Agglomeration versus dispersion in a Currency Union. Evidence from Intra-Industry Trade

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Abstract

This paper tests for the alternative hypothesis of dispersion versus agglomeration of economic activity in a currency union by estimating the effect of the EMU on the share of intra-industry trade (IIT) on total trade. "The European Commission View" suggests that greater integration increases IIT while "The Krugman View" argues that greater integration leads to increased regional concentration – specialization. So, the EMU will increase / decrease business cycles' harmonization leading to a convergence / divergence among member countries decreasing / increasing the potential for asymmetric shocks. If EMU countries are increasing / decreasing it convergence, IIT should be becoming a greater share of total trade. Our preliminary results, using data for the Spanish economy in the period 1988-2005 and standard IIT determinants' econometric estimators suggest that the EMU is contributing to an increase in the divergence of Spain with its EMU partners and that industry activity may be agglomerating in the Euro area as in the USA.

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Keywords : Intra-industry trade, economic integration, European Monetary Union, xchange rate variability, agglomeration, dispersion, European Union, Spain.

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1. Introduction

There is a growing interest in understanding whether the creation of a currency union as the European Monetary Union (EMU) have an effect on location choices of firms and on the productive structure of countries. More precisely, there are in the literature two opposing views on what would be the effect of closer (monetary) integration on regional specialization, namely "The European Commission View" and "The Krugman View"[1]. According to European Commission (1990), greater integration increases intra-industry trade (IIT) more than inter-industry trade and, hence, the more integrated countries are, the more similarly they will be affected by disturbances and therefore the more synchronized their business cycles will be. So, deeper integration leads to a convergence among member countries increasing the potential for symmetric shocks. In the other hand, Krugman (1991, 1993), taken the experience of the USA as an example, argues that greater integration leads to increased regional concentration – specialization – in order to profit from economies of scale. It decreases harmonization of business cycles and, hence, increases the potential for asymmetric shocks. So, deeper integration and more trade will lead to more divergence between countries.

More recently, Ricci (2006) has developed a theoretical model which demonstrates that creating a currency union fosters agglomeration towards the area and dispersion within the area. That is to say, a currency union would decrease specialization in different industries within the area and increase intra-industry specialization. The currency union will increase convergence among countries which share now a common currency. Based in the Ricci arguments, among others that will be explain in the next section, in this paper we test if the EMU has increased intra-industry specialization within the Euro area. We do that by testing if the EMU has a positive and significant effect on IIT between EMU countries. If the EMU has increased IIT in total trade, the EMU should be leading to a convergence in the productive structure of EMU

[1] De Grauwe (1997) was the first to use these denominations.

countries and not to a divergence and our results will support “The European Commission View” against “The Krugman View”.

Analysing this topic is relevant for many reasons. First, it contributes to the empirical evidence of the effects of currency unions on trade. Second, in contributes to the endogenous Optimum Currency Area (OCA) literature. According to this literature, the main costs of adopting a common currency arise from the fact of the country’s loosing its own monetary and exchange rate policies. These costs will be greater the greater the chance of shocks to be asymmetric. External shocks will be more asymmetric as more different the countries’ productive structures are. As long as a currency union increases trade between its members it could help to the countries to achieve convergence ex-post, decreasing the costs of being a member of the currency union (Micco et al., 2003). However, we argue that it is not only an increase in trade that matters. The crucial point is which kind of trade is fostered by the creation of a currency union. As long as currency unions increase IIT more than inter-industry trade, currency unions will increase the similarity of members’ production structures increasing, hence, the synchronization of business cycles. This greater synchronization decreases the asymmetry of shocks between currency unions’ members and this decreases the cost of loosing the national currency. If the currency union fosters mainly interindustry trade, divergence will increase, business cycles will be less synchronized and the asymmetry of shocks will be greater.

The paper is organized as follows. Section 2 reviews the literature about currency unions, exchange rate volatility and trade. Section 3 presents some figures about IIT between Spain and the European Union (15) from 1988 to 2005. Section 4 discusses the empirical model and the econometrical methodology. Section 5 presents the results and section 6 draws the main conclusions.

2. Literature Review: exchange rate volatility, currency areas and (intra-industry) trade

Exchange rate volatility and trade

The first branch of the literature related to the effects of exchange rates on trade, focused on the effect of exchange rate volatility on the volume of bilateral trade between countries. The underlying assumption is that uncertainty about the final prices of the traded goods reduces bilateral trade. An empirical review of this literature is reported in Flam and Jansson (2000) and in Baldwin et al. (2005). All these studies report a positive or mixed effect of exchange rate volatility on total trade, depending on the type of data used (times series, cross-section or panel).The effect of the role of exchange rate regimes in trade has also been studied in the context of countries that have pegged their currencies to the US dollar. Klein and Shambaugh (2006), focusing on the post-Bretton Woods era (1960-1999 sample) show that countries that have pegged to US dollar had fostered bilateral trade by about 35%. The nations included in this study were typically poor and very small economically and, in this sense, are different from countries of the EU included in this paper. But these estimations confirm the importance of the exchange rate questions (common union of fixed exchange rate regimes) on the volume of bilateral trade. However, such literature is mostly concentrated on the effect of exchange rate volatility on the volume of *total* trade, which is not exactly the same as the effect on *intra-industry* trade.

Common currencies and trade

Since the introduction of the Euro in 1999 there have been lots of studies to estimate the impact of the Monetary Union on bilateral trade. Those results have confirmed the benefits of the Euro for the trade between the Euro-zone countries, and they have also affected the debate in non-Euro countries on whether to adopt the Euro (notably in the United Kingdom, Sweden or the new EU members). The most famous of these works is Rose (2000), which predicted that currency unions tended to hugely increase bilateral trade flows by about 200% according to some of his estimates. After Rose, some studies have estimated the effect of a common union on total trade with *ex-post* data, giving very different results depending on the sample and the statistical technique. For example, Micco et al. (2003) estimated an increase on total trade between 5% and 20%; Flam and Nordström (2003) suggested that the Euro effect is positive and lies in the range of 5% to 40%; Bar et al. (2003) estimated an increase of 29%; Baldwin et al. (2005) indicated that the mere creation of EMU would increase trade by 70% to 112% and, more recently, Bun and Klaassen (2007) estimated an impact of only 3%.

Exchange rate volatility, currency unions and intra-industry trade

The issue of how exchange rate variability -or how the implementation of a common currency- could affect intra-industry trade has not been given much attention. It is argued that the share of intra-industry trade (IIT) between two countries could increase after the creation of the EMU. Two arguments have been brought forward to support this hypothesis. On the one hand, the Euro has contributed to a reduction of trade transaction costs, by reducing the need of information about the volatility of exchange rates. We argue that the elimination of exchange rate volatility would benefit trade in differentiated products, i. e. IIT, more than trade in homogeneous products, i.e. inter-industry trade. On the other hand, the combination of the Single Market effects and Monetary Union effects would lead to a reduction of asymmetries of shocks between individual member countries, and this process will not affect trade types in the same way: If the perceived elasticity of demand is very high, small variations in exchange rates may have a large impact on trade in similar products (IIT), with particular influence on IIT in horizontally differentiated products.

