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# Regional and Interregional Business Cycle Comovement in Europe, Asia, and North America

Baher Ahmed Elgahry
*University of Lille*

## Abstract

This study examines Regional vs. Interregional Business cycle comovement in Europe, Asia, and North America from 1965 to 2016. Our results show that regional business cycles are relatively more synchronous than inter-regional business cycles particularly in North America and Europe. Thus, we empirically studied the determinants of regional output comovement. We employ Panel Granger causality techniques to examine the causal relationships between output correlation, trade integration, and financial linkages. First, for Europe, our results show that there is evidence of a bidirectional causal relationship between output comovement and trade integration in the short run. Also, both bilateral trade and bilateral Foreign Direct Investment (FDI) jointly Granger cause real GDP correlation (unidirectional causality) in the long run. Second, for Asia, we found a bidirectional causal relationship between output comovement and both bilateral trade and bilateral FDI. Finally, for North America, our results provide evidence of a bidirectional causal relationship between output correlation and bilateral trade.

Baher Ahmed Elgahry, LEM Lab – UFR LEA University of Lille, 651 Avenue des Nations-Unies, 59100 Roubaix, France, Tel: +33 7 510 300 58, email: baher.elgahry@hotmail.com
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**Contact:** Baher Ahmed Elgahry - baher.elgahry@hotmail.com.
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## 1. Introduction

The global economy has recently evolved towards greater integration. International trade flows have grown considerably, and financial markets have become increasingly integrated. At the same time, regional economic linkages have also developed with the proliferation of trade agreements. Moreover, the volume of global financial flows became significant in the late 1980s. Thus, an increase in intra-regional financial flows has also been observed over the last fifteen years notably in Europe, Asia, and North America. These phenomena have had a remarkable impact on the global and regional evolution of the business cycles.

This development has raised a debate on the question of whether regional factors have a deeper impact on business cycles in the era of globalization. On one hand, trade and financial globalization should strengthen the links between national economic cycles and ultimately lead to cyclical global convergence. On the other hand, if regional shocks affect the real economy more than global turbulence-and the effects of regional linkages are stronger than global linkages-then business cycles should be regionalized.

Hence, in the context of the debates which have just been described-and given that the arguments presented here may give rise to contradictory assessments of the veracity of the hypothesis of the regionalization of business cycles-we propose a reflection on the impact of intra-regionalism vs. inter-regionalism on business cycle synchronization with an emphasis on Europe, Asia, and North America.

There are several reasons to study these three regions. First, despite the intensity of trade and financial linkages of these three continents, they have experienced heterogeneous growth curves since the global financial crisis of 2008. Asia has had a relatively stable economic activity during the crisis and quickly returned to growth. North America and Europe experienced deep recessions followed by limited recovery or double recessions.

Second, there is debate on the theory of the endogenous optimal currency areas (OCAs). This discussion considers that the European Economic and Monetary Union (EMU) could itself promote the emergence of a common business cycle in the euro area as a result of important economic and financial integration. Beine et al. (2003) and Artis et al. (2004) decided in favor of the theory of a high degree of business cycle synchronization in the Euro area. Harding and Pagan (2001) and Altavilla (2003) found that the level of conjuncture cycle transmission remains low compared to the growth cycle synchronization.

Finally, per the WTO report (International Trade Statistics 2018), these three regions represent the most significant proportion of exports in the intra-regional trade accounts. In Europe, trade within the region accounted for more than 70% of the region's total merchandise exports in 2016 and 2017. In Asia, over 65% of its total exports were sold within Asia. North America's share of intra-regional trade was slightly lower with 50% of its total exports being sold within the region.

These observations lead to a basic question: Have regional business cycles become more synchronized than interregional conjuncture cycles in an era of globalization? To answer this question, we adopt an approach that follows from the analyzes of the paradoxical coupling / decoupling hypothesis of the global and regional business cycles. This debate has been significant in recent years notably after the American crisis of 2008. From this perspective, financial crises appear to be particular periods that reveal the economic stakes underlying the functioning of the global and regional sphere.

Thus, this note contributes to the current debate on the coupling/decoupling hypothesis of the global and regional business cycles by highlighting regional vs. interregional output comovement in the era of globalization.

This paper is organized as follows. We present a brief survey of the literature on global and regional business cycle synchronization in Section 2. Our empirical model and database are introduced in Section 3. Section 4 reports the results of regional business cycles comovement. Section 5 measures the interregional business cycle synchronization. Section 6, empirically, discusses the determinants of regional cycles over the post-globalization period, and Section 7 concludes.

## 2. Globalization vs. regionalization of business cycles: literature approach

The latest vision of cyclical synchronization debate finds that regional factors rather than global factors seem to become the major mechanism that impacts business cycles. It appears that this observation is not recent. A branch of literature focusing specifically on advanced industrial economies has observed the emergence of a "European business cycle" since the early 1980s (Artis and Zhang, 1997, 1999, and Artis, 2004). Thus, Artis and Zhang (1997) studied the linkage and the synchronization of cyclical fluctuations between countries in terms of the European Exchange Rate Mechanism (ERM) of the European Monetary System (EMS). They found that there are strong cyclical correlations between European economies—especially after the ERM was created. In addition, Rose and Engel (2002) tested the cyclical correlation between member countries of a monetary union. They found that business cycles of the latter are more synchronized than those of other countries that do not share the common currency.

More recently, Hirata et al. (2013) showed that regional business cycles have become more distinct especially in regions where trade and financial linkages have grown rapidly since the 1980s. Their results offer a distinct explanation of the effect of globalization on the synchronization of business cycles. They found that regional factors have gradually become a crucial determinant during the recent globalization phase; hence, the development of regional business cycles. Also, Elgahry (2016) observed that the effect of regionalism on business cycle transmission is significant.

While these studies are based on country data, little work has been done at the regional vs. interregional level. On the one hand, a branch of literature focusing only on Business cycles correlation between member countries of a monetary union. The classic treatment of this issue is Kenen (1969), McKinnon (1963), Mundell (1961), Furceri and Karras (2008), Alesina and Barro (2002) and Degiannakis et al. (2014). On the other hand, most observers argue that globalization of trade and financial linkages have led to global Busines cycles convergence as well. For example, Kose et al. (2003) found that globalization leads to an increase in the degree of business cycles correlation because of trade and financial-market integration. In addition, Di Giovanni and Levchenko (2010) focused only on the role of trade in business cycle transmission using a large cross-country panel dataset of manufacturing production and trade. The novelty of this paper is to bridge this gap by investigating the impact of intra-regionalism (regionalization) vs. inter-regionalism (globalization) on business cycle synchronization with an emphasis on three major regions: Europe, Asia, and North America. Our paper is the first to examine both regional and interregional output comovement in three major continents, providing a richer picture of the underlying effects and transmission mechanisms in the era of globalization. First, we provide a theoretical and an empirical analysis of the coupling/decoupling hypothesis of the global and regional business cycles. Second, we examine the degree of business cycles correlation by region (regional business cycles) and then we verify the cyclical transmission across regions

(interregional business cycles). Third, we divide our sample into two sub-periods—the pre-globalization period (1965–90) and the globalization period (1991–2016) for the purpose of testing how regional and interregional business cycle synchronization have evolved over time. Last, we study the determinants of regional output comovement (trade integration, financial linkages) by using Granger causality test based on panel VAR/VECM framework. This all-encompassing approach is new evidence in the literature.

