International Portfolio Investment Integration and Business Cycle Synchronization

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Abstract

This paper argues that the correlation of cross-border portfolio investment integration with business cycle synchronization is conditional on different types of shocks. Exploiting panel data on bilateral portfolio holdings from 29 advanced economies covering 17 years, I filter idiosyncratic and common shock drivers of synchronization. I show that portfolio investment and synchronization correlate negatively in response to common shocks, consistent with previous results and suggesting flight to safety effects. However, they correlate positively in response to idiosyncratic shocks, suggesting that output smoothing takes place. This result is robust to a number of robustness tests, notably controlling for bank loan integration. The evidence suggests that if we want to find remedies for asymmetric business cycles, we need to take asset specific effects into account.

Keywords: Business Cycle Synchronization, Financial Integration, Portfolio Investment, Shocks
JEL: G32, F15, G01

The interplay between international financial asset holdings and economic activity is at the center of policy and academic debates. In 2007, asset holdings spread the global financial crisis from the United States (US) to the rest of the world. In 2010, bond market holdings fueled the Eurozone crisis. Yet, today many policy makers underline benefits of international asset holdings, such as risk sharing mechanisms, that smooth economic cycles. Identifying such risk sharing mechanisms is particularly important for the Eurozone, where business cycle asymmetries are potentially impeding monetary policy. Although assessing effects of asset holdings on business cycle synchronization is of large interest, only few empirical studies on portfolio investment exist.

In this paper, I study the correlation between cross-border portfolio investment and business cycle synchronization conditional on common and idiosyn-

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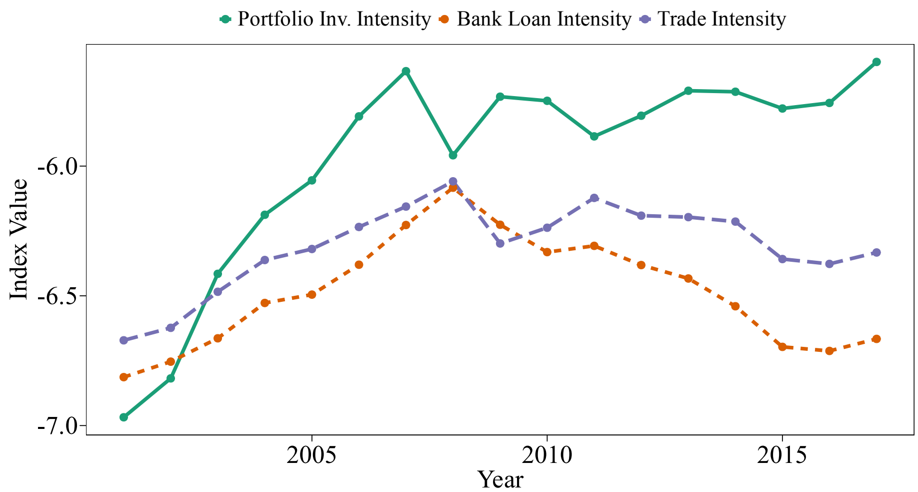


Figure 1: Bilateral portfolio investment, bank loan, and trade integration over time
Notes: This figure plots mean time series of cross-border financial integration and trade intensity indices for each country-pair ij at t across a sample of 29 advanced economies. Based on Coordinated Portfolio Investment Survey (CPIS) and Bank of International Settlements (BIS) data. The indices shown are simple intensity measures based on equation 4.

cratic shocks. Usually, researchers categorize cross-border financial integration into bank loan and portfolio investment holdings. Knowing the effects of portfolio integration is important due to two reasons. First, descriptive evidence shows less correlation between portfolio integration and other main drivers of financial and real integration, indeed indicating a potential mechanism for risk sharing. Figure 1 plots mean portfolio investment, banking and trade integration indices among 29 advanced economies and shows that in particular portfolio investment integration only partly co-moves with trade and banking integration. Second, while effects of banking integration have received much interest in the business cycle synchronization literature, current estimates on effects of portfolio investment are still based on cross-sectional data (Davis, 2014), focus solely on the US (Pyun and An, 2016), and do not account for country-pair specific time-invariant factors.[2]

This paper aims to overcome these issues and puts the literature on portfolio investment and business cycle synchronization on par with recent estimates on banking integration effects. I argue that the correlation of cross-border portfolio

[2]Important contributions to the synchronization literature have demonstrated that business cycle synchronization and greater banking integration correlate negatively (Kalemli-Ozcan et al., 2013b,a). Recently, Cesa-Bianchi et al. (2019) have shown that this result is conditional on the type of shock. In response to idiosyncratic shocks, greater banking integration and synchronization correlate positively. But in response to common shocks, the correlation turns negative.

investment integration and business cycle synchronization is conditional on two types of shocks. In presence of idiosyncratic shocks, greater portfolio investment integration is positively correlated with synchronization. However, in presence of common shocks the correlation turns negative. Thus, the relationship between synchronization and portfolio investment integration mirrors signs found in the literature focusing on banking integration.

One potential explanation for this result is that estimating portfolio investment integration effects on synchronization is simply testing the indirect effect of cross-border bank loan integration.[3] In the literature, greater portfolio investment integration is usually associated with wealth and balance sheet effects of stock and bond markets (Pyun and An, 2016) that are directly linked to bank loans. (i) Wealth effects are linked to cross-border stock market integration, which leads to greater risk sharing and output smoothing. Thus, they tend to decrease business cycle synchronization, because the country owning stocks abroad has a temporary advantage of 'taking leisure' while the other works (Baxter and Crucini, 1995; Davis, 2014). (ii) Balance sheet effects involve bond market integration, which is at the origin of 'financial multiplier' effects of leveraged intermediaries, and increase synchronization. Because banks earn interest and non-interest income through lending and trading, a change of economic situation in one economy has two effects. First, to safeguard their trading portfolio, banks withdraw assets from risky economies. Second, banks adjust lending because they need to follow Basel II regulations and lower risk exposure. Overall, this results in greater business cycle synchronization.

I argue that the correlation of portfolio investment integration and synchronization is not necessarily the result of bank loan integration. To do so, I additionally control for bank loan integration and still find persistent signs of portfolio investment integration. The correlation of portfolio investment and synchronization depends on whether shocks are idiosyncratic or common. In presence of idiosyncratic shocks, output smoothing takes place which leads to more synchronization. In presence of common shocks, all financial actors loose wealth and flight to safety in portfolio holdings leads to less synchronization.

To test these mechanisms, I exploit a panel of 29 advanced economies' bilateral cross-border portfolio investment holdings over the 2001-17 period originating from the International Monetary Fund's (IMF) Coordinated Portfolio Investment Survey (CPIS). Thus, I provide evidence on how portfolio investment integration affects synchronization for a global sample of advanced economies. This is important because, despite the fact that the US is still at the center of the global financial system, important secondary clusters have developed (Figure 5).

To gauge the relationship between portfolio investment integration and business cycle synchronization, I regress bilateral indices of cross-border financial

[3] For example, an idiosyncratic shock decreases value of cross-border portfolio asset holdings in the foreign economy which results in a loss on the home economy's balance sheet. The home economy experiences a credit crunch as banks adjust loans and both economies become more synchronized. In this scenario, the connection between the financial and real sectors are bank loans.

and real integration on indicators of real GDP growth synchronization. I notably improve on prior approaches on three dimensions.

First, to account for the endogenous relationship between financial integration and business cycle synchronization, I take a conservative approach and use a set of instruments that have become standard in the literature. The main instruments are based on the Fernández et al. (2016) capital control indices database. My main identifying assumption is that the average level of capital controls across a country-pair is exogenous to the amount of assets held across each country-pair. Thus, to challenge this assumption, country-pairs would need to coordinate on the exact amount and timing of raising or lowering capital controls, a relatively weak assumption consistently made in the literature. Second, I control for important factors such as trade and industry specialization patterns that might also affect synchronization. Third, contrary to prior studies on portfolio investment, I account for shocks common to all economies, as well as bilateral country-pair fixed effects. The recent literature on the effect of greater banking integration on synchronization exhibits the importance of accounting for country-specific loadings via fixed-effects due to two reasons (Cesa-Bianchi et al., 2019).[4] First, the canonical real business cycle model of Backus et al. (1992) shows that after a technology shock, financial flows across country-pairs increase while business cycle synchronization decreases. Thus, the underlying theoretical unit of observation is within country-pair. The second empirical argument is that unobserved time-invariant country-pair heterogeneity, such as language or culture, influences bilateral variables. This country-pair heterogeneity is absorbed by the fixed effects.

Arguably, the 2001-17 period has seen one major global shock in form of the 2008 US crisis, preceded and followed by more regionally restricted shocks such as the European sovereign debt crisis or the Dot-com bubble crash. Thus, potential estimates for business cycle synchronization have to distinguish between common and idiosyncratic shocks. To take this observation into account, I follow the recent approach from Cesa-Bianchi et al. (2019) and decompose business cycle synchronization into a common and idiosyncratic part. To do so, I employ a principal component analysis and identify components that are common to at least two economies. Factor loadings on each principal component are allowed to be country-specific.