There is a related branch of the literature that focus on the correlation between IIT and business cycles synchronization. This literature suggests that increasing trade itself does not necessarily lead to business cycle harmonization. It depends on the nature of such trade. Frankel and Rose (1997) report a significant and positive correlation between OCDE trade intensity and their correlation of business cycles as measured by four separate indicators of economic activity. Although this is one of the first papers suggesting that a currency union can lead to an increase on intra-industry trade, they do not include IIT measures in their analysis. More recently, Firdmuc (2004) found that augmenting Frankel and Rose' analysis by including IIT there is no relation between business cycle and trade but between the former and IIT. Shin and Wang (2003), in a larger model for 12 East Asian countries which includes more explanatory variables, found that IIT is the major channel through which the business cycles become synchronized and not by increasing trade by itself. Finally, Cortinhas (2007) finds the same evidence for the ASEAN countries.

Although to test the relationship between IIT increase and the synchronization of business cycles is not the focus of this paper, this subject is relevant for us for three reasons. First, it suggests that a currency union leads to an increase of IIT. Second, it provides the link between IIT and the subject of our analysis: convergence and divergence in a currency union. This literature suggests that the effect of more trade between two countries on the synchronization of business cycles depends on the nature of such trade. If more trade means more IIT, we should expect more symmetric shocks and more business cycles synchronization. However, if more trade means more inter-industry trade, we should expect more asymmetric shocks. Finally, it suggest that even countries creating a currency union may not be an optimum currency union *ex-ante*, if the currency union leads to an increase of IIT, it generates itself an optimum currency area *ex-post*.

Kenen (1969) points out that diversified economies, presenting a large share of IIT in their total trade, will experience more symmetric shocks. On the basis of this idea, the Emerson Report (1990) identified a mechanism, so called "Mechanism 13", transforming integration related effects into conditions favourable to the sustainability of the European Monetary Union. The general idea is that inside the EU comparative advantages have been losing their significance as a determinant of trade patterns and that most increase in intra-EU trade has been intra-industry trade. This connects with the Frankel and Rose (1997) argument exposed before that integration reinforces the symmetry of shocks affecting countries.

Ricci (1997 and 2006) provides a theoretical framework and also empirical evidence illustrating how a common union could foster agglomeration *towards* the area and dispersion *within* the area (thereafter Ricci-hypothesis). This model suggests that the sales for firms located in small countries vary more with the volatility of exchange rates than those located in large ones, generating an incentive for firms to locate in large countries (or currency areas). Thus volatility of exchange rates has a negative long-run effect on the flow of net inward foreign direct investment (FDI), while for a large country (or currency areas) this effect is positive and could foster agglomeration. The creation of a currency union attracts firms towards the area and generates a disincentive to locate outside of the area. Within the area, the elimination of exchange rate volatility induces firms to disperse, since the advantages of agglomeration – lower exchange rate volatility – disappear. Hence, the Ricci-hypothesis suggests that the common currency could foster intra-industry trade.

Baldwin et al. (2005) propose a theoretical model for explaining how the Euro could increase trade beyond the effects of lower exchange rate volatility. In a monopolistic competition set-up, they show that the effect of exchange rate uncertainty has non-linear features, suggesting that EMU and a measure of exchange rate volatility should be jointly significant. A striking feature of their model is that the trade it generates is, only, IIT.

However, IIT can occur on horizontally – two-way trade in varieties - or on vertically – two way trade in qualities- differentiated goods. While de former type of IIT fits the Kenen hypothesis, as all varieties are produced with the same factor intensity, the latter could imply, as in Falvey and Kierzkowsky (1987), different factor contents depending on the quality of varieties. Symmetry of shocks and welfare implications from IIT on vertical IIT could be similar to the ones derived from inter-industry trade. So, in order to correctly assert the effects of an increase on the share of IIT on business cycles we have to take into account the nature of IIT.

The arguments described previously seem to be in contradiction to what is suggested by the New Economic Geography literature. Krugman (1991, 1993) argued that the creation of a monetary union could promote specialization and concentration of firms according to comparative advantage of countries. He sustained that the combination of the Single Market effects (since 1992) and the monetary union effects will lead to make American-style regional crises without American-style fiscal federalism. A more integrated economy tends to lead to geographical concentration of industries (clusters like those of Silicon Valley). Those regional clusters would ordinarily lead to a divergence between regions in terms of their industrial structure, and an increased specialization of countries and a greater geographical concentration of industries. Krugman concludes that countries gain from the efficiencies of specialization, from the greater ability to exploit external economies and linkages that concentration of industries provides. But that regional concentration, being less diversified, are more subject to asymmetric demand shocks. Krugman's argument could be interpreted in terms of the structure of share trade: the EMU will increase the divergence of business cycles and will be likely to foster inter-industry trade in Europe (thereafter Krugman-hypothesis).

Until the best of our knowledge, the only paper that addresses the effects of a currency union on IIT is Fontagné et Freudenberg (1999). However, they provided an *ex-ante* prediction and we are going to text the *ex-post* effects of a currency union on IIT. They analysed the effects of exchange rate variability on EU IIT (differentiating horizontal IIT and vertical IIT), over the period 1980-1994. They pointed out that intra-industry trade, especially horizontal IIT, was weakened by the variability of exchange rates. So, they predict that the common currency and the European Monetary Union (EMU) will likely to foster intra-industry trade in the Euro-zone, leading to more symmetric shocks between member states. The argument is based in the demand's elasticity: if the perceived elasticity of demand is very high, variations in exchange rates – and the consequent growth of uncertainty in prices of imports and exports- may have a large impact on trade in similar products differentiated only by some minor attributes (IIT), with particular influence on IIT in horizontally differentiated products. By contrast, variations in exchange rates may not affect the demand of homogeneous goods, leaving inter-industry trade flows less vulnerable. As a consequence, the Euro would lead to an increase of the intra-industry trade flows within Europe.

We now have enough data to directly test all these effects on the countries of the Euro-area. We are not interested in contrasting the effects of the Euro on the adjustment problems of countries before suffering an asymmetric demand shock. Thus, the question is not to contrast the OCA theory, focused on asymmetric shocks, labour mobility and the asymmetric disturbances in the output after the implementation of the Euro. We are interested in contrasting if the Euro has led to a growth of intra-industry trade between countries (Ricci-hypothesis) or a growth of inter-industry trade (Krugman-hypothesis). As a first empirical approach to this subject, we test these hypotheses using Spanish data of bilateral trade with EU-15 countries from 1988 to 2005.

3. Spanish Intra-industry trade in the EMU

We measure the share of IIT in total trade at the 5-digit level of the SITC classification (*j*), using the Grubel and Lloyd index, adjusted for categorical aggregation (Greenaway and Milner, 1983).

$$GL_i = \frac{\sum_{j=1}^{J}\left(X_{ij} + M_{ij}\right) - \sum_{j=1}^{J}\left|X_{ij} - M_{ij}\right|}{\sum_{j=1}^{J}\left(X_{ij} + M_{ij}\right)} \times 100 \qquad (1)$$

where *X* / *M* are bilateral exports / imports of Spain with partner *i* in a given year.

