Preliminary draft
31 January 2005

How Much do Trade and Financial Linkages Matter for Business Cycle Synchronization?

Alicia García Herrero and Juan M. Ruiz[1]

Bank of Spain

Abstract

We estimate a system of equations to analyze whether trade and financial linkages influence business cycle synchronization directly or indirectly. We use a small, open economy (Spain) as benchmark for the results, instead of the US as generally done in the literature. Neither trade nor financial linkages are found significant in directly influencing business cycle synchronization. Only the similarity in productive structure appears to foster economic integration, after controlling for common policies. Trade linkages are found to increase output synchronization indirectly, by contributing to the similarity of productive structures, which might point to the prevalence of intra-industry trade. The positive influence of financial linkages on output synchronization is even more indirect, by fostering trade integration and, thereby, a more similar productive structure.

Keywords: business cycle synchronization, trade linkages, financial linkages, productive structure, integration.

JEL classification: E32, F41, F12, E44.

[1] Mailing Address: Bank of Spain, Dept. of International Economics, Alcalá 48, 28014 Madrid, Spain. Authors can be contacted at alicia.garcia-herrero@bde.es and jruiz@bde.es. The opinions expressed herein are those of the authors and not necessarily those of the Bank of Spain.

Introduction

The last few years have witnessed increasing economic globalization stemming from a very rapid growth in trade and financial linkages, among other factors. At least at first sight, one would be tempted to think that tighter trade and financial linkages contribute to the synchronization of business cycles. However, there is neither a clear *a priori* in the theoretical literature nor a consensus in the empirical work. In fact, they generate both demand and supply reactions, which may counteract each other. In addition, it is not even clear whether business cycle synchronization has increased over time. It very much depends on how synchronization is measured and which countries are considered.

The issue is relevant for several reasons. First, if business cycles are more synchronized, the transmission of shocks across countries will be stronger and faster. This could be an important rationale in favor of international policy coordination. Second, business cycles synchronization has profound implications for the design and functioning of common currency areas. Third, if the business cycle in a country is mainly driven by external factors, such as trade and financial linkages, domestic policies aimed at economic stabilization are bound to have a smaller impact. In the same vein, if trade linkages lead to business cycle synchronization, external demand will not manage to dampen economic fluctuations, but quite the opposite. This implies that exchange rate policy will be unlikely to play an important role in boosting demand at times of low economic activity.

This paper contributes to the empirical literature mainly in two ways. First, most of the existing studies analyze the issue estimating a reduced-form equation. However, there are a number of interrelations between trade linkages, financial integration and business cycle synchronization, which need to be taken into account so that the results are meaningful. We, therefore, use a system of equations to analyze the issue.

Second, many studies suffer from the lack of bilateral data to measure financial linkages and use aggregate financial stocks or flows. This, which measures financial integration with the rest of the world, can hardly explain business cycle co-movements between two countries. Those studies which use bilateral data generally take the US or a group of big economies as a benchmark to measure business cycle synchronization. Such a large economy, or area, influences other countries through many channels other than trade and financial linkages, which is bound to bias the estimated coefficients. To minimize this problem, we use a small open economy, namely Spain, as a benchmark.

1. Related Literature

Although the synchronization of business cycles has been extensively analyzed in the literature, there is no clear picture of whether it has increased over time, even less so of its determinants.

The conflicting evidence on the trend of synchronization over time may be attributed to the country coverage, the sample period and/or the econometric technique applied. On the one hand, Helbling and Bayoumi (2003) find decreasing synchronization between the US and rest of G-7 countries. Heathcote and Perri (2003a,b) report a similar result between the US and an aggregate of Europe, Japan and Canada. On the other hand, Kose et al (2003b) show an increasing co-movement between individual advanced countries and world (G-7) aggregates. With a broader perspective, Bordo and Helbling (2003) find increased synchronization over the last 125 years for 16 industrial countries. In the same vein, using dynamic factor models, Stock and Watson (2003),[2] Helbling and Bayoumi (2003) and Lumsdaine and Prasad (2003) show strong evidence of a common factor driving business cycles in advanced countries. However, with a similar methodology but for a sample of sixty countries, Kose, Otrok and Whiteman (2003) find that the common component (the so-called "world factor") is less important in developing countries.

There are also large differences in how synchronization is measured. Kose et al (2003b) use correlations of output and consumption of countries with respect to aggregate consumption and output of G-7 countries. They complement it with dynamic factor models to look for common components and assess whether the importance of the common component has increased over time, signaling a stronger synchronization. Heathcote and Perri (2003b) split the sample in two equal-length periods and measure cross-regional correlations of the log-difference of US GDP with that of an aggregate of Europe, Japan and Canada. They also propose and use a measure of correlation that corrects for the existence of high conditional volatility, based on Loretan and English (2000). Helbling and Bayoumi (2003) employ various indicators of synchronization, including a binary indicator of expansions and recessions; correlation coefficients and detrended series.[3] They finally use dynamic factor models to assess what is the role of common components on output synchronization. Finally, Imbs (2004b) measures synchronization by using cross-country correlations of band-pass series of quarterly GDP over the last 20 years.

[2] In particular, they find that find that this common component has become more important to explain G-7 business cycles after 1984 than between 1960 and 1983

[3] Detrending is done using Baxter and King (1999) band-pass filter to eliminate low- and high-frequency components to keep business cycle components defined as those between 6 and 32 quarters. An alternative method used is log first differences.

Moving to the potential channels of synchronization we focus on this study, namely trade and financial linkages, neither the theoretical nor the empirical literature offer a definitive answer on their impact on synchronization. Regarding trade, Kose and Yi (2001) suggest that higher trade integration might lead to more or less synchronization of cycles, depending on the nature of trade and the type of shocks. Countries will become more synchronized if there is an increase of intra-industry trade and industry-specific shocks are the main drivers of business cycles. However, if there is more inter-industry trade, then industry-specific shocks would reduce the co-movement of output in both countries. Empirical studies find that higher trade integration increases cross-country output correlations, especially among advanced economies [Frankel and Rose (1998), Clark and van Wincoop (2001), Imbs (2004a, 2004b)], possibly reflecting increased intra-industry trade rather than inter-industry trade.

Measures of trade linkages also differ across studies. Some of the earlier studies used aggregate measures of trade openness (i.e., trade integration instead of trade linkages between two countries). This is obviously less appropriate to investigate the determinants of business cycle synchronization between two countries. As for bilateral trade relations, some authors have used *de jure* measures namely restrictions to trade, such as import duties [IMF WEO (2002)]. The most common *de facto* measure is the sum of exports and imports between two countries, divided by GDP [IMF WEO (2002), Imbs (2004b)], or over the ratio of the product of GDPs divided by world output, to make it independent of country size (Clark and van Wincoop (2001)). Another alternative, non-standard measure is the dispersion between two countries' goods prices [IMF WEO (2002)]. More details on these measures will be offered in Section 3, since we shall be using them in our study.

As for financial linkages, there is some evidence of a positive relationship between financial integration and business cycle co-movements both in output and consumption in the case of advanced economies (Imbs 2004a,b) but not so for developing economies (Kose, Prasad and Terrones (2003b)). In addition, these results are challenged by potential reverse causality. In fact, Heathcote and Perri (2003b) propose that higher financial integration may arise as a result of less correlated real shocks, since the gains from asset trade are bigger. By fostering financial flows, financial integration would dampen GDP correlations more than the reduction implied by the lower correlation of shocks

The measures of financial linkages also differ.[4] As for trade linkages, earlier studies used aggregate measures rather than bilateral ones (i.e., trade integration instead of linkages). This is even more the case than for trade because of the difficulties in finding bilateral data of financial transactions. Among the aggregate measures, several authors have employed aggregate *de jure* indicators, namely a global index of capital account restrictions from the IMF Annual Report on Exchange Arrangements and Exchange Restrictions[5]. Imbs (2004b) uses the sum of these indices in two countries as a bilateral *de jure* measure of their financial linkages. Another *de jure* measure of aggregate financial integration is an index of stock market liberalization (Prasad et al (2003)). Among *de facto* measures, there are quantity and price measures, most of which are aggregate and not bilateral. The most comprehensive aggregate quantity measure is the sum of stocks of external assets and liabilities of foreign direct investment and portfolio investment[6] (IMF WEO (2002), IMF WEO (2001b) , Prasad et al. (2003)[7] and Heathcote and Perri (2003b)[8]).[9] Other aggregate measures are total capital flows as a share of GDP, but it suffers from large volatility (Prasad et al (2003)). Others are proxies of risk sharing obtained regressing GDP on disposable income (Kalemli-Ozcan et al (2003)) [10] A bilateral quantity measure (i.e., of financial linkages) is the sum of gross asset positions between two countries, but this is only readily available for the US against the rest of the world (Imbs, 2004b)). An alternative source of bilateral data are equity transaction flows (Portes and Rey (2003)) although it is only available for a few countries, and equity holdings from the Coordinated Portfolio Investment Survey conducted by the IMF in 1997 and 2001. The latter also has geographical limitations, as well as underreporting and a poor collection method (Lane and Milesi-Ferretti (2004)). There are also bilateral price measures, such as differences from covered interest rate parity, but with very limited data availability (Frankel, 1992), and asset price arbitrage (IMF, 2001) based on rolling correlations of stock and bond prices. The latter, though, suffers from potential reverse causality.

[4] Edison et al (2002) and Prasad et al (2003) provide surveys of different measures of financial integration.

[5] Prasad et al. (2003), IMF (2001b) and IMF (2002).

[6] Bank lending is not included.

[7] Prasad et al (2003) also separate financial flows into its main constituents: FDI, bank loans and portfolio flows.

[8] Heathcote and Perri (2003b) use, for assets, the sum of FDI plus the equity part of portfolio investment. They also test for separate measures (FDI on one side and equity holdings on the other).

[9] The original indices were also constructed by Lane and Milesi-Ferretti (2001) from the accumulation of financial flows and with some valuation adjustments.

[10] The idea is that with perfect risk sharing, disposable income should be unrelated to GDP, whereas in the absence of risk sharing, they should be closely related. Kalemli-Ozcan et al (2003) also use measures of consumption risk sharing. Imbs (2004b) uses pair wise sums of this estimate of risk sharing as measure of bilateral financial integration

The methodology generally used in the literature to test for the relevance of trade and financial channels is the estimation of a single equation. The fact that there may be indirect effects going in opposite directions might account for the generally small impact found in studies using single equation regressions. To our knowledge, Imbs (2004b) is the only one who estimates a system of simultaneous equations to take into account direct and indirect effects on synchronization but there are a number of differences between his analysis and ours. First, he does not consider the possible two-way relationship between financial linkages and trade linkages (Aizenman and Noy (2001) or the incentives for financial linkages that might stem from a low correlation of business cycles Heathcote and Perri (2003b). Second, he works with a limited set of 24 countries, with a very high proportion of rich economies in the sample. Having mostly developed countries in the sample might induce a selection bias in the results, as developing countries are likely to be also very poorly linked commercially and financially. Third, his estimated coefficients might be picking up some other channels through which big economies affect other countries' business cycles. Finally, Imbs (2004b) includes output correlations from the 80s and 90s. However, the existence of a number global common shocks in the 80s (although less prevalent than in the 70s) makes it difficult to identify the source of output co-movements.

