
| SIMSIZE | 0.0469 | -0.1889 | -0.4123 | 1 | | | | | | | |
| RELENDOW | -0.2389 | 0.0232 | 0.0892 | -0.2504 | 1 | | | | | | |
| DIST | -0.4528 | -0.153 | 0.037 | -0.1565 | 0.2688 | 1 | | | | | |
| LMFN | -0.326 | -0.2192 | -0.0279 | 0.0378 | 0.7244 | 0.3454 | 1 | | | | |
| LNTB | -0.1414 | -0.2043 | 0.0835 | 0.0368 | 0.1684 | 0.0573 | 0.4344 | 1 | | | |
| ERV1 | 0.1104 | 0.0776 | 0.1386 | -0.0901 | -0.0501 | -0.0168 | -0.047 | -0.1456 | 1 | | |
| ERV2 | -0.2967 | -0.0415 | -0.013 | 0.0154 | 0.3355 | 0.291 | 0.3314 | 0.3034 | -0.2372 | 1 | |
| CI | 0.2974 | 0.1711 | 0.1039 | 0.063 | -0.7635 | -0.2304 | -0.5388 | -0.0949 | 0.1468 | -0.4035 | 1 |

| **1993** | LEXPS | LFDIST | SUMGDP | SIMSIZE | RELENDOW | DIST | LMFN | LNTB | ERV1 | ERV2 | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LEXPS | 1 | | | | | | | | | | |
| LFDIST | 0.7244 | 1 | | | | | | | | | |
| SUMGDP | 0.6013 | 0.6211 | 1 | | | | | | | | |
| SIMSIZE | 0.0085 | -0.1157 | -0.4595 | 1 | | | | | | | |
| RELENDOW | -0.1035 | -0.0236 | 0.1037 | -0.1823 | 1 | | | | | | |
| DIST | -0.4987 | -0.2417 | 0.0314 | -0.1199 | 0.2562 | 1 | | | | | |
| LMFN | -0.1907 | -0.2014 | 0.0062 | 0.0181 | 0.7829 | 0.3325 | 1 | | | | |
| LNTB | -0.0716 | -0.0919 | 0.1338 | 0.0738 | 0.0525 | -0.0021 | 0.3982 | 1 | | | |
| ERV1 | 0.017 | 0.0416 | 0.0934 | -0.0675 | 0.0227 | 0.0178 | 0.0084 | -0.0508 | 1 | | |
| ERV2 | -0.1282 | 0.012 | -0.0044 | 0.1401 | 0.1721 | 0.1518 | 0.0804 | -0.1512 | 0.049 | 1 | |
| CI | 0.1099 | 0.1244 | 0.0388 | -0.0762 | -0.7407 | -0.2326 | -0.5731 | 0.0577 | -0.0135 | -0.2432 | 1 |

| **1996** | LEXPS | LFDIST | SUMGDP | SIMSIZE | RELENDOW | DIST | LMFN | LNTB | ERV1 | ERV2 | CI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| LEXPS | 1 | | | | | | | | | | |
| LFDIST | 0.7184 | 1 | | | | | | | | | |
| SUMGDP | 0.5809 | 0.6198 | 1 | | | | | | | | |
| SIMSIZE | -0.003 | -0.1258 | -0.4787 | 1 | | | | | | | |
| RELENDOW | -0.0943 | -0.0515 | 0.1078 | -0.142 | 1 | | | | | | |
| DIST | -0.49 | -0.2552 | 0.0488 | -0.1126 | 0.2316 | 1 | | | | | |
| LMFN | -0.2254 | -0.1747 | 0.0229 | 0.0433 | 0.8065 | 0.3666 | 1 | | | | |
| LNTB | -0.0943 | -0.001 | 0.2282 | 0.0869 | 0.1746 | 0.1507 | 0.4249 | 1 | | | |
| ERV1 | 0.0599 | 0.085 | 0.102 | -0.0144 | 0.0598 | 0.0064 | 0.0524 | -0.0417 | 1 | | |
| ERV2 | -0.0775 | 0.0194 | -0.0243 | 0.1124 | 0.1034 | 0.069 | 0.1186 | -0.0521 | 0.1134 | 1 | |
| CI | 0.0627 | 0.107 | -0.0062 | -0.15 | -0.7653 | -0.1822 | -0.6334 | -0.0786 | -0.0961 | -0.1973 | 1 |