To measure the nature (vertical or horizontal) of IIT we use relative unit values per tonne of exports and imports, computed at the same level of disaggregation[2]. Unit value indexes are considered as a proxy for prices, assuming that prices properly reflect quality. IIT can thus be divided into horizontal IIT and vertical IIT. Horizontal IIT is defined as the simultaneous exports and imports of a 5-digit SITC item where the unit value of exports, UV^x, relative to the unit value of imports, UV^m, is within a range of ± α per cent:

$$1 - \alpha \leq \frac{UV_{ij}^{x}}{UV_{ij}^{m}} \leq 1 + \alpha \qquad (2)$$

IIT is considered as vertical when the relative unit value of exports and imports is outside this range:

$$\frac{UV_{ij}^{x}}{UV_{ij}^{m}} \prec 1 - \alpha \qquad (3)$$

or

$$\frac{UV_{ij}^{x}}{UV_{ij}^{m}} \succ 1 + \alpha \qquad (4)$$

In the former case, it is also defined as exporter low-quality IIT and in the later exporter high-quality IIT.

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[2] This methodology was first proposed by Abd-el-Rahman (1986) and (1991).

An alternative measure for total IIT is the Fontagné and Freudenberg (FF) index of ITT. Fontagné and Freudenberg (1997) consider that the decomposition of total trade resulting from the GL index in trade overlap (representing intra-industry trade) and the imbalance (inter-industry trade) raise the problem that there are two different explanations for the majority flow: perfect competition (inter-industry part) and imperfect competition (intra-industry part)[3]. Hence, all trade in a good should be recorded as intra-industry when exports to imports overlap exceeds a certain level. Usually, this level is fixed at a 10 %. So, when a country exports / imports are less than a 10% of imports / exports in the same good ITT volume is set to zero. They call it one way trade. When exports / imports are almost a 10% of its imports / exports in that good the sum of exports and imports add to its ITT volume (two-way trade). They compute the index of ITT as the share of two-way trade in gross trade.

However, Hamilton and Kniest (1991) were the first to point out that these static measures of IIT could fail in explaining changes on the share of IIT between two periods of time. A higher value of the IIT index is not necessarily caused by more intra-industry trade but for a decrease in the absolute value of the trade balance due to a higher increase of imports / exports than in exports / imports. Subsequently, a number of authors have proposed different dynamic measures of IIT or indexes of marginal IIT (MIIT). A widely employed measure is the one proposed by Brülhart (1994). The Brülhart's index for marginal IIT (B) applies to trade changes using a ratio between a matched growth or contraction of imports and exports in relation to total trade. For a particular industry - good - it is given by:

[3] However, Nielsen and Lüthje (2002) consider this argument inconsistent with some of the main contributions within the new trade theory that explains intra-industry trade. Since intra-industry trade is sensitive to factor endowments, trade in a given product is, generally, characterized by both intra- and inter-industry trade in differentiated products.

$$MIIT_j = \left(1 - \frac{|\Delta X - \Delta M|}{|\Delta X| + |\Delta M|}\right) \times 100 \quad (5)$$

This index varies between 0 and 100, where 0 indicates marginal trade in the particular industry to be completely of the inter-industry type and 100 to represent marginal trade to be entirely of the intra-industry type.

The B index can be summed across industries of the same level of statistical disaggregation by applying the following formula for a weighted average:

$$MIIT_{tot} = \sum_{j=1}^{k} w_i MIIT_j \qquad \text{Where } w_j = \frac{|\Delta X|_j + |\Delta M|_j}{\sum_{j=1}^{k}\left(|\Delta X|_j + |\Delta M|_j\right)} \quad (6)$$

Trade data comes from the Dirección General de Aduanas[4] and is from 1988 to 2005.

Figure 1 shows that IIT between Spain and the UE15 has steadily growth since 1988. Most IIT is of a vertical nature, mainly with Spain exporting low quality varieties. IIT with the EMU area is higher than with the EU15 countries that preserve their national currencies. However, it seems that figures have come closer since the year 2000.

Figure A1 in the annex, shows de FF index between Spain and the EU15. A striking feature of this index is that IIT figure are very high. They reach more than 90% of total trade for most years and for EMU and non EMU countries. We consider that these figures are too high to be realistic and that the GL measures are preferable. Figure A2 shows de index of marginal IIT. Figures are lower than for the static measures of IIT. They show that the percentage of changes in trade between Spain and the UE15 that had consisted in matched increases is around 14%. There are no big differences between

[4] The DGA offers trade data at 8 digits of the TARIC. However, most papers on IIT use the 5 digit SITC disaggregation. We have aggregate DGA data up to 5 digits of the SITC using a correspondence table.

the EMU and non EMU EU15 members. Perhaps figures are higher for the later at the end of the period.

4.- Empirical model and econometrical issues

Although the purpose of this paper is not to explain the determinants of IIT but to test for the effect of the EMU on such trade, the empirical model takes into account the theory about IIT. In fact, as pointed out by Hummels and Levinshon (1995), the weak relationship between the empirical tests of the determinants of IIT and the theory is, maybe, the main shortcoming of this type of analysis. So, following these authors, we depart from the work of Helpman (1987) as for the theoretical framework for explaining intra-industry trade. Helpman (1987) developed some simple models of monopolistic competition and trade and tested some hypotheses that were directly motivated by the theory. Following Hummels and Levinshon (1995), we use direct measures for factor endowment differences instead of income per capita and add to the empirical specification a variable measuring the geographical distance between countries. Because we use as the reference country Spain, we also include in the model a dummy variable for those partner countries that are members of the European Union (EU). To this basic model, we add a variable that measures the exchange rate volatility between the Spanish and its trade partner currencies and a dummy variable that captures the fact of the partner country to be a member of the EMU.

So our empirical model is:

$$\begin{aligned} IIT_{it} = \alpha_0 + \alpha_1 kldif_{it} + \alpha_2 \min gdp_{it} + \alpha_3 \max gdp_{it} + \alpha_4 dist_i + \\ + \alpha_5 eu_{it} + \alpha_6 ver_{it} + \alpha_7 emu_{it} \mu_{it} \end{aligned} \tag{7}$$

Where:

IIT_{it} is the index of intra-industry trade between Spain and partner country *i* in year *t*.

$kldif_{it}$ measures relative factor composition as the logarithm of the difference in the ratio stock of capital / working population between Spain and partner country *i* in year *t*

$$\log\left|\frac{K_t^{Spain}}{L_t^{Spain}} - \frac{K_t^i}{L_t^i}\right| \qquad (8)$$

$mingdp_{it}$ (*$maxgdp_{it}$*) is the minimum (maximum) of the logarithm of the GDPs of Spain and partner country *i* in year *t*

$$\min(\log GDP_t^{Spain}, \log GDP_t^i) \qquad (9)$$

$$\max(\log GDP_t^{Spain}, \log GDP_t^i) \qquad (10)$$

and both control for relative size effects.

K, *L* and *GDP* come from The Penn World Tables 6 - see Hummels and Levinshon (1995) to an explanation about how *K* and *L* are computed.