2. Paper's objective

We assess empirically whether trade and financial linkages foster or hinder the synchronization of business cycles, while taking into account other potentially relevant determinants of synchronization. Both in the case of trade and financial linkages, there are arguments for and against their fostering synchronization.

Trade linkages should, in principle, lead to more synchronized business cycles as higher investment or consumption in one country implies an increase in imports from trade partners. However, depending on the patterns of trade, larger commercial linkages might increase or decrease synchronization. If both countries develop intra-industry trade, then output should be more synchronized even if shocks are mostly sector-specific. However, trade may also foster specialization in production, thereby reducing business cycle synchronization if shocks are mostly industry-specific.

Financial linkages could strengthen or weaken the co-movement of output, depending on its effect on specialization and the nature of shocks. On the one hand, there may be more synchronization if financial linkages allow for spillovers from demand shocks. On the other, there should be less

synchronization if financial links lead to the reallocation of capital according to comparative advantage. This should contribute to specialization in production, fostering inter-industry instead of intra-industry trade.

The description of the way in which trade and financial linkages may affect synchronization is clearly multi-directional. This implies potential endogeneity problems. Moreover, the different directions of indirect effects might offset each other and lead to very small net effects if we just try to correct the endogeneity problem using instrumental variables in the estimation. We shall, thus, use a system of equations to deal with this issue.

We also consider other possible sources of synchronization, namely the convergence of economic policies, which we approximate with the volatility of exchange rates and the differences in inflation rates.

Finally, we use bilateral data to account for trade and financial linkages. Data on financial linkages is particularly difficult to find except for the US, which obliges us to focus on one aspect of financial integration for which bilateral data is available, namely FDI.[11] We choose a small open economy as a benchmark country, Spain. This is unlikely to have other channels of influence on other countries, limitting the problem of omitted variables in previous studies with *de facto* bilateral data of financial linkages.

3. Estimation strategy and data issues

The direct and indirect channels through which trade and financial linkages may affect business cycle synchronization can only be taken into account through a system of equations. We, therefore, estimate a system of four equations, in which we test for the determinants of business cycle synchronization (eq. 1), those of trade and financial linkages (eqs. 2 and 3, respectively) and those of the similarity in productive structure (eq. 4). As previously explained, the latter is a key variable both in the cases of trade linkages and also business cycle synchronization.

$$\text{(Eq. 1):} \qquad \rho_{i,t} = \alpha_0 + \alpha_1 T_{i,t} + \alpha_2 S_{i,t} + \alpha_3 F_{i,t} + \text{Controls}(\rho) + \varepsilon_\rho$$

$$\text{(Eq. 2):} \qquad T_{i,t} = \beta_0 + \beta_1 S_{i,t} + \beta_2 F_{i,t} + \text{Controls}(T) + \varepsilon_T$$

$$\text{(Eq. 3):} \qquad F_{i,t} = \delta_0 + \delta_1 \rho_{i,t} + \delta_2 T_{i,t} + \text{Controls}(F) + \varepsilon_F$$

$$\text{(Eq. 4):} \qquad S_{i,t} = \gamma_0 + \gamma_1 T_{i,t} + \gamma_2 F_{i,t} + \text{Controls}(S) + \varepsilon_S$$

[11] In future versions of this paper we plan to make use of newly processed data for bilateral financial flows and stocks (including FDI, but also portfolio and equity flows) obtained from the Spanish Balance of Payments.

where:

$\rho_{i,t}$ is the correlation between Spain's business cycle and country *i* at time *t*.

$T_{i,t}$ is bilateral trade integration between Spain and country *i* at time *t*. In principle, the expected sign of its coefficient in Eq. 1 is positive but it could be dampened or even reversed if trade contributed to a high degree of specialization.

$S_{i,t}$ is an index of the similarity of economic structure between Spain and country *i*. This should be closely linked to the share of intra versus inter-industry trade. The more similar the economic structure (i.e., the lower the degree of specialization between two countries), a tighter business cycle synchronization is expected.

$F_{i,t}$ is bilateral financial integration with country *i*. As for trade, the expected sign of its coefficient in Eq. 1 is ambiguous for the reasons previously mentioned.

Although optimally one should conduct a panel data regression with the structure outlined above, given the poor quality of the financial data prior to 1997, we choose to conduct a cross section regression using data for the period 1997-2003.[12] We, therefore, drop the time subindex for all variables considered.

Among several possibilities in the literature, we choose to measure business cycle synchronization (ρ_I) as the Pearson correlation of the log difference of annual GDP.[13]

For trade linkages T_i between Spain and country i , we use the standard bilateral *de facto* measure, as in Frankel and Rose (1998) as a benchmark, namely the sum of bilateral imports and exports between Spain (*ESP*) and country *i* divided by the sum of their respective GDPs. Denoting this measure by $T^1_{ESP,i}$, we have:

$$T^1_{ESP,i} = \frac{1}{T}\sum_t \frac{X_{ESP,i,t} + M_{ESP,i,t}}{GDP_{ESP,t} + GDP_{i,t}}$$

[12] Although the quality of data from the OECD is is homogeneous for the years prior to 1997, in future versions of this paper we plan to use recently processed data obtained from Spain's balance of payments. This will allow us to extend the analysis to a wider set of countries which are not individually reported by the OECD. However, the quality of the data prior to 1997 is not very good, especially with respect to the geographical assignment of financial flows.

[13] GDP is measured at purchasing power parity and was obtained from the IMF's World Economic Outlook database.

where $X_{ESP,i,t}$ are exports from Spain to country *i* at time *t*, $M_{ESP,i,t}$ are imports to Spain from country *i* at time *t*, and $GDP_{i,t}$ is country *i*'s GDP at time *t*.[14] Note that we are taking a time average (over the period under study) of this measure.

As a robustness exercise, we also consider Clark and van Wincoop (2001)'s measure, which is independent of country size (and dependent only on trade barriers). Denoting this alternative measure $T^2_{ESP,i}$ we have:

$$T^2_{ESP,i} = \frac{\frac{1}{T}\sum_t \left(\frac{X_{ESP,i,t} + M_{ESP,i,t}}{GDP_{ESP,t} \times GDP_{i,t}} \right) GDP_{World,t}}{2}$$

Taking into account Deardorff (1998)'s, who shows that this measure is equal to one if preferences are homothetic and there are no trade barriers, we not that if we use $T^2_{ESP,i}$ in the regressions, we can drop $GDP_{World,t}$ from the computation of the index. This would just be a scaling factor which will multiply the coefficient of $T^2_{ESP,i}$ but will not change its sign or significance. All the results presented here are robust to measuring trade linkages in this alternative way.

In order to measure financial integration through a bilateral *de facto* measure, we initially used bilateral FDI flows from and to Spain from the OECD. Although data on stocks of FDI would have been a better indicator, it was not available for Spain. We measure financial integration by taking the sum of inward and outward FDI flows and computing a time average over the period of study:

$$F_{ESP,i} = \frac{1}{T}\sum_t I_{ESP,i,t} + I_{i,ESP,t}$$

where I_{ijt} represents financial flows from country *i* to country *j* (*ESP* denotes Spain) at time *t*.

The similarity in productive structure can be measured in several alternative ways. All of them are based on data of shares of each productive sector, and differ in the depth of dissagregation of economic activities and whether or not they concentrate on manufactures (at greater dissagregation[15]) or on all sectors (at lower dissagregation[16]). Let $s_{n,i,t}$ be the share of industry *n* in country *i* at time *t*. Then the first measure of economic similarity can be expressed as

[14] Data for exports and imports is obtained from the IMF's Direction of Trade Statistics. Data for GDP (at purchasing power parity) is obtained from the IMF's World Economic Outlook database. All data are annual.

[15] Typically, 2- or 3-digit ISIC classification groups.

$$S^1_{ESP,i} = -\frac{1}{T}\sum_t \sum_{n=1}^{N} \left| s_{n,ESP,t} - s_{n,i,t} \right|$$

where N is the number of sectors. Note that $S^1_{ESP,i}$ represents the time average of discrepancies in economic structures, as in Imbs (2004b).[17] $S^1_{ESP,i}$ might take values between 0 for identical structures and –2 for disjoint productive structures. Therefore *higher* values for $S^1_{ESP,i}$ imply *more* similarity between the Spanish productive structure and that of country i. Clark and van Wincoop (2001) use a similar concept but taking time averages of structures before computing distances in shares.[18]

$$S^2_{ESP,i} = -\sum_{n=1}^{N} \frac{1}{T} \left| \sum_t s_{n,ESP,t} - \sum_t s_{n,i,t} \right|$$

Industry shares $s_{n,i,t}$ can be measured using a number of different indicators. The three main indicators are shares in total employment, shares of value added, or shares of production. All the results presented in the next section use the definition $S^1_{ESP,i}$ described above applied to shares of value added, although the results are robust to using other definitions or data on employment or production, as they are highly correlated. We use data for the industrial sector at the two-digit ISIC level from UNIDO.[19]

We also use a number of controls in the regressions as suggested by previous work on each subject. One potential source of business cycle synchronization is the similarity of macroeconomic policies and the similarity of productive structures. We therefore include a number of variables to approximate this effect, such as the volatility of the bilateral exchange rate, the average inflation differential and a dummy variable to account for use of the euro as official currency.

In the case of trade linkages, a number of studies have suggested that gravity variables play an important role in explaining the importance of trade between two countries. We therefore include

[16] At 1-digit ISIC classification groups.

[17] We include a minus sign in front of the definition of structure similarity so that a higher value of S implies more similarity between the productive structures in both countries. This of course only changes the sign of its associated estimated parameter, but neither its size nor its significance.

[18] Clark and van Wincoop (2001) use a similar concept but taking time averages of structures before computing distances in shares. Imbs (2001) uses the Pearson correlation coefficient between sectorial shares $s_{n,i,t}$.

[19] We could in principle use data at the three-digit ISIC level and increase the dissagregation of activities. However, some countries in the sample do not report data at that level of dissagregation, and therefore we opted for a lower level of dissagregation in order to increase the sample size.

distance, sum of land areas, product of populations, product of GDPs, and two dummy variables to account for sovereign access to the sea and a common main language.[20]

Recent studies[21] have suggested that gravity variables also explain bilateral financial linkages. We, thus, include distance, time difference between main financial centers, common language and the sum of per capita GDPs.[22] This last variable tries to capture the idea that richer countries tend to generate more financial flows (both inward and outward).

Surely the most difficult variable to control is the similarity of productive structure. Following on Imbs and Wacziarg (2003) we use the pair-wise difference of per capita GDPs, based on the idea that rich countries tend to be more diversified and thus possibly more similar, whereas poorer countries tend to be more specialized.

4. Results

As a preliminary step we show some stylized facts of the main variables of interest in this study: business cycle synchronization, trade and FDI linkages.

