How Much do Trade and Financial Linkages Affect Business Cycle Synchronization for Small Open Economies?

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Abstract

We analyze empirically whether trade and financial linkages between two countries increase the synchronization of their business cycles directly or indirectly. In a system of equations, we use a newly processed database on the bilateral linkages of a small open economy, namely Spain. We prefer this to the generally used US data, to avoid other channels of influence of such a large economy affecting the results. We find that both trade or financial linkages only foster synchronization of business cycles indirectly, by increasing the similarity of economic structure between countries, which itself induces more similar output movements. This result suggests that sectoral shocks, rather than intra-industry shocks, have prevailed in the last 15 years. The net effects of both trade and financial linkages on business cycle synchronization are statistically significant, but very small in economic terms. Common macroeconomic policies, instead, are much more important determinants of output co-movements.

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

JEL classification: E32, F41, F12, E44.

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1. Introduction

The last few years have witnessed increasing economic globalization stemming from 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, theoretical models do not have such clear prediction; in fact, they propose both positive and negative effects on the synchronization of cycles, which may counteract each other.

The issue is relevant for several reasons. First, more synchronized business cycles would presumably mean a stronger and faster transmission of shocks across countries, which could provide an important reason in favor of international policy coordination. Second, if a country's business cycle were mostly driven by external factors, such as trade and financial linkages, domestic policy aimed at economic stabilization would have a small impact on output developments. In the same vein, if trade linkages led to business cycle synchronization, external demand would not manage to dampen economic fluctuations, but quite the opposite. This implies that exchange rate policy could not play an important role in boosting demand at times of low economic activity. Finally, deeper business-cycle synchronization is crucial for the good functioning of common currency areas, as is the case of EMU. Therefore, it is important to know which are the main drivers of such synchronization and adopt policies contributing to it.

Given the importance of the matter and lack of consensus in the theoretical literature on the role of trade and financial linkages, an empirical analysis seems warranted. The existing evidence offers a number of diverging results when testing for the influence of trade and financial integration on business cycle co-movements. While reflecting the different predictions of the theoretical literature, these results suffer from important caveats.

The lack of appropriate data on financial linkages is probably the main drawback. Many studies use aggregate financial stocks or flows (with the rest of the world), which is obviously a very imperfect way to capture bilateral linkages. The few studies with bilateral data generally take the US as a benchmark. Such a large economy influences other countries through many channels other than trade and financial linkages, some of which are difficult to take into account among the control variables. This is bound to bias the estimated coefficients. There is one study with bilateral data for a few large economies (Portes and Rey, 2003) but it only includes equity flows. To tackle this

problem, we use a newly processed dataset on all bilateral financial flows for a small open economy, namely Spain.

Second, most studies estimate 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. Although in principle these endogeneity problems can be addressed using instrumental variable estimation, the possibility of conflicting indirect effects between these variables might reduce the net effects, even when partial effects are strong. Imbs (2004a and 2004b) uses a system of equations to disentangle direct and indirect effects on business cycle synchronization. We follow his approach but in a more comprehensive way in order to include additional potentially important channels through which trade and financial linkages may affect output movements.

From our empirical exercise, we obtain several conclusions: First, trade or financial linkages only influence the synchronization of business cycles indirectly, through their effect on the similarity of economic structure. Second, the synchronization of output increases as economic structures become more similar and as macroeconomic policies become more synchronized. The former suggests — suggesting the prevalence of sectoral shocks in the timeframe of our analysis, namely the last fifteen years. Third, more trade integration *reduces* the similarity of productive structures (which might point to trade fostering specialization), which should in principle contribute to *lower* business cycle synchronization. However, this is only one of the effects, as we also find that higher trade integration fosters financial integration, which in turn promotes a more similar productive structure. The *net effect* of trade integration on the similarity of productive structures turns out to be positive and statistically significant but small in economic terms. Fourth, the net effect of financial linkages on output synchronization is also indirect, positive, and very small: while it fosters trade linkages, it has a larger positive effect on the similarity of productive structures, increasing thereby the correlation of cycles.

The most important conclusion, however, is that these statistically significant indirect effects of trade and financial linkages over business cycle are not very relevant in economic terms. In particular, an increase in the size of bilateral trade or financial linkages between Spain and its partners by one standard deviation from its mean would raise the correlation of their output from 0.710 to 0717 and 0.727, respectively (that is, slightly higher for financial linkages). In comparison to these effects, the similarity of productive structures or common macroeconomic policies seem more relevant in influencing the synchronization of cycles.

The rest of the paper is organized as follows: the next section reviews recent literature on the relationship between trade and financial integration and business cycle synchronization; section 3 outlines the main theoretical predictions and the estimation strategy; section 4 presents the empirical results and section 5 concludes.

2 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 and 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 single 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 employ a measure of correlation that corrects for the existence of high conditional volatility, based on Loretan and English (2000). Helbling and Bayoumi (2003) explore various indicators of synchronization, including a binary indicator of

[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

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.

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. Regarding trade, Kose and Yi (2001) suggest that a higher 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 more intra-industry trade and industry-specific shocks are the main drivers of business cycles. However, if inter-industry trade prevails, then industry-specific shocks would reduce the co-movement of output. Other 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)]. This is in line with the idea of higher intra-industry trade than inter-industry one in developed countries.

Measures of trade linkages also differ across studies. Some of the earlier studies used aggregate measures of trade openness (instead of trade flows between two countries). This is obviously not very appropriate to investigate the determinants of business cycle synchronization between two countries. As for bilateral flows, some authors employ *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 the sum of their GDP [Frankel and Rose (1998), IMF WEO (2002) and Imbs (2004b)]. An alternative measure is the sum of exports and imports 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 one is the dispersion between two countries' goods prices [IMF WEO (2002)]. More details will be offered in Section 3.

In the case of 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 stem from less correlated

[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.

real shocks, since the gains from trading assets are bigger. Increased financial integration would, thus, be associated with lower GDP correlations.

Financial linkages are measured in several ways.[4] Many studies used aggregate measures rather than bilateral ones. 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 *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 this aggregate index for two countries as a proxy of their bilateral financial linkages. Another aggregate *de jure* measure 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] A wider aggregate measure is the total amount of capital flows as a share of GDP, but this suffers from large volatility (Prasad et al (2003)). A bilateral quantity measure of financial linkages is the sum of gross asset positions between two countries, but this is only readily available for the US. Another bilateral quantitative measure which has recently been used are equity transaction flows (Portes and Rey (2003)) although they are only available for a few countries. Equity holdings are also available from the Coordinated Portfolio Investment Survey conducted by the IMF in 1997 and 2001 but it has geographical limitations, as well as underreporting and a poor collection method (Lane and Milesi-Ferretti (2004)). As for price measures, there are a few bilateral ones, such as differences from covered interest rate parity, but with very limited data availability (Frankel, 1992), and proxies of asset price arbitrage (IMF, 2001) based on rolling correlations of stock and bond prices from bilateral transactions. The latter, though, suffers from potential reverse causality. Finally, some

[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.

authors have opted for proxies of risk sharing obtained regressing GDP on disposable income (Kalemli-Ozcan et al (2003)) [10] .

