The Few Leading The Many: Foreign Affiliates and Business Cycle Comovement

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This paper argues that the correlation of business cycles across countries is largely due to linkages between multinational firms and their foreign affiliates. There are very few foreign affiliates in France, but they contribute considerably to aggregate economic activities. We exploit the heterogeneity in the presence and origin of foreign affiliates across French regions to identify their impact on comovement. We find a positive impact of foreign affiliates' presence on the comovement of business cycles between their regions of location and their countries of origin. This effect is not primarily driven by foreign affiliates' trade with their countries of origin.

An extensive literature in international economics searches for the key forces driving the propagation of shocks and the comovement of economic activities across countries. The empirical literature has listed many potential candidates which include trade and financial integration, sector specialization, or geography.[1] Surprisingly, the role of multinational firms and their cross-border network of affiliates has received less attention.[2] It is however a potentially important factor as shocks are likely to propagate along the cross-country networks of multina-

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[1] See di Giovanni and Levchenko (2010) for a discussion of the role of trade in the synchronization of real business cycles. A discussion of the role of financial integration is provided in Kalemli-Ozcan, Papaioannou and Peydro (2009). See also Imbs (2004) for an investigation of the role of specialization and Clark and van Wincoop (2001) for an analysis of the role of distance in business cycle comovement.

[2] One particularly interesting study is Burstein, Kurz and Tesar (2008), which provides evidence of the role of trade in inputs within U.S. multinationals (used as a measure of production sharing) on the comovement of activities. In a theoretical paper, Zlate (2010) points to the transmission of economic shocks through offshoring. Bergin, Feenstra and Hanson (2009) show the impact of offshoring by U.S. multinationals on the volatility of employment in Mexico.

tional firms. Moreover, multinational firms and their foreign affiliates make up a large fraction of economic activities (Helpman, 2011). They might therefore have a meaningful economic effect on aggregate outcomes and strengthen economic linkages between countries.

In this paper, we analyze the effects of foreign affiliates on the comovement of business cycles across countries. We explore this question using a unique database which combines information on the the balance sheet, the ownership, and the countries of origin of all firms located in France, and their bilateral (arm's-length and intra-firm) trade with foreign partners.[3] We document that the activities of foreign affiliates are unevenly distributed across French regions and depend on their countries of origin. We exploit this heterogeneity to identify the effect of foreign affiliates on business cycle comovement. We aggregate the data at the regional level and, for each country of origin, we construct the share of foreign affiliates in regional employment and in arms-length and intra-firm trade. We match the data to a large cross-section of bilateral pairs of correlations between the GDP growth rates of French regions and 162 countries computed for the 1990 to 2006 period.

Our main finding is that the presence of foreign affiliates has a positive and significant impact on business cycle comovement between the affiliate's region of location and its parent country. This finding is robust to the introduction of the main driving forces of comovement listed in the literature (bilateral trade, similarities in industrial structure, and intra-industry trade), as well as to the inclusion of country and region fixed effects. Moreover, we perform and report an extensive set of sensitivity checks that confirm our main results. The sensitivity checks include controlling for: bilateral distance and common borders, spatial effects, common historical ties, and changes in the sample and the definition of the main variables.

The magnitude of the effect of foreign affiliates' presence on business cycle comovement is economically meaningful. Based on our econometric results, a quantification exercise shows that the level of comovement between regions and countries decreases on average by 16 percent without the presence of foreign affiliates.

We develop a simple theoretical framework to guide our empirical analysis. Two conditions are necessary to generate real business cycle comovement. First, foreign affiliates must contribute to a non-negligible share of the economic activities in the regions where they locate. Their impact on business cycle comovement thus depends on their contribution to real economic activities rather than on investment flows or investment stocks. Second, the growth in value added between the parent firm and the foreign affiliates must be positively correlated. We discuss two different mechanisms that can explain this positive correlation, namely the transfer of intangible inputs and vertical integration.[4] We show that the effect of

[3]The data cover firms in the manufacturing, extractive, and agricultural industries.

[4]See Helpman (2014) and Markusen (2002) for the transfer of intangible inputs and Burstein, Kurz

foreign affiliates is not systematically driven by intra-firm trade (used as a proxy of vertical integration).[5] This suggests that the transfer of intangible inputs recently emphasized by Atalay, Hortacsu and Syverson (2014) and Ramondo, Rappoport and Ruhl (2011) may have important implications for business cycle comovement.

This article contributes to the literature on business cycle comovement in several respects. A few empirical papers have focused on the role of foreign direct investment on business cycle correlation (Jansen and Stokman, 2006; Hsu, Wu and Yau, 2011).[6] Instead of measuring the activities of foreign affiliates by using foreign direct investment, we use their real activities as suggested by the theory.

Many papers have found evidence that more bilateral trade between countries leads to more business cycle synchronization (Frankel and Rose, 1998; Baxter and Kouparitsas, 2005; Kose and Yi, 2006; Calderon, Chong and Stein, 2007; Inklaar, Jong-A-Pin and de Haan, 2008). A few papers have advocated the specificity of intra-industry trade (Imbs, 2004), trade in intermediate inputs (di Giovanni and Levchenko, 2010; Ng, 2010), or production sharing between countries (Burstein, Kurz and Tesar, 2008). We find that the effect of trade has approximately the same magnitude as the effect of the share of foreign affiliate employment. Furthermore, the overall effect of bilateral trade drops when we control for the activities of foreign affiliates.

On the theoretical side, Backus, Kehoe and Kydland (1992) show that bilateral trade alone cannot explain the cross-border comovement of activities in international real business cycle models. Subsequent works by Ambler, Cardia and Zimmermann (2002), Arkolakis and Ramanarayanan (2009) and Johnson (2012) reach the same conclusion from models integrating input trade into the analysis. Our empirical findings suggest that the network of multinational firms offers a simple explanation for the transmission and/or the correlation of productivity shocks across borders.

The paper is also related to a new strand of the literature pointing to the specific behavior of large firms and their role in aggregate *fluctuations* (Gabaix, 2011; di Giovanni and Levchenko, 2012; di Giovanni, Levchenko and Méjean, 2014).[7] We document that large firms differ in terms of their ownership structure from smaller firms. We then provide evidence that these few, large foreign affiliates give rise to (aggregate) business cycle *co-fluctuations*.

The remainder of this paper is structured as follows. Section I provides an illustrative framework to guide the empirical analysis. Section II describes the

and Tesar (2008) and Tesar (2008) for vertical integration.

[5]The role of multinational firms in comovement is not explained by the share of these firms in total trade either.

[6]The evidence provided by Desai and Foley (2004) is also telling. They document the micro comovement of the rates of returns and investments between U.S. multinational parents and their affiliates. In on-going work, Cravino and Levchenko (2014) extend the micro-analysis of Desai and Foley (2004) to multiple countries and draw implications for the transmission of international business cycles.

[7]Parallel contributions point to striking heterogeneity in the behavior of large and small firms (Moscarini and Postel-Vinay, 2009; Goldberg and Hellerstein, 2009; Mansfield, 1962; Shimomura and Thisse, 2009; Parenti, 2012). Neary (2009) suggests that these superstar firms are (domestic or foreign) multinationals.

data. Section III presents key stylized facts. Section IV describes the empirical methodology. Section V presents the econometric results and a series of robustness checks. Section VI concludes.

I. Illustrative Framework

A breakdown of business cycle comovement. — We consider two economies c and r.[8] International business cycle comovement between c and r is measured by the correlation of GDP growth (ρ_{rc}) across countries and regions.

$$\rho_{rc} \equiv cov\left(\Delta gdp_{rt}, \Delta gdp_{ct}\right) / (\sigma_r \sigma_c) \tag{1}$$

where Δ is the first-difference operator, gdp_{it} is the logarithm of the real GDP of economy i at date t, and σ_i is the standard deviation of Δgdp_{it}.

By definition, the GDP is the sum of firms' value added in the economy. GDP growth is thus a weighted average of individual growth rates:

$$\rho_{rc} = \frac{1}{\sigma_r \sigma_c} \sum_{f \in F_r} \sum_{f' \in F_c} w_f^r w_{f'}^c cov\left(\Delta v_{ft}, \Delta v_{f'(c)t}\right) \tag{2}$$

where v_f is the value added of firm f, F_r and F_c are the set of firms in economies r and c respectively, and w_f is the weight of firm f in the value added of the economy.

