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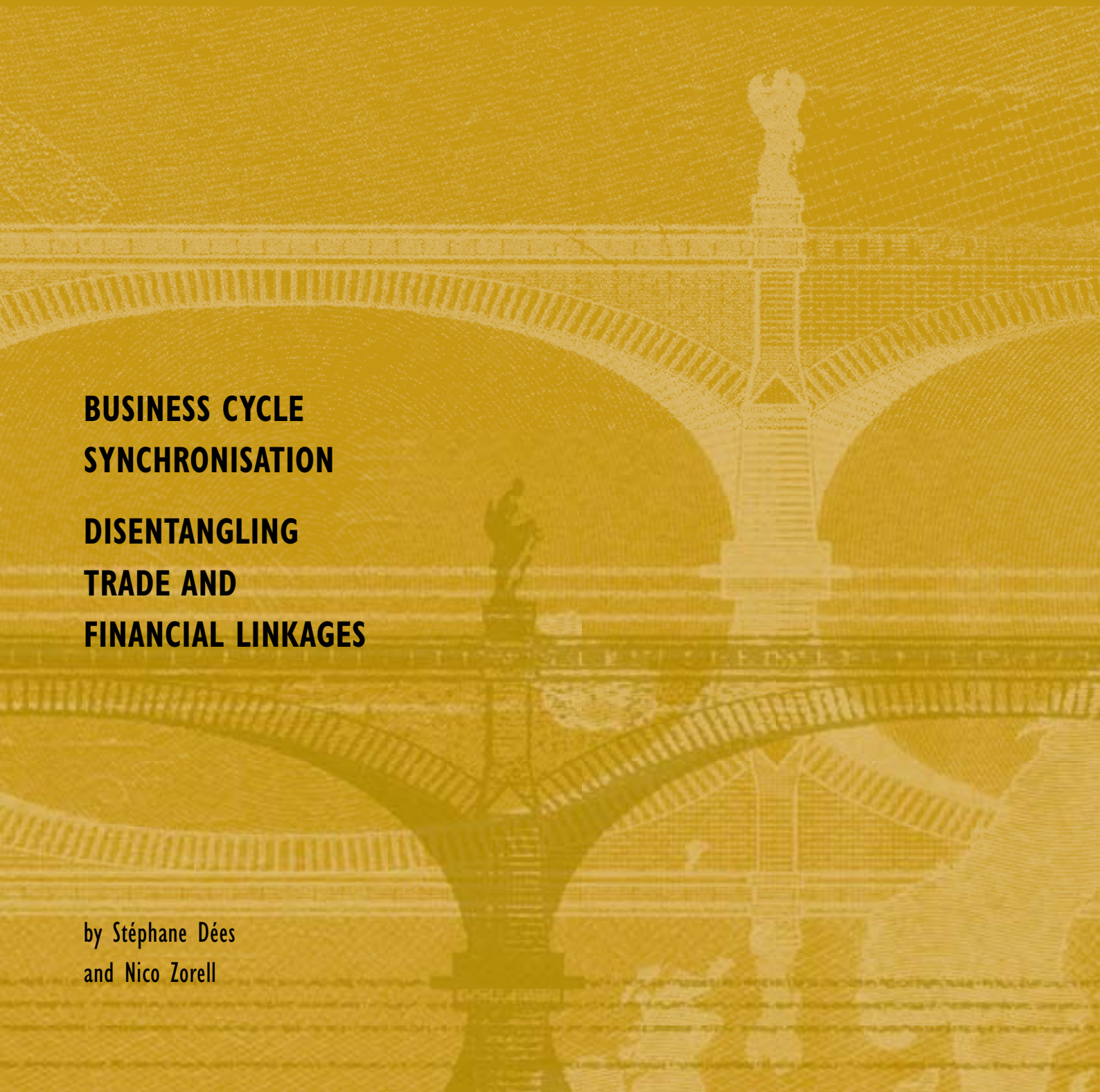

BUSINESS CYCLE SYNCHRONISATION

DISENTANGLING TRADE AND FINANCIAL LINKAGES

by Stéphane Dées

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by Stéphane Dées[2]

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In 2011 all ECB publications feature a motif taken from the €100 banknote.

1 We are grateful to Claudia Buch, Jean Imbs, Filippo di Mauro, Warwick McKibbin and an anonymous referee for helpful comments and to Martin Schindler for making his database available to us. All remaining errors are the sole responsibility of the authors.

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ISSN 1725-2806 (online)

CONTENTS

Abstract

Drawing on a large sample of countries, this paper explores whether closer economic ties between countries foster business cycle synchronisation and disentangles the role of the various channels, including trade and financial linkages as well as the similarity in sectoral specialisation. Overall, our results confirm that trade integration fosters business cycle synchronisation. Similar patterns of sectoral specialisation also lead to closer business cycle co-movement. By contrast, it remains difficult to find a direct relationship between bilateral financial linkages and output correlation. However, our results suggest that financial integration affects business cycle synchronisation indirectly by raising the similarity in sectoral specialisation. Through this indirect link, financial integration tends to raise business cycle comovement between countries.

Keywords: *International transmission of shocks, Financial integration, International business cycle.*

JEL Classification: E32, F41, E44.

NON-TECHNICAL SUMMARY

The 2007-09 financial crisis led to a deep and synchronised global downturn, accompanied by a severe contraction in international trade. It is widely held that the unprecedented synchronisation of the downturn across countries is related to the economic globalisation witnessed over the decades leading up to the crisis. Globalisation has tied the countries more closely together in various ways.

To start with, globalisation has led to closer trade linkages across the globe. Trade of goods and services as a share of world GDP increased from around 15% in the early 1980s to around 25% before the start of the crisis in 2007. In parallel, financial integration has increased even more. Foreign direct investment (FDI) in particular has grown at rates far larger than those of trade or output. From the early 1980s to 2007, the stock of FDI rose almost fivefold to reach around 30% of world GDP. Furthermore, trade openness and international financial openness have been highly correlated across both industrial and developing countries. Countries that are more open to trade also tend to be more integrated into global financial markets. While globalisation forces have made countries more interconnected, structural differences of the various economies might have also generated differences in business cycles. This calls for taking into account the degree of similarity in the structure of production across countries when studying the factors underlying cross-country output correlations.

Against this backdrop, this paper explores whether closer economic ties between countries indeed foster business cycle synchronisation. Drawing on the work by Imbs (2004 and 2006), we also seek to disentangle the role of the various channels. More specifically, we allow for a complex interplay between trade integration, financial integration and business cycle synchronisation. Cross-country differences in production structure and their indirect connections with international linkages are also taken into account.

Our paper adds to the existing literature in several ways. First, the analysis rests on a relatively large sample of countries, including various emerging economies, particularly in Central and Eastern Europe. Second, we use several measures of financial integration, with one of the measures capturing bilateral FDI linkages. This is a novelty in this branch of the literature and allows us to assess whether the various types of financial integration have different effects on business cycle synchronisation. Third, to account for endogeneity problems, we use various sets of instruments, particularly for financial integration. We find that some results turn out to be quite sensitive to the financial instruments used. Finally, we assess how much the results depend on the country coverage by repeating our empirical exercise for two different sub-samples consisting of the OECD countries and the EU Member States, respectively.

Overall, our empirical analysis shows that business cycle synchronisation is mostly explained by the similarity in production structure and by trade linkages. Financial linkages contribute to closer output correlations rather indirectly, by making countries more similar. It seems worth noting that we define financial linkages in a very narrow sense, i.e. in terms of bilateral asset holdings. Therefore, we are unlikely to fully capture the financial transmission of global shocks or shocks spreading through contagion effects via third countries. These phenomena are likely to have played an important role in the remarkable synchronicity of the downturn across countries that followed the 2007-09 financial crisis, in addition to the channels described in this paper.

1 Introduction

The 2007-09 financial crisis led to a deep and synchronised global downturn, accompanied by a severe contraction in international trade. It is widely held that the unprecedented synchronisation of the downturn across countries is related to the economic globalisation witnessed over the decades leading up to the crisis. Globalisation has tied the countries more closely together in various ways.

To start with, globalisation has led to closer trade linkages across the globe. Trade of goods and services as a share of world GDP increased from around 15% in the early 1980s to around 25% before the start of the crisis in 2007. In parallel, financial integration has increased even more. Foreign direct investment (FDI) in particular has grown at rates far larger than those of trade or output. From the early 1980s to 2007, the stock of FDI rose almost fivefold to around 30% of world GDP.[1] These developments partly reflect the increasing role of offshoring. Amador and Cabral (2009), for instance, find that vertical specialisation activities as a share of world manufacturing imports have risen significantly over the past decades, with some acceleration over time. Furthermore, trade openness and international financial openness have been highly correlated across both industrial and developing countries. Countries that are more open to trade also tend to be more integrated into global financial markets (IMF 2002).

While globalisation forces have made countries more interconnected, structural differences of the various economies might have also generated differences in business cycles. This calls for taking into account the degree of similarity in the structure of production across countries when studying the factors underlying cross-country output correlations.

Against this backdrop, based on a sample of 56 countries, this paper explores

[1] These shares have been computed by the authors using different sources. Values for world trade of goods and services are from the WTO International Trade Statistics (2008). Values for the world stock of FDI is from the UNCTAD World Investment Report (2008). Values for world GDP are from the IMF World Economic Outlook (2009).

whether closer economic ties between countries indeed foster business cycle synchronisation. Drawing on the work by Imbs (2004 and 2006), we also seek to disentangle the role of the various channels.[2] More specifically, we allow for a complex interplay between trade integration, financial integration and business cycle synchronisation. Cross-country differences in production structure and their indirect connections with international linkages are also taken into account.

Overall, our results confirm that economic integration fosters business cycle synchronisation. Above all, the GDPs of economies with more intensive bilateral trade move more closely together. Apart from this, similarity in production structure leads to closer business cycle comovements. By contrast, it remains difficult to find a direct relationship between bilateral financial linkages and output correlation. Our results suggest that financial integration affects business cycle synchronisation not directly, but acts more indirectly by raising the similarity in production structure. Through this indirect link, financial integration tends to raise business cycle comovement between countries.

Our paper adds to the existing literature in several ways. First, the analysis rests on a relatively large sample of countries, including various emerging economies, particularly in Central and Eastern Europe. This might be especially relevant when considering the effects of vertical integration on business cycle correlation. Second, we use several measures of financial integration, with one of the measures capturing bilateral FDI linkages. This is a novelty in this branch of the literature and allows us to assess whether the various types of financial integration have different effects on business cycle synchronisation. Third, to account for endogeneity problems, we use various sets of instruments,

[2] In addition to Imbs (2004, 2006), Abbott et al. (2008) also follow the same approach to study the effects of trade, specialisation and financial integration for business cycle synchronisation in 15 OECD countries. Similarly, Garcia-Herrero and Ruiz (2008) apply the same methodology to business cycle synchronisation between Spain and a large set of economies.

particularly for financial integration. We find that some results turn out to be quite sensitive to the financial instruments used, a point that deserves special attention in future research. Finally, we assess how much the results depend on the country coverage by repeating our empirical exercise for two different sub-samples consisting of the OECD countries and the EU Member States, respectively. While we still have difficulties to find significant direct effects between financial linkages and output correlations for the OECD sample, these effects become positive and significant for the EU sample.

Overall, our empirical analysis shows that business cycle synchronisation is mostly explained by similarity in production structure and trade linkages. Financial linkages contribute to closer output correlations rather indirectly, by making countries more similar.

The remainder is structured as follows. The next section briefly reviews the related theoretical and empirical literature. Our empirical methodology is described in Section 3. In Section 4 we discuss the results, before concluding in Section 5.

2 Literature review

Trade and financial linkages play a significant role in the international transmission of shocks and in business cycle sychronisation. However, empirical studies and theoretical models have so far often produced conflicting results. While empirical research has generally found that pairs of countries with relatively strong trade and financial linkages tend to have highly correlated business cycles, the theoretical models cannot deliver results that are quantitatively consistent with such empirical findings.

Existing theoretical models studying business cycle synchronisation are mostly based on the standard international real business cycle model. In a two-country

open economy model with complete financial markets, Backus et al. (1992) show that, in a world of fully integrated asset markets, high trade intensity is associated with lower business cycle correlations. Extending this model to account for vertical specialisation, Kose and Yi (2001) suggest that higher trade integration might lead to more or less synchronisation, depending on the nature of trade and the type of shocks hitting the economies. If higher trade linkages foster specialisation, then the presence of industry-specific shocks will result in more idiosyncratic business cycles. By contrast, if higher trade linkages increase intra-industry trade (also in parts and components), then stronger trade ties might lead to higher business cycle synchronisation. Other theoretical models also show that intense bilateral trade tends to be associated with highly correlated business cycles (Canova and Dellas, 1992).

While theoretical models support, to some extent, a positive relationship between trade linkages and business cycle synchronisation, the impacts of financial integration on output correlations have remained unclear. On the one hand, the ability to borrow and lend internationally facilitates the transfer of resources between economies and can decrease output correlations. Backus et al. (1992) show that, in a complete markets model, a positive technology shock in one economy attracts capital flows from the rest of the world, resulting in negatively correlated output fluctuations. On the other hand, a model in which individuals have incomplete access to international risk sharing instruments can lead to opposite predictions, as Baxter and Crucini (1995) show.

Another explanation for business cycle comovement is the similarity in production structure. In theory, similar production patterns should affect synchronisation positively, since two economies producing the same types of goods will then be subject to similar shocks. Thus, countries with similar production patterns tend to have synchronised economic cycles.

Empirically, higher trade integration increases cross-country output correlations (Frankel and Rose, 1998; Clark and van Wincoop, 2001). Also, most empirical studies show a positive relationship between financial integration and business cycle synchronisation (see for instance Imbs, 2004 and 2006). However, Kalemli-Ozcan et al. (2009) argue that the positive assocation between financial integration and business cycle synchronisation is mainly due to not accounting for the effects of country-pair factors and global shocks. Using a rich panel data set on banks' international bilateral exposures over 30 years and 20 developed countries, they are able to account for these factors and find a negative relationship between financial integration and business cycle synchronisation. Finally, concerning the similarity in production structure, Kalemli-Ozcan et al. (2001) and Imbs (2004 and 2006) all find that country pairs with similar production structure exhibit closer output correlation.

Furthermore, interactions between integration and production structure have to be taken into account. For instance, Kalemli-Ozcan et al. (2003) show that financially integrated economies tend to specialise in different sectors, in line with their comparative advantages. However, financial integration between two economies could also increase the similarity of their production structures, as foreign investment could be concentrated on similar activities, for instance those dependent on external funds (Imbs, 2006). FDI flows could also be concentrated on sectors where the home country has a comparative advantage, thus replicating in the host country a similar productive structure (Garcia-Herrero and Ruiz, 2008). The production structure might in turn influence the way trade and financial integration affect output correlations.

It is therefore important to consider all these linkages together. The methodology generally used in the literature to test for the relevance of trade and financial channels is the estimation of a single equation. The fact that there may

be indirect effects going in opposite directions might account for the generally small impact found in studies using single equation regressions. For instance, Kose et al. (2003), using a single-equation regression, find a positive effect of trade on business cycle synchronisation, but a non-significant effect of financial links on output correlations. To address the possibility of conflicting indirect effects, Imbs (2004 and 2006) estimates a system of simultaneous equations to take into account direct and indirect effects on the synchronisation of output. He finds that similarity in production structure has a sizable effect on business cycles. Most of this effect directly reflects differences in GDP per capita. Also, economic regions with strong financial links are found to be significantly more synchronised, even though they also tend to be more specialised.

3 Methodology

We follow Imbs (2004 and 2006) and estimate a system of equations relating bilateral output correlations with measures of trade and financial integration as well as the similarity in production structures. We present first the system of equations that will be used in our empirical analysis. We then give details about the data used and the various measures computed. Finally, we present the estimation strategy.

3.1 Framework

Similarly to Imbs (2004 and 2006), we estimate the following system of four equations simultaneously. Each observation corresponds to a country pair (i, j):

$$\rho_{i,j} = \alpha_0 + \alpha_1 T_{i,j} + \alpha_2 F_{i,j} + \alpha_3 S_{i,j} + \alpha_4 I_{1,i,j} + \varepsilon_{1,i,j} \quad (1)$$

$$T_{i,j} = \beta_0 + \beta_1 F_{i,j} + \beta_2 S_{i,j} + \beta_3 I_{2,i,j} + \varepsilon_{2,i,j} \quad (2)$$

$$S_{i,j} = \gamma_0 + \gamma_1 T_{i,j} + \gamma_2 F_{i,j} + \gamma_3 I_{3,i,j} + \varepsilon_{4,i,j} \quad (3)$$

$$F_{i,j} = \delta_0 + \delta_1 I_{4,i,j} + \varepsilon_{3,i,j} \quad (4)$$

Here, the four endogenous variables are the bilateral output correlation ρ, the bilateral trade intensity T, an index S capturing the similarity between country i and j,and the intensity of financial links between these two countries denoted F. I_1, I_2, I_3 and I_4 denote exogenous variables. As shown by Imbs (2004), the identification of the system requires differences between at least I_2 and I_3, as well as instruments for F.

Equation (1) is rather standard in the literature studying the empirical determinants of cross-country GDP in the vein of Frankel and Rose (1998) and relates bilateral output correlations to measures of trade and financial integration as well as the similarity in production patterns. Equations (2) to (4) capture the interaction of the endogenous explanatory variables, allowing us to disentangle direct from indirect channels. The specifications chosen are those used in Imbs (2004 and 2006).[3]

3.2 Data

As in Imbs (2006), the **dependent variable** is the pairwise correlation of HP-filtered GDP, computed here over 1993-2007.[4]

Regarding **goods market integration**, we also follow Imbs (2006) and

[3] Imbs (2004) estimates a similar system with $\beta_1 = 0$ and Imbs (2006) imposes $\beta_2 = \gamma_1 = 0$ and includes T as dependent variable in Eq. (4).

[4] Other filtering techniques have also been used, including the asymmetric Christiano-Fitzgerald filter, the Baxter-King bandpass filter and simple year-on-year log-differences. Results using GDP correlation coefficients based on these alternative filtering methods are not reported here, but are very similar to those presented below and consistent with the main conclusions of this paper.

make use of Deardorff's (1998) indicator:

$$T_{ij} = \frac{1}{T} \sum_{t} \frac{(EX_{ij,t} + IM_{ij,t})\, NYW_t}{NY_{i,t} NY_{j,t}}. \tag{5}$$

Here, $EX_{ij,t}$ and $IM_{ij,t}$ denote total merchandise exports and imports, respectively, from country i to country j. Futhermore, NYW_t stands for world nominal output, while $NY_{i,t}$ and $NY_{j,t}$ denote nominal GDP in country i and j, respectively.

Turning to **financial market integration**, existing studies on the role of financial linkages in business cycle synchronisation focus on portfolio investment. While we follow this approach, we also use FDI-related linkages as an alternative measure of financial integration. FDI has drastically gained importance over the last decade and may have different effects on the international transmission of shocks than portfolio investment. Bilateral FDI linkages are measured by the sum of country i's FDI positions in country j and j's FDI position in i. Information on FDI holdings (in US dollars) are taken from the OECD's Foreign Direct Investment Statistics. Since most countries report inward as well as outward FDI holdings, we are able to expand the sample beyond the pairs formed by the 30 reporting OECD economies. Analogously, portfolio investment linkages are measured as the sum of bilateral portfolio investment positions based on the IMF's CPIS database, as well as a decomposition into three broad sub-categories, namely short-term debt securities, long-term debt securities and equity securities.

Similarities in the production structure are captured by S_{ij},

$$S_{ij} = \frac{1}{T} \sum_{t} \sum_{n}^{N} \left| s_{n,i,t} - s_{n,j,t} \right|, \tag{6}$$

where $s_{n,i}$ ($s_{n,j}$) is sector n's share in total value added in country i (j). The

total number of sectors is N. If i and j are completetly symmetric, then $S_{ij} = 0$.[5]

We turn now to a description of the **exogenous variables** and **instruments** used in our analysis. In the trade equation (2), I_2 comprises standard gravity variables: the bilateral distance between the countries' capitals and two dummy variables indicating, respectively, if the countries share a common border and if they were part of a single jurisdiction in the past. All these measures are provided by CEPII.

Imbs and Wacziarg (2003) find that the specialisation patterns depend on income per capita and that this relationship is non-monotonous. As countries become more affluent, they first diversify their production, only to specialise again when they pass a certain threshold. In line with Imbs (2004), we therefore include in I_4 both the bilateral (log) product of and the difference between GDPs per capita. Both measures are assumed to be exogenous to S and are based on UN data for 1993-2007.

The financial instruments are taken from a dataset by Schindler (2009), which, in turn, is based on the IMF's Annual Report on Exchange Rate Arrangements and Restrictions (AREAER). Although the dataset features several measures of financial restrictions, we make use of two indices reflecting, respectively, overall financial restrictions and restrictions to FDI. In addition, we construct a complementary index for restrictions on financial transactions other than FDI. For all three indices, we employ two different versions. The first version is a simple average over the rules applicable to financial inflows and outflows in both countries. In some cases, however, restrictions are not cumulative and only the stricter rule is binding. The second version takes this into account and averages only over the stricter set of rules, e.g. the maximum of outward restrictions in

[5] We use UNIDO data on gross value added for six broad sectors: Agriculture, hunting, forestry, fishing (ISIC A-B); mining, manufacturing, utilities (ISIC C-E); construction (ISIC F); wholesale, retail trade, restaurants and hotels (ISIC G-H); transport, storage and communication (ISIC I); other Activities (ISIC J-P).

country i on the one hand and inward restrictions in country j on the other hand.

We also use a number of control variables in the regressions to account for the role of macroeconomic policy coordination. In particular, we include dummy variables to control for common currency union (e.g. EMU) and for trade aggrements (e.g. EU).

All in all, our full sample comprises 56 countries (see list in the Appendix). Taking into account missing observations, we arrive at a maximum of 964 country pairs for the whole sample. This large country coverage is particularly relevent to take third-country effects into account. The possibility that cycles in two countries can be correlated only because both countries are integrated with a third country is a clear bias in empirical studies with a small sample size. By extending the number of countries, we reduce the probability that the results are biased due to third-country effects as most of the relevant third countries are likely to be included in the sample. By comparison, Imbs (2004) only considered 24 countries and Imbs (2006) included 41 countries in the sample. We also consider two sub-samples to check the robustness of the results obtained with the full sample and to assess whether the composition of the sample matters for the estimation results. We first reestimate the system (1)-(4) over a sub-sample of OECD countries and then by considering EU countries only.

4 Empirical results

The estimation of the system of equations (1)-(4) is realised along three dimensions. First, we estimate the system with different measures of financial integration (FDI, portfolio investment and its sub-components). Second, we consider different samples with regard to the country pairs included: the whole sample, pairs of OECD economies and pairs of EU Member States. Third, as our

results are obtained by instrumenting financial integration by a new set of indicators, we test the robustness of our results by using another set of instruments that is widely used in the literature (based on La Porta et al., 1998).

4.1 Simple data analysis

We start with a very simple analysis of the data based on unconditional correlations (Table 1). A few interesting results emerge. First, the correlation between output correlations (ρ) and its determinants (trade - T -, finance - F - and similarity - S -) is relatively high. For the whole sample, it is the lowest vis-à-vis trade integration (8%) and much higher vis-à-vis the similarity in production structure (20%) and financial integration (between 20 and 30%). While the correlation between ρ and S remains broadly unchanged whatever sample considered, the correlations between ρ and T and between ρ and F is the highest when we restrict the pairs to OECD countries. Second, the correlation between trade and financial integration is overall rather low. However, when considering FDI-based relationships, this correlation increases somewhat (standing between 10 and 20%). Third, there is a rather high correlation between the similarity index S and financial integration F (between 30 and 45%), especially when F is measured by portfolio investment. Finally, the correlation across the various measures of financial integration is very high. However, while this correlation is close to 90% between equity investment and debt holdings, it is somewhat lower between portfolio and FDI-based measures, justifying our approach to estimate the system with alternative measures of financial integration.

Overall, while this simple correlation-based analysis anticipates some of the estimation-based results, it shows above all the complexity of the interconnections across the various channels that are at play in the transmission of cyclical developments. It supports an empirical analysis based on a system of simulta-

neous equations, as detailed above, given the potential for high and significant indirect effects between output correlations and its various determinants.

4.2 Estimation results

To account for the possible endogenity of some dependent variables, we estimate the system (1)-(4) with three-stage least squares (3SLS). 3SLS is used when endogenous variables are correlated with error terms and the error terms are correlated between equations. As argued by Imbs (2004), this procedure is perfectly adapted to our needs, as it provides the features of simultaneous equation methods and allows for the possible endogeneity of some dependent variables.

Table 2 gives the 3SLS estimates of Eq. (1)-(4) for the period 1993-2007[6] and reports estimates with financial integration measured by various investment types (FDI, portfolio investment and its sub-categories). Estimations reported in Table 3 restrict the sample to OECD pairs, while Table 4 presents results from estimations based on pairs of EU Member States.

Among the determinants of output correlations, trade integration and the similarity in production structure are significant with the expected signs (Eq. (1)). First, trade integration tends to foster business cycle synchronisation. This is in line with the results of Frankel and Rose (1998), Clark and Van Wincoop (2001) and Kose and Yi (2001). The value of the coefficient α_1 is higher when restricting the sample to OECD or EU pairs. However, this coefficient is found insignificant for EU pairs when F is measured by FDI or equity investment. This result could appear surprising. In fact, in a similar exercise, Abbott et al. (2008) identify a positive and significant relationship between trade intensity and business cycle correlation for 16 European countries (when looking at

[6] Estimates on shorter sub-periods are available upon requests. They have not been included in the present paper as they do not show large differences with the whole sample ones.

the individual-country results). However, one should keep in mind that the EU Member States share relatively strong bilateral trade linkages. Restricting the sample to these countries thus reduces the variance in the trade variable, diminishing the precision with which the coefficient α_1 is estimated.

Furthermore, the coefficient associated with similarities in sectoral structure is in most cases negative, i.e. the more similar two countries are (low S), the higher is the correlation of their outputs. This result is in line with Imbs (2006). The coefficient is slightly lower when the sample includes only OECD or EU economies.

We generally cannot find a positive, significant relationship between bilateral financial linkages and business cycle correlation. This result is somewhat different from previous empirical research on financial integration (e.g. Kose et al., 2003 or Imbs, 2006). In two cases only are we able to find positive, significant values for α_2: when F is measured using debt holdings and when the sample is restricted to EU country pairs. We will discuss this issue in greater detail below.

Concerning the indirect effects working through trade (Eq. (2)), the impact of financial integration on trade is negative, as shown by the estimates of β_1. Thus, closer financial integration is associated with lower bilateral trade flows. While Imbs (2006) had difficulties to find significant effects of finance on trade, we find significant, negative coefficients whatever measure of financial linkages used. These results indicate that financial integration might be a substitute to trade integration. The value of β_1 is higher when restricting the sample to OECD countries. In addition, similarity in production structures increases trade linkages ($\beta_2 < 0$), especially when F is measured by portfolio investment. This finding points to the importance of intra-industry trade in our data.

Finally, the indirect channels operating through sectoral structure (Eq. (4))

appear relevant. Trade linkages between two countries reduce the similarity in their structure of production ($\gamma_1 > 0$). Interestingly, this coefficient is highest when F is measured by FDI. However, this effect is not significant when restricting the sample to EU country pairs. Again, this might be related to the fact that the variance of the trade variable is lower in the EU sample. Also, horizontal integration and intra-industry trade play an important role among EU economies.

Concerning the effects of financial integration on structural similarity, the sign of γ_2 is a priori ambivalent, as pointed out by Imbs (2006). Financial integration could either favour specialisation in different sectors or rather foster the concentration of activities in certain sectors, e.g. those dependent on foreign capital. Unlike Kalemli-Ozcan et al. (2001, 2003), we find γ_2 negative and significant, whatever sample considered. Hence closer financial linkages are associated with greater similarity in production. The effect is particularly strong for the OECD sample. One explanation could be that financial integration is particularly important between advanced countries, which engage in a division of labour in line with the rationale for intra-industry trade. Also, when F is measured by FDI, the value of γ_2 is - in absolute terms - higher than when it is measured by portfolio investment. This confirms the previous interpretation that sharing production processes increases the degree of similarity across countries, making them therefore more sensitive to common industry-specific shocks.

[TABLE 2 HERE]

[TABLE 3 HERE]

[TABLE 4 HERE]

Overall, the results are broadly consistent with previous empirical evidence. The only noticeable difference concerns the absence of a significant effect of

financial integration on business cycle synchronisation. This result, which particularly contradicts Imbs (2004 and 2006), deserves some further investigation. First, this result only concerns direct effects and there is a clear need to assess the importance of indirect channels. This will be done in Section 4.3. Second, the issue of endogeneity across the various explanatory variables appears important when estimating the system. Instrumenting financial integration appears in particular very critical in the estimation process. This issue is further discussed in Section 4.4.

4.3 Disentangling the importance of the different channels

The system of equations Eq. (1)-(4) allows for a complex interplay of direct and indirect channels affecting business cycle synchronisation. Thus, the direct effects suggested by Eq. (1) could be offset by the indirect ones captured by the remaining equations. To derive the overall impacts of trade and financial integration as well as sectoral similarity, we combine the direct and indirect effects, using the results from the simultaneous estimation. Tables 5 and 6 report the values for the indirect channels together with the overall effects when F is measured with FDI and portfolio investment, respectively.[7]

[TABLE 5 HERE]

[TABLE 6 HERE]

To start with, we have seen that the direct effect of trade on output correlations (α_1) is overall found to be positive and significant. Given the specification of our system, indirect trade effects can only stem from interactions with sectoral similarity S. We already know that trade integration tends to reduce the

[7] Computatins based on estimates including F measured with equity and debt holdings are available upon request.

similarity in production structure. As this in turn reduces output correlation, the indirect trade effect of trade on business cycle synchronisation ($\alpha_3\gamma_1$) tends to be negative, countervailing the direct impact. However, the overall effect ($\alpha_1 + \alpha_3\gamma_1$) remains positive and significant. It is the highest in the OECD sub-sample and in the EU sub-sample, when F is measured by portforlio investment. Only in one case, using the whole sample and measuring F by FDI, do the indirect effects of trade cancel out the direct ones.

Turning to sectoral similarity S, our system allows only for indirect effects through trade integration. As we have found that lower similarity tends to be associated with lower trade linkages, this may reinforce the direct effect. However, the indirect effects are found small and insignificant. Thus, the overall impact ($\alpha_3 + \alpha_1\beta_2$) is fairly close to the direct one, confirming that higher similarity in production structures leads to higher business cycle synchronisation. The impact is the largest when estimating the system on the whole sample.

As already indicated, taking heed of indirect channels is particularly relevant for financial integration. While we have not been able to find positive, significant direct effects of financial linkages on output correlation, the indirect effects are large enough to change the overall assessment. The first indirect effect stems from interactions with trade integration. Since we have found that financial integration tends to reduce bilateral trade (and trade fosters output correlation), this indirect effect could diminish the impact of financial linkages on business cycle correlation. However, as shown in Tables 5 and 6, this indirect effect is small and in most cases insignificant. The second indirect effect operates through sectoral similarity. Our estimates show that financial integration between two countries makes them more similar in terms of sectoral production patterns. Sectoral similarity, in turn, tends to increase output correlation. Thus, the second indirect channel creates a positive link between financial in-

tegration and business cycle synchronisation. It is large and significant, so that the overall financial channel ($\alpha_2 + \alpha_1\beta_1 + \alpha_3\gamma_2$) is clearly positive and significant. It is specially large for the sub-samples including only OECD or EU countries. In a nutshell, we find that financial linkages do not foster output correlation directly, but indirectly, by increasing the similarity of the financially integrated economies. Imbs (2006) also reports cases where lifting financial restrictions lowers S, i.e. where financial integration induces greater similarity, which in turn increases the correlation of output.[8] Estimating a similar system for Spain, Garcia-Herrero and Ruiz (2008) also find a positive indirect effect of financial linkages on output synchronisation by fostering sectoral similarity, although this indirect effect is not large enough to compensate the negative direct effect between financial linkages and GDP synchronisation.

4.4 Sensitivity to the financial integration instruments

Our estimation strategy allows to deal with the possible endogeneity of the dependent variables, using instruments to isolate the different components of the endogenous variables. While instrumenting trade or sectoral similarity is fairly straightforward, finding suitable instruments for financial integration is more difficult. Imbs (2004, 2006) uses institutional variables from La Porta et al. (1998)[9], arguing that legal institutions are important determinants of financial developments. However, these variables do not so much relate to cross-border financial transactions, but to the local legal framework in general (including rules for domestic investors). By contrast, the financial instruments used in our benchmark estimations rely on measures of de jure restrictions on cross-border

[8] However, this result is not robust. Using other measures of financial integration, Imbs (2006) also finds results similar to Kalemli-Ozcan et al. (2001, 2003).

[9] These instruments reflect shareholder rights (with variables capturing whether one share carries one vote, whether the distribution of dividends is mandatory, whether proxy vote by mail is allowed, and the percentage of capital necessary to call an extraordinary shareholders' meeting), creditor rights, and an assessment of accounting standards and the rule of law.

financial transactions, provided by Schindler (2009). Like several others (e.g. Miniane 2004), Schindler (2009) draws on the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), but provides information at a more disaggregated level. In particular, measures of financial integration are available for individual asset categories (e.g. equity, bonds, FDI). Furthermore, the country coverage is fairly broad, ranging from low-income to high-income countries.[10] Both features of this set dovetail with our data requirements, while its shorter time coverage as compared with other data sources is less important to us.

To check whether the choice of instruments for financial integration might influence the results, we re-estimate our system using - like Imbs - the set of institutional variables taken from La Porta et al. (1998). This re-estimation shows that the set of variables used to instrument F do matter, since - like in Imbs' work - α_2 becomes positive for the OECD sample when using the variables from La Porta et al. (1998) instead of those from Schindler (2009) (Table 7).

[TABLE 7 HERE]

However, the choice of the instruments does not fully explain the differences between Imbs' results and our findings, since the direct effects of financial integration remain insignificant for the whole sample. In fact, the sampling also seems to matter a lot to explain differences with the existing literature. In this respect, our sample is much larger than the one used by Imbs. For instance, Imbs (2004) uses a sample of 276 pairs and Imbs (2006) uses a maximum of 347 pairs. By contrast, our full sample comprises between 756 and 964 pairs, depending on the specification. Using a much broader sample seems to influence the results, especially when including countries with large differences in development levels. Garcia-Herrero and Ruiz (2008) also obtain results that are

[10] The balanced panel covers 91 countries from 1995 to 2005 at annual frequency.

different from Imbs using a sample that includes many emerging economies.

To summarise, the sensitivity of the results related to financial integration with respect to the financial instruments used signals that future research should pay special attention to this issue. It also puts another complexion on the results of existing studies in this field. Similarly, the country coverage seems to be relevant in some respects, indicating that the relationship between integration and business cycle synchronisation might be different for emerging and advanced economies.

5 Concluding remarks

Drawing on work by Imbs (2004 and 2006), our empirial analysis has brought some evidence about the role of trade and financial linkages in international business cycle synchronisation. Overall, our results confirm that economic integration fosters business cycle synchronisation. Above all, the GDPs of economies with more intensive bilateral trade move more closely together. Apart from this, similar production structure lead to closer business cycle co-movement. By contrast, it remains difficult to find a direct relationship between bilateral financial linkages and output correlation. Our results suggest that financial integration affects business cycle synchronisation not directly, but acts more indirectly by raising the similarity in production structures. Through this indirect link, financial integration tends to raise business cycle comovement between countries.

The absence of direct link between financial linkages and output correlation is in contrast with previous empirical studies. We have shown that this result might be due to the choice of financial instruments used to account for endogeneity. Moreover, the sensitivity of the results to the country coverage indicates that the relationship between integration and business cycle synchronisation might be different for emerging and advanced economies. Finally, it

seems worth noting that we define financial linkages in a very narrow sense, i.e. in terms of bilateral asset holdings. Therefore, we are unlikely to fully capture the financial transmission of global shocks or shocks spreading through contagion effects via third countries. These phenomena are likely to have played an important role in the remarkable synchronicity of the downturn across countries that followed the 2007-09 financial crisis, in addition to the channels described in this paper. That said, our findings are in line with recent econometric studies on the 2007-09 financial crisis, which find no evidence that ex-ante bilateral exposure can explain the differential impact of the global crisis on a large cross section of countries (e.g. Rose and Spiegel, 2009). One explanation for this finding might be that international financial integration fosters output comovement between countries, even under limited trade and portfolio exposure, through international correlation in credit spreads for instance (Dedola and Lombardo, 2010). We leave the empirical implementation of this idea to future research