To test for the impact of trade and financial channels on output synchronization, the methodology generally used is a single equation estimation. The fact that there may be indirect effects going in opposite directions might account for the generally small impact found in these studies. 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. We follow his approach while improving it in a number of ways. First, in addition to the indirect channels included in Imbs (2004b), we add a potential two-way relationship between financial and trade links (as found in Aizenman and Noy, 2001), as well as the possibility of increased financial linkages between countries with poorly correlated business cycles (as in Heathcote and Perri, 2003b). Second, Imbs works with a limited set of 24 countries, with a very high proportion of rich economies in the sample. Such a large share of developed countries in the sample might induce a selection bias in the results, as developing countries are likely to be relatively less linked commercially and financially. In the same vein, his sample includes a good number of large and close economies, so that the estimated coefficients might be picking up some other channels through which these economies affect other countries' business cycles In our sample, instead, we have bilateral relations of Spain with 101 countries, with a large proportion of developing countries. Finally, Imbs (2004b) includes output correlations since the beginning of the 1980s. However, the existence of a number of global common shocks in the 80s (although less prevalent than in the 70s) makes it difficult to identify the source of output co-movements. This problem, and the unavailability of data for financial linkages, forces us to concentrate in the 1990s.

3 Estimation

3.1 Theoretical predictions

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, this

[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

will depend on the pattern of trade between the two countries. If both countries develop intra-industry trade, 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.

The impact of financial linkages on the co-movement of output will also depend on how they affect the specialization of production and the nature of shocks. If financial linkages allow spillovers from demand shocks, they should foster output synchronization. However, if increased financial linkages lead to the reallocation of capital according to comparative advantage, there should be more production specialization, contributing to inter-industry instead of intra-industry trade.

3.2 Estimation strategy

The above description of how trade and financial linkages may affect synchronization is clearly multi-directional, which highlights the importance of dealing with endogeneity problems. Moreover, the divergent directions of indirect effects imply that they could offset each other, leading to very small net effects. Instrumental variables can solve the problem only partially since the estimated coefficient will continue to be the net result of possibly conflicting effects, and thus very small. We, therefore, prefer to use a system of four equations, to reflect separately all direct and indirect effects.

In the first equation, we include all potential determinants of the synchronization of business cycles, with particular attention to trade and financial linkages and the similarity of economic structures (eq. 1). We, then, explore the factors behind trade and financial linkages (eqs. 2 and 3, respectively), and those explaining the degree of similarity in productive structures (eq. 4). As previously mentioned, the latter is a key variable for business cycle synchronization directly or through its effect on trade linkages.

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

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

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

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

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 industry trade in total trade. A priori, the more similar the economic structure (i.e., the lower the degree of specialization between two countries), the closer outputs are synchronized.

$F_{i,t}$ 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, we opt for a cross section regression due to the poor quality of bilateral financial data for Spain prior to 1998. To this end, we take averages for the period 1998-2003[11] and drop the time subindex for all variables considered. The number of observations is 101, which reflects the number of countries for which we have data on all the variables mentioned before.

3.3. Variable definitions and data

We measure business cycle synchronization as the Pearson correlation (ρ_I) of the log difference of annual GDP. One Pearson correlation is calculated for all the seven years included in our sample. GDP data is defined at purchasing power parity and is drawn from the IMF's World Economic Outlook database.

For trade linkages T_i between Spain and country i , we use the standard *de facto* measure, 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:

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

[11] The quality of data prior to 1998 is not very good with respect to the geographical assignment of origin and destination of financial flows, especially portfolio transactions.

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.[12] Note that $T^1_{ESP,i}$ is a time average over the period under study. Data on bilateral trade flows is readily available from the IMF's Direction of Trade Statistics

To conduct a robustness exercise, we construct another measure of bilateral linkages, namely that of Clark and van Wincoop (2001)'s, which is independent of country size. 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 that this measure is equal to one if preferences are homothetic and there are no trade barriers (as shown by Deardorff, 1998), we can drop $GDP_{World,t}$ from the computation of the $T^2_{ESP,i}$. In fact, $GDP_{World,t}$ would just be a scaling factor multiplying the coefficient of $T^2_{ESP,i}$ but would not change its sign or significance. All our results are robust to measuring trade linkages in this alternative way.

For financial linkages, we use a newly processed dataset for bilateral financial flows between Spain and countries in the rest of the world from the Spanish Balance of Payments. Although data on international financial positions (stocks) would have been a less volatile measure of financial linkages, it is not available yet for Spain. One important advantage of using this dataset is that it includes all types of flows: FDI, portfolio and other flows (mainly cross-border bank lending), in contrast with Portes and Rey (2005)'s database, which only includes stocks. We take the sum of the absolute values of inward and outward flows, for each type of flow, and compute a time average over the seven years for which accurate data is available. Denoting it $F_{ESP,i}$, we have:

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

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

[12] 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.

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[13]) or on all sectors (at lower dissagregation[14]). Let $s_{n,i,t}$ be the share of industry n in country i at time t. A first measure of economic similarity can be expressed as:

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

where N is the number of sectors. $S^1_{ESP,i}$ represents the time average of discrepancies in economic structures, as in Imbs (2004b).[15] $S^1_{ESP,i}$ can take values between 0 for identical structures and –2 for disjoint productive structures. *Higher* values for $S^1_{ESP,i}$, therefore, imply *more* similarity between the Spanish productive structure and that of country i. Clark and van Wincoop (2001) propose an alternative measure of similarity of economic structures with which we shall conduct robustness tests. They propose to take taking time averages of sectoral shares in output before computing distances of those shares.[16]

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

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 and of production. All the results presented in the next section use shares of value added but the results are robust to using different 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.[17]

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

[14] At 1-digit ISIC classification groups.

[15] As compared to Imbs (2004b), 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.

[16] 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 $s_{n,i,t}$.

[17] 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.

We also include a number of controls in the regressions based on the existing theoretical and empirical literature on the subject. As other potential sources of business cycle synchronization we consider how similar – or coordinated - are macroeconomic policies or, even, how close the countries are from a monetary union. These are measured by the volatility of the bilateral exchange rate, the average inflation differential and a dummy variable to account for the use of the euro as official currency.

There are also a number of control variables for the other three equations of our system, namely those explaining, trade, financial linkages and the similarity of the economic structure. In the case of trade linkages, there is wide consensus that gravity variables play an important role in explaining trade between two countries. We include some of the most usual ones, namely distance between the two countries, the sum of their land areas, the product of populations, the product of GDPs, and two dummy variables to account for sovereign access to the sea and a common main language.[18]

Recent studies[19] have suggested that gravity variables also explain bilateral financial linkages. Thus, as controls of third equation, we include distance, the time difference between the countries' main financial centers, a dummy to reflect a common language and the sum of per capita GDP. This last variable tries to capture the idea that richer countries tend to generate more financial flows

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 use the log of distance and time differences, instead of its levels, in a robustness exercise.

As control for the equation explaining the similarity of productive structure (eq. 4), we use the pairwise difference of per capita GDPs, based on Imbs and Wacziarg (2003). This is based on the idea that rich countries tend to be more diversified and, thereby, more similar, whereas poorer countries tend to be more specialized.

4 Results

Before embarking in the regressions, we show some stylized facts of the main variables of interest in this study: business cycle synchronization, trade and FDI linkages for the case of Spain,

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

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

The degree of bilateral business cycle synchronization between Spain and EU countries increased substantially from 1960 to 1995, particularly since 1986 (figure 1). After 1995, it fell 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 between Spain and Latin American countries have been less correlated over time and have even started to 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.