Several factors have been put forward to explain cyclical comovement in business cycle literature starting from trade and financial linkages arriving to monetary integration and fiscal policies similarity. The main factor that may affect correlations over time: greater international transmission of domestic shocks as a result of amplified trade and financial integration[1].

## 3. Database and Methodology

### 3.1. Database

Our database includes 35 countries partitioned into three regions: Europe, Asia, and North America[2]. The primary source of our data series is the World Bank's *World Development Indicators*. The database comprises annual data over the period 1965–2016. Real GDP corresponds to the measure of national output.

To examine how regional and interregional business cycle synchronization have evolved over time, we divide our sample into two distinct periods—the pre-globalization period (1965–90) and the globalization period (1991–2016). In addition to having roughly equal number of observations in each subperiod, there are three reasons for this demarcation. First, global Trade and Financial flows have increased distinctly since 1990. Also, regional economic linkages have also developed with rapid development of regional trade agreements as discussed earlier. Second, the volatility of business cycles in both advanced and developing countries witnessed a marked structural decline with the beginning of the globalization period until the financial crisis of 2008–09 (Hirata et al., 2013). Third, the Treaty on the European Union signed in Maastricht is represents a major breakthrough for the EU because it lays down clear rules for the future single currency and foreign policy. In addition, the North American Free Trade Agreement (NAFTA) (signed in 1992 and taking effect on Jan. 1, 1994) established a free-trade zone in North America.

### 3.2. Methodology[3]:

We first examined the degree of business cycles correlation by region between European economies, Asian economies, and North American countries (regional business cycles). Second, we verify the cyclical transmission between these three regions (interregional business cycles).
We prefer to use the instantaneous quasi-correlation measure proposed by Abiad et al. (2013) to estimate the degree of business cycle synchronization because it reserves some advantages as mentioned below. Among the studies that have adopted this method, we can cite that of Duval et al. (2014), which is published by the IMF, Chemingui and Eris (2016), and Zhang et al. (2019). The quasi-correlation of real GDP growth rates between countries i and j at time t is defined as:

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[1] More details are mentioned in the appendix.

[2] Our database includes 19 European economies: Austria, Belgium, Switzerland, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Iceland, Italy, Luxembourg, Netherlands, Norway, Portugal, Sweden, and Turkey). There are also 13 Asian countries: China, Hong Kong, Indonesia, India, Japan, Korea, Sri Lanka, Malaysia, Nepal, Pakistan, Philippines, Singapore, and Thailand. In addition, 3 economies in North America: United States, Canada, and Mexico.

[3] This part is inspired, by extending it with significant contributions, from one of our publications.

$$QCORR_{ijt} = \frac{(g_{it} - g_i^*) * (g_{jt} - g_j^*)}{\sigma_i^g * \sigma_j^g}$$

Where $g_{it}$ and $g_{jt}$ represent the real GDP growth rate of country i and j in year t, and $g_i^*$ ($g_j^*$) and $\sigma_i^g$ ($\sigma_j^g$) stand for the mean and standard deviation of output growth rate of country i (j), respectively, during the sample period.

Some of the advantages of this method are: It first examines the quarterly or annual correlation of GDP. This makes it possible to calculate the co-movements of the growth rates at any point in time. Thus, it is useful in studies that estimate the correlation of production at any timepoint. Second, the quasi-correlation measure supports some effective statistical properties. On one hand, the average period of the measurement would be asymptotically converged to the Pearson correlation coefficient standard. On the other hand, at any point in time, the measure is not necessarily limited between (-1) and (1). According to Otto et al. (2001) and Inklaar et al. (2008), if the measure of the cyclical correlation is between -1 and 1, then there are error terms in the regression explaining that it is unlikely to be normally distributed. Finally, we calculate correlations based on real growth rates rather than trend rates because the latter mainly depends on the choice of filtering methods.

## 4. Regional business cycles

We have briefly documented in our introduction that there has been a significant increase in global trade and financial flows over the last two decades. This period also observed an important growth of intra-regional trade and financial linkages in some regions. Considering these observations, it appears important to study the evolution of regional business cycles synchronization over time. First, we estimate our quasi-correlation measure from 1965 to 2016. Second, we calculate the gauge under two sub-periods: pre-globalization (1965–90) and during globalization period (1991–2016).

For Europe, business cycle correlation of each European economy in our sample is measured against the other. Having selected 19 countries, we obtain 342 cross-correlations per year between these countries (i.e. 17784 cross-correlations over the period covering 52 years). The average of these correlations makes it possible to obtain a synthetic measure of the average degree of correlation between Europe per year. Our estimates show that there is a positive average correlation of 0.434 between the European business cycles from 1965 to 2016. We also note that Europe is more synchronized during globalization—the average correlation reaches 0.492 versus 0.366 in the pre-globalization period.

For Asia, our sample includes 13 Asian countries. Thus, we obtained 156 cross-correlations per year between these countries (i.e. 8112 cross-correlations over the period). The results indicate that there is a positive degree of synchronization of 0.164 (on average) across Asian economies over the period. However, the business cycles of India and Nepal are not synchronized with the Asian business cycles over this period. The effect of the globalization on Asian output correlation appears significant. There is a positive average correlation of 0.068 over the pre-globalization period versus 0.259 over the post-globalization period. On the other hand, our estimates conclude that the economies of China, Sri Lanka, and Nepal are not synchronized before the globalization period. In addition, the Indian economy remains decoupled from the Asian economies over the two subperiods.

For North America, our sample also includes Canada, Mexico, and United States with 6 cross-correlations per year (i.e. 312 cross-correlations over the period). The results show that there is a significant average correlation of 0.512 across North American economies over the period.

Moreover, our evaluations indicate that output co-movement of these economies is almost the same over the pre-globalization and post-globalization periods.