Equation 2 shows that the comovement of economic activities is driven by individual comovement between firms and the weight of these firms in economic activities. From this equation, we see that multinational firms (say parent firms in c and their affiliates in r) may contribute to the positive comovement of activities between c and r if i) the value-added growth of parents and their affiliates is positively correlated, and ii) the parents and their affiliates account for a non-negligible share of activities. The next section proposes a simple model to understand the positive correlation between the value added of the parent and its foreign affiliates.

Changes in value added at the firm level. — We assume that a firm f has a Cobb-Douglas production function of the form:

$$Y_{ft} = \left(A_{ft} N_{ft}\right)^{1-\theta} M_{ft}^{\theta}$$

[8] As will become clearer in the empirical analysis, we study the comovement of activities between French regions r and foreign countries c.

where N_{ft} is a composite of factors of production (a sub Cobb-Douglas with capital and labor for instance) and M_{ft} is the bundle of intermediate inputs used in the production process. The share of intermediate inputs used in the production is $\theta = \frac{c_{ft}M_{ft}}{p_{ft}Y_{ft}}$ where c_{ft} is the price of inputs paid by firm f at date t and p_{ft} is the production price charged by firm f at date t (an increasing and concave function of the marginal costs). We define real value added as: $V_{ft} \equiv Y_{ft} - \frac{c_{ft}}{p_{ft}}M_{ft}$.[9] The change in value added at the firm level can be written as:

$$\Delta v_{ft} = \Delta b_{ft} + \Delta a_{ft} + \Delta n_{ft} \tag{3}$$

where the lower-case variables are the logarithm of the variables with capital letters and $B_{ft} = (1-\theta)\left(\frac{p_{ft}}{c_{ft}}\theta\right)^{\frac{\theta}{1-\theta}}$. Changes in value added are driven by changes in productivity (a_{ft}), changes in the use of production factors (n_{ft}), and changes in the price of inputs (through b_{ft}).

In what follows, we discuss the conditions under which productivity is transmitted across economies and generates aggregate comovement through multinational firms. For the sake of clarity, we focus on the transmission to economy r of shocks originating in economy c.

Comovement between related parties. — We define a multinational company as a company which has ownership control on firms in the two economies, r and c. For instance a firm f' in country c has a foreign affiliate f located in r. The covariance of value added between the two parties is:

$$cov(\Delta v_{f't}, \Delta v_{ft}) = cov(\Delta b_{f't} + \Delta a_{f't} + \Delta n_{f't}, \Delta b_{ft} + \Delta a_{ft} + \Delta n_{ft})$$

We identify two sources of comovement between related parties. First, productivity shocks can be transferred across units of a multinational firm:

$$cov(a_{f't}, a_{ft}) > 0$$

This is consistent with the recent theory of multinational firms which examines the ability of multinationals to geographically separate the services of knowledge-based and knowledge-generating activities from production, such as R&D and management know-how (Helpman, 2014; Markusen, 2002). These knowledge-based services have a (partial) joint-input characteristic which means that they can be supplied to additional production facilities at a low cost and affects the productivity and size of the foreign affiliates.[10] The shocks transmitted across

[9] See Bruno (1984) for instance. We obtain that: $V_{ft} = (1-\theta)\, Y_{ft}$.

[10] The literature proposes different types of intangible transfers: knowledge capital (Markusen, 1984),

affiliates can be specific to the firm or common to all firms in the country of location.[11]

Second, if related parties trade inputs (say firm f' exports inputs to its affiliate f), the correlation in value added may be driven by a transmission of productivity shocks through the price of imported inputs:

$$cov(a_{f't}, n_{ft}) > 0$$

This source of correlation is consistent with Burstein, Kurz and Tesar (2008) who have shown that production sharing - measured by intra-firm trade - is an important determinant of business cycle comovement. Once again, the shocks affecting the productivity of firm f' can be firm- or country-specific.[12]

Aggregate comovement and multinational firms. — We discuss how shocks originating in economy c can generate comovement between c and r due to the presence of multinational firms. We define four sets of firms. The set of pairs of related firms from c and r (S_{rc}), the set of multinational firms in economy r (MNE_r), the set of pairs of related firms trading inputs (T_{rc}), and the set of multinational firms in economy r purchasing their good from related parties in c ($ImpMne_r$). We further specify the structure of shocks affecting firms in c, and their link with comovement. The productivity growth of a firm f' in c is: $\Delta a_{f't} = \gamma^c_{f't} + \gamma_{ct}$. The growth of value added of a firm f located in r with a parent in c is $\Delta a_{ft} = (\alpha + \beta)\left(\gamma^c_{f't} + \gamma_{ct}\right)$ if it is related to firm f' through common ownership and trade in inputs ($\beta = 0$ in the absence of trade in inputs) and zero otherwise. The terms $\gamma_{f't}$ and γ_{ct} are the firm- and country-specific shocks. The parameter α can be interpreted as the share of affiliates' productivity which is driven by the parent's productivity. The transmission also depends on β which captures the sensitivity of imported input prices to productivity shocks. The variance of firm-specific shocks is common across firms and equal to σ_{id}, and the variance of country-specific shocks is σ_a.

technology capital (McGrattan and Prescott, 2009), and managerial ability (Bloom and Van-Reenen, 2007; Garicano and Rossi-Hansberg, 2006). For instance, Burstein and Monge-Naranjo (2009) show the importance for output and welfare of the reallocation of management know-how across countries through the control of production abroad.

[11] For instance, Toyota Motor France argues that the efficiency of its French plant is due to the application of the *Toyota Production System*, a concept developed in Japan. This concept combines Japanese methods such as the just-in-time system with methods that are more specific to Toyota like *Jidoka*, a process that limits the transmission of problems along the production chain). The firm also emphasizes the importance of *Kaizen* which corresponds to the continuous improvement of the efficiency of its plants in Japan and abroad. $http : tmmf.toyota - europe.comtps$.

[12] Note that even in the presence of intra-firm trade, this channel might be mitigated by the nature of trade between the two parties. The intra-firm prices are transfer prices. It may well be that for fiscal reasons, the parent decides to lower its profits in the destination country and therefore avoids transmitting the positive shocks.

$$(4)\quad \rho_{rc} = \frac{\sigma_{id}}{\sigma_r \sigma_c}\left(\alpha \sum_{(f,f')\in S} w_f^r w_{f'}^c + \beta \sum_{(f,f')\in T} w_f^r w_{f'}^c\right) + \frac{\sigma_a}{\sigma_r \sigma_c}\left(\alpha \sum_{f\in MNE} w_f^r + \beta \sum_{f\in ImpMNE} w_f^r\right)$$

Aggregate comovement may arise through the transfer of idiosyncratic shocks (the first two terms of eq. 4). In that case, the weights of the related parties in both c and r matter. If the related parties in both countries are sufficiently large, then shocks to their productivity have an impact on aggregate comovement.

Aggregate comovement may also be the consequence of country-specific shocks (the last two terms of eq. 4). The importance of this channel depends on the weight in economy r of firms with related parties in economy c, and the sensitivity of firms in r to shocks to their related party in c. If their weight is sufficiently important, they will affect aggregate comovement.[13]

Implications for the empirical analysis. — The model shows that the effect of foreign affiliates on comovement depends on their weight in the economic activities of the regions of location. In the empirical analysis below, we precisely measure the share of foreign affiliates in the economic activities of French regions. While the literature focuses on the share of intra-firm trade in total trade to measure the effect of production sharing, our model suggests computing the economic contribution of foreign affiliates engaged in intra-firm trade (as well as the share of inputs imported from their parent - which we cannot observe).

As the database does not contain information on the size of the related parties in country c (we cannot observe $w_{f'}^c$), we focus on the presence of affiliates located in region r with a parent from country c ($\sum_{f\in MNE} w_f^r$). Using this proxy allows us to capture the average impact of multinational firms on comovement. The lack of information on the related parties that are located outside France prevents us from identifying whether the shocks are idiosyncratic or country-specific.

II. The Data

Analyzing the correlation between business cycle comovement and foreign affiliates requires precise information on the location and the economic activities of firms in France and on the link between the foreign parents and their affiliates. Our data set is based on the aggregation of five confidential micro-level databases that are provided by different French administrations. It describes value added, employment, and sales in French regions, as well as these regions' bilateral exports to and imports from 162 partner countries (with a distinction between intra-firm trade and arm's-length trade of foreign affiliates) in the manufacturing, extractive, and agricultural industries. Within regions, this information is

[13] Notice that in that case, the comovement does not depend on the weight of firms in c since all firms in c are impacted by the aggregate shock, by definition.

disaggregated based on the ownership status of the firm. Namely, we distinguish the economic activities of independent firms, affiliates of French multinationals, and foreign affiliates, i.e. the affiliates of foreign multinationals. The data are matched to a cross-section of bilateral correlations of business cycles between 21 Metropolitan French regions and 162 countries. We briefly describe the main traits of our database in the next paragraphs. A limitation of the data is that they do not provide information on the activities of firms *located* outside France. These affiliates are a source of comovement between France and their countries of location that cannot be accounted for. We give more details on the data and data processing in the Online Appendix.

