How Much do Trade and Financial Linkages Matter for Business Cycle Synchronization in a small economy?

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Abstract

We estimate a system of equations to analyze whether trade and financial linkages influence business cycle synchronization directly and/or indirectly. We use a small, open economy (Spain) as benchmark for the results, instead of the US as generally done in the literature. As in Imbs (2004b) we find that both the similarity of productive structure and trade links promote the synchronization of cycles. However, the main contribution of the paper is the use of data on bilateral financial flows to measure bilateral financial integration. When we do this we find that, contrary to Imbs (2004b) —which uses global financial flows—, bilateral financial links are inversely related to the comovement of output, which might point to financial integration allowing an easier transfer of resources between two economies, which could enable their decoupling. Both the effects of trade and financial links on output synchronization are statistically and economically significant.

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 a clear prediction regarding the relationship between these variables. In fact, the theoretical literature is able to propose both positive and negative effects on the synchronization of cycles, which may counteract each other. The question is therefore an empirical one, but the empirical literature also reflects these unclear theoretical predictions, as there are a number of diverging results when testing for the influence of trade and financial integration on business cycle comovements, especially because of poor data on financial flows. This paper tries to measure the effect of trade and financial links on business cycle synchronization for a small, open economy, taking Spain as a benchmark. We ask whether these two variables exert a positive or negative influence over the synchronization of output and whether the influence is not only statistically but also economically significant.

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, business-cycle synchronization has profound implications for the design and functioning of common currency areas. Third, if business cycles in a country are mostly driven by external factors, such as trade and financial linkages, domestic policy aimed at economic stabilization or even policy coordination itself is 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. Although in principle these endogeneity problems can be tackled using instrumental variable estimation, the possibility of conflicting indirect effects between these variables might lead to low net effects, even when partial effects are strong. We, therefore, use a system of equations to disentangle direct and indirect effects on business cycle synchronization.

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. Studies that 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 relatively small and open economy (Spain), as a benchmark and take advantage of a newly available dataset on bilateral financial flows by geographical origin and destiny, from the Spanish Balance of Payments.

From our empirical exercise, we obtain several conclusions: as in Imbs (2004b) we find that both the similarity of productive structure and trade links enhance the synchronization of business cycles. However, our use of bilateral financial flows gives us very different results from Imbs (2004b) —who uses global financial flows. We find that bilateral financial links are *inversely* related to the comovement of output, which might point to financial integration allowing an easier transfer of resources between two economies, which could enable their decoupling, in the line of Heathcote and Perry (2003b). Both the effects of trade and financial links on output synchronization are statistically and economically significant. In particular, in our benchmark regression we find that an increase in trade links or a reduction of financial links by one standard deviation increases business cycle synchronization by around 40% of one standard deviation.

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. 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.

Moving to the potential channels of synchronization, neither the theoretical nor the empirical literature offer a definitive answer on the impact of trade and financial linkages on the synchronization of output. 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 were 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.

There might also be some indirect effects of trade links on output synchronization, through the similarity of productive structure or through financial links. Thus, for example, stronger trade links

[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 (i.e. growth rates).

might increase financial linkages because they promote FDI in export-oriented industries, or because they foster international loans (Rose and Spiegel, 2004). In turn, stronger trade links might induce more or less similarity of economic structure, depending on whether trade is mostly inter-industries or intra-industries.

Measures of trade linkages also differ across studies. Some of the earlier studies used aggregate measures of trade openness (i.e., global trade integration instead of bilateral trade links 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 because 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.

As with the case of trade linkages, there might also be some indirect effects of financial links on output synchronization, through trade links or the similarity of productive structure. In the first case, stronger financial links might allow the relocation of capital by comparative advantage, thus increasing opportunities for trade. In the second case, more financial integration between two economies might increase the similarity of economic structures between the two countries, if FDI flows are concentrated on those sectors where the source country has a comparative advantage, thus replicating the productive structure at home. However stronger financial links also allow for the unhinging of production and consumption, and therefore allows greater specialization in production and so differing economic structures (Kalemli-Ozcan et al, 2003 and Helpman and Razin, 1978).

The measures of financial linkages also differ in the literature.[4] As in the case of trade linkages, earlier studies used measures of global financial integration rather than measures of bilateral links. In fact, the use of measures of global integration is even more pronounced for financial links than for trade links,

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

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, though they suffer 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 based on rolling correlations of stock and bond prices (IMF, 2001). The latter, though, suffers from potential reverse causality. In this paper, we will make extensive use of newly available data on the geographical distribution of bilateral financial flows from and to Spain from the spanish balance of payments, to construct several measures of bilateral financial integration for different types of flows.

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

[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, 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

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 measures of financial integration consider global financial flows for each country, instead of bilateral financial flows between a country-pair. Fourth, 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 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.

3 Estimation

3.1 Theoretical predictions

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.

As described in the previous section, 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. Thus, we shall use a system of equations to deal with this issue.

We also consider other possible sources of synchronization, such as the convergence of economic policies —which we approximate with the volatility of exchange rates and the differences in inflation rates— or a similar exposure to global shocks, such as oil shocks.

Finally, we use bilateral data to account for trade and financial linkages. While data on bilateral trade flows is readily available from the IMF's Direction of Trade Statistics, bilateral financial flows are

particularly difficult to find except for the US[11]. This paper uses a newly processed dataset for bilateral financial flows (including FDI, but also portfolio flows, including equity flows other than those considered as FDI), obtained from the Spanish Balance of Payments. Choosing Spain as a benchmark country also has the advantage of using a small open economy that is unlikely to have other channels of influence on other countries, limiting the problem of omitted variables in previous studies with *de facto* bilateral data of financial linkages.

3.2 Estimation strategy and data issues

Measuring the direct and indirect channels through which trade and financial linkages may affect business cycle synchronization can only be undertaken through the estimation of a system of equations. We 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, there are theoretical reasons to support the idea that it could be a key variable governing the indirect effects of trade and financial links on cycle comovements:

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

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

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

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

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 promotes 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), the higher the degree of business cycle synchronization.

[11] The CPIS matrix on bilateral financial flows compiled by the IMF provides data for a limited number of years, and is therefore not suitable for a study involving business cycle synchronization. Its data is also compiled by surveys and therefore its accuracy is relatively limited. The OECD compiles data on bilateral FDI flows only, although we are interested in financial integration involving *total* flows.

$F_{i,t}$ is bilateral financial integration with country *i*. As explained earlier, the expected sign of its coefficient in Eq. 1 is ambiguous.

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 correlation between detrended annual GDP in Spain and each partner country. Detrending is done using Baxter and King's (1999) band-pass filter.[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:

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

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.

An alternative measure, proposed by Clark and van Wincoop (2001), which is independent of country size (and dependent only on trade barriers) includes also world GDP:

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

[12] The quality of data prior to 1997 is not very good, especially with respect to the geographical assignment of origin and destination of financial flows, especially portfolio transactions.

[13] GDP is measured at purchasing power parity and was obtained from the IMF's World Economic Outlook database. We also conducted the same exercise using the correlation of GDP growth rates or the correlation of HP-filtered annual GDP series. The qualitative results remain unchanged in both cases.

[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.

Note that if we use ${T^2}_{ESP,i}$ in the regressions, we can drop $GDP_{World,t}$ from the computation of the index, as it will be included into the constant term. 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 use total bilateral financial flows (portfolio and FDI flows) from the Spanish Balance of Payments. Although data on international financial positions (stocks) would have been a better indicator, it was not available for Spain. We measure financial integration by taking the sum of the absolute values of inward and outward financial flows and computing a time average over the period of study, dividing it over the sum of GDPs:

$$ {F^1}_{ESP,i} = \frac{1}{T}\sum_t I_{ESP,i,t} + I_{i,ESP,t} $$

where I_{ijt} represents financial flows from country i to country j (*ESP* denotes Spain) at time t. However, in order to scale the importance of financial flows relative to the size of economic activity, we consider in our benchmark regression financial linkages relative to partner's GDP:

$$ {F^2}_{ESP,i} = \frac{1}{T}\sum_t \frac{I_{ESP,i,t} + I_{i,ESP,t}}{GDP_{ESP,t} + GDP_{i,t}} $$

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 disaggregation of economic activities and whether or not they concentrate on manufactures (at greater disaggregation[15]) or on all sectors (at lower disaggregation[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

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

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

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

[16] At 1-digit ISIC classification groups.

