Does Foreign Direct Investment Synchronise Business Cycles? Results from a Panel Approach

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Contribution to the Project

In this research paper we identify the sources of business cycle divergence in the EU. Based on the results policy conclusions can be drawn on which kind of economic integration should be assisted in order to enforce convergence and therefore enhance the effective operation of the monetary policy in the union. The results will add to the reinforced policy coordination measures of the EU by giving structural policies that foster synchronisation a role for improving the efficiency of the single monetary policy.

Does Foreign Direct Investment Synchronise Business Cycles? Results from a Panel Approach*

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Abstract

A considerable degree of business cycle synchronization is key to a successful operating currency union. The European Monetary Union as well as many other countries strives to attract foreign direct investment (FDI) because of its reputation as being highly beneficial for the host economy. But stronger FDI linkages may also have a significant impact on business cycles and co-movement of these cycles between countries and therefore create a potential conflict between policies that promote FDI and the conduct of the common monetary policy. In this paper we empirically analyze the FDI channel in more detail revisiting the main determinants of synchronization. Previous studies were mainly interested in the long-run impact employing cross-sectional variation for identification. Their typical identification strategy, however, neglects the strongly time variant nature in the process of globalization in general and of FDI in specific. We extend the literature on the determinants of business cycle synchronization by estimating the impact of the determinants with true panel data and a suitable panel estimator. Results indicate that the trade channel is not as important as cross-section models suggest but that FDI may have the potential to increase co-movement of business cycles.

JEL Classification: F21, F41, F44, F49
Key Words: Business Cycle Synchronization, FDI, Trade, Sectoral Differences

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1 Introduction

In this paper we identify the main sources of business cycle synchronization across a set of highly economically integrated countries. This research aim has a tradition in the literature that studies conditions on the optimality of currency areas in terms of business cycle synchronization. The policy relevance of this strand of research arises since a considerable degree of business cycle synchronization between member countries is an important prerequisite for a successful operation of monetary policy (because of the one-size-fits-all interest rate). Empirical evidence on the channels through which cyclical co-movement is induced will add to the reinforced policy coordination measures of the EU by giving structural policies that foster synchronization a role for improving the efficiency of the single monetary policy.

We extend the previous literature on the determinants of business cycle synchronization in two dimensions: First, we explore linkages between the main determinants of business cycle synchronization, namely trade integration and differences in the sectoral structure and put special attention to the influence of financial integration through intensified foreign direct investment (FDI) relations. FDI stocks have increased strongly in the past decades, much stronger than trade links, and by now few large multinational firms represent in many countries a big share of economic output and employment (Kleinert, Martin, and Toubal, 2012). They provide therefore a basis for strong international linkages through their cross-border activities such as intra-firm trade, firm-wide investment plans or wage setting. In particular for the European Monetary Union (EMU), foreign direct investments are essential elements for completing the Internal Market and thus promoting economic integration and the overall competitiveness of the region. While economic rational and research suggests that promoting FDI through investment policies are valid instruments to remove barriers to the completion of the Internal Market (Ilzkovitz, Dierx, Kovacs, and Sousa, 2007), theory and available empirical evidence are more unclear about the effects of deeper cross-border capital links within a region on business cycle synchronization. Thus, there could be a potential conflict between European policies that aim to foster FDI linkages and the efficient policy-making by the European Central Bank if member states' cycles tend to move apart because of desynchronizing forces of the FDI channel. Studying the question whether two countries that are strongly linked through capital stocks show a higher co-movement of output cycles than two countries that are less connected through capital cross-links will clarify such concerns.

Our second contribution to the literature is a more technical one, however, as we argue below, a necessary step forward in the empirics of business cycle synchronization by using panel instead of cross-section data to identify contemporaneous bilateral relations among the determinants. Previous research mainly focused on averaging the data over time and running cross-section regressions on country (pair) means of the explanatory variables. In such regressions, business cycle synchronization between two countries is usually measured

by the Pearson correlation coefficient of GDP cycles over the whole sample period. Some studies impose a panel structure by computing correlation coefficients and averages over few non-overlapping sub-periods of equal size (e.g. Schiavo, 2008; Hsu, Wu, and Yau, 2011). These approaches lead to an identification problem if the data are characterized by trends over time since averages become time dependent and the building of arbitrary sub-periods will randomly influence regression results. As we show below, in particular trade and FDI intensity measures display strong time trends. A more systematic way of exploiting the between and within variation of the data is to directly run panel regressions and, moreover, take country-pair and period fixed effects into account. Country-pair fixed effects consider unobserved heterogeneity between two countries that arises, for instance, due to geographical or cultural proximity while period specific effects capture common time shocks in the similarity measures. The latter are relevant to distinguish the transmission of shocks through trade and FDI linkages from common shocks as source of output cycle synchronization (e.g. Kappler, 2011). Thus, panel estimations are much more capable of reconciling theory with empiricism than pure cross-sectional or pseudo panel estimation approaches can do.

Our results show indeed that the contemporaneous effect of trade integration on business cycle synchronization is not as robust as reported by previous studies. Thus, the correlation between trade relations and synchronization may be largely driven by common underlying factors. Furthermore, regarding FDI linkages we find a significant positive in most cases or insignificant coefficient. This implies that policies fostering bilateral FDI integration do not harm synchronization between these countries. In contrast, they may even increase co-movement. Finally, increasing heterogeneity in the sector composition between countries is found to have a negative impact on their cyclical synchronization.

Before introducing our empirical approach in section 3, the next section provides a short overview of the motivation and the results for the main determinants of business cycle synchronization from the literature. Section 4 clarifies data and measurement concepts, estimation results are presented in section 5. The last section concludes.

2 Literature

Despite the considerable degree of cross-boarder activities arising from foreign direct investment, so far theoretical analyses on the effects of financial integration on business cycles focused almost exclusively on the case of portfolio investment and bank integration. The studies by Russ (2007) and Cavallari (2007, 2008, 2010) are an exception. These authors integrate heterogeneous firms in a monetary two country business cycle model, which choose according to their productivity whether to enter a domestic or foreign market and whether to serve foreign markets through trade or through a foreign affiliate. Households participate in firms activity by holding shares of all types of home

based firms. Thus, the activities of multinational firms foster the co-movement of output across countries by increasing the degree of (dividend) income interdependence.
As regards financial integration in a broader sense, Heathcote and Perri (2002) show that in standard two-country two good international real business cycle (IRBC) models the cross-country correlation between output is higher in the case of financial autarky than with the existence of an internationally integrated bond market or complete asset market. In open financial markets firms can reallocated their resources more efficiently, i.e., to the country with higher productivity, if hit by a shock. Thus, increased financial integration lowers the synchronization of output. But if investors are subject to binding collateral constraints, Devereux and Yetman (2010) and Devereux and Sutherland (2011) find that co-movement differs with respect to the type of financial integration. While integration in bond markets continues to result in lower output correlation in their model, integration in equity markets, where constraints are in place, leads to a transmission of technology shocks across countries through the balance sheet of constrained (international) investors causing output fluctuations to co-move. A similar mechanisms is emphasized by IRBC models incorporating multinational banks, which were developed in the aftermath of the financial crisis of 2007 (see Olivero, 2010; Enders, Kollmann, and Müller, 2011; Ueda, 2012). Financial integration in these studies is modeled by financial intermediaries (banks) operating at a global level. In consequence, a negative country-specific shock to the capital of a bank spreads to another country because of binding capital constraints faced by the international bank, which results in co-movement of international output fluctuations. In contrast, country-specific technology shocks do not lead to synchronized business cycles just like in a conventional IRBC model such as Backus, Kehoe, and Kydland (1992).
The empirical literature suggests several additional transmission channels of business cycle shocks through multinational firms which are not incorporated into business cycle theory so far. First, FDI gives rise to increasingly international supply chains enhancing the spill-over of idiosyncratic shocks from one country to another.[1] Furthermore, Stevens and Lipsey (1992) and Desai and Foley (2006) provide evidence that rates of return and investment of affiliates within a multinational firm are highly correlated pointing to cross-border investment plans. Budd, Konings, and Slaughter (2005) and Jansen and Stokman (2006) both come to the same conclusion, though the first study is based on a firm-level panel and the second on macro data, that multinationals share their profits between their affiliates providing a further transmission channel. Balance sheet effects (similar to what Devereux and Yetman (2010) and Devereux and Sutherland (2011) propose) may be another transmission channel since the balance sheet of a multinational may be more susceptible to changes in the financial conditions in one of its host countries due to its international exposure (see Desai, Foley, and Forbes, 2008). But multinational firms may also benefit from their internal capital markets (see Desai, Foley, and Hines, 2004) and therefore perform better than local firms under strong financial constraints as Hovakimian

[1]IRBC models in the spirit of Burstein, Kurz, and Tesar (2008) capture vertical integration by explicitly including trade in intermediate goods. They find this to be an important channel for synchronization.