To appreciate the size of the activity of foreign affiliates in France, we need data on sales, value added and employment. This data is taken from the *BRN* database (Bénéfice Réel Normal). The BRN is a compulsory report for all firms that have an annual turnover of more than 763,000 euros. In order to identify the ownership status of the firms, we use the *LIFI* data which is an administrative data set on the ownership and nationality of the parent company of firms located in France (LIaison FInancière).[14] According to the French statistical institute (INSEE), a firm is an affiliate of a group if the latter has the (direct or indirect) majority of voting rights. In our data, the share of voting rights owned by the parent firms varies from 50 percent to 100 percent. While the average share of voting rights is 86 percent, the median is 99 percent. We can therefore expect the parent company to exert a control on the decisions of the majority-owned affiliates. Moreover, having majority-owned affiliate ensures that the parent company is located in exactly one country. We classify firms based on their nationality. A French affiliate, which we denote by MNE, is located in France and owned by a French group. We denote the foreign affiliates by FME, which are located in France and owned by a foreign group. We also keep track of their nationality whenever they are foreign-owned. The residual group of firms is denoted by IND. It is composed of firms that are located in France, but that are not majority owned by a group.

LIFI also has information on the main sector of activity of the parent and the affiliates at the 4-digit level. This allows us to identify whether the affiliates in France are in the same sector as their parent and gives us a crude method to distinguish between vertical and horizontal production networks (Buch et al., 2005; Ramondo, Rappoport and Ruhl, 2011; Alfaro and Charlton, 2009). Moreover, we have precise information on foreign affiliate trade. We use the EIIG firm-level survey (Échanges Internationaux Intra-Groupe) from the INSEE which provides a detailed geographical breakdown of the trade value of French firms at the product level (HS4) and their sourcing modes – arm's-length trade or intra-firm trade.

[14] All firms with more than 500 employees, or having a yearly turnover greater than 30 million euros, or having more than 1.2 million euros of shares in other firms are asked about their ownership and financial structure. This includes their links with small businesses, which allows us to have information on small foreign affiliates. The INSEE further completes this survey with another data (DIANE) which increases its coverage.

The data are more precise than the data provided by the Bureau of Economic Analysis since we have information on arm's-length trade of foreign affiliates in France. In addition, we can identify through the product dimension whether the exports of a French affiliate to its country of origin are in intermediate inputs.

Data on bilateral exports and imports of firms located in France are provided by the French Customs. In 2004, 15 percent of the total number of registered firms were involved in foreign trade (exports, imports or both). Yet the participation of firms to foreign trade differed to a great extent with their ownership structure and nationality. Among the three categories of firms defined above, the group of independent firms was far less internationalized than the group of affiliates of French firms. While we only find 9.6 percent of the total number of independent firms that were trading, there were respectively 36 percent of French affiliates and 78 percent of foreign affiliates that participated to foreign trade.

A firm located in France might have branches in different regions. When it comes to filling out the BRN or the Customs forms, the value added, sales or trade values are always allocated to the region of location of the headquarters. We follow the INSEE methodology and reallocate the value added, sales and trade of multi-plant firms across regions on the basis of employment measured at the branch level.[15] The statistics are then aggregated to the level of the Metropolitan French regions for each year between 1999 and 2004.

Each cross-section is then combined with a vector of correlation of the business cycles between a French region r and a partner country c. We construct the correlation between each of the 21 regions and 162 partner countries over the 1990-2006 period.

The data on regional GDP are taken from the INSEE while the data on national GDP are taken from the World Bank. The database is completed with the total exports and imports of the partner countries that we take from the Direction Of Trade Statistics (DOTS).

III. The Key Role of Foreign Affiliates

We document four sets of facts on the contribution of multinational firms to economic activities, the linkages with their parent countries, and their location across regions. We also show the heterogeneity in the correlation between the GDP growth of French regions and their partner countries.

FACTS I: THE FEW LEADING THE MANY. — It is well documented that multinational firms represent only a tiny fraction of the total number of firms. We show that the foreign affiliates of multinational firms contribute substantially to the economic

[15] In our sample, only 1.8 percent of firms are multi-plant and multi-region. Yet these firms account for 9.8 percent of total employment. Note that this is not a big issue since, in our main specification, we measure foreign affiliates presence through employment, which is provided at the branch level.

activities of their host regions. As shown in our framework, this is a necessary condition for foreign affiliates to impact business cycle comovement.

In Table **??**, we provide a regional breakdown of the yearly contribution of independent firms, French affiliates, and foreign affiliates for six different outcomes: number of firms, employment, sales, value added, exports, and imports. A striking feature of Table **??** is the disproportionate role of affiliated firms - foreign affiliates in particular - in aggregate outcomes.

– Table **??** about here –

About 30 to 70 percent of the largest (top1 percent) firms are foreign-owned. Less than 10 percent are independent. By contrast, the remaining group of small firms is mostly made up of independent firms and the share of foreign affiliates is never greater than 10 percent.[16]. This fact suggests not only that firms are different with respect to their size and that a few firms are sizably larger than other firms, but that they are also different in terms of their ownership structure. A change in foreign affiliates' output or trade activities will directly affect regional GDPs. Adding indirect effects, through the link to local suppliers and customers, the impact of foreign affiliates would probably be even larger. It is worth stressing that within the group of foreign affiliates, economic activities are concentrated in the hands of a very small number of firms (see additional statistics on this in the Online Appendix).

In Figure 1, we investigate the ownership breakdown of the share of value added among the largest 1 percent of firms. We also show figures on the composition of firms in the remaining sample, once we exclude the top 1 percent firms.

– Figures 1 about here –

Foreign affiliates and French affiliates account for the vast majority of employment, sales and trade, while they represent very few firms (5.2 percent of firms are FMEs and 17.2 percent are MNEs). French affiliates account for more than 41 percent of employment, sales and value added and more than one third of trade. Foreign affiliates account for about 1/3 of value added and sales, more than 22 percent of employment, and half of French trade. The concentration of economic activities in the hands of foreign affiliates is very pronounced in some regions such as Alsace or Brittany.

[16]The information on the ownership of firms comes from LIFI. As discussed in the Appendix, this survey is exhaustive for firms with an annual turnover above 1 million euros and firms with more than 500 employees. If we focus on the sample of firms that are above one of these thresholds, we drop half of the firms, but the remaining ones account for 94 percent of the total value added. Focusing on this reduced sample of firms, we find the same difference in the composition of the top 1 percent against the others. In particular, FMEs are over-represented in the largest 1 percent of firms in this sample. Namely, FMEs account for 49 percent of the top 1 percent and MNEs account for 42 percent. By contrast, FMEs account for only 9.5 percent of the smallest firms, and MNEs 33 percent

FACTS II: HETEROGENEITY IN THE ORIGIN AND THE LOCATION OF FOREIGN AFFILIATES. — We have shown that foreign affiliates constitute a large share of regional employment, value added and trade. We will now go into the details of their countries of ownership and their regions of location. The composition of ownership in terms of nationality is stable over the sample period.[17] Affiliates from a given foreign country must contribute to a significant share of regional outcomes to have an impact on the comovement of business cycles. In France, 55 percent of foreign affiliates are owned by parents from the United States, Spain, Germany, the United Kingdom, and the Netherlands. They account for more than two-thirds of the total value added generated by foreign affiliates.

To be able to use the cross-region dimension of the data, we need some heterogeneity with respect to the nationality of foreign affiliates across regions. The shares of value added by country of ownership are not evenly distributed across all regions. It is interesting to look at the regional distribution of the shares of value added for important source countries; two sharing a border with France (Germany and Spain) and two outside Europe (the U.S. and Japan). This is represented in Figure 2.

– Figure 2 about here –

These maps show the uneven distribution of foreign affiliates across French regions. For instance, the value added shares of German affiliates are large in Alsace-Lorraine, but also in Midi Pyrénées, which does not share a border with Germany. Spanish affiliates contribute largely to the value added created in Pays de la Loire and not in Midi-Pyrénées or Aquitaine, regions which border Spain.