[17] As opposed to Imbs (2004b) and most of the related literature, we include a minus sign in front of the definition of similarity of productive structure so that a higher value of S implies higher 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.

and –2 for disjoint productive structures. Therefore *higher* values for $S^1_{ESP,i}$ imply *more* similarity between the structure of Spanish production 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, the similarity of productive structures, and a similar exposure to global shocks such as movements in the price of oil. We therefore include a number of variables to approximate these effects, such as the volatility of the bilateral exchange rate, the average inflation differential, a dummy variable to account for use of the euro as official currency, and an index of similarity of oil dependency.

This index of similarity of oil dependency tries to approximate global shocks. Specifically, 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[20]. 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.

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

[18] In this paper we present the empirical results using the first measure of similarity of productive structure. Both measures outlined here are highly correlated, thus using the second definition does not affect the results significantly.

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

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

distance between countries, land areas, and dummy variables to account for access to the sea, a common main language and membership in the Europen Union.[21]

Recent studies (e.g. Portes and Rey, 2003) have suggested that gravity variables might also explain bilateral financial linkages. Thus, we include (the log of) distance, time difference between main financial centers, common language and the partner's per capita GDPs. 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 explain 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 have a more diversified productive structure, but in a similar way among themselves, whereas poorer countries tend to be more specialized in production.

4 Estimation 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.

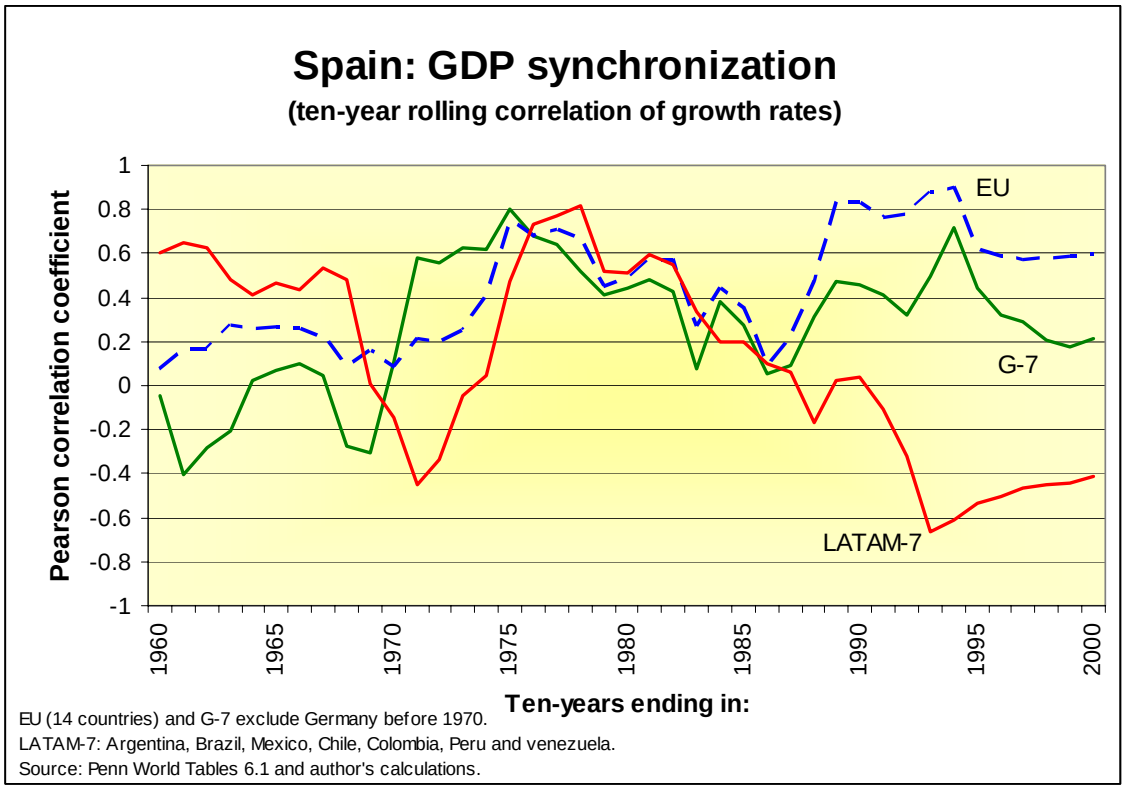

Figure 1: Evolution of GDP synchronization between Spain and selected regions.

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

The degree of bilateral business cycle synchronization between Spain and EU countries has 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.

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). Trade linkages with G7 countries began to grow later, in the mid 1980s and at a much lower pace, while trade linkages with Latin American countries haven remained relatively small throughout the period.

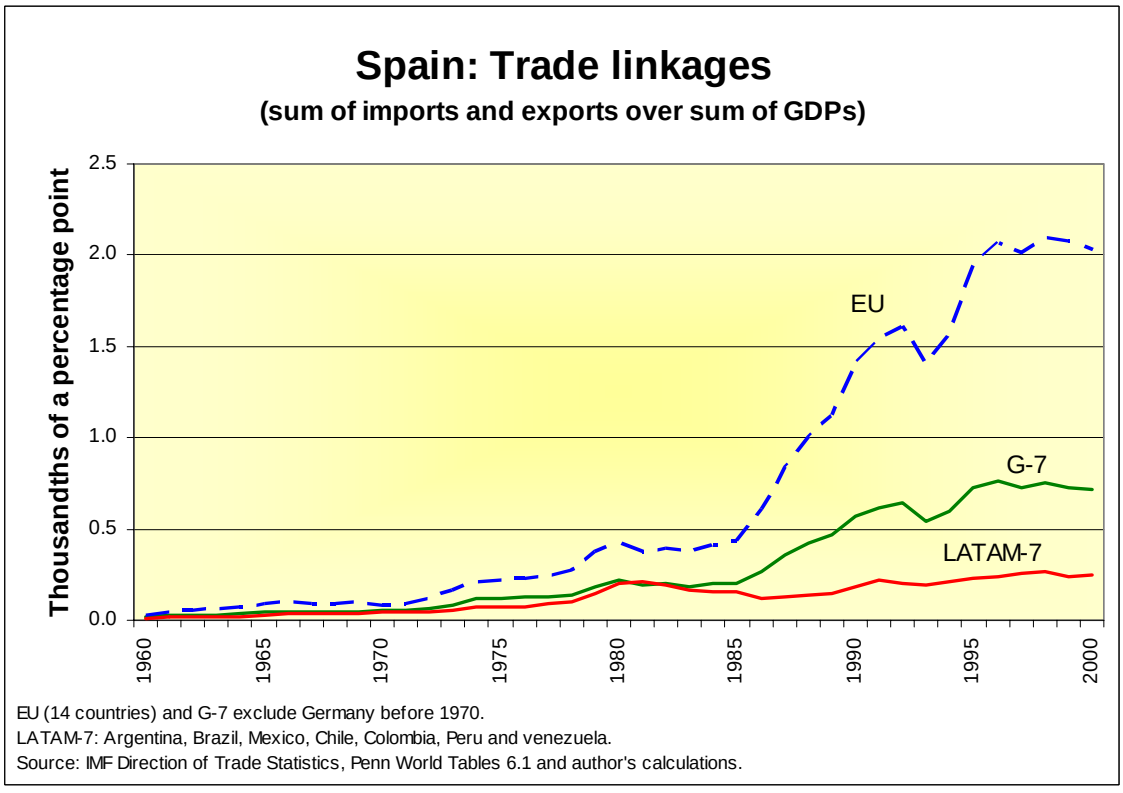

Figure 2: Evolution of trade linkages between Spain and selected regions.