The degree of bilateral business cycle synchronization between Spain and EU countries increased substantially from 1960 to 1995 (figure 1). Since then, it has fallen somewhat and now hovers at 0.6 (in terms of Pearson correlation coefficient of annual growth rates). Bilateral synchronization between Spain and G7 countries also rose fast from 1970 to 1976 but then fell again. Since Spain's entry in EU in 1986, it has risen at a slower pace than synchronization with EU countries. Business cycles in Spain and in Latin American countries move in opposite directions since the late 1980s. All in all the period of closer synchronization between Spain and other countries was from 1975 to 1985.

[20] Some studies include, instead of common language, a dummy variable capturing past colonial relationship. In the case of Spain both variables coincide.

[21] See, for example, Portes and Rey (2003).

[22] As the effect of distance on trade and financial integration might not be linear, but stronger for shorter distances (in other words, an increase in distance reduces trade and financial integration, but at a diminishing rate) we also try the log of distance and time differences, instead of its levels.

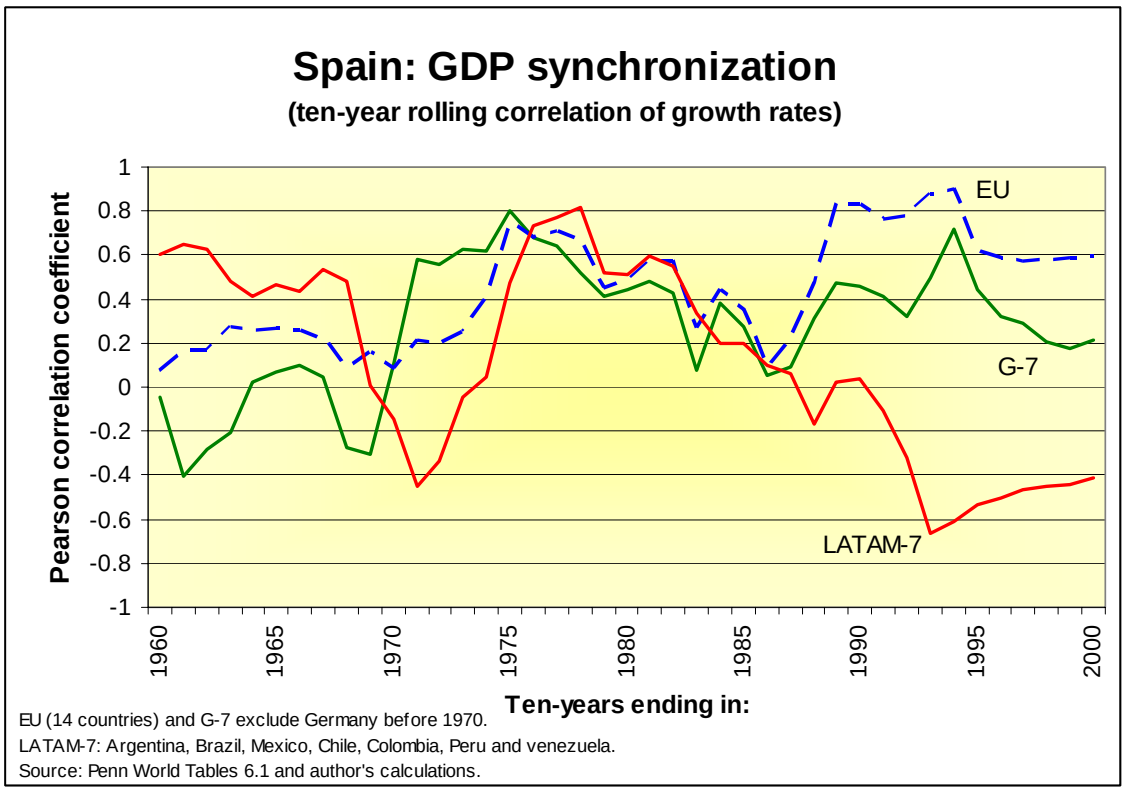

Figure 1: Evolution of GDP synchronization between Spain and selected regions.

Trade linkages between Spain and EU countries started to rise already ten years before Spain's entry into EU but since then the increase has been exponential (Figure 2). In fact the sum of imports from and exports to EU countries has reached 0.002% of those countries' combined GDP. Trade linkages with G7 countries began to grow later, in the mid 1980s and at a much lower pace, reaching about 0.0007% of their combined GDP as a sum of imports and exports. Trade linkages with Latin American countries haven remained relatively small throughout the period.

Spain started to have FDI linkages with EU and G7 countries in the mid-1980s, which increased enormously in the mid-1990s (Figure 3). FDI linkages with Latin American countries also rose then but at a lower pace. In 2000, there was a sharp fall of FDI linkages with all countries but it has recovered again with Latin American countries in the last few years. Still the size of these FDI linkages is smaller than that with EU and, to a lesser extent, G7 countries.

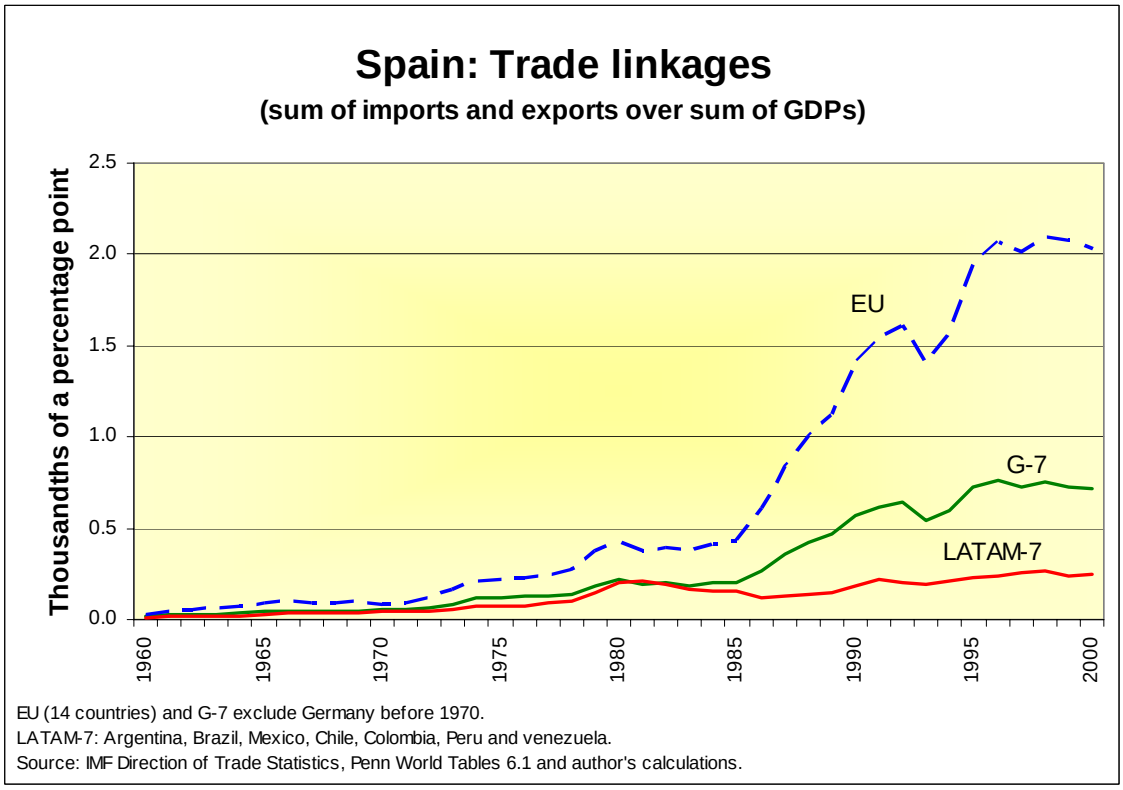

Figure 2: Evolution of trade linkages between Spain and selected regions.

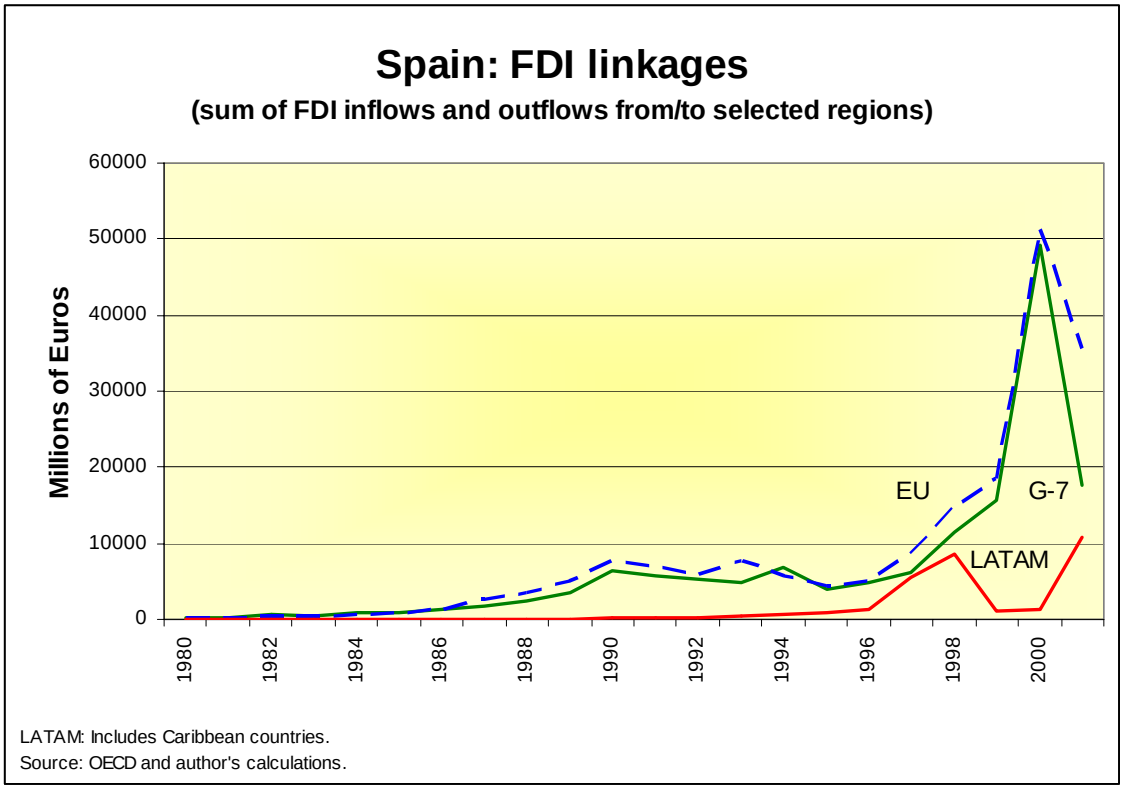

Figure 3: Evolution of FDI linkages between Spain and selected regions.

Turning to the estimation of the system of four equations, we first report the results of the estimation of each equation separately, using OLS. Since there are good reasons to suspect endogeneity problems, we complement the estimation of equation 1 (the main equation of interest to us) with the use of suitable instruments for trade and financial linkages (*T* and *F*) and similarity of structure *S*. In order to disentangle the direct and indirect effects of trade and financial linkages on business cycle synchronization, we finally turn to a joint estimation of the whole system of four equations, using three-stage least squares (3SLS).