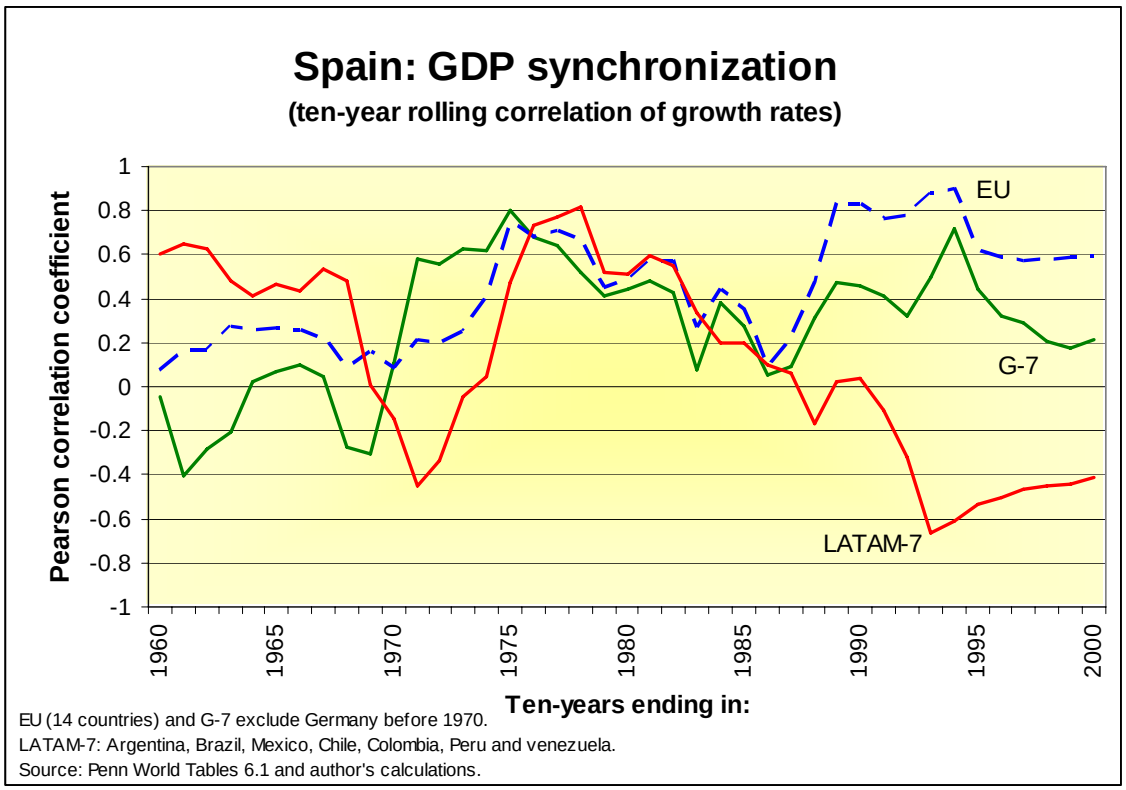

Figure 1: Evolution of GDP synchronization between Spain and selected regions.

Trade linkages between Spain and EU countries started to rise already ten years before Spain's entry into EU but the increase has been exponential since then (Figure 2). In fact, the sum of imports from and exports to other EU countries has reached 0.002% of EU 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 the G-7 GDP, as a sum of imports and exports. Trade linkages with Latin American countries haven remained relatively small throughout the period.

Reliable data for bilateral financial flows is only available from 1998 onwards (figure 3). Total flows rose substantially in the last 7 years to 2004, and have concentrated in the euro area and in the

UK[20]. The relevance of Latin America in total financial flows is very small but it is larger for FDI flows (figure 4)

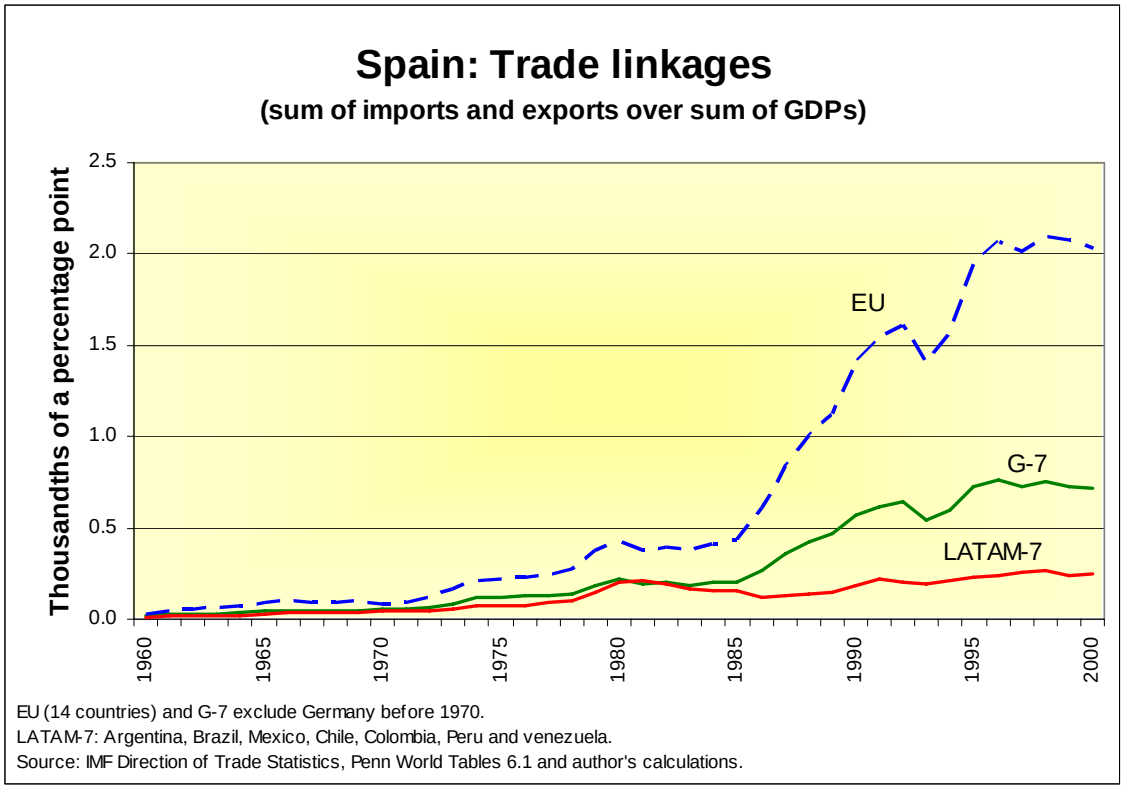

Figure 2: Evolution of trade linkages between Spain and selected regions.

[20] UK accounts for almost 95 percent of total financial flows to EU countries outside the euro area.