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. A similar picture emerges

when looking at total financial flows, for which reliable data by geographical origin/destination is only available from 1998 (figure 4). Total flows rise greatly in the last 6 years, and they concentrate mainly in the euro area and in the UK,[22] whereas the importance of Latin America is greatly diminished with respect to FDI flows.

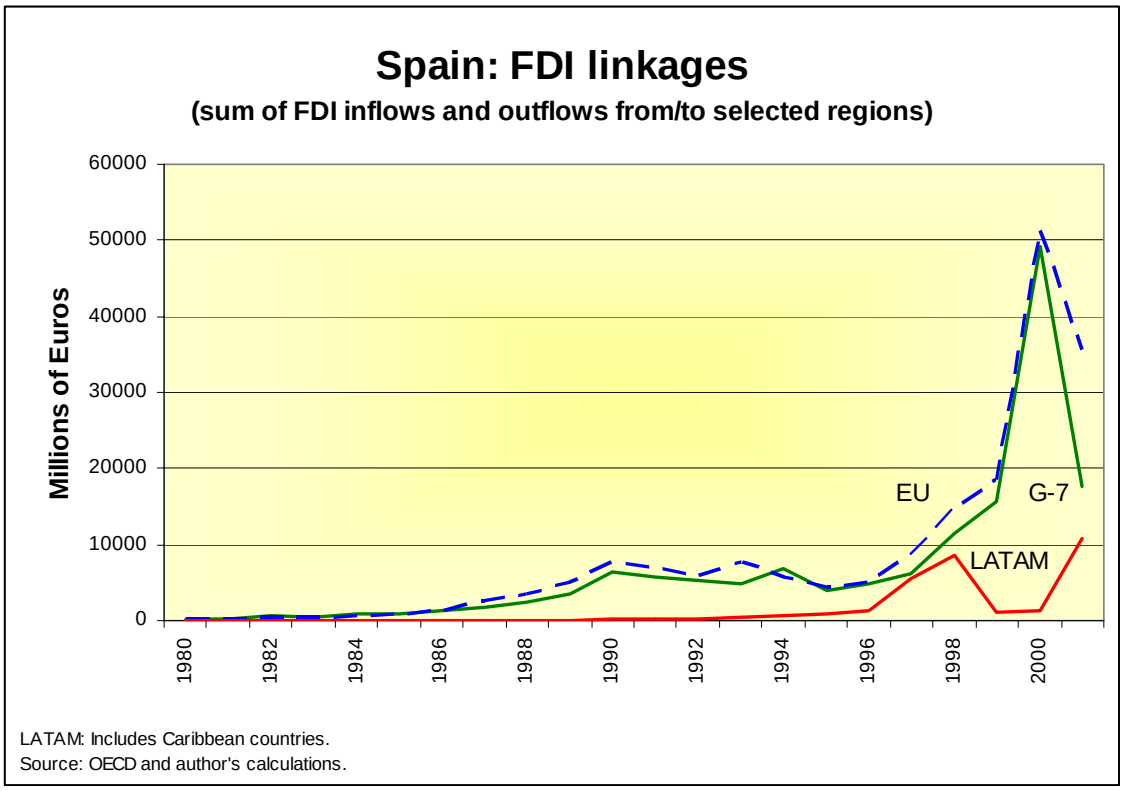

Figure 3: Evolution of FDI linkages between Spain and selected regions.

Turning to the estimation of our system of four equations, we first report the results of the estimation of equation 1, our equation of interest, using OLS. Table 1 reports parameter estimates for different specifications. A salient feature of these estimations is the negligible role of financial integration or the similarity of productive structure in promoting a closer comovement of output between Spain and other countries. Only trade links seem to promote stronger output synchronization, and even that effect disappears once we control for membership of the euro area, which in turn might be increasing trade and financial flows.

Since there are good reasons to suspect endogeneity problems and thus biased estimates in table 1, 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 for the similarity of structure S.[23] Table 2 presents IV estimates for the same specifications as table 1, and we can already see that endogeneity of

[22] The United Kingdom accounts for almost 95 percent of total financial flows to EU countries outside the euro area.
[23] Instruments used in the IV estimation are the same as those used for three stage least squares, described next.

regressors is indeed a severe problem. First, coefficient estimates differ significantly from those in table 1, financial integration and the similarity of productive structure are now statistically significant to explain output comovement, and the similarity of macro policies, as captured by inflation differentials also seem to play a role (exchange rate differentials do not seem to play a role, but membership in the euro area is already used as instrument for trade and financial links). Second, the Anderson-Rubin test of significance of endogenous regressors also point to the importance of *T*, *F* and *S* as explanatory variables.

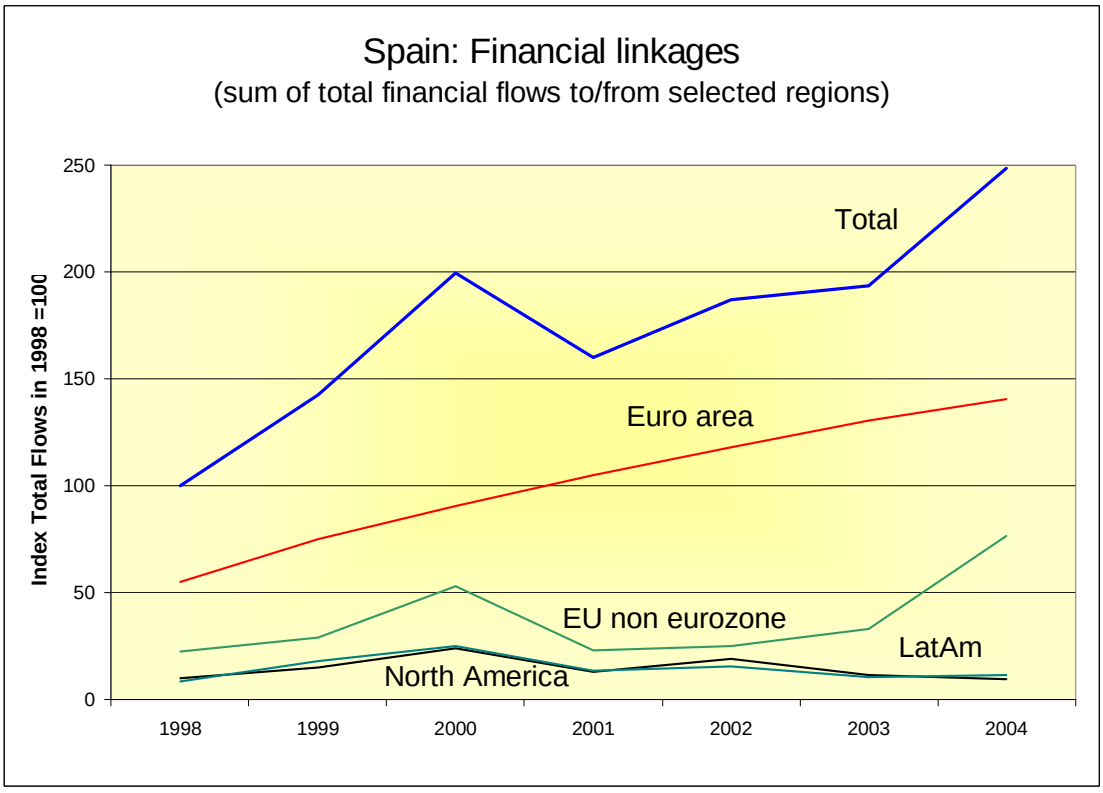

Figure 4: Evolution of total financial linkages between Spain and selected regions.

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 thus go a step further than the IV estimation in table 2 and try to disentangle the direct and indirect effects of trade and financial linkages on business cycle synchronization, as described in the previous section. Thus, we conduct a three-stage least-squares regression (3SLS) on the whole system of four equations.