As regards the determinants of business cycle synchronization, estimated by a single equation (equation 1), trade integration seems significant in explaining the correlation of business cycles (Table 1), although once we control for common policies (the volatility of exchange rates seems particularly significant), this effect vanishes. In these OLS estimations for equation 1, neither financial linkages nor the similarity of productive structure appear significant, However, the endogeneity of trade (*T*) and financial linkages (*F*) (measured with FDI only), and the similarity of the productive structure (*S*) might lead to highly biased coefficients. This problem is tackled later by the use of IV estimation as reported in the lower half of table 1. Before turning to the estimation of equation 1 using instrumental variables, we turn to the OLS estimation of equations 2 to 4.

The estimation of trade linkages (Eq 2) shows that financial linkages, approximated by FDI, affect trade positively ($\beta_2>0$) and significantly (Table 2). Among the variables included to account for a gravity model, distance to the main city appears as highly significant and with the correct sign. The coefficient of the similarity in productive structure (β_1) is not significant. This could be due to endogeneity problems or because of conflicting effects, depending on whether intra or interindustry trade is more prevalent. The coefficient on the product of average GDPs should have a positive sign, although in specification V and VI it is significantly negative. Again this may point to a bias due to the endogeneity of FDI integration, as the problem only appears when *F* is included in the regression.

Financial linkages, estimated by OLS on equation 3 seem to be determined by trade linkages and distance. The only anomaly is in the sign of the time difference between financial centers, which might again point towards and endogeneity problem. The significance of lagged trade linkages might point out to a global effect of trade integration on financial integration, as described by Aizenman and Noy (2004). An alternative and simpler explanation could be the high correlation of trade integration in the 80s and 90s.

An OLS regression for the similarity in productive structure (Eq. 4) described in Table 4 points to the difference in percapita GDP as a good explanatory variable, as suggested by the theory. The similarity in productive structure seems to be positively influenced by trade linkages. In other words, trade linkages promote a similar economic structure. Again, all these coefficients might suffer from important biases stemming from the endogeneity of *T* and *F*.

Given the biases introduced in the estimation of equation 1 due to the endogeneity of *T*, *F*, and *S*, we proceed to estimate equation 1 using appropriate instruments for those variables.[23] We report estimates of instrumental-variable regressions with alternative specifications of equation 1 in the lower half of table 1. The last three regressions include our controls for common policies. Note that, because of the availability of instruments, the number of observations drop to 43. Although coefficients change slightly from the top half of table 1, overall we still see no significant contribution of trade or financial linkages to explain business cycle synchronization, once we control for our proxies for common policies.

Estimation of equation 1 by instrumental variables, however, still pools together the direct and indirect effects of trade and financial linkages over business cycles synchronization, for example through their effect over the convergence of productive structures between Spain and the other countries in the sample. If indirect effects through different channels point to opposite directions, the net effect might become small and thus contribute to its statistical insignificance. We therefore conduct a three-stage least-squares regression on the whole system of four equations.

Estimating the system of four equations, the results change to a large extent (Table 5a). The most relevant, for the purpose of our study, is that only the similarity in productive structure (*S*) is found significant in determining output synchronization, after controlling for the effect of common policies. In this regard, exchange rate volatility is found significant while differences in inflation are not. Trade linkages influence output synchronization only indirectly through their effect on the similarity of productive structure. This was already the case in the single equation estimation of productive structure. As expected, such indirect effect is positive. The influence of financial linkages on output synchronization is even more indirect, through its effect on trade integration and, thereby, on the similarity of productive structure. The indirect effect is positive and significant.

The important influence of a similar economic structure on business cycle synchronization is in line with Imbs (2004b) but the relevance of trade and financial linkages is smaller in our case, since he

[23] In order to instrument *T, F* and *S*, we use the same regressors as those in tables 2 to 4.

also finds direct effects. This difference might be related to the fact that we use a small open economy as a benchmark, and a wider set of countries, as opposed to Imbs (2004b). The latter may have biased upward the coefficients, as there are other channels of influence of the US economy which are not considered. Another reason, as regard financial linkages, might be the limitation of our data. FDI flows are only one type of financial linkages considered, albeit an important one.

There are also other findings from the system of equations, worth mentioning: (i) We did not find a reverse causality from business cycle synchronization to financial linkages, as argued by Heathcote and Perri (2003b); (ii) the model seems to confirm a double causality between trade and financial linkages; (iii) a similar productive structure, apart from contributing to higher output synchronization, also tends to foster trade. Such positive influence should be understood in terms of intra- more than inter-industry patterns of trade in line with the results by Kose and Yi (2001).

The relations that have been found significant in the system of equations can be summarized in the following diagram.

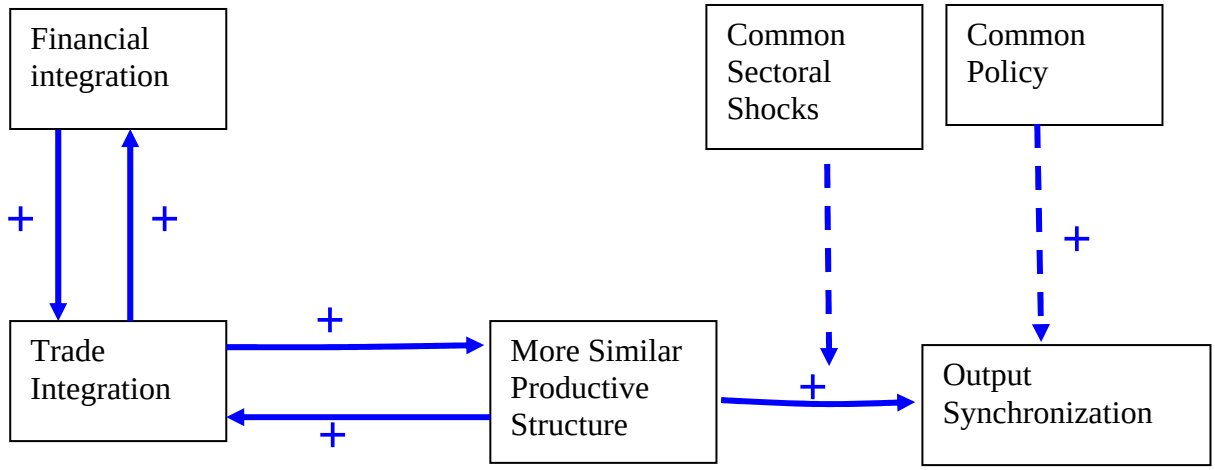

Figure 4: Channels leading to business cycle synchronization found in the empirical exercise.

A number of additional tests are conducted to test for the robustness of our results.

First, we include an alternative hypothesis for the gravity models is that the effect of distance on trade and financial integration might not be linear, but stronger for shorter distances. In other words an increase in distance reduces trade and financial integration, but at a diminishing rate. This hypothesis is captured by including the log of distance and time differences, instead of its levels, and estimating with 3SLS as before. The gravity variables for trade and financial integration become more significant (Table 5b) than in the benchmark case. The significance of the variables of interest, and the channels of influence on business cycle synchronization does not change much.

The exception is the bi-directional relationship between trade and the similarity of economic structure. This now becomes only one-way, with trade integration affecting the similarity of productive structure, but not vice-versa.

A second robustness exercise aims at tackling the problem of the low number of observations (43), in the system of equations. We extend the number of observations by imputing the value of zero to the observations where no data on FDI flows is available. The list of countries now included in the regression increases to 104.[24] As can be seen from Table 8 in the appendix,[25] this is a relatively safe assumption in many cases but not all[26]. The results are relatively similar to the extent that trade and financial linkages do not seem to affect business cycle synchronization directly but only indirectly through their effect on the similarity of productive structure (Table 5c). Still, there are a number of differences in the results worth mentioning. First, there is now a negative and significant effect from contemporaneous trade linkages to FDI linkages (Eq 3). However, the positive effect from previous trade integration is maintained. Second, the link from the similarity of productive structure to trade linkages also seems to be broken (Eq. 2). Third, FDI linkages appear significant in increasing the similarity of productive structure. This was not the case before, which implied an even more indirect impact of financial linkages on business cycle synchronization. The diagram in the appendix (figure 5) summarizes the relations that have been found significant in this case.

Finally, in order to control for global shocks, we also introduced a variable to approximate the similarity in the exposure of both economies to oil shocks. For each country, we measure net imports of oil as a percentage of GDP and average that percentage for the period 1990-2002. We then multiply that measure with the equivalent one for Spain, which is positive[27]. In principle, countries that are more dependent of oil should have a high and positive dependency ratio, whereas oil exporting countries have a highly negative indicator. A high and positive product of both indicators indicates countries that are affected by an oil shock in a similar way as Spain. A highly negative indicator represents countries that would benefit from an increase in the price of oil, as opposed to the Spanish economy.

[24] Consistent with the inclusion of new observations in the estimation of the system of simultaneous equations, the table of cross correlations has been expanded (See Table 7b in Appendix). Correlation coefficients above 0.6 are highlighted.

[25] The table highlights the 44 countries included in the original regression.

[26] The main risk of introducing a bias lies in those countries in Latin America that are summarized in the OECD data, like Peru.

[27] Details of the construction and sources used for this oil dependency index can be found in Appendix B.

We introduce this indicator as an explanatory variable for growth correlations. However, it turns out not to be statistically significant[28] in any of the specifications tried (OLS, IV or 3SLS estimations). This result could be interpreted as confirmation that in the period of study (1990-2003) oil shocks were not an important factor driving global economic fluctuations, as they were in the 70s or, to a lesser extent, in the 80s.

5. Conclusions

This paper assesses what is the role of trade and financial linkages in business cycle synchronization while considering a large number of interrelations between the relevant variables through a system of equations. This allows us to identify direct and indirect effects of trade and financial linkages on output co-movements. While there are number of possible endogeneity problems associated with trade and financial linkages as explanatory variables for output synchronization, in principle one could eliminate those biases by using suitable and readily available instruments. However, the reduced form IV estimates might appear small or not significant because, in theory, direct and indirect effects might run in opposite directions, cancelling each other. We, therefore, conducted the estimation of system of equations in order to separate direct and indirect effects of trade and financial linkages on output synchronization. This approach seems validated by our finding that only indirect effects (through their effect on the similarity of productive structure between the two countries) are significant.

The other contribution of the paper is to take a small, open economy as benchmark of the analysis and not the US or a group of rich countries accounting for a big share of world GDP. Business cycle synchronization between small open economies should depend more on trade and financial linkages than on other factors, many of which cannot be explicitly included in the analysis. These have probably biased upward the estimation of the trade and financial coefficients in previous studies. Our finding of no direct influence of trade or financial linkages on cycle synchronization is even more interesting for a small open economy, such as Spain. In addition, the significance of indirect influence justifies the use of a system of equations, instead of a reduced form.

Summarizing the results, we find that only the similarity in productive structure (*S*) is significant in determining output synchronization, after controlling for common policies (exchange rate volatility). Trade and financial linkages appear to increase output synchronization only indirectly, by fostering the specialization of productive structure. While trade and financial integration do lead

[28] P-values for a test of significance of this variable are never lower than 0.88 in all specifications.

to increased output synchronization, its indirect influence highlights that a precondition for this effect is the convergence of the productive structure of both countries. In particular, financial or trade liberalization without measures to allow the reallocation of productive resources inside a country might not lead to a correlation of business cycles. Another interesting policy conclusion is to weaken the idea that, with the increasing economic globalization, external demand both for goods and services, but also for financial assets, does not help boost the economy.

In any event, these results are only preliminary, mainly because of data limitations. In fact, financial integration is only measured through bilateral FDI flows and there is no account of portfolio or other capital flows.[29] This might lead to underestimating financial linkages and their effect on business cycle synchronization.

[29] New versions of this paper will make use of newly processed data for bilateral financial flows and stocks obtained from the Spanish Balance of Payments.

References

Aizenman, Joshua and Ilan Noy (2004): "On the Two Way Feedback Between Financial and Trade Openness," NBER Working Paper 10496.

Baxter, Marianne and Robert King (1999): "Measuring Business Cycles: Approximate Band-Pass Filters for Economic Time Series," *Review of Economics and Statistics,* 81, pp. 575-93.

Bordo, Michael and Thomas Helbling (2003): "Have National Business Cycles become More Synchronized?," NBER Working Paper 10130.

Clark, Todd and Eric van Wincoop (2001): "Borders and Business Cycles," *Journal of International Economics,* vol. 55, pp. 59-85.

Deardorff, Alan (1998): "Determinant of Bilateral Trade: Does Gravity Work in a Neoclessical World?," in Frankel J. (ed.) *The Regionalization of the World Economy,* University of Chicago Press.

Edison, Hali, Michael Klein, Luca Ricci and Torsten Slok (2002): "Capital Account Liberalization and Economic Performance: Survey and Synthesis," IMF Working Paper 02/120.

Forni, Mario, Marc Hallin, Marco Lippi and Lucrezia Reichlin (2000): "The Generalized Dynamic-Factor Model: Identification and Estimation," The Review of Economics and Statistics. 82(4), pp. 540-554.

Frankel, Jeffrey (1992): "Measuring International Capital Mobility: A Review," American Economic Review Papers and Proceedings, 82(2) pp. 197-202.

Frankel, Jeffrey and Andrew Rose (1998): "The Endogeneity of the Optimum Currency Area Criteria," *Economic Journal* 108, pp. 1009-25.

Heathcote, Jonathan and Fabrizio Perri (2003a): "Why has the U.S. Economy Become Less Correlated with the Rest of the World?," American Economic Review Papers and Procceedings," vol 93, pp. 63-69

Heathcote, Jonathan and Fabrizio Perri (2003b): "Financial Globalization and Real Regionalization," Working Paper, Georgetown University.

Helbling, Thomas and Tamim Bayoumi (2003): "Are they all in the Same Boat? The 2000-01 Growth Slowdown and the G-7 Business Cycle Linkages," IMF Working Paper 03/46.

Imbs, Jean (2003): "Co-Fluctuations," mimeo.
(`http://faculty.london.edu/jimbs/Research/Cofluct2001.pdf`)

Imbs, Jean (2004a): "The Real Effects of Financial Integration," Working Paper, London Business School.

Imbs, Jean (2004b): "Trade, Finance, Specialization and Synchronization," *Review of Economics and Statistics*, forthcoming.

Imbs, Jean and Romain Wacziarg (2003): "Stages of Diversification," *American Economic Review*, 93(1).

International Monetary Fund (1997): *World Economic Outlook*, May.

International Monetary Fund (2001a): "International Linkages: Three Perspectives," World Economic Outlook, Chapter II, October.

International Monetary Fund (2001b): "International Financial Integration and Developing Countries," World Economic Outlook, Chapter IV, October.

International Monetary Fund (2002): "Trade and Financial Integration," World Economic Outlook, Chapter III, April.

Kalemli-Ozcan, Sebnem, Bent Sorensen and Oved Yosha (2003): "Risk Sharing and Industrial Specialization: Regional and International Evidence," American Economic Review, vol 93, pp. 903-18.

Kose, Ayhan and Kei-MuYi (2001): "International Trade and Business Cycles: Is Vertical Specialization the Missing Link?," *American Economic Review Papers and Proceedings*, vol 91. pp 371-75.

Kose, Ayhan, Eswar Prasad and Marco Terrones (2003a): "Financial Integration and Macroeconomic Volatility," IMF Staff Papers, Vol 50, pp. 119-42.

Kose, Ayhan, Eswar Prasad and Marco Terrones (2003b): "How Does Globalization Affect the Synchronization of Business Cycles?," IMF Working Paper 03/27

Lane, Philip and Gian Maria Milesi-Ferretti (2001): "The External Wealth of Nations: Measures of Foreign Assets and Liabilities for Industrial and Developing Countries," *Journal of International Economics* 55, pp. 263-294.

Lane, Philip and Gian Maria Milesi Ferretti (2004): "International Investment Patterns," IIIS Discussion Paper 24.

Loretan, M. and W. English (2000): "Evaluating 'correlation breakdowns' during periods of market volatility," International Finance Discussion Paper 658, Board of Governors of the Federal Reserve System.

Lumsdaine Robin and Eswar Prasad (2003): "Identifying the Common Component of International Economic Fluctuations: A New Approach," *The Economic Journal*, 113 (484), pp. 101-127.

Nadal-de Simone, Francisco (2002): "Common and Idiosyncratic Components in Real Output: Further International Evidence," IMF Working Paper 02/229.

Portes, Richard and Hélène Rey (2003): "The Determinants of Cross-Border Equity Flows," mimeo.

Prasad, Eswar, Kenneth Rogoff, Shang-Jin Wei and Ayhan Kose (2003): "Effects of Financial Globalization on Developing Countries: Some Empirical Evidence," mimeo, IMF.

Stock, James and Mark Watson (2003): "Understanding Changes in International Business Cycle Dynamics," NBER Working Paper 9859.

Appendix A: Tables

Table 1
Dependent Variable: Growth correlations with Spain, 1990-2003 (ρ)

OLS Estimation

Specification	Ia	IIa	IIIa	IVa	Va	VIa	VIIa
Number of Observations	162	50	49	126	152	50	49
Trade Linkages 1990-1999[1] (T)	28270.24 **	17911.03	16519.16 *	21551.52 ***	14683.55	1282.891	2173.28
	(9326.31)	(11349.81)	(9885.22)	(8318.65)	(11181.21)	(11538.26)	(11045.42)
FDI Linkages 1991-2000[2] (F)		0.0000373	0.0000334			0.0000558	0.0000486
		(0.0000558)	(0.0000482)			(0.0000439)	(0.0000421)
Similarity in Productive Structure 1980-2000[3] (S)			-0.1234	0.0102476			-0.087102
			(0.2494)	(0.0783445)			(0.2140615)
Member of Euro Area (1=yes)					0.1048364	0.087204	0.0981344
					(0.1042206)	(0.0971558)	(0.0932183)
Average Inflation differencial 1990-2003					-0.000219 ***	0.0000239	0.0002579
					(0.00008)	(0.000305)	(0.0003062)
Exchange rate volatility 1990-2003[4]					-0.060645 **	-0.183092 ***	-0.169869 ***
					(0.0308499)	(0.0504493)	(0.0484815)
Adjusted R^2	0.05	0.08	0.07	0.05	0.21	0.46	0.41

IV Estimation[5] (Two-Stage Least-Squares)

Specification	Ib	IIb	IIIb	IVb	Vb	VIb	VIIb
Number of Observations	43	43	43	43	43	43	43
Trade Linkages 1990-1999[1] (T)	15845.18 **	15396.28 *	13571.05	12904.9 *	11035.64	9515.291	8618.184
	(6123.641)	(7961.088)	(8346.635)	(6903.678)	(7568.933)	(9760.288)	(10202.96)
FDI Linkages 1991-2000[2] (F)		3.64E-06	-6.28E-06			9.45E-06	-5.29E-06
		(0.0000405)	(0.0000426)			(0.0000379)	(0.0000409)
Similarity in Productive Structure 1980-2000[3] (S)			0.3346314	0.3226887			0.4502342
			(0.3415994)	(0.3265886)			(0.3216657)
Member of Euro Area (1=yes)					0.0290518	0.034051	0.0136597
					(0.0726864)	(0.0758788)	(0.080493)
Average Inflation differencial 1990-2003					0.0000563	0.0000492	2.76E-06
					(0.0002409)	(0.0002442)	(0.0002569)
Exchange rate volatility 1990-2003[4]					-0.102627 **	-0.102297 **	-0.102971 **
					(0.0428706)	(0.0431826)	(0.0450546)
Adjusted R^2	0.89	0.07	0.03	0.06	0.25	0.24	0.18

Standard errors in parenthesis

[1] Measured as the average over the period of the sum of bilateral exports plus imports over the sum of the respective GDPs

[2] Measured as the average over the period of bilateral inflows and outflows of FDI to and from Spain

[3] Computed from value added from the industrial sector only. S may take values between -2 (disjoint structure) and 0 (identical structure)

[4] Coefficient of variation of the bilateral exchange rate with Spain (monthly average).

[5] Instruments used are the same as those used in the three-stage least-squares regression in tables 5a-c.

* Significant at 10%, ** Significant at 5%, *** Significant at 1%

Table 2

Dependent Variable: Trade Linkages with Spain 1990-19991 (T)

OLS Estimation

Specification	I	II	III	IV	V	VI
Number of Observations	164	50	49	165	50	49
FDI Linkages 1991-20002 (F)		2.49E-09 ***	2.35E-09 ***		3.90E-09 ***	3.71E-09 ***
		(5.81E-10)	(5.99E-10)		(7.98E-10)	(8.08E-10)
Similarity in Productive Structure 1980-2000[3] (S)			3.47E-06			4.87E-06
			(3.90E-06)		( )	(3.78E-06)
Distance to main city (km)	-2.33E-10 ***	-2.44E-10 **	-2.48E-10 **	-2.28E-10 ***	-1.57E-10	-1.52E-10
	(5.50E-11)	(1.04E-10)	(1.06E-10)	(5.38E-11)	(1.05E-10)	(1.06E-10)
Spanish spoken (1=yes)	1.02E-07	-4.21E-07	-1.61E-07	2.02E-07	-1.03E-06	-6.86E-07
	(5.85E-07)	(1.49E-06)	(1.54E-06)	(5.66E-07)	(1.44E-06)	(1.47E-06)
Access to seacoast (1=yes)	9.61E-07 **	1.61E-06	2.14E-06	7.94E-07	1.74E-06	2.49E-06
	(4.35E-07)	(1.52E-06)	(1.62E-06)	(4.19E-07)	(1.45E-06)	(1.54E-06)
Sum of Land Areas (in km^2)				-1.46E-13	-1.19E-13	-1.57E-13
				(1.03E-13)	(1.45E-13)	(1.47E-13)
Product of populations (in billions)				-3.38E-11	7.93E-11	7.08E-11
				(4.44E-11)	(6.41E-11)	(6.43E-11)
Product of average GDPs 1990-2003				1.86E-24 ***	-2.12E-24 **	-2.03E-24 **
				(5.00E-25)	(9.72E-25)	(9.73E-25)
Adjusted R^2	0.11	0.37	0.37	0.17	0.43	0.44