FACTS III: PARENT AND AFFILIATE LINKAGES. — There are multiple potential financial and economic linkages between foreign affiliates and their countries of ownership. The data provide information on multinationals' trade and intra-firm trade. In France, About 40 percent of French exports and 45 percent of French imports are intra-firm. As a comparison, Bernard et al. (2010) report that 46 percent of US imports are intra-firm. Striking evidence from the EIIG survey indicates that intra-firm trade is much larger when the exchange involves the participation of the country of origin. More specifically, 15 percent of the exports of foreign affiliates and about 26 percent of their imports are with their parent countries, and almost 80 percent of trade is intra-firm. These shares are substantial given the number of countries in our sample. This suggests that there are very strong linkages between foreign affiliates and their parent countries.

[17]The first ten countries of origin account for more than 85 percent of the total number of foreign affiliates in the LIFI data. The Spearman rank correlation of all nationalities across years is above 96 percent.

FACTS IV: BUSINESS CYCLE COMOVEMENT. — The heterogeneity in the GDP growth correlations between French regions and foreign countries has three dimensions. First, a single country might have a high level of synchronization with some French regions but not with others. Second, a single region might have a high level of correlation with one country but not with another.[18] Third, there might be some bilateral components explaining the heterogeneity in the GDP growth correlations between a French region and a foreign country. This third aspect is examined in the rest of the paper. Using a variance decomposition of GDP growth correlation across French regions and countries, we find that half of the variance is due to country fixed effects and another eighth of the variance is driven by region fixed effects. Three-eighths of the variance are therefore driven by bilateral determinants.

IV. Empirical Strategy

Our analysis uses a cross-section of business cycle correlations between the 21 French metropolitan regions and 162 countries. Not all countries in the sample invest in France, so that the vector of correlations has many zero values. There are thirty-four countries with majority-owned affiliates that report positive employment in the sample.[19] However, most of these countries share a trade relationship with French regions. We do not discard the zero values in our first test. Yet, we show in Section V that our main findings hold when we do so. Our baseline equation is the following:

$$\rho_{cr} = \alpha FME_{cr} + \Omega_{cr}\beta + \nu_r + \nu_c + \epsilon_{cr} \tag{5}$$

where ϵ_{rc} is the disturbance term and ρ_{cr} is a vector of correlations of GDP growth rates between a country c and a region r computed over the 1990-2006 period. It is defined as: $\rho_{cr} = corr(\frac{GDP_{c,t}-GDP_{c,t-1}}{GDP_{c,t-1}}, \frac{GDP_{r,t}-GDP_{r,t-1}}{GDP_{r,t-1}})$.[20]

In all regressions, we add a set of country and region fixed effects ν_r and ν_c which do not only control for the demand and supply shocks, but also for omitted variables at the regional and national level. The region fixed effects also have the advantage of controlling for many factors which determine the location of affiliates

[18] For instance, Alsace's GDP growth is positively correlated with the German GDP growth, but not with the Spanish GDP growth, while the reverse is true for Auvergne.

[19] Australia, Austria, Belgium, Canada, China, the Czech Republic, Denmark, Germany, Greece, India, Ireland, Iceland, Israel, Italy, Finland, Japan, South Korea, Lebanon, Malaysia, Morocco, the Netherlands, Norway, Portugal, Saudi Arabia, Singapore, Spain, Switzerland, Sweden, Thailand, Tunisia, Turkey, the United Kingdom, the United States, and Venezuela. Nine of them have positive employment in all regions: Belgium, Germany, Italy, Finland, the Netherlands, Switzerland, Sweden, the United Kingdom, and the United States.

[20] To test the robustness of our results, we also transform the GDP series (in logs) using the filter proposed by Hodrick-Prescott (1997) and compute the correlation between the cyclical components of regional and country GDPs. Since we use yearly data, we apply a smoothing parameter of 6.25 as recommended by Raven O. and Uhlig (2002). The results are provided in the Online Appendix.

in France.[21] FME_{cr} is an indicator of the importance of foreign affiliates from country c in the economic activities of region r. We define FME_{cr} as the share of employment by foreign affiliates of country c in region r.

$$FME_{cr} = \frac{\sum_f Emp_{fcr}}{Emp_r} \tag{6}$$

where Emp_{fcr} is the employment of firm f with ownership from c in region r. The denominator Emp_r is the total employment in region r. We consider employment rather than value added for two reasons. First, employment is less subject to manipulation for tax reasons than value added (Lipsey, 2008). Second, information on employment is observed at the establishment level which is key for firms with establishments across several regions.

The literature has emphasized other important determinants of business cycle comovement. We include them in the Ω_{rc} matrix. A first important factor relates to bilateral trade intensity (Frankel and Rose, 1998). We construct the index of bilateral trade intensity as the ratio of exports and imports between country c and region r over the sum of the region and country GDPs.

$$BT_{cr} = \frac{x_{cr} + m_{cr}}{GDP_c + GDP_r} \tag{7}$$

It has also been shown that both the productive structure and the structure of bilateral trade are key determinants of business cycle comovement (Imbs, 2004). Due to the limitation in existing data, we compare the specialization/production structure of countries by looking at the composition of their exports.[22] We compute the dissimilarity index as follows:

$$DISIM_{cr} = \sum_k |\frac{X_c^k}{X_c} - \frac{X_r^k}{X_r}| \tag{8}$$

Where X_i^k/X_i is the share of sector k in the total exports of country i. Exports are computed at the 3-digit ISIC sector level. Since it is likely that similar partners face the same supply and demand shocks, a strong similarity should lead to a greater synchronization of business cycles.

Since we have bilateral trade data at the sector level, we can also evaluate

[21] Crozet, Mayer and Mucchielli (2004) show that market potential, labor costs, regional policy, and agglomeration variables are potentially important determinants of the location of foreign firms in French regions. These determinants are region-specific and thus captured by the region fixed effects. In the empirical analysis, we also control for other determinants of the location of foreign firms, such as distance to or contiguity with their parent countries.

[22] We also computed an index based on 1-digit production. The use of this variable does not change our results qualitatively. They are available upon request.

the importance of intra-industry trade on business cycle comovement (Calderon, Chong and Stein, 2007; di Giovanni and Levchenko, 2010; Fidrmuc, 2004). We use French Customs data to allocate exporters and importers across regions and compute a Grubel-Lloyd index for each country and region pair.

$$IIT_{cr} = 1 - \frac{\sum_k |X_{cr}^k - M_{cr}^k|}{\sum_k X_{cr}^k + M_{cr}^k} \tag{9}$$

where X_{cr}^k and M_{cr}^k are the exports to and imports from country c, by region r, for sector k. In our analysis, we consider 4-digit level sectors of the HS nomenclature. The summary statistics of the different variables used in the empirical analysis are reported in Table 2.

– Table 2 about here –

There are other factors that might influence the synchronization of business cycles. Kose and Yi (2006), Imbs (2004) and more recently Kalemli-Ozcan, Papaioannou and Peydro (2009) show that increased financial integration affects business cycle comovement across countries. Unfortunately, we do not have the relevant information to investigate the relevance of this potential source of comovement.

V. Econometric Results

A. Baseline Results

Table 3 presents the results of estimating Equation 5. The specifications include a full set of region- and country-specific effects.

– Table 3 about here –

Columns (1) and (2) respectively investigate the effect of the share of foreign affiliate employment and bilateral trade on business cycle correlations. Both variables have a positive impact on the level of synchronization. Once we include both variables in column (3), the impact of the bilateral trade variable is less important and estimated with a much lower degree of precision. It is an indication of the role of foreign affiliates in French international trade.

The impact of the share of foreign affiliate employment is not only significant, but it is also quantitatively important. Based on the preferred estimates from column (4), the standardized coefficient of the FME_{cr} variable is 0.06, while the standardized coefficients of the BT_{cr} and IIT_{cr} variables are 0.03 and 0.02 respectively. The effect of foreign affiliates is therefore great enough to be of substantial interest. Since we estimate a linear model, we can evaluate the elasticity of the FME_{cr} variable at mean values. Taking information from Table 2,

we find that a 10 percent percent increase in the employment intensity of foreign affiliates raises the business cycle correlation between their countries of ownership and their regions of location by about 0.6 percent.