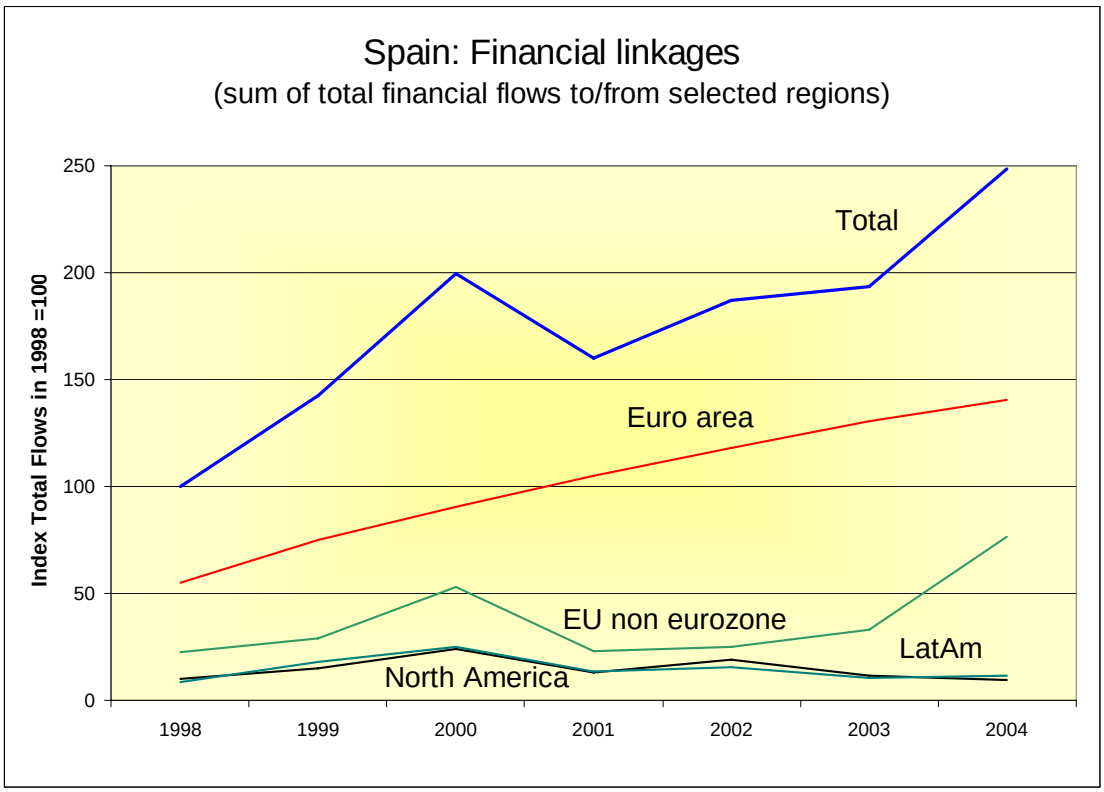

Figure 3: Evolution of total financial linkages between Spain and selected regions.

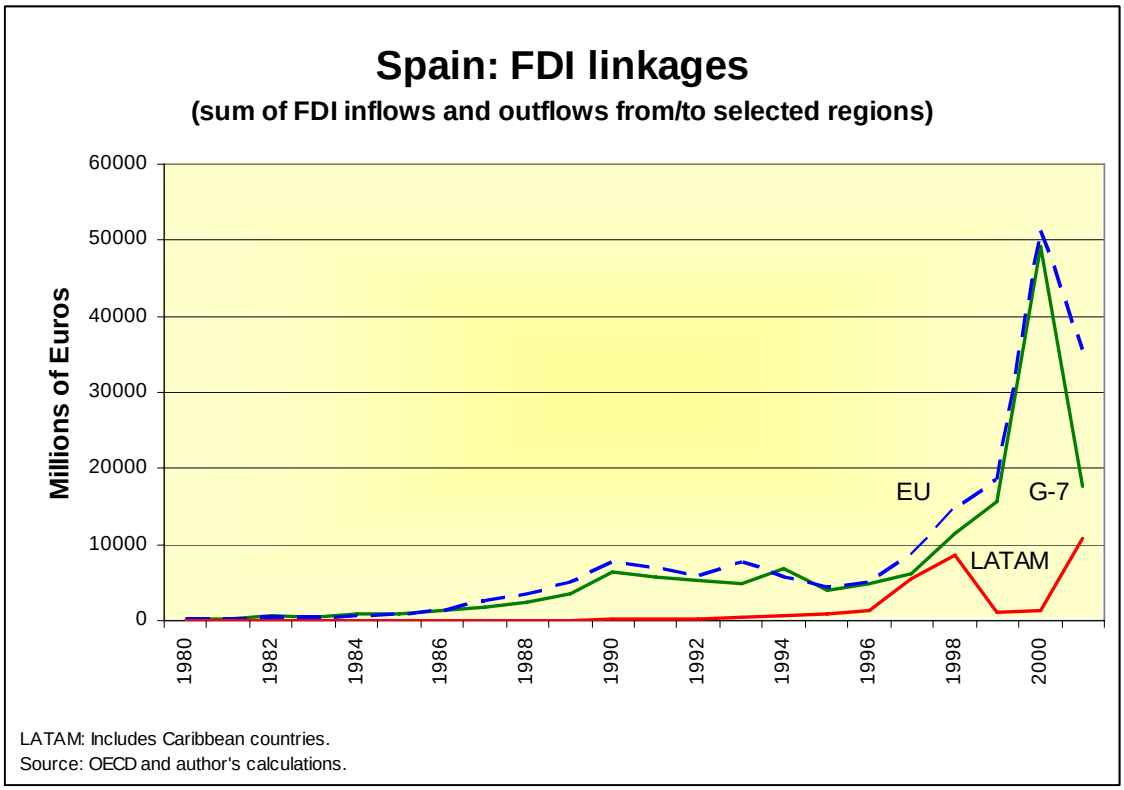

Figure 4: Evolution of FDI linkages between Spain and selected regions.

Turning to the empirical results, we proceed in several steps until reaching our preferred estimation method: a system of four equations. We, first, estimate each equation separately, using OLS. Second, since there are good reasons to suspect endogeneity problems, we complement the estimation of the equation explaining business cycles (eq. 1) with suitable instruments for trade and financial linkages (*T* and *F*) and for the similarity of productive structure *S.* Third, in order to disentangle the direct and indirect effects of trade and financial linkages, we turn to a joint estimation of the four equations, using three-stage least squares (3SLS).

In the separate estimation of eq. 1, trade integration seems significant in explaining the correlation of business cycles (Table 1). However, once we control for common policies, the effect vanishes. The volatility of exchange rates is found significant at a 10% level and with the expected sign: a higher volatility reduces output co-movement. Neither financial linkages nor the similarity of productive structure appear significant. These results suffer from several caveats: First, the regression explains a very small fraction of the variablility of the correlation of GDP growth. Second, the endogeneity of trade (*T*), financial linkages (*F*), and similarity of the productive structure (*S*) probably leads to highly biased coefficients.

Before analyzing the estimation of equation 1 using instrumental variables, we turn to the OLS estimation of equations 2 to 4, separately. The estimation of trade linkages (Eq 2) shows that financial linkages, affect trade positively (i.e., $\beta_2>0$) and significantly (Table 2). Among the controls included based on the gravity model, distance to the main city and access to the seacoast appear highly significant and with the expected correct sign. The similarity of the 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.

Financial linkages seem to be affected by trade linkages and the sum of per capita GDPs (Table 3). The significance of lagged trade linkages is also consistent with findings by Aizenman and Noy (2004). One explanation for this lagged effect is that trade integration in Spain started to rise in the mid 80s, while the process of financial integration took off in the mid 90s.

The similarity in productive structure (Eq. 4) is explained by the difference in per capita GDPs and the sum of per capita GDPs (Table 4), in line with findings by Imbs and Wacziarg (2003). In addition, it is positively influenced by trade linkages and financial linkages in some of the specifications. Again, it should be recalled that all these coefficients might suffer from important biases stemming from the endogeneity of *T* and *F*. In fact, we shall see in our three-stage estimation,

that these estimated effects of T and F on the similarity of productive structures turn out to be net effects, stemming from conflicting positive and negative effect. This may account for the low statistical significance of their coefficients in some of the specifications in table 4.