In the first part of the paper, I establish the key result. Greater portfolio investment integration is positively correlated with business cycle synchronization over the total sample period. However, the effects are dependent on two types of shocks. Portfolio investment and synchronization correlate positively in response to idiosyncratic shocks, but they correlate negatively in response to common shocks. This result is highly robust to the inclusion of controls such as bilateral trade intensity or industry specialization patterns. To account for the potential endogeneity between portfolio integration and synchronization, I use

[4]See also Kalemli-Ozcan et al. (2013a), who were the first to control for common shocks using homogeneous country-pair factor loadings in their estimations.

an index on average capital market restrictions across each country-pair originating from Fernández et al. (2016). The signs of the relationship are robust to the instrumental variable approach and the inclusion of multiple control variables. Thus, my main result complements recent evidence on the correlation of cross-border banking integration with business cycle synchronization (Cesa-Bianchi et al., 2019; Kalemli-Ozcan et al., 2013a). My estimates indicate that the correlation between portfolio investment and synchronization moves in the same direction as the correlation between banking integration and synchronization.

Is this result simply a reformulation of recent evidence on bank level integration from Cesa-Bianchi et al. (2019)? It is a well-known fact that portfolio investment integration is strongly correlated with bank loan integration.[5] To study this question, I complement the CPIS data with data from the Bank of International Settlements (BIS) Locational Statistics. While additionally controlling for cross-border bank loan integration reduces statistical significance of the estimates due to the smaller sample size of the BIS data, the main result holds. Interestingly, in response to common shocks, bank loan integration enters the specification with a positive sign, suggesting that it partly alleviates the negative correlation between portfolio investment and synchronization. This suggests that flight to safety primarily occurred in portfolio investment holdings, while bank loan integration enabled some form of burden sharing, when shocks were global.

What are the underlying drivers of portfolio investment effects? To investigate this question, I dissect portfolio investment integration into its two main components: stock and bond holdings. I employ Fernández et al. (2016) sub-indicators on credit and capital market integration restrictions as instruments.[6] The results indicate that it's mainly bond market integration that drives the overall sign of portfolio investment effects. I only find limited evidence that stock market integration has statistically significant effects.

As an additional robustness check, I employ 3-Stage-Least Squares (3SLS) simultaneous equations that account for direct and indirect effects among the main drivers of business cycle synchronization. I use a simultaneous equation system that explains bilateral business cycle synchronization with bilateral portfolio investment integration, trade integration, and industry pattern similarity. Important contributions by Imbs (2004, 2006), Davis (2014) and Pyun and An (2016) have used comparable approaches for cross-sectional and panel data. I augment their approach with time and country-pair fixed effects and use stan-

[5]Restricting our sample to the 18 economies used in Kalemli-Ozcan et al. (2013a) and Cesa-Bianchi et al. (2019) the correlation is 0.82 over the 2001-12 period.

[6]Note, however, that despite the popularity of these instruments in previous research, the cross-border capital market restriction instrument suffers from F-scores that are largely below 10. Credit market restriction indices, however, fulfill the usual requirements of a relevant instrument for bond market integration with F-scores above 10. I leave a more thorough investigation of this question to further research.

dard instruments.[7] I confirm the main result on the correlation between business cycle synchronization and portfolio investment integration.

This paper relates to two strands of the literature. First, it contributes to a large strand of the literature that has sought to explain the different theoretical and empirical mechanisms influencing business cycle synchronization. Over the last decades, researchers have considered factors such as trade integration (Frankel and Rose, 1998), industry specialization patterns (Kalemli-Ozcan et al., 2003; Imbs, 2004), or monetary integration (Fatás, 1997). My results particularly relate to studies on the effects of bank (Morgan et al., 2004; Kalemli-Ozcan et al., 2013b; Cesa-Bianchi et al., 2019) and portfolio investment integration (Imbs, 2006; Davis, 2014). The main finding contributes to evidence on the effect of the 2008 financial shock on business cycle synchronization from a US perspective (Pyun and An, 2016). However, contrary to Pyun and An (2016), I take a global perspective and study financial integration effects in a bilateral country-pair setting covering 29 advanced economies. I show that the reversal of portfolio investment effects is a general phenomenon in presence of common shocks. It took place on a global scale, even across country groups excluding the US.

Second, it relates to a strand of the literature that analyzes the common and idiosyncratic parts of business cycles. This strand of the literature has shown that a large part of a country's business cycle can be attributed to common shocks (Kose et al., 2003a, 2008; Hirata et al., 2013; Crucini et al., 2011). My results are particularly related to Cesa-Bianchi et al. (2019), who have shown that a principal factor decomposition of business cycle synchronization into common and idiosyncratic parts is crucial when trying to explain business cycle synchronization.

The rest of the paper is organized as follows. The next section discusses the theoretical underpinnings of wealth, balance sheet, and bank loan integration effects. Then, I discuss the data in section 2. Section 3 presents descriptive evidence showing that while the US is at the center of the world financial system other important secondary financial networks have evolved over the last decade. Based on this first empirical evidence, I build an econometric framework in section 4 and explain identification and instrument choice. Section 5 presents the first main result and section 6 discusses how the main results relates to recent evidence on bank loan integration. Section 7 computes additional robustness checks and section 8 concludes.

1. Theoretical framework: Balance sheet dynamics

This section explains the three theoretical mechanisms underlying the interpretation of the empirical evidence. Using a simple framework based on two

[7] I instrument cross-border portfolio investment integration with the mean of the capital restriction index across the country-pair. Cross-border trade integration is instrumented with an indicator on bilateral trade agreements. Industry specialization patterns are instrumented with the log product and absolute difference of bilateral per capita GDP.

economies' balance sheets, I explain how greater stock and bond market integration affect bank loan integration and how this leads to more or less business cycle synchronization.[8]

Let a (home) and b (foreign) denote two representative banks in countries A (home) and B (foreign). All physical capital loans in this two-country economy to firms and households are made by those two banks. Figure 2 shows the simplified balance sheets of these two banks. The asset side of both banks is composed of loans and portfolio investment holdings (stocks and bonds) held in home and foreign economies.[9] Banks finance this loan and financial security portfolio with home and foreign deposits. Subscripts A and B denote the country where the entity is held. *Equity* denotes equity invested in bank a or b. I assume that the banks allocation decision is subject to home bias, e.g. the share of physical capital loans to domestic firms and households is greater than physical capital loans to foreign firms and households. Using this simple framework, one can study the balance sheet dynamics of idiosyncratic country-pair specific and common shocks.

There are two types of shocks that have distinct effects. A locally restricted shock in country B leads to a loss in assets in bank b's balance sheet. This loss can occur in two ways. First, the local shock in country B lowers the value of $PortfolioInv._B$. The loss in asset value in bank b's balance sheet means that this bank has to adjust its loans downward to keep the asset/debt ratio constant. The lower value of $PortfolioInv._B$ calls for similar adjustments in country A. Both countries experience a credit crunch and synchronization increases. Second, loan defaults in country B directly decrease the value of $Loans_B$. Compared to the initial situation the asset/debt ratio of the country B bank deteriorates. Bank b is constrained to reduce credit supply. The asset defaults also deteriorates the asset/debt ratio of the representative bank in country A, depending on the amount of physical capital loan defaults in B's economy. To decrease its asset/debt ratio, Bank a is constrained to pay off its assets in country B, resulting in less credit supply in country A. Thus, there is less credit provision in both countries which results in greater synchronization of cycles. The local shock in country A led to a contagion effect from A to B. At the same time, while there is greater synchronization, the impact of the shock has been diversified across the two economies. Thus, there is some kind of output smoothing due to greater financial integration. Empirically, Cesa-Bianchi et al. (2019) confirm the theoretical mechanism on bank loan integration using BIS data on 18 economies over the 1980-2012 period. They find that greater banking integration correlates positively with business cycle synchronization, in response to country-specific shocks.

[8]For simplicity, I restrict the analysis to bank balance sheet integration. Beyond depository-taking corporations, the CPIS data also cover central banks, general government, and other financial institutions such as mutual funds or insurers.

[9]Stock and bond holdings are defined in the broadest way possible. Stocks represent an ownership interest in an entity and bond holdings are any security representing a creditor relationship with another entity.

Country A

Bank a

Assets	Liabilities
$Loans_A$	$Deposits_A$
$Loans_B$	$Deposits_B$
$PortfolioInv._A$	$Equity_a$
$PortfolioInv._B$	
of which	
$Stocks_A$	
$Stocks_B$	
$Bonds_A$	
$Bonds_B$	

Country B

Bank b

Assets	Liabilities
$Loans_B$	$Deposits_B$
$Loans_A$	$Deposits_A$
$PortfolioInv._B$	$Equity_b$
$PortfolioInv._A$	
of which	
$Stocks_B$	
$Stocks_A$	
$Bonds_B$	
$Bonds_A$	

Figure 2: Balance sheet dynamics

A global shock affecting both economies has again two ways to affect the real sector. First, a global shock affects the value of both $PortfolioInv._A$ and $PortfolioInv._B$. In this case, bank a might decide not to pay off its assets placed in the foreign country if it is considered to be a safe haven. Thus, despite the fact that both economies are hit by a common shock, one is relatively worse off than the other. Thus, they face different credit provision leading to less synchronization. Second, both economies might directly experience loan defaults. Again, their business cycle synchronization decreases, because not all loans are paid off similarly as the foreign economy is deemed to be a safe haven. In both cases, flight to safety might occur in just one asset (portfolio holdings or bank loans) depending on specific economies. In this case it is the relative magnitude of both channels that shapes the correlation of financial integration and business cycle correlation.

These theoretical mechanisms imply that the effect of greater cross-border financial integration on business cycle synchronization are distinct depending on whether the idiosyncratic or common factor of business cycles is affected. The next subsection details how I decompose business cycle synchronization into its idiosyncratic and common factors and presents the data.

2. Data

I use four main databases to test the theoretical mechanisms outlined in the previous section: World Development Indicator data (WDI), the Coordinated Portfolio Investment Survey (CPIS), Direction of Trade Statistics (DOTS), and United Nations National Accounts.

2.1. Synchronization

To measure business cycle synchronization, the literature usually computes the following year-to-year measure of co-movement.

$$S_{ij,t} = -|g_{it} - g_{jt}| \tag{1}$$

where g_{it} and g_{ij} indicate the log difference of annual GDP growth of countries i and j at t. Thus, equation (1) measures business cycle synchronization as the average similarity in GDP growth rates across the country-pair. A similar measure has been used by Kalemli-Ozcan et al. (2013a) and many other researchers. A higher value of S indicates more co-movement. Perfect co-movement is achieved at zero.

However, equation (1) does not distinguish between common or global shocks. As shown by Cesa-Bianchi et al. (2019), computing S might be troublesome, because even if two economies respond to a shock in the same manner, S might actually decrease if the magnitude of the GDP growth increase is different across the two economies. It is more a dispersion measure than a measure of business cycle synchronization.

To overcome this issue, I follow the recent approach from Cesa-Bianchi et al. (2019), who argue that common shocks have heterogeneous effects across economies due to their different elasticities in response to common shocks. Thus, S can be decomposed into an idiosyncratic part S^e and a common part S^F.[10]

Assume that GDP growth can be described by a common and idiosyncratic part.

$$y_{it} = a_i^y + b_i^y F_t^y + \epsilon_{it}^y \tag{2}$$

where a_i^y is the average GDP growth of country i, ϵ_{it}^y is the response of GDP growth to an idiosyncratic shock, and F_t^y is a vector of common factors obtained via principal component analysis. b_i^y can thus be interpreted as the elasticity of country i to a common factor. By definition we can thus rewrite (1) as:

$$S_{ij,t} = -|a_i^y - a_j^y + S^e + S^F| \tag{3}$$

where $S_{ij,t}^e = \epsilon_{it}^y - \epsilon_{jt}^y$ describes the idiosyncratic part of business cycle synchronization and $S_{ij,t}^F = (b_i^y - b_j^y)F_t^y$ denotes the common part.

To compute the three synchronization variables, I retrieve country-level data on GDP from the WDI Database in constant 2010 US Dollars. I deflate country-level GDP with their US dollar deflator and compute annual growth rates. To identify common and idiosyncratic shocks, I decompose the variance in the dependent variable into n factors. Then, I consider eigenvalues associated with each factor. Following Cesa-Bianchi et al. (2019), I define shocks with eigenvalues strictly below one as idiosyncratic, and shocks with eigenvalues larger than one as common. Because my country sample covers 29 advanced economies, I need six factors to explain all common variance in GDP growth.

2.2. Portfolio investment integration

The most suitable information available on bilateral portfolio investment holdings is the IMF's Coordinated Portfolio Investment Survey (CPIS). The CPIS indicates asset and liability stocks of bilateral portfolio assets of central banks, depository-taking corporations, general government, and other financial institutions such as mutual funds or insurers. It also offers a decomposition of portfolio investment into stock (equities) and bond (debt) market holdings. The raw sample covers the 2001-2018 period and comprises 62 economies. However, many economies suffer from "quality issues" in their reporting of cross-border assets. These "issues" are particularly pronounced for tax havens such as Panama or the Isle of Man. I take a cautious approach and only keep 29 advanced economies following standard IMF World Economic Outlook definition.[11] The data are in USD and deflated using the US GDP deflator. Similar to a measure of trade intensity I sum cross-border portfolio assets and liabilities and normalize by the sum of the two countries' deflated GDP in USD. Computing such

[10] See Cesa-Bianchi et al. (2019) for an overview of the methodology.

[11] While estimates are much more imprecise, our main result is robust to taking the full 62 economy sample.

financial integration measures has a long tradition in the literature (Lane and Milesi-Ferretti, 2003; Kose et al., 2003b).

$$PI_{ij,t} = \frac{1}{4}[ln(\frac{A_{ij,t}}{Y_{i,t}+Y_{j,t}})+ln(\frac{L_{ij,t}}{Y_{i,t}+Y_{j,t}})+ln(\frac{A_{ji,t}}{Y_{i,t}+Y_{j,t}})+ln(\frac{L_{ji,t}}{Y_{i,t}+Y_{j,t}})] \quad (4)$$

where $PI_{ij,t}$ is an index measuring cross-border portfolio investment integration. This index is composed of cross-border assets $A_{ij,t}$ and cross-border liabilities $L_{ij,t}$ held across each country-pair ij at t. $Y_{i,t}$ and $Y_{j,t}$ are the respective economies' GDP figures.

2.3. Trade intensity

I use a well-established measure of bilateral trade intensity (Frankel and Rose, 1998). Using data on bilateral exports and imports originating from the IMF's Direction of Trade Statistics database, I normalize imports (CIF) and exports (FOB) by the sum of the two countries GDPs. The data are in USD and deflated using the US deflator.

$$T_{ij,t} = ln(\frac{(X_{ij,t}+M_{ij,t})}{(Y_{i,t}+Y_{j,t})}) \quad (5)$$

where $X_{ij,t}$ indicates exports and $M_{ij,t}$ designates imports across each country-pair ij at t. $Y_{i,t}$ and $Y_{j,t}$ are the respective economies' GDP figures.

2.4. Industry specialization

I create a measure for similarity in the production structure or industry specialization. Based on data from the United Nations Statistics Division, I obtain country-level value added per industry sector. The data are in national currencies and deflated with each country's GDP deflator. Then, I compute the sum of differences in the share of value added for six International Standard Industrial Classification (ISIC) 4 industry sectors across each country-pair.[12]

$$Spec_{ij,t} = \frac{1}{D}\sum_{d=1}^{D}|\frac{VA^d_{i,t}}{VA_{i,t}} - \frac{VA^d_{j,t}}{VA_{j,t}}| \quad (6)$$

where $\frac{VA^d_{i,t}}{VA_{i,t}}$ denotes the share of industry sub-sector d value added in country i total value added. $\frac{VA^d_{j,t}}{VA_{j,t}}$ is the equivalent for all j. D is the number of distinct sectors. Thus, I compute the average differences across each sector to obtain an indicator of the similarity of the production structure across the country-pair. A similar index has been used by Pyun and An (2016) or Cesa-Bianchi et al. (2019).

[12] The sectors are: Agriculture, hunting, forestry, fishing (ISIC A-B), Mining, manufacturing, utilities (ISIC C, E), Manufacturing (ISIC D), Construction (ISIC F), Other Activities (ISIC J-P), Transport, storage and communication (ISIC I), Wholesale, retail trade, restaurants and hotels (ISIC G-H).

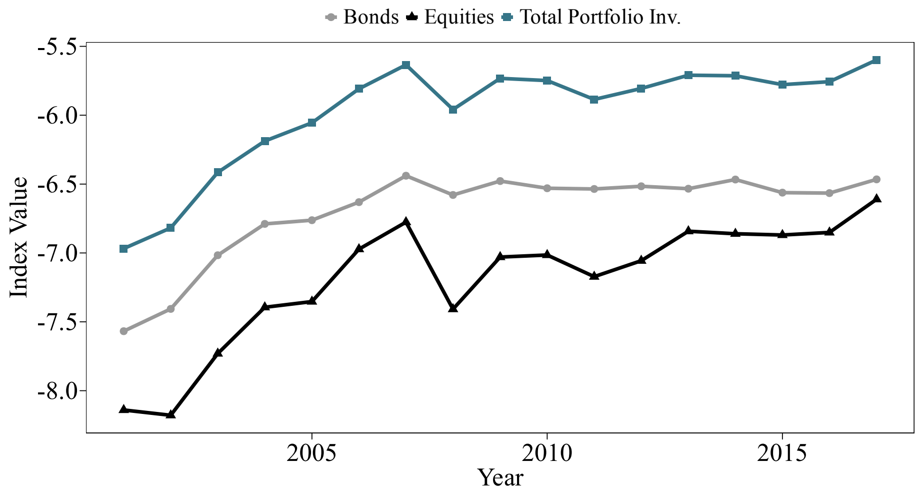


Figure 3: Portfolio investment integration over time

Notes: This figure plots the mean time series of the financial integration index for each country i at t across the total sample. Based on CPIS data. The index is based on equation 4.

3. Descriptive evidence: Mapping financial and real integration

Using the CPIS data, I document two sets of facts on geographical and asset type dependency of cross-border financial integration. First, I highlight that there was a global aggregate trend towards greater cross-border financial integration, which stopped with the 2008 financial crisis. Second, using a network approach, I identify different communities based on the Girvan and Newman (2002) algorithm. The results give a first indication that cross-border portfolio investment integration is still heterogeneous in nature and depends on geographical distance and asset types.

3.1. Portfolio investment integration and business cycle synchronization

Figure 3 shows the development of the main variables of interest for different economies over time. Portfolio investment, stock, and bond market integration variables have a clear pattern: Integration increased until the crisis years of 2008-10, dropped sharply, and recovered slowly afterwards. The magnitude of this pattern varies largely across economies. In particular economies that were affected by crises, such as Greece, Ireland or Spain, experience large declines in international asset integration with the rest of the world.

Figure 4 shows that the average level of business cycle synchronization follows this pattern. However, business cycle synchronization differs significantly depending on whether one looks at its common or idiosyncratic parts. Unsurprisingly, the overall development of business cycle synchronization was clearly driven by common shocks over the sample period. S^F increased until 2008,

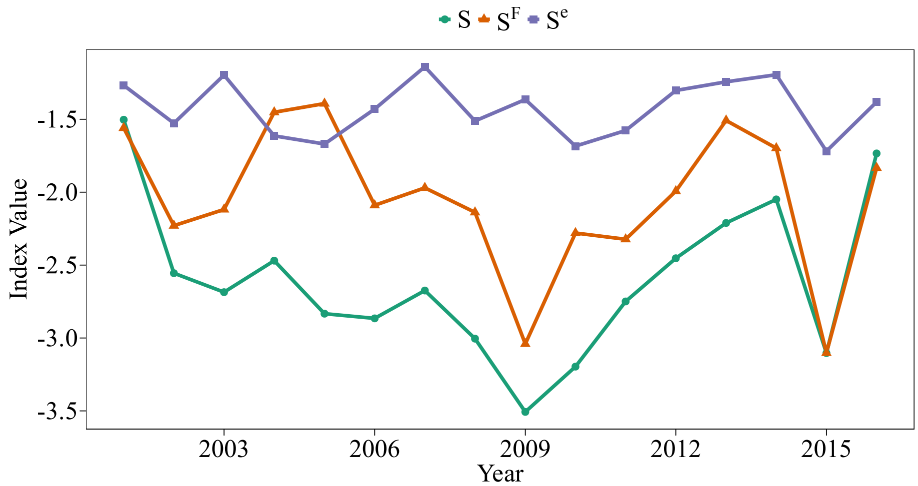


Figure 4: Business cycle synchronization over time

Notes: This figure plots the mean time series of the business cycle synchronization variables across the total sample.

slumped, and recovered to pre-2008 levels in 2013. Idiosyncratic business cycle synchronization S^e fluctuates at consistently lower levels.

3.2. Identifying communities of portfolio investment integration

The aggregate figures suggest that cross-border integration indices follow a trend. They increased rapidly until the Great Financial Crisis (GFC) of 2008, then dropped, and have slowly recovered ever since. This subsection presents additional evidence that despite this global trend, cross-border financial market integration is still heterogeneous in nature. Applying the Girvan and Newman (2002) algorithm, I identify community structures in the bilateral financial networks formed by the cross-border portfolio investment integration indices. A community is defined as a set of nodes that are densely connected internally but have few connections between groups.[13] The detected communities have two dimensions. First, they are based on geography. Cross-border financial integration increased among some country groups, such as the European economies, while it receded among others.[14] Second, communities vary depending on the type of integration indices and over time.

[13]Specifically, I form weighted networks based on the different integration indices. The Girvan and Newman (2002) algorithm identifies edges that are between communities and then removes them. Thus, at the end we are left with the communities themselves. This identification employs the betweenness centrality measure, which quantifies the number of times a node acts as a bridge along the shortest path between two other nodes.

[14]See for instance Martin and Rey (2000) and Portes and Rey (2005) for theoretical and empirical explanations for different geographical developments.

Figure 5 compares results of the community detection algorithm applied to the portfolio investment integration variable in 2001 and 2017.[15] Unsurprisingly, many communities intersect. However, a comparison between 2001 and 2017 particularly reveals the large increase in cross-border financial market integration and the emergence of economies such as Luxembourg, the Netherlands, and Ireland.

Figure 6 shows that stock market integration has been marked by the emergence of Ireland as European hub. Via Great Britain, Ireland represents the main link to the United States in 2017.[16] This development is also in line with evidence from Lane and Milesi-Ferretti (2007), who illustrated this shift in stock markets from non-European to European economies. At the same time, the economies in the sample have become much more intertwined as showcased by the larger node links.

Eurozone bias has even been stronger in bond markets (figure 7 and Lane (2006)), where intra-European cross-border bond integration has increased since 2001. Yet, bond markets seem to be much more disconnected beyond certain subcommunities compared to stock markets. There are three distinct groups that partly intersect. A large European group composed of countries such as Austria, Belgium, Spain, Italy, France, Germany, Netherlands, and Ireland. A second group comprising economies such as the United States, Japan, Australia, Canada, Hong Kong, and Singapore. A third group is composed of the remaining economies such as South Korea, Cyprus, and Estonia.

The community organization of cross-border financial integration portrayed conveys the need for a country-pair world sample when assessing effects of cross-border portfolio investment integration. While the US is undoubtedly one global player in capital markets, other countries play also important roles. The next sections take stock of this empirical fact and focus on portfolio integration effects across 29 advanced economies.

4. Identification strategy

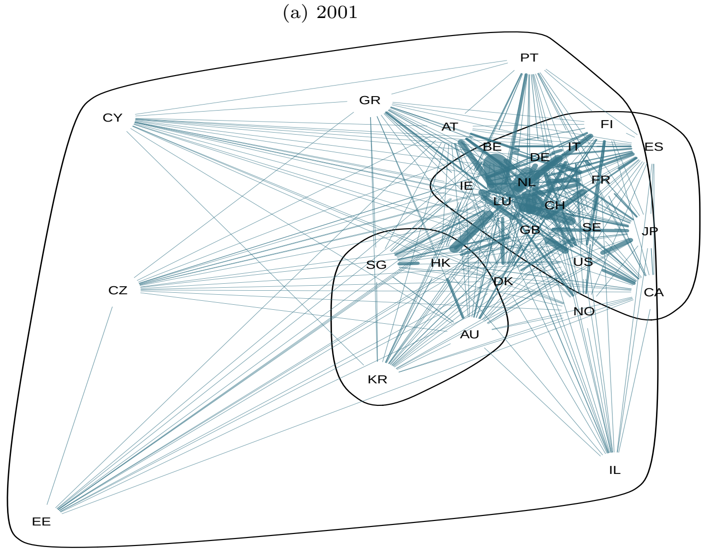
Armed with the first descriptive evidence showing large cross-country heterogeneity in cross-border financial integration, this section outlines the econometric framework used to estimate the correlation between portfolio investment integration and synchronization. The baseline relationship is the following (7).

$$S_{ij,t} = \mu_t + \mu_{ij} + \alpha_1 FinInteg_{ij,t} + \alpha_2 Controls_{ij,t} + \epsilon_{ij,t} \tag{7}$$

[15]Due to the bilateral nature of CPIS stocks, I cannot observe indirect asset flows, such as from Germany to the US via Ireland. However, plotting networks represents in part a remedy for this problem.

[16]Most likely, Ireland plays an even larger role since the CPIS data suffer from under-reporting. Hobza and Zeugner (2014) report the severe under-reporting of stock flows to Luxembourg and Ireland in the CPIS data. They reveal that in 2007 only 60% of the reported portfolio stock liabilities reported by Luxembourg were declared as assets by other countries. For Ireland this ratio drops to 33%.

(a) 2001



(b) 2017

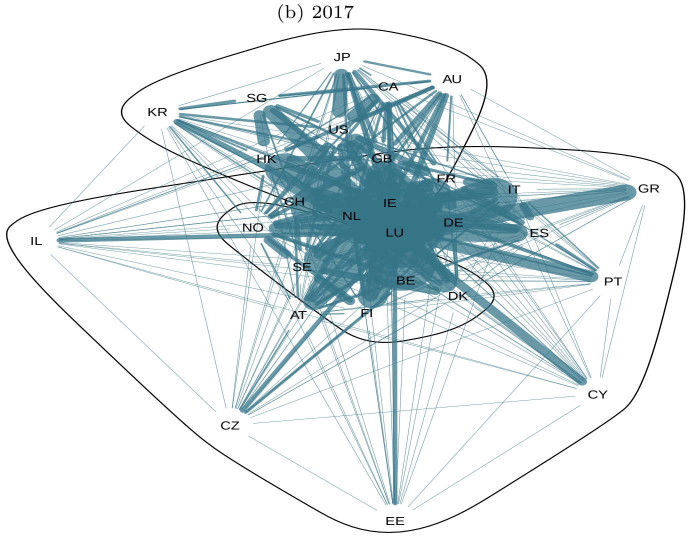
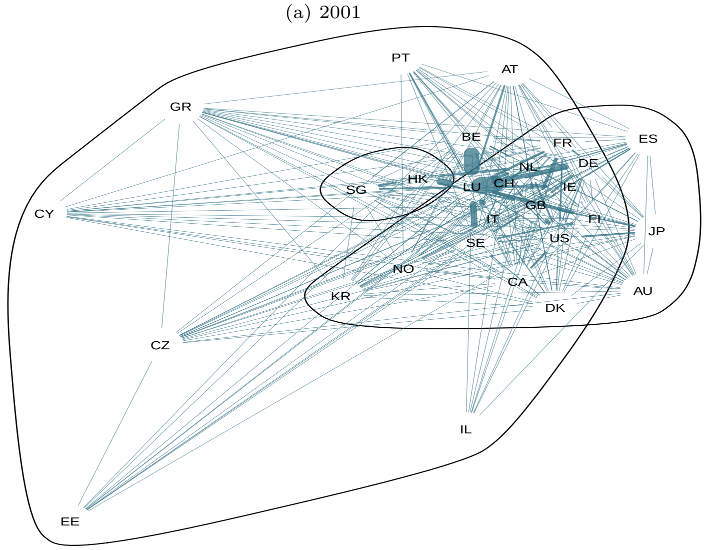


Figure 5: Community structure in cross-border portfolio investment integration

Notes: Using the Girvan and Newman (2002) community structure detection algorithm, this figure plots the community structure of bilateral portfolio investment integration indices. Node links are proportional to the integration indices across each country-pair.

(a) 2001



(b) 2017

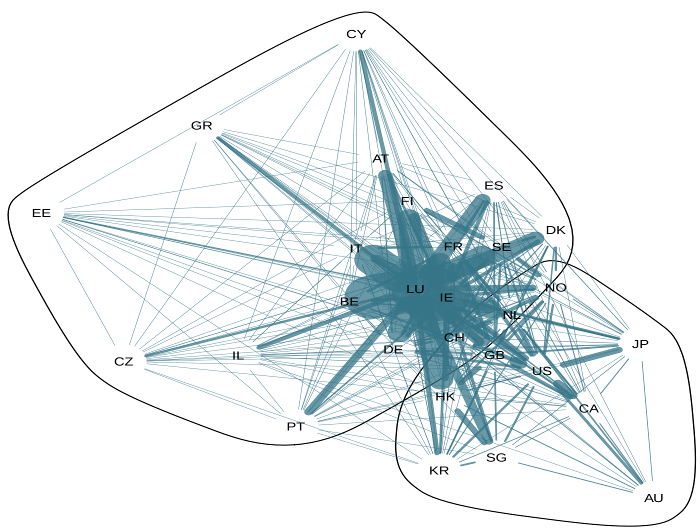
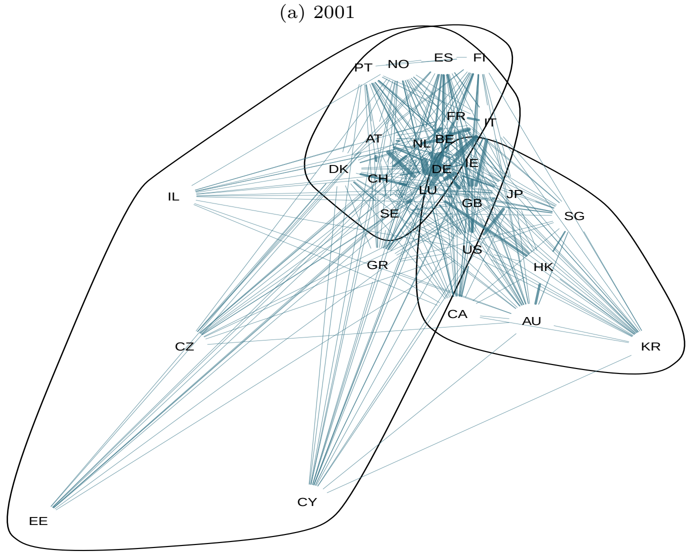


Figure 6: Community structure in cross-border stock market integration

Notes: Using the Girvan and Newman (2002) community structure detection algorithm, this figure plots the community structure of bilateral stock market investment integration indices. Node links are proportional to the integration indices across each country-pair.

(a) 2001



(b) 2017

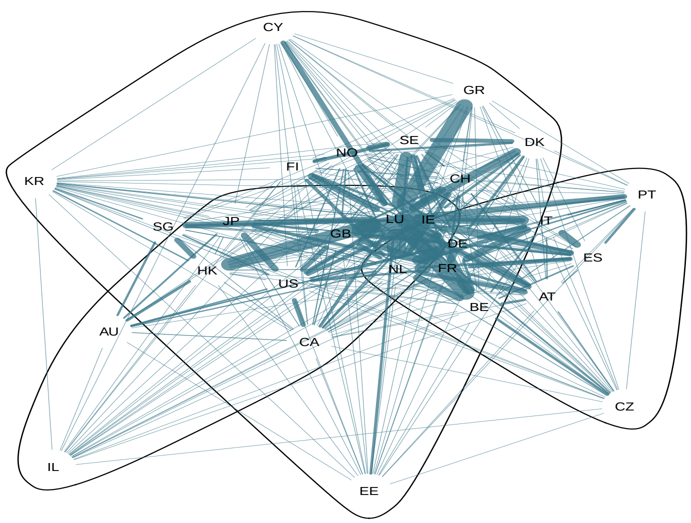


Figure 7: Community structure in cross-border bond market integration

Notes: Using the Girvan and Newman (2002) community structure detection algorithm, this figure plots the community structure of bilateral bond market investment integration indices. Node links are proportional to the integration indices across each country-pair.

where $S_{ij,t}$ is an index of GDP growth co-movement between country-pair ij at t. $FinInteg$ comprises indices of cross-border financial integration such as portfolio investment. $X_{ij,t}$ is a set of controls, potentially affecting business cycle synchronization, such as banking integration, bilateral trade intensity $T_{ij,t}$, and industry-specialization patters $Spec_{ij,t}$. Alternatively, I estimate the effect of $FinInteg$ on the common and idiosyncratic components $S^F_{ij,t}$ and $S^e_{ij,t}$.

There are three well-known identification challenges. First, there is clearly an endogeneity concern. Since investors are likely driven by risk diversification objectives, $FinInteg$ takes high values the more two economies are desynchronized. To address this endogeneity concern, I exploit recently updated legal restriction indicators. Since Porta et al. (1997), many studies have used the relationship between legal institutions and financial development. I follow this practice and use data from Fernández et al. (2016), who provide a whole set of indicators covering country-level legal restrictions for different financial asset classes. Thus, portfolio investment integration indices are instrumented with the mean of the financial market restriction index across the country-pair. Each of these variables are continuous on a scale from zero to one. The main identifying assumption is that the average level of capital controls across a country-pair is exogenous to the amount of assets held across each country-pair. Thus, to challenge this assumption, country-pairs would need to coordinate on the exact amount and timing of raising or lowering capital controls, a relatively weak assumption consistently made in the literature.

Second, a shock global to all economies could simultaneously affect all economies. This could lead to false interpretations of signs on the role of financial integration on output co-movement. This might result in overestimating causal effects of financial market integration, even if the effect when accounting for global factors was zero. I overcome this second challenge by adding yearly fixed effects μ_t that control for time trends common to all countries.

Third, country-pair unobserved time-invariant heterogeneity could affect the relationship between financial integration and business cycle synchronization. Indeed, there's large evidence from the international trade literature that time-invariant determinants such as cultural proximity or language influence trade and financial integration (Portes et al., 2001; Portes and Rey, 2005). Thus, I include time invariant country-pair fixed effects μ_{ij} that control for this potentially important unobserved heterogeneity.

5. Results

In this section, I report the results of applying the baseline relationship (7) to the 2001-17 period. First, I show that portfolio investment correlates positively with business cycle synchronization and in response to idiosyncratic shocks. Yet, it correlates negatively in response to global shocks. I conclude that greater portfolio investment integration may enable GDP smoothing in presence of idiosyncratic shocks, but leads to business cycle contagion in presence of global shocks.

VARIABLES	(1) S	(2) Se	(3) SF	(4) S	(5) Se	(6) SF	(7) S	(8) Se	(9) SF
Portfolio Inv.	0.08	0.06	0.13**	0.04	0.05	0.08	0.05	0.06	0.08
	(0.330)	(0.136)	(0.044)	(0.632)	(0.174)	(0.208)	(0.545)	(0.147)	(0.155)
Trade				0.32**	0.04	0.39***	0.34**	0.05	0.40***
				(0.041)	(0.555)	(0.002)	(0.024)	(0.483)	(0.001)
Dissimil. (log)							-1.33***	-0.44***	-0.83***
							(0.000)	(0.000)	(0.000)
Observations	5,288	5,288	5,288	5,288	5,288	5,288	5,288	5,288	5,288
R-squared	0.22	0.33	0.34	0.23	0.33	0.34	0.24	0.33	0.35
Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
CP FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cl. s.e.	CP	CP	CP	CP	CP	CP	CP	CP	CP
N. Clusters	314	314	314	314	314	314	314	314	314

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1: OLS: Panel "within" estimates

Notes: This table reports distinct OLS estimates. The outcome in all columns is an index of bilateral GDP growth synchronization S, its idiosyncratic component S^e, or its common component S^F. A positive (negative) coefficient means that the higher cross-border financial market integration the higher (lower) business cycle synchronization. Standard errors are clustered at the country-pair level.

5.1. OLS baseline

As baseline, I estimate equation (7) over the 2001-17 period with simple OLS. Table 1 shows the results of the main equation for the three left-hand side variables S, S^e, and S^F. Note that all estimations include country-pair and year fixed effects. Column (1) shows results for the overall indicator of synchronization S. Column (2) shows estimates for the synchronization index driven by idiosyncratic shocks, and column (3) shows estimates for the index driven by common shocks only. Columns (4) to (9) add additional control variables. Overall, estimates on the correlation between financial integration and business cycle synchronization are relatively imprecise and not statistically significant.