$dist_i$ is the logarithm of the geographical distance between Spain and partner country *i*. We use alternatively two measures of *dist*. One is an approach to the cost of merchandise transportation by road (fuel, plus tolls plus ferry), measured in euros (*dist*). The other proxy is the distance in kms. between Madrid and the economical capital of partner country i (*distk*). Both measures are taken from www.viamichelin.com

eu_{it} is a dummy variable taking the value 1 for those countries which are members of the European Union in year *t* and 0 if they are not[5].

ver_{it} is the exchange rate volatility between the Spanish and partner country *i* currencies in year *t*. It has been computed from monthly average exchange rates as:

$$ver_{it} = \frac{\left(\max er_i^s - \min er_i^r\right)}{\min er_i^r} \qquad (11)$$

where *er* is the monthly (*s*) Exchange rate between the Spanish and partner country (*i*) currency. Data come from BDSICE (Ministerio de Economía y Hacienda).

emu_{it} is a dummy variable which takes the value 1 if Spain and the partner country *i* are both members of the EMU in year t and zero otherwise.

[5] The *eu* variable has a *t* subscript because some countries in our sample joint the EU in 1995.

According to Helpman (1987) and Hummels and Levinshon (1995), the model predicts α_1, α_3 and α_4 to be negative and α_2 to be positive[6]. We expect α_5 to be positive as long as be member of the same integration process, the EU in this case, facilitates trade. We include this variable in order to avoid that the volatility or the emu variable could be capturing the European membership effect. The parameters for the exchange rate variability - α_6 - and EMU - α_7 – variables could be either positive or negative depending on if the convergence or the divergence hypothesis is at work in the EMU. If positive, we follow Baldwin et al (2005) and expect that the variables ver and EMU are jointly significant.

However, we remain sceptics about the expected negative sign for the differences in factor endowments parameter. Although the hypothesis of Helpman (1987) is correct in a model of monopolistic competition, which generates horizontal intra-industry trade, it is not in models that explain vertical intra-industry trade, as Falvey and Kierzkowsky (1987). They stated that IIT could be positively related with differences in factor endowments when goods are vertically differentiated[7]. Moreover, recent empirical work on the nature of IIT has provided evidence that for most countries trade in vertically differentiated products is not only significant but also higher and more dynamic than trade in horizontally differentiated products[8]. When we estimate for total IIT it is not possible to be sure about the sign of the effect of factor endowments differences on total IIT. In any case and according to the previous literature we can expect also a positive sign for this parameter, as most Spanish IIT is vertical IIT. Nevertheless, as we also estimate the model for vertical and for horizontal IIT we can properly identify the sign of the effect of factor endowments differences on IIT. In the sensibility analysis we use alternatively different measures for differences in factor endowments: differences in the land per worker endowment and differences in per capita GDP. For the rest of the explanatory variables, the theory suggest us to expect the same sign of its effect on the two types of IIT as well as for total IIT.

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[6] See Helpman (1987) and Hummels and Levinshon (1995) for the economic justification to the expected signs for α_1 to α_4 parameters.

[7] Greenaway et al. (1994) were the first to show, disentangling total IIT in vertical and horizontal IIT in UK trade, that vertical IIT increases with differences in factor endowments. For the case of Spain, we can find the first evidence in Blanes and Martín (2000).

[8] See Brülhart and Hine (1999) for most EU countries (Spain is not included) and, apart from Blanes and Martín (2000), Martín-Montaner and Orts (2002) or Díaz (2002) for Spain.

Estimating the determinants of IIT poses several econometrical problems, widely discussed in the literature. The dummy variable EMU also introduces a problem of endogeneity of this dependent variable. According to the OCA theory, high indexes of IIT between a group of countries make them good *ex-ante* candidates to create a currency union. However, after a group of countries have adopted the same currency, it can lead to more IIT relative to total trade validating *ex-post* the creation of the currency union, as explained in the previous section.

The first problem in estimating an empirical model of IIT comes from the fact that IIT index are truncated as they vary between 0 and 1. With a truncated variable, OLS cannot be directly used to estimate the model because estimated coefficients would be not efficient. Two solutions are usually offered by the existing literature[9]. One, to apply a logistic transformation to *IIT* and then use OLS to estimate the model:

$$\log\left(\frac{IIT_{it}}{1-IIT_{it}}\right)=\beta' X_{it}+\mu_{it} \qquad (12)$$

where β and X are, respectively, the vectors of parameters and explanatory variables.

Although the logit transformation has the advantage of ensuring that predicted values are within the range 0 to 1, it has the disadvantage of excluding all observations where the index of IIT takes values 0 or 1. This is why some authors have made use of a logistic function estimated by Non-Linear Lest Squares (NLLS):

$$IIT_{it}=\frac{1}{1+\exp(-\beta' X_{it})}+\mu_{it} \qquad (13)$$

Because in the data set used in this paper we have no values equal to zero or one of any of the IIT measures, we do not use this approach.

[9] See for a discussion Balassa (1986).

Other authors, as Martin-Montaner and Orts (2002) use a two step estimation method as the tobit model. The idea is that there are determinants of IIT that are necessary for it to be and other determinants of the share of IIT in total trade. Hence they use a tobit model and estimate first the probability of IIT to occur and then the effect of a set of explanatory variables on the index of IIT. Usually, the variables that are necessary to IIT to occur are industry level characteristics determinants directly derived from monopolistic competition models, as product differentiation and scale economies. As long as we are explaining bilateral indexes of IIT with country level variables, we do not use this approach.

Although some of the first papers to estimate the determinants of IIT have use cross-section data base, usually, pooled data are used. Some papers estimate OLS directly on the IIT index, other on its logistic transformation and others using a logistic function estimated by NLLS. More recently, a few papers - as Hughes (1993) and Egger (2004) - have made use of static panel data techniques. These estimation techniques may suffer from serial correlation, heteroskedasticity and endogeneity of some explanatory variables. Arellano and Bond (1991) and Arellano and Bover (1995) found a solution to these econometric problems: first-differenced GMM estimator. Later, Blundell and Bond (1998, 2000) criticised this estimator since the levels may be valid instruments but can prove to be poor instruments for first differences if the data are highly persistent, and developed the GMM System estimator. The GMM system estimator is a system containing both first-differenced and levels equations. That is to say, it uses instruments in first differences for equations in levels in addition to using instruments in levels for equation in first differences. To the best of our knowledge, the only paper that has used this estimator for a model of IIT is Faustino and Leitao (2007).

The GMM system estimator controls for the endogeneity of the explanatory variables. A standard assumption on the initial conditions allows the use of the endogenous lagged variables for two or more periods as valid instruments if there is no serial correlation. If we assume that the first differences of the variables are orthogonal to the country-specific effects, this additionally allows the use of lagged first differences of variables for one or two periods as instruments for equations in levels. Validity of instruments requires the absence of second-order serial correlation in the residuals.

Overall validity of instruments is tested using a Sargan test of over-identifying restrictions. Fist-order and second-order serial correlation in the first differenced residuals is tested using m1 and m2 Arellano and Bond (1991) statistics. The GMM system estimator is consistent if there is no second-order serial correlation in residuals. The dynamic panel data model is valid if the estimator is consistent and the instruments are valid.