(2011) and Alfaro and Chen (2012) point out. Finally, when engaging in business abroad multinational firms trigger knowledge and technology transfers which in turn may narrow the gap between GDP growth rates.
To summarize, from a theoretical point of view the direction of the influence of FDI on synchronization is not clear. Most of the possible channels though point to a positive relation between FDI integration and cyclical co-movement. But as Morgan, Rime, and Strahan (2004) point out, the sign of the relation may strongly depend on the type of shock. If the financial sector of a foreign country is hit by a negative shock, a parent company may support its affiliate with financial liquidity. If in contrast there is an adverse shock to productivity, the parent may withdraw its support and shift resources to more profitable locations.

Most empirical studies on the determinants of business cycle synchronization report a positive impact of financial integration on output co-movement irrespective of the measure in use. De-jure measures like composite indices based on the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)[2] are employed as well as de-facto volume-based or price-based measures like bilateral asset holdings and capital flows or return spreads of equity or bond holdings (see e.g. Kose, Prasad, and Terrones, 2003; Imbs, 2004, 2006; Schiavo, 2008; Keil and Sachs, 2012). In contrast to these studies, Kalemli-Ozcan, Papaioannou, and Peydró (2013) use bilateral international bank assets and liabilities and adopt panel methods including country pair and time fixed effects to quarterly data. They detect a strong negative effect of their measure of financial integration on business cycle synchronization and ascribe this opposing result to an omitted variable bias in cross-section analyses, which could not account for global shocks and unobservable country pair specific heterogeneity.
Only few empirical studies investigate the influence of bilateral FDI linkages on co-movement of business cycles. Considering the strong growth and large scale of of foreign direct investment positions but also the various potential transmission channels arising from multinational firms discussed above, this economic linkage is more than just a financial link and a relevant factor to be included. Empirical findings by Otto, Voss, and Willard (2001), Hsu, Wu, and Yau (2011), Jansen and Stokman (2011) and Keil and Sachs (2012) conclude that the positive effects of increased FDI linkages dominate. The latter two note that there is a shift in importance from trade to FDI in the mid nineties. Dées and Zorell (2012) in contrast do not find a significant direct impact of FDI which may be due to their unusual unscaled FDI measure.

In addition to FDI linkages, we include as major endogenous factors explaining business cycle synchronisation trade integration and differences in countries' sector structure. Trade linkages are the most reviewed and robust determinant of business cycle synchro-

[2]See for instance the Chinn-Ito index (Chinn and Ito, 2008) or the restriction indices by Schindler (2009).

nization in the literature.[3] The positive direct effect of stronger trade relations found in the data is in line with theoretical considerations according to which trade directly links foreign and domestic demand and supply. Thus, trade seems to be an obvious channel for transmission of demand and supply shocks. However, IRBC models have notorious difficulties to match the empirical findings quantitatively (see Kose and Yi, 2006). Comparing estimations over subperiods, Böwer and Guillemineau (2006), Jansen and Stokman (2011) and Keil and Sachs (2012) find that the relevance of trade linkages for bilateral synchronization has decreased since the mid nineties. New evidence on the dynamic relationship between synchronization and trade intensity by Kappler (2011) casts doubt on the importance of trade in the transmission of cyclical shocks. His results support the common shock view as they point to common or global factors being the main drivers of synchronization which trigger changes in trade flows contemporaneously. In this study we focus on the contemporaneous effect of time-varying trade intensity while accounting for common shocks through year specific effects.

Similarities in the sectoral structure of two countries may also be of importance for the bilateral co-movement of their business cycles. Countries with a similar industry structure are supposed to exhibit higher co-movement other things being equal since they will respond in similar ways to global and sector-specific shocks. An idiosyncratic shock to a sector in a country will more likely spread to another country if the countries are engaged in related businesses. However, extant empirical evidence on the importance of sectoral similarity is mixed. Differences in the sectoral structure are either found to decrease synchronization of business cycles significantly (for instance Imbs, 2004, 2006 or Inklaar, Jong-A-Pin, and De Haan, 2008) or to have no significant impact at all (see Baxter and Kouparitsas, 2005).

3 Empirical Approach

To identify the determinants of co-movement in cyclical fluctuations, we base our estimations on the first equation of a system of simultaneous equations similar to the equation model first proposed by Imbs (2004), which explicitly allows the endogenous determinants to depend on each other. Therefore, the system includes in addition to the equation explaining bilateral business cycle synchronization one equation for each endogenous determinant and can be written as follows:

$$\rho_{ijt} = \alpha_1 FDI_{ijt} + \alpha_2 T_{ijt} + \alpha_3 SD_{ijt} + \alpha_4 I_{1,ijt} + u_{1,ijt} \quad (1)$$

$$FDI_{ijt} = \beta_1 T_{ijt} + \beta_2 SD_{ijt} + \beta_3 I_{2,ijt} + u_{2,ijt} \quad (2)$$

$$T_{ijt} = \gamma_1 FDI_{ijt} + \gamma_2 SD_{ijt} + \gamma_3 I_{3,ijt} + u_{3,ijt} \quad (3)$$

$$SD_{ijt} = \delta_1 FDI_{ijt} + \delta_2 T_{ijt} + \delta_3 I_{4,ijt} + u_{4,ijt} \quad (4)$$

[3] See Frankel and Rose (1998), Imbs (2004), Baxter and Kouparitsas (2005) to cite the most influential.

where ρ_{ijt} is our measure of business cycle synchronization between country i and country j at time t. The endogenous determinants are given by the bilateral FDI intensity FDI_{ijt}, a measure for trade integration T_{ijt}, and the differences in the sectoral structure within country pairs SD_{ijt}. Furthermore, in each equation m we include a set of exogenous covariates $I_{m,ijt}$. These exogenous covariates serve as instruments in order to identify the impact of the endogenous explanatory variables in equation (1) and in all other equations, where they are not included as exogenous covariates. If all equations are correctly identified, indirect effects of the endogenous determinants on synchronization can be measured in addition to the direct effects. But since there no valid instrument sets for equation (2) to (4) available, we focus on the estimation of equation (1). The disturbances $u_{m,ijt}$ follow a two-way error component model:

$$u_{m,ijt} = \mu_{m,ij} + \lambda_{m,t} + \varepsilon_{m,ijt} \tag{5}$$

where $\mu_{m,ij}$ denotes country pair specific effects, $\lambda_{m,t}$ common year specific effects and $\varepsilon_{m,ijt}$ the remainder stochastic disturbance of equation m. A detailed description of all variables as well as of measurement concepts and of the potential impact of these variables in the system is given in the next section.

In our analysis we proceed as follows. We focus on identifying the direct effects of the determinants of co-movement in business cycles, i.e. we estimate equation (1). First, we test whether we can reproduce the results from literature in a collapsed cross-section sample with observations pooled over time. In the second step, we employ the full panel data set and estimate equation (1) with an error component two-stage least square (EC2SLS) estimator proposed by Baltagi (1981). We test several instrument sets and compute coefficients for different subsets of our data. Finally, we conduct a bunch of sensitivity tests to our results.