5.2. Main result

Instrumenting the main endogenous variable of interest, cross-border portfolio integration, with the average financial market restriction index originating from Fernández et al. (2016) improves precision of estimates. Table 2 shows results for the instrumented regressions for our three main variables of interest. All estimates show first stage Kleibergen-Paap F-scores of instrument relevance that are largely above the usual cut-off rate of 10. Column (1) still shows slightly insignificant estimates when using the simple synchronization measure S. However, when using the idiosyncratic part of the synchronization decomposition as dependent variable, column (2) now presents statistically significant and positive estimates for the correlation between greater portfolio investment integration and synchronization. Thus, the estimates indicate that in response

VARIABLES	(1) S	(2) Se	(3) SF	(4) S	(5) Se	(6) SF	(7) S	(8) Se	(9) SF
Portfolio Inv.	0.05	0.50**	-0.49*	0.01	0.51**	-0.55**	-0.16	0.45**	-0.66***
	(0.892)	(0.010)	(0.057)	(0.978)	(0.012)	(0.029)	(0.691)	(0.022)	(0.010)
Trade				0.43*	-0.10	0.68***	0.52**	-0.07	0.74***
				(0.063)	(0.336)	(0.000)	(0.023)	(0.509)	(0.000)
Dissimil. (log)							-1.29***	-0.46***	-0.80***
							(0.000)	(0.000)	(0.000)
Observations	5,069	5,069	5,069	5,069	5,069	5,069	5,069	5,069	5,069
R-squared	0.00	-0.04	-0.03	0.00	-0.04	-0.03	0.02	-0.03	-0.03
Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
CP FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cl. s.e.	CP	CP	CP	CP	CP	CP	CP	CP	CP
K.P. F-stat	32.77	32.77	32.77	37.39	37.39	37.39	38.59	38.59	38.59
N. Clusters	301	301	301	301	301	301	301	301	301

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: 2SLS: Panel "within" estimates

Notes: This table reports distinct 2SLS estimates. The outcome in all columns is an index of bilateral GDP growth synchronization S, its idiosyncratic component S^e, or its common component S^F. A positive (negative) coefficient means that the higher cross-border financial market integration the higher (lower) business cycle synchronization. Standard errors are clustered at the country-pair level.

to idiosyncratic shocks, portfolio investment integration and synchronization correlate positively. Column (3) uses the common part of the synchronization decomposition as dependent variable. It indicates a significant negative relationship, suggesting that portfolio investment integration and synchronization correlate negatively in response to common shocks. Columns (4)-(6) additionally control for bilateral trade integration, and columns (7)-(9) also control for bilateral industry specialization similarity. All estimates indicate: (i) a statistically significant positive relationship between portfolio integration and synchronization in response to idiosyncratic shocks; (ii) a statistically significant negative relationship between portfolio integration and synchronization in response to common shocks.

6. Discussion: Where does this result come from?

This paper has two key results. First, portfolio investment and synchronization correlate positively in response to idiosyncratic shocks. Second, they correlate negatively in response to global shocks. Thus, estimates suggest that greater portfolio investment enables risk diversification and GDP smoothing when faced with idiosyncratic shocks. However, portfolio investment leads to contagion when the shock is global. This section discusses how these findings contribute to recent evidence on bank loan integration and synchronization. To do so, I combine the CPIS data with data from the Locational Banking Statistics database of the BIS on bank loan integration. Two important reasons for this choice need further discussion.

First, the theoretical channel of propagation of portfolio investment integration to the real economy is tied to balance sheets of banks or individuals. Indeed, the literature usually distinguishes between stock or bond market integration effects and argues that depending on which effect dominates, greater portfolio investment integration leads to more or less synchronization, respectively (Davis, 2014).[17] Reasoning at country-pair level, this implies that our estimates capture the indirect effect of stock and bond market integration on (bank) balance sheets. However, estimates do not yet control for the direct channel via bank loan integration.

Second, the switching signs, conditional on idiosyncratic and common shocks, mirror recent results on bank loan integration. Cesa-Bianchi et al. (2019) show that economies with GDPs that are elastic to global shocks are the destination of capital flows in booms, and their origin during busts. Is this paper's main result simply a reformulation of previous results on cross-border bank loan integration (Kalemli-Ozcan et al., 2013a; Cesa-Bianchi et al., 2019)?

To evaluate this question, I retrieve detailed country-tables from the Locational Banking Statistics database of the BIS. Then, I compute a loan measure based on bilateral claims in loans and deposits from country i to country j.

$$Loan_{ij,t} = ln \frac{(Claims_{\overrightarrow{ij,t}} + Claims_{\overrightarrow{ji,t}})}{(Y_{i,t} + Y_{j,t})} \tag{8}$$

Since the data are bilateral and liabilities are not always fully reported, I use the sum of claims from country i to j and j to i which I normalize by the sum of the two economies GDP. This measure originates from Epstein et al. (2016). Parts of the BIS data are confidential and, thus, our sample becomes unbalanced.

Note, however, that there is a strong relationship between portfolio investment and bank loan integration, which might be problematic given our IV strategy. The raw correlation between portfolio investment and bank loan integration is 0.77. A regression (with time and country-pair fixed effects) of bank loan integration on portfolio investment yields a positive coefficient of 0.24 significant at the 1 percent confidence level. This correlation is potentially troublesome for the use of the financial market restriction index as instrument. For example, the financial restriction index could correlate or even partly explain bank loan integration.

However, it is also possible that the correlation between portfolio investment and bank loan integration is solely caused by portfolio investment integration. This might be the case, if two economies tend to first align on their financial restrictions, which causes greater portfolio investment integration. Once some degree of portfolio investment integration has been achieved, banks follow suit and start extending their business in the partner economy.

[17] This result goes back to Davis (2014), who shows the opposite effects of stock and bond market integration on synchronization using cross-sectional data.

VARIABLES	(1) S	(2) Se	(3) SF	(4) S	(5) Se	(6) SF	(7) S	(8) Se	(9) SF
Portfolio Inv.	-0.77	0.37	-1.14**	-0.77	0.37	-1.14**	-0.74	0.38	-1.12**
	(0.175)	(0.227)	(0.019)	(0.169)	(0.228)	(0.012)	(0.196)	(0.212)	(0.013)
LD	0.44***	-0.03	0.43***	0.39**	-0.03	0.37***	0.33**	-0.05	0.34**
	(0.010)	(0.733)	(0.005)	(0.011)	(0.726)	(0.006)	(0.033)	(0.492)	(0.012)
Trade				0.61**	-0.02	0.78***	0.63**	-0.02	0.79***
				(0.035)	(0.856)	(0.001)	(0.028)	(0.901)	(0.001)
Dissimil. (log)							-1.39***	-0.61***	-0.65***
							(0.000)	(0.000)	(0.001)
Observations	4,532	4,532	4,532	4,532	4,532	4,532	4,532	4,532	4,532
R-squared	-0.02	-0.02	-0.11	-0.01	-0.02	-0.10	0.00	-0.01	-0.09
Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
CP FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cl. s.e.	CP	CP	CP	CP	CP	CP	CP	CP	CP
K.P. F-stat	17.14	17.14	17.14	19.44	19.44	19.44	19.77	19.77	19.77
N. Clusters	293	293	293	293	293	293	293	293	293

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: 2SLS: Panel "within" estimates controlling for bank loan integration
Notes: This table reports distinct 2SLS regressions of the main endogenous variables. The outcome in all columns is an index of bilateral GDP growth co-movement S. A positive (negative) coefficient means that the higher cross-border financial market integration the higher (lower) co-movement.

Until there are two distinct instruments that clearly separate portfolio integration effects from bank loan integration, it will be impossible to clearly identify channels.[18] Thus, I simply present results taking bank loan integration as exogenously given. Table 3 presents estimates on portfolio investment, additionally controlling for cross-border bank loans. Despite having a slightly reduced sample, our main results on portfolio investment partly holds. Portfolio investment is still positively correlated in response to idiosyncratic shocks, albeit not statistically significant at conventional levels of significance. However, in response to global shocks, portfolio investment is still significantly negatively correlated with greater portfolio integration. Interestingly, bank loan integration partly alleviates this effect. This suggests that flight to safety primarily occurred in portfolio investment holdings while bank loan integration enabled some form of burden sharing.

[18]Note, that the usual instrument for banking integration in the synchronization literature is based on the adoption of EU directives (Kalemli-Ozcan et al., 2013a). However, both instruments are not sufficiently strong to be used jointly with the financial market restriction instrument of this paper.

7. Extensions and sensitivity analysis

7.1. Distinct effects of stock and bond market integration?

The main results in table 2 show that the correlation of portfolio investment integration depends on whether shocks are idiosyncratic or common. It may be questioned whether these results are indeed shaped by the two main components of portfolio investment: stocks and bonds. As described in section 6, the previous literature usually distinguishes between stock or bond market integration effects and argues that depending on which effect dominates, greater portfolio investment integration leads to more or less synchronization. However, previous results either only focus on the United States Pyun and An (2016) or only provide cross-sectional evidence (Davis, 2014). Given that the CPIS data provides a decomposition of portfolio investment integration into stocks and bonds, it may be suggested to employ the same empirical framework to test stock and bond specific effects.

Tables 4 and 5 show results of this exercise. I follow Pyun and An (2016) and use Fernández et al. (2016) sub-indicators on credit and capital market restrictions to instrument for stock and bond market integration, respectively. Interestingly, both stock and bond market integration show the same signs. The overall effect of portfolio investment integration on synchronization seems to be driven by bond holdings (Table 4), while estimates on stock market integration show the same signs but are largely statistically insignificant (Table 5). However, estimates on stock market integration have to be taken with a grain of salt as the capital market restriction index is clearly a weak instrument for stock market integration.