Estimating the system of four equations by 3SLS (table 3), parameter estimates for equation 1 differ significantly (see e.g. estimation 7 in table 2, which is comparable), although signs are unchanged. Both trade links and the similarity of productive structures directly foster business cycle

synchronization, possibly through external demand channels in the first case, and through similar exposure to external shocks (even is they are sector-specific in nature) in the second. The negative influence of financial links on business cycle synchronization might at first be counterintuitive, but it might reflect that an easier transfer of resources across countries allows a decoupling of business cycles. Further, our measure of similar fuel dependency is not statistically significant in explaining output correlations in this exercise, which might point to oil shocks not being an important factor driving global economic fluctuations in the period of study (1990-2003), as they were in the 70s or, to a lesser extent, in the 80s.

Table 3 also shows, in its second column, that trade linkages (Eq 2) do not seem to be significantly affected by financial linkages (i.e. we cannot reject that β_2=0), beyond what is predicted by standard gravity variables. The latter include statistically significant effects, related to the cost of bilateral trade, stemming from distance, access to the seacoast and land area, with the expected signs.

Financial linkages, estimated in column 3 of table 3, seem to be determined also by gravity variables, in line with (Portes and Rey, 2003) such as distance, common language and common currency, with the expected sign. Beyond these effects and those captured by the partner's GDP percapita (which significantly promotes financial links) trade linkages do not seem to be statistically significant, as opposed to Aizenman and Noy (2004). Interestingly, controlling for all the previous effects, a stronger correlation of business cycles is associated with lower financial flows as percentage of GDP, which might point to a reduction in risk-hedging opportunities as economies become more synchronized.

Finally, the last column in table 3 tries to identify the determinants of the similarity in productive structure (Eq. 4). As in Imbs and Wacziarg (2003) the absolute difference in percapita GDPs is a good explanatory variable, together with financial flows.

Beyond the direct effects on GDP correlation of our main variables of interest (equation 1), there are also possible indirect effects of trade and financial linkages on business cycle synchronization, both through their influence on each other and though their effect on the similarity of productive structures. As described before, in table 3, our benchmark regression, we find no statistically significant effect from (to) trade links to (from) financial links, and only a significantly positive effect of financial links on the similarity of productive structure, which might point to the importance of FDI flows and its influence on production in the recipient country. All in all, however, the net effect of financial links on business cycle synchronization is negative, as summarized by $\alpha_3 + \alpha_2 \gamma_2 + \alpha_1 \beta_2 = -0.0083$[24]. As expected by the non-significance of the indirect effects of trade, including them does not significantly

[24] Using the delta method, a test of significance of this estimate gives a t-statistic of –2.72, with a p-value of 0.007.

change the estimate of its total effect on business cycle synchronization, given by $\alpha_1 + \alpha_2 \gamma_1 + \alpha_3 \delta_2 = 0.113$.[25]

The positive influence of a similar economic structure and trade links on business cycle synchronization is in line with Imbs (2004b) though the effect of financial linkages is negative in our case and positive in his. This difference might be related both to the fact that we use a small open economy as a benchmark, a wider set of countries (including more emerging countries than in his sample), and bilateral financial links, instead of a broad proxy from aggregate financial integration in both partners as in his case. Another reason, as regard financial linkages, might be that our data only includes FDI and portfolio flows which are only a part of all possible financial linkages, albeit possibly the most important ones that might influence the synchronization of economic activity.

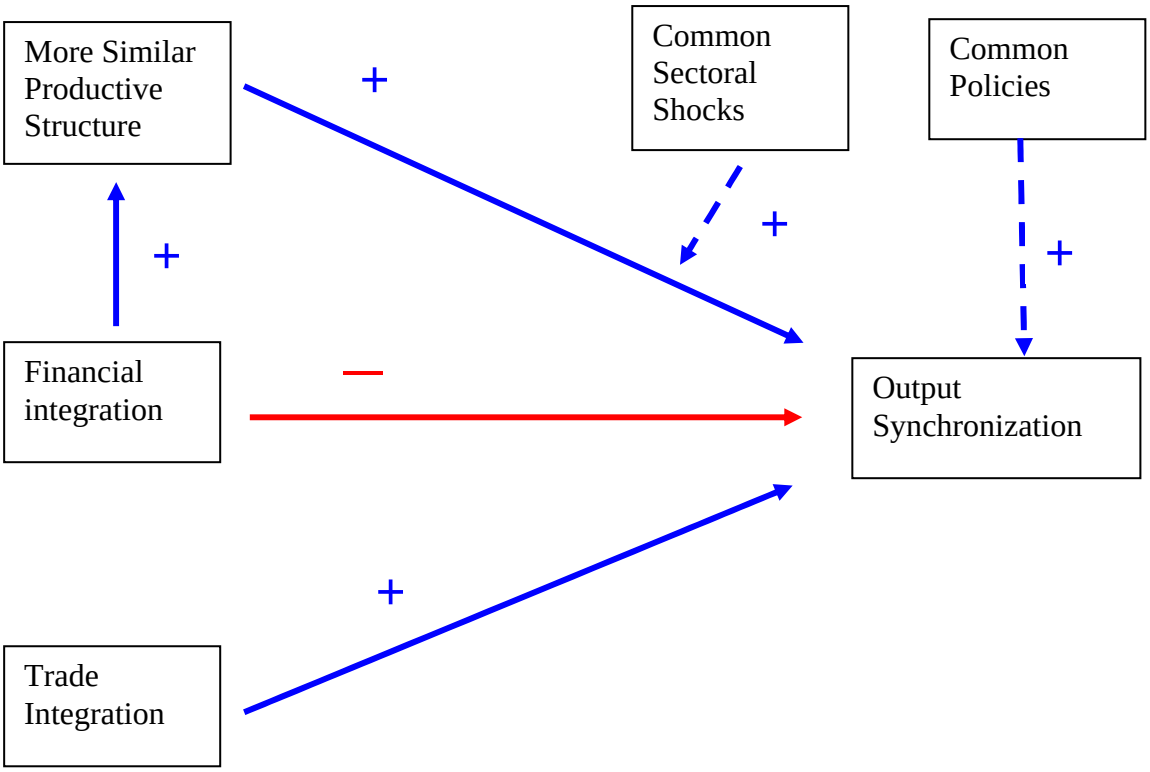

Figure 5: Statistically significant channels leading to business cycle synchronization found in the empirical exercise, and their associated signs.

Other findings worth highlighting from the system of equations are: (i) we do find a reverse causality from business cycle synchronization to financial linkages (i.e. δ_1 is significantly different from zero), as argued by Heathcote and Perri (2003b); and (ii) the estimation does not find a double causality between trade and financial linkages (i.e. δ_1 and β_2 are not statistically significant from zero). The statistically significant relations are summarized in figure 4.

[25] Again using the delta method, this estimate has a t-statistic of 2.11, with a p-value of 0.036.

Another important question concerns the economic relevance of the statistically significant effects found in the previous exercise. As described before, the total effect of trade and that of financial links on the synchronization of business cycles is given through their direct and indirect effects. Specifically, as described before, for our benchmark 3SLS regression in table 3, the effect of trade links on our measure of comovement of output is $\alpha_1 + \alpha_2 \gamma_1 + \alpha_3 \delta_2 = 0.113$ the effect of financial links is $\alpha_3 + \alpha_2 \gamma_2 + \alpha_1 \beta_2 = -0.0083$, whereas. In order to gauge whether this is a big or small effect on output synchronization, we can check the effect of increasing trade or financial links by one standard deviation, as described in table 11. Increasing trade links by one standard deviation starting from its mean, increases bilateral cross country correlation of GDP from 0.160 to 0.311. In turn, increasing financial links by one standard deviation lowers the correlation of output from 0.160 to 0.005. In both cases this represents moving the correlation of output by around 40% of one standard deviation, an economically significant effect.

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

Since the main deviation from Imbs (2004b) concerns the role of financial links, we explore alternative measures of financial links. First, we include total financial flows in levels (instead of measured as percentage of GDP, as described earlier), an indicator also used in the literature. The results of this regression are shown in table 4, where we can see that parameter estimates do not differ strongly from previous estimates, and the total effects from trade or financial links to business cycle synchronization are very similar in magnitude.