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Tables and Figures

Table 1: Unconditional correlations

	ρ	T	F_{FDI}	F_{PF}	F_{EQ}	F_{DB}	S
Whole sample							
ρ	1.00						
T	0.08	1.00					
F_{FDI}	0.30	0.10	1.00				
F_{PF}	0.25	-0.02	0.76	1.00			
F_{EQ}	0.19	-0.02	0.76	0.92	1.00		
F_{DB}	0.27	-0.00	0.73	0.97	0.84	1.00	
S	-0.20	0.03	-0.29	-0.43	-0.39	-0.43	1.00
OECD sample							
ρ	1.00						
T	0.18	1.00					
F_{FDI}	0.42	0.21	1.00				
F_{PF}	0.41	0.09	0.79	1.00			
F_{EQ}	0.35	0.05	0.80	0.95	1.00		
F_{DB}	0.35	0.12	0.75	0.98	0.88	1.00	
S	-0.19	-0.01	-0.29	-0.40	-0.39	-0.39	1.00
EU sample							
ρ	1.00						
T	0.03	1.00					
F_{FDI}	0.37	0.09	1.00				
F_{PF}	0.35	-0.09	0.80	1.00			
F_{EQ}	0.35	0.01	0.78	0.93	1.00		
F_{DB}	0.34	-0.13	0.78	0.99	0.89	1.00	
S	-0.25	-0.06	-0.32	-0.46	-0.41	-0.45	1.00

Notes: All variables measured in logs, except ρ. Variables are averages over 1993-2007. ρ denotes bilateral correlations in GDP on the basis of HP filtered annual data. T is the measure of bilateral trade described in the text. F_{FDI}, F_{PF}, F_{EQ}, F_{DB} are the measures of bilateral financial asset holdings based on respectively foreign direct investment, portfolio investment, equity and debt holdings. S is the measure of similarity in production structure described in the text.

Table 2: Estimation results - Whole sample -

	Measure of F			
	F_{FDI}	F_{PF}	F_{EQ}	F_{DB}
(1) GDP correlation				
α_1	0.05	0.04	0.04	0.02
	(3.06)	(3.24)	(3.10)	(1.69)
α_2	-0.02	-0.01	0.00	0.02
	(-1.38)	(-1.20)	(0.10)	(1.82)
α_3	-0.23	-0.26	-0.22	-0.12
	(-4.50)	(-4.81)	(-3.91)	(-1.83)
(2) Trade links T				
β_1	-0.07	-0.05	-0.08	-0.10
	(-2.18)	(-2.22)	(-2.95)	(-2.73)
β_2	-0.23	-0.37	-0.31	-0.38
	(-1.55)	(-2.59)	(-2.01)	(-2.14)
(3) Prod. struct.S				
γ_1	0.14	0.07	0.07	0.07
	(4.56)	(3.65)	(2.84)	(3.17)
γ_2	-0.20	-0.10	-0.12	-0.12
	(-8.42)	(-9.31)	(-7.36)	(-7.92)
nb. obs.	853	964	756	814

Notes: All variables measured in logs, except ρ. Variables are averages over 1993-2007. ρ denotes bilateral correlations in GDP on the basis of HP filtered annual data. T is the measure of bilateral trade described in the text. F_{FDI}, F_{PF}, F_{EQ}, F_{DB} are the measures of bilateral financial asset holdings based on respectively foreign direct investment, portfolio investment, equity and debt holdings. S is the measure of similarity in production structure described in the text. All specifications use 3SLS, with instruments details in the main text. T-statistics in parentheses.

Equations:

(1) $\rho_{i,j} = \alpha_0 + \alpha_1 T_{i,j} + \alpha_2 F_{i,j} + \alpha_3 S_{i,j} + \alpha_4 I_{1,i,j} + \varepsilon_{1,i,j}$;
(2) $T_{i,j} = \beta_0 + \beta_1 F_{i,j} + \beta_2 S_{i,j} + \beta_3 I_{2,i,j} + \varepsilon_{2,i,j}$;
(3) $S_{i,j} = \gamma_0 + \gamma_1 T_{i,j} + \gamma_2 F_{i,j} + \gamma_3 I_{3,i,j} + \varepsilon_{4,i,j}$.

Table 3: Estimation results - OECD sample -

	Measure of F			
	F_{FDI}	F_{PF}	F_{EQ}	F_{DB}
(1) GDP correlation				
α_1	0.07	0.07	0.07	0.07
	(3.12)	(4.46)	(4.56)	(3.87)
α_2	0.02	0.02	0.02	0.04
	(1.03)	(1.13)	(1.54)	(2.33)
α_3	-0.19	-0.17	-0.18	-0.13
	(-3.13)	(-2.50)	(-2.52)	(-1.94)
(2) Trade links T				
β_1	-0.03	-0.07	-0.12	-0.20
	(-0.62)	(-1.75)	(-3.09)	(-3.50)
β_2	-0.34	-0.60	-0.65	-0.93
	(-2.00)	(-2.94)	(-3.53)	(-3.93)
(3) Prod. struct.S				
γ_1	0.19	0.08	0.06	0.09
	(4.43)	(2.97)	(2.15)	(3.10)
γ_2	-0.23	-0.15	-0.17	-0.16
	(-6.74)	(-9.16)	(-8.04)	(-8.30)
nb. obs.	416	421	391	393

Notes: All variables measured in logs, except ρ. Variables are averages over 1993-2007. ρ denotes bilateral correlations in GDP on the basis of HP filtered annual data. T is the measure of bilateral trade described in the text. F_{FDI}, F_{PF}, F_{EQ}, F_{DB} are the measures of bilateral financial asset holdings based on respectively foreign direct investment, portfolio investment, equity and debt holdings. S is the measure of similarity in production structure described in the text. All specifications use 3SLS, with instruments details in the main text. T-statistics in parentheses.

Equations:

(1) $\rho_{i,j} = \alpha_0 + \alpha_1 T_{i,j} + \alpha_2 F_{i,j} + \alpha_3 S_{i,j} + \alpha_4 I_{1,i,j} + \varepsilon_{1,i,j}$;

(2) $T_{i,j} = \beta_0 + \beta_1 F_{i,j} + \beta_2 S_{i,j} + \beta_3 I_{2,i,j} + \varepsilon_{2,i,j}$;

(3) $S_{i,j} = \gamma_0 + \gamma_1 T_{i,j} + \gamma_2 F_{i,j} + \gamma_3 I_{3,i,j} + \varepsilon_{4,i,j}$.