7.2. Subsamples

The total sample period of 2001-2017 has been subject to large common and regionally restricted shocks. Thus, it is important to assess whether the results also hold in specific subsamples. Table 6 shows 2SLS estimations for different subsamples. Three out of four subsamples, the 2001-17, 2003-17, and 2005-17 samples show positive signs in response to idiosyncratic shocks and negative signs in response to common shocks. Estimates in columns (10)-(12) focusing on the GFC subsample, 2007-17, suggest that GDP smoothing completely stopped and the correlation between portfolio investment and synchronization turned negative regardless of the dependent variable.

7.3. Taking into account indirect effects: Simultaneous equations

Most of the previous literature that estimates effects of portfolio investment on synchronization uses 3-Stage-Least-Squares (3SLS) to account for cross-equation correlation.[19] The argument is simple: The main specification in equation (7) does not distinguish between direct and indirect effects of variables. For

[19]Note, that with the exception of Pyun and An (2016), this 3SLS estimation strategy has been solely used on cross-sectional data.

VARIABLES	(1) S	(2) Se	(3) SF	(4) S	(5) Se	(6) SF	(7) S	(8) Se	(9) SF
Bond	0.30	0.34**	-0.35*	0.27	0.35**	-0.43**	0.25	0.35**	-0.44**
	(0.277)	(0.033)	(0.075)	(0.373)	(0.040)	(0.031)	(0.400)	(0.042)	(0.029)
Trade				0.32	-0.06	0.68***	0.35*	-0.05	0.69***
				(0.132)	(0.564)	(0.000)	(0.097)	(0.619)	(0.000)
Dissimil. (log)							-1.34***	-0.47***	-0.82***
							(0.000)	(0.000)	(0.000)
Observations	4,836	4,836	4,836	4,836	4,836	4,836	4,836	4,836	4,836
R-squared	0.00	-0.03	-0.03	0.00	-0.03	-0.03	0.02	-0.02	-0.02
Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
CP FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cl. s.e.	CP	CP	CP	CP	CP	CP	CP	CP	CP
K.P. F-stat	30.82	30.82	30.82	33.70	33.70	33.70	33.85	33.85	33.85
N. Clusters	301	301	301	301	301	301	301	301	301

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: 2SLS: Panel "within" estimates bond market integration

Notes: This table reports distinct 2SLS regressions of the main endogenous variables. The outcome in all columns is an index of bilateral GDP growth co-movement S. A positive (negative) coefficient means that the higher cross-border financial market integration the higher (lower) co-movement.

VARIABLES	(1) S	(2) Se	(3) SF	(4) S	(5) Se	(6) SF	(7) S	(8) Se	(9) SF
Equity	0.80	1.17	-0.37	0.79	1.21	-0.43	0.10	0.88	-0.74
	(0.564)	(0.195)	(0.605)	(0.584)	(0.193)	(0.547)	(0.932)	(0.196)	(0.279)
Trade				0.08	-0.46	0.65*	0.40	-0.31	0.79**
				(0.909)	(0.279)	(0.067)	(0.459)	(0.323)	(0.023)
Dissimil. (log)							-1.47***	-0.70***	-0.65***
							(0.000)	(0.001)	(0.003)
Observations	4,783	4,783	4,783	4,783	4,783	4,783	4,783	4,783	4,783
R-squared	-0.06	-0.39	-0.01	-0.06	-0.41	-0.01	0.02	-0.19	-0.04
Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
CP FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cl. s.e.	CP	CP	CP	CP	CP	CP	CP	CP	CP
K.P. F-stat	2.501	2.501	2.501	2.611	2.611	2.611	3.374	3.374	3.374
N. Clusters	300	300	300	300	300	300	300	300	300

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: 2SLS: Panel "within" estimates stock market integration

Notes: This table reports distinct 2SLS regressions of the main endogenous variables. The outcome in all columns is an index of bilateral GDP growth co-movement S. A positive (negative) coefficient means that the higher cross-border financial market integration the higher (lower) co-movement.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	S	Se	SF	S	Se	SF	S	Se	SF	S	Se	SF
Portfolio Inv.	0.05	0.50**	-0.49*	-0.29	0.19	-0.74**	-0.71	0.06	-0.01	-2.57***	-0.80**	-1.15**
	(0.892)	(0.010)	(0.057)	(0.504)	(0.349)	(0.015)	(0.232)	(0.848)	(0.975)	(0.007)	(0.041)	(0.046)
Observations	5,069	5,069	5,069	4,492	4,492	4,492	3,894	3,894	3,894	3,293	3,293	3,293
R-squared	0.00	-0.04	-0.03	-0.01	-0.01	-0.05	-0.03	0.00	-0.00	-0.23	-0.08	-0.11
Y FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
CP FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cl. s.e.	CP	CP	CP	CP	CP	CP	CP	CP	CP	CP	CP	CP
K.P. F-stat	32.77	32.77	32.77	35.80	35.80	35.80	27.43	27.43	27.43	20.12	20.12	20.12
N. Clusters	301	301	301	301	301	301	301	301	301	301	301	301
Sample Starts	2001	2001	2001	2003	2003	2003	2005	2005	2005	2007	2007	2007

Robust pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6: 2SLS: Panel "within" estimates subsamples

Notes: This table reports distinct 2SLS estimates. The outcome in all columns is an index of bilateral GDP growth synchronization S, its idiosyncratic component S^e, or its common component S^F. A positive (negative) coefficient means that the higher cross-border financial market integration the higher (lower) business cycle synchronization. Standard errors are clustered at the country-pair level.

instance, α_1 might report both the direct and indirect effect of financial integration on output. Thus, estimates of α_1 might suffer from upward bias. This is likely, because countries with greater financial integration also trade more. Due to this reason, important contributions such as Imbs (2004, 2006), Davis (2014), and Pyun and An (2016) employ simultaneous equation estimation. These papers estimate a form of the following equation system (9), which takes into account both direct and indirect effects of the main endogenous drivers of synchronization: financial integration, trade, and industry specialization.

$$
\begin{cases}
S_{ij,t} = \mu_{ij} + \mu_t + \alpha_0 + \alpha_1 FinInteg_{ij,t} + \alpha_2 T_{ij,t} + \alpha_3 Spec_{ij,t} + \epsilon_{ij,t} \\
FinInteg_{ij,t} = \mu_{ij} + \mu_t + \beta_0 + \beta_1 T_{ij,t} + \beta_2 Spec_{ij,t} + \beta_3 X_{ij,t}^{FinInteg} + u_{ij,t} \\
T_{ij,t} = \mu_{ij} + \mu_t + \theta_0 + \theta_1 FinInteg_{ij,t} + \theta_2 Spec_{ij,t} + \theta_3 X_{ij,t}^{T} + w_{ij,t} \\
Spec_{ij,t} = \mu_{ij} + \mu_t + \lambda_0 + \lambda_1 FinInteg_{ij,t} + \lambda_2 T_{ij,t} + \lambda_3 X_{ij,t}^{Spec} + e_{ij,t}
\end{cases}
\tag{9}
$$

where $FinInteg_{ij,t}$ is the indicator of portfolio integration, $T_{ij,t}$ is an indicator of bilateral trade intensity, and $Spec_{ij,t}$ captures bilateral industry similarity.

However, this approach comes at a cost. To disentangle the direct and indirect channels, I need one unique instrument per endogenous variable and finding suitable time varying instruments for endogenous drivers of synchronization is a difficult task. Additionally, the rank condition states that for each equation in the system I need to exclude at least as many exogenous variables as I include endogenous variables (Hayashi, 2000).

Thus, $X_{ij,t}^{FinInteg}$, $X_{ij,t}^{T}$, and $X_{ij,t}^{Spec}$ are vectors composed of exogenous variables, instruments, to identify the endogenous variables in the system. Coefficients α_1 to α_3 capture the direct effects of financial integration. Coefficients β, θ, and λ capture the indirect effects. All specifications also include time and country-pair fixed effects (μ_{ij} and μ_t) to account for time trends common to all countries and potentially unobserved country-pair heterogeneity that is stable over time.

There is a rich literature proposing different instrumental variables (IV) for financial and real variables. I take a conservative approach and use one well established instrument per endogenous variable in each of the sub-equations of system (9).

To instrument for $FinInteg$, I employ again data from Fernández et al. (2016) on financial capital control restrictions. To instrument for bilateral trade relation I use dummy variables indicating bilateral trade agreements, an approach that has been extensively used in the literature. I retrieve a detailed indicator from Egger and Larch (2008) that distinguishes between four types of trade agreements. Instrumenting for industry specialization is a difficult task.[20] One potential approach exploits the fact that a respective economy's level of development is a determinant of specialization patterns. In particular, Imbs

[20] See also Cesa-Bianchi et al. (2019) who discuss this question extensively.

and Wacziarg (2003) have shown that rich economies are more diversified and, therefore, experience higher co-movement. I follow their argument and instrument specialization with the log product and absolute difference of bilateral per capita GDP.

Beyond these unique instruments, I follow a conservative approach and use country-pair and year dummies as additional common instruments. Country-pair fixed effects capture main differences across each country-pair affecting endogenous variables. Including these country-pair fixed effects is crucial and represents a major improvement compared to prior evidence which mostly focuses on cross-sectional data or does not take country-pair unobserved heterogeneity into account.[21] Second, I include year dummies that account for global time trends affecting all economies similarly.