To conclude, we note that business cycles of the North American countries are the most regionalized during this period (1965-2016). Intra-regionalism has a more significant effect on cyclical transmission between European countries than Asian economies. In addition, we found that business cycle coupling appears more significant between North American and European economies over the post-globalization period especially from 2001 to 2016 (Table 1).

**Table 1: Degree of Business Cycle correlation in Europe, Asia, and North America**

| Countries | 1965-2016 | Pre-globalization | Post-globalization | | |
|---|---|---|---|---|---|
| | | 1965-1990 | 1991-2016 | *1991-2000* | *2001-2016* |
| Europe | 0.434 | 0.366 | 0.492 | *0.202* | *0.681* |
| Asia | 0.164 | 0.068 | 0.259 | *0.365* | *0.193* |
| North America | 0.512 | 0.526 | 0.517 | *0.244* | *0.651* |

**Source: Author calculations**

## 5. Interregional Business cycle

In this section, we verify output comovement between Europe, Asia, and North America. We use the same methodology applied to estimate regional cycle.

First, for Europe and Asia, the business cycle correlation of each European economy in our sample is measured against each Asian economy. Having selected 19 European countries and 13 Asian economies, we obtain 247 cross-correlations per year between these countries (i.e. 12844 cross-correlations over the period covering 52 years). The average of these correlations makes it possible to obtain a synthetic measure of the average degree of correlation between these two regions. Thus, our calculations show a positive cyclical correlation between the European economies and the Asian economies that arrived at an average of 0.136. It appears that output comovement between the two regions slightly increased over the post-globalization period. However, China, India, Nepal, and Sri Lanka have a negative business cycle correlation with European economies over this period (1965-2016). Our results also show that China, Indonesia, and Nepal have been more decoupled with Europe over the post-globalization period. On the other hand, Hong-Kong and Singapore have the most significant cyclical transmission weight with European countries.

Second, for Europe and North America**,** the three North American countries have 57 cross-correlations per year between this group of countries (i.e. 2964 cross-correlations over the period). Our results show that there is a positive correlation between North American business cycles and European business cycles that arrived at an average of 0.400 over the period (1965-2016). Globally, we found that business cycles synchronization between these two regions increased over the post-globalization period. The economies of France, Italy, and Netherlands are the most synchronized with North American economies. However, Turkey, Ireland, and Luxembourg registered the lowest cyclical transmission degree with this region. Canada and the United States have the most important output comovement with Europe.

Finally, for North America and Asia**,** our sample led to 39 cross-correlations per year between these two regions (i.e. 2028 cross-correlations over the period). Our estimations indicate that there is an average positive cyclical correlation of 0.155 between North America and Asia. Business cycles transmission between the two regions slightly decreased over the post-globalization period. China and India have a negative business cycle correlation with North American economies from 1965 to 2016. In addition, our results show that China, Indonesia, India, and Nepal have been more decoupled with North America over the post-globalization period. On the other hand, Hong-Kong and Singapore have registered the most significant cyclical

transmission degree with this region. The United States' output remains the most synchronized with Asian economies over this period.

In conclusion, regional business cycles are relatively more synchronous than interregional business cycles particularly over the post-globalization period (Table 2). This result raises the debate that business cycles are regionalized in the era of globalization. Hence, it seems important to empirically study the determinants of regional output comovement in the next section.

**Table 2: Degree of business cycle correlation (regional vs interregional)**

| **Regions** | **1965-2016** | **Pre-globalization** | **Post-globalization** |
|---|---|---|---|
| | | **1965-1990** | **1991-2016** |
| *Europe-Europe* | 0.434 | 0.366 | 0.492 |
| *Asia-Asia* | 0.164 | 0.068 | 0.259 |
| *North America-North America* | 0.512 | 0.526 | 0.517 |
| **Average regional business cycle correlation** | **0.370** | **0.320** | **0.422** |
| **Inter-Regions** | **1965-2016** | **Pre-globalization** | **Post-globalization** |
| | | **1965-1990** | **1991-2016** |
| *Europe-Asia* | 0.136 | 0.131 | 0.141 |
| *Europe-North America* | 0.4 | 0.349 | 0.451 |
| *North America-Asia* | 0.155 | 0.152 | 0.158 |
| **Average interregional Business cycle correlation** | **0.230** | **0.210** | **0.250** |

**Source: Author calculations**

## 6. Determinants of regional output comovement: empirical evidence

### *6.1. Econometric methodology:*

The main objective of the model is to examine the causal relationships between output comovement, trade integration, and financial linkages. Causality is examined through the Granger (1969) causality framework (Gujarati & Porter, 2009; Wooldridge, 2013). The main principle in the Granger (1969) causality test literature is that a variable (say trade integration) can only be said to cause (G. cause) another variable (say output comovement) if current values of "output comovement" are conditional on past values of "trade integration". In this context, Mahembe & Mbaya Odhiambo (2019) mentioned that: "*Recent developments in the Granger (1969) causality literature have seen the extension of this methodology from time series to panel data. Further developments have also included the need to test for the time series properties of the data, including stationarity and cointegration tests. If the variables are integrated of the same order [I(1)] and are co-integrated, Granger causality can be tested through the VECM as proposed by Granger (1988), while a vector autoregressions (VARs) approach could be employed if the variables are not co-integrated (Dumitrescu & Hurlin, 2012; Mahembe, 2014; Muye & Muye, 2016*)".

Therefore, we begin our model by testing the variables' stationarity properties (by region) through panel unit root tests. Then, panel cointegration tests are conducted if the variables are not stationary in levels, but stationary in first difference. If the results show that the variables are stationary but not cointegrated, the Granger causality test could be done with the panel VAR framework. However, if the variables are integrated of the same order and cointegrated, a panel VECM can be applied to test both short-run and long-run causality.

### *6.2. Data:*

As we mentioned in the literature review, the main determinants that may affect business cycle correlations over time include trade integration and financial linkages. For trade integration, we use bilateral trade intensity ($Bil\_TR_{ijt}$) variable defined as:

$$\text{Bil\_TR}_{\text{ijt}} = \frac{X_{ijt} + M_{ijt}}{GDP_{it} + GDP_{jt}}$$

Here, $X_{ijt}$ denotes exports from country i to country j in period t, $M_{ijt}$ is the imports of country i from country j in period t, and $GDP_{it}$ and $GDP_{jt}$ represent the GDPs of country i and j, respectively.

