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INTERNATIONAL BUSINESS CYCLE SYNCHRONIZATION

A SYNTHETIC ASSESSMENT

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ABSTRACT

We synthetically assess the three major transmission channels of international business cycles: bilateral trade, foreign direct investment (FDI), and portfolio investment flows between economies with multiple fixed effects. Using the data of 72 economies during 2010–2019, we find that real and financial integration generates heterogeneous impacts on business cycle comovement. Trade integration, particularly through intermediate input trade, drives business cycle synchronization. We also find greenfield FDI leads business cycle comovements. This may be due to deepening intra-industry trade and dense global value chains. Higher debt market integration is also associated with more synchronized business cycle comovement, implying that balance sheet effects and the related credit cycle can exert influence on business cycle comovements. However, equity integration leads to business cycle divergence, suggesting that cross-border equity holdings may help stabilize transmission of a foreign economy's shocks.

Keywords: business cycle synchronization, trade, FDI, portfolio investment

JEL codes: F15, F21, F34, F44

1. Introduction

Academia and policy makers have given international business cycle comovement significant attention amid increasingly connected global economic activities. Business cycle fluctuations—mainly ups and downs in output, employment, and income—create economic uncertainty. They complicate economic planning among individuals and in societies, have asymmetric impacts on economic agents, and require costly economic adjustment. As such national policy makers aim to stabilize domestic business cycles using various macroeconomic stabilization policies. However, individual economies' business cycles are no longer independent of international business cycles. First, economies may be exposed to a common global shock, such as in the oil market. Second, an idiosyncratic shock in one economy can spill over to other economies through a variety of cross-border economic and financial channels.

Previous studies have shown that three major channels can drive international business cycle synchronization: trade, foreign direct investment (FDI), and portfolio investment. Trade and FDI are related to firms' activities and their operations in domestic and foreign markets, directly affecting economic activities between two economies. In the third channel, scholars and policy makers have increasingly discussed portfolio investment as international capital flows have grown strongly across economies, influencing firms' funding conditions and investment decisions. Indeed, cross-border financial investment influences each economy's financial conditions, affecting the real economy through changes in credit supply and liquidity.

In this context, we synthetically assess all three major transmission channels of international business cycle synchronization across economies around the world. FDI is further decomposed into greenfield FDI and cross-border mergers and acquisitions (M&A), while portfolio investment is further split into equity investment and into long- and short-term debt assets. As such, we simultaneously assess six transmission channels of international business cycle synchronization.

The novel features of this study are as follows: First, while there have been empirical studies on each of trade, FDI, and portfolio integration and their impact on output comovement (e.g., Dées and Zorell 2012; Abiad et al. 2013; Davis 2014; Fries and Kappler 2015; Cesa-Bianchi, Imbs, and Saleheen 2019; An, Kim, and Pyun 2021), we synthetically analyze the effects of three competing channels on business cycle synchronization, with a wide range of samples for 72 economies during 2010–2019, after the global financial crisis. Second, to the extent of our knowledge, there has been no study assessing the differential impacts of detailed trade, FDI, and financial linkages in a unified framework: intermediate input trade vs. final goods trade; greenfield FDI vs. cross-border M&A; and equity vs. long- and short-term debt. By assessing this, the study helps reduce omitted variable bias in determining the international transmission of business cycles and deepen understanding of the possible channels for business cycle synchronization. Methodologically, we take into account unobserved economy-specific factors and other heterogeneity in various dimensions, such as economy-pair and economy-time for source and destination economies.

We find that real and financial integration leads to different outcomes in business cycle comovement. Trade integration, particularly through intermediate input trade, drives business cycle synchronization, which is consistent with di Giovanni and Levchenko (2010). We provide new evidence that greenfield FDI integration leads to business cycle synchronization. This reflects deepening intra-industry trade and dense global value chains. Higher debt market integration is associated with more synchronized business cycle comovement, implying that balance sheet effects and the related credit cycle can influence business cycle comovements. However, equity integration leads to business cycle divergence, suggesting that equity may help buffer the international transmission of shocks between economies (e.g., Davis 2014).

In the rest of the paper, Section 2 comprehensively reviews the literature on international business cycle synchronization. Section 3 introduces the empirical framework we adopted to comprehensively assess the three channels of international business cycle synchronization. In Section 4, we report and discuss our empirical results. Section 5 concludes.

2. Literature Review

Two main factors can generate international business cycle synchronization: common global shocks and bilateral spillovers of idiosyncratic shocks from one economy to another (Cesa-Bianchi, Imbs, and Saleheen 2019). While some studies investigate the nature of shocks and focus on those that propagate cross-border spillover impacts, we maintain that shocks can transmit through various channels simultaneously (An, Kim, and Pyun 2021). Among them, previous studies note three major channels: bilateral trade, bilateral FDI, and bilateral portfolio investment. This section reviews the literature on each of the three.