To validate the instrument choice, I proceed in two steps. First, I verify descriptively that the instruments have time variation across country-pairs. Figure 8 plots the natural logarithm of the main instruments across the total sample. It is evident that there is time variation for the main instruments that ensures identification over the panel. Second, I take a closer look at the joint significance of the instruments by estimating each sub-equation of equation (9) with simple 2-Stage-Least-Squares (2SLS), instrumenting each endogenous variable with the unique instrument. Specifically, I run the following regressions:

$$S_{ij,t} = \mu_t + \mu_{ij} + \alpha_1 Endog_{ij,t} + \epsilon_{ij,t} \tag{10}$$

where $S_{ij,t}$ is the business cycle synchronization index described in equation (1) and $Endog_{ij,t}$ is one of the main endogenous variables portfolio investment integration $PI_{ij,t}$, $T_{ij,t}$, or $Spec_{ij,t}$. $PI_{ij,t}$ is instrumented with the log mean of legal restrictions applying to portfolio investment across the country-pair. $Trade_{ij,t}$ is instrumented with a dummy variable ranging from 1-4 for different trade agreements based on Egger and Larch (2008). $Spec_{ij,t}$ is instrumented with the absolute difference of GDP per capita and the log product of GDP per capita across the country-pair. Table 8 shows the result of this exercise and showcases that we can safely reject the presence of weak instruments via the Kleibergen-Paap F-Statistic.

Having established the relevance of the main instruments, table 8 shows the results of applying the simultaneous equation system (9) to the full sample of 29 advanced economies. S^e and S^F show significant positive and negative correlations with portfolio investment. The magnitude of estimates is slightly larger in particular for the idiosyncratic component of synchronization. Overall, estimates confirm the main results of this paper.

[21] Pyun and An (2016), for instance, use additional instruments such as physical distance, dummies on common official language, or indicators on the type of monetary pegs among country-pairs. However, these variables have zero variation over time for each country-pair unit of observation. Thus, including the country-pair fixed effects accounts for all of these potentially unobserved variables.

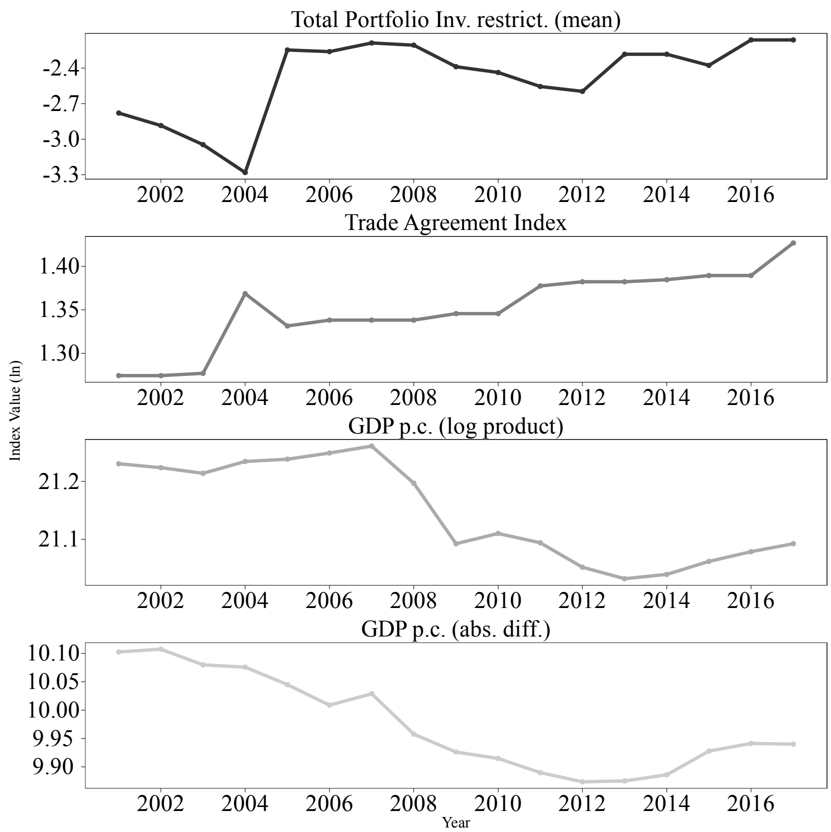


Figure 8: Instruments

Notes: This figure plots the natural logarithm of different instrumental variables for the total sample of 29 economies. The total portfolio investment market restrictions index originates from Fernández et al. (2016). The index on bilateral trade agreements originates from Egger and Larch (2008). GDP figures are deflated and originate from the World Development Indicator Database.

VARIABLES	(1) S	(2) S	(3) S
Portfolio Inv.	0.0526		
	(0.892)		
Trade		1.096	
		(0.280)	
Dissimil. (log)			0.0457
			(0.957)
Observations	5,069	5,069	5,069
R-squared	0.000	-0.004	-0.001
Y FE	Y	Y	Y
CP FE	Y	Y	Y
Cl. s.e.	CP	CP	CP
K.P. F-stat	32.77	10.03	44.49
N. Clusters	301	301	301

Robust pval in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Robustness: Instrument relevance

Notes: This table reports distinct 2SLS regressions of the main endogenous variables. The outcome in all columns is an index of bilateral GDP growth co-movement $S_{ij,t}$. A positive (negative) coefficient means that the higher cross-border financial market integration the higher (lower) co-movement.

	(1) S	(2) Se	(3) SF
In Mainsample			
Portfolio Inv.	0.429	0.780***	-0.545*
	(0.270)	(0.000)	(0.046)
Trade	0.423	-1.681*	0.765
	(0.776)	(0.022)	(0.463)
Dissimil. (log)	-0.0972	-1.077***	-1.201**
	(0.874)	(0.000)	(0.005)
N	5069	5069	5069
Country-Pair fixed effects			
Time fixed effect			

p-values in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Robustness: Results from simultaneous equations (3SLS)

Notes: This table reports estimates for the main equation of interest from simultaneous equation (3SLS) regressions. The outcome in all columns is an index of bilateral GDP growth co-movement $S_{ij,t}$, and two additional indices $S^e_{ij,t}$ and $S^F_{ij,t}$ that purge $S_{ij,t}$ of common and idiosyncratic shocks. A positive (negative) coefficient means that the higher cross-border financial market integration the higher (lower) co-movement.

8. Conclusion

This paper provides new evidence on the correlation between cross-border portfolio investment integration and business cycle synchronization. It analyzes bilateral panel data on portfolio investment holdings among 29 economies over the 2001-17 period.

I follow the recent literature and employ a principal component decomposition to identify common and idiosyncratic shocks driving business cycle synchronization. To overcome endogeneity concerns, I exploit the fact that capital control restrictions affect portfolio asset holdings across each country-pair.

Two key findings stand out. First, portfolio investment and synchronization correlate positively in response to purely idiosyncratic shocks. Second, they correlate negatively in response to global shocks. This result is highly robust to a multitude of robustness checks.

The findings in this paper contribute to the academic debate on the effects of cross-border financial integration on business cycle synchronization (Kalemli-Ozcan et al., 2013b,a). They particularly relate to recent evidence on the correlation between banking integration and synchronization from Cesa-Bianchi et al. (2019). Augmenting this paper's main specification with BIS data on bank loan integration shows that the main result on portfolio integration still holds. This suggests a different mechanism of how portfolio investment holdings affect business cycle synchronization compared to bank loan integration effects. On the policy side, these results suggest that it is particularly important to account for different asset classes when weighting the costs and benefits of greater cross-border financial integration.

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Table .9: Summary statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
S	5,338	−2.55	2.36	−19.03	−3.44	−0.86	−0.00
S^e	5,338	−1.41	1.22	−9.87	−1.99	−0.47	−0.00
S^F	5,338	−2.01	1.82	−18.49	−2.77	−0.69	−0.00
Portfolio Inv. (PI)	5,288	−5.97	2.13	−15.21	−7.25	−4.45	−1.04
Stock	4,998	−7.18	2.41	−17.05	−8.57	−5.50	−1.30
Bond	5,050	−6.69	2.20	−16.56	−8.08	−5.06	−2.31
LD	4,759	−6.48	2.16	−15.64	−7.87	−4.83	−1.85
Trade	5,338	−6.31	1.57	−13.15	−7.18	−5.26	−2.21
Dissimilarity Index ($Spec$)	5,338	0.29	0.16	0.03	0.18	0.37	1.17

Table .10: List of countries in sample

	Country Name	ISO2
1	Austria	AT
2	Australia	AU
3	Belgium	BE
4	Canada	CA
5	Switzerland	CH
6	Cyprus	CY
7	Czechia	CZ
8	Germany	DE
9	Denmark	DK
10	Estonia	EE
11	Spain	ES
12	Finland	FI
13	France	FR
14	United Kingdom	GB
15	Greece	GR
16	Hong Kong SAR China	HK
17	Ireland	IE
18	Israel	IL
19	Italy	IT
20	Japan	JP
21	South Korea	KR
22	Luxembourg	LU
23	Malta	MT
24	Netherlands	NL
25	Norway	NO
26	Portugal	PT
27	Sweden	SE
28	Singapore	SG
29	United States	US