A pure cross-section or between identification strategy employing means of time-varying variables is subject to several objections. Identification over the variation in long-term average behaviour between country pairs is based on the assumption of a stable relation between the variables over time. Several studies like Frankel and Rose (1998), Inklaar, Jong-A-Pin, and De Haan (2008) or Keil and Sachs (2012) deal indirectly with the concern of missing stability by splitting their sample into subperiods (which serves in Inklaar, Jong-A-Pin, and De Haan (2008) also to generate more observations). If results for subperiods are considered separately, they point to a change in the importance of trade and FDI over time corroborating this concern. As we show below, measures of trade and FDI integration contain strong trends in their behaviour over time. Thus, an interpretation of their means over the long term is highly questionable. However, applying panel estimation methods allows to capture the within variation in the data. In addition, cross-section estimates may suffer from omitted variable bias, since some variables of interest are not observable and a sound theoretical foundation of the equation is not at hand. Using panel data

enables us to mitigate this problem by taking unobservable country pair specific effects into account which capture time invariant explanatory factors. Furthermore, we introduce year specific effects to control for common shocks to both countries. This is an important aspect in the light of the strong global shocks of the last years and cannot be tackled in a cross-section approach. Cross-section data does not allow to disentangle whether higher co-movement is caused by transmission, e.g. through trade, or by common shocks. In contrast, the impact of a strong global shock may in the cross-section view be interpreted as stronger economic integration, i.e., increased transmission, because the variables of interest contemporaneously move in the same direction.

In the second step, we estimate the equation explaining synchronization with an appropriate panel two stage least squares approach. Nevertheless, we take the whole system into account when instrumenting, since the instruments stem from the exogenous variables included in the remaining equations. Even if we do not estimate these equations "... much can be gained in specifying a system of simultaneous equations as it permits identification of the coefficients of endogenous regressors using as instruments exogenous regressors excluded from the equation of interest.", as Cameron and Trivedi (2005, p.762) state. We employ the EC2SLS estimator expounded in Baltagi (2008), which is a random effect 2SLS estimator based on a weighted average of fixed effects and between 2SLS estimators. It differs from a conventional random effects or generalized 2SLS estimator in taking endogeneity between the explanatory variables into account (not only correlations between country pair fixed effects and explanatory variables). We test its consistency vis-á-vis a consistent but less efficient FE2SLS estimator by applying the Hausman-test principle. As we discuss at the end of section 5, the identification of the indirect effects by estimating equation 2 to 4 is problematic because proper instruments are not available. Therefore, an estimation of the whole system with an EC3SLS estimator, which takes contemporaneous correlations across equations into account and is thus more efficient, would suffer from a bias due to this problem.

4 Measurement Concepts and Data

4.1 Business Cycle Synchronization and its Endogenous Determinants

We measure bilateral synchronization of business cycles ρ_{ijt} as the negative absolute difference between two countries' real GDP growth rate following Giannone and Reichlin (2008), Kappler (2011) and Kalemli-Ozcan, Papaioannou, and Peydró (2013).[4]

$$\rho_{ijt} = -\left|\Delta Y_{it} - \Delta Y_{jt}\right| \tag{6}$$

[4]Detailed information on data sources are listed in appendix A.

This approach has an interpretation similar to the Pearson correlation coefficient—higher levels of ρ_{ijt} indicate a higher degree of bilateral synchronization between country i and j in year t. But it has several advantages over this traditional time-invariant correlation measure of business cycle synchronization. First, it reveals the variation in synchronization over time. Thereby the stationary characteristic of synchronization becomes evident.[5] Second, ρ_{ijt} is independent of the underlying sample period for each t, which is not the case for the mean-based correlation coefficient, even if it is estimated over sub-periods or a rolling window. In addition, this growth rate based measure is not subject to measurement errors and to critiques on filtering methods which applies to estimated measures of business cycles, e.g. by the HP filter, and their correlations.

When measuring bilateral FDI and trade integration, we want to capture the economic importance of these linkages for both countries. Therefore, we apply the following measurement concept

$$T_{ijt} = \frac{EX_{ijt} + IM_{ijt}}{GDP_{it} + GDP_{jt}} \tag{7}$$

$$FDI_{ijt} = \frac{Out_{ijt} + In_{ijt}}{GDP_{it} + GDP_{jt}} \tag{8}$$

where bilateral export and import flows and FDI inward and outward stocks respectively are scaled by the sum over the GDP of both countries.[6] So as long as a shock affects trade or FDI and output proportionally, we observe no change in our intensity measure. We do not account for FDI flows, since they are of minor relevance with respect to their size (relative to GDP). And being mainly the adjustment of existing FDI relations they are just one of the channels through which existing multinationals affect business cycle co-movement.

To capture differences in the sectoral structure between countries we resort to value added shares s_{zit} for the sectors $z = (1, ..., Z)$ of the OECD STAN database covering all economic activities (including services) according to the International Standard Industrial Classification (ISIC) rev. 3 to compute

$$SD_{ijt} = \sum_{z=1}^{Z} |s_{zit} - s_{zjt}| \tag{9}$$

[5] This applies not only to the synchronization measure used in this paper but also to other time-variant synchronization measures proposed in literature, namely by Yetman (2011), Mink, Jacobs, and De Haan (2007), Morgan, Rime, and Strahan (2004) and Alesina, Barro, and Tenreyro (2002).

[6] In some studies total trade flows/FDI positions of both countries are used as scaling factor. The resulting measures have a different interpretation from ours: they capture the importance of a particular bilateral trade/FDI relation relative to overall trade/FDI of these countries. Thus, these measures assign the same importance to large trade flows between very open countries and small trade flows between relatively closed countries with small overall trade. We think that it is the economic value of linkages which matters for synchronization and not their share in countries' overall linkage portfolio.

This measure is equal to zero if countries have an identical sector structure and reaches its maximum of two for complete disjunct sectors. We expect a negative coefficient in our estimation since larger differences in the sector structure between two countries should decrease their degree of synchronization.

Our three endogenous determinants of business cycle synchronization may interact with each other as stated by the equation system above. To be specific, inter-industry trade integration is supposed to rise as result of increasing differences in the sector structure to exploit endowment differences or comparative advantages. Intra-industry trade, in contrast, may be fostered by more similar industries. Higher similarity may in addition stimulate new FDI in order to benefit from technological knowhow abroad, to be closer to the costumer or to reduce transport costs. The impact of FDI linkages on the industry composition is ambiguous. Due to FDI induced technology transfer countries might become more similar with respect to their industry composition, whereas the slicing of the supply chain and the possibility to diversify risks gives rise to a higher degree of specialization. Regarding trade integration effects could point in both directions as well: on the one hand, FDI may substitute trade where trade costs are prohibitively high (horizontal FDI), on the other hand vertical FDI (i.e., off-shoring parts of the production) or export-platform FDI may stimulate trade in intermediate as well as in final goods. Increased trade integration in turn results in deeper specialization according to classical trade theory based on comparative advantages and economies of scale. This argument is valid for inter-industry trade. But as pointed out by Frankel and Rose (1998) and Imbs (2004) among others, trade between industrialized countries and especially between European countries is predominantly of the intra-industry type. As such it could be source for knowledge spill-overs like FDI and therefore augment similarity. Finally, trade is supposed to show a positive impact on FDI since both are driven by common factors such as firm-level productivity (see Helpman, Melitz, and Yeaple, 2004).

4.2 Instruments and Exogenous Variables

Each equation m in the system includes a set of exogenous explanatory variables denoted by $I_{m,ijt}$. These groups of independent variables enter the respective equation directly and are used as instruments for the identification of the coefficients of endogenous regressors in the synchronization equation (and all equations where they are not in the set of explanatory variables).