2.1. Trade Integration

The linkage between trade integration and business cycle comovement has been discussed theoretically for patterns of production and trade (inter-industry trade vs. intra-industry trade). For example, Eichengreen (1992) and Krugman (1993) argue that tighter trade linkages can lead to greater specialization of production, in turn yielding less synchronization of business cycles. In contrast, Frankel and Rose (1998) show that economies with closer trade links tend to have more tightly correlated business cycles if intra-industry trade accounts for most trade. Shin and Wang (2004) find that among 12 Asian economies, intra-industry trade tends to drive business cycle synchronization, rather than inter-industry trade or the volume of trade itself.

Therefore, if inter-industry trade dominates between economies, trade may lead to business cycle divergence. On the other hand, an increase in intra-industry trade may lead to higher business cycle synchronization. Many empirical studies find that an increase in trade between two economies leads to higher business cycle synchronization between them (e.g., Frankel and Rose 1998; Baxter and Kouparitsas 2005; Imbs 2004; Inklaar, Jong-A-Pin, and de Haan 2008; Pyun and An 2016). However, Kalemli-Ozcan, Papaioannou, and Perri (2013) and Abiad et al. (2013) find that trade integration has insignificant effects on business cycle comovement when considering economy-pair unobserved heterogeneity in the panel setting. Further, An, Kim, and Pyun (2021), by

including economy-pair fixed effects and controlling for endogeneity, show that trade integration leads to business cycle synchronization with some variations.

While previous studies expect that different trade patterns between economies lead to different business cycle comovement outcomes by examining economy-level trade data, few studies provide micro-level evidence using disaggregated data. Further, since the global production network has become more connected and complicated, it is important to understand detailed trade linkages across industries and economies. Di Giovanni and Levchenko (2010), employing a cross-economy, industry-level panel dataset of manufacturing production and trade, find a greater positive impact of intra-industry trade on comovement of outputs between sector pairs that share intermediate inputs. It implies vertical trade along the value chain can generate greater comovement than final goods trade. Theoretically, trade in final goods and intermediate inputs can have either similar or different effects on business cycle comovements depending on the sectors where certain trade linkages are formed. While final goods trade can occur both within and across industries, intermediate input trade tends to generate vertical linkages within one industry. Duval et al. (2016), by distinguishing between value-added and gross trade, show that bilateral trade intensity measured in value-added terms has a statistically significant and positive impact on synchronization. Miyamoto and Nguyen (2021), using an augmented multi-economy, two-sector real business cycle model, show that international input-output linkages lead to a reduction in output volatilities for each economy, whereas the spillover effect of economy-specific shock via the linkages increases.

2.2. Foreign Direct Investment Integration

While FDI flows have increased substantially in recent decades, there have been relatively few studies on the linkage between FDI and business cycle synchronization. FDI integration contributes to international supply chains through which the spillover of idiosyncratic shocks can be made from one economy to another. However, the relationship between FDI and business cycle comovement may depend on the type of

FDI and shocks (Jansen and Stokman 2011, Fries and Kappler 2015). First, horizontal FDI indicates that firms run similar operations at different locations to access the foreign market better. If two separate establishments are run by the same multinational corporation in two different economies (without idiosyncratic shocks), FDI activity by the multinational corporation would increase business cycles synchronization between the two. However, idiosyncratic shocks and market conditions may lead to unpredictable business cycle comovement outcomes. Vertical FDI arises when firms want to benefit from the international differences in factor prices, such as wages. Firms split the production process over different economies based on cost-efficiency. Thus, efficient resource allocation via vertical FDI across economies can lead to business cycle divergence, but common intermediate inputs and production processes in vertical FDI can cause synchronization (see di Giovanni and Levchenko 2010). On the other hand, while horizontal FDI can be a substitute for international trade, vertical FDI can increase trade in both intermediate goods and final goods, bringing confounding effects to the relationship between trade integration and business cycle comovement.

Also, the types and nature of shocks may matter for the relationship between FDI integration and business cycle comovement. For example, if a common shock hits FDI source and host economies, a parent company and its affiliate in the host economy may respond to the shock symmetrically, leading to business cycle synchronization between home and host economies. In contrast, if the host economy experiences an idiosyncratic negative shock, the parent company may be tempted to reallocate resources to more profitable locations, resulting in business cycle divergence. Note that FDI linkages can transmit even a host economy's idiosyncratic shocks to the home economy. Due to this FDI spillover effect, business cycles can be synchronized.

Previous empirical studies such as Stevens and Lipsey (1992) and Desai and Foley (2004) find high correlations between the rates of return and investment of affiliates within a multinational firm, possibly leading to business cycle comovement. Budd, Konings, and Slaughter (2005) find that for multinational firms, parent's profits per worker are positively associated with foreign wages in the majority and fully owned affiliates, implying that

international profit sharing between parents and affiliates in multinational firms can transmit economic conditions across national borders. Jansen and Stokman (2011), using eight advanced economies for 1982–2010, show that the positive relationship between FDI and synchronized business cycles was more pronounced during 1995–2010 than before 1995. Fries and Kappler (2015), using 16 advanced economies for 1982–2009, find that FDI linkages have the positive and significant contemporaneous effect on business cycle synchronization in most cases, except for Inter-European FDI relations. This finding suggests that while FDI linkages overall lead to business cycle synchronization, FDI in regional blocs contributes to business cycle divergence.