Bun and Klaasen (2007) summarize the econometric problems on estimating the effects of currency unions on trade. First, estimates could be biased upwards because the currency union dummy (which is 1 only at the end of the sample) picks up increasing trends in trade that are actually caused by omitted variables. We try to avoid this omitted trending variable bias by including time dummy variables, which corrects for any residual trend common to all bilateral trade flows, as well as our model also includes other trending variables as mingdp, maxgdp and differences in factor endowments. However, Bun and Klaasen (2007) also point out that trending behaviour of trade flows may also be affected by variables not included in the specification and trends may vary across country-pairs, both due to country specific and country-pair-specific factors. Some our explanatory variables are country-pair specific (differences in factor endowments) and may show a trend. However, it is unlikely to be able to find proxies to capture all omitted trending variables. They propose to correct for this allowing the time dummy variables to have heterogeneous coefficients across country-pairs which would account for both country and country-pair-trending variables.

In a next version of this paper, we are going to estimate a dynamic panel data. Also, with a multilateral data set we will be able to introduce heterogeneous coefficients across country-pairs for the time dummy variables. By now, we estimate pooled data by OLS and a static panel data (fixed effects), both on the logistic transformation of the IIT index.

5.- Estimation results

We first estimate the model by OLS on the logistic transformation of the GL index with pooled data. We estimate 8 different specifications, depending on the combination of explanatory variables – *eu*, *ver* and *emu* – included. This way we try to check if their effect on IIT is sensible to the inclusion or not of the other variables. We also estimate for IIT according to its nature, horizontal or vertical (and both, high and low Spanish IIT). Then we check for the robustness of these results in four different ways. First, using alternative measures of IIT. Second, using a wider range α for disentangling horizontal and vertical IIT. Third, estimating the model for two different periods: before the EMU (1988-1998) and during the EMU (1999-2005). Finally, we estimate the model using a static panel data (fixed-effects). We do also a sensibility analysis estimating the model for additional specifications and using alternative measures for the factor endowments and distance variables.

Looking at the results in Table 1, we first observe that the variables in the basic IIT model are significant and present the expected signs, with the exception of *maxgdp* that is not significant. Differences in capital per worker has a positive effect on the share of IIT, according to Spanish IIT to be mostly of a vertical nature, and the distance between partner countries has a negative impact, suggesting that differentiated goods are more sensible that homogeneous goods to trade costs. As for the variables of interest in this paper, the exchange rate variability is not significant, with the exception of specification V were it's significant (90%) but positive. The *emu* dummy is always significant and negative. That is, our results suggest that "The Krugman view" or Divergence Hypothesis is correct, at least with respect to the Spanish experience in the EMU. If we estimate for the different types of IIT, this result holds both for horizontal and vertical IIT, in the later specially for IIT in Spanish low quality varieties (tables 2 to 5). Results hold using both a range of 15% and 25%. So, the EMU and the exchange rate variability do not seem to be affecting in a different way to the different types of IIT.

We test if our results are robust to alternative measures of IIT (Table 6). Results hold for the marginal IIT indexes. For the FF indexes, results for the EMU dummy and the exchange rate measures are the inverse that with the other IIT measures and the Convergence hypothesis should be at work. However, we do not have too much confidence on the FF index. As shown in section 3, figures of IIT measured with the FF index reach almost 95% of total trade. We think that regressing on this index we are capturing the effects on total trade and not only on IIT trade. Papers that use as its dependent variables a measure of total trade, find that exchange rate volatility has a negative effect on trade and that a currency union enhances (total) trade.

Next we estimate our model separately for the EMU and pre-EMU periods (Table 7). Results remain. We also use a different estimation method, a static panel data (Table 8). Results are somewhere different – the *emu* dummy is not significant and the exchange rate variability is positive and significant for more types of IIT – but, again, they do not show any evidence for the convergence hypothesis.

We then have tested for the sensibility of our results to different specifications: excluding time dummy variables, excluding the factor endowments variable, excluding the distance variable and including different measures for factor endowments (land per worker and gdp per capita) and distance (*distk*). This changes mainly affect the *eu* dummy, which became significant when the distance variable is excluded, but do not affect the results for the exchange rate variability – remains non significant or positive – and the *emu* dummy – that never has a positive effect.

6.- Concluding remarks

This paper is a first approach to test for the validity of the convergence hypothesis versus the divergence hypothesis in the context of the EMU. We have studied the case of the Spanish economy. Results suggest that the convergence of the Spanish economy with the other EMU countries is not increasing due to the fact of being in the EMU. Our results suggest that the EMU is not contributing to increase the share of IIT on total trade. Hence, convergence of productive structures is not increasing and, hence, business cycles are not becoming more synchronized and shocks may not be less asymmetric. So, the ex-post argument of the endogenous OCA theory may not be at work. However, many concerns remain. We have to extent this analysis to all EMU countries and we should also include other non EMU and non EU countries in our data set, as papers on currency unions' effect on total trade do. Econometrics also must be improved to deal with endogeneity and serial correlation problems.

Figure 1: Spanish GL index of IIT with the UE 15 by nature (1988-2005)

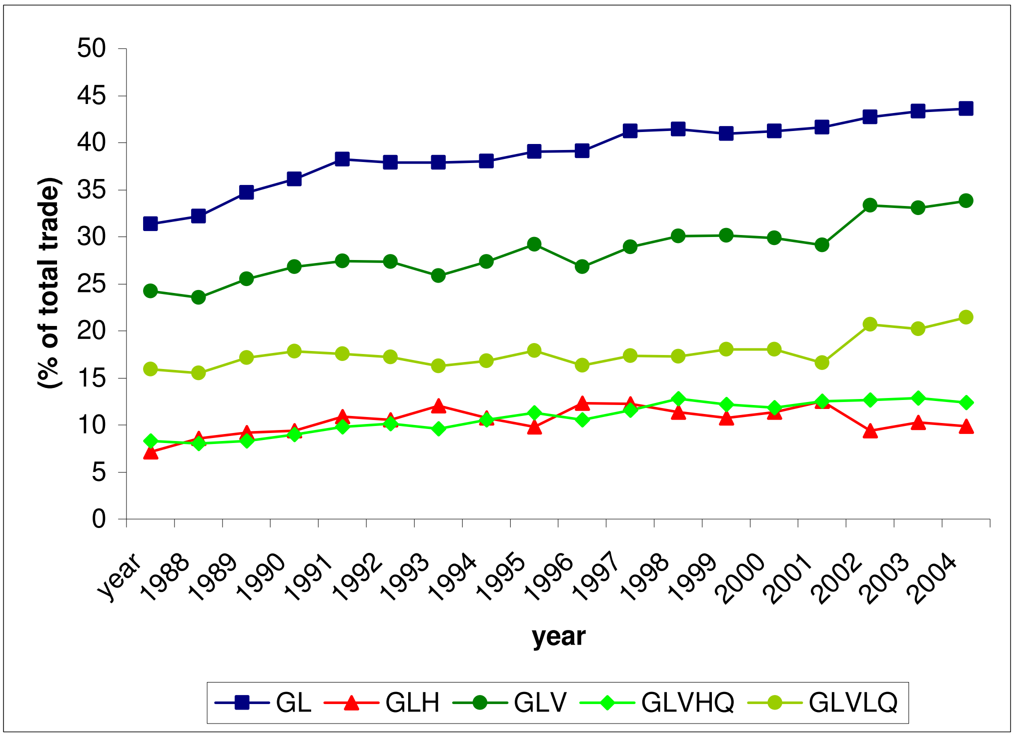

Figure 2: Spanish GL index of IIT by EMU partner Status (1988-1995)