We now proceed to estimate Eq. 1 with IV, using appropriate instruments for T, F, and S.[21] The results are in the lower part of Table 1. Because of the inclusion of instruments, the number of observations drops up to 101. The last three regressions include our controls for common macroeconomic policies. Although coefficients change slightly compared to the top part of Table 1, overall we still find no significant contribution of trade or financial linkages in explaining business cycle synchronization, once we control for common policies. However, it is important to notice that the similarity of productive structure becomes statistically significant ($\alpha_2>0$). This might point to the prevalence of sectoral shocks during this period, as opposed to intra-industry shocks. In fact, a more similar productive structure promotes synchronization if external shocks are mainly sector-specific.

The IV estimation, however, still pools together the direct and indirect effects of trade and financial linkages over business cycles synchronization. In addition, if indirect effects through different channels go in opposite directions, the net effect might be small, contributing to a low statistical significance. We, therefore, use 3SLS to estimate the whole system of four equations.

This different estimation technique substantially changes the results (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 macroeconomic policies. Trade linkages influence output synchronization only indirectly through their effect on the similarity of productive structure. This is actually negative ($\gamma_1<0$), which implies that stronger trade linkages tend to make productive structures less similar, probably because of the larger weight of inter-industry trade. On the other hand, more trade linkages appear to foster financial linkages ($\delta_2>0$), which in turn lead to a more similar productive structure ($\gamma_2>0$). The net effect of trade on the similarity of productive structures is still positive ($\gamma_1+ \gamma_2 \delta_2>0$), in line with previous results, which do not separate the two effects.

The influence of financial linkages on output synchronization is also indirect, through their effect on the similarity of productive structure. The latter is positive and significant ($\gamma_2>0$). In addition, financial linkages foster trade ones ($\beta_2>0$), which partly offsets the previous effect on the similarity

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

of productive structures. The net effect on S (and thereby on business cycle synchronization) is still positive ($\gamma_2 + \gamma_1 \beta_2 > 0$).

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 also finds direct effects. This difference might be related to the fact that we use a small open economy as a benchmark, rather than the US. The latter may have biased upward the coefficients, as there are other channels of influence of the US on business cycle sincronization, which are not considered among the control variables.

There are also two 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); and (ii) the model seems to confirm a double causality between trade and financial linkages. Figure 4 summarizes the statistically significant relations.

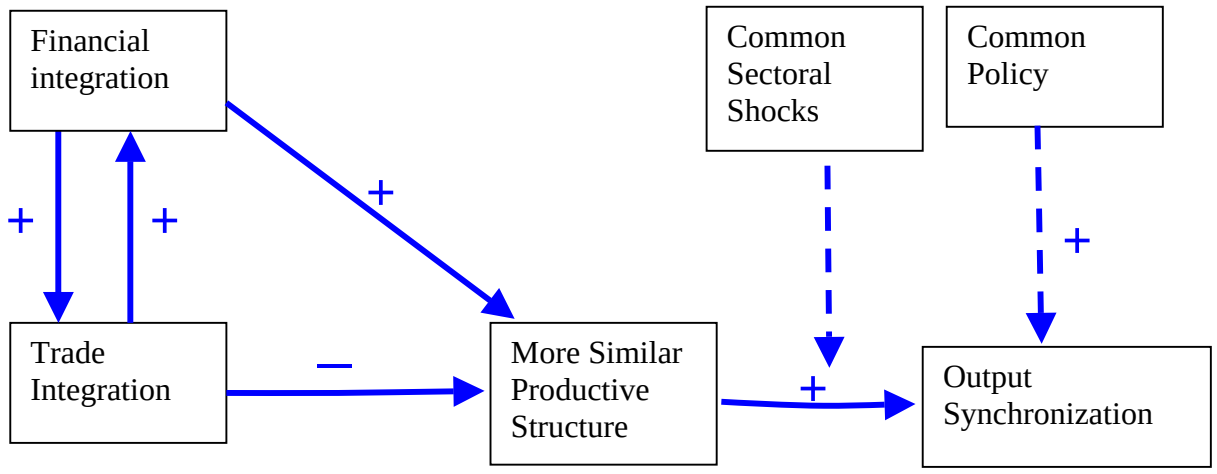

Figure 4: Channels leading to business cycle synchronization found in the empirical exercise.

Another important question concerns the economic relevance of the statistically significant effects. As described before, the total effect of trade on the synchronization of business cycles is given indirectly through an increase in the similarity of productive structures. Specifically, in our benchmark 3SLS regression in table 5a, the effect of trade linkages on our measure of co-movement

of output is equal to $\alpha_2(\gamma_1+ \gamma_2 \delta_2)$= 2911.32, whereas the total effect of financial linkages is given by $\alpha_2 (\gamma_2+ \gamma_1 \beta_2)$= $3.82x10^{-6}$. This implies that increasing trade linkages between two countries by one standard deviation from its mean (see table 6), raises the bilateral correlation of GDP between Spain and its partners from 0.710 to 0.717. In the same vein, increasing financial linkages by one standard deviation, raises the correlation of their output from 0.710 to 0.727.

This is hardly an economically meaningful change, and reflects the fact that business synchronization between Spain and its partners has presumably been more influenced by common macroeconomic policies and similar sectoral shocks. In fact, an increase in the similarity of productive structures (*S*) or inflation differentials by one standard deviation would raise bilateral GDP correlation from 0.710 to 0.778 and 0.858, respectively. Exchange rate volatility, in turn, would reduce it to 0.603 (from 0.710). The three are much stronger effects than those of trade and financial linkages.

We conduct a number of additional tests to confirm the robustness of our results.

First, we include alternative measures of the similarity in productive structure, since this is a key factor that links our variables of interest to the dependent variable: GDP correlations. A first one is taking the log of our previous measurement for *S*. As Table 5b shows, both the significance of the regressors and the estimated total effect of trade and financial integration on output synchronization remain relatively unchanged. A second alternative definition of similarity of productive structures is $S^2_{ESP,I}$, as explained in the previous section. Table 5c shows that using this alternative definition does not change the main results.

Second, we control for global shocks by introducing 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.[22] In principle, countries that are more dependent of oil should have a high and positive dependency ratio, whereas oil exporting countries should have a negative one. In other words, a high and positive product of this indicator for Spain and each of its partners indicates that they are affected by an oil shock in a similar way as Spain. We introduce this indicator of global shocks as additional regressor in Eq. 1 and find that it is not statistically significant[23] in any of the specifications (OLS, IV or 3SLS estimations, as reported in tables 1 and

[22] Details of the construction and sources used for this oil dependency index can be found in Appendix B.
[23] P-values for a test of significance of this variable are never lower than 0.88 in all specifications.

5a,b,c). 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. While our dataset does not allow us to analyze 70s or even the 80s, we would have expected this coefficient to be significant in that larger timeframe.

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 theory one could eliminate those biases by using suitable and readily available instruments, through IV estimation. However, the coefficients might appear small or not significant because direct and indirect effects might run in opposite directions, partially offsetting each other. This is precisely what we find in the empirical exercise when we estimate a system of equations through 3SLS and separate direct and indirect effects of trade and financial linkages on output synchronization.

We find that only indirect effects of trade and financial linkages (through their impact on the similarity of productive structure between Spain and each of its partners) are statistically significant and that their economic significance is very small. Business cycle synchronization appears more influenced by common policies and a similar productive structure. The latter might point to the prevalence of sectoral, rather than intra-industry, shocks in the period under study. Finally, global shocks, in particular oil shocks, do not seem very relevant in the timeframe of our study (the last fifteen years).