FDI has two entry modes, such as greenfield FDI and cross-border M&A. A typical example of greenfield FDI is the construction of new facilities which can increase the stock of physical capital, create new jobs, and lead to more market competition. M&A FDI, on the other hand, typically refers to the acquisition of local companies through M&A and an ownership change. Due to their distinctive characteristics, the two FDI modes may have different impacts on the economic growth of the host economy. For example, Wang and Wong (2009) find that while greenfield FDI stimulates economic growth, M&A's positive effect on growth may depend on the host economy's absorptive capacity such as adequate human capital. Harms and Méon (2011) also argue that the growth effect of M&A is uncertain, while greenfield investment is seen to significantly boosts growth. Thus, it seems reasonable to anticipate different impacts of greenfield FDI and cross-border M&A on the synchronization of international business cycles as well. In particular, it is conjectured that greenfield FDI influences a destination economy's business cycles more than cross-border M&A, because it creates new business facilities, jobs, and economic activities, adding to the destination economy's gross domestic product (GDP).

2.3. Financial Integration

Previous literature on financial integration and the international transmission of real business cycles provides mixed theoretical predictions. A strand of literature starting from Backus, Kehoe, and Kydland (1992) emphasize that financial integration can insulate the

spillover effect of an idiosyncratic shock as financial market integration allows economies to share risks associated with the shock or rebalance asset portfolio accordingly. However, Krugman (2008) coins the term “international financial multipliers” during financial crises and argues that bank loan or debt linkages facilitate and amplify the spillover of adverse shocks across borders. Devereux and Yetman (2010); Ueda (2012); and Kalemli-Ozcan, Papaioannou, and Perri (2013) introduce the propagation mechanism of financial shocks by incorporating financial integration into the international real business cycle model.

Empirical studies so far have mixed findings on the effects of financial integration on international business cycle comovement (e.g., Kalemli-Ozcan, Sørensen, and Yosha 2003; Kose, Prasad, and Terrones 2003; Imbs 2004). Davis (2014) reconciles previous debates by arguing that different propagation mechanisms (wealth effect vs. balance sheet effect) exist in each market. He shows that equity and debt market integration lead to different outcomes in business cycle comovement. For example, equity market integration leads to business cycle divergence, since negative domestic shocks reduce domestic consumption but increase foreign savings (channeled into an investment) via the risk-sharing channels (when the wealth effect dominates). Pyun and An (2016) confirm the different roles of equity and debt market integration in business cycle comovement during normal times and the global financial crisis. They noted particularly, debt market integration with the United States insulated the balance sheet effect during the global financial crisis.

Kalemli-Ozcan, Papaioannou, and Perri (2013) examine the different nature of shocks such as productivity and financial shocks and show that banking integration is associated with more divergent cycles in normal times but results in higher business cycle synchronization during the global financial crisis. Cesa-Bianchi, Imbs, and Saleheen (2019) decompose shocks into their common and idiosyncratic parts to explain the heterogeneous effects of banking integration on business cycle comovement. An, Kim, and Pyun (2021) dissect debt market integration by separating it into short-term and long-term debt integration using economy-pair data of 57 economies for 2001–2013. They find

nuanced evidence that short-term debt integration drives business cycle synchronization during crises; however, long-term debt market integration seems to be related to business cycle divergence during crises.

3. Data and Empirical Specification

We construct an empirical specification to estimate the determinants of international business cycle synchronization. Following Giannone Lenza, and Reichlin (2010) and Kalemli-Ozcan, Papaioannou, and Perri (2013), our dependent variable is calculated as the real GDP growth rate difference between two economies multiplied by -1, as follows:

(1) $SYNCH_{i,j,t} = - \mid g_{i,t} - g_{j,t} \mid$,

where $g_{i,t}$ and $g_{j,t}$ indicate the growth rates of the real GDP of economies i and j, respectively, in year t. Thus, the higher the value (e.g., the closer to zero), the higher the degree of synchronization. For the robustness of the results, we introduce an alternative business cycle comovement measure, *SYNCH1*, as employed by Morgan, Rime, and Strahan (2004) and Kalemli-Ozcan, Papaioannou, and Peydro (2013). First, we regress GDP growth on the economy fixed effect and year fixed effects for all the economies as follows: $(lnY_t^i - lnY_{t-1}^i) = \alpha_i + \alpha_t + \nu_t^i$. Then, the residuals ν_t^i and ν_t^j represent the degree of deviation in the output growth of economies *i* and *j*, respectively, from the average growth over the estimation. We construct a proxy for the business cycle synchronization as the negative absolute value of the difference in residuals: $SYNCH1_{i,j,t} = -\left|\nu_t^i - \nu_t^j\right|$. This index measures the similarity in output growth moves between two economies in any given year.