For financial integration, we utilize the bilateral Foreign Direct Investment ($\text{Bil\_FDI}_{\text{ijt}}^{\text{Stock}}$) variable defined as:

$$\text{Bil\_FDI}_{\text{ijt}}^{\text{Stock}} = \frac{\text{FDI}_{\text{ijt}}^{\text{Stock}} + \text{FDI}_{\text{jit}}^{\text{Stock}}}{GDP_{it} + GDP_{jt}}$$

where $\text{FDI}_{\text{ijt}}^{\text{Stock}}$ denotes the value of bilateral FDI originating from country $i$ and hosted in country $j$ in period t, $\text{FDI}_{\text{jit}}^{\text{Stock}}$ is the value of bilateral FDI originating from country j and hosted in country i in period t, and $\text{GDP}_{\text{it}}$ and $\text{GDP}_{\text{jt}}$ represent the GDPs of country i and j, respectively.

***6.3.Panel data unit root tests:***

From empirical literature view, the main panel unit root tests are Levin, Lin, and Chu (2002) (LLC) and Im, Pesaran, and Shin (2003) (IPS). Both tests are based on the augmented Dickey–Fuller (ADF) assumption. The tests were conducted on the three variables (by region) in levels, and in the first differences. Specifications included (i) with intercept only, and (ii) with intercept and trend. The LLC test assumes common unit root process, while the other assumes individual unit root process. We test the null hypothesis that the variable in question is non-stationary. Thus, rejection of the null hypothesis means the variable is stationary.

As shown in Table 3, all variables are not stationary in levels, but stationary in first difference. Thus, we conduct the cointegration tests before applying Granger causality.

**Table 3: Panel unit root tests**

| | **Europe** | | | | | |
|---|---|---|---|---|---|---|
| Test statistics | Variables | | | | | |
| | Level data | | | First difference data | | |
| | $QCORR_{ijt}$ | $\text{Bil\_TR}_{\text{ijt}}$ | $\text{Bil\_FDI}_{\text{ijt}}^{\text{Stock}}$ | $QCORR_{ijt}$ | $\text{Bil\_TR}_{\text{ijt}}$ | $\text{Bil\_FDI}_{\text{ijt}}^{\text{Stock}}$ |
| *Case 1: With intercept only* | | | | | | |
| LLC | 5.21432 | 0.9566 | 1.65021 | -62.6042*** | -42.6667*** | -38.2183*** |
| IPS | -1.73100** | -0.70811 | -0.82840 | -47.9717*** | -33.6428*** | -30.2466*** |
| *Case 2: With intercept and trend* | | | | | | |
| LLC | 33.5451 | 9.14545 | 5.35883 | -52.5563*** | -36.9286*** | -35.3525*** |
| IPS | 5.87050 | -1.11159 | 2.27166 | -35.8579*** | -25.1965*** | -25.4298*** |
| | **Asia** | | | | | |
| Test statistics | Variables | | | | | |
| | Level data | | | First difference data | | |
| | $QCORR_{ijt}$ | $\text{Bil\_TR}_{\text{ijt}}$ | $\text{Bil\_FDI}_{\text{ijt}}^{\text{Stock}}$ | $QCORR_{ijt}$ | $\text{Bil\_TR}_{\text{ijt}}$ | $\text{Bil\_FDI}_{\text{ijt}}^{\text{Stock}}$ |
| *Case 1: With intercept only* | | | | | | |
| LLC | 23.1817 | 5.41750 | 1.82859 | -37.4944*** | -24.5160*** | -19.3954*** |
| IPS | -1.73007** | -0.50611 | 7.00475 | -33.0341*** | -20.9206*** | -15.3403*** |
| *Case 2: With intercept and trend* | | | | | | |
| LLC | 15.9762 | 7.72794 | 18.1141 | -31.8100*** | -21.6024*** | -14.8451*** |
| IPS | -1.09798 | 1.85333 | -0.29512 | -25.1339*** | -16.4890*** | -11.8215*** |

| Test statistics | North America | | | | | |
|---|---|---|---|---|---|---|
| | Variables | | | | | |
| | Level data | | | First difference data | | |
| | $QCORR_{ijt}$ | $\text{Bil\_TR}_{ijt}$ | $\text{Bil\_FDI}_{ijt}^{Stock}$ | $QCORR_{ijt}$ | $\text{Bil\_TR}_{ijt}$ | $\text{Bil\_FDI}_{ijt}^{Stock}$ |
| *Case 1: With intercept only* | | | | | | |
| LLC | 0.67546 | 0.03767 | -0.92205 | -9.58575*** | -5.59938*** | -7.80139*** |
| IPS | -1.17531 | 0.63995 | 0.32120 | -6.97593*** | -4.14020*** | -6.70627*** |
| *Case 2: With intercept and trend* | | | | | | |
| LLC | 2.04863 | 2.60463 | 1.89255 | -8.44098*** | -4.98426*** | -5.88903*** |
| IPS | 0.00312 | -1.27852 | -0.62499 | -5.50927*** | -2.82979*** | -5.71650*** |

**Source: Author calculations.** *** denotes significance at the 1% level and ** denotes significance at the 5% level The abbreviations LLC: Levine-Lin-Chu statistics; IPS: Im-Pessaran-Shin statistics.

### *6.4. Panel cointegration test:*

We apply here the Pedroni (1999, 2004) panel cointegration tests. For this test, the null hypothesis is that there is no cointegration.

Table 4 reports the results of the cointegration tests. For Europe, the panel cointegration test results show that four out of the seven Pedroni statistics reject the null hypothesis of no cointegration at the 1% level of significance. Thus, the Granger causality test could be done with the panel VECM framework. However, for the two other regions, the null hypothesis of no cointegration cannot be rejected by five tests for Asia and by all the seven tests for North America. Therefore, the empirical properties of the variables examined require estimation of a panel VAR, since no cointegration relationships exist between the (non-stationary) variables (in level).

