Determinants of Business Cycle Synchronization in ASEAN-5 Countries

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Abstract: After severely hit by the Asian crisis in 1997, the interest of forming a common currency area in ASEAN countries has been more urgent to replace current exchange rate regimes that showed significant flaws during the crisis. According to theory of optimal currency area (OCA), the most important requirement for the launch of such an area is the level of business cycle synchronization. In order to know how ASEAN-5 countries are becoming better prepared to form a currency area, this study aims at investigating the determinants of cycle co-movement in the region.

Based on various estimation strategies applied in the literature such as OLS, Instrumental Variables (IV) regression, panel technique and panel-based IV approach, the study found that business cycles in ASEAN-5 are likely to be more harmonized if more trade integration, especially more intra-industry trade intensity, more similarity of industrial structure and more fiscal policy convergence occur. However, more inter-industry trade intensity seems to de-synchronize the cycles due to the dominance of industry-specific shocks in the region. The study also shows that the effect of intra-industry trade is largest among determinants. Fiscal policy convergence is at least as important as bilateral trade ties in shaping the business cycle co-movement.

These findings propose an important implication. Accordingly, after the launch of a currency union, if the increase of trade is mainly created by inter-industry trade, the business cycle synchronization could be weakened and then make the joining of union more costly. Thus the establishment of a currency union in ASEAN-5 should be initiated for countries with high level of intra-industry trade links and let the remaining have adjustment time to enhance trade within the same industries.

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1. Introduction

The Association of Southeast Asian Nations (ASEAN) was established in Bangkok in 1967 with original five members: Indonesia, Malaysia, Philippines, Singapore and Thailand or ASEAN-5. It was then joined by Brunei Darussalam (1984), Vietnam (1995), Laos and Myanmar (1997) and Cambodia (1999). The association has been emerged as one of the regions of most successful economic development in the world. However, historically the fluctuation of bilateral exchange rate has influenced heavily the competitiveness of ASEAN exports given common export markets for these countries. When the trade integration has been more intense recently, the pressure to stimulate the exchange rate stability among countries has been increasing. The creation of a common currency area in ASEAN seems to be the best option to stabilize the region's exports and motivate the benefits of trade integration. After severely hit by the Asian monetary and financial crisis in 1997, the interest of forming a common currency area has been more urgent to replace current exchange rate regimes that showed significant flaws during the crisis. In addition, the successful introduction of the Euro in 1999 and its claimed benefits are also encouraging a common currency arrangement in the region. In reality, some movements have been implemented to promote regional financial stability, monetary policy cooperation, economic integration and then common currency area. They can be named such as the signing of AFTA (ASEAN Free Trade Area) in 1992, the establishment of Manila Framework Group in 1997, the adoption of "ASEAN Vision 2020" in 1997 where a timetable is set up to create an ASEAN Economic Region, "ASEAN Surveillance Process" in 1998, "Chiang Mai Initiative" in 2000, etc...

According to traditional theory of optimal currency area (OCA) initiated by Mundell (1961) and McKinnon (1963), key criteria to join a common currency area are trade intensity and symmetry of business cycles. That is because the decline in transaction costs associated with the use of a common currency has a larger effect on the volume of trade and investment flows across countries in the area. In addition, business cycle synchronization plays an important role in determining the costs if scarifying an independent monetary policy. While traditional OCA literature considers these criteria as exogenous, recent literature treats them as endogenous. One of the most influential papers on this topic is by Frankel and Rose (1998). According to the authors, two requirements for the launch of a common currency are i) the intensity of trade among potential members and ii) the degree of business cycle co-movement across countries.

Given the fact that trade integration has been pushed up recently in ASEAN countries, the plausible concerns posed are whether business cycles in the region are synchronized and what determine the cycle synchronization? Answering these questions, we can know whether ASEAN countries are becoming better prepared to form a currency area. The first concern has been addressed in the previous studywith the conclusion that business cycles in the region are highly harmonized. The second concern is left to this chapter. Knowing how possible determinants will shape business cycle co-movement in the region is then significant and helpful to propose valuable implications for the prospect of a common currency union in ASEAN.

Though many empirical studies on determinants of business cycle synchronization have been implemented in the literature, a few of them focus on ASEAN countries. Among them, Cortinhas (2005) analyzes the business cycle co-movement in ASEAN-5 countries but just examines the effect of intra-industry trade intensity only. In addition, the methodology to control the endogeneity of trade and business cycle synchronization is controversial in the literature. Frankel and Rose (1998) advocate Instrumental Variable estimation (IV) while Gruben et al (2002) apply Ordinary Least Square (OLS) and Shin and Wang (2004) implement panel technique. Therefore, a new study investigating more comprehensively the determinants of business cycle coherence in ASEAN countries, applying all possible regression methodologies is significant and worthy to get the whole picture of business cycle synchronization in the region. That is also the purpose of this study.

In that tone, this study aims at answering two research questions. *Firstly*, what are the major determinants of business cycle synchronization in ASEAN and *secondly*, how relatively important of each determinant? To address these two questions, based on Stockman (1988)'s theoretical model, we use four possible estimation approaches (OLS, IV, panel regression and panel-based IV regression) applied to the data over the period 1972-2000 for the empirical investigation. In this study, we just focus on ASEAN-5 because some important data in the remaining countries in the region is not available and trustful.

The study is began by a brief summary of relevant studies in the literature, and followed by theoretical framework, data and variable description and some more discussions about empirical approaches. Next are statistical description of variables, estimation results from all approaches and then the robustness analysis. The study ends with summary of main findings and implications.

2. Brief Empirical Literature Review

In the literature, many factors have been so far believed to drive business cycle synchronization. They can be grouped into four main determinants, i.e. i) trade intensity, ii) financial integration, iii) similarity of industrial structure or specialization and iv) similarity of policies or policy coordination, especially fiscal policy similarity. Among them, the most prominent and also widely mentioned in almost studies is trade intensity. The effect of each of these factors found in the literature will be presented in detail as follows

- **Trade Intensity**

The economic theories provide an ambiguous correlation between trade intensity and business cycle synchronization. Historically, there are two mainstreams concerning this issue. The first is "European Commission View" originated from Kenen (1969), which believes that more trade integration will make asymmetric shocks occur less frequently among economies with a large share of intra-industry trade. Because most trade in EU countries is intra-industry trade, trade intensity can make these countries be influenced similarly by shocks and then result in business cycle harