# 2

# Business Cycle Synchronisation: Disentangling Global Trade and Financial Linkages

## 2.1 Introduction

Trade and financial linkages are the arteries through which the lifeblood of the world economy circulates. Does this imply that trade and financial integration increasingly synchronise the 'pulse rates' of modern economies, that is, their business cycles? And how can we disentangle the roles played by trade and financial linkages?

The relationship between economic integration and business cycle synchronisation has drastically gained importance of late, as the global economy witnessed a highly synchronised downturn in response to shock waves emanating from the US. It is widely held that this strong international co-movement can be partly explained by the high degree of economic integration of the world economy. After decades of globalisation, all major economies – including the US and the euro area – are tightly bound together by financial and trade linkages.

Looking ahead, the link between economic integration and output co-movement will also affect the shape of the world economy after the crisis. In particular, it may partly determine whether emerging markets could decouple from conjunctural fluctuations in advanced economies, particularly in the US. Provided that the commitment to open markets by world leaders survives the crisis largely unscathed, decoupling in the midst of a globalising economy may prove illusory.

Against this backdrop, we explore empirically whether economic integration fosters the co-movement of business cycles. Moreover, we disentangle the role played by financial and trade linkages in business cycle synchronisation.

The remainder of this chapter is structured as follows. Section 2.2 presents stylised facts on the relationship between business cycle



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co-movement and linkages in trade and finance, with a special focus on the US and the euro area. Section 2.3 describes the empirical framework underlying our analysis, while Section 2.4 discusses the results. Section 2.5 concludes.

## 2.2 Stylised facts

Over the last decades, globalisation has drastically expanded the real and financial channels through which shocks can be transmitted across countries. Above all, the international exchange of goods and services has increased significantly, with world imports rising from around 20% of world GDP in the early 1980s to around 30% in 2008 (Figure 2.1). In parallel, financial markets have become more intertwined over time, as indicated by surging cross-country capital flows. Foreign direct investment (FDI) stocks, in particular, increased fivefold, from around 6% of world GDP in the early 1980s to 28% in 2007.[1]

These developments not only reflect an intensification of traditional forms of international transactions, but also sweeping changes in the organisation of production. In particular, firms are increasingly participating in global supply chains, as distance costs are plummeting. Such qualitative changes to cross-country linkages are likely to affect the synchronisation of business cycles, too.[2]

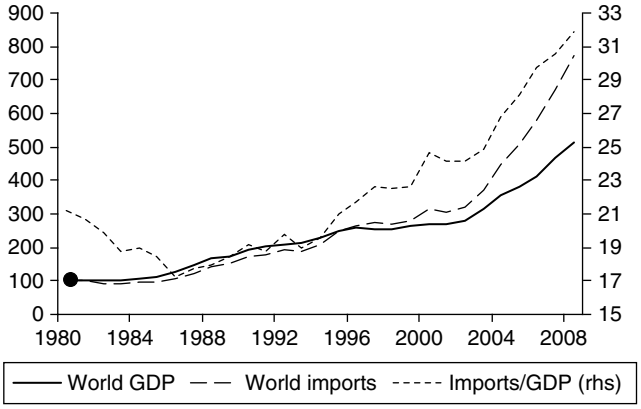


*Figure 2.1* World GDP and world imports (left-hand axis: indices, 1980=100; right-hand axis: percentages; annual data)

*Note*: Last observation refers to 2008.

*Source*: IMF World Economic Outlook database.

### 2.2.1 Trade channel

International trade in goods and services is the traditional channel through which shocks are transmitted from one economy to another. Different countries have a different degree of openness to external trade, and can therefore be more or less vulnerable to trade shocks. The euro area is significantly more open than either the United States or Japan. In fact, its openness in terms of the combined value of imports and exports of goods and services is equivalent (in 2008) to around 55% of its GDP, compared with around 36% and 32% for Japan and the United States, respectively. At any rate, the trade openness of leading world economies has been strongly increasing in the past decade (Figure 2.2).

For a glance at the relevance of the trade on real activity in the euro area, we can look at the interaction between exports, imports, GDP and the net trade contribution to GDP over the last decade (Figure 2.3). Three points seem particularly relevant. First, euro area exports and imports tend to move closely together over the medium term. This might be related to the Feldstein-Horioka puzzle, stating that the robust correlation between saving and investment implies, prima facie, far from perfect capital mobility across countries (see Feldstein and Horioka,

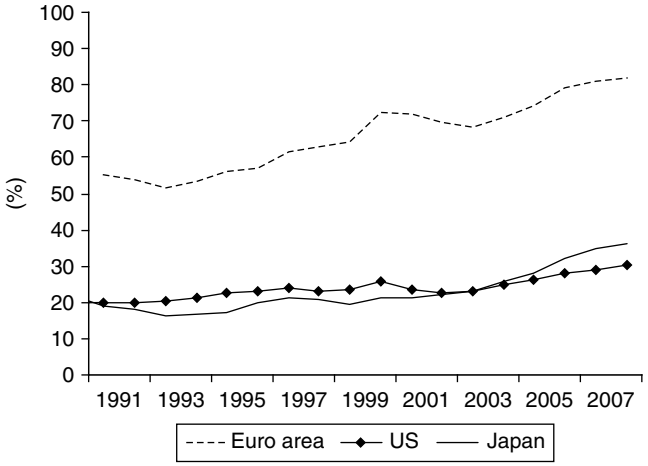


*Figure 2.2* Evolution of the trade openness of the euro area, the United States and Japan (percentage of GDP; annual data)

*Note*: Trade openness is measured as exports plus imports of goods and services as a percentage of GDP. The data for the euro area includes intra and extra trade. Last observation refers to 2008.

*Source*: IMF (World Economic Outlook).

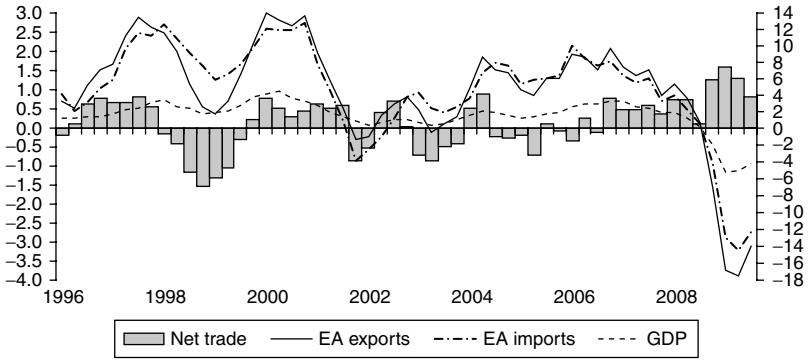


*Figure 2.3* Euro area trade volumes and real GDP (annual growth in percentages; net trade contribution in percentage points)

*Note*: Exports and imports cover goods and services and include intra-euro area trade. Last observation refers to 2009Q3.

*Source*: ECB computations based on Eurostat national accounts data.

1980). Nevertheless, the import-export correlation is not just a mirror of the saving-investment correlation (Bebczuk, 2008). In particular, the tendency of imports and exports to move together is possibly due to a higher share of the production processes being delocalised abroad in order to benefit from lower labour costs, therefore generating additional trade flows partly via an increase in imported intermediate inputs. Second, when considering the contribution of trade to GDP, one must take into account the overall impacts on the economy rather than just the basic net trade contribution, which appears to be rather small. Third, while the spillovers to euro area GDP of the relatively strong export growth appear to have been rather subdued, the dynamics of activity – though less volatile – shares some similarity with the trade ones.

### 2.2.2 Financial channel

Cross-border capital and financial flows represent an increasingly important channel for the international transmission of shocks. During the 1990s, cross-border portfolio financial flows increased in magnitude, stimulated by the liberalisation of financial markets and technological innovations that allowed investors to trade more easily on global markets. Moreover, global competition spurred merger and acquisition (M&A) activities between euro area and non-euro area companies, leading to a considerable increase in FDI.

Looking at its financial account, in net terms, the euro area was an importer of capital during 2002–3 and 2007, while being a net exporter since the beginning of 2008 (Figure 2.4).

Foreign direct investments are not the only form of financial transmission: the financial channel may also operate in a less direct fashion. Financial markets have become increasingly integrated, so that a tightening of financing conditions in one country has therefore repercussions on other countries as well. This will of course have an impact on real activity in each country.

Another important aspect of the financial channel is the role of international bank lending. In periods of financial stress, many banks respond by cutting lending or selling other assets to reduce the size of their balance sheet. This deleveraging process takes on a global dimension through the fall in international bank lending, amplifying the international propagation of financial turmoil. Globalisation has been an important feature in the banking sector. Banks' external claims have shown a strong upward trend rising from USD 10 trillion in 1999 to about USD 35 trillion prior to the financial crisis in the second half of 2008 (Figure 2.5). As a response to capital shortages, several institutions

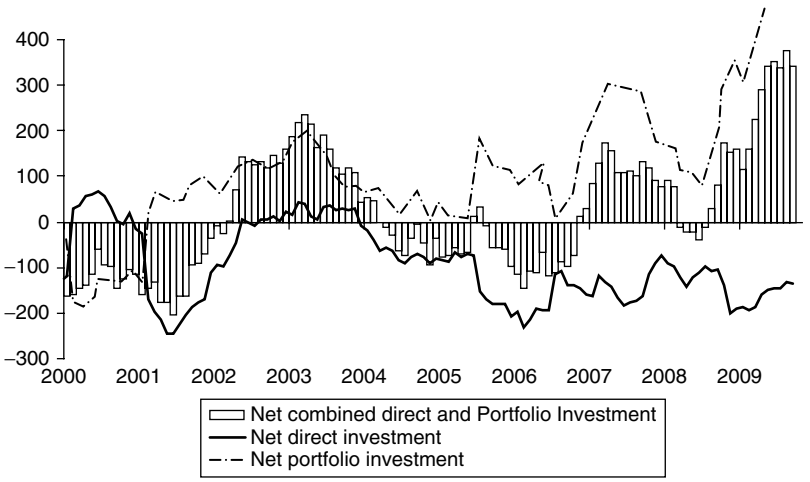


*Figure 2.4* Euro area net direct and portfolio investment flows (EUR billions; 12-month cumulated data)

*Note*: A positive (negative) number indicates a net inflow (outflow) into (out of) the euro area. Last observation refers to September 2009.

*Source*: ECB.