Standard errors in parenthesis

[1] Measured as the average over the period of the sum of bilateral exports plus imports over the sum of the respective GDPs

[2] Measured as the average over the period of bilateral inflows and outflows of FDI to and from Spain

[3] Computed from value added from the industrial sector only. S may take values between -2 (disjoint structure) and 0 (identical structure)

* Significant at 10%, ** Significant at 5%, *** Significant at 1%

Table 3

Dependent Variable: FDI Linkages with Spain 1991-20002 (F)

OLS Estimation

Specification	I	II	III	IV	V	VI	VI
Number of Observations	51	50	44	49	44	50	44
Trade Linkages 1990-19991 (T)		9.70E+07 ***	-5.73E+07	9.33E+07 ***		9.83E+07 ***	
		(2.73E+07)	(7.31E+07)	(2.85E+07)		(2.89E+07)	
Trade Linkages 1980-19891 (lagged T)			5.17E+08 **		3.42E+08 ***		3.68E+08 ***
			(2.27E+08)		(9.19E+07)		(9.30E+07)
Similarity in Productive Structure 1980-2000[3] (S)				551.822	436.485		
				(805.832)	(824.528)		
Growth correlations with Spain, 1990-2003 (ρ)						-66.499	-430.519
						(420.718)	(738.892)
Distance to main city (km)	-0.114 **	-0.088 *	-0.070	-0.089 *	-0.076	-0.088	-0.073
	(0.059)	(0.053)	(0.055)	(0.054)	(0.055)	(0.054)	(0.055)
Spanish spoken (1=yes)	275.891	198.125	16.674	243.758	106.274	195.286	16.831
	(346.251)	(312.821)	(330.851)	(325.407)	(332.493)	(316.938)	(337.539)
Access to seacoast (1=yes)	377.424	93.736	94.286	162.926	125.242	95.213	82.741
	(346.876)	(321.498)	(409.611)	(345.193)	(421.415)	(325.340)	(410.638)
Absolute time difference to main financial centre	113.809	128.538 *	110.780	130.867 *	119.524	129.090	120.118
	(86.830)	(78.352)	(80.699)	(79.876)	(80.685)	(79.333)	(80.654)
Sum of percapita GDPs (average 1990-2003)	0.042 ***	0.026 **	0.023 *	0.026 **	0.023 *	0.027 *	0.026 *
	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
Adjusted R^2	0.20	0.37	0.40	0.35	0.40	0.35	0.40

Standard errors in parenthesis

[1] Measured as the average over the period of the sum of bilateral exports plus imports over the sum of the respective GDPs

[2] Measured as the average over the period of bilateral inflows and outflows of FDI to and from Spain

[3] Computed from value added from the industrial sector only. S may take values between -2 (disjoint structure) and 0 (identical structure)

* Significant at 10%, ** Significant at 5%, *** Significant at 1%

Table 4

Dependent Variable: Similarity in Productive Structure 1980-2000[3] (S)

OLS Estimation

Specification	I	II	III	IV	V	VI	VI
Number of Observations	128	50	49	128	50	49	128
Trade Linkages 1990-19991 (T)	42218.00 ***		5.47E+03	24043.81 *		2323.486	28199.85 ***
	(9.01E+03)		(5.79E+03)	(9293.399)		(6288.534)	(9079.603)
FDI Linkages 1991-20002 (F)		2.60E-05	0.0000113		0.0000275	0.0000208	
		(2.29E-05)	(2.84E-05)	( )	(0.0000255)	(0.0000318)	
Absolute difference of percapita GDPs				-0.000017	-9.24E-06	-8.10E-06	-2.45E-05 ***
(average 1990-2003)				(7.08E-06)	(5.83E-06)	(6.62E-06)	(5.77E-06)
Sum of percapita GDPs (average 1990-2003)				6.94E-06	-6.21E-07	-5.03E-07	
				(3.87E-06)	(2.88E-06)	(2.96E-06)	
Adjusted R^2	0.14	0.01	0.01	0.26	0.02	0.00	0.24

Standard errors in parenthesis

[1] Measured as the average over the period of the sum of bilateral exports plus imports over the sum of the respective GDPs

[2] Measured as the average over the period of bilateral inflows and outflows of FDI to and from Spain

[3] Computed from value added from the industrial sector only. S may take values between -2 (disjoint structure) and 0 (identical structure)

* Significant at 10%, ** Significant at 5%, *** Significant at 1%

Table 5a

Three-stage Least Square regression on the whole system of four equations

43 Observations

Dependent Variable	**Output Synchron. (ρ) (Equation 1)**	**Trade Linkages (T) (Equation 2)**	**FDI Linkages (F) (Equation 3)**	**Similarity in Prod. Struct. (S) (Equation 4)**
Trade Linkages 1990-1999[1] (T)	7553.61		-1.44E+08	15285.44 **
	(9082.60)		(1.31E+08)	(7190.144)
Trade Linkages 1980-1989[1] (lagged T)			8.34E+08 **	
			(3.61E+08)	
FDI Linkages 1991-2000[2] (F)	-2.27E-05	3.55E-09 ***		7.00E-05
	(3.69E-05)	(1.22E-09)		(5.64E-05)
FDI Linkages 1981-1990[2] (Lagged F)				-0.000374
				(0.0003418)
Growth correlations with Spain, 1990-2003 (ρ)			-607.2559	
			(1407.631)	
Similarity in Productive Structure 1980-2000[3] (S)	0.7018 ***	0.000032 ***		
	(0.2826)	(9.77E-06)		
Distance to main city (km)		-2.85E-11	-0.056278	
		(1.13E-10)	(0.0497338)	
Spanish spoken (1=yes)		6.03E-07	-144.9104	
		(1.63E-06)	(340.891)	
Access to seacoast (1=yes)		3.08E-06		
		(2.04E-06)		
Absolute time difference to main financial centre			99.70097	
			(72.85905)	
Member of Euro Area (1=yes)	0.0026			
	(0.0706)			
Average Inflation differencial 1990-2003	-0.0001			
	(0.0002)			
Exchange rate volatility 1990-2003[4]	-0.0970 ***			
	(0.0397)			
Sum of Land Areas (in km^2)		-5.21E-13 **		
		(2.52E-13)		
Product of populations (in billions)		8.55E-11		
		(8.55E-11)		
Product of average GDPs 1990-2003		-1.49E-24		
		(1.19E-24)		
Sum of percapita GDPs (average 1990-2003)			0.0250425 *	
			(0.0153059)	
Absolute difference of percapita GDPs (average 1990-2003)				-3.17E-07
				(5.73E-06)
Implicit R^2	0.16	0.00	0.48	-0.04

Standard errors in parenthesis

[1] Measured as the average over the period of the sum of bilateral exports plus imports over the sum of the respective GDPs

[2] Measured as the average over the period of bilateral inflows and outflows of FDI to and from Spain

[3] Computed from value added from the industrial sector only. S may take values between -2 (disjoint structure) and 0 (identical structure)

[4] Coefficient of variation of the bilateral exchange rate with Spain (monthly average).

* Significant at 10%, ** Significant at 5%, *** Significant at 1%

Table 5b

Three-stage Least Square regression on the whole system of four equations

43 Observations

Dependent Variable	**Output Synchron. (ρ) (Equation 1)**	**Trade Linkages (T) (Equation 2)**	**FDI Linkages (F) (Equation 3)**	**Similarity in Prod. Struct. (S) (Equation 4)**
Trade Linkages 1990-1999[1] (T)	2731.86		-1.04E+08	6725.705
	(9691.41)		(1.28E+08)	(7261.269)
Trade Linkages 1980-1989[1] (lagged T)			7.28E+08 **	
			(3.30E+08)	
FDI Linkages 1991-2000[2] (F)	0.000024	5.37E-09 ***		0.0000136
	(0.000040)	(1.44E-09)		(0.0000359)
FDI Linkages 1981-1990[2] (Lagged F)				
Growth correlations with Spain, 1990-2003 (ρ)			-359.0764	
			(1291.439)	
Similarity in Productive Structure 1980-2000[3] (S)	0.4816 **	0.0000198 ***		
	(0.2426)	(7.28E-06)		
Log of Distance to main city (km)		-3.98E-07	-119.8954	
		(7.91E-07)	(168.7232)	
Spanish spoken (1=yes)		4.87E-07	-73.63136	
		(1.72E-06)	(322.7569)	
Access to seacoast (1=yes)		2.45E-06		
		(1.94E-06)		
Log of absolute time difference to main financial centre			73.23183 **	
			(32.78706)	
Member of Euro Area (1=yes)	0.0347			
	(0.0707)			
Average Inflation differencial 1990-2003	0.0000			
	(0.0002)			
Exchange rate volatility 1990-2003[4]	-0.0987 ***			
	(0.0389)			
Sum of Land Areas (in km^2)		-4.33E-13 *		
		(2.41E-13)		
Product of populations (in billions)		1.28E-10 *		
		(7.21E-11)		
Product of average GDPs 1990-2003		-2.05E-24 *		
		(1.32E-24)		
Sum of percapita GDPs (average 1990-2003)			0.0300283 **	
			(0.0146192)	
Absolute difference of percapita GDPs (average 1990-2003)				-4.24E-06
				(6.06E-06)
Implicit R^2	0.31	0.27	0.52	0.09

Standard errors in parenthesis

[1] Measured as the average over the period of the sum of bilateral exports plus imports over the sum of the respective GDPs

[2] Measured as the average over the period of bilateral inflows and outflows of FDI to and from Spain

[3] Computed from value added from the industrial sector only. S may take values between -2 (disjoint structure) and 0 (identical structure)

[4] Coefficient of variation of the bilateral exchange rate with Spain (monthly average).

* Significant at 10%, ** Significant at 5%, *** Significant at 1%

Table 5c

Three-stage Least Square regression on the whole system of four equations

104 Observations

Dependent Variable	**Output Synchron. (ρ) (Equation 1)**	**Trade Linkages (T) (Equation 2)**	**FDI Linkages (F) (Equation 3)**	**Similarity in Prod. Struct. (S) (Equation 4)**
Trade Linkages 1990-19991 (T)	-6733.33		-1.82E+08 **	-4925.193
	(12268.77)		(9.33E+07	(12525.26)
Trade Linkages 1980-19891 (lagged T)			8.62E+08 ***	
			(2.51E+08)	
FDI Linkages 1991-20002 (F)	0.000062	7.55E-09 ***		0.0002277 ***
	(0.000054)	(1.16E-09)		(0.0000637)
FDI Linkages 1981-19902 (Lagged F)				
Growth correlations with Spain, 1990-2003 (ρ)			415.645	
			(589.1573)	
Similarity in Productive Structure 1980-2000[3] (S)	0.2075 **	1.45E-06		
	(0.1019)	(1.69E-06)		
Log of Distance to main city (km)		-1.92E-07	-32.50794	
		(4.43E-07)	(85.5454)	
Spanish spoken (1=yes)		-2.81E-07	-49.95582	
		(6.77E-07)	(115.1807)	
Access to seacoast (1=yes)		-7.38E-08		
		(6.60E-07)		
Log of absolute time difference to main financial centre			26.34079 *	
			(15.73312)	
Member of Euro Area (1=yes)	0.0738			
	(0.0827)			
Average Inflation differencial 1990-2003	0.0006 ***			
	(0.0002)			
Exchange rate volatility 1990-2003[4]	-0.1461 ***			
	(0.0378)			
Sum of Land Areas (in km^2)		-1.96E-13		
		(1.66E-13)		
Product of populations (in billions)		1.80E-10 ***		
		(5.98E-11)		
Product of average GDPs 1990-2003		-3.90E-24 ***		
		(1.08E-24)		
Sum of percapita GDPs (average 1990-2003)			0.0126983 *	
			(0.0073866)	
Absolute difference of percapita GDPs (average 1990-2003)				-2.85E-05 ***
				(5.97E-06)
Implicit R^2	0.19	0.34	0.43	0.30

Standard errors in parenthesis

[1] Measured as the average over the period of the sum of bilateral exports plus imports over the sum of the respective GDPs

[2] Measured as the average over the period of bilateral inflows and outflows of FDI to and from Spain

[3] Computed from value added from the industrial sector only. S may take values between -2 (disjoint structure) and 0 (identical structure)

[4] Coefficient of variation of the bilateral exchange rate with Spain (monthly average).