This small effect of trade and financial linkages on output co-movements contrasts with the larger effects found in some recent work as in Imbs (2004b). The difference might be due to the use of the US as a benchmark, which influences other countries through many other channels hard to account for. Another possible explanation lies on the restrictions in our timeframe imposed by the availability of bilateral financial flows. In any event, 0ur finding of no direct influence of trade or financial linkages on cycle synchronization, as opposed to Imbs (2004b) does seem coherent with using a small open economy as a benchmark. Finally, the significance of the indirect influence of trade and financial linkages 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, as well as common macroeconomic policies. The former points to the relevance of sectoral shocks in our timeframe (the last 15 years). Larger trade and financial linkages contribute to output synchronization only in an indirect and small way (through a more similar economic structure).

There are two important policy conclusions to draw from these results. First, globalization, understood as increasing trade and financial linkages, will continue to boost the domestic economy through a higher external demand of goods, services or financial assets. Second, deeper real and financial integration between two countries will not lead to more synchronized business cycles unless the productive structure converges rapidly. This will depend on the relevance of sectoral shocks, as opposed to intra-industry ones. Common macroeconomic policies, however, are bound to increase output co-movement much more rapidly

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	169	169	133	133	146	146	124
Trade Linkages 1990-1999[1] (T)	28276.552 ***	24182.738 *	18729.572 *	22349.352 ***	14932.748	11177.125	12138.385
	(8935.4163)	(13251.373)	(11151.835)	(7981.2523)	(10333.848)	(13034.887)	(11418.178)
Financial Linkages 1998-2003[2] (F)		2.68E-06	2.42E-06			2.71E-06	1.97E-06
		(6.38E-06)	(5.18E-06)			(5.71E-06)	(4.89E-06)
Similarity in Productive Structure 1980-2000[3] (S)			-0.0081357	-0.0064998			-0.0697694
			(0.07573193)	(0.07542254)			(0.07525938)
Member of Euro Area (1=yes)					0.1045561	0.0985504	0.09351266
					(0.0988607)	(0.0999385)	(0.08584553)
Average Inflation differencial 1990-2003					-0.000143	-0.000144	0.0000434
					(0.0001392)	(0.0001396)	(0.00014781)
Exchange rate volatility 1990-2003[4]					-0.067044 *	-0.067005 *	-0.0652961 *
					(0.0346912)	(0.0347876)	(0.03365546)
Similar fuel dependency (average 1990-2002)					-0.001087	-0.001116	0.00024332
					(0.0012664)	(0.0012714)	(0.00119058)
Adjusted R^2	0.05	0.05	0.04	0.05	0.14	0.14	0.08

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

Specification	Ib	IIb	IIIb	IVb	Vb	VIb	VIIb
Number of Observations	124	124	108	108	109	109	101
Trade Linkages 1990-1999[1] (T)	19755.765 ***	11125.101	10063.47	4484.3986	11133.47	2441.0837	11082.366
	(7196.1608)	(26822.744)	(24198.164)	(8489.3293)	(7316.7821)	(23134.601)	(24159.591)
Financial Linkages 1998-2003[2] (F)		5.34E-06	-3.68E-06			4.84E-06	-3.72E-06
		(1.599E-05)	(0.00001491)			(1.219E-05)	(0.00001327)
Similarity in Productive Structure 1980-2000[3] (S)			0.30209469 **	0.29415264 **			0.19172927 *
			(0.12076779)	(0.11537577)			(0.10647852)
Member of Euro Area (1=yes)					0.0356855	0.0483724	0.01388321
					(0.074396)	(0.0817866)	(0.08699554)
Average Inflation differencial 1990-2003					0.0004542 ***	0.0004424 ***	0.0004968 ***
					(0.0001577)	(0.0001623)	(0.00017253)
Exchange rate volatility 1990-2003[4]					-0.12279 ***	-0.121704 ***	-0.1341361 ***
					(0.0327557)	(0.0332538)	(0.03565103)
Similar fuel dependency (average 1990-2002)					-6.24E-05	-0.000145	0.00016795
					(0.0009815)	(0.0010149)	(0.00111342)
Adjusted R^2	0.04	0.03	0.01	0.03	0.15	0.13	0.11

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 total financial flows 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 in the three-stage least-squares regression in table 5a.

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

Table 2

Dependent Variable: Trade Linkages with Spain 1990-1999[1] (T)

OLS Estimation

Specification	I	II	III	IV	V	VI
Number of Observations	172	172	135	172	172	135
Financial Linkages 1998-2003[2] (F)		3.02E-10 ***	2.84E-10 ***		3.02E-10 ***	2.88E-10 ***
		(2.50E-11)	(2.87E-11)		(2.72E-11)	(3.07E-11)
Similarity in Productive Structure 1980-2000[3] (S)			8.24E-07			9.82E-07 *
			(5.50E-07)			(5.90E-07)
Log of distance to main city (km)	-1.86E-06 ***	-9.93E-07 ***	-9.73E-07 ***	-1.84E-06 ***	-9.93E-07 ***	-9.16E-07 **
	(2.42E-07)	(1.91E-07)	(2.31E-07)	(2.40E-07)	(1.97E-07)	(2.45E-07)
Spanish spoken (1=yes)	5.35E-07	2.28E-07	1.32E-07	6.49E-07	2.38E-07	8.64E-08
	(5.33E-07)	(3.92E-07)	(4.45E-07)	(5.22E-07)	(3.97E-07)	(4.55E-07)
Access to seacoast (1=yes)	1.09E-06 ***	7.09E-07 **	7.82E-07 **	9.30E-07 **	7.02E-07 **	7.95E-07 **
	(3.80E-07)	(2.80E-07)	(3.74E-07)	(3.74E-07)	(2.84E-07)	(3.77E-07)
Sum of Land Areas (in km^2)				-1.23E-13	-5.87E-14	-8.66E-14
				(9.47E-14)	(7.20E-14)	(8.25E-14)
Product of populations (in billions)				3.84E-12	2.68E-11	1.68E-11
				(3.94E-11)	(3.00E-11)	(3.37E-11)
Product of average GDPs 1990-2003				1.15E-24 ***	-2.05E-29	-4.12E-26
				(3.65E-25)	(2.95E-25)	(3.31E-25)
Adjusted R^2	0.27	0.61	0.61	0.31	0.60	0.60

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 total financial flows 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: Financial Linkages with Spain 1998-2003[2] (F)