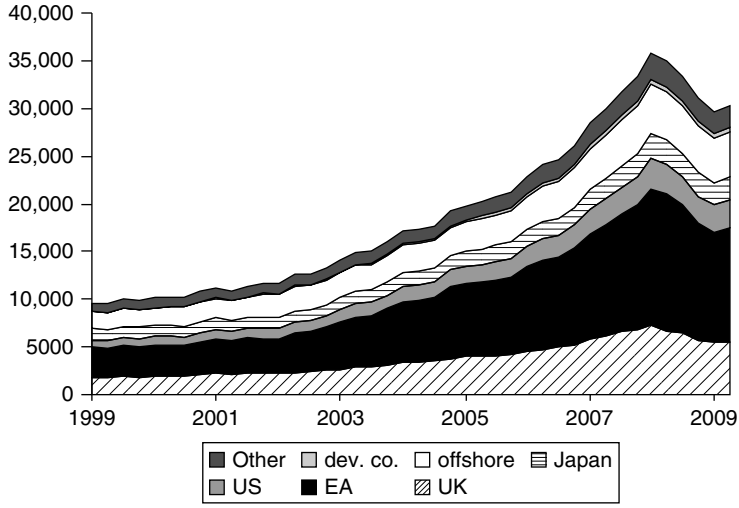


*Figure 2.5* Bank's external claims in major countries (total amount outstanding – stock – in USD billions)

*Notes*: Locational data, based on resident principle. EA includes intra-euro area lending. Last observation: 2009Q2.

*Sources*: BIS and ECB calculations.

cut their external claims, leading to a steep decline in international bank lending.

While Chapter 6 gives more details about the role of global deleveraging in the 2008–9 financial crisis, this episode of financial stress shows how a generalised weakness of the banking sector might have some impact on credit formation, in turn widening the negative impacts of a shock to the real economy.

### 2.2.3 Integration and business cycle synchronisation

All in all, one would expect the business cycles of highly integrated economies to move more closely together. Figure 2.6 provides preliminary evidence for this conjecture (data description in Appendix 2.1). For the sake of simplicity, we focus on the bilateral GDP correlations of selected economies – including most euro area countries – *with the US*.[3] First, it appears that countries trading intensively with the US co-move more with US GDP than others. Second, higher bilateral FDI-related linkages go hand in hand with higher GDP correlations. Third, there is a – rather weak – positive link between the bilateral stocks of portfolio

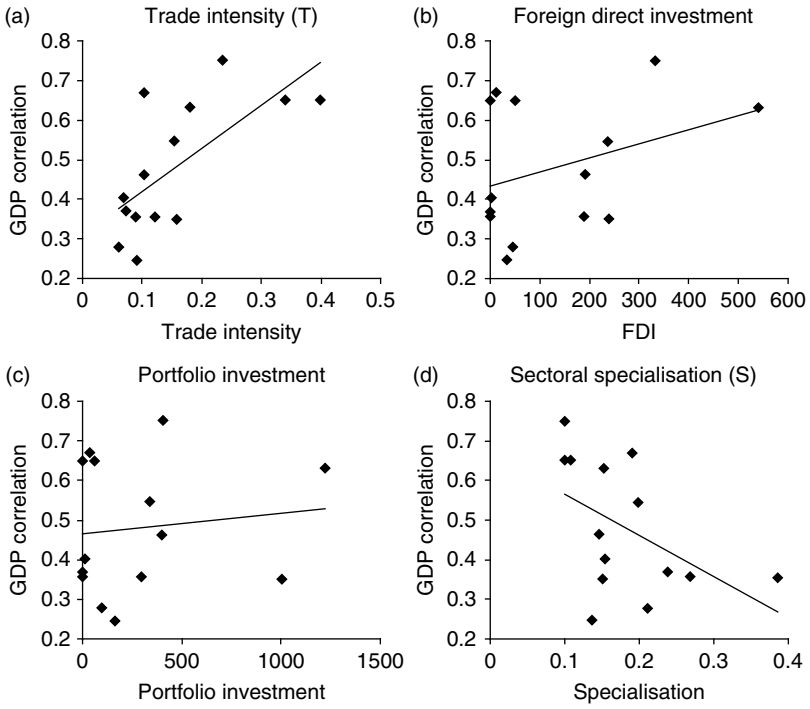


*Figure 2.6* Bilateral GDP correlation with the US and its determinants for selected countries

*Note*: This small sub-sample of 14 countries includes all euro area countries (except Greece, Finland, Ireland and Slovenia) as well as Japan and the UK.

capital and business cycle co-movement. Fourth, if the sectoral specialisation of a country differs significantly from that of the US, the bilateral GDP correlation is lower.

Starting from these stylised facts, we will now investigate more rigorously the relationship between economic integration and business cycle synchronisation. To this end, we expand our sample to 56 emerging and advanced economies.

## 2.3 Literature review

Trade and financial linkages play a significant role in the international transmission of shocks and in business cycle synchronisation. Empirical studies and theoretical predictions, however, give contradictory results.

While empirical research has generally found that pairs of countries with relatively strong trade and financial linkages tend to have more highly correlated business cycles, the theoretical models cannot deliver results that are quantitatively consistent with such empirical findings.

Theoretical models studying business cycle synchronisation are based on the standard international real business cycle model à la Backus et al. (1992). In a two-country open economy model with complete financial markets, these authors 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 of cycles, depending on the nature of trade and the type of shocks hitting the economies. If higher trade linkages foster specialisation, then industry-specific shocks will mostly hit countries specialising in this industry, probably resulting in more idiosyncratic business cycles. On the contrary, if higher trade linkages increase intra-industry trade – implying in particular an increasing amount of vertical or fragmented trade – then the business cycle might be positively associated with stronger trade ties. Other theoretical models are also able to show that intense bilateral trade tends to accompany highly correlated business cycles (Canova and Dellas, 1993).

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

Another explanation for business cycle co-movement is similarity in industrial 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 stochastic developments. Thus countries with similar production patterns will tend to have synchronised economic cycles.

Empirically, higher trade integration increases cross-country output correlations (Clark and van Wincoop, 2001; Frankel and Rose, 1998). Also, most empirical studies show a positive relationship between financial

integration and business cycle synchronisation (see for instance Imbs, 2004, 2006). For Kalemli-Ozcan et al. (2009), however, the positive association between financial integration and business cycle synchronisation is mainly due to not accounting for the effects of country-pair factors and global shocks. Using rich panel data 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), Bower and Guillemineau (2006) and Imbs (2004) all find that countries with a more specialised production structure exhibit output fluctuations that are less correlated with those of other countries.