Turning to the other covariates, the results suggest that the effects of bilateral trade are positive and significant in most specifications, and that those of intra-industry trade are not significant.[23] The dissimilarity in the production structure is negative and significant. In line with Imbs (1999) and Imbs (2004), synchronization is reduced in regions that have dissimilar sectoral production patterns. This is robust across specifications.

In order to assess the effect of foreign affiliates on business cycle correlations, based on previous regressions, we evaluate the impact on business cycle comovement of turning foreign affiliates from a region into domestically-owned affiliates. In this exercise, we focus on the sample of countries that invest in at least one region in France (the results with all countries are quantitatively the same). In the top panel of Figure 3, the distribution of the GDP comovement of region-country pairs for regions that host foreign affiliates is compared with the comovement for regions that do not. The figure points to a stochastic dominance of the distribution of GDP correlations for regions where there are foreign affiliates (the average correlation is 0.187 in regions with foreign affiliates versus 0.040 in regions without foreign affiliates).

– Figure 3 about here –

Being located in a region with foreign affiliates has a strong positive impact on business cycle correlations. However, this effect might be driven by confounding factors such as trade or similar specialization, among others. In order to deal with this issue, we proceed in two steps. We first predict the GDP correlation from the estimates in our baseline regression in which we mute the effect of the presence of foreign affiliates. We then compare the distribution of the predicted GDP correlation without foreign affiliates with the observed distribution of GDP correlation with foreign affiliates. In the bottom panel of Figure 3, we include the distribution of the predicted GDP correlation without foreign affiliates.[24] It appears that part of the gap (in terms of comovement) between region-country pairs with and without foreign affiliates is driven by the presence of foreign affiliates. If we exclude foreign affiliates, the level of comovement between regions and countries decreases on average by 16 percent (The average correlation is 0.187 with foreign affiliates versus 0.161 using the predicted correlation without foreign affiliates). This estimate is a lower bound, as we do not account for the outward

[23]In the last column, the effect of bilateral trade is not significantly different from zero. Note that if we remove the intra-industry trade variable (which is not significant and close to zero), the effect becomes significant. Furthermore, if one constructs a measure of trade that excludes trade between foreign affiliates and their parent countries, then the trade variable is always significant. All these results are available upon request.

[24]We use a Kolmogorov-Smirnov test which confirms the stochastic dominance of the distribution of GDP correlation with the presence of foreign affiliates over the distribution of the predicted GDP correlation (combined test: D= 0.0628; p-value=0.000).

activity of multinational firms, or the impact of foreign affiliates on other firms in the region.[25]

B. Robustness Checks

Dealing with zeros. — The baseline sample includes countries that do not invest in French regions. One way to investigate whether the results are driven by these zeros for employment intensity is to keep the countries which have a positive value of employment in at least one region. We present the results in Table 4. Notice that in this case, we drop about 80 percent of the observations in the initial baseline sample.

– Table 4 about here –

Columns (1) to (4) show that the foreign affiliate employment share is still significant and positive. The estimated elasticity is slightly larger (because it is evaluated at different mean values). In column (4), we find that a 10 percent increase in the employment share of foreign affiliates raises the business cycle correlation between their countries of ownership and their regions of location by about 0.7 percent.[26]

Geography and spatial effects. — We investigate whether the introduction of geography and spatial effects influences the effect of the foreign affiliate presence on business cycle correlation. First, it is likely that regions and countries that are geographically close are affected by similar demand and supply shocks (Clark and van Wincoop, 2001). Distance and/or adjacency are therefore potentially important omitted variables. The results of regressions including these variables are reported in Table 5, columns (1) and (2).[27] In column (1), we find a negative and significant effect of distance, while the border variable is insignificant. In column (2), we introduce the baseline variables. Bilateral distance and borders do not influence the coefficient of the foreign affiliate employment intensity significantly.

[25]In Table 1 of the Online Appendix, we propose an alternative assessment of the magnitude of the effect. We regress the cyclical movements in the regional level of employment in France on the cyclical fluctuations of aggregate employment in the countries of origin, as well as on an interaction term with the presence of foreign affiliates. The presence of foreign affiliates magnifies the impact of the change in the foreign GDP on the cyclical movement in the regional output level. If a country's GDP growth doubles, this increases employment growth in the median French region by 2 percent. Increasing the presence of multinationals by one standard deviation leads to a 3 percent increase in employment growth. To put it differently, the presence of foreign affiliates increases the transmission of shocks by 50 percent.

[26]The mean value of the GDP growth rate correlations and of the employment shares in this sample are 0.12 and 0.001, respectively.

[27]The $Border_{rc}$ variable equals one if country c and region r share a common border. To compute the distance between country c and region r, we first identify the latitude and longitude of each firm in our sample and of the capital city of each country. We then compute the distance between each firm and each country. The distance between region r and country c is the arithmetic average of the individual distance that separates the firms of region r and the capital of country c.

Compared to the results of Table 3, the inclusion of the bilateral distance and border variables does not involve any notable change to the explanatory power of our regressions as measured by the R^2. It is worth noting that our regressions include distance and country fixed effects. There is little distance variance in the cross-pair dimension which explains why the variable is not significant. The fact that the border coefficient is not significant is consistent with the low correlation of Switzerland, Luxembourg, Italy and Belgium with their bordering regions.

– Table 5 about here –

A potential bias could arise due to the presence of foreign affiliates in neighboring regions.[28] We thus include a measure of the share of foreign affiliate employment from the same country in other regions. We compute an indicator which is the distance-weighted share of foreign affiliate employment from country c in other regions. This indicator is computed as $FME_{cr}^{other} = \sum_{r'} \frac{FME_{r'c}}{log(dist_{rr'})}$. The results are reported in column (3). The presence of foreign affiliates in neighboring regions does not significantly affect the business cycle comovement and the FME_{cr} variable remains significant.

As a last robustness check, we focus on the activity of foreign headquarters that have foreign affiliates in France *only*. We perform this check to avoid indirect linkages between regions and countries that might be due to the presence in a third country of foreign investors in France. As we focus on foreign affiliates that have headquarters that do not invest in other countries than France, we lose 36 percent of the total number of foreign affiliates. The specification in column (4) of Table 5 shows that our results are robust to the alternative definition of foreign presence. All coefficients have the expected sign and about the same level of significance as in the baseline regression.[29]

Linkages. — The findings reported in Table 3 point to an impact of the presence of foreign affiliates without distinguishing between the types of linkages that these affiliates share with their countries of origin. An important aspect concerns the nature of the international production network, and whether it is vertically or horizontally integrated. The data allows us to imperfectly identify vertically integrated networks. One crude methodology is to compare the 4-digit sector of the parent with the 4-digit sector of its affiliates (Alfaro and Charlton, 2009). If

[28] To illustrate the source of this concern, consider two regions a and b, and a country c. Assume that country c has affiliates in region a only and that the real cycle of region b is perfectly correlated with the real cycle of region a, because b produces inputs for a. A correlation between country c and region b might be found despite the absence of foreign affiliates from c. In this case, the coefficient of the FME_{cr} variable in the baseline regression should be biased downward. The coefficient should not be significant in our example: both regions are correlated with Germany, while one has German affiliates and the other does not.

[29] The Lifi dataset reports the number of affiliates controlled by the headquarters. If the difference between this number and the number of affiliates controlled by the firms and located in France is nil, we deduce that the headquarters invests only in France.

these sectors do not match, we have a measure of a vertically integrated network. We report the results in Table 6:

– Table 6 about here –

Column (1) of Table 6 replicates the baseline analysis using the employment intensity of affiliates that evolve in a different sector than their parents ($FMEvertical$ variable). We find a positive and significant impact of this intensity on business cycle comovement. As both the vertical and overall FME variables are correlated, the vertical FME could just pick up the effect of the overall FME.[30] We therefore include the overall FME variable in column (2). The additional effect of the vertical production network vanishes, while the coefficient of the overall FME variable is about of the same order of magnitude as in the baseline specification of Table 3.

In column (3), we replicate column (2) substituting the presence of foreign affiliates by the intensity of affiliates that are engaged in intra-firm trade with their parent countries ($FME_{cr}intrafirm$). Note that 43 percent of foreign affiliates trade with their parents. However, the correlation between $FME_{cr}intrafirm$ and $FME_{cr}NOintrafirm$ is relatively high (80 percent). The coefficient of the employment intensity of affiliates doing intra-firm trade is not significant.

In columns (4) and (5), as additional explanatory variables, we introduce the share of intra-firm trade in total trade, as well as the share of affiliates' trade with their countries of origin. In column (4), the share of intra-firm trade is significant and positive. It becomes statistically insignificant when we control for the affiliate share of employment (whether we include or exclude the vertical FME variable). The overall FME variable is still positive and significant.