In the synchronization equation (1) we include in $I_{1,ijt}$ bilateral measures comparing monetary and fiscal policy within country pairs. The discrepancy in monetary policy between countries is captured by absolute differences between short term interest rates. This measure is the higher, the higher the discrepancy between monetary policies, whereas

for country pairs which are both in the EMU it becomes zero[7]. Coordinated monetary policy may increase synchronization by enhancing similar reactions to a common shock or being itself the source of a common shock. In a currency union the stability of the exchange rate may provide an additional indirect positive effect by stimulating trade integration. But in case of idiosyncratic shocks countries under a common monetary policy may lack the possibility of adjustment to keep cycles moving together. Empirical studies find only weak evidence for similarity in monetary policy as enhancing factor (see Baxter and Kouparitsas, 2005). Divergence in fiscal policy is measured as bilateral differences in the government budget balance in percentage of GDP following Darvas, Rose, and Szapary (2007). From a theoretical point of view, the effect of fiscal policies on synchronization is ambiguous depending on the type of economic shock and on the type of fiscal policy. On the one hand, discretionary or rule-based fiscal spending may be used to dampen the effects of country-specific or asymmetric shocks implying a positive impact of fiscal divergence on cyclical co-movement. On the other hand, fiscal policy may also be employed in pro-cyclical way or even be source of a country-specific shock and therefore loosen co-movement. Empirical studies of Darvas, Rose, and Szapary (2007) or Inklaar, Jong-A-Pin, and De Haan (2008) suggest that a higher discrepancy between fiscal deficits has at best a negative effect on the co-movement of business cycles or none as Clark and Van Wincoop (2001) find. Although previous literature (see Inklaar, Jong-A-Pin, and De Haan, 2008) based on cross-section identification shows that there are no major differences in the results between an exogenous and an endogenous treatment of these policy variables, the assumption of no contemporaneous reaction of policy to cyclical fluctuations might be problematic in a panel model. We therefore consider an alternative specification where we include both policy variables with a lag of one year instead of the contemporaneous variables. For the lagged variables the assumption of exogeneity is justifiable from a theoretical point of view. Furthermore, it is known that business cycles usually react with a lag to changes in fiscal and monetary policy. Qualitatively there is virtually no difference in the results between including the contemporaneous and the lagged values of the policy variables. While a noteworthy change in the size of coefficients is only observed for FDI integration which result to be about 25% higher in some specifications when lagged policy measures are used.

Previous papers use as instruments for the endogenous regressors (and as covariates for the remaining equations) mainly time-invariant country pair specific variables like the well-know gravity variables for trade or the indicators on the degree of de jure financial openness by La Porta, Siliances, Schleifer, and Vishny (1998) for financial integration. In our panel estimation approach all time-invariant explanatory factors are absorbed by

[7]Differences in the short term interest rates may be seen as lower bound of overall differences in monetary policy. The extraordinary country specific measures used by the ECB in the last years show that there may be additional differences even within a currency union, at least during times of crisis. In consequence, the coefficient of monetary policy has to be interpreted as an upper bound.

country pair fixed effects. Therefore, by our research design only time-variant variables are considered as instruments and covariates respectively.

Theoretically, an optimal candidate for $I_{2,ijt}$ as an instrument and exogenous explanatory variable for FDI integration would be a de jure measure of openness to FDI. The OECD provides an index on FDI Regulatory Restrictiveness, but unfortunately only for few years.[8] But even more comprehensive data on the legal situation like the indices by Schindler (2009) on direct investment restrictions or the more general Chinn-Ito index (Chinn and Ito, 2008) measuring the degree of capital account openness are problematic for panel data analyses since their within variation is low for most countries. Regressions including one of these variables—transformed into a bilateral measure by taking sums or differences—in $I_{2,ijt}$ return an insignificant effect in the first stage no matter in which estimation specification, while the coefficients of the second stage do not change. Therefore, we do not include any de jure measure of capital or FDI openness in $I_{2,ijt}$. Instead we use indicators for de facto capital controls to explain the degree of bilateral FDI linkages. A better general access to capital in each single country may be an important criterion for direct investment decisions and therefore be favourable to FDI integration. Since the following measures are not based on true bilateral data but are computed by taking differences or sums of indicators for overall capital openness of each of the two countries, their endogeneity may be less of an issue. We include the bilateral sum of the gross private capital flow ratio to GDP as a volume-based measure of capital openness. As alternative, we use a price-based measure, namely the return spread between share price indices which are constructed to represent share price movements in national stock markets. According to theory, in perfectly integrated capital markets the law of one price should hold implying equal returns on comparable assets (Keil and Sachs, 2012). Smaller return spreads indicating a higher degree of financial market integration are therefore expected to foster FDI integration. Additionally, we include lagged FDI integration as suggested by Schiavo (2008) and a measure of overall economic development of a country pair given by the bilateral sum of GDP per capita.

In explaining trade integration with panel data we can build on an established literature. We follow Egger (2000) in including the following index measuring the similarity in the economic size of countries in $I_{3,ijt}$:

$$GDPsimilar_{ijt} = 1 - \left(\frac{GDP_{it}}{GDP_{it} + GDP_{jt}}\right)^2 - \left(\frac{GDP_{jt}}{GDP_{it} + GDP_{jt}}\right)^2 \tag{10}$$

This index is the larger, the more similar two countries are in terms of GDP. Very similar countries are supposed to have a high degree of intra-industry trade and therefore also of general trade linkages. Furthermore, $I_{3,ijt}$ contains the same measure of overall economic development like $I_{2,ijt}$. Additionally, we include an index on the degree of bilateral (de

[8] The index is provided for the years 1997, 2003, 2006 and on an annual basis since 2010.

jure) economic integration which is taken from the Database on Economic Integration Agreements by Baier and Bergstrand (2007), but which is only available until 2005.

Differences in the sector structure are explained by overall economic development (like trade and FDI linkages) and by differences in economic development/wealth between countries measured by the absolute difference in GDP per capita. These two measures both draw on the idea that economies manifest certain patterns regarding the industrial composition in different states of development (Imbs and Wacziarg, 2003). This argument may be less appropriate the more similar countries are with respect to their sectoral structure and stage of development.

4.3 Data Overview

Since the emphasis of our identification approach lies on the within variation in the data, we choose the longest possible sample at the expense of a reduction of the number of country pairs. After the exclusion of South Korea because of its strongly differing synchronization patterns, there are 16 countries left yielding 120 country pairs.[9] Due to the limitations in time range given by OECD's bilateral FDI data and OECD STAN database used to calculate sectoral differences, we obtain a usable data set for the period from 1982 to 2009 at an annual frequency. Descriptive statistics for all variables are included in the appendix A in table 7.

In figure 1 we plot cross-section averages for each point in time of our synchronization measure and the three endogenous determinants. The plots reveal that all variables but synchronization exhibit significant changes in levels over time casting the meaningfulness of long-term averages into doubt.

5 Results

In this section we first report estimation results for the cross-section and then for the panel dimension. We start with a parsimonious specification where we include one (time-variant) instrument for each endogenous variable. These instruments are the volume-based measure of capital openness, economic similarity and overall economic development. We discuss and test the choice of instruments by employing the other available instruments discussed before in our panel estimations.

[9]These countries are: Austria, Canada, Denmark, Finland, France, Germany, Greece, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, UK, US.

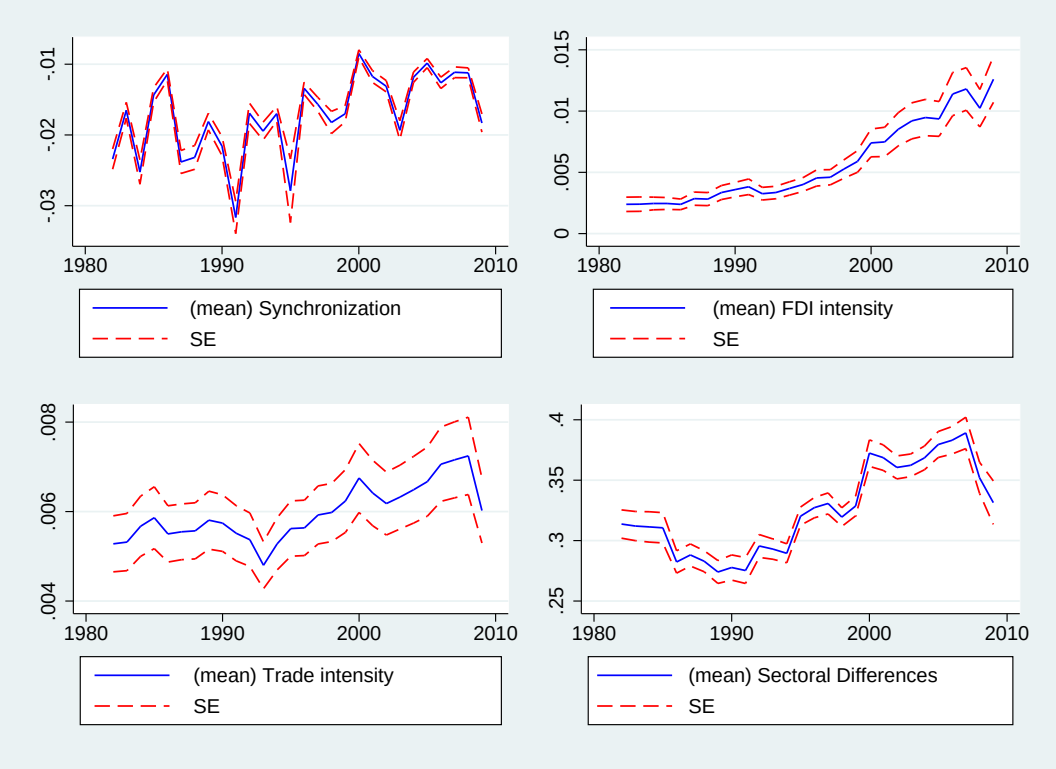

Figure 1: Cross-sectional means of business cycle synchronization and its endogenous determinants