* Significant at 10%, ** Significant at 5%, *** Significant at 1%

Table 6

Summary Statistics

Variable	No. Observ.	Mean	Std. Dev.	Min	Max	Coeff. of Variation	Percentiles 5%	50%	95%
Growth correlations with Spain, 1990-2003 (ρ)	177	0.7063	0.2944	-0.3294	0.9890	0.42	0.0604	0.8339	0.9628
Trade Linkages 1990-1999[1] (T)	165	0.00000085	0.00000242	0.00000000	0.00001900	2.84	0.00000000	0.00000012	0.00000301
Trade Linkages 1980-1989[1] (lagged T)	122	0.00000045	0.00000092	0.00000000	0.00000612	2.07	0.00000000	0.00000012	0.00000194
FDI Linkages 1991-2000[2] (F)	52	397.66	815.66	0.17	3554.15	2.05	0.34	29.44	2333.90
Similarity in Productive Structure 1980-2000[3] (S)	142	-0.6636	0.2964	-1.4457	-0.1890	0.45	-1.1706	-0.6534	-0.2550
Member of Euro Area (1=yes)	199	0.080	0.273	0.000	1.000	3.39	0.000	0.000	1.000
Average Inflation differencial 1990-2003	163	85.357	336.407	0.533	3320.130	3.94	1.561	5.711	489.304
Exchange rate volatility 1990-2003[4]	183	0.568	0.887	0.003	5.303	1.56	0.075	0.200	2.442
Distance to main city (km)	199	6262	3923	494	19589	0.63	1282	6037	15374
Log of distance to main city	199	8.517	0.731	6.203	9.883	0.09	7.156	8.706	9.640
Spanish spoken (1=yes)	199	0.106	0.308	0	1	2.92	0	0	1
Access to seacoast (1=yes)	199	0.794	0.405	0	1	0.51	0	1	1
Absolute time difference to main financial center	199	3	3.177945	0	1.20E+01	0.95	0	2	10
Log of time difference to financial center	199	-0.49	3.31	-6.91	2.48	-6.73	-6.91	0.69	2.30
Sum of Land Areas (in km^2)	199	1182581	1898689	504784	17600000	1.61	505043	616872	3010592
Product of populations (in billions)	197	1145.52	4490.48	0.70	48145.25	3.92	2.56	222.89	4537.81
Product of average GDPs 1990-2003	167	1.E+17	5.E+17	1.E+14	5.E+18	3.42	5.E+14	1.E+16	7.E+17
Sum of percapita GDPs (average 1990-2003)	167	23414	7469	15554	50361	0.3189786	16493	20730	38921
Absolute difference of percapita GDPs	167	10192	4249	627	18802	0.4169212	2095	11072	14947

[1] Average over the period of the sum of bilateral exports plus imports over the sum of GDPs

[2] Average over the period of bilateral inflows and outflows of FDI to and from Spain

[3] Computed from value added from the industrial sector only. Higher values imply more similarity.

[4] Coefficient of variation of the bilateral exchange rate with Spain (monthly average).

Table 7a

Cross Correlations

(Based on common 44 observations. Boldface: correlations above 0.6)

	Growth correlations with Spain, 1990-2003 (ρ)	Trade Linkages 1990-1999[1] (T)	Trade Linkages 1980-1989[1] (lagged T)	FDI Linkages 1991-2000[2] (F)	Similarity in Productive Structure 1980-2000[3] (S	Member of Euro Area (1=yes)	Average Inflation differencial 1990-2003	Exchange rate volatility 1990-2003[4]	Distance to main city (km)	Log of distance to main city	Spanish spoken (1=yes)	Access to seacoast (1=yes)	Absolute time difference to main financial centre	Log of time difference to financial center	Sum of Land Areas (in km^2)	Product of populations (in billions)	Product of average GDPs 1990-2003	Sum of percapita GDPs (average 1990-2003)	Absolute difference of percapita GDPs
Growth correlations with Spain, 1990-2003 (ρ)	**1.000**																		
Trade Linkages 1990-1999[1] (T)	0.342	**1.000**																	
Trade Linkages 1980-1989[1] (lagged T)	0.345	**0.940**	**1.000**																
FDI Linkages 1991-2000[2] (F)	0.251	0.569	**0.642**	**1.000**															
Similarity in Productive Structure 1980-2000[3] (S)	0.199	0.256	0.244	0.210	**1.000**														
Member of Euro Area (1=yes)	0.359	**0.661**	0.567	0.253	0.231	**1.000**													
Average Inflation differencial 1990-2003	-0.329	-0.097	-0.105	0.058	0.101	-0.139	**1.000**												
Exchange rate volatility 1990-2003[4]	-0.496	-0.177	-0.121	-0.026	0.043	-0.214	**0.727**	**1.000**											
Distance to main city (km)	-0.099	-0.454	-0.456	-0.288	-0.178	-0.476	0.111	0.010	**1.000**										
Log of distance to main city	-0.168	-0.617	-0.573	-0.335	-0.195	-0.580	0.166	0.104	**0.931**	**1.000**									
Spanish spoken (1=yes)	-0.320	-0.132	-0.055	-0.052	-0.241	-0.182	0.208	0.023	0.223	0.293	**1.000**								
Access to seacoast (1=yes)	0.000	0.036	0.036	0.034	-0.233	-0.086	0.066	0.071	0.250	0.272	0.097	**1.000**							
Absolute time difference to main financial centre	-0.063	-0.418	-0.404	-0.180	-0.193	-0.457	0.019	-0.018	**0.924**	**0.875**	0.234	0.281	**1.000**						
Log of time difference to financial center	-0.201	-0.485	-0.482	-0.190	-0.344	-0.422	0.129	0.171	**0.665**	**0.690**	0.253	0.457	**0.755**	**1.000**					
Sum of Land Areas (in km^2)	0.073	-0.191	-0.155	0.202	0.282	-0.245	0.335	0.261	0.306	0.362	-0.008	0.145	0.385	0.342	**1.000**				
Product of populations (in billions)	0.101	-0.107	-0.116	0.008	0.142	-0.145	0.009	0.004	0.177	0.233	-0.082	0.100	0.247	0.214	0.510	**1.000**			
Product of average GDPs 1990-2003	0.190	0.083	0.135	**0.602**	0.196	-0.053	-0.007	-0.026	0.068	0.126	-0.108	0.115	0.233	0.141	0.588	0.512	**1.000**		
Sum of percapita GDPs (average 1990-2003)	0.482	0.321	0.317	0.407	0.179	0.314	-0.217	-0.367	-0.190	-0.259	-0.279	-0.157	-0.145	-0.388	0.003	-0.322	0.212	**1.000**	
Absolute difference of percapita GDPs	-0.256	-0.385	-0.271	-0.075	-0.204	-0.501	0.055	0.272	0.138	0.273	0.065	0.023	0.187	0.216	0.374	0.473	0.338	-0.476	**1.000**

[1] Average over the period of the sum of bilateral exports plus imports over the sum of GDPs

[2] Average over the period of bilateral inflows and outflows of FDI to and from Spain

[3] Computed from value added from the industrial sector only. Higher values imply more similarity.

[4] Coefficient of variation of the bilateral exchange rate with Spain (monthly average).

Table 7b

Table of Cross Correlations - extended set of observations

(Based on common 104* observations. Boldface: correlations above 0.6)

	Growth correlations with Spain, 1990-2003 (ρ)	Trade Linkages 1990-19991 (T)	Trade Linkages 1980-19891 (lagged T)	FDI Linkages 1991-20002 (F)	Similarity in Productive Structure 1980-2000[3] (S	Member of Euro Area (1=yes)	Average Inflation differencial 1990-2003	Exchange rate volatility 1990-2003[4]	Distance to main city (km)	Log of distance to main city	Spanish spoken (1=yes)	Access to seacoast (1=yes)	Absolute time difference to main financial centre	Log of time difference to financial center	Sum of Land Areas (in km^2)	Product of populations (in billions)	Product of average GDPs 1990-2003	Sum of percapita GDPs (average 1990-2003)	Absolute difference of percapita GDPs
Growth correlations with Spain, 1990-2003 (ρ)	**1.000**																		
Trade Linkages 1990-19991 (T)	0.246	**1.000**																	
Trade Linkages 1980-19891 (lagged T)	0.259	**0.944**	**1.000**																
FDI Linkages 1991-20002 (F)	0.184	**0.629**	**0.681**	**1.000**															
Similarity in Productive Structure 1980-2000[3] (S)	0.244	0.409	0.452	0.345	**1.000**														
Member of Euro Area (1=yes)	0.245	**0.660**	0.575	0.324	0.319	**1.000**													
Average Inflation differencial 1990-2003	-0.042	-0.051	-0.055	0.019	0.028	-0.073	**1.000**												
Exchange rate volatility 1990-2003[4]	-0.237	-0.112	-0.081	-0.037	0.034	-0.147	**0.838**	**1.000**											
Distance to main city (km)	-0.073	-0.381	-0.396	-0.242	-0.090	-0.391	0.110	0.075	**1.000**										
Log of distance to main city	-0.138	-0.577	-0.571	-0.336	-0.222	-0.514	0.133	0.125	**0.914**	**1.000**									
Spanish spoken (1=yes)	-0.029	-0.120	-0.096	-0.075	-0.044	-0.149	0.295	0.240	0.260	0.309	**1.000**								
Access to seacoast (1=yes)	0.185	0.130	0.159	0.100	0.300	0.063	0.076	0.017	0.076	0.013	0.075	**1.000**							
Absolute time difference to main financial centre	0.067	-0.269	-0.270	-0.105	0.037	-0.287	0.140	0.083	**0.860**	**0.767**	0.359	0.263	**1.000**						
Log of time difference to financial center	-0.088	-0.378	-0.409	-0.155	-0.138	-0.282	0.121	0.145	**0.630**	**0.661**	0.251	0.143	**0.719**	**1.000**					
Sum of Land Areas (in km^2)	0.096	-0.022	0.042	0.291	0.347	-0.109	0.153	0.149	0.190	0.173	-0.051	0.104	0.237	0.159	**1.000**				
Product of populations (in billions)	0.115	0.014	0.027	0.097	0.257	-0.049	-0.005	-0.015	0.118	0.125	-0.095	0.109	0.175	0.122	0.543	**1.000**			
Product of average GDPs 1990-2003	0.162	0.222	0.279	**0.654**	0.351	0.070	-0.009	-0.035	0.024	0.009	-0.104	0.140	0.168	0.061	**0.629**	0.551	**1.000**		
Sum of percapita GDPs (average 1990-2003)	0.323	0.470	0.490	0.497	0.598	0.397	-0.100	-0.211	-0.128	-0.281	-0.165	0.198	0.005	-0.208	0.201	-0.056	0.376	**1.000**	
Absolute difference of percapita GDPs	-0.233	-0.425	-0.390	-0.246	-0.550	-0.419	0.061	0.177	0.055	0.225	0.054	-0.297	-0.046	0.068	0.030	0.128	-0.038	-0.752	**1.000**

[1] Average over the period of the sum of bilateral exports plus imports over the sum of GDPs

[2] Average over the period of bilateral inflows and outflows of FDI to and from Spain

[3] Computed from value added from the industrial sector only. Higher values imply more similarity.