Overall, the links between trade and financial integration on business cycle synchronisation depend on the type of linkages one country has with another. Accounting for the impact of integration on specialisation is also an important aspect to look at. For instance, Kalemli-Ozcan et al. (2003) show that financial integration causes higher industrial specialisation. The production structure might in turn affect the way trade and financial integration affect output correlations. It is therefore important to consider all the 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 (and consumption) co-movement. To address the possibility of conflicting indirect effects, Imbs (2004, 2006) estimates a system of simultaneous equations to take into account direct and indirect effects on the synchronisation of output. He finds that specialisation patterns have 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.

## 2.4 Framework

If country pairs trade intensively and are tightly bound together by financial linkages, will they exhibit more synchronised business cycles? And how can we disentangle the roles played by trade and financial linkages?

We assess these questions empirically, based on a broad cross section of 56 advanced and emerging countries. Compared to the existing literature, two innovations stand out:[4] First, we also cover financial integration related to FDI, a salient feature of the most recent phase of globalisation. Second, our data sample includes several emerging economies, particularly in Central and Eastern Europe. Both contributions allow us to shed light on the repercussions of vertical integration on the co-movement of business cycles.

Figure 2.7 gives an overview of the estimation framework. Our analysis focuses on three determinants of business cycle co-movement: trade flows, financial links and cross-country differences in sectoral specialisation. The motivation for including the third explanatory variable alongside the two measures of economic integration is straightforward. Countries with similar patterns of sectoral specialisation are more likely to be hit by similar industry-specific shocks. This should make their business cycles more synchronised, all other things being the same.

As can be seen in Figure 2.7, our estimation framework captures a rich set of interactions between the determinants of business cycle synchronisation. This will allow us to disentangle the various channels through which economic integration affects cross-country output correlations.

First, there are *direct* effects of trade, financial linkages and specialisation on business cycle synchronisation (marked by 'a' in Figure 2.7). For instance, closer trade linkages might increase output correlations, because a rise in country A's activity will raise country B's exports to A and, thereby, B's production, resulting in a simultaneous rise in GDP.[5]

Second, we also take heed of *indirect* effects. For instance, higher trade flows may lead to more specialisation in production, which, in turn, can have an impact on output co-movement. This indirect effect of trade on business cycle synchronisation could either amplify or counterbalance

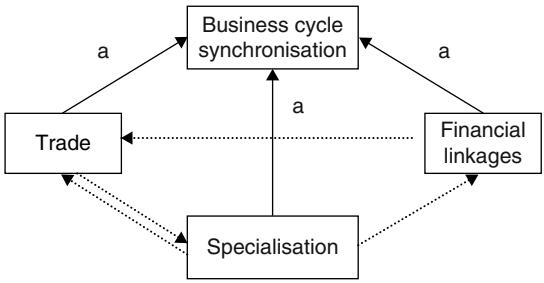


*Figure 2.7* Estimation framework

the direct effect. Hence the *overall* impact of trade integration has to be assessed by combining the direct and the indirect effects. The same applies, of course, to financial linkages and specialisation.

Put differently, the explanatory variables are not independent but rather interact with each other. Therefore, we simultaneously estimate the following system of four equations, following Imbs (2004, 2006):

Direct effects:

$$\rho_{i,j} = \alpha_0 + \alpha_1 T_{i,j} + \alpha_2 F_{i,j} + \alpha_3 S_{i,j} + \alpha_4 I_{1,i,j} + \varepsilon_{1,i,j} \tag{2.1}$$

Indirect effects:

Trade links:

$$T_{i,j} = \beta_0 + \beta_1 F_{i,j} + \beta_2 S_{i,j} + \beta_3 I_{2,i,j} + \varepsilon_{2,i,j} \tag{2.2}$$

Financial links:

$$F_{i,j} = \gamma_0 + \gamma_1 I_{3,i,j} + \varepsilon_{3,i,j} \tag{2.3}$$

Specialisation:

$$S_{i,j} = \delta_0 + \delta_1 T_{i,j} + \delta_2 F_{i,j} + \delta_3 I_{4,i,j} + \varepsilon_{4,i,j} \tag{2.4}$$

Each observation refers to one country pair (i,j).

The coefficients of the first equation will give us the direct effects of, respectively, trade ($T$), financial linkages ($F$) and specialisation ($S$) on bilateral output correlation ($\rho$).[6] The remaining equations (2.2)–(2.4) capture the interaction of the explanatory variables and, thereby, allow us to keep track of the indirect effects on business cycle synchronisation. More specifically, equation (2.2) shows how bilateral trade relationships are affected by financial linkages and the pattern of specialisation. Equation (2.3) gives the effects of trade and specialisation on financial linkages, while equation (2.4) looks at the impact of trade and finance on specialisation. Finally, additional exogenous variables are included in $I_1$, $I_2$, $I_3$ and $I_4$.

To derive the overall (or 'net') effects of, respectively, trade and financial ties on business cycle synchronisation, one has to combine the direct and the indirect effects. To this end, we will ultimately use the

parameters of equations (2.1)–(2.4), to study the overall 'response' of the whole system to increases in trade and financial linkages.

As business cycle synchronisation and the three determinants considered here – trade, financial links and specialisation – form a system of simultaneous equations, simple ordinary-least-squares (OLS) estimation may lead to biased results. To account for this so-called endogeneity problem, we estimate the system (2.1)–(2.4) with three-stage-least-squares (3SLS). More details on this method are left for Appendix 2.1.