5.1 Cross-section

Before conducting panel estimates we confront our data basis with the cross-section based literature. We do this by estimating the synchronization equation with cross-section data obtained by averaging the data over time. To make the comparison more appropriate, we additionally include a set of time-invariant exogenous variables. Our identification approach based on time-variant instruments presented in section 4.2 cannot correctly identify effects in the cross-section where fixed effects cannot be taken into account. In such a setting, we obtain low F-statistics for FDI and trade integration in the first stage pointing to weak instruments. Including some time-invariant variables serves to at least partially control for country pair specific characteristics. We use standard gravity variables, namely the distance between the main economic centers and dummy variables for common border from CEPII's Gravity dataset[10], as well as the bilateral sum of an index measuring share holder rights provided by La Porta, Siliances, Schleifer, and Vishny (1998). These additional variables remedy the weak instruments problem in the cross-section raising the F-statistics of first step estimations well above the rule of thumb value of 10. In addition, Hansen's J test does not report problems with the validity of the instruments. Estimations are carried out based on pooled data over the whole period

[10]http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=8

from 1982 to 2009 as well as over the subperiods 1982-1994 and 1995-2009. The choice of subperiods follows Jansen and Stokman (2011) who justify their decision by the strong expansion of FDI activity since 1995.

In table 1 the estimates for these three samples are reported. We find that coefficients—especially those of trade and FDI intensity—vary strongly with the underlying sample period. In specific, cross-section estimates can reproduce the positive significant effect of trade linkages on the co-movement of business cycles found in previous studies as long as data from the 1980ies and early 1990ies is included in the sample. Otherwise the coefficient is insignificant or even negative significant. In a similar fashion, we observe a positive significant impact of FDI integration only for the last 15 years of our sample. The shift in the coefficients over time has not necessarily to be a signal for a change in

Table 1: 2SLS cross-section basic specification (including time-invariant instruments)

Dependent Variable	Synchronization	Synchronization	Synchronization
Period	1982-2009	1982-1994	1995-2009
FDI	0.118	-1.583	0.594
	(0.164)	(0.654)**	(0.227)***
Trade	0.058	0.727	-0.703
	(0.208)	(0.223)***	(0.342)**
Sectoral Differences	-0.000	-0.035	-0.034
	(0.016)	(0.010)***	(0.017)*
Monetary Policy	-0.120	-0.043	-0.245
	(0.037)***	(0.033)	(0.070)***
Fiscal Policy	-0.029	-0.027	0.061
	(0.034)	(0.029)	(0.032)*
N	120	59	120
Hansen's J Test			
χ^2 (d.f.)	7.47 (3)	.79 (3)	.37 (3)
p-value	.058	.853	.946

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

the strength of the underlying relation between FDI or trade linkages and synchronization but may simply be driven by the calculation of means over time series containing trends.

5.2 Panel approach

In this section we discuss the results of estimating equation (1) employing the error component two stage least squares (EC2SLS) estimator on panel data. All panel estimations include country-pair specific effects and a full set of year dummies if not stated differently.

Table 2: EC2SLS basic specification with parsimonious instrument set for subperiods

Dependent Variable	Synchronization	Synchronization	Synchronization
Period	1982-2009	1982-1994	1995-2009
FDI	0.249	0.175	0.176
	(0.124)**	(0.969)	(0.116)
Trade	-0.157	-0.118	-0.005
	(0.198)	(0.483)	(0.198)
Sectoral Differences	-0.039	-0.037	-0.034
	(0.009)***	(0.015)**	(0.009)***
Monetary Policy	-0.097	-0.038	-0.117
	(0.024)***	(0.044)	(0.028)***
Fiscal Policy	0.064	0.043	0.051
	(0.012)***	(0.028)	(0.015)***
Year Dummies	Yes	Yes	Yes
N	1,793	331	1,462
Hausman Test FE2SLS vs. EC2SLS			
χ^2 (d.f.)	4.53 (32)	.35 (6)	9.03 (7)
p-value	1	.999	.25
Hansen's J Test			
χ^2 (d.f.)	19.98 (25)	15.885 (12)	20.08 (17)
p-value	.748	0.197	.27

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Basic Specification with Parsimonious Instrument Set The results of our basic specification with the same parsimonious (time-variant) instrument set and over the same subperiods as in the cross-section approach are reported in table 2. In contrast to the cross-section, estimates for the recent period from 1995-2009 are not very different from the overall sample, whereas there are some changes in significance for the earlier period. However, these results should not be over-interpreted since estimations on the earlier sample may suffer from the relatively low number of observations. FDI has a significant positive effect on synchronization over the entire period but remains insignificant for the subperiods. We additionally estimate the equation excluding the crises driven years since 2007. The results of this estimation are not reported since the only remarkable change is a higher impact of FDI (0.397) on synchronization at a 1% significance level. Regarding trade we do not find a significant impact for any subsample. As we will show in the following the coefficient of trade integration is insignificant not only in our basic specification but also in our sensitivity tests. Differences in the sectoral structure in turn have a negative significant effect on cyclical co-movement implying that the transmission of idiosyncratic shocks between countries is the weaker the bigger the differences in their sectoral structure. Therefore, it may well be possible that FDI and trade exert an indirect influence on business cycle synchronization by causing changes in the sectoral composition of economies.

The differences in monetary policy are estimated to have a negative impact on the cyclical co-movement of a country pair implying higher synchronization in countries with similar short term interest rates. In contrast, differences in the net lending position of governments have a positive effect. This result may arise from the fact that governments make deficits when trying to buffer their country from idiosyncratic shocks.

The last part of table 2 reports Hausman tests based on the difference between fixed effects two stage least squares (FE2SLS) and EC2SLS estimates.[11] The null hypothesis of consistent EC2SLS estimations cannot be rejected for any of the three samples. Furthermore we checked the F-statistics of the EC2SLS and FE2SLS first stage regressions, which signal no problems of weak instrumentation for any of the endogenous covariates being all two-digit. We find F-statistics from FE2SLS to be higher than the single-digit F-statistics of first stage between regressions emphasizing that country pair specific effects should not be neglected. In addition, we test the exogeneity of instruments by means of Hansen's J test, i.e., testing the validity of overidentifying restrictions. In contrast to the Sargan test this test is consistent in the presence of heteroscedasticity. With our parsimonious instrument set containing just one instrument for each endogenous variable, such a test is only possible for random effect estimators. When applying the EC2SLS estimator the exogenous regressors (in our case the indicators for monetary and fiscal policy as well as all year dummies) are subject to a GLS transformation before the estimation. In the IV estimation (on the transformed data) the transformed regressors are all treated as

[11] In appendix B the FE2SLS estimation results are reported in table 8.

endogenous while for each of them their demeaned and recentered transformation as well as their group mean transformation are used as excluded instruments. In contrast, for the FE2SLS the test is not applicable since the equation is just identified. The results of Hansen's J test on the EC2SLS estimations confirm our parsimonious instrumentation.

Alternative Instrumentation In order to test the dependence of our results on the instrumentation, we add the alternative instruments named in section 4.2 one-by-one to the parsimonious instrument set. In table 3 we report the estimation results as well as the test statistics of Hansen's J Test. The first column repeats the results of the parsimonious instrument set, the following columns add in turn the measures of differences in economic development, differences in return spreads and the indicator on Economic Integration Agreements (EIA) and finally lagged FDI intensity to the instrument set.[12] The changes in the instrumentation do not come with significant changes in the results reported for the parsimonious specification except for the FDI coefficient when including EIA or lagged values of FDI. In the first case the impact of FDI is bigger, which is due to the data limitations of the EIA indicator. As mentioned before, it stops in 2005 so that the crisis years are excluded from the sample. Including lagged FDI integration as an instrument yields an insignificant effect of FDI integration on business cycle synchronization. We repeat this exercise with our second subperiod from 1995 to 2009[13] and find a very similar picture: The coefficient of FDI linkages is significant in all but the parsimonious specification and the one including lagged FDI.