Drawing on previous studies, we simultaneously assess the three major transmission channels of business cycles between economies: bilateral trade, bilateral FDI, and bilateral portfolio investment.

Bilateral trade linkage is calculated as:

(2) $TRADE_{i,j,t} = (TOTAL\ TRADE_{i,j,t}) / (GDP_{i,t} + GDP_{j,t})$,

where $TOTAL\ TRADE_{i,j,t}$ is the sum of bilateral exports and imports of goods between economies i and j in year t; $GDP_{i,t}$ is GDP of economy i in year t; and $GDP_{j,t}$ is GDP of economy j in year t. Exports data are in millions of US dollars, from the Organisation for Economic Co-operation and Development's (OECD) Bilateral Trade Database by Industry and End-Use category (BTDIxE).[1] We also introduce detailed trade data such as intermediate inputs and final goods (consumption goods and capital goods) according to end-use categories based on International Standard Industrial Classification (ISIC) industry four-digit classification, which are collected from OECD statistics.

Bilateral FDI linkage is calculated as:

$$(3)\ FDI_{i,j,t} = (TOTAL\ FDI_{i,j,t}) / (GDP_{i,t} + GDP_{j,t}),$$

where $TOTAL\ FDI_{i,j,t}$ is sum of bilateral FDI between economies i and j in year t. Bilateral FDI will be further divided into greenfield FDI and mergers acquisitions (M&A). The data on bilateral greenfield FDI was acquired from fDi Intelligence (Financial Times Ltd.), while the data on bilateral M&A was from the SDC Platinum Database (Thomson Reuters). Bilateral FDI flows are highly volatile. We therefore use a 3-year averaged FDI integration variable from t-2 to t.

Bilateral portfolio investment linkage is calculated as:

$$(4)\ PORTFOLIO_{i,j,t} = (TOTAL\ PORTFOLIO_{i,j,t}) / (GDP_{i,t} + GDP_{j,t}),$$

where $TOTAL\ PORTFOLIO_{i,j,t}$ is sum of bilateral portfolio investment between economies i and j in year t.

We use the International Monetary Fund's Coordinated Portfolio Investment Survey (CPIS) data on cross-border holdings of portfolio investment (equities and debt securities).[2] The CPIS collects information on investment by domestic residents in equity, short-term, and long-term debt securities issued by unrelated non-residents. Equity security that is an investment of 10% or more of total securities is considered direct

[1] See Bilateral Trade in Goods by Industry and End-use Category at https://www.oecd.org/sti/ind/bilateraltradeingoodsbyindustryandend-usecategory.htm.

[2] See the International Monetary Fund's Coordinated Portfolio Investment Survey (CPIS) at https://data.imf.org/?sk=B981B4E3–4E58–467E-9B90–9DE0C3367363

investment and is thus excluded. For the alternative measure of financial integration, we follow Cesa-Bianchi, Imbs, and Saleheen (2019)'s approach by calculating the mean of log of $Assets_{ijt}$ /($GDP_{i,t}$ + $GDP_{j,t}$) and log of $Liabilities_{ijt}$ /($GDP_{i,t}$ + $GDP_{j,t}$). Before taking a log, we add 1 ($1 million) to avoid dropping out zero observations. All bilateral linkage variables are unidirectional to match business cycle comovement between economies.[3]

Thus, our study is confined to the sample of economies for which data on GDP growth rates, trade, FDI, and portfolio investment are simultaneously available. In fact, among these variables, data on portfolio investment data is least available; hence, our sample is largely determined by its availability.[4] There are 77 economies in our sample and hence (77 × 76) pairs for the 10 years during 2010–2019, but we exclude five tax haven economies in our main analysis, such as the Bahamas; Barbados; Bermuda; Hong Kong, China; and Mauritius (see Appendix 1 for the economies in our sample). Appendix 2A reports the summary statistics of the variables for all economy pairs, and Appendix 2B the simple correlations among explanatory variables.

Finally, this paper utilizes the heavy sets of fixed effects:[5]

$$(5)\ SYNCH_{i,j,t} = \alpha + \beta_1 TRADE_{i,j,t} + \beta_2 FDI_{i,j,t} + \beta_3 PORTFOLIO_{i,j,t} + u_{i,j} + u_{i,t} + u_{j,t} + \varepsilon_{i,j,t}$$

where we include the abovementioned bilateral linkage variables. u_{it} is pair dummy variable for economies i and j, u_{it} is time-specific dummy variable for economy i, u_{jt} is time-specific dummy variable for economy j. ε_{ijt} is error term. Thus, our specification incorporates bilateral economy-pair fixed effects ($u_{i,j}$) that displace all time-invariant pair variables such as geographic distance. This allows us to examine whether within pairs of economies, business cycle synchronization is associated with bilateral trade, FDI, and portfolio investments. Our specification also includes time-varying home fixed effects ($u_{i,t}$)

[3] One may argue that business cycles synchronization depends on the direction of trade and investment. However, since the current study examines the business cycle *comovement* outcome of the economy-pair, bidirectional trade and investment matter to shape the comovement but not the one-way flow. If the transmission of the business cycle in a "specific" destination is examined, then the direction of trade and investment needs to be considered.