**Table 4 : Panel cointegration test**

| **Europe** | | | | |
|---|---|---|---|---|
| | | Depended variables | | |
| Test | Statistic | $QCORR_{ijt}$ | $\text{Bil\_TR}_{ijt}$ | $\text{Bil\_FDI}_{ijt}^{Stock}$ |
| Pedroni (1999,2004) | Panel v-Statistic | -0.478004 | 0.648066 | -3.489058 |
| | Panel rho-Statistic | -1.088576 | 0.42565 | 1.217470 |
| | Panel PP-Statistic | -13.22063*** | -5.154877*** | -5.785159*** |
| | Panel ADF-Statistic | -11.95604*** | -5.218201*** | -6.965299*** |
| | Group rho-Statistic | 1.865786 | 5.004820 | 6.315882 |
| | Group PP-Statistic | -24.67431*** | -3.625801*** | -5.461685*** |
| | Group ADF-Statistic | -15.04952*** | -3.744925*** | -5.436016*** |
| ***Inference*** | | *Cointegrated* | *Cointegrated* | *Cointegrated* |
| **Asia** | | | | |
| | | Depended variables | | |
| Test | Statistic | $QCORR_{ijt}$ | $\text{Bil\_TR}_{ijt}$ | $\text{Bil\_FDI}_{ijt}^{Stock}$ |
| Pedroni (1999,2004) | Panel v-Statistic | -0.075073 | -0.108315 | -103802.3 |
| | Panel rho-Statistic | -0.779747 | 0.987968 | 1.945581 |
| | Panel PP-Statistic | -11.85434*** | -1.339048 | -1.389044 |
| | Panel ADF-Statistic | -0.329898 | -2.536384*** | -1.982214*** |
| | Group rho-Statistic | 1.204351 | 4.321837 | 6.711589 |
| | Group PP-Statistic | -16.40155*** | -0.667492 | 5.864740 |
| | Group ADF-Statistic | -0.456597 | -4.192558*** | 6.021631 |
| ***Inference*** | | *No-Cointegrated* | *No-Cointegrated* | *No-Cointegrated* |

| North America | | | | |
|---|---|---|---|---|
| Test | Statistic | Depended variables | | |
| | | $QCORR_{ijt}$ | $\text{Bil\_TR}_{ijt}$ | $\text{Bil\_FDI}_{ijt}^{Stock}$ |
| Pedroni (1999,2004) | Panel v-Statistic | -0.479875 | 0.558267 | -0.827681 |
| | Panel rho-Statistic | 0.090164 | 0.280329 | 0.773363 |
| | Panel PP-Statistic | -1.566624 | 0.204696 | -0.224217 |
| | Panel ADF-Statistic | -1.611130 | -0.811120 | -0.289883 |
| | Group rho-Statistic | 0.767516 | 1.106982 | 1.355737 |
| | Group PP-Statistic | -1.270932 | 0.533599 | 0.233637 |
| | Group ADF-Statistic | -1.332301 | -0.163778 | 0.253842 |
| ***Inference*** | | *No-Cointegrated* | *No-Cointegrated* | *No-Cointegrated* |

**Source: Author calculations.** *** denotes significance at the 1% level.

### 6.5. Econometric methodology:

The model specification follows by Holtz-Eakin, Newey, and Rosen (1988), and describes the causal relationships between output comovement, bilateral trade and bilateral FDI as shown in Equation (1):

$$\text{QCORR}_{ijt} = f(\text{Bil\_TR}_{ijt}, \text{Bil\_FDI}_{ijt}^{Stock}) \quad (1)$$

Where $QCORR_{ijt}$ is the quasi-correlation of real GDP growth rates of countries i and j in period t, $\text{Bil\_TR}_{ijt}$ is the bilateral trade intensity between countries i and j in period t and $\text{Bil\_FDI}_{ijt}^{Stock}$ is the bilateral foreign direct investment between countries i and j in period t.

Following Mahembe & Mbaya Odhiambo (2019), this causal framework can be written in the VECM and matrix format as shown in Equation (2).

$$\begin{bmatrix} \Delta\text{QCORR}_{ijt} \\ \Delta\text{Bil\_TR}_{ijt} \\ \Delta\text{Bil\_FDI}_{ijt}^{Stock} \end{bmatrix} = \begin{bmatrix} \alpha_{1k} \\ \alpha_{2k} \\ \alpha_{3k} \end{bmatrix} + \sum_{L=1}^{p-1} \begin{bmatrix} \beta_{11ijL}(M)\beta_{12ijL}(M)\beta_{13ijL}(M) \\ \beta_{21ijL}(M)\beta_{22ijL}(M)\beta_{23ijL}(M) \\ \beta_{31ijL}(M)\beta_{32ijL}(M)\beta_{33ijL}(M) \end{bmatrix} \begin{bmatrix} \Delta\text{QCORR}_{ijt-L} \\ \Delta\text{Bil\_TR}_{ijt-L} \\ \Delta\text{Bil\_FDI}_{ijt-L}^{Stock} \end{bmatrix} + \begin{bmatrix} \lambda_{1k}\text{ECT}_{ijt-1} \\ \lambda_{2k}\text{ECT}_{ijt-1} \\ \lambda_{3k}\text{ECT}_{ijt-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1ijt} \\ \varepsilon_{2ijt} \\ \varepsilon_{3ijt} \end{bmatrix} \quad (2)$$

Where $\text{QCORR}_{ijt}$, $\text{Bil\_TR}_{ijt}$ and $\text{Bil\_FDI}_{ijt}^{Stock}$ are as defined in equation (1); $\Delta$ is the first difference operator; i and j = 1, …, N; t = 1, …, T; $\alpha_S$, $\beta_S$,and $\lambda_S$ (k= 1 …, 3) are parameters to be estimated; $\varepsilon_{kt}$ (k = 1 …, 3) are white noise error terms; $\text{ECT}_{ijt-1}$ are the lagged values of the error correction terms from the cointegration regressions; while $\lambda_S$ are speed of adjustment along the long-run equilibrium path. Short-run causality is inferred from the lagged dynamic variables of the explanatory variables $\beta_S$ using the partial $\chi 2$ statistics of the Wald test (Wald, 1943), while the long-run causality is tested through the lagged cointegrating vectors $\text{ECT}_{t-k}\lambda_S$. After estimating the VECM, causality can be inferred by checking the regressors and ECT t-statistics. Short-run causal effects are inferred if the regressors' t-statistics are statistically significant, while long-run causality is inferred when the coefficient of ECT is negative and statistically significant.

The panel VAR equation is like Equation 2 but without the error correction component (A panel VECM is restricted panel VAR). In a panel VAR, only short-run causality is inferred.

As mentioned above, for Asia and North America, the variables are stationary but not cointegrated, we apply the Granger causality with the panel VAR framework. However, for Europe, the variables are integrated of the same order and cointegrated, the Granger causality test could be done with the panel VECM framework to test both short-run and long-run causality.

### 6.6. Granger panel causality test results:

The number of optimal lags was established as two, using the Schwarz information criteria under the unrestricted panel VAR model. For Europe, the panel Granger causality test results, based on the panel VECM framework, are shown in Table 5.

As illustrated in Table 5, in the short-run, there is evidence of (i) a bidirectional causal relationship between quasi-correlation of real GDP growth rates and bilateral trade intensity ($QCORR_{ijt} \leftrightarrow Bil\_TR_{ijt}$), (ii) a unidirectional causal relationship from quasi-correlation of real GDP growth rates to bilateral Foreign Direct Investment ($QCORR_{ijt} \rightarrow$ Bil_FDI$^{\text{Stock}}_{\text{ijt}}$) and (iii) a unidirectional causality from bilateral Foreign Direct Investment to bilateral trade intensity (Bil_FDI$^{\text{Stock}}_{\text{ijt}} \rightarrow Bil_TR_{ijt}$).