OLS Estimation

Specification	I	II	III	IV	V	VI	VII
Number of Observations	175	172	126	135	110	169	124
Trade Linkages 1990-1999[1] (T)		1.43E+09 ***	4.92E+08	1.43E+09 ***		1.42E+09 ***	
		(1.31E+08)	(3.63E+08)	(1.54E+08)		(1.36E+08)	
Trade Linkages 1980-1989[1] (lagged T)			3.32E+09 ***		4.73E+09 ***		4.65E+09 ***
			(1.07E+09)		(5.18E+08)		(4.73E+08)
Similarity in Productive Structure 1980-2000[3] (S)				-308.38456	-848.0289		
				(1323.6356)	(1577.4637)		
Growth correlations with Spain, 1990-2003 (ρ)						-40.40767	-818.04458
						(989.6026)	(1604.4596)
Log of distance to main city (km)	-2059.278 ***	182.34821	576.47412	178.92116	463.93484	190.17835	426.44016
	(628.15142)	(530.75015)	(643.11731)	(656.91254)	(712.08365)	(550.27034)	(645.48254)
Spanish spoken (1=yes)	1266.9385	432.31737	-223.58097	584.02029	-181.778	457.47058	-191.45196
	(1095.6633)	(870.86802)	(935.20182)	(1018.765)	(1025.5452)	(901.59865)	(965.45879)
Access to seacoast (1=yes)	612.40449	-604.91316	-534.49508	-696.09789	-544.9924	-583.2391	-583.06513
	(822.88819)	(644.78093)	(905.31586)	(882.97242)	(1043.8004)	(660.91507)	(916.939)
Log of Absolute time difference	-10.30051	-4.3840384	29.137448	-3.1992559	42.065177	-2.817231	39.618944
to main financial centre	(52.649029)	(40.614395)	(49.463386)	(52.605461)	(58.5535)	(41.291938)	(50.076532)
Sum of percapita GDPs (average 1990-2003)	0.2222462 ***	0.1104541 ***	0.04775553	0.1270508 ***	0.0664305	0.1157181 ***	0.05426265
	(0.0446836)	(0.0362098)	(0.04628984)	(0.04592979)	(0.0556659)	(0.0380558)	(0.04943778)
Adjusted R^2	0.24	0.55	0.59	0.54	0.58	0.55	0.59

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 total financial flows 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	VII
Number of Observations	135	150	135	135	138	135	135
Trade Linkages 1990-1999[1] (T)	42050.239 ***		36987.724 ***	22900.604 **		19263.127	27761.665 ***
	(8734.6039)		(12837.475)	(8938.3616)		(12624.038)	(8802.1044)
Financial Linkages 1998-2003[2] (F)		1.588E-05 ***	3.32E-06		8.86E-06 **	2.48E-06	
		(4.32E-06)	(6.15E-06)		(4.27E-06)	(6.05E-06)	
Absolute difference of percapita GDPs (average 1990-2003)				-1.801E-05 ***	-2.26E-05 ***	-1.87E-05 ***	-2.438E-05 ***
				(6.14E-06)	(5.85E-06)	(6.39E-06)	(5.53E-06)
Sum of percapita GDPs (average 1990-2003)				7.11E-06 **	6.24E-06 *	6.66E-06 *	
				(3.17E-06)	(3.35E-06)	(3.37E-06)	
Adjusted R^2	0.14	0.08	0.14	0.27	0.27	0.26	0.25

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 total financial flows 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

101 Observations

Dependent Variable	**Output Synchron. (ρ)**	**Trade Linkages (T)**	**Financial Linkages (F)**	**Similarity in Prod. Struct. (S)**
Trade Linkages 1990-1999[1] (T)	-5351.413		1.42E+09 ***	-77069.86 ***
	(22587.15)		(3.23E+08)	(28199.21)
Trade Linkages 1980-1989[1] (lagged T)			6.94E+08	
			(8.10E+08)	
Financial Linkages 1998-2003[2] (F)	4.85E-06	6.03E-10 ***		0.0000633 ***
	(1.24E-05)	(5.87E-11)		(0.0000159)
Growth correlations with Spain, 1990-2003 (ρ)			-764.844	
			(3464.891)	
Similarity in Productive Structure 1980-2000[3] (S)	0.227161 **	-9.95E-07		
(lower values imply more similarity)	(0.098337)	(1.37E-06)		
Log of distance to main city (km)		-4.06E-07	525.5104	
		(3.30E-07)	(566.4753)	
Spanish spoken (1=yes)		8.61E-08	-48.13363	
		(5.40E-07)	(894.2213)	
Access to seacoast (1=yes)		1.68E-07		
		(3.85E-07)		
Log of absolute time difference to main financial centre			-0.5414815	
			(23.5606)	
Member of Euro Area (1=yes)	0.036258			
	(0.081015)			
Average Inflation differencial 1990-2003	0.000449 ***			
	(0.000162)			
Exchange rate volatility 1990-2003[4]	-0.122575 ***			
	(0.033545)			
Sum of Land Areas (in km^2)		1.78E-14		
		(7.12E-14)		
Product of populations (in billions)		3.03E-11		
		(2.67E-11)		
Product of average GDPs 1990-2003		-2.83E-25		
		(2.42E-25)		
Sum of percapita GDPs (average 1990-2003)			0.0516209	
			(0.0500922)	
Absolute difference of percapita GDPs (average 1990-2003)				-0.0000244 ***
				(6.34E-06)
Similar fuel dependency (average 1990-2003)	-1.07E-05			
	(0.001039)			
Implicit R^2	0.14	0.37	0.59	-0.47

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 total financial flows 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

101 Observations

Dependent Variable	**Output Synchron. (ρ) (Equation 1)**	**Trade Linkages (T) (Equation 2)**	**Financial Linkages (F) (Equation 3)**	**Similarity in Prod. Structure (log S) (Equation 4)**
Trade Linkages 1990-1999[1] (T)	-6893.099		1.46E+09 ***	-137529.3 ***
	(22542.54)		(3.32E+08)	(47477.19)
Trade Linkages 1980-1989[1] (lagged T)			5.20E+08	
			(8.50E+08)	
Financial Linkages 1998-2003[2] (F)	5.97E-06	6.16E-10 ***		0.0001167 ***
	(1.24E-05)	(6.11E-11)		(0.0000267)
Growth correlations with Spain, 1990-2003 (ρ)			-638.2137	
			(3313.685)	
Log of Similarity in Productive Structure	0.116 **	-6.39E-07		
1980-2000[3] (log S)	(0.056246)	(7.90E-07)		
Log of Distance to main city (km)		-3.79E-07	493.2159	
		(3.20E-07)	(556.3871)	
Spanish spoken (1=yes)		2.02E-07	-326.6846	
		(5.25E-07)	(877.4963)	
Access to seacoast (1=yes)		1.13E-07		
		(3.29E-07)		
Log of absolute time difference			-1.639503	
to main financial centre			(23.72455)	
Member of Euro Area (1=yes)	0.037157			
	(0.081122)			
Average Inflation differencial 1990-2003	0.000442 ***			
	(0.000161)			
Exchange rate volatility 1990-2003[4]	-0.12018 ***			
	(0.033317)			
Sum of Land Areas (in km^2)		2.73E-14		
		(7.90E-14)		
Product of populations (in billions)		2.97E-11		
		(2.63E-11)		
Product of average GDPs 1990-2003		-3.15E-25		
		(2.56E-25)		
Sum of percapita GDPs (average 1990-2003)			0.0535118	
			(0.0497083)	
Absolute difference of percapita GDPs				-0.0000419 ***
(average 1990-2003)				(0.0000107)
Similar fuel dependency (average 1990-2002)	-0.000109			
	(0.001029)			
Implicit R^2	0.14	0.34	0.58	-0.53

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 total financial flows 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