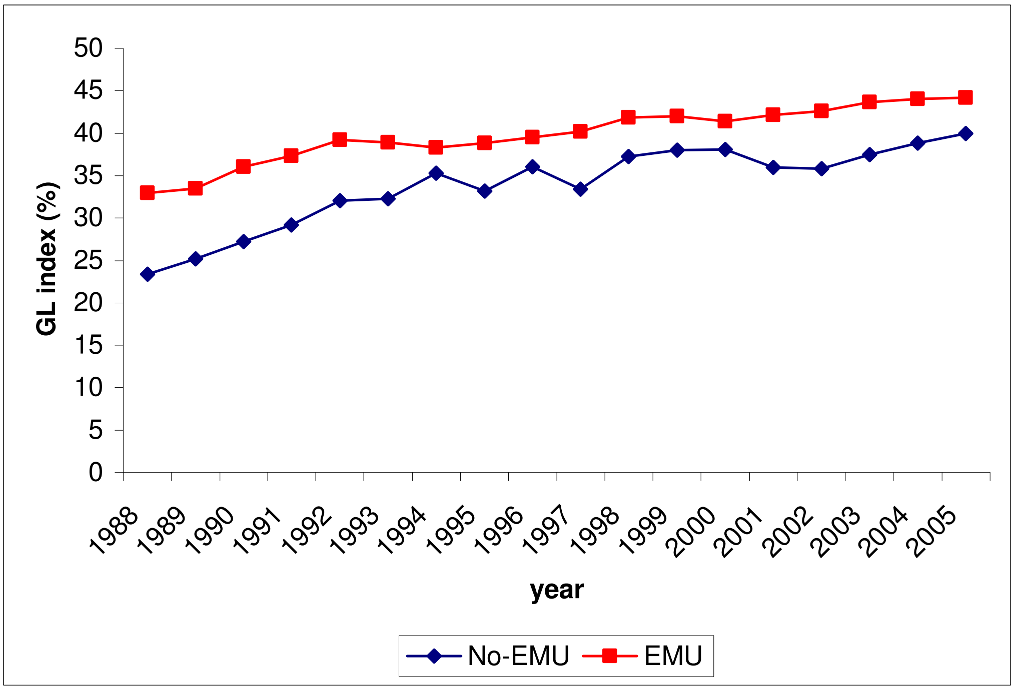

Table 1: Total IIT (OLS on logit transformation of GL index)

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
mingdp	2.08a (17.7)	2.09a (17.50)	2.08a (17.88)	2.07a (18.45)	2.08a (17.55)	2.08a (18.19)	2.07a (18.43)	2.07a (18.18)
maxgdp	-0.13 (-0.33)	-0.16 (-0.76)	-0.15 (-0.76)	-0.14 (-0.69)	-0.19 (-0.87)	-0.16 (-0.77)	-0.15 (-0.73)	-0.17 (-0.82)
kldif	0.14a (4.32)	0.14a (4.36)	0.15a (4.69)	0.16a (5.07)	0.15a (4.74)	0.16a (5.07)	0.16a (5.17)	0.16a (5.16)
dist	-0.95a (-24.87)	-0.96a (-21.91)	-0.99a (-25.45)	-0.99a (-25.09)	-0.98a (-22.68)	-0.98a (-22.04)	-0.99a (-25.40)	-0.98a (-22.49)
eu	----	0.06 1.08	----	----	0.08 (1.24)	0.06 (0.95)	----	0.07 (1.03)
ver	----	---	1.12 (1.55)	----	1.19c (1.65)	---	0.56 (0.75)	0.63 (0.85)
emu	----	---	----	-0.22a (-3.00)	----	-0.21a (-2.99)	-0.20a (-2.66)	-0.20a -(2.61)
constant	-7.60 (-9.13)	-7.63 (-9.13)	-7.52 (-8.76)	-7.57 (-9.07)	-7.55 (-8.76)	-7.60 (-9.07)	-7.83 (-8.83)	-7.56 (-8.81)
Adj. R^2	0.8903	0.8906	0.8915	0.8945	0.8920	0.8948	0.8948	0.8951
N	234							

Note: All estimations include time dummy variables.

t-ratios, based on heteroscedasticity robust standard errors, are given in parentheses; except for *constant*, a, b, c, indicates significance at the 1%, 5% and 10% level respectively.

kldif and dist are in logs.

Table 2: Horizontal IIT (OLS on logit transformation of GL index)

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
mingdp	2.43a (11.9)	2.45a (11.88)	2.42a (11.76)	2.42a (12.04)	2.43a (11.75)	2.43a (12.01)	2.41a (11.88)	2.43a (11.85)
maxgdp	-0.57b (-1.99)	-0.65b (-2.18)	-0.62b (-2.16)	-0.57b (-2.04)	-0.71a (-2.37)	-0.66b (-2.23)	-0.61b (-2.16)	-0.70a (-2.36)
kldif	0.22a (3.70)	0.23a (3.88)	0.24a (3.82)	0.24a (3.95)	0.26a (4.03)	0.25a (4.11)	0.25a (3.97)	0.26a (4.16)
dist	-1.14a (-15.15)	-1.10a (-13.25)	-1.14a (-15.15)	-1.16a (-15.18)	-1.12a (-14.20)	-1.12a (-13.25)	-1.17a (-16.08)	-1.13a (-13.97)
eu	----	0.23 1.46	----	----	0.26 (1.59)	0.28 (1.40)	----	0.25 (1.50)
ver	----	---	2.17 (1.54)	----	2.40c (1.76)	---	1.53 (1.04)	1.79 (1.25)
emu	----	---	----	-0.27a (-2.36)	----	-0.27b (-2.31)	-0.23c (-1.84)	-0.21c -(1.73)
constant	-8.60 (-8.07)	-8.72 (-8.09)	-8.42 (-8.12)	-8.56 (-8.22)	-8.54 (-8.12)	-8.67 (-8.22)	-8.44 (-8.22)	-8.55 (-8.20)
Adj. R^2	0.7741	0.7770	0.7773	0.7788	0.7809	0.7815	0.7802	0.7834
N	234							

Note: All estimations include time dummy variables.
t-ratios, based on heteroscedasticity robust standard errors, are given in parentheses; except for *constant*, a, b, c, indicates significance at the 1%, 5% and 10% level respectively.
kldif and dist are in logs.