For the long-run causality results, only the coefficient of the ECT when quasi-correlation of real GDP growth rates is the dependent variable, is negative and statistically significant. This implies that both bilateral trade and bilateral FDI jointly Granger cause quasi-correlation of real GDP in the long-run ($Bil\_TR_{ijt}$ & Bil_FDI$^{\text{Stock}}_{\text{ijt}} \rightarrow QCORR_{ijt}$). In contrast, there is no evidence of a long-run relationship or causality when $\Delta\ Bil\_TR_{ijt}$ and $\Delta$Bil_FDI$^{\text{Stock}}_{\text{ijt}}$ are the dependent variables.

**Table 5: Panel Granger causality based on VECM estimation (Europe)**

| **Dependent variable** | **Direction of causality/explanatory variables** | | | |
|---|---|---|---|---|
| | **Short run** | | | **Long run** |
| | **χ2 statistics (p-value)** | | | **coefficient (t-statistics)** |
| | $\Delta QCORR_{ijt}$ | $\Delta Bil\_TR_{ijt}$ | $\Delta Bil\_FDI^{Stock}_{ijt}$ | *ECT* |
| $\Delta QCORR_{ijt}$ | - | 6.333272** *(0.0421)* | 3.991848 *(0.1359)* | -1.07761*** *(-28.02024)* |
| $\Delta Bil\_TR_{ijt}$ | 15.64046*** *(0.000)* | - | 33.98020*** *(0.000)* | 0.000110*** *(5.006613)* |
| $\Delta Bil\_FDI^{Stock}_{ijt}$ | 10.78562*** (0.004) | 3.650182 (0.1612) | - | 0.000144 *(0.226961)* |

**Source: Author calculations.** For the s***hort run:*** The sum of the lagged coefficients for the respective short-run changes in the independent variable(s) are shown with their corresponding Wald χ2 statistics and p-values in brackets (). For **the long-run**, coefficients of the ECT are reported and in brackets () are the t-statistics. The *** and ** denote a significance of 1% and 5%, respectively.

For Asia and North America, the panel Granger causality test results, based on the panel VAR framework, are illustrated in Table 6. First, for Asia, we found a bidirectional causal relationship between quasi-correlation of real GDP growth rates and both bilateral trade and bilateral FDI ($Bil\_TR_{ijt}$ & Bil_FDI$^{\text{Stock}}_{\text{ijt}} \leftrightarrow QCORR_{ijt}$). Also, our results show a unidirectional causality from bilateral trade intensity to bilateral Foreign Direct Investment ($Bil_TR_{ijt} \rightarrow$Bil_FDI$^{\text{Stock}}_{\text{ijt}}$). Second, for North America, our results provide evidence of a bidirectional causal relationship between quasi-correlation of real GDP and bilateral trade ($QCORR_{ijt} \leftrightarrow Bil\_TR_{ijt}$).

**Table 6: Panel Granger causality based on VAR estimation**

| **Asia** | | | |
|---|---|---|---|
| **Dependent variable** | **Direction of causality/explanatory variables** | | |
| | **χ2 statistics (p-value)** | | |
| | $\Delta QCORR_{ijt}$ | $\Delta Bil\_TR_{ijt}$ | $\Delta Bil\_FDI_{ijt}^{Stock}$ |
| $\Delta QCORR_{ijt}$ | - | 33.09625*** *(0.000)* | 20.21556*** *(0.000)* |
| $\Delta Bil\_TR_{ijt}$ | 10.85439*** *(0.004)* | - | 0.705427 *(0.702)* |
| $\Delta Bil\_FDI_{ijt}^{Stock}$ | 5.133762* *(0.0768)* | 81.14434*** *(0.000)* | - |
| **North America** | | | |
| **Dependent variable** | **Direction of causality/explanatory variables** | | |
| | **χ2 statistics (p-value)** | | |
| | ***Qcorr*** | ***Bi trade*** | ***Bi FDI*** |
| $\Delta QCORR_{ijt}$ | - | 3.751792* *(0.0528)* | 1.007425 *(0.3155)* |
| $\Delta Bil\_TR_{ijt}$ | 4.729941** *(0.0296)* | - | 0.005000 *(0.9436)* |
| $\Delta Bil\_FDI_{ijt}^{Stock}$ | 0.005672 (0.9400) | 2.550933 (0.1102) | - |

**Source: Author calculations.** The ***, ** and * denote a significance of 1%, 5% and 10%, respectively.

## 7. Conclusion and Policy implications:

This study provides a theoretical and an empirical analysis of the coupling/decoupling hypothesis of the global and regional business cycles in Europe, Asia, and North America. Our results show that regional business cycles are relatively more synchronous than interregional business cycles particularly in North America and Europe over the post-globalization period.

In this context, how should policymakers implement economic policy? this question seems interesting particularly during recession periods. Policymakers need to understand the impact of their policies—at both the domestic level and the regional level—and to see how that may affect their path forward as a region. In this regard, Funashima and Ohtsuka (2019) show that spatial correlations of economic activities affect the effects of government expenditures. Also, they added that fiscal policies should be designed based on the situation in each region.

For fiscal policy, our results have important policy implications for North American and European governments, which must revitalize regional economies while reducing an excessive deficit by cutting wasteful spending. Knowledge of these sizable spatial spillovers and regional output correlations are beneficial to North America and Europe's policymakers, who must address the urgent task of stimulating the regional economy and eliminating excessive spending to ensure fiscal reconstruction.

For Europe, to the extent that spatial spillovers exist across region, fiscal policy design should be carried out by the European commission. First, it seems important for Europe to implement an aggregate fiscal stimulus. In recession periods, fiscal support should include a strong component of government investment and growth-enhancing expenditure. According to the European Fiscal Board (2020): *"Any initiative, including at the EU level, aimed at pushing government investment in the short term, would be an important step towards achieving three objectives: stimulating aggregate demand, boosting future growth, and improving the long-term sustainability of fiscal policy*". Second, policymakers should take discretionary measures to support aggregate demand beyond the effects of automatic stabilizers. Finally, the adoption of

central fiscal capacity within the framework of the European budget could help smooth both country-specific and common shocks. This fiscal capacity would require a macroeconomic stabilization fund financed by countries contributions that are used to develop assets in good times (boom periods) and make transfers to countries in bad times (recession periods).