[4] The first CPIS was conducted in 1997 with 29 economies participating. Since 2001, the CPIS has been undertaken annually. The number of participating economies reached 67 economies in 2001 and 87 by 2015.

[5] We estimate equation (5) using the ordinary least squares (OLS) estimator. With the presence of multiple high-dimensional fixed effects, all estimates are obtained, using Guimarães and Portugal (2010)'s fast estimations method.

and partner fixed effects ($u_{j,t}$) that displace all home and partner-specific variables. Thus, by including a set of time-varying home and partner fixed effects in addition to the bilateral pair fixed effects, we can alleviate the endogeneity problem and the omitted variable problem. This specification is also used by Baier and Bergstrand (2007), who estimate the gravity equation with time-varying multilateral terms as well as bilateral fixed effects when they assess the effects of preferential trade agreements on bilateral trade.[6]

4. Estimation Results

4.1. Benchmark Results

In this section, we report and discuss our main empirical results. Table 1 reports the benchmark results for 2010–2019, including a set of time-varying home and partner fixed effects in addition to the economy-pair fixed effects. Column (1) begins with an analysis of three main channels that we focus on: trade integration, FDI integration, and portfolio integration. Column (2) then separates trade into trade in intermediate inputs and final goods (consumption goods and capital goods), FDI integration into greenfield FDI and cross-border M&A, and portfolio integration into equity and debt integrations. Column (3), following An, Kim, and Pyun (2021), further divides debt integration into two different categories and checks whether long-term and short-term debt markets lead to different business cycle comovement outcomes. First, throughout columns (1) to (3), the coefficients on trade integration (TRADE) are positive and significant, implying that a higher level of bilateral trade is associated with greater business cycle synchronization. This finding is also consistent with previous studies that emphasize intra-industry trade patterns. In columns (2) and (3), we show that trade in intermediate inputs leads to the business cycle comovements outcome in column (1). This finding suggests that each economy is connected vertically in the production network by sharing common intermediate inputs.

[6] In their gravity equation estimation, using a number of different experiments, they find that instrumental-variable approach does not adjust for endogeneity well, but their panel fixed effects approach does.

Table 1: Effects of Bilateral Economic Linkages on Business Cycle Synchronization, All Economies

	(1)	(2)	(3)
	Dependent variable = SYNCH		
TRADE	0.172		
	(0.113)		
FDI	-0.030		
	(0.106)		
PORTFOLIO	-0.004		
	(0.012)		
Intermediate inputs TRADE		0.749***	0.839***
		(0.278)	(0.270)
Final goods TRADE		-1.070	-0.546
		(0.758)	(0.729)
Greenfield FDI		1.288**	1.348*
		(0.642)	(0.728)
M&A FDI		-0.053	-0.082
		(0.098)	(0.094)
EQUITY		-0.044**	-0.020
		(0.018)	(0.016)
DEBT		0.064*	
		(0.033)	
Long-term DEBT			0.028
			(0.029)
Short-term DEBT			0.494***
			(0.185)
Fixed effects			
Economy–pair	Yes	Yes	Yes
Home–year	Yes	Yes	Yes
Partner–year	Yes	Yes	Yes
Number of observation	22,010	20,718	19,711
R-squared	0.861	0.854	0.857

FDI = foreign direct investment, M&A = merger and acquisition.

Notes: Constant term is included but not reported. In parentheses are standard errors based on clustering by economy-pair. * p<0.1, ** p<0.05, *** p<0.01. SYNCH is an alternative measure of business cycle comovement.

Source: Authors' calculations.

In contrast, FDI integration (FDI) carries a negative coefficient but insignificant in column (1). As discussed in Section 2, theoretical predictions of FDI integration on business cycle comovement is not unidirectional, and empirical findings are mixed. In columns (2) and (3), we also divide FDI integration into greenfield FDI and cross-border M&A. Interestingly, the estimated coefficients on greenfield FDI is significantly positive, however, those on cross-border M&A are negative and insignificant. Our findings suggest that greenfield FDI has a more significant spillover effect than cross-border M&A, which leads to business cycle synchronization. While this result deserves further examination, the heterogeneous effects of greenfield FDI and cross-border M&A on international business cycles may depend on their different practices. Greenfield FDI requires a firm to bring its own capabilities; however, cross-border M&A allows a firm to get costly access to the economy-specific capabilities of the acquired firms (Nocke and Yeaple 2007). Thus, (more independent) greenfield FDI would transmit the FDI source economy's economic conditions to the host economy better than cross-border M&A.