These results suggest that the influence of multinational activities on real business cycle comovement goes beyond the trade in goods between the affiliates and their parents. Two recent, interesting contributions show that the transfer of intangible inputs is an essential trait of the relationship between the parent and the affiliate (Atalay, Hortacsu and Syverson, 2014; Ramondo, Rappoport and Ruhl, 2011). Atalay, Hortacsu and Syverson (2014) find in particular that vertical integration promotes efficient intra-firm transfers of intangible inputs rather than the transfer of goods. It is however difficult to have precise firm-level information on the transfer of intangible inputs.

Other Checks. — We have conducted a series of additional robustness checks that are discussed in the Online Appendix (Sections 3-6). We first investigate whether changes in the composition of foreign affiliates over time influences our results. We propose a series of tests which all suggest that changes in composition were limited over the period and do not affect our main results.

[30] The correlation between the overall FME and the vertical FME is about 85 percent. The correlation between the vertical FME and the non-vertical FME is about 98 percent.

We also verify that the results are not driven by region-country pairs that have a common history. For instance, one might suspect that both the high level of comovement between Alsace and Germany and the tremendous presence of German multinationals in this region are due to historical ties. Excluding all such region-country pairs does not affect the results qualitatively. The effect of multinationals' presence on business cycle comovement remains positive and significant.

In a further sensitivity check, we use the ratio of foreign affiliates' value added to regional GDP as an alternative measure of the FME_{cr} variable. As emphasized by Lipsey (2008), this ratio is less relevant than the employment intensity since it is likely to be manipulated for tax reasons. Our main findings are robust to this alternative measure.

We also present the results obtained using an alternative definition of business cycle comovement. In this specification, comovement is computed as the correlation of HP-filtered GDP. The use of this alternative measure of comovement does not change the baseline results.

As a final sensitivity check, we randomly assign the true foreign affiliate employment intensity of each region to another. This falsification exercise leads to non-significant results, suggesting that our findings are not driven by spurious correlations.

VI. Conclusion

This paper shows that the comovement of international real business cycles is greatly influenced by cross-border networks of foreign affiliates. Using a new database on the location and activities of multinational firms in France, we show a positive impact of foreign affiliates' presence on the comovement of business cycles between their regions of location and their countries of origin. Further investigation suggests that offshoring and trade by multinationals do not explain our results. One important topic for future research is thus obtaining a better understanding of the transmission channels of shocks between the parent and its affiliates. Different economic linkages, such as the transfer of financial assets and intangible inputs may strengthen the transmission of shocks within multinational companies across countries.

The findings presented in this paper might have several implications. First, we show the importance of the nationality and ownership of firms to explain macroeconomic outcomes such as business cycle comovement. The results thus suggest that introducing (large) multinational firms into international real business cycle models may help to explain the correlation of productivity shocks across countries and reproduce the data more accurately. From a policy perspective, our results highlight the fact that regional business cycles are sensitive to the country of ownership of the firms which are active in the region.

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Table 1—: French regions: contribution of firms to economic activities by ownership structure

	# of firms			Employ.		Sales	
	IND	MNE	FMEs	MNE	FMEs	MNE	FMEs
Alsace	75.5	14.4	10.1	29.9	38.5	29.9	51.1
Aquitaine	78.9	16.3	4.8	36.9	18.7	41.0	30.4
Auvergne	77.3	18.4	4.2	48.0	15.5	50.7	25.5
Basse-Normandie	74.1	21.5	4.5	42.6	18.2	46.7	25.8
Bourgogne	73.9	20.0	6.2	42.6	26.4	44.4	34.6
Bretagne	76.4	20.5	3.1	51.5	11.2	59.5	13.3
Centre	75.3	18.6	6.1	40.2	27.1	40.1	38.8
Champagne-Ardenne	74.1	19.6	6.3	41.9	26.0	44.9	31.9
Franche-Comte	75.6	19.8	4.6	49.0	16.2	52.4	22.8
Haute-Normandie	73.4	19.9	6.7	43.0	27.8	47.9	38.7
Ile-de-France	81.1	13.9	5.1	42.2	23.8	44.3	36.3
Languedoc-Rousssillon	81.0	15.2	3.8	35.3	16.0	39.3	25.6
Limousin	77.0	18.4	4.6	36.7	16.9	42.8	22.0
Lorraine	75.5	17.0	7.5	36.4	30.4	37.7	42.6
Midi Pyrénées	79.5	16.6	3.9	37.3	19.8	32.2	39.0
Nord Pas-de-Calais	74.4	19.2	6.4	43.6	23.5	43.9	36.2
PACA	83.4	13.0	3.6	35.2	17.9	40.2	28.8
Pays de Loire	71.7	23.8	4.5	48.7	18.1	51.2	26.1
Picardie	74.6	18.1	7.3	37.2	31.4	37.7	43.8
Poitou Charentes	75.7	20.4	3.9	41.9	18.5	47.7	20.6
Rhône Alpes	77.6	17.6	4.8	41.7	22.2	44.9	30.6
Weighted average	77.6	17.2	5.2	41.6	22.7	43.9	33.5

Note: This table displays the percentage contribution of independent French firms (IND), French multinational firms (MNEs), and foreign multinational firms (FMEs) to the economic activities of French regions in the manufacturing, extractive, and agricultural industries. *Employ.* stands for employment. Figures by region are averages over the 1999-2004 period. The row "Average" gives the weighted mean of regional values. Weights reflect the importance of each region for each outcome (their weight in France's total sales, or France's total employment). The sales are expressed in euros.

Source: Authors' computations from BRN, STOJAN, LIFI, and the French Customs data.

Table 1 (continue): French regions: contribution of firms to economic activities by ownership structure

	Value added		Exports		Imports	
	MNE	FMEs	MNE	FMEs	MNE	FMEs
Alsace	27.2	49.5	21.4	69.8	14.2	76.7
Aquitaine	37.7	31.1	33.8	52.8	25.4	59.5
Auvergne	43.6	31.4	65.4	25.5	58.5	31.0
Basse-Normandie	42.9	23.1	36.0	50.4	31.6	54.7
Bourgogne	44.5	30.3	43.6	48.0	25.9	67.3
Bretagne	51.4	15.7	56.0	29.1	48.7	36.4
Centre	38.2	36.6	37.9	54.2	22.8	68.5
Champagne-Ardenne	45.0	29.4	49.0	38.9	27.8	61.0
Franche-Comte	47.1	22.6	43.6	44.2	48.8	36.8
Haute-Normandie	48.1	34.6	42.2	50.5	45.3	50.6
Ile-de-France	41.9	35.3	46.3	39.3	31.4	59.1
Languedoc-Rousssillon	37.1	25.3	37.1	49.0	35.9	47.5
Limousin	39.7	20.5	40.0	41.8	42.9	39.5
Lorraine	33.5	41.4	28.9	62.7	26.6	62.7
Midi Pyrénées	36.2	31.8	19.4	54.9	19.5	58.5
Nord Pas-de-Calais	39.1	37.5	42.0	49.8	34.9	52.3
PACA	38.2	25.6	33.9	47.0	40.5	42.5
Pays de Loire	46.7	28.9	46.0	42.3	39.7	49.5
Picardie	35.6	40.3	33.3	56.5	23.6	64.9
Poitou Charentes	47.4	20.5	61.8	25.5	46.3	37.1
Rhône Alpes	43.2	26.5	44.7	41.5	35.7	50.7
Weighted average	41.3	32.1	40.5	46.7	32.1	56.4

Note: This table displays the percentage contribution of independent French firms (IND), French multinational firms (MNEs), and foreign multinational firms (FMEs) to the economic activities of French regions in the manufacturing, extractive, and agricultural industries. Figures by region are averages over the 1999-2004 period. The row "Average" gives the weighted mean of regional values. Weights reflect the importance of each region for each outcome (their weight in France's total value added, exports, or imports). Value-added, exports, and imports are expressed in euros.

Source: Authors' computations from BRN, STOJAN, LIFI, and the French Customs data.