Relation of FDI and Trade A potential reason for the insignificant effects of trade integration could be its multicollinearity with FDI. Indeed, in the cross-section we observe an unconditional correlation as high as 0.71 between the two variables, which makes cross-section based estimations including trade and FDI even more questionable. In the panel data the unconditional correlation still amounts to 0.65, but drops to 0.44 if we take country-pair fixed effects into account and to 0.37 if additionally year specific effects are included. Considering the correlation between country pairs and within country pairs separately, it emerges that the high correlation is mainly driven by strong relations between trade and FDI across country pairs, but not over time. The correlation between country pairs amounts to 0.69 averaged over all years, whereas the correlation over time adds just up to 0.31 averaged over all country pairs (a detailed statistic on between and within correlation is included in appendix B, figure 2 and 3). This said, multicollinearity seems to be more of an issue if we look at shorter samples or at the cross-section.

As a further test of the importance of multicollinearity for our estimation results, we compute estimations excluding in turn trade and FDI. In the first case, we obtain a some-

[12] In addition, we tried various combinations of bigger instrument sets, but in most of the cases Hansen's J test rejected these bigger instrument sets.

[13] Results are reported in appendix B, table 9.

Table 3: EC2SLS with additional instruments

	(1)	(2)	(3)	(4)	(5)
Instrumentation	Pars.	Ec. Diff.	Return Spread	EIA	L.FDI
FDI	0.249	0.269	0.285	0.489	-0.011
	(0.124)**	(0.134)**	(0.123)**	(0.168)***	(0.059)
Trade	-0.157	-0.172	-0.194	-0.204	0.069
	(0.198)	(0.218)	(0.192)	(0.226)	(0.160)
Sectoral Differences	-0.039	-0.037	-0.038	-0.032	-0.040
	(0.009)***	(0.009)***	(0.008)***	(0.009)***	(0.009)***
Monetary Policy	-0.097	-0.095	-0.096	-0.093	-0.083
	(0.024)***	(0.024)***	(0.024)***	(0.026)***	(0.024)***
Fiscal Policy	0.064	0.063	0.064	0.059	0.054
	(0.012)***	(0.012)***	(0.012)***	(0.015)***	(0.012)***
Year Dummies	Yes	Yes	Yes	Yes	Yes
Period	1982-2009	1982-2009	1982-2009	1982-2005	1983-2009
N	1,793	1,793	1,791	1,447	1,750
Hansen's J Test					
χ^2 (d.f.)	19.98 (25)	17.39 (27)	29.59 (27)	26.21 (21)	21.26 (28)
p-value	.748	.921	0.333	.198	.814

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Excluding trade/FDI

Period	1982-2009	1995-2009	1982-2009	1995-2009
FDI	0.186	0.180		
	(0.088)**	(0.068)***		
Trade			0.160	0.296
			(0.128)	(0.081)***
Sectoral Differences	-0.037	-0.033	-0.035	-0.030
	(0.009)***	(0.009)***	(0.009)***	(0.007)***
Monetary Policy	-0.089	-0.116	-0.058	-0.077
	(0.023)***	(0.026)***	(0.023)**	(0.023)***
Fiscal Policy	0.063	0.050	0.055	0.050
	(0.012)***	(0.015)***	(0.012)***	(0.014)***
Year Dummies	Yes	Yes	Yes	Yes
N	1,793	1,462	1,802	1,471
Hansen's J Test				
χ^2 (d.f.)	18.65 (24)	15.92 (16)	24.5 (24)	40.365 (16)
p-value	.77	.459	.433	0.001

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

what smaller but significant coefficient for FDI linkages in the synchronization equation, for 1995-2009 even at the 1% level, leaving the remaining results qualitatively unchanged (see table 4). Excluding FDI instead leads to bigger changes: the trade coefficient becomes positive, but it is only significant in the subperiod from 1995 to 2009, where the parsimonious instrument set is rejected, though. These results imply that trade effects are not completely irrelevant for the synchronization of business cycles. But the impact of trade may be more of the indirect type, i.e., by fostering stronger FDI linkages and influencing the degree of sectoral differences between economies. Taking FDI out of the system eliminates the first of these indirect channels and results in a weak direct relation.

Synchronization in the EU and EMU We also investigate whether our conclusions from the OECD countries sample hold for the European environment. Therefore, we re-estimate the equation for two smaller country samples, the first limited to country pairs in the European Union and the second including only relations between Euro-area members. Since before 1988 for some of the variables there is no bilateral inner European data available, we report the results for these shorter time frame for all country groups. Estimated coefficients are presented in table 5. They imply very similar results for synchronization in the EU and the OECD. In the Euro area, the impact of FDI remains insignificant, i.e., inner European FDI linkages seem not to affect business cycle synchronization between member countries neither in a positive nor in a negative way.

Table 5: EC2SLS basic specification for EU and EMU

Period		1988-2009	
Country Group	OECD	EU	EMU
FDI	0.249	0.249	0.183
	(0.115)**	(0.124)**	(0.182)
Trade	-0.137	-0.157	-0.169
	(0.183)	(0.198)	(0.267)
Sectoral Differences	-0.040	-0.039	-0.050
	(0.008)***	(0.009)***	(0.022)**
Monetary Policy	-0.101	-0.097	-0.172
	(0.024)***	(0.024)***	(0.036)***
Fiscal Policy	0.063	0.064	0.089
	(0.012)***	(0.012)***	(0.022)***
Year Dummies	Yes	Yes	Yes
N	1,763	1,014	574
Hansen's J Test			
χ^2 (d.f.)	21.14 (23)	14.52 (19)	9.30 (15)
p-value	0.573	.753	.861

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.3 Sensitivity

To test the sensitivity of our results, we estimate several variations of our basic specification.

Alternative Measures of FDI and Trade Linkages In a first step, we use alternative measures for FDI and trade intensity which take the asymmetry between countries into account. In case a country pair consists in countries which differ strongly with respect to their economic size, our trade and FDI integration measures may understate the importance of linkages for the small country. Therefore, we repeat our estimations employing a measure where bilateral trade and FDI linkages are scaled by the GDP of the smaller country as proposed by Otto, Voss, and Willard (2001).

$$\begin{aligned} Ta_{ijt} &= \max\left(\frac{EX_{ijt}+IM_{ijt}}{GDP_{it}}, \frac{EX_{ijt}+IM_{ijt}}{GDP_{jt}}\right) \\ FDIa_{ijt} &= \max\left(\frac{Out_{ijt}+In_{ijt}}{GDP_{it}}, \frac{Out_{ijt}+In_{ijt}}{GDP_{jt}}\right) \end{aligned}$$

Since the results are very similar to those displayed in table 2, we do not include them here for the sake of saving space.

Alternative Measures of Synchronization Furthermore, we conduct estimations with alternative synchronization measures. On the one hand, we use our synchronization measure based on the business cycle computed as HP-filtered output instead of year-on-year growth rates of output. On the other hand, we adopt a measure proposed by Morgan, Rime, and Strahan (2004), which is computed in two steps: first, we recover the residuals from of a regression of real GDP growth on country-pair and year specific fixed effects.

$$\Delta Y_{it} = \mu_i + \lambda_t + \varepsilon_{it}$$

Simply speaking, this residual GDP growth captures for a given year a country's deviation from its own long-run GDP growth and from the cross-section average growth rate in that specific year. The alternative synchronization measure is then constructed in a similar fashion as the basic measure by taking the negative absolute difference between residual GDP growth, i.e.,

$$\rho_{ijt}^{alt.} = -|\varepsilon_{it} - \varepsilon_{jt}|$$

In contrast to our basic measure, this proxy is corrected for changes in the amplitude of fluctuations. In table 6 we compare the estimated coefficients for these different measurement concepts. We find that for the latter measure qualitative results are altered

only for FDI which is insignificant in the parsimonious specification but significant for several other instrumentations (not shown). Whereas when the HP-filtered measure is used, in addition to FDI, monetary policy looses its significance. Furthermore, the instrumentation seems problematic when the dependent variable is based on HP-filtered GDP. There is no sign of weak instruments, but Hansen's J Test rejects the exogeneity of our parsimonious instrument set as well as of alternative instrumentation.

Table 6: EC2SLS with alternative synchronization measures

Based on	Synchronization GDP Growth	Synchronization HP-filtered GDP	Synchronization residual GDP growth
FDI	0.249	0.139	0.194
	(0.124)**	(0.113)	(0.136)
Trade	-0.157	0.198	-0.012
	(0.198)	(0.179)	(0.218)
Sectoral Differences	-0.039	-0.049	-0.032
	(0.009)***	(0.008)***	(0.009)***
Monetary Policy	-0.097	0.017	-0.147
	(0.024)***	(0.022)	(0.025)***
Fiscal Policy	0.064	0.042	0.056
	(0.012)***	(0.011)***	(0.013)***
Year Dummies	Yes	Yes	Yes
N	1,793	1,793	1,793
Hausman Test FE2SLS vs. EC2SLS			
χ^2 (d.f.)	4.53 (32)	15.41 (32)	6.74 (32)
p-value	1	.994	1
Hansen's J Test			
χ^2 (d.f.)	19.98 (25)	73.88 (25)	32.15 (25)
p-value	.748	0	.154

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Alternative Error Structure In our basic specification, contemporaneous correlation of the errors across panel individuals arising e.g. by common shocks hitting the country-pairs are modelled by common time effects in the error term. To check the robustness of the reported results with respect to this choice, we follow an alternative approach proposed by Pesaran (2006) and include cross-sectional averages of the endogenous variables instead of year dummies in the estimation equations. The cross-sectional averages provide a solution to soak up cross-sectional correlation. The idea of this approach is to model the residuals of the panel equation as being composed of two orthogonal components. The first component comprises common factors that soak up the cross-sectional co-movement in the data whereas the second component captures mainly idiosyncratic variable-specific movements. Following Pesaran (2006), we estimate the common factors consistently by cross-sectional averages of the country-specific variables (synchronization, FDI, trade and

sectoral differences) and their lagged values. In general, results are qualitatively very similar to those reported in table 3 with year dummies, the only exception being the parsimonious specification with a negative trade coefficient which is significant at the 10% level. But Hansen's J test rejects the validity of instruments for this specification pointing to inconsistent estimates. Quantitative changes occurred only in the FDI coefficient which is about 20% higher in all specification when cross-sectional averages are included.

Estimation in Log-like Transformation We estimate our model not only in levels but also in a log-like transformation following Levy Yeyati, Panizza, and Stein (2007) which for a variable x can be written as[14]

$$loglike(x) = sign(x) * ln(1 + abs(x))$$

Results produced by estimating the transformed system do not differ significantly from the ones of the basic specification and are not reported.

Estimating the Indirect Effects Most studies on the determinants of business cycles building on the system proposed by Imbs (2004) provide estimates of the remaining equations of the system. An estimation of these equations is useful to disentangle the indirect effects of determinants resulting from their interdependence, e.g. we would know whether trade linkages indirectly foster synchronization by enhancing FDI or decrease the differences in the sector composition. In our attempt to identify these relations, we came across the same problem in all three equations: Our available instrument sets were rejected by Hansen's J test in almost all cases. One of the possible reasons may be the close relation of trade and FDI, which are determined by very similar factors. This makes it difficult to find an instrument which is correlated to the one and exogenous to the other of the two. If the exogeneity condition for the instruments is not met, inconsistent estimated coefficients are the consequence. Therefore we refrain from reporting non properly identified indirect effects here. Previous studies reporting estimates for these relations either worked with exactly identified systems where overidentifying tests can not be applied or without reporting tests of their instrumentation.

6 Conclusions

We readdressed the determinants of business cycle synchronization in this paper to test, on the one hand whether FDI promoting policies may have consequences on the business cycle behaviour, and on the other hand whether more plausible identification strategies

[14]This more complicated transformation is necessary, since FDI positions and in consequence our measure for bilateral FDI intensity can be negative and are therefore not compatible with a simple logarithmic transformation.

change previous results. Understanding the determinants of synchronization is important, since a considerable degree of cyclical co-movement is important for the efficiency of a common monetary policy in a currency union. This fact became especially evident in the light of the past years, when the heterogeneity in economic development between the countries in the Euro-zone increased forcing the European Central Bank (ECB) to use country targeted policy measures in addition to the common interest rate. Since these measures are highly disputed by experts and come at a risk, the ECB plans to abandon the non-standard measures once its member countries exhibit a stable and more similar economic development. Our results suggest that the beneficial effects of trade integration for the similarity of business cycles are less robust than previously thought. One explanation for this result is, that trade moves together with business cycle synchronization because of common shocks. In contrast, linkages through foreign direct investment are found to contribute in most cases positively to the synchronization between concerned countries. This implies that policies to attract more FDI from abroad go, in general, hand in hand with an increased similarity of business cycles with these international partners. In the specific case of bilateral synchronization between EMU members we do not identify a positive significant effect for the long sample but also no negative one. Thus, our results suggest no conflict of goals between policies to promote FDI and the necessary synchronization of business cycles in the EMU. Furthermore, we find that larger differences in the sector structure between two economies result in a bigger gap between their business cycles.

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A Measures and Data Sources

Synchronization: Negative absolute difference of real GDP growth, see equation 6. *Source:* OECD Economic Outlook.
FDI integration: Sum of bilateral FDI inward and outward positions divided by the sum of nominal GDP, see equation 7. *Source:* OECD International Direct Investment

Statistics; World Bank, World Development Indicators.

Trade integration: Bilateral import and export divided by the sum of nominal GDP, see equation 8. *Source:* IMF, Direction of Trade Statistics; World Bank, World Development Indicators.

Differences in the sector structure: Sum over negative absolute differences between value added shares for 41 sectors, see equation 9. *Source:* OECD STAN database.

Monetary policy: Absolute difference in short term interest rates (three month nominal interest rate, mainly interbank rates). *Source:* OECD Economic Outlook.

Fiscal policy: Absolute difference in government budget balance. *Source:* IMF, World Economic Outlook April 2012.

Return spreads between share price indices: Absolute difference in growth of share price index. *Source:* IMF, IFS

Volume-based measure of capital openness: Bilateral sum of gross private capital flows ratio to GDP. *Source:* World Bank WDI.

Overall economic development: Bilateral sum of GDP per capita (in PPP). *Source:* World Bank, International Comparison Program database.

Economic similarity: Indicator based on nominal GDP following Egger (2000), see equation 10. *Source:* World Bank, World Development Indicators.

De jure economic integration: Ranking of bilateral degree of economic integration. *Source:* Baier and Bergstrand (2007), Database on Economic Integration Agreements.

Differences in economic development: Absolute differences in GDP per capita (in PPP). *Source:* World Bank, International Comparison Program database.

Distance between the main economic centers: mean of (by population) weighted distances between biggest cities/areas. *Source:* CEPII, Gravity dataset, http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=8.

Common border: Dummy variables with value 1 if countries have a common border and 0 otherwise. *Source:* CEPII, Gravity dataset, http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=8.