We turn next to decompose total financial flows and to take, first, all flows related to investment in productive capacity abroad, which might influence GDP and/or trade more directly than fixed-income instruments like bond purchases. In particular, in table 5 we describe the results of the 3SLS estimation taking as financial linkages the aggregate of equity purchases and FDI flows over GDP. As expected, this narrower definition of financial integration now significantly influences trade links, although in table 6, where we use just FDI flows, the effect vanishes. In both cases, however, the total effects over the synchronization of business cycles are not very different from those obtained from table 2. More specifically, according to regression results in tables 5 and 6, an increase of trade links by one standard deviation from its mean would increase output correlation from 0.16 to 0.29 and 0.31, respectively. Equivalently, and increase in financial links by one standard deviation would reduce output correlation from 0.16 to 0.03 and 0.01, respectively. That is, when we use total equity flows as measure of financial integration, an increase of trade links or reduction of financial links by one standard deviation results approximately in an increase in output correlation equivalent to around one third of its standard deviation. When we use only FDI flows this ratio increases to around 40%, the same effect as in the benchmark regression.

The other dimension in which we check for the robustness of our results is the normalization of trade and financial links as proportion of GDP. Since we are interested in measuring the effect of trade and financial links on the synchronization of output, it is perhaps more relevant to normalize the size of those links by the smaller of the two GDPs in the pair. The idea is that, for the same size of trade flows, two countries might be more synchronized the more unequal in size, since then the bigger country can "pull" the other more strongly through external demand. The same reasoning migh also apply for financial links. Thus, we conduct the same estimations in tables 3, 5 and 6 but with trade and financial links defined as percentage of the minimum of the two GDPs involved. The corresponding estimation results are presented in tables 7, 8 and 9. For the most part, the qualitative results are unchanged, except that now we do observe a double causality between trade and financial linkages mentioned in the literature (i.e. δ_1 and β_2 are statistically significant from zero). Both the signs and statistical significance of the effect of trade and financial links on output correlation are unchanged from the previous exercise, and the magnitude increases up to 60% of a standard deviation of GDP correlation, as summarized by table 10.

5 Conclusions

This paper assesses 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. However, the reduced form IV estimates might appear small or not significant because, in theory, direct and indirect effects might run in opposite directions, partially offsetting each other. When we conduct the estimation of a system of equations in order to separate direct and indirect effects of trade and financial linkages on output synchronization, we actually find conflicting direct and indirect effects of financial links, though they do not reverse the sign of the negative direct effect on synchronization.

In line with Imbs (2004b) we find that both the similarity of productive structure and trade links promote the synchronization of cycles. However, the main contribution of the paper is the use of bilateral financial flows to measure bilateral financial integration. When we do this we find that, contrary to Imbs (2004b) —which uses global financial flows—, bilateral financial links are inversely related to the comovement of output, which might point to financial integration allowing an easier transfer of resources between two economies, which could enable their decoupling. This is in line with results by Heathcote and Perry (2003b),

that point to financial integration fostering financial flows, and thus dampening GDP correlations as domestic investors seek out to diversify to less correlated economies abroad.

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Appendix A: Tables

Table 1

OLS regressions
Dependent variable: GDP correlation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Trade Integration (T)	0.090***	0.096**	0.093**	0.083**	0.015	0.026	0.027	0.019
	(0.033)	(0.037)	(0.037)	(0.034)	(0.034)	(0.037)	(0.038)	(0.033)
Financial Integration : all flows (F)		-0.001	-0.002			-0.002	-0.002	
		(0.002)	(0.002)			(0.002)	(0.002)	
Similarity of Prod. Structure (S)			0.105	0.058			0.035	-0.013
			(0.094)	(0.074)			(0.080)	(0.067)
Member of Euro Area					0.579***	0.603***	0.594***	0.575***
					(0.084)	(0.088)	(0.093)	(0.089)
Inflation differential					-0.063*	-0.059*	-0.061*	-0.064**
					(0.032)	(0.033)	(0.034)	(0.031)
Exchange Rate Volatility					0.018	0.016	0.019	0.022
					(0.052)	(0.052)	(0.053)	(0.050)
Similar Fuel Dependency					-0.001	-0.001	-0.001	
					(0.002)	(0.002)	(0.002)	
Constant	1.364***	1.429***	1.315***	1.238***	0.448	0.568	0.554	0.528
	(0.444)	(0.477)	(0.478)	(0.460)	(0.488)	(0.517)	(0.521)	(0.469)
Observations	109	109	109	109	109	109	109	109
R-squared	0.10	0.10	0.11	0.10	0.34	0.35	0.35	0.34

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables measured in logs except dummy variables.

Table 2

IV regressions
Dependent variable: GDP correlation

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Trade Integration (T)	0.127***	0.172***	0.180***	0.116***	0.108***	0.150***	0.169***	0.100**
	(0.034)	(0.044)	(0.047)	(0.040)	(0.036)	(0.046)	(0.049)	(0.042)
Financial Integration : all flows (F)		-0.004*	-0.011***			-0.004	-0.010***	
		(0.002)	(0.003)			(0.002)	(0.003)	
Similarity of Prod. Structure (S)			0.345**	0.064			0.315**	0.050
			(0.139)	(0.095)			(0.131)	(0.089)
Inflation differential					-0.074**	-0.069**	-0.081	-0.077**
					(0.032)	(0.035)	(0.049)	(0.034)
Exchange Rate Volatility					0.001	0.000	0.032	0.006
					(0.053)	(0.055)	(0.064)	(0.052)
Similar Fuel Dependency					0.000	0.001	0.002	0.000
					(0.002)	(0.002)	(0.002)	(0.002)
Constant	1.862***	2.406***	2.220***	1.669***	1.753***	2.257***	2.312***	1.626***
	(0.458)	(0.563)	(0.621)	(0.563)	(0.518)	(0.637)	(0.656)	(0.618)
Observations	109	109	109	109	109	109	109	109
R-squared	0.08	0.04	-0.05	0.09	0.18	0.14	0.05	0.19
Anderson (1984) LR-test of identification	108.85	62.46	45.76	80.52	106.78	62.05	41.61	88.23
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cragg-Donald Chi-sq test of identification	186.88	84.33	56.87	119.16	181.33	83.59	50.67	135.89
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Anderson-Rubin test of significance of endog. Regressors	436.13	436.13	436.13	436.13	206.64	206.64	206.64	206.64
p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables measured in logs except dummy variables.

Table 3

Three-stage least squares regression: system of four equations (1)-(4)
(Financial Linkages: total flows over GDP)

Equation Number	(1)	(2)	(3)	(4)
Dependent variable	Output Correlation (ρ)	Trade Linkages (T)	Financial Linkages (F)	Similarity of Prod. Struct. (S)
GDP correlation (ρ)			-23.707*	
			(12.939)	
Trade Integration (T)	0.110**		-0.698	-0.023
	(0.049)		(2.916)	(0.046)
Financial Integration:all flows (F)	-0.012***	0.017		0.011***
	(0.004)	(0.017)		(0.004)
Similarity of Prod. Structure (S)	0.203*	0.043		
	(0.123)	(0.582)		
Member of Euro Area	0.561***	0.190	17.934**	
	(0.137)	(0.549)	(8.632)	
Inflation differential	-0.040			
	(0.035)			
Exchange Rate Volatility	0.003			
	(0.053)			
Similar Fuel Dependency	-0.000			
	(0.002)			
Distance		-0.856***	-10.080***	
		(0.155)	(3.747)	
EU-15		0.504		
		(0.527)		
Common Language		0.742	20.312***	
		(0.526)	(5.448)	
Access to sea		0.792***		
		(0.214)		
Partner's Land area		-0.103**		
		(0.044)		
Absolute difference of GDP per capita				-0.213***
				(0.051)
Absolute time difference			0.304	
			(0.229)	
Partner's GDP Per Cápita			8.799***	
			(1.556)	
Constant	1.337**	-5.524***	-16.876	0.730
	(0.649)	(1.187)	(36.245)	(0.576)
Observations	109	109	109	109
R-squared	0.20	0.59	0.44	0.45

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables measured in logs except dummy variables.