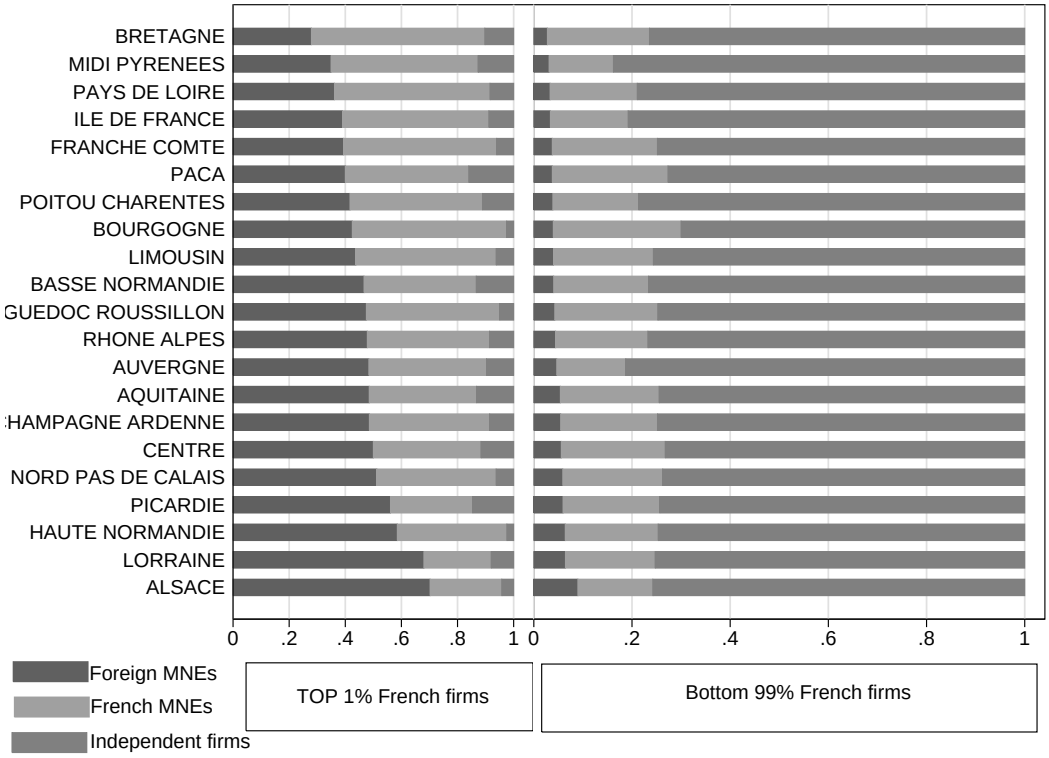


Figure 1. : Ownership breakdown of firms in terms of v.a., by French region

Note: This figure presents the (average over 1999-2004) ownership structure of the 1 percent largest firms and the 99 percent smallest firms, for each French region in terms of value added. Three ownership structures are distinguished: independent French firms, French multinational firms, and foreign multinational firms. The results stand for manufacturing, extractive, and agricultural industries.
Source: The figure is based on the authors' computations relying on 3 data sets: BRN, STOJAN, and LIFI.

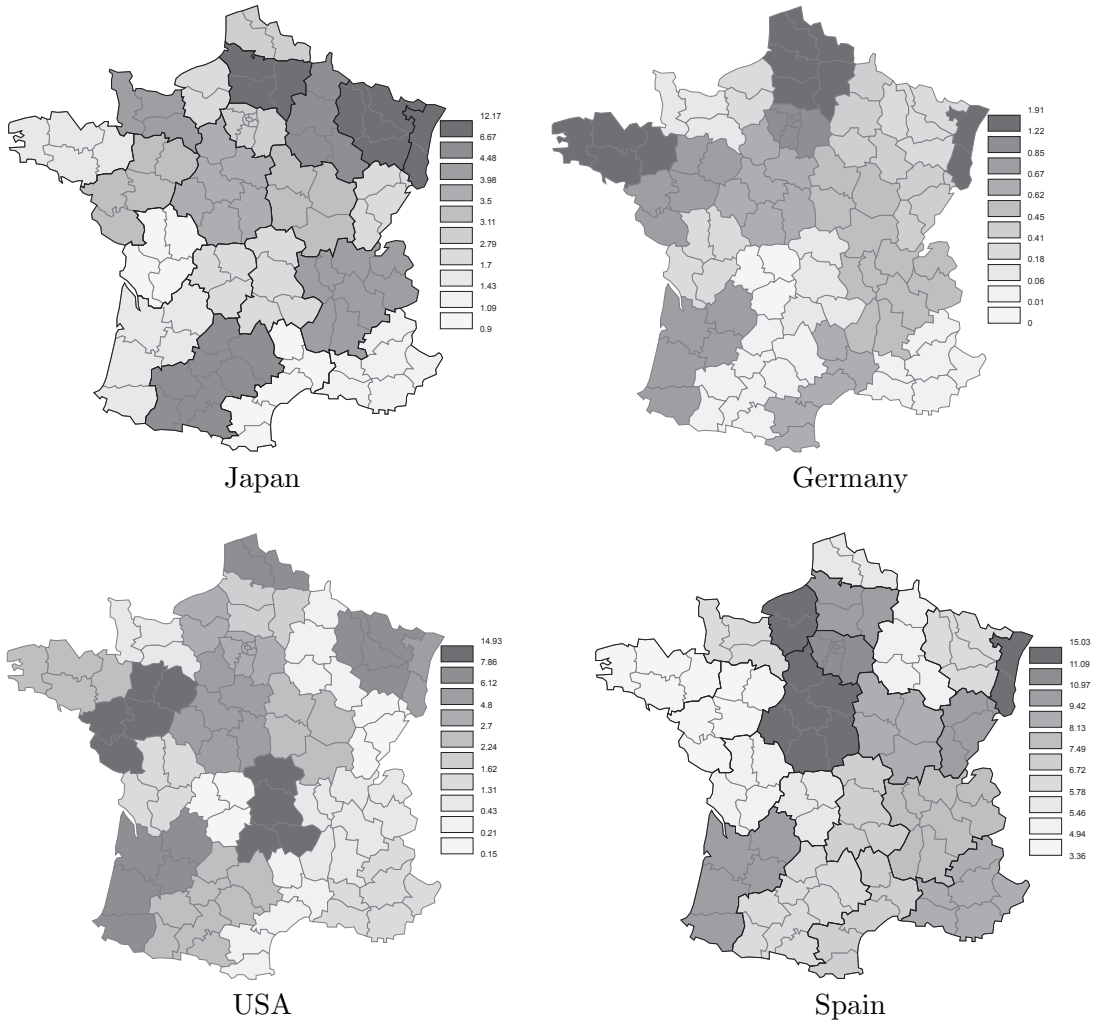
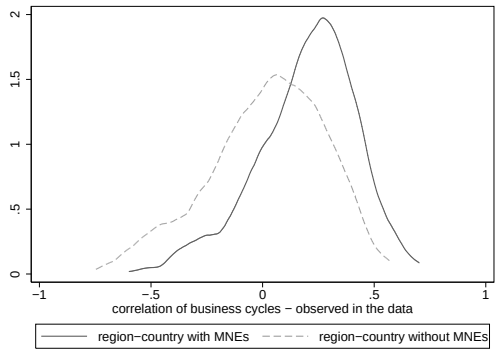


Figure 2. : Share of foreign affiliates in regional value added, by country of origin of the parent, 2004 (percent total)

Note: The Figure describes the share of foreign affiliates in regional value added for manufacturing extractive, and agricultural industries in2004, 2004. Foreign affiliates with a headquarter in Germany, Japan, Spain, and the US are considered.
Source: The figure is based on the authors' computations relying on 3 data sets: BRN, STOJAN, and LIFI.