For North America, fiscal policy coordination is required as business cycles in this region are more synchronized. First, governments should build stronger automatic stabilizers into the budget and prepare to use discretionary countercyclical fiscal policy. When the regional economy falls into recession and unemployment rises, the economic and social costs of the lost output and lost jobs can be exceptionally large. Second, fiscal stimulus may be necessary to boost economic growth. The evolution of corporate and household debt (particularly in North America), increasing business closures and unemployment, and increasing economic uncertainty, that may reduce future investment and consumption at regional level. Where the recovery is anemic, it seems crucial for maintaining expansionary fiscal policy for a sustained period to stimulate regional consumption and investment and restore confidence. Finally, governments should increase public investment during recession periods. In the long run, though, policymakers will need larger increases in taxes and reductions in benefits in order to put debt on a downward path.

For monetary policy, our results are also interesting and have important policy implications. First, policymakers must balance price and output objectives. indeed, if the ECB targets only inflation, it must pay attention to stabilizing output and keeping the economy near full employment. And at the Fed, the employment goal should be identified and placed on an equal footing with the inflation goal. Second, monetary policy coordination is required. In this context, it will be easier to implement a common monetary policy if countries' business cycles are aligned. Inklaar et al. (2005) noted that: *"… If various countries in the monetary union are not at the same points in the business cycle, decision-making on the appropriate monetary policy stance becomes a difficult task*". Finally, the main objective of monetary policy should be to maintain price stability in the medium and longer term. By attaining this objective, monetary policy encourages sustainable growth and helps to reduce the volatility of aggregate output at regional level.

In addition, we study the determinants of regional output comovement by examining the causal relationships between output comovement, trade integration, and financial linkages. Causality is examined through the Granger (1969) causality framework. Basing on the panel unit root and the panel cointegration tests' results, we apply the panel VECM Granger causality for Europe, and the panel VAR framework for Asia and North America. First, for Europe, our results show that there is evidence of a bidirectional causal relationship between output comovement and bilateral trade intensity ($QCORR_{ijt} \leftrightarrow Bil\_TR_{ijt}$) in the short-run. Also, both bilateral trade and bilateral FDI jointly Granger cause quasi-correlation of real GDP in the long-run ($Bil\_TR_{ijt}$ & $\text{Bil\_FDI}_{\text{ijt}}^{\text{Stock}} \rightarrow QCORR_{ijt}$). Second, for Asia, we found a bidirectional causal relationship between quasi-correlation of real GDP growth rates and both bilateral trade and bilateral FDI ($Bil\_TR_{ijt}$ & $\text{Bil\_FDI}_{\text{ijt}}^{\text{Stock}} \leftrightarrow QCORR_{ijt}$). Finally, for North America, our results provide evidence of a bidirectional causal relationship between output comovement and bilateral trade ($QCORR_{ijt} \leftrightarrow Bil\_TR_{ijt}$).

| Appendix. Determinants of Business cycle synchronization: literature review | | |
|---|---|---|
| | **Trade integration** | **Financial integration** |
| ***Theoretically*** | the impact of trade on business cycle synchronization is ambiguous: On one hand, according to the traditional theory of international trade, trade openness should lead to greater specialization in different countries. Practically, and to the extent that business cycles are dominated by industry-specific supply shocks, higher trade integration should reduce cyclical correlation. For Krugman (1993), trade openness is accompanied by greater specialization of countries in sectors where they have comparative advantages. On the other hand, if trade specialization and trade patterns are dominated by intra-industry trade, then greater trade integration must be associated with a higher degree of output comovement in the presence of industry-specific supply shocks. If demand factors are the main drivers of business cycles, then greater trade integration should also increase the cyclical transmission regardless of whether the specialization models are dominated by inter or intra-industry trade. | Obstfeld (1994) formalizes a mechanism that produces a negative effect of the financial integration and business cycles synchronization. In his model, financial integration moves investments to risky projects allowing countries to specialize according to their comparative advantage, which implies that the growth of output between the financially integrated countries should be negatively correlated. Hence, international financial integration can favor the specialization of countries in terms of production and can limit the transmission of shocks. Kalemli-Ozcan, Sorensen, and Yosha (2000) argue that financial integration allows for a better sharing of risk and leads economies to specialize in sectors where they have comparative advantages thus reducing the correlations between business cycles. |
| ***Empirically*** | Frankel and Rose (2000) find that trade openness contributes to business cycle transmission between economies. This result is confirmed by several recent studies (Clark and van Wincoop (2001), Imbs (2004), Inklaar and others (2001), Park and Shin (2009)). | Imbs (2006) used IMF bilateral data on financial assets across a large sample of countries and showed a significant positive correlation between bilateral financial linkages and output synchronization |
| | Baxter and Kouparitsas (2005) note that the effect of bilateral trade on GDP correlation is robust to the inclusion of geographic proximity variables | Otto et al. (2001) found that cyclical cycles are more similar for OECD countries with investment ties. |
| | Duval et al. (2014) identified a strong positive effect of trade intensity on Business Cycle synchronization. That impact is more significant in crisis times. | Kose et al. (2003) found that financially open countries are more synchronized. |
| | Gong and Kim (2018) observed that regional trade integration has a positive effect on regional business cycle synchronization. | Ozcan et al. (2013) observed a negative effect of banking integration on the co-movement of output. |
| | Calderon, Chong, and Stein (2003), Shin and Wang (2004)) concluded that the increase in trade does not necessarily lead to more synchronous business cycles. | Gong and Kim (2018) found that regional financial integration has a negative effect on regional business cycle comovement. |

## References


- Abiad, Abdul, Davide Furceri, Sebnem Kalemli-Ozcan et Andrea Pescatori (2013). "Dancing Together? Spillovers, Common Shocks, and the Role of Financial and Trade Linkages". World Economic Outlook, 81–111.
- Artis, Michael J and Zhang (1997). "International Business Cycles and the ERM: Is There a European Business Cycle?". *International Journal of Finance & Economics*, John Wiley & Sons, Ltd., vol. 2(1), 1-16.
- Artis, Michael J (1994). "Predicting Turning Points in the UK Inflation Cycle". CEPR Discussion Papers 880.
- Artis, Michael J, Marcellino, Massimiliano and Proietti, Tommaso (2004). "Characterizing the Business Cycle for Accession Countries". CEPR Discussion Papers 4457.

- Baxter, Marianne and Michael Kouparitsas (2005). "Determinants of business cycle comovement: a robust analysis". *Journal of Monetary Economics*, vol. 52(1), 113-157.
- Beine, M., F. Docquier and H. Rapoport (2003). “Brain drain and LDC’s growth: winners and Losers”. IZA Discussion papers No 819, July.
- Calderón, Cesar and Chong, Alberto and Stein, Ernesto. (2003). "Trade Intensity and Business Cycle Synchronization: Are Developing Countries Any Different?". *Journal of International Economics.* vol. 71, 2-21.
- Carlo Altavilla, 2003. "Assessing monetary rules performance across EMU countries". *International Journal of Finance & Economics*, John Wiley & Sons, Ltd., vol. 8(2), 131-151.
- Chemingui, Mohamed and Eris, Mehmet. (2016). “Trade integration and business cycles synchronization: evidences from Arab countries experiences”. Unpublished.
- Chinn, Menzie D. and Hiro Ito (2006). "What Matters for Financial Development? Capital Controls, Institutions, and Interactions." *Journal of Development Economics*, vol. 81, Issue 1, 163-192.
- Clark, Todd E. and van Wincoop, Eric (2001). "Borders and business cycles". *Journal of International Economics*, vol. 55(1), 59-85.
- Davide Furceri and Georgios Karras (2008), “Business-cycle synchronization in the EMU”. *Applied Economics,* 2008, vol. 40, issue 12, 1491-1501.
- Dees, Stephane and Zorell, Nico (2011). “Business Cycle Synchronisation: Disentangling Trade and Financial Linkages”. ECB Working Paper No. 1322.
- Degiannakis, Stavros & Filis, George & Kizys, Renatas. (2014). The Effects of Oil Price Shocks on Stock Market Volatility: Evidence from European Data. *The Energy Journal.* 35. 35-56. 10.5547/01956574.35.1.3.

- Di Giovanni, J., and A.A. Levchenko (2010) “Putting the Parts Together: Trade, Vertical Linkages, and Business Cycle Comovement,” *American Economic Journal: Macroeconomics*, 2 (2), 95-124.
- Duval R., Cheng K., Hwa OH K., Saraf R. and Seneviratne D. (2014), “Trade Integration and Business Cycle Synchronization : A Reappraisal with Focus on Asia”. IMF Working Paper, WP/14/52
- Edmore Mahembe & Nicholas Mbaya Odhiambo (2019). “Foreign aid, poverty and economic growth in developing countries: A dynamic panel data causality analysis” *Cogent Economics & Finance*, 7:1, 1626321, DOI: 10.1080/23322039.2019.1626321.
- Elgahry Baher Ahmed (2016), « La synchronisation intra- et inter-régionale des cycles économiques en Europe et en Asie », *Revue Interventions économiques*, 55/2016.
- European Fiscal Board (2020). « Assessment of the fiscal stance appropriate for the euro area in 2021 ».
- Evgenia Passari and Hélène Rey (2015). "Financial Flows and the International Monetary System". *Economic Journal,* Royal Economic Society, vol. 0(584), 675-698.
- Funashima, Y. and Y. Ohtsuka (2019) “Spatial crowding-out and crowding-in effects of government spending on the private sector in Japan,” *Regional Science and Urban Economics* 75, 35-48

- Gayer, Christian (2007). “A fresh look at business cycle synchronization in the Euro area”. European Economy, Economic Papers, European Commission, Directorate-General for Economic and Financial Affairs, Publications number 287.
- Giancarlo Corsetti, Paolo Pesenti, Nouriel Roubini (1999). "What Caused the Asian Currency and Financial Crisis?". *Japan and the World Economy*, vol. 11, 305-373.
- Gong, Chi and Kim, Soyoung (2018). "Regional business cycle synchronization in emerging and developing countries: Regional or global integration? Trade or financial integration?". *Journal of International Money and Finance*, vol. 84(C), 42-57.
- Harding, D., and Pagan, A. (2001). “Extracting, Analyzing and Using Cyclical Information”. Mimeo: University of Melbourne.
- Hirata, H., A.M. Kose, and C. Otrok. (2013) “Regionalization vs. Globalization.” Global Interdependence, Decoupling, and Recoupling, 87-130, MIT Press.
- Ilzetzki, Ethan, Carmen M. Reinhart, and Kenneth S. Rogoff. (2019). “Exchange Arrangements Entering the 21st Century: Which Anchor Will Hold?” *Quarterly Journal of Economics,* vol. 134 (2), 599-646.
- Inklaar, Robert; Jong-A-Pin, Richard; de Haan, Jakob (2005) : Trade and business cycle synchronization in OECD countries : a re-examination, CESifo Working Paper, No. 1546, Center for Economic Studies and ifo Institute (CESifo), Munich
- Inklaar, Robert and Jakob de Haan (2001). “Is there really a European business cycle? A comment”. *Oxford Economic Papers* 53, 215-220.
- Kenen, P. B. (1969). The theory of optimum currency areas: An eclectic view. Monetary problems of the international economy.
- Kim, Lee and Park (2011). "Emerging Asia: Decoupling or Recoupling". *The World Economy*, Volume 34, Issue 1, 23–53.
- Kose, M.A., E.S. Prasad, and M.E. Terrones (2003) “How does globalization affect the synchronization of business cycles?” *American Economic Review,* 93(2), 57-62.
- Kose, Ayhan, and Kei-Mu Yi. (2001). "International Trade and Business Cycles: Is Vertical Specialization the Missing Link?". *American Economic Review*, 91 (2): 371-375.
- Krugman, Paul (1993). "What Do Undergrads Need to Know about Trade?". *American Economic Review*, vol. 83(2), 23-26.
- McKinnon, R. (1963). Optimum Currency Areas. *The American Economic Review, 53*(4), 717-725. Retrieved October 1, 2020, from http://www.jstor.org/stable/1811021Obstfeld,
- Maurice (1994). "Risk-Taking, Global Diversification, and Growth" *American Economic Review*, vol. 84(5), 1310-29.
- Mundell, R. (1961). A Theory of Optimum Currency Areas. *The American Economic Review,* 51(4), 657-665.
- Oscar Torres-Reyna (2007). “Panel Data Analysis Fixed and Random Effects using Stata”. Princeton university.
- Otto, G., Voss, G., Willard, L., (2001). “Understanding OECD output correlations”. Research Discussion Paper 05, Reserve Bank of Australia.
- Rose, Andrew K. and Charles Engel (2002)."Currency unions and international integration". *Journal of money, credit and banking*, vol. 34, 1067-89.

- Wei Jiang, Yunong Li, and Shajuan Zhang (2019). "Business cycle synchronisation in East Asia: Therole of value-added trade". *The World Economy*, John Wiley and sons Ltd, 226-241.
- World Bank database. World development indicators.
- World Trade Organization (WTO) (2018). International Trade Statistics.