Table 7: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Synchronization	3360	-0.017	0.017	-0.169	0.000
FDI	2744	0.006	0.012	-0.001	0.119
Trade	3360	0.006	0.008	0.000	0.039
Sectoral Differences	2685	0.329	0.106	0.107	0.823
Monetary policy	3360	0.030	0.033	0.000	0.189
Fiscal policy	2454	0.047	0.044	0.000	0.285
Return Spread	3022	0.173	0.202	0.000	2.115
Capital Openess	3345	-0.001	0.006	-0.036	0.030
Economic Similarity	3360	0.298	0.155	0.021	0.500
Economic Development	3360	5.390	1.104	2.760	9.289
Development Differences	3360	0.583	0.474	0.000	2.711

B Additional Tables

Table 8: FE2SLS vs. EC2SLS

Dependent Variable	Synchronization	Synchronization	Synchronization
Period	1982-2009	1982-1994	1995-2009
FDI	0.775	142.363	-0.085
	(0.734)	(679.389)	(0.567)
Trade	4.435	1.709	3.009
	(3.996)	(63.364)	(9.393)
Sectoral Differences	0.043	-0.061	-0.219
	(0.088)	(2.636)	(0.191)
Monetary Policy	-0.048	0.102	-0.205
	(0.077)	(0.683)	(0.124)*
Fiscal Policy	0.090	-0.026	0.111
	(0.054)*	(1.376)	(0.067)*
Year Dummies	Yes	Yes	Yes
N	1,793	331	1,462
Hausman Test FE2SLS vs. EC2SLS			
χ^2 (d.f.)	4.53 (32)	.35 (6)	9.02 (7)
p-value	1	.999	.25

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: EC2SLS with additional instruments for 1995 to 2009

	(1)	(2)	(3)	(4)	(5)
Instrumentation	Pars.	Ec. Diff.	Return Spread	EIA	L.FDI
FDI	0.176	0.215	0.200	0.301	-0.056
	(0.116)	(0.107)**	(0.112)*	(0.174)*	(0.061)
Trade	-0.005	-0.046	-0.076	-0.004	0.191
	(0.198)	(0.185)	(0.189)	(0.262)	(0.166)
Sectoral Differences	-0.034	-0.033	-0.034	-0.034	-0.035
	(0.009)***	(0.008)***	(0.008)***	(0.011)***	(0.010)***
Monetary Policy	-0.117	-0.120	-0.122	-0.109	-0.093
	(0.028)***	(0.027)***	(0.027)***	(0.031)***	(0.027)***
Fiscal Policy	0.051	0.053	0.051	0.049	0.040
	(0.015)***	(0.014)***	(0.015)***	(0.020)**	(0.015)***
Year Dummies	Yes	Yes	Yes	Yes	Yes
Period	1982-2009	1982-2009	1982-2009	1988-2005	1983-2009
N	1,462	1,462	1,462	1,146	1,437
Hansen's J Test					
χ^2 (d.f.)	20.08 (17)	22.06 (19)	29.5 (19)	14.09 (15)	20.88 (20)
p-value	.27	.281	.058	.519	.404

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

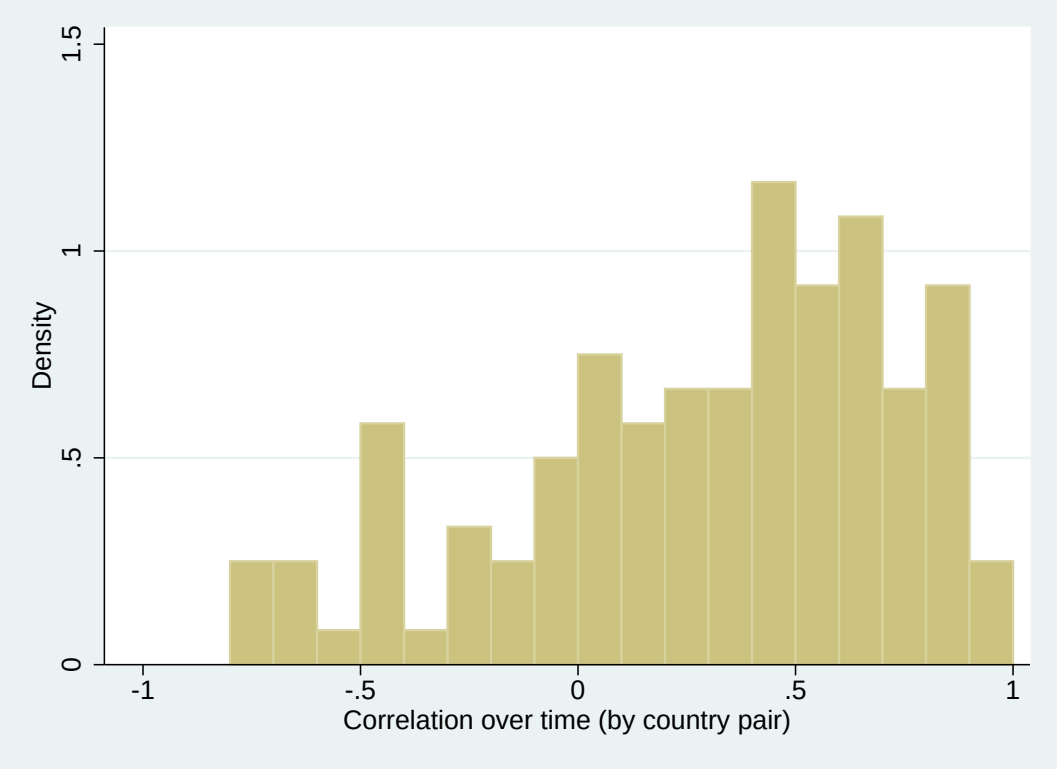

Figure 2: Distribution of "within"-correlation of trade and FDI

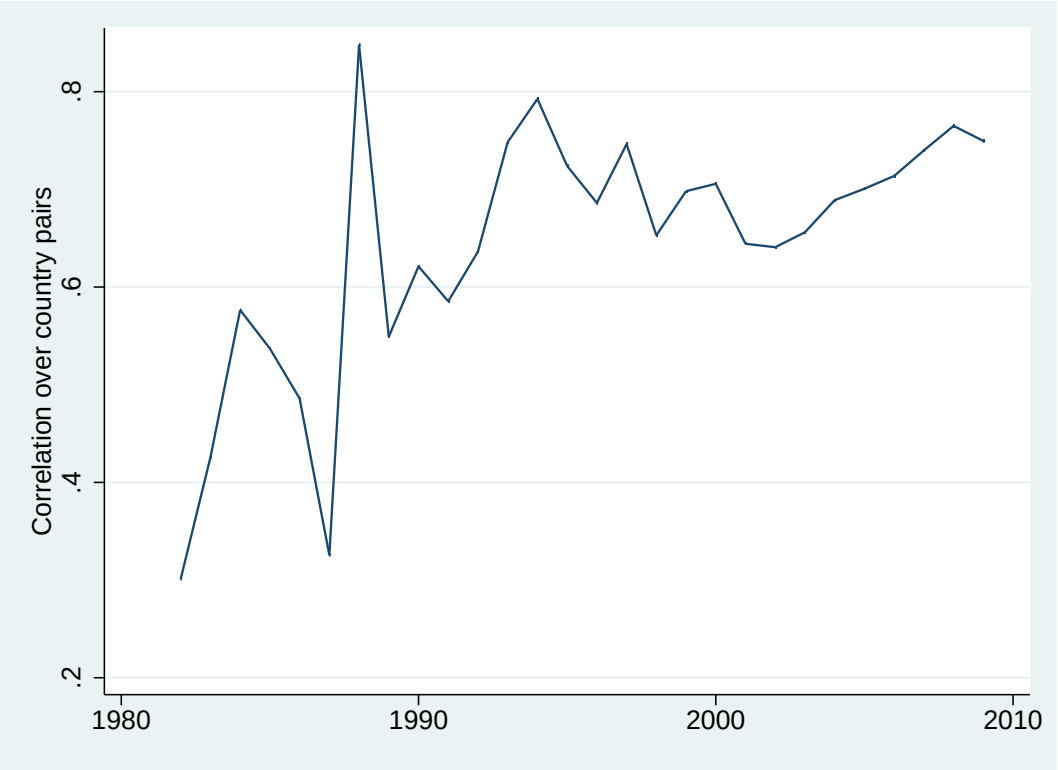

Figure 3: Evolution of "between"-correlation of trade and FDI

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Project Information

Welfare, Wealth and Work for Europe

A European research consortium is working on the analytical foundations for a socio-ecological transition

Abstract

Europe needs a change: The financial crisis has exposed long neglected deficiencies in the present growth path, most visibly in unemployment and public debt. At the same time Europe has to cope with new challenges ranging from globalisation and demographic shifts to new technologies and ecological challenges. Under the title of Welfare, Wealth and Work for Europe – WWWforEurope – a European research consortium is laying the analytical foundations for a new development strategy that enables a socio-ecological transition to high levels of employment, social inclusion, gender equity and environmental sustainability. The four year research project within the 7th Framework Programme funded by the European Commission started in April 2012. The consortium brings together researchers from 33 scientific institutions in 12 European countries and is coordinated by the Austrian Institute of Economic Research (WIFO). Project coordinator is Karl Aiginger, director of WIFO.

For details on WWWforEurope see: www.foreurope.eu

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