Table 3: Vertical IIT (OLS on logit transformation of GL index)

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
mingdp	1.84a (15.51)	1.84a (15.44)	1.83a (15.72)	1.83a (16.12)	1.84a (15.63)	1.83a (16.04)	1.83a (16.20)	1.83a (16.10)
maxgdp	-0.21 (-0.89)	-0.22 (-0.94)	-0.22 (-0.92)	-0.21 (-0.90)	-0.24 (-0.98)	-0.22 (-0.94)	-0.21 (-0.89)	-0.23 (-0.92)
kldif	0.10a (2.93)	0.10a (2.94)	0.10a (3.22)	0.11a (3.68)	0.11a (3.23)	0.11a (3.64)	0.11a (3.73)	0.11a (3.67)
dist	-0.83a (-19.24)	-0.82a (-17.12)	-0.84a (-18.84)	-0.84a (-19.34)	-0.83a (-17.06)	-0.84a (-17.23)	-0.84a (-18.86)	-0.84a (-17.04)
eu	----	0.04 0.60	----	----	0.05 (0.69)	0.04 (0.50)	----	0.04 (0.50)
ver	----	---	0.70 (0.92)	----	0.74 (0.97)	---	0.07 (0.09)	0.10 (0.13)
emu	----	---	----	-0.23a (-2.86)	----	-0.27a (-2.85)	-0.22a (-2.77)	-0.22a -(2.73)
constant	-6.63 (-6.41)	-6.66 (-6.40)	-6.58 (-6.16)	-6.60 (-6.29)	-6.60 (-6.16)	-6.62 (-6.29)	-6.60 (-6.16)	-6.61 (-6.16)
Adj. R^2	0.8173	0.8174	0.8179	0.8230	0.8181	0.8232	0.8230	0.8232
N	234							

Note: All estimations include time dummy variables.
t-ratios, based on heteroscedasticity robust standard errors, are given in parentheses; except for *constant*, a, b, c, indicates significance at the 1%, 5% and 10% level respectively.
kldif and dist are in logs.

Table 4: Vertical Spanish High Quality IIT (OLS on logit transformation of GL index)

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
mingdp	1.53a (11.15)	1.52a (11.65)	1.52a (11.56)	1.52a (11.59)	1.52a (11.64)	1.52a (11.71)	1.52a (11.57)	1.52a (11.68)
maxgdp	-0.54a (-3.00)	-0.51a (-2.83)	-0.56a (-3.04)	-0.54a (-2.99)	-0.54a (-2.87)	-0.51a (-2.83)	-0.56a (-3.01)	-0.53a (-2.84)
kldif	0.13a (3.79)	0.12a (3.62)	0.14a (4.01)	0.14a (4.02)	0.13a (3.82)	0.13a (3.85)	0.14a (4.12)	0.14a (3.93)
dist	-0.86a (-18.69)	-0.87a (-17.99)	-0.87a (-19.06)	-0.87a (-18.92)	-0.88a (-18.33)	-0.89a (-18.20)	-0.88a (-19.03)	-0.89a (-18.33)
eu	----	0.08 1.13	----	----	-0.07 (-0.95)	-0.09 (-1.17)	----	-0.08 (-1.04)
ver	----	---	1.10 (1.55)	----	1.04 (1.43)	---	0.75 (1.04)	0.67 (0.90)
emu	----	---	----	-0.15c (-1.84)	----	-0.15c (-1.85)	-0.12 (-1.50)	-0.13a -(1.54)
constant	-4.35 (-5.81)	-4.30 (-5.80)	-4.26 (-5.55)	-4.32 (-5.72)	-4.23 (-5.56)	-4.28 (-5.70)	-4.27 (-5.52)	-4.35 (-5.81)
Adj. R^2	0.8039	0.8047	0.8058	0.8070	0.8064	0.8079	0.8078	0.8085
N	234							

Note: All estimations include time dummy variables.
t-ratios, based on heteroscedasticity robust standard errors, are given in parentheses; except for *constant*, a, b, c, indicates significance at the 1%, 5% and 10% level respectively.
kldif and dist are in logs.

Table 5: Vertical Spanish Low Quality IIT (OLS on logit transformation of GL index)

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
mingdp	1.99a (13.30)	2.00a (13.36)	1.99a (13.40)	1.98a (13.80)	2.00a (13.47)	1.98a (13.85)	1.98a (13.85)	1.99a (13.89)
maxgdp	-0.24 (-0.85)	-0.28 (-1.00)	-0.24 (-0.85)	-0.24 (-0.86)	-0.29 (-1.01)	-0.28 (-1.00)	-0.23 (-0.81)	-0.27 (-0.94)
kldif	0.05 (1.30)	0.05 (1.41)	0.05 (1.39)	0.07c (1.95)	0.06 (1.54)	0.07b (2.04)	0.06c (1.83)	0.07c (1.93)
dist	-0.68a (-11.48)	-0.66a (-9.94)	-0.69a (-11.07)	-0.70a (-11.69)	-0.66a (-9.75)	-0.68a (-10.14)	-0.70a (-11.27)	-0.68a (-9.93)
eu	----	0.13 1.44	----	----	0.13 1.46	0.12 1.32	----	0.11 1.26
ver	----	---	0.31 (0.32)	----	0.42 (0.44)	---	-0.55 (-0.56)	-0.43 -(0.43)
emu	----	---	----	-0.29a (-2.92)	----	-0.28a (-2.90)	-0.30a (-3.02)	-0.30a (-2.95)
constant	-8.13 (-6.51)	-8.19 (-6.55)	-8.11 (-6.34)	-8.09 (-6.41)	-8.16 (-6.37)	-8.15 (-6.44)	-8.13 (-6.37)	-8.18 (-6.38)
Adj. R^2	0.7159	0.7174	0.7160	0.7247	0.7176	0.7260	0.7250	0.7262
N	234							

Note: All estimations include time dummy variables.
t-ratios, based on heteroscedasticity robust standard errors, are given in parentheses; except for *constant*, a, b, c, indicates significance at the 1%, 5% and 10% level respectively.
kldif and dist are in logs.

Table 6: Different IIT measures. Total IIT. OLS on logistic transformation of the index.

	MIIT		FF		GL	
	V	VIII	V	VIII	V	VIII
mingdp	0.72a (4.17)	0.71a (4.10)	1.68a (12.59)	1.69a (12.82)	2.08a (17.55)	2.07a (18.18)
maxgdp	-0.46 (-1.61)	-0.43 (-1.52)	1.75a (8.16)	1.73a (8.23)	-0.19 (-0.87)	-0.17 (-0.82)
kldif	-0.005 (-0.11)	0.009 (0.19)	0.15a (4.37)	0.14a (4.13)	0.15a (4.74)	0.16a (5.16)
dist	-0.41a (-5.65)	-0.42a (-5.90)	-1.61a (-25.47)	-1.60a (-24.89)	-0.98a (-22.68)	-0.98a (-22.49)
eu	0.16 (1.37)	0.13 (1.15)	0.05 (0.43)	0.07 (0.57)	0.08 (1.24)	0.07 (1.03)
ver	2.84b (2.18)	1.76 (1.28)	-3.37a (-2.67)	-2.59b (-2.02)	1.19c (1.65)	0.63 (0.85)
emu	----	-0.36a (-3.19)	----	0.27b 2.47	----	-0.20a -(2.61)
constant	-1.09 (-0.81)	-0.88 (-0.64)	-9.82 (-9.56)	-9.82 (-9.56)	-7.55 (-8.76)	-7.56 (-8.81)
Adj. R^2	0.2335	0.2567	0.8968	0.8994	0.8920	0.8951
N	221		234			

Note: All estimations include time dummy variables.
t-ratios, based on heteroscedasticity robust standard errors, are given in parentheses; except for *constant*, a, b, c, indicates significance at the 1%, 5% and 10% level respectively.
kldif and dist are in logs.