Table 4: Estimation results - EU sample -

	Measure of F			
	F_{FDI}	F_{PF}	F_{EQ}	F_{DB}
(1) GDP correlation				
α_1	0.03	0.06	0.04	0.07
	(1.05)	(2.12)	(1.54)	(2.31)
α_2	0.04	0.03	0.02	0.04
	(2.91)	(2.52)	(1.52)	(3.14)
α_3	-0.19	-0.21	-0.27	-0.15
	(-2.64)	(-2.61)	(-3.49)	(-1.74)
(2) Trade links T				
β_1	-0.11	-0.11	-0.10	-0.13
	(-3.54)	(-4.25)	(-3.99)	(-4.53)
β_2	-0.16	-0.06	-0.23	-0.53
	(-1.04)	(-1.29)	(-1.49)	(-3.21)
(3) Prod. struct.S				
γ_1	0.06	-0.06	-0.03	-0.07
	(0.92)	(-1.29)	(-0.60)	(-1.28)
γ_2	-0.13	-0.09	-0.08	-0.10
	(-4.96)	(-5.60)	(-4.87)	(-5.83)
nb. obs.	251	268	242	265

Notes: All variables measured in logs, except ρ. Variables are averages over 1993-2007. ρ denotes bilateral correlations in GDP on the basis of HP filtered annual data. T is the measure of bilateral trade described in the text. F_{FDI}, F_{PF}, F_{EQ}, F_{DB} are the measures of bilateral financial asset holdings based on respectively foreign direct investment, portfolio investment, equity and debt holdings. S is the measure of similarity in production structure described in the text. All specifications use 3SLS, with instruments details in the main text. T-statistics in parentheses.

Equations:

(1) $\rho_{i,j} = \alpha_0 + \alpha_1 T_{i,j} + \alpha_2 F_{i,j} + \alpha_3 S_{i,j} + \alpha_4 I_{1,i,j} + \varepsilon_{1,i,j}$;

(2) $T_{i,j} = \beta_0 + \beta_1 F_{i,j} + \beta_2 S_{i,j} + \beta_3 I_{2,i,j} + \varepsilon_{2,i,j}$;

(3) $S_{i,j} = \gamma_0 + \gamma_1 T_{i,j} + \gamma_2 F_{i,j} + \gamma_3 I_{3,i,j} + \varepsilon_{4,i,j}$.

Table 5: Channels to business cycle synchronisation (with F measured by FDI)

	Sample		
	Whole	OECD	EU
	Trade channel		
Direct (α_1)	0.05***	0.07**	0.03
Indirect			
via prod. struct. ($\alpha_3\gamma_1$)	-0.03***	-0.04**	-0.01
Overall ($\alpha_1 + \alpha_3\gamma_1$)	0.01	0.02*	0.02
	Prod. struct. channel		
Direct (α_3)	-0.23***	-0.19***	-0.19***
Indirect			
via trade ($\alpha_1\beta_2$)	-0.01	-0.02*	-0.00
Overall ($\alpha_3 + \alpha_1\beta_2$)	-0.25***	-0.21***	-0.19***
	Financial channel		
Direct (α_2)	-0.02	0.02	0.04***
Indirect			
via trade ($\alpha_1\beta_1$)	-0.00*	-0.00	-0.00
via prod. struct. ($\alpha_3\gamma_2$)	0.05***	0.04***	0.02**
Overall ($\alpha_2 + \alpha_1\beta_1 + \alpha_3\gamma_2$)	0.03***	0.06***	0.06***

Notes: The values are computed on the basis of the estimates reported in Tables 2, 3 and 4. ***/**/* denote significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Channels to business cycle synchronisation (with F measured by Portfolio investment)

	Sample		
	Whole	OECD	EU
	Trade channel		
Direct (α_1)	0.04***	0.07***	0.06**
Indirect			
via prod. struct. ($\alpha_3\gamma_1$)	-0.02**	-0.01*	0.01
Overall ($\alpha_1 + \alpha_3\gamma_1$)	0.02*	0.06***	0.07**
	Prod. struct. channel		
Direct (α_3)	-0.26**	-0.17***	-0.21***
Indirect			
via trade ($\alpha_1\beta_2$)	-0.02**	-0.04**	-0.03*
Overall ($\alpha_3 + \alpha_1\beta_2$)	-0.27***	-0.21***	-0.24***
	Financial channel		
Direct (α_2)	-0.01	0.02	0.03**
Indirect			
via trade ($\alpha_1\beta_1$)	-0.00*	-0.01*	-0.01*
via prod. struct. ($\alpha_3\gamma_2$)	0.03***	0.03**	0.02**
Overall ($\alpha_2 + \alpha_1\beta_1 + \alpha_3\gamma_2$)	0.01***	0.04***	0.04***

Notes: The values are computed on the basis of the estimates reported in Tables 2, 3 and 4. ***/**/* denote significance at the 1%, 5%, and 10% levels, respectively.

Table 7: Effects of financial linkages on output correlation - Comparison with alternative set of instruments

	Instruments			
	Schindler (2009)		La Porta et al. (1998)	
Measure of F	F_{FDI}	F_{PF}	F_{FDI}	F_{PF}
	Whole Sample			
Direct (α_2)	-0.02	-0.01	0.01	-0.01
Overall ($\alpha_2 + \alpha_1\beta_1 + \alpha_3\gamma_2$)	0.03***	0.01***	0.02***	0.03***
	OECD Sample			
Direct (α_2)	0.02	0.02	0.05***	0.04***
Overall ($\alpha_2 + \alpha_1\beta_1 + \alpha_3\gamma_2$)	0.06***	0.04***	0.06***	0.05***
	EU Sample			
Direct (α_2)	0.04***	0.03**	0.04***	0.02
Overall ($\alpha_2 + \alpha_1\beta_1 + \alpha_3\gamma_2$)	0.06***	0.04***	0.06***	0.05***

Notes: F_{FDI} and F_{PF} are the measures of bilateral financial asset holdings based on respectively foreign direct investment and portfolio investment. Direct and overall effects are derived as for Tables 5 and 6. ***/**/* denote significance at the 1%, 5%, and 10% levels.

Appendix : List of countries

1. **Whole sample (56 countries):**

   Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Colombia, Costa Rica, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Latvia, Korea, Luxembourg, Malaysia, Malta, Mauritius, Mexico, Netherlands, New Zealand, Norway, Pakistan, Panama, Philippines, Poland, Portugal, Romania, Russia, Slovak Republic, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, United States, Uruguay, Venezuela.

2. **OECD economies (30 countries):**

   Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

3. **EU sample (25 countries)[11]:**

   Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden, United Kingdom.

[11] For data availability reasons, Slovenia and Lithuania have not been included in the panel.