101 Observations

Dependent Variable	**Output Synchron. (ρ) (Equation 1)**	**Trade Linkages (T) (Equation 2)**	**Financial Linkages (F) (Equation 3)**	**Similarity in Prod. Structure log S, measure S_2 (Equation 4)**
Trade Linkages 1990-1999[1] (T)	-9495.007		1.43E+09 ***	-136460.4 **
	(22616.19)		(3.30E+08)	(53667.33)
Trade Linkages 1980-1989[1] (lagged T)			6.00E+08	
			(8.36E+08)	
Financial Linkages 1998-2003[2] (F)	7.96E-06	6.08E-10 ***		0.0001128 ***
	(1.23E-05)	(5.84E-11)		(0.0000304)
Growth correlations with Spain, 1990-2003 (ρ)			-284.3701	
			(3394.972)	
Log of Similarity in Productive Structure	0.109199 **	-4.26E-07		
1980-2000[3] (log S, measure S_2)	(0.051948)	(6.97E-07)		
Log of Distance to main city (km)		-3.43E-07	424.6154	
		(3.37E-07)	(577.9393)	
Spanish spoken (1=yes)		2.37E-07	-443.2402	
		(5.50E-07)	(916.4571)	
Access to seacoast (1=yes)		7.94E-08		
		(3.34E-07)		
Log of absolute time difference			-0.3256785	
to main financial centre			(24.22303)	
Member of Euro Area (1=yes)	0.040329			
	(0.080886)			
Average Inflation differencial 1990-2003	0.000443 ***			
	(0.000162)			
Exchange rate volatility 1990-2003[4]	-0.119433 ***			
	(0.033477)			
Sum of Land Areas (in km^2)		1.08E-14		
		(7.32E-14)		
Product of populations (in billions)		2.43E-11		
		(2.57E-11)		
Product of average GDPs 1990-2003		-2.50E-25		
		(2.37E-25)		
Sum of percapita GDPs (average 1990-2003)			0.0404434	
			(0.0471115)	
Absolute difference of percapita GDPs				-0.0000465 ***
(average 1990-2003)				(0.000012)
Similar fuel dependency (average 1990-2002)	-0.0001			
	(0.001034)			
Implicit R^2				

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 total financial flows 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)	185	0.7102	0.2910	-0.3294	0.9890	0.410	0.1403	0.8371	0.9623
Trade Linkages 1990-1999[1] (T)	172	0.000000887	0.000002440	0.000000000	0.000019000	2.754	0.00000000	0.00000014	0.00000328
Trade Linkages 1980-1989[1] (lagged T)	126	0.000000471	0.000000947	0.000000000	0.000006120	2.011	0.00000000	0.00000012	0.00000269
Financial Linkages 1998-2003[2] (F)	235	986.27	4374.84	0.00	39781.87	4.436	0.0000	0.0000	4963.80
Similarity in Productive Structure 1980-2000[3] (S)	150	-0.6502	0.2963	-1.4457	-0.1890	-0.456	-1.1706	-0.6433	-0.2463
Member of Euro Area (1=yes)	207	0.0821	0.2752	0.0000	1.0000	3.351	0.0000	0.0000	1.0000
Average Inflation differencial 1990-2003	170	81.9713	329.7735	0.5328	3320.1300	4.023	1.5302	5.3283	489.3044
Exchange rate volatility 1990-2003[4]	190	0.5518	0.8739	0.0028	5.3032	1.584	0.0674	0.1996	2.4420
Distance to main city (km)	207	6237.7	3944.7	494.0	19589.0	0.632	1282.0	5956.0	14719.0
Log of distance to main city	207	8.5058	0.7422	6.2025	9.8827	0.087	7.1562	8.6922	9.5969
Spanish spoken (1=yes)	207	0.1014	0.3027	0.0000	1.0000	2.983	0.0000	0.0000	1.0000
Access to seacoast (1=yes)	207	0.7874	0.4101	0.0000	1.0000	0.521	0.0000	1.0000	1.0000
Absolute time difference to main financial center	207	3.3623	3.1820	0.0000	12.0000	0.946	0.0000	2.0000	10.0000
Log of time difference to financial center	207	-2.9284	7.9878	-18.4207	2.4849	-2.728	-18.4207	0.6931	2.3026
Sum of Land Areas (in km^2)	207	1206343	1965988	504784	17600000	1.630	505044	616152	3010592
Product of populations (in billions)	205	1186.01	4455.57	0.70	48145.25	3.757	2.71	228.83	4537.81
Product of average GDPs 1990-2003	175	1.61E+17	5.67E+17	1.08E+14	4.77E+18	3.519	5.36E+14	1.62E+16	7.23E+17
Sum of percapita GDPs (average 1990-2003)	175	23908	7921	15554	50361	0.331	16493	20927	39509
Absolute difference of percapita GDPs	175	10110	4341	627	18802	0.429	1890	11002	14970

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

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

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

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

Table 7

Table of Cross Correlations

(Based on common 108 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)	Financial Linkages 1998-2003[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)	0.251	**1.000**																	
Trade Linkages 1980-1989[1] (lagged T)	0.265	**0.946**	**1.000**																
Financial Linkages 1998-2003[2] (F)	0.193	**0.753**	**0.773**	**1.000**															
Similarity in Productive Structure 1980-2000[3] (S)	0.256	0.422	0.467	0.351	**1.000**														
Member of Euro Area (1=yes)	0.238	**0.633**	0.539	0.448	0.306	**1.000**													
Average Inflation differencial 1990-2003	-0.046	-0.054	-0.059	0.007	0.022	-0.070	**1.000**												
Exchange rate volatility 1990-2003[4]	-0.242	-0.115	-0.087	-0.057	0.025	-0.142	**0.839**	**1.000**											
Distance to main city (km)	-0.072	-0.398	-0.413	-0.284	-0.100	-0.384	0.106	0.071	**1.000**										
Log of distance to main city	-0.137	-0.593	-0.587	-0.399	-0.230	-0.501	0.128	0.121	**0.916**	**1.000**									
Spanish spoken (1=yes)	-0.037	-0.125	-0.104	-0.077	-0.055	-0.143	0.297	0.244	0.249	0.298	**1.000**								
Access to seacoast (1=yes)	0.191	0.135	0.164	0.114	0.306	0.057	0.072	0.012	0.078	0.014	0.067	**1.000**							
Absolute time difference to main financial centre	0.074	-0.278	-0.275	-0.174	0.040	-0.289	0.132	0.074	**0.859**	**0.769**	0.338	0.268	**1.000**						
Log of time difference to financial center	-0.106	-0.354	-0.379	-0.231	-0.145	-0.265	0.100	0.137	0.545	0.583	0.192	0.119	**0.622**	**1.000**					
Sum of Land Areas (in km^2)	0.111	-0.023	0.051	0.127	0.347	-0.109	0.132	0.127	0.160	0.159	-0.060	0.108	0.242	0.135	**1.000**				
Product of populations (in billions)	0.123	0.015	0.034	0.054	0.266	-0.053	-0.008	-0.019	0.110	0.120	-0.099	0.113	0.180	0.105	0.548	**1.000**			
Product of average GDPs 1990-2003	0.172	0.188	0.260	0.342	0.340	0.034	-0.022	-0.047	-0.003	0.002	-0.110	0.138	0.176	0.063	**0.697**	0.513	**1.000**		
Sum of percapita GDPs (average 1990-2003)	0.325	0.462	0.492	0.436	0.593	0.355	-0.105	-0.213	-0.125	-0.265	-0.177	0.208	0.034	-0.187	0.262	-0.022	0.436	**1.000**	
Absolute difference of percapita GDPs	-0.230	-0.443	-0.408	-0.320	-0.544	-0.410	0.062	0.176	0.075	0.246	0.056	-0.293	-0.024	0.078	0.060	0.135	0.004	-0.707	**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 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 with total financial flows greater than zero.

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 and portfolio flows between Spain and a given country. This measure is then averaged over the duration of the period. Data obtained from the Spanish Balance of Payments.

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.