Table 4

Three-stage least squares regression: system of four equations (1)-(4)
(Financial Linkages: flows in levels)

Equation Number	(1)	(2)	(3)	(4)
Dependent variable	Output Correlation (ρ)	Trade Linkages (T)	Financial Linkages (F)	Similarity of Prod. Struct. (S)
GDP correlation (ρ)			-7.620	
			(11.850)	
Trade Integration (T)	0.095**		-1.328	-0.086**
	(0.046)		(2.553)	(0.044)
Financial Integration : all flows (F)	-0.011***	0.035**		0.017***
	(0.003)	(0.015)		(0.003)
Similarity of Prod. Structure (S)	0.335***	-1.121**		
	(0.124)	(0.524)		
Member of Euro Area	0.539***	0.073	6.889	
	(0.136)	(0.551)	(7.873)	
Inflation differential	-0.066*			
	(0.037)			
Exchange Rate Volatility	0.035			
	(0.057)			
Similar Fuel Dependency	-0.001			
	(0.002)			
Distance		-0.793***	-10.665***	
		(0.154)	(3.333)	
EU-15		0.604		
		(0.517)		
Common Language		0.433	21.629***	
		(0.484)	(4.954)	
Access to sea		0.804***		
		(0.210)		
Common Border		0.394		
		(0.659)		
Partner's Land area		-0.082*		
		(0.042)		
Absolute difference of GDP per capita				-0.126**
				(0.050)
Absolute time difference			0.125	
			(0.215)	
Partner's GDP			5.121***	
			(0.688)	
Partner's GDP Per Cápita			6.776***	
			(1.553)	
Constant	1.213*	-5.382***	-93.813***	-0.173
	(0.619)	(1.184)	(33.553)	(0.553)
Observations	109	109	109	109
R-squared	0.18	0.47	0.67	0.37

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables measured in logs except dummy variables.

Table 5

Three-stage least squares regression: system of four equations (1)-(4)
(Financial Linkages: Equity flows [stocks + FDI] over partner's GDP)

Equation Number	(1)	(2)	(3)	(4)
Dependent variable	Output Correlation (ρ)	Trade Linkages (T)	Financial Linkages (F)	Similarity of Prod. Struct. (S)
GDP correlation (ρ)			-10.026	
			(12.648)	
Trade Integration (T)	0.101**		0.348	-0.016
	(0.049)		(2.844)	(0.045)
Financial Integration:Equity+FDI (F)	-0.011***	0.029*		0.009***
	(0.004)	(0.017)		(0.003)
Similarity of Prod. Structure (S)	0.188	-0.316		
	(0.121)	(0.555)		
Member of Euro Area	0.558***	0.116	10.124	
	(0.136)	(0.555)	(8.386)	
Inflation differential	-0.049			
	(0.036)			
Exchange Rate Volatility	0.012			
	(0.056)			
Similar Fuel Dependency	-0.001			
	(0.002)			
Distance		-0.818***	-7.069*	
		(0.152)	(3.676)	
EU-15		0.504		
		(0.536)		
Common Language		0.411	23.041***	
		(0.517)	(5.347)	
Access to sea		0.798***		
		(0.215)		
Partner's Land area		-0.087**		
		(0.044)		
Absolute difference of GDP per capita				-0.225***
				(0.049)
Absolute time difference			0.251	
			(0.230)	
Partner's GDP Per Cápita			8.501***	
			(1.522)	
Constant	1.266*	-5.542***	-28.193	0.820
	(0.654)	(1.197)	(35.541)	(0.568)
Observations	109	109	109	109
R-squared	0.24	0.57	0.54	0.46

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables measured in logs except dummy variables.

Table 6

Three-stage least squares regression: system of four equations (1)-(4)
(Financial Linkages: FDI flows over partner's GDP)

Equation Number	(1)	(2)	(3)	(4)
Dependent variable	Output Correlation (ρ)	Trade Linkages (T)	Financial Linkages (F)	Similarity of Prod. Struct. (S)
GDP correlation (ρ)			-23.313*	
			(12.722)	
Trade Integration (T)	0.109**		-0.763	-0.019
	(0.049)		(2.870)	(0.046)
Financial Integration:FDI (F)	-0.012***	0.017		0.010***
	(0.004)	(0.018)		(0.004)
Similarity of Prod. Structure (S)	0.191	0.054		
	(0.121)	(0.584)		
Member of Euro Area	0.555***	0.192	17.025**	
	(0.137)	(0.549)	(8.488)	
Inflation differential	-0.039			
	(0.035)			
Exchange Rate Volatility	0.002			
	(0.053)			
Similar Fuel Dependency	-0.000			
	(0.002)			
Distance		-0.856***	-10.070***	
		(0.157)	(3.685)	
EU-15		0.515		
		(0.525)		
Common Language		0.733	20.682***	
		(0.538)	(5.363)	
Access to sea		0.793***		
		(0.214)		
Partner's Land area		-0.103**		
		(0.044)		
Absolute difference of GDP per capita				-0.218***
				(0.050)
Absolute time difference			0.304	
			(0.225)	
Partner's GDP Per Cápita			8.594***	
			(1.531)	
Constant	1.322**	-5.527***	-16.494	0.793
	(0.647)	(1.186)	(35.665)	(0.573)
Observations	109	109	109	109
R-squared	0.21	0.59	0.44	0.45

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables measured in logs except dummy variables.

Table 7

Three-stage least squares regression: system of four equations (1)-(4)
(Financial Linkages: Total flows over minimum of Spain's and partner's GDP)

Equation Number	(1)	(2)	(3)	(4)
Dependent variable	Output Correlation (ρ)	Trade Linkages (T)	Financial Linkages (F)	Similarity of Prod. Struct. (S)
GDP correlation (ρ)			-8.737	
			(11.957)	
Trade Integration: trade over min(GDP_i, GDP_{Spain}) (T)	0.131**		6.565***	0.021
	(0.055)		(2.520)	(0.049)
Financial Integration: all flows over min(GDP_i, GDP_{Spain}) (F)	-0.013***	0.057***		0.008**
	(0.004)	(0.017)		(0.004)
Similarity of Prod. Structure (S)	0.134	-0.828		
	(0.122)	(0.582)		
Member of Euro Area	0.538***	0.138	5.184	
	(0.138)	(0.550)	(8.038)	
Inflation differential	-0.039			
	(0.036)			
Exchange Rate Volatility	-0.001			
	(0.054)			
Similar Fuel Dependency	-0.001			
	(0.002)			
Distance		-0.622***	-1.406	
		(0.159)	(3.218)	
EU-15		0.433		
		(0.513)		
Common Language		-0.471	17.309***	
		(0.518)	(4.817)	
Access to sea		0.678***		
		(0.220)		
Partner's Land area		0.012		
		(0.043)		
Absolute difference of GDP per capita				-0.210***
				(0.050)
Constant	1.636**	-7.299***	27.278	1.267**
	(0.709)	(1.219)	(34.514)	(0.609)
Absolute time difference			0.174	
			(0.204)	
Partner's GDP Per Cápita			6.286***	
			(1.540)	
Observations	109	109	109	109
R-squared	0.18	0.45	0.49	0.45

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables measured in logs except dummy variables.