Table 7: Pre-EMU and EMU periods estimations

a. Pre-EMU (1988-1998)

	GL	GLH	GLV	GLVHQ	GLVLQ
mingdp	1.98a (14.52)	2.20a (9.51)	1.80a (12.57)	1.57a (9.67)	1.90a (10.74)
maxgdp	0.11 (0.43)	-0.17 (-0.50)	-0.02 (-0.07)	-0.38c (-1.67)	-0.05 (-0.14)
kldif	0.08c (1.81)	0.14c (1.81)	0.03 (0.61)	0.07c (1.77)	-0.04 (-0.65)
dist	-1.01a (-15.75)	-1.18a (-10.45)	-0.87a (-12.05)	-0.94a (-15.08)	-0.74a (-7.08)
eu	0.02 (0.26)	0.16 (0.90)	-0.01 (-0.17)	-0.14c (-1.91)	0.06 (0.58)
ver	0.30 (0.39)	1.39 (0.91)	-0.12 (-0.15)	0.54 (0.74)	-0.64 (-0.60)
constant	-7.74 (-7.29)	-8.86 (-7.44)	-6.52 (-4.69)	-4.38 (-4.83)	-7.65 (-4.48)
Adj. R^2	0.8964	0.7878	0.8213	0.8173	0.7252
N	143				

b. EMU Period (1999-2005)

	GL	GLH	GLV	GLVHQ	GLVLQ
mingdp	2.32a (11.43)	2.97a (7.80)	1.94a (10.12)	1.47a (6.85)	2.18a (8.70)
maxgdp	-0.70c (-1.98)	-1.70a (-3.13)	-0.58 (-1.45)	-0.76b (-2.30)	-0.66 (-1.36)
kldif	0.21a (5.41)	0.33a (4.15)	0.17a (4.37)	0.18a (3.47)	0.13a (3.11)
dist	-0.99a (-16.96)	-1.12a (-9.40)	-0.83a (-13.00)	-0.86a (-11.23)	-0.65a (-7.49)
emu	-0.25a (-3.38)	-0.31b (-2.44)	-0.25a (-3.20)	-0.17b (-2.05)	-0.31a (-3.07)
constant	-5.69 (-4.08)	-5.52 (-2.98)	-5.33 (-3.10)	-2.73 (-1.99)	-7.54 (-3.72)
Adj. R^2	0.8990	0.7966	0.8263	0.7813	0.7374
N	91				

Note: All estimations include time dummy variables.
t-ratios, based on heteroscedasticity robust standard errors, are given in parentheses; except for *constant*, a, b, c, indicates significance at the 1%, 5% and 10% level respectively.
kldif and dist are in logs.

Table 8: Static panel data. Fixed Effects on logit transformation of the IIT index

	GL	GLH	GLV	GLVHQ	GLVLQ
mingdp	0.03 (0.06)	-2.28b (-1.91)	0.58 (1.11)	-0.74 (-1.27)	1.63b (2.41)
maxgdp	2.00b (2.53)	2.30 (1.10)	1.63c (1.80)	1.45 (1.42)	1.27 (1.07)
kldif	0.09a (3.62)	0.06 (0.86)	0.12a (4.04)	0.06c (1.83)	0.14a (3.68)
eu	0.23a (3.75)	0.24 (1.50)	0.25a (3.58)	0.07 (0.83)	0.33 (3.63)
ver	1.41a (2.93)	0.91 (0.72)	1.33b (2.40)	0.78 (1.25)	1.36c (1.88)
emu	-0.02 -(0.31)	-0.02 (-0.15)	-0.01 -(0.16)	0.04 (0.60)	-0.05 (-0.65)
constant	-14.26 (-2.77)	-5.32 (-0.39)	-15.60 (-2.63)	-8.06 (-1.21)	-19.85 (-2.57)
R^2	0.5474	0.1346	0.4697	0.4566	0.2715
N	234				

Note: All estimations include time dummy variables.
t-ratios, based on heteroscedasticity robust standard errors, are given in parentheses; except for *constant*, a, b, c, indicates significance at the 1%, 5% and 10% level respectively.
kldif and dist are in logs.

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ANNEX

Figure A1: Spanish FF index of IIT (1988-1995).

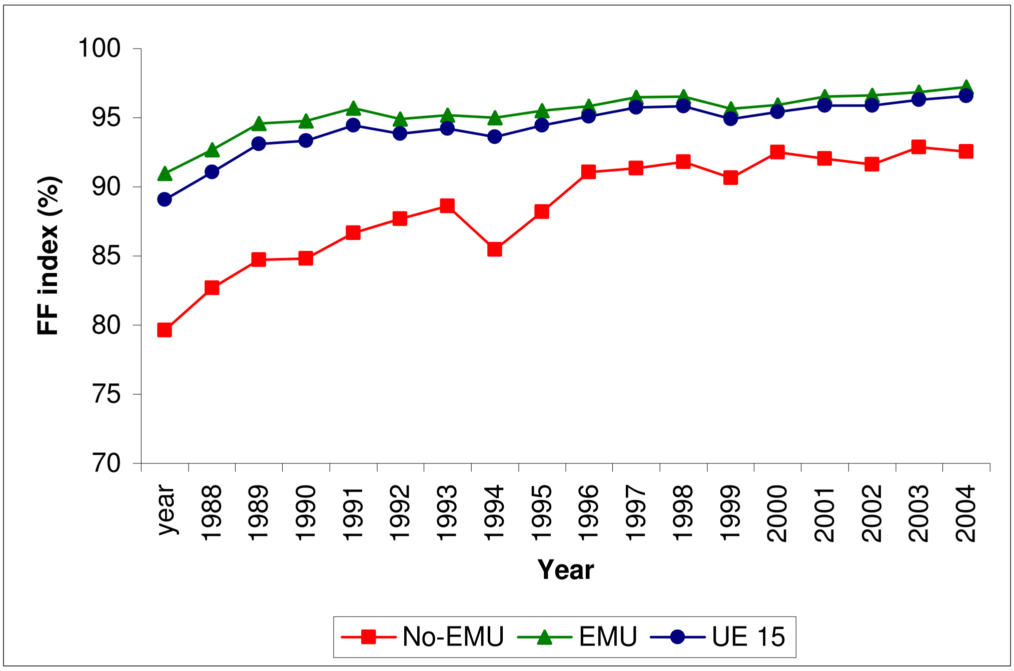

Figure A2: Spanish MIIT index (1988-2005). Year by year measured.