Observed in the data



Observed in the data versus predicted without foreign affiliates

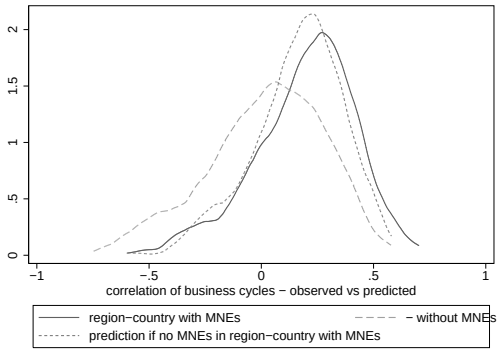


Figure 3. : Distribution of GDP correlations across region and country pairs

Table 2—: Summary Statistics

Variable	Label	Obs	Mean	Std. Dev.
Whole sample				
Correlation of GDP growth rate	ρ_{rc}	3329	0.047	0.241
Correlation of HP-filtered GDP	ρ_{rc}	3329	0.082	0.251
Foreign Value Added Share	FME_{cr}	3329	3.10^{-4}	0.002
Foreign Employment Share	$FME_{cr}(Empl.)$	3329	2.10^{-4}	0.001
Foreign Employment Share (vertical)	$FMEV_{cr}$	3329	2.43^{-5}	0.0003
Bilateral Trade	BT_{cr}	3329	2.10^{-4}	0.001
Distance	$Distance_{cr}$	3329	7.935	0.823
Intra-Industry Trade	IIT_{cr}	3329	0.036	0.087
Border	$Border_{cr}$	3329	0.003	0.057
Dissimilarity	$DISIM_{cr}$	3329	1.07	0.39
Intra-firm exports	IF_{cr}	3276	1.9210^{-3}	0.013
Sample of countries investing in at least one French region				
Correlation of GDP growth rate	ρ_{rc}	714	0.117	0.23
Foreign Value Added Share	FME_{cr}	714	1.56^{-3}	0.004
Foreign Employment Share	$FME_{cr}(Empl.)$	714	1.13^{-3}	0.003
Foreign Employment Share (vertical)	$FMEV_{cr}$	714	2.35^{-4}	0.0006
Bilateral Trade	BT_{cr}	714	5.84^{-4}	0.001
Distance	$Distance_{cr}$	714	7.31	1.066
Intra-Industry Trade	IIT_{cr}	714	0.126	0.123
Border	$Border_{cr}$	714	0.018	0.134
Dissimilarity	$DISIM_{cr}$	714	0.779	0.29
Intra-firm exports	IF_{cr}	651	9.6610^{-3}	0.029

Table 3—: Foreign Affiliates and Business Cycle Correlations

Dep. variable: ρ_{cr}=*Correlation of growth rate of GDPs*				
	(1)	(2)	(3)	(4)
$FME_{cr}(Empl.)$	12.72***		11.01***	11.39***
	(4.053)		(3.431)	(3.509)
BT_{cr}		20.42***	15.36*	11.45
		(2.680)	(1.951)	(1.508)
IIT_{cr}				0.06
				(1.345)
$DISIM_{cr}$				-0.06***
				(-4.460)
Region FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Observations	3,402	3,402	3,402	3,329
R^2	0.691	0.690	0.691	0.695

Note: This table investigates the determinants of the bilateral comovement of business cycles between French regions and 162 countries. The comovement is measured by the correlation of the yearly growth of region r and country c GDPs over the 1990-2006 period. The explanatory variables are the share of employment (FME_{cr}) generated by foreign affiliates from country c in region r, the bilateral trade (BT_{cr}) between region r and country c, normalized by the two GDPs, the share of intra-industry trade (IIT_{cr}) between region r and country c, and the dissimilarity ($DISIM_{cr}$) of country c and region r in terms of specialization. All regressions include region and country fixed effects. Robust t-statistics are reported between parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels respectively.

Table 4—: Foreign Affiliates and BCC - Restricted Sample of Countries

Dep. variable: ρ_{cr}=*Correlation of growth rate of GDPs*				
	(1)	(2)	(3)	(4)
$FME_{cr}(Empl.)$	8.75**		7.16**	7.62**
	(2.462)		(1.964)	(2.042)
BT_{cr}		20.40**	15.72	13.03
		(2.074)	(1.591)	(1.337)
IIT_{cr}				0.01
				(0.073)
$DISIM_{cr}$				-0.10***
				(-3.019)
Region FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Observations	714	714	714	714
R^2	0.653	0.653	0.655	0.661

Note: This table investigates the determinants of the bilateral comovement of business cycles between French regions and 162 countries. It focuses on the sample of countries that invest in at least one region in France. The comovement is measured by the correlation of the yearly growth of region r and country c GDPs over the 1990-2006 period. The explanatory variables are the share of employment (FME_{cr}) generated by foreign affiliates from country c in region r, the bilateral trade (BT_{cr}) between region r and country c, normalized by the two GDPs, the share of intra-industry trade (IIT_{cr}) between region r and country c, and the dissimilarity ($DISIM_{cr}$) of country c and region r in terms of specialization. All regressions include region and country fixed effects. Robust t-statistics are reported between parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels respectively.

Table 5—: Geography and Spatial Effects, Foreign Affiliates and Business Cycle Correlations

Dependent variable: ρ_{cr}=*Correlation of growth rate of GDPs*				
	(1)	(2)	(3)	(4)
$FME_{cr}(Empl.)$		10.75***	14.55***	
		(3.091)	(3.720)	
$FME_{cr}^{other}(Empl.)$			36.29	
			(1.533)	
$FME_{cr}^{nothird}(Empl.)$				28.65***
				(4.627)
BT_{cr}		9.64	10.83	17.43*
		(1.183)	(1.475)	(1.766)
IIT_{cr}		0.06	0.05	0.06
		(1.309)	(1.299)	(1.345)
$DISIM_{cr}$		-0.06***	-0.06***	-0.06***
		(-4.425)	(-4.423)	(-4.539)
$Distance_{cr}$	-0.05*	-0.02		
	(-1.892)	(-0.722)		
$Border_{cr}$	0.06	0.01		
	(1.060)	(0.126)		
Region FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Observations	3402	3329	3329	3329
R^2	0.690	0.690	0.691	0.691

Note: This table investigates the determinants of the bilateral comovement of business cycles between French regions and 162 countries. The comovement is measured by the correlation of the yearly growth of region r and country c GDPs over the 1990-2006 period. The explanatory variables are the share of employment (FME_{cr}) generated by foreign affiliates from country c in region r, the share of employment in neighboring regions (FME_{cr}^{other}), the share of employment generated by foreign affiliates wose arents invest only in France ($FME_{cr}^{nothird}$), the bilateral trade (BT_{cr}) between region r and country c, normalized by the two GDPs, the share of intra-industry trade (IIT_{cr}) between region r and country c, the dissimilarity ($DISIM_{cr}$) of country c and region r in terms of specialization, the bilateral distance, and a dummy equal to one for contiguous region-country pairs. All regressions include region and country fixed effects. Robust t-statistics are reported between parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels respectively.

Table 6—: Vertically Integrated Networks and Business Cycle Correlations,

Dep. variable: ρ_{cr} *=Correlation of growth rate of GDPs*					
	(1)	(2)	(3)	(4)	(5)
$FME_{cr}(Empl.)$		9.18**	19.35***		11.77***
		(2.072)	(2.387)		(3.737)
$FME_{cr}vertical(Empl.)$	35.26***	12.99			
	(2.591)	(0.760)			
$FME_{cr}intrafirm(Empl.)$			-9.59		
			(-0.851)		
IF_{cr}				0.54**	0.28
				(2.322)	(1.223)
Out_{cr}				9.31	3.17
				(0.649)	(0.300)
BT_{cr}	13.97*	11.49	-0.72	4.77	-1.21
	(1.943)	(1.530)	(-0.080)	(0.556)	(-0.140)
IIT_{cr}	0.06	0.06	0.07	0.07	0.07
	(1.325)	(1.308)	(1.614)	(1.584)	(1.530)
$DISIM_{cr}$	-0.06***	-0.06***	-0.06***	-0.06***	-0.06***
	(-4.325)	(-4.429)	(-4.607)	(-4.598)	(-4.608)
Sample	Full	Full	Full	Full	Full
Region FE	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	3,329	3,329	3,329	3,329	3,329
R-squared	0.695	0.695	0.695	0.695	0.696

Note: This table investigates the determinants of the bilateral comovement of business cycles between French regions and 162 countries. The comovement is measured by the correlation of the yearly growth of region r and country c GDPs over the 1990-2006 period. The explanatory variables are the share of foreign affiliates in employment (FME_{cr}), the share of employment ($FME_{cr}vertical$) generated by foreign affiliates which belong to a different industry than their parent from country c in region r, the share of employment ($FME_{cr}intrafirm$) generated by foreign affiliates which do intrafirm trade with their parent country, the bilateral trade (BT_{cr}) between region r and country c, normalized by the two GDPs, the share of intra-industry trade (IIT_{cr}) between region r and country c, the dissimilarity ($DISIM_{cr}$) of country c and region r in terms of specialization, the share of foreign affiliate (from c) intra-firm trade with country c in total trade (IF_{cr}), and the share of foreign affiliate (from c) arm's-length trade with country c in total trade (Out_{cr}). All regressions include region and country fixed effects. Robust t-statistics are reported between parentheses. *, **, and *** indicate significance at the 10, 5, and 1 percent levels respectively.