Table 8

Three-stage least squares regression: system of four equations (1)-(4)
(Financial Linkages: Equity flows [stocks + FDI] over minimum of Spain's and partner's GDP)

Equation Number	(1)	(2)	(3)	(4)
Dependent variable	Output Correlation (ρ)	Trade Linkages (T)	Financial Linkages (F)	Similarity of Prod. Struct. (S)
GDP correlation (ρ)			1.288	
			(11.746)	
Trade Integration: trade over min(GDP_i, GDP_{Spain}) (T)	0.112**		6.836***	0.032
	(0.055)		(2.513)	(0.049)
Financial Integration: Equity + FDI flows over min(GDP_i, GDP_{Spain}) (F)	-0.011***	0.065***		0.007*
	(0.004)	(0.016)		(0.004)
Similarity of Prod. Structure (S)	0.130	-0.961*		
	(0.121)	(0.549)		
Member of Euro Area	0.545***	0.176	-0.028	
	(0.137)	(0.537)	(7.872)	
Inflation differential	-0.048			
	(0.037)			
Exchange Rate Volatility	0.009			
	(0.056)			
Similar Fuel Dependency	-0.001			
	(0.002)			
Distance		-0.622***	0.458	
		(0.156)	(3.161)	
EU-15		0.284		
		(0.490)		
Common Language		-0.700	20.215***	
		(0.500)	(4.820)	
Access to sea		0.666***		
		(0.221)		
Partner's Land area		0.016		
		(0.042)		
Absolute difference of GDP per capita				-0.221***
				(0.049)
Absolute time difference			0.114	
			(0.197)	
Partner's GDP Per Cßpita			6.055***	
			(1.553)	
Constant	1.428**	-7.054***	14.916	1.416**
	(0.715)	(1.226)	(34.673)	(0.601)
Observations	109	109	109	109
R-squared	0.24	0.42	0.50	0.45

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables measured in logs except dummy variables.

Table 9

Three-stage least squares regression: system of four equations (1)-(4)
(Financial Linkages: FDI flows over minimum of Spain's and partner's GDP)

Equation Number	(1)	(2)	(3)	(4)
Dependent variable	Output Correlation (ρ)	Trade Linkages (T)	Financial Linkages (F)	Similarity of Prod. Struct. (S)
GDP correlation (ρ)			-8.582	
			(11.727)	
Trade Integration: trade over min(GDP_i, GDP_{Spain}) (T)	0.130**		6.337**	0.026
	(0.055)		(2.473)	(0.049)
Financial Integration: FDI flows over min(GDP_i, GDP_{Spain}) (F)	-0.012***	0.058***		0.008**
	(0.004)	(0.017)		(0.004)
Similarity of Prod. Structure (S)	0.123	-0.820		
	(0.121)	(0.587)		
Member of Euro Area	0.531***	0.160	4.517	
	(0.138)	(0.552)	(7.884)	
Inflation differential	-0.038			
	(0.036)			
Exchange Rate Volatility	-0.002			
	(0.054)			
Similar Fuel Dependency	-0.001			
	(0.002)			
Distance		-0.617***	-1.571	
		(0.161)	(3.157)	
EU-15		0.449		
		(0.515)		
Common Language		-0.512	17.759***	
		(0.532)	(4.727)	
Access to sea		0.686***		
		(0.221)		
Partner's Land area		0.011		
		(0.043)		
Absolute difference of GDP per capita				-0.214***
				(0.050)
Absolute time difference			0.175	
			(0.200)	
Partner's GDP Per Cßpita			6.146***	
			(1.513)	
Constant	1.619**	-7.305***	26.425	1.342**
	(0.706)	(1.223)	(33.869)	(0.603)
Observations	109	109	109	109
R-squared	0.19	0.45	0.49	0.45

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
All variables measured in logs except dummy variables.

Table 10

Effect on GDP correlation from increase by 1 standard deviation in trade or financial links

Specification as in:	**Table 3**	**Table 5**	**Table 6**	**Table 7**	**Table 8**	**Table 9**
Absolute variation of GDP correlation						
Trade Integration (T)	0.1509	0.1254	0.1527	0.1750	0.1496	0.1737
Financial Integration (F)	-0.1550	-0.1222	-0.1538	-0.2439	-0.2037	-0.2207
Percentage of standard deviation of GDP correlation						
Trade Integration (T)	39.3%	32.7%	39.7%	45.6%	38.9%	45.2%
Financial Integration (F)	-40.4%	-31.8%	-40.0%	-63.5%	-53.0%	-57.5%

Memo:

Mean GDP correlation in sample:	0.160
Standard deviation of GDP correlation:	0.384

Table 11

Summary Statistics

Variable	No. Observ.	Mean	Std. Dev.	Min	Max	Coeff. of Variation	Percentiles 5%	50%	95%
Output correlation with Spain, 1990-2004 (ρ)	109	0.160	0.384	-0.846	0.898	2.401	-0.528	0.173	0.838
Trade Linkages over partner's GDP 1997-2003[1] (T)	109	-13.379	1.336	-17.188	-10.143	-0.100	-15.711	-13.256	-11.584
Trade Linkages over min(GDP_i, GDP_{Spain}) 1997-2003[1] (T)	109	-13.274	1.355	-17.188	-10.143	-0.102	-15.665	-13.184	-11.184
Total Financial Linkages over partner's GDP 1998-2003[2] (F)	109	-16.350	18.676	-36.841	6.554	-1.142	-36.841	-2.503	3.242
Total Financial Linkages over min(GDP_i, GDP_{Spain}) 1998-2003[2] (F)	109	-16.255	18.760	-36.841	6.554	-1.154	-36.841	-2.362	3.650
Equity Financial Linkages over partner's GDP 1998-2003[2] (F)	109	-16.894	18.515	-36.841	6.139	-1.096	-36.841	-2.846	2.759
Equity Financial Linkages over min(GDP_i, GDP_{Spain}) 1998-2003[2] (F)	109	-16.894	18.515	-36.841	6.139	-1.096	-36.841	-2.846	2.759
FDI Financial Linkages over partner's GDP 1998-2003[2] (F)	109	-16.751	18.312	-36.841	5.635	-1.093	-36.841	-3.136	2.536
FDI Financial Linkages over min(GDP_i, GDP_{Spain}) 1998-2003[2] (F)	109	-16.655	18.394	-36.841	5.635	-1.104	-36.841	-3.136	2.536
Similarity in Productive Structure 1980-2000[3] (S)	109	0.594	0.489	-0.281	1.666	0.824	-0.158	0.497	1.401
Member of Euro Area (1=yes)	109	0.101	0.303	0.000	1.000	2.999	0.000	0.000	1.000
Member of the EU	109	0.128	0.336	0.000	1.000	2.617	0.000	0.000	1.000
Average Inflation differencial 1990-2003	109	1.994	1.530	-0.630	7.298	0.767	0.446	1.713	5.053
Exchange rate volatility 1990-2003[4]	109	-1.415	0.998	-3.302	1.668	-0.706	-2.697	-1.612	0.779
Similar fuel dependency 1990-2002	109	-0.621	14.837	-73.975	13.445	-23.884	-28.360	3.481	11.020
Distance to main city (km)	109	8.424	0.785	6.217	9.883	0.093	7.140	8.672	9.365
Spanish spoken (1=yes)	109	0.156	0.364	0	1	2.337	0	0	1
Access to seacoast (1=yes)	109	0.807	0.396	0	1	0.491	0	1	1
Sharing a land border	109	0.018	0.135	0	1	7.348	0	0	0
Partner's Land area	109	12.032	2.154	5.756	16.653	0.179	7.621	12.378	15.855
Absolute time difference to main financial centre	109	-2.786	6.557	-13.816	2.398	-2.354	-13.816	0.000	2.079
Average GDP 1990-2003	109	17.877	1.928	13.594	22.877	0.108	15.206	17.622	20.978
Average per capita GDP 1990-2003	109	8.610	1.104	6.133	10.615	0.128	6.729	8.642	10.149
Absolute difference of percapita GDPs 1990-2003	109	1.271	0.946	0.043	3.616	0.745	0.150	1.106	3.019

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

[2] Average over the period of total bilateral inflows and outflows 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 12

Table of Cross Correlations

(Based on common 109 observations. Star: correlations significantly different from zero at 95% confidence level)