Portfolio integration shows a negative but insignificant sign in column (1). However, when separating portfolio integration into equity and debt integration in column (2), we find that while the estimated coefficient of equity integration is negative and significant, debt integration shows a significant positive sign, which is consistent with previous works such as Davis (2014) and Pyun and An (2016). The negative relationship between equity integration and business cycle comovement echoes the risk-sharing role of FDI integration. Further, equity integration promotes portfolio rebalancing across economies via the wealth effect, thereby leading to business cycle divergence. However, higher debt integration instead results in business cycle comovement, suggesting that cross-border debt issuance and pay-off can occur simultaneously, and credit supply will be synchronized via the balance sheet effect.

In column (3), following An, Kim, and Pyun (2021), we divide debt integration further into short-term debt and long-term debt. The estimated coefficient on short-term debt is positive and significant at the 5% level, while that on long-term debt is positive but marginally significant. Furthermore, the size of the coefficient for short-term debt is far

greater than that for long-term debt. This suggests that the balance sheet effect in debt market integration can be driven by short-term debt, rather than long-term debt. An, Kim, and Pyun (2021) also show that, during crises, only the short-term debt integration led to business cycle comovement, which amplified the balance sheet effects. However, long-term debt integration played a buffering role in the transmission of crisis shock, leading to business cycle divergence.

Table 2 shows the robustness of the results. Column (1) introduces the alternative measure of business cycle comovement (*SYNCH1*) proposed by Morgan, Rime, and Strahan (2004). Column (2) replaces the financial integration measure with the alternative proposed by Cesa-Bianchi, Imbs, and Saleheen (2019). Column (3) shows analysis by including tax haven economies in the full sample. Column (4) uses lagged bilateral linkage variables to consider lagged effects of real and financial integration on business cycle comovement. The results are overall consistent with the main results in Table 1. We confirm in particular that intermediate input trade integration leads to business cycle synchronization, and higher greenfield FDI integration leads to business cycle synchronization. Note that, in column (1), the negative sign on cross-border M&A gains statistical significance. While multinational firms' activities are closely linked, they may allocate their resources efficiently between parents and affiliates, so their presence via FDI integration in two different locations contributes to less output comovement. Column (2) also shows that short-term debt integration loses statistical significance (for short-term debt integration results, it is maybe due to about 75% zeros in the total observations in the short-term debt integration).

Table 2: Robustness: Effects of Bilateral Economic Linkages on Business Cycle Synchronization, All Economies

	(1)	(2)	(3)	(4)
	SYNCH1	Alternative FI	Including tax havens	With lagged variables
Intermediate inputs TRADE	0.378***	0.812***	0.676***	0.513**
	(0.135)	(0.262)	(0.234)	(0.223)
Final goods TRADE	0.511	-0.553	-0.400	-0.422
	(0.447)	(0.735)	(0.621)	(0.577)
Greenfield FDI	0.805	1.489**	1.348*	1.839**
	(0.559)	(0.728)	(0.691)	(0.876)
M&A FDI	-0.159**	-0.098	-0.132	0.069
	(0.068)	(0.218)	(0.098)	(0.097)
EQUITY	-0.015**	-0.086***	-0.019	-0.033*
	(0.007)	(0.027)	(0.015)	(0.017)
Long-term DEBT	0.025*	0.090***	0.026	-0.037
	(0.015)	(0.024)	(0.028)	(0.034)
Short-term DEBT	0.293***	-0.000	0.452***	0.328**
	(0.110)	(0.014)	(0.171)	(0.167)
Fixed effects				
Economy-pair	Yes	Yes	Yes	Yes
Home-year	Yes	Yes	Yes	Yes
Partner-year	Yes	Yes	Yes	Yes
Number of observations	19,711	19,598	21,530	17,815
R-squared	0.885	0.857	0.859	0.875

FDI = foreign direct investment, FI = financial integration, M&A = merger and acquisition.

Notes: Constant term is included but not reported. In parentheses are standard errors based on clustering by economy-pair. p<0.1, ** p<0.05, *** p<0.01. SYNCH1 is an alternative measure of business cycle comovement.

Source: Authors' calculations.

4.2. Sub-sample Analysis: Advanced Economies vs Other Economies

To consider heterogeneity of the economies, Table 3 reports the results with the sub-sample of advanced economies as home economies. Our advanced economy classification includes economies with IMF International Financial Statistics (IFS) Country Codes less than 199, other than Malta and Türkiye, as advanced economies. [7] In column (1), we examine economy pairs between advanced economies and all destination economies. Columns (2) and (3) divide the destination economies into advanced and other economies samples. Trade integration for intermediate inputs and final goods (consumption goods and capital goods) in column (1) turns out to be insignificant. However, the estimated coefficient of intermediate input trade integration for the advanced-advanced sample in column (2) are significantly positive and opposite to those for advanced and others sample in column (3). This implies that intra-industry trade pattern may dominate among advanced economies, whereas inter-industry trade may take place more frequently between advanced and other economies. However, overall, advanced and world economies seem to be linked through complex trade networks and, thus, trade linkages lead to ambiguous business cycle comovement outcomes. Greenfield FDI shows positive and significant signs in columns (1) and (2), suggesting that the advanced-advanced sample drives the results in column (1), and higher greenfield FDI between advanced economies leads to business cycle synchronization. This implies that greenfield FDI linkages done by multinational enterprises play a role in business cycle synchronization among advanced economies. However, in column (2) of the advanced-advanced sample, the estimated coefficient on cross-border M&A is significantly negative. Among advanced economies, cross-border M&A are associated with business cycle divergence, implying that multinational enterprises' acquiring assets in the counterpart advanced economies can diversify their business cycle risk through resource reallocation.