## 2.5 Empirical results

In this section, we present the results of our empirical analysis based on a cross section of 56 advanced and emerging economies (which together form 964 country pairs).[7] The following findings stand out:

1. Direct effects (Figure 2.8): In line with conventional wisdom, economies with more intensive trade ties move more closely together. Also, similar patterns of sectoral specialisation lead to closer business cycle co-movement. By contrast, it remains difficult to find a positive, significant relationship between bilateral financial linkages and output correlation.
2. Indirect effects (Figure 2.8): We find that higher trade flows induce specialisation, which, in turn, reduces output correlations. While this effect diminishes the direct effect of trade on business cycle synchronisation, the indirect effects of financial links on specialisation also increase output correlations.
3. Total effects: Making allowance for indirect repercussions, the positive effect of financial integration on business cycle synchronisation is amplified significantly. By contrast, the positive direct effect of

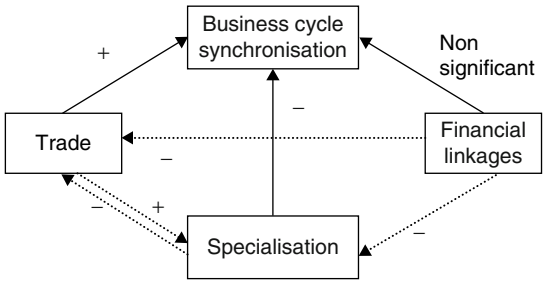


*Figure 2.8* Summary of estimation results

trade is diminished only marginally by indirect repercussions so that its overall effect remains positive.

Our estimation strategy consists of two steps. First, we estimate the system of equations (2.1)–(2.4) simultaneously to explore the direct and indirect effects of trade, financial links and specialisation on business cycle synchronisation. Second, we derive the overall effects, that is, the combination of direct and indirect effects.

### 2.5.1 Step 1: Estimation

As described in the previous section, in a first step we estimate simultaneously the system of equations (2.1)–(2.4). This will give us (a) the direct effects of trade, financial integration and specialisation on business cycle synchronisation, as well as (b) the indirect effects stemming from the interaction of the three determinants. We take up each in turn.

*(a) Direct effects:*

The direct effects – as reported in Table 2.1 – are given by the estimated coefficients from equation (2.1). In a nutshell, the coefficients of trade and specialisation are significant with the expected sign. However, we cannot find any significant relationship between financial integration and output correlations.

In more details, we find first that economies with intensive trade relationships move more closely together than other country pairs

*Table 2.1* Estimation results of equation (2.1) – direct effects

| **Measures of F →**<br>**Right-hand side variables↓** | **FDI** | **Portf. total** |
|---|---|---|
| | Eq. (2.1) – Correlations ($\rho_{i,j}$) | |
| T ($\alpha_1$) | 0.05 | 0.04 |
| | (3.06) | (3.24) |
| F ($\alpha_2$) | –0.02 | –0.01 |
| | (–1.38) | (–1.20) |
| S ($\alpha_3$) | –0.23 | –0.26 |
| | (–4.50) | (–4.81) |
| nb. obs. | 853 | 964 |

*Notes*: All variables measured in logs, except $\rho$. Variables are averages over 1993–2007. All specifications perform 3SLS, with instruments detailed in Appendix 2.1. T-statistics in parentheses.

($\alpha_1 > 0$). This is in line with existing studies, for example, Frankel and Rose (1998), Clark and van Wincoop (2001) and Kose and Yi (2001). Intuitively, if countries A and B exchange goods on a large scale, a rise in country A's activity will raise country B's exports to A and, thereby, B's production, resulting in a simultaneous rise in GDP. To be more specific, an increase in the trade intensity by 1% raises the GDP correlation by about 0.05, depending on the measure of financial integration used.[9]

Second, the direct financial channels ($\alpha_2$) refers in its narrowest definition to the financial integration between economies through cross-border capital and financial flows. While some studies have pointed out a positive relationship between financial integration and business cycle co-movements in the case of advanced economies (Imbs, 2004, 2006), this result runs against the predictions of a standard international business cycle model (Backus et al., 1992) and becomes challenged when it is extended to developing economies (Kose et al., 2003 or Garcia-Herrero and Ruiz, 2008). As shown in Table 2.1, we cannot find a positive, significant relationship between bilateral financial linkages and business cycle correlation. While the absence of direct link between financial linkages and output correlation is in contrast with previous empirical studies, this result might be partly due to the sample of countries chosen. 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 853 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 different from Imbs using a sample that includes many emerging economies. Moreover, Dees and Zorell (2010) show that the choice of financial instruments used to account for endogeneity issues among the dependent variables also explains part of the differences with the empirical literature. The financial instruments used in our estimations rely on measures of de jure restrictions on cross-border financial transactions, provided by Schindler (2009), while Imbs (2004, 2006) uses institutional variables that do not so much relate to cross-border financial transactions, but to the local legal framework in general. Testing for the sensitivity of the results to the financial instrument set, Dees and Zorell (2010) show that the choice of such instruments does matter, since cases with a positive, significant $\alpha_2$ can be found when using the same instruments as Imbs.

Finally, as expected, countries specialising in different sectors of production tend to have less synchronised business cycles ($\alpha_3 < 0$). This result is borne out, for instance, by Kalemli-Ozcan et al. (2001), Bower and Guillemineau (2006) and Imbs (2004, 2006). Countries specialising in different sectors of production are less likely to be hit by the same industry-specific shocks, which should reduce GDP correlations. More specifically, an increase in the measure of specialisation *S* diminishes output correlation by 0.23–0.26, depending on the measure of financial integration used in the estimation.

*(b) Indirect effects:*

Apart from the direct effects on business cycle synchronisation, there is a complex but intuitive interplay between the three determinants (Figure 2.9 and Table 2.2). Taking these indirect effects into account is important, as they may either reinforce or diminish the direct impacts.

To start with, closer trade linkages foster specialisation in different sectors of production ($\delta_1 > 0$). In essence, international trade allows countries to specialise in sectors for which they have a comparative advantage. Since specialisation is related negatively with business cycle synchronisation, this indirect effect diminishes the direct effect of trade on output co-movement. At the same time, similarity in production structures (low *S*) is supportive to trade ($\beta_2 < 0$). This mainly reflects the fact that international trade is particularly intense between similar

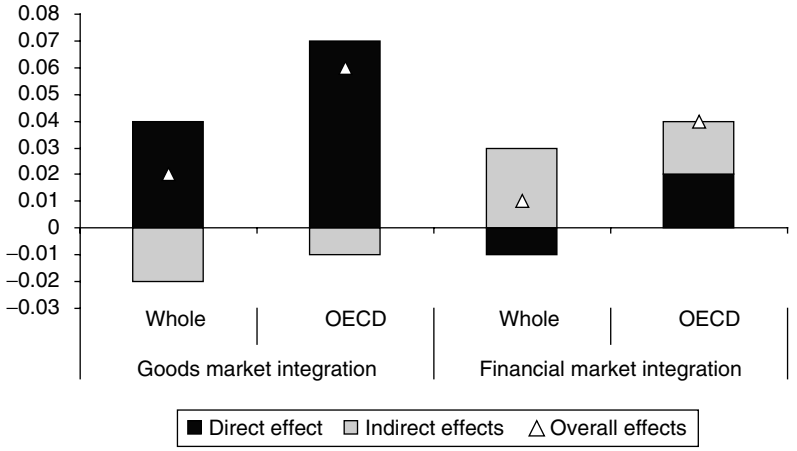


*Figure 2.9* Overall effects on business cycle correlation and breakdown by direct and indirect effects (whole sample and OECD sample)

*Table 2.2* Estimation results of equations (2.2)–(2.4) – indirect effects (whole sample)

| **Measures of F →**<br>**Right-hand side variables↓** | **FDI** | **Portf. total** |
|---|---|---|
| | Eq. (2.2) – Trade ($T_{i,j}$) | |
| F ($\beta_1$) | –0.07 | –0.05 |
| | (–2.18) | (–2.22) |
| S ($\beta_2$) | –0.23 | –0.37 |
| | (–1.55) | (–2.59) |
| | Eq. (2.4) – Specialisation ($S_{i,j}$) | |
| T ($\delta_1$) | 0.14 | 0.07 |
| | (4.56) | (3.65) |
| F ($\delta_2$) | –0.20 | –0.10 |
| | (–8.42) | (–9.31) |
| Nb. obs. | 853 | 964 |

*Notes*: All variables measured in logs, except $\rho$. Variables are averages over 1993–2007. All specifications perform 3SLS, with instruments detailed in Appendix 2.1. T-statistics in parentheses.

countries – especially among advanced economies – due to the importance of intra-industry trade.

Unlike trade, however, financial integration appears to make countries more similar in their production structures ($\delta_2 < 0$). As Imbs (2006) points out, theory provides no clear guidance regarding the expected sign of $\delta_2$. In any case, the negative impact of financial integration on specialisation creates a positive effect of financial linkages on business cycle synchronisation.

Finally, financial integration has a negative impact on trade ($\beta_1 < 0$), thereby indirectly diminishing the positive effect of financial linkages on business cycle synchronisation. The negative impact is stronger if FDI rather than portfolio investment is used to measure financial integration. These results indicate that financial integration would be a substitute for trade integration, especially when it relates to production sharing.

To check whether such conclusions hold with more restricted samples, we also estimate the system (2.1)–(2.4) based on OECD country pairs. As Table 2.3 shows, the results remain qualitatively similar. Interestingly, the negative relationship between financial linkages and specialisation is stronger for the OECD sample than for the whole sample. One explanation could be that financial integration is particularly important between

*Table 2.3* Estimation results of equations (2.1)–(2.4) (OECD sample)

| **Measures of F →**<br>**Right-hand side variables ↓** | **FDI** | **Portf. total** |
|---|---|---|
| | Eq. (2.1) – Correlations ($\rho_{i,j}$) | |
| T ($\alpha_1$) | 0.07 | 0.07 |
| | (3.12) | (4.46) |
| F ($\alpha_2$) | 0.02 | 0.02 |
| | (1.03) | (1.13) |
| S ($\alpha_2$) | –0.19 | –0.17 |
| | (–3.13) | (–2.50) |
| | Eq. (2.2) – Trade ($T_{i,j}$) | |
| F ($\beta_1$) | –0.03 | –0.07 |
| | (–0.62) | (–1.75) |
| S ($\beta_2$) | –0.34 | –0.60 |
| | (–2.00) | (–2.94) |
| | Eq. (2.4) – Specialisation ($S_{i,j}$) | |
| T ($\delta_1$) | 0.19 | 0.08 |
| | (4.43) | (2.97) |
| F ($\delta_2$) | –0.23 | –0.15 |
| | (–6.74) | (–9.16) |
| Nb. obs. | 416 | 421 |

*Notes*: All variables measured in logs, except $\rho$. Variables are averages over 1993–2007. All specifications perform 3SLS, with instruments detailed in Appendix 2.1. T-statistics in parentheses.