	Output correlation with Spain, 1990-2004 (r)	Trade Linkages over partner's GDP 1997-20031 (T)	Trade Linkages over min(GDPi, GDP Spain) 1997-20031 (T)	Total Financial Linkages over partner's GDP 1998-20032 (F)	Total Financial Linkages over min(GDPi, GDP Spain) 1998-20032	Equity Financial Linkages over partner's GDP 1998-20032 (F)	Equity Financial Linkages over min(GDPi, GDP Spain) 1998-2003:	FDI Financial Linkages over partner's GDP 1998-20032 (F)	FDI Financial Linkages over min(GDPi, GDP Spain) 1998-20032 (I	Similarity in Productive Structure 1980-20003 (S)	Member of Euro Area (1=yes)	Member of the EU	Average Inflation differencial 1990-2003	Exchange rate volatility 1990-20034	Similar fuel dependency 1990-2002	Distance to main city (km)	Spanish spoken (1=yes)	Access to seacoast (1=yes)	Sharing a land border	Partner's Land area	Absolute time difference to main financial centre	Average GDP 1990-2003	Average per capita GDP 1990-2003	Absolute difference of percapita GDPs 1990-2003
Output correlation with Spain, 1990-2004 (ρ)	1.0000																							
Trade Linkages over partner's GDP 1997-2003[1] (T)	0.3130*	1.0000																						
Trade Linkages over min(GDP_i, GDP_{Spain}) 1997-2003[1] (T)	0.3065*	0.9615*	1.0000																					
Total Financial Linkages over partner's GDP 1998-2003[2] (F)	0.1094	0.4711*	0.5299*	1.0000																				
Total Financial Linkages over min(GDP_i, GDP_{Spain}) 1998-2003[2] (F)	0.1088	0.4674*	0.5312*	0.9998*	1.0000																			
Equity Financial Linkages over partner's GDP 1998-2003[2] (F)	0.1026	0.4692*	0.5288*	0.9833*	0.9832*	1.0000																		
Equity Financial Linkages over min(GDP_i, GDP_{Spain}) 1998-2003[2] (F)	0.1026	0.4692*	0.5288*	0.9833*	0.9832*	1.0000*	1.0000																	
FDI Financial Linkages over partner's GDP 1998-2003[2] (F)	0.0990	0.4676*	0.5245*	0.9997*	0.9994*	0.9832*	0.9832*	1.0000																
FDI Financial Linkages over min(GDP_i, GDP_{Spain}) 1998-2003[2] (F)	0.0984	0.4639*	0.5260*	0.9996*	0.9997*	0.9833*	0.9833*	0.9998*	1.0000															
Similarity in Productive Structure 1980-2000[3] (S)	0.1675	0.3243*	0.3992*	0.5765*	0.5792*	0.5823*	0.5823*	0.5714*	0.5742*	1.0000														
Member of Euro Area (1=yes)	0.5396*	0.4803*	0.4977*	0.3491*	0.3493*	0.3462*	0.3462*	0.3379*	0.3382*	0.3506*	1.0000													
Member of the EU	0.5415*	0.5260*	0.5468*	0.3974*	0.3977*	0.3945*	0.3945*	0.3847*	0.3851*	0.4020*	0.8727*	1.0000												
Average Inflation differencial 1990-2003	-0.3608*	-0.1796	-0.2133*	-0.0294	-0.0321	-0.0428	-0.0428	-0.0208	-0.0236	-0.0442	-0.3132*	-0.3573*	1.0000											
Exchange rate volatility 1990-2003[4]	-0.3272*	-0.2167*	-0.2284*	-0.0903	-0.0913	-0.0781	-0.0781	-0.0822	-0.0832	-0.1321	-0.3501*	-0.3892*	0.8362*	1.0000										
Similar fuel dependency 1990-2002	-0.0264	-0.1379	-0.1302	0.0606	0.0609	0.0486	0.0486	0.0598	0.0601	-0.0086	0.0653	0.0646	-0.0450	-0.1174	1.0000									
Distance to main city (km)	-0.5098*	-0.5828*	-0.5669*	-0.2913*	-0.2896*	-0.2732*	-0.2732*	-0.2853*	-0.2836*	-0.3396*	-0.4993*	-0.5420*	0.1624	0.2564*	0.0326	1.0000								
Spanish spoken (1=yes)	-0.3669*	0.0830	0.0511	0.3455*	0.3419*	0.3592*	0.3592*	0.3572*	0.3534*	-0.1353	-0.1440	-0.1650	0.3252*	0.2391*	0.0189	0.3568*	1.0000							
Access to seacoast (1=yes)	-0.1792	0.2897*	0.3233*	0.1593	0.1611	0.1494	0.1494	0.1567	0.1585	0.1624	0.0092	0.0485	-0.0019	0.0062	-0.1670	0.0690	0.0818	1.0000						
Sharing a land border	0.2604*	0.2897*	0.3076*	0.1437	0.1446	0.1443	0.1443	0.1411	0.1420	0.1683	0.4081*	0.3561*	-0.1254	-0.1593	0.0318	-0.3215*	-0.0588	0.0668	1.0000					
Partner's Land area	-0.1366	-0.1403	-0.0432	0.1980*	0.2034*	0.2070*	0.2070*	0.2002*	0.2057*	0.2638*	-0.0919	-0.0827	0.2355*	0.2984*	-0.2674*	0.1477	0.1106	0.0657	0.0186	1.0000				
Absolute time difference to main financial centre	-0.3595*	-0.3881*	-0.3659*	-0.1070	-0.1055	-0.1093	-0.1093	-0.1024	-0.1010	-0.2768*	-0.3083*	-0.3585*	0.1068	0.2557*	0.2668*	0.6481*	0.2984*	0.1633	-0.0863	0.0636	1.0000			
Average GDP 1990-2003	0.0432	0.1432	0.2977*	0.5698*	0.5777*	0.5788*	0.5788*	0.5658*	0.5740*	0.7358*	0.2496*	0.2986*	-0.0639	-0.0464	-0.0985	-0.1104	-0.0172	0.2448*	0.1442	0.5999*	-0.0394	1.0000		
Average per capita GDP 1990-2003	0.2126*	0.4840*	0.5340*	0.6007*	0.6018*	0.5902*	0.5902*	0.5932*	0.5945*	0.6243*	0.4208*	0.4866*	-0.3277*	-0.4053*	0.0120	-0.2851*	-0.0378	0.2369*	0.1475	-0.1603	-0.2194*	0.4433*	1.0000	
Absolute difference of percapita GDPs 1990-2003	-0.1353	-0.4583*	-0.4883*	-0.5616*	-0.5615*	-0.5493*	-0.5493*	-0.5563*	-0.5563*	-0.6089*	-0.3440*	-0.3943*	0.2526*	0.3682*	-0.0128	0.2418*	-0.0164	-0.2841*	-0.1584	0.1784	0.1653	-0.4047*	-0.9665*	1.0000

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

[2] Average over the period of total bilateral inflows and outflows 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 13

Countries included in the regressions (total=109)

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

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 filtered series of GDP for Spain and for the partner country. GDP data was filtered using Baxter and King's band-pass filter. Alternative specifications use H-P filtered data or the log difference (growth rates) of annual GDPs. 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 partner's GDPs. This measure is then averaged over the denoted period. That is,

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

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, divided over the partner's GDP. Alternative specifications use just the level of inflows plus outflows, or divide them over the minimum of Spain's and the partner's GDP. This measure is then averaged over the duration of the period. This measure can also be constructed for Equity flows (Stock + FDI) or for FDI flows. 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 that takes value 1 if a given country has Spanish as the main language. Data was elaborated by the authors.

Access to seacoast: dummy variable that 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 that takes value 1 if a given country has joined the Euro. Data elaborated by the authors.

Member of European Union: dummy variable that takes value 1 if a given country has joined the European Union (before 2004). 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.

Land area: Partner's land area (in square km). Data for land areas was obtained from `http://www.infoplease.com/ipa/A0004379.html` and the CIA World Factbook.

Population: Average population of partner country for the period chosen (in millions). Data on countries' population was obtained from the World Bank.

Average GDP: Partner's average GDP measured at PPP. GDP data at PPP was obtained from the Penn World Tables 6.1.

Per capita GDPs: Partner's average per capita GDP. Data was obtained from the Penn World Tables 6.1.

Absolute difference of per-capita GDPs: (between Spain and the partner country) 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.