Interestingly, equity market integrations in the sub-sample of advanced economies show significant and positive signs while debt market integrations do not have significant effects

[7] IMF. World Economic Outlook April 2021: Country Data Documentation. https://www.imf.org/external/pubs/ft/weo/2021/01/weodata/co.pdf.

on business cycle comovements. In column (2) of the advanced-advanced sample, the estimated coefficient of equity market integration is positive, which is the opposite of main results in Table 1. This indicates that higher equity integration within the advanced economies causes business cycle synchronization. Davis (2014) and Pyun and An (2016) argue that financial integration possibly results in either business cycle synchronization or divergence via the balance sheet effects and wealth effects, respectively. In this regard, the balance sheet effect (credit supply synchronization) dominates in the integrated equity market of advanced economies, because the advanced economies' industry structures are similar and their equity markets are highly interlocked.

Table 3: Effects of Bilateral Economic Linkages on Business Cycle Synchronization, Advanced Economies

	Advanced vs. All Economies	Advanced vs. Advanced	Advanced vs. Others
	(1)	(2)	(3)
	Dependent variable = SYNCH		
Intermediate inputs TRADE	-0.229 (0.252)	0.576** (0.256)	-0.583 (0.429)
Final goods TRADE	-1.150 (0.741)	0.210 (0.692)	-1.851 (1.403)
Greenfield FDI	2.429*** (0.915)	2.406*** (0.885)	0.989 (1.082)
M&A FDI	-0.074 (0.086)	-0.218*** (0.084)	0.469 (0.506)
EQUITY	0.029** (0.014)	0.055*** (0.016)	0.010 (0.145)
Long-term DEBT	-0.001 (0.021)	-0.013 (0.022)	-0.012 (0.113)
Short-term DEBT	0.244 (0.157)	0.128 (0.147)	0.438 (0.527)
Fixed effects			
Economy–pair	Yes	Yes	Yes
Home–year	Yes	Yes	Yes
Partner–year	Yes	Yes	Yes

	Advanced vs. All Economies	Advanced vs. Advanced	Advanced vs. Others
	(1)	(2)	(3)
	Dependent variable = SYNCH		
Number of observations	9,529	4,004	5,515
R-squared	0.919	0.936	0.922

FDI = foreign direct investment, FI = financial integration, M&A = merger and acquisition.

Notes: Constant term is included but not reported. In parentheses are standard errors based on clustering by economy-pair. * p<0.1, ** p<0.05, *** p<0.01. SYNCH is an alternative measure of business cycle comovement.

Source: Authors' calculations.

5. Conclusion

Considerable debate has surrounded the effects of real and financial integration on international business cycles. Earlier studies examined the specific types of integration, such as trade or financial integration, or different types of shocks transmitted across economies. Our study builds on the main literature on business cycle comovement but extends it to include all three major transmission channels, namely bilateral trade, FDI, and portfolio investment. Further, we investigate the detailed composition of such channels. For example, we use two types of FDI (greenfield and M&A) and three types of portfolio investment (equity investment, long-term debts, and short-term debts) for the analysis.

We find that real and financial integration leads to different outcomes in business cycle comovement. First, (vertical) trade integration drives business cycle synchronization. This is in line with past studies showing that deeper intra-industry trade drives business cycle comovements. Also, greenfield FDI leads to business cycle synchronization, while we have weak evidence that cross-border M&A is associated with business cycle divergence. Higher debt market integration is associated with more synchronized business cycles. This may reflect the balance sheet effect, in which credit cycles contribute to business cycle correlations. Last, equity market integration leads to business cycle divergence. This suggests that the investors may use these types of financial integration instead of bilateral trade to

avoid the international transmission of shocks between economies and ride out real business cycles.

Some of our results reaffirm the findings of the earlier literature. Yet, there are still new findings that help reassess the relationship between real and financial integration and business cycle comovement. First, our results show that intra-industry trade integration leads to international business cycle synchronization. Also, multinational companies' operation via FDI across economies contributes to business cycle coupling. In particular, only greenfield FDI significantly leads to business cycle synchronization. While firms with greenfield FDI need to bring their own capabilities, those using cross-border M&A tend to exploit to the economy-specific capabilities of their acquired firms (Nocke and Yeaple 2007). So, the heterogeneous effects of greenfield FDI and cross-border M&A on international business cycles requires further research on firm level capabilities and business cycle outcomes.