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 $\delta_2$ 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.

### 2.5.2 Step 2: Overall effects

So far, we have studied the direct and indirect channels affecting business cycle synchronisation separately (as illustrated by Figure 2.9). Ultimately, however, we are interested in the *overall* (or 'net') effects of – respectively – trade and financial linkages on the co-movement of business cycles. To this end, we now compute the overall effects, using the estimated coefficients of the model.

The system of equations Eq. (2.1)–(2.4) 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. Figure 2.9 illustrates the extent of the overall effects and its decomposition into direct and indirect influences when F is measured with portfolio investment. More details are available in Table 2.4, which reports the values for the indirect channels together with the overall effects.

To start with, we have seen that the direct effect of trade on output correlations ($\alpha_1$) is overall found to be positive and significant. Given the specification of our system, indirect trade effects can only stem from interactions with sectoral specialisation S. We already know that trade integration tends to reduce the similarity in production structure (or increase specialisation). As specialisation in turn reduces output correlation, the indirect trade effect of trade on business cycle synchronisation ($\alpha_3\delta_1$) tends to be negative, countervailing the direct impact. However, the overall effect ($\alpha_1 + \alpha_3\delta_1$) remains positive and significant.

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 Table 2.4, this indirect effect is small and in most cases insignificant. The second indirect effect operates through sectoral specialisation. 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 integration 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. 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, that is, where financial integration induces greater

similarity, which in turn increases the correlation of output. Estimating a similar system for Spain, Garcia-Herrero and Ruiz (2008) also find a positive indirect effect of financial linkages on output synchronisation via specialisation, although this indirect effect is not large enough to compensate the negative direct effect between financial linkages and GDP synchronisation.

Finally, it seems worth noting that we define financial linkages in a very narrow sense, that is, in terms of bilateral asset holdings. Financial integration could be understood in a broader sense, for example, in terms of the mobility of financial flows rather than actual stocks or flows. Also, if financial linkages act through third countries or at the global level, this will not be adequately reflected by bilateral stock data. In this case, the tightening of financing conditions in one country, for instance, may even have repercussions on countries with a relatively low direct financial exposure to this country. In such a framework, financial market integration could also contribute to business cycle synchronisation by 'globalising' shocks rather than as a pure transmission channel.

## 2.6 Conclusion

At the beginning of this chapter we noted – with only little exaggeration – that trade and financial linkages are the lifeblood of the world economy. We asked if this would imply that trade and financial integration synchronise the 'pulse rates' of modern economies, that is, their business cycles. In line with the literature, our empirical analysis provides an intuitive answer: Intensive trade and close financial ties clearly boost business cycle synchronisation.

We also dissected the overall impact of, respectively, higher trade flows and financial integration into direct and indirect effects working through other variables. Notably, while the direct effects of financial integration are found insignificant, they become indirectly significant owing to the repercussions of lower specialisation in production induced by closer financial ties. The positive direct effects of trade integration, however, are slightly diminished by an opposing indirect effect resulting from higher specialisation.

Our empirical analysis has direct implications for the linkages between the US and the euro area. Business cycles in the two areas are highly synchronised (see also Chapter 3). Our regression analysis would suggest that this co-movement could be partly explained by intensive bilateral relationships in both the real and financial spheres.

Moreover, our analysis shows the importance of indirect effects, especially as regards the role of financial integration on similarity in production structure. From a euro area perspective, this is consistent with the fact that a significant part of euro area mergers and acquisitions moved away from manufacturing and towards telecommunications from the late 1990s. In particular, euro area firms have invested heavily in acquiring US technology companies associated with ICT, thereby internalising the knowledge capital of the US economy.[10] Such financial integration between the two economic areas has fostered the catching up of euro area firms with their US counterparts, thereby increasing their similarity and probably strengthening their sensitivity to common shocks.

Overall, this analysis supports the view that the high degree of economic integration between the two regions – and worldwide – at the eve of the global crisis has contributed to the staggering synchronicity of the downturn in late 2008 and early 2009.

What do our findings imply for the medium-term prospects of the global economy? At the current juncture, in the midst of a severe economic crisis, fears of a protectionist spiral and de-globalisation haunt the world economy. Cross-border holdings of financial assets have dwindled amid a flight to safety and widespread repatriation of funds. Moreover, worrying signs of increasing protectionist pressures have emerged across the globe. Our empirical analysis suggests that a retreat of globalisation would weaken the synchronisation of business cycles in the future – in the US, the euro area and beyond. This could come on top of another source of de-synchronisation: The unwinding of global imbalances and deleveraging in some regions of the world (see Chapter 7). If, however, policy-makers avoid succumbing to economic nationalism and if investors resume prudential cross-border financial transactions, 'Globalisation 2.0' might somewhat counterbalance the side-effects on business cycle synchronisation exerted by the global readjustment process.

## Appendix 2.1

### List of countries

Full 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,

Luxembourg, Malaysia, Malta, Mauritius, Mexico, Netherlands, New Zealand, Norway, Pakistan, Panama, Philippines, Poland, Portugal, Romania, Russia, Slovakia, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, United States, Uruguay and Venezuela.

**Data description**

The dependent variable in our regressions is the pairwise GDP correlation coefficient. GDP data (HP filtered), in PPP terms, cover the period 1993–2007 and are taken from the IMF's WEO database.