[4] Coefficient of variation of the bilateral exchange rate with Spain (monthly average).

* Includes 44 observations from previous table plus common observations included by setting FDI Linkages equal to zero for missing values.

Table 8

Countries included in the regressions (total=104)

ISO code	Country Name	ISO code	Country Name	ISO code	Country Name	ISO code	Country Name
ARG	**Argentina**	DZA	Algeria	JAM	Jamaica	**POL**	**Poland**
AUS	**Australia**	ECU	Ecuador	JOR	Jordan	**PRT**	**Portugal**
AUT	**Austria**	**EGY**	**Egypt**	**JPN**	**Japan**	PRY	Paraguay
BDI	Burundi	ETH	Ethiopia	KEN	Kenya	**ROU**	**Romania**
BEN	Benin	**FIN**	**Finland**	**KOR**	**Korea**	RWA	Rwanda
BFA	Burkina Faso	FJI	Fiji Is.	LCA	St. Lucia	SEN	Senegal
BGD	Bangladesh	**FRA**	**France**	LKA	Sri Lanka	**SGP**	**Singapore**
BLZ	Belize	GAB	Gabon	LSO	Lesotho	SLE	Sierra Leone
BOL	Bolivia	**GBR**	**UK**	**MAR**	**Morocco**	SLV	El Salvador
BRA	**Brazil**	**GER**	**Germany**	MDG	Madagascar	**SWE**	**Sweden**
BRB	Barbados	GHA	Ghana	**MEX**	**Mexico**	SYC	Seychelles
BWA	Bostwana	GMB	Gambia	MUS	Mauritius	SYR	Syria
CAF	Central African Republic	GNQ	Equatorial Guinea	MWI	Malawi	TGO	Togo
CAN	**Canada**	**GRC**	**Greece**	**MYS**	**Malaysia**	**THA**	**Thailand**
CHE	**Switzerland**	GTM	Guatemala	NER	Niger	TTO	Trinidad and Tobago
CHL	**Chile**	**HKG**	**Hong Kong**	NGA	Nigeria	TUN	Tunisia
CHN	**China**	HND	Honduras	NIC	Nicaragua	**TUR**	**Turkey**
CIV	Cote d'Ivoire	HTI	Haiti	**NLD**	**Netherlands**	TZA	Tanzania
CMR	Cameroon	**HUN**	**Hungary**	**NOR**	**Norway**	UGA	Uganda
COG	Congo Brazzaville	**IDN**	**Indonesia**	NPL	Nepal	URY	Uruguay
COL	**Colombia**	**IND**	**India**	**NZL**	**New Zealand**	**USA**	**USA**
CPV	Cape Verde	**IRL**	**Ireland**	PAK	Pakistan	**VEN**	**Venezuela**
CRI	Costa Rica	**IRN**	**Iran**	PAN	Panama	VNM	Vietnam
CYP	Cyprus	**ISL**	**Iceland**	PER	Peru	**ZAF**	**South Africa**
DNK	**Denmark**	**ISR**	**Israel**	**PHL**	**Phillipines**	ZMB	Zambia
DOM	Dominican Republic	**ITA**	**Italy**	PNG	Papua New Guinea	ZWE	Zimbabwe

In boldface: countries included in the original sample of 44 countries. The rest of countries (60) were added after setting Financial Integration (F) equal to zero for all missing observations of that variable.

Appendix B: Definition of Variables and Sources.

Output Synchronization (ρ): Measured as the Pearson correlation between the log differences (growth rates) of annual GDP for Spain and those of a given country. Data for annual GDP at purchasing power parity was taken from the IMF's World Economic Outlook database.

Trade Linkages (T): Measured as the sum of imports and exports between Spain and a given country, over the sum of their respective GDPs. This measure is then averaged over the denoted period of time. That is,

$$T_{ESP,i} = \frac{1}{T}\sum_{t}\frac{X_{ESP,i,t} + M_{ESP,i,t}}{GDP_{ESP,t} + GDP_{i,t}}$$

Data for exports and imports was obtained from the IMF's Direction of Trade Statistics. GDP data was taken from the Penn World Tables version 6.1.

Financial Linkages (F): Measured as the sum of inflows and outflows of FDI between Spain and a given country. This measure is then averaged over the duration of the period. Data for FDI flows was obtained from the OECD's International Direct Investment Statistics.

Similarity in productive structure (S): Measured as the time average of discrepancies in economic structures. In particular, we take the shares $s_{n,i,t}$ of value added for industrial sector n in country i at time t and construct the following indicator of distance:

$$S^{1}{}_{ESP,i} = -\frac{1}{T}\sum_{t}\sum_{n=1}^{N}\left|s_{n,ESP,t} - s_{n,i,t}\right|$$

For value added, we take industrial sectors at 2-digit ISIC level. Data was obtained from the United Nations Industrial Development Organization (UNIDO).

Distance to main city: Computed at the great circle distance (in km) between Madrid (Spain), and the main city of a given country. In general, we take the capital city as the main city, except for the US (New York), Pakistan (Karachi), Brazil (Sao Paulo), China (Shanghai), Canada (Toronto), Switzerland (Zurich), Germany (Frankfurt), Turkey (Istambul), Israel (Tel Aviv), India (Mumbay), Australia (Sydney), Cote d'Ivoire (Abidjan), Kazakhstan (Almaty), Morocco (Casablanca), New Zealand (Auckland), Nigeria (Lagos), South Africa (Johannesburg) and Yemen (Aden). Data was obtained from `http://www.indo.com/distance/index.html`.

Spanish spoken: dummy variable which takes value 1 if a given country has Spanish as the main language. Data was elaborated by the authors.

Access to seacoast: dummy variable which takes value 1 if a country has sovereign access to the seacoast. Data elaborated by the authors.

Absolute time difference to main financial center: Absolute value of the standard time zone difference between the main city used for "distance" and mainland Spain. Source: http://www.timeanddate.com/worldclock/

Member of Euro Area: dummy variable which takes value 1 if a given country has joined the Euro. Data elaborated by the authors.

Average Inflation Differential: Computed as the time average over the period referred of the absolute difference of quarterly inflation rates between Spain and a given country. Annual inflation data was obtained from the IMF's International Financial Statistics.

Exchange Rate Volatility: Computed as the standard deviation (over the period referred) of the bilateral nominal exchange rate (monthly average) between Spain and a given country. Monthly exchange rate data was obtained from the IMF's International Financial Statistics using bilateral exchange rates for both countries vis-à-vis the US dollar.

Sum of land areas: Computed as the sum of land areas (in square km) of Spain and a given country. Data for land areas was obtained from http://www.infoplease.com/ipa/A0004379.html and the CIA World Factbook.

Product of Populations: Computed as the product of average populations in both countries for the period chosen (divided by 10^{12}). Data on countries' population was obtained from the World Bank.

Product of Average GDPs: obtained as the product of average annual GDPs measured at PPP. GDP data at PPP was obtained from the Penn World Tables 6.1.

Sum of per capita GDPs: time average of the sum of per capita GDP for Spain and a given country. Data was obtained from the Penn World Tables 6.1.

Absolute difference of per-capita GDPs: measured as the time average over the referred period. Data was obtained from the Penn World Tables 6.1.

Similarity of oil dependency: constructed as the product of average oil dependency in Spain and a given country *i*:

$$\left(\frac{1}{T}\sum_{t}\frac{Moil_{i,t}-Xoil_{i,t}}{GDP_{i,t}}\right)\times\left(\frac{1}{T}\sum_{t}\frac{Moil_{ESP,t}-Xoil_{ESP,t}}{GDP_{ESP,t}}\right)$$

where $Moil_{i,t}$ and $Xoil_{i,t}$ are imports and exports of oil in country *i* at time *t* and *ESP* represents Spain. Data for oil imports and exports as well as nominal GDP (all in current US dollars) was obtained from the World Bank.

Appendix C: Additional Graphs

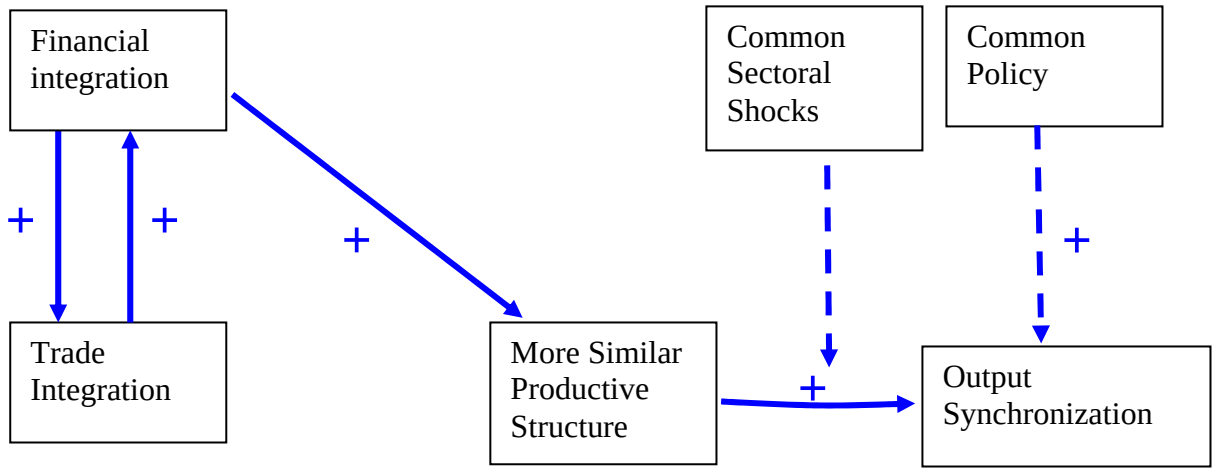

Figure 5: Channels of effects found in the empirical exercise with the extended set of countries (104).