In sum, our findings of trade and FDI integration suggest that global value chains shaped by intermediate input trade and FDI amplify the spillover effects of a shock to business cycles of trading partners (e.g., di Giovanni and Levchenko 2010, Miyamoto and Nguyen 2021). Thus, understanding domestic and foreign firms' detailed production networks in the global value chain would be helpful to assess the combined impact of trade and FDI integration on business cycle comovements.

Second, our findings suggest significant effect of cross-border portfolio debt investment flows on business cycle comovement, although the effect of equity market integration seems muted. This finding is robust, even as we control for unobserved economy-time and economy-pair heterogeneities. The result seems to be related to the changed patterns of global portfolio investment flows. Since the global financial crisis, cross-border debt investment has increased significantly between advanced and developing economies (An, Kim, and Pyun 2021), which might have positively affected credit conditions in developing economies and promoted business cycle synchronization. However, there is considerable heterogeneity in the pattern of cross-border portfolio

investments by individuals and governments across economies as well as subject to different levels of financial development across individual economies. These factors seem to lessen the effect of overall portfolio investment flows on business cycle correlations.

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Appendixes

Appendix 1: List of 77 Economies in the Sample

Economies	Advanced	Economies	Advanced
Albania		Korea, Republic of	
Argentina		Kuwait	
Aruba		Latvia	
Australia	O	Lebanon	
Austria	O	Lithuania	
Bahamas		Luxembourg	O
Bahrain		Macau, China	
Barbados		Malaysia	
Belarus		Malta	
Belgium	O	Mauritius	
Bermuda		Mexico	
Bolivia		Mongolia	
Brazil		Netherlands	O
Bulgaria		New Zealand	O
Canada	O	North Macedonia	
Chile		Norway	O
China, People's Republic of		Pakistan	
Colombia		Panama	
Costa Rica		Peru	
Cyprus		Philippines	
Czech Republic		Poland	
Denmark	O	Portugal	O
Egypt		Romania	
Estonia	O	Russian Federation	
Finland	O	Saudi Arabia	
France	O	Singapore	
Germany	O	Slovakia	
Greece	O	Slovenia	
Honduras		South Africa	
Hong Kong, China		Spain	O
Hungary		Sweden	O
Iceland	O	Switzerland	O
India		Thailand	
Indonesia		Türkiye	
Ireland	O	Ukraine	
Israel		United Kingdom	O
Italy	O	United States	O
Japan	O	Uruguay	
Kazakhstan		Venezuela	

Source: Authors' compilation.

Appendix 2A: Summary Statistics

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
SYNCH	21,980	-2.66437	2.73328	-28.99210	-0.00008
Intermediate inputs TRADE	21,980	0.00173	0.00436	0.00000	0.08080
Final goods TRADE	21,980	0.00094	0.00213	0.00000	0.02498
Greenfield FDI	21,980	0.00009	0.00032	0.00000	0.01159
M&A FDI	21,980	0.00017	0.00118	0.00000	0.09279
EQUITY	21,980	0.00533	0.02632	-0.00040	0.62068
Long-term DEBT	21,980	0.00469	0.01477	-0.00003	0.26123
Short-term DEBT	21,980	0.00057	0.00257	-0.00077	0.03817

FDI = foreign direct investment, M&A = merger and acquisition.

Note: SYNCH is an alternative measure of business cycle comovement. Please see the main text for the definitions of the variables.

Source: Authors' calculations.

Appendix 2B: Simple Correlations among Explanatory Variables

	Intermediate inputs TRADE	Final goods TRADE	Greenfield FDI	M&A FDI	EQUITY	Long-term DEBT	Short-term DEBT
Intermediate inputs TRADE	1.0000						
Final goods TRADE	0.2090	1.0000					
Greenfield FDI	-0.0115	0.0027	1.0000				
M&A FDI	0.0132	-0.0019	-0.0045	1.0000			
EQUITY	-0.0119	0.0088	-0.0198	0.0682	1.0000		
Long-term DEBT	-0.0148	0.0021	0.0029	0.0099	0.2783	1.0000	
Short-term DEBT	-0.0204	0.0156	-0.0005	-0.0098	0.1575	0.1626	1.0000

FDI = foreign direct investment, M&A = merger and acquisition.

Note: In the regression analyses, we used fixed effects estimator which is equivalent to differencing data around the mean. Therefore, we report correlations among first differences of the variables. Please see the main text for the definitions of the variables.

Source: Authors' calculations.

International Business Cycle Synchronization

A Synthetic Assessment

The study synthetically assessed the three major transmission channels of international business cycles: trade, foreign direct investment (FDI), and portfolio flows between economies with multiple fixed effects. Results showed that real and financial integration generates heterogeneous impacts on business cycle comovement. Trade integration and greenfield FDI lead business cycle comovements, likely due to deepening intra-industry trade and dense global value chains. Higher debt market integration is associated with more synchronized business cycle comovement, while equity integration leads to business cycle divergence.

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