All endogenous explanatory variables, except for the specialisation index *S*, relate to economic integration, measured on a de facto basis. Starting with goods market integration, we follow Imbs (2006) and make use of Deardorff's (1998) indicator:

$$T_{i,j} = \frac{1}{T}\sum_{t}\frac{(EX_{ij,t} + IM_{ij,t})\,NYW_{t}}{NY_{i,t}\,NY_{j,t}} \tag{2.5}$$

Here, $EX_{ij,t}$ and $IM_{ij,t}$ denote total merchandise exports and imports, respectively, from country i to country j. Furthermore, $NYW_{t}$ stands for world nominal output, while $NY_{i,t}$ and $NY_{j,t}$ denote nominal GDP in countries i and j, respectively. Data on bilateral goods trade are extracted from the IMF's Direction of Trade Statistics, nominal GDP data from the IMF's WEO database (all in US dollars). In the benchmark regression, we use data averaged over 1995–2007.

Furthermore, we make use of several alternative measures of financial linkages. The first measure relies on bilateral FDI holdings, that is, the sum of country i's direct investment stocks in country j and country j's assets in country 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. We average observations over 2000–6.

The second measure of financial linkages, in terms of portfolio investment, is defined analogously and based on the IMF's CPIS database. For our estimation, we average available observations (expressed in US dollars) over the period 2001–6.

Similarities in the production structure are captured by $S_{i,j}$,

$$S_{ij} = \frac{1}{T}\sum_{t}\sum_{n}^{N} |S_{n,i} - S_{n,j}| \tag{2.6}$$

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 completely symmetric, then $S_{i,j} = 0$. We use UNIDO data on sectoral gross value added (in 1990 US dollars) at the one-digit level, averaging observations over 2000–7.[11]

We turn now to a description of the exogenous variables and instruments used in our analysis. In the trade equation (2.2), $I_2$ 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 patterns of specialisation 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). Covering the period 1995–2005, 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, for example, the maximum of outward restrictions in country i on the one hand and inward restrictions in country j on the other hand.

It should be noted that $I_2$ and $I_4$ are distinct sets of variables. This is necessary for the identification of the system (2.1)–(2.4), as shown by Imbs (2004).

All in all, our full sample comprises 56 countries (see the list above), of which 27 are considered as emerging or developing economies and 29 as advanced economies. The latter group includes the US and 25

EU countries. Taking into account missing observations, we arrive at a maximum of 728 country pairs for the whole sample.

**Estimation method: Three-stage-least-squares (3SLS)**

As already indicated in the main text, the three-stage-least-squares (3SLS) method is used when endogenous variables are correlated with error terms and the error terms are correlated across equations. It is tantamount to the two-stage-least-squares (2SLS) approach followed by a Seemingly Unrelated Regression (SUR).

More specifically, the 3SLS estimator is obtained by carrying out three steps. The first stage is identical to the 2SLS procedure: Instruments for the endogenous regressors are computed as the predicted values of an ordinary-least-squares regression of each endogenous regressor on all exogenous regressors. In the second stage, the 2SLS estimator for each equation is computed and the residuals are used to obtain an estimate of the covariance matrix of the error terms of the simultaneous equations model. In the third stage, the estimate of the covariance matrix of the error terms is used to calculate the generalised least-squares estimator and an estimate of its covariance matrix.

As argued by Imbs (2004), this procedure is perfectly adapted to our needs since it combines the features of simultaneous equations procedures, while allowing for the possible endogeneity of some dependent variables.

**Details on the computation of overall effects**

*Table 2.4* Channels to business cycle synchronisation

| **Sample** | **Whole** | **OECD** |
|---|---|---|
| | Trade channel | |
| Direct effect ($\alpha_1$) | 0.04*** | 0.07*** |
| Indirect effect ($\alpha_3\delta_1$) | –0.02*** | –0.01* |
| Overall effects ($\alpha_1 + \alpha_3\delta_1$) | 0.02* | 0.06*** |
| | Financial channel | |
| Direct effect ($\alpha_2$) | –0.01 | 0.02 |
| Indirect effect via trade ($\alpha_1\beta_1$) | –0.00* | –0.01* |
| Indirect effect via spec. ($\alpha_3\delta_2$) | 0.03*** | 0.03** |
| Overall effects ($\alpha_2 + \alpha_1\beta_1 + \alpha_3\delta_2$) | 0.01*** | 0.04*** |

*Notes*: The values are computed on the basis of the estimates reported in Tables 2.1, 2.2 and 2.3. ***/**/* denote significance at the 1%, 5%, and 10% levels, respectively. F is measured in portfolio investment terms, but the estimates based on FDI would give similar results.

## Notes

1. Sources: IMF WEO database (trade, GDP), UNCTAD World Investment Report 2008 (FDI).
2. For a theoretical model on the link between vertical specialisation and business cycle synchronisation see Burstein et al. (2008).
3. (Our subsequent regression analysis will cover a far larger sample, including more countries and all bilateral correlations.)
4. For closely related papers see, for instance, Garcia-Herrero and Ruiz (2008), Imbs (2004, 2006) and Abbott et al. (2008).
5. In a saving-investment perspective, if global savings are unchanged an investment-led increase in activity in country A should be counterbalanced by a decline in investment in the rest of the world (although not necessarily in country B). This effect might somewhat dampen the direct effects.
6. A detailed description of the data and measures used can be found in Appendix 2.1.
7. A country list can be found in Appendix 2.1.
8. We have also conducted the same estimation using several subcomponents of portfolio investment (equities, short-term debt and long-term debt). The results are broadly in line with those based on total portfolio holdings and therefore not reported here.
9. It should be noted that the trade intensity measure used in our estimation corrects for the size of the economies. Hence an increase in $T$ by 1% is not tantamount to an increase in trade flows by 1%.
10. For further analysis of the knowledge-seeking motive behind euro area FDI to the US in the second half of the 1990s, see De Santis et al. (2004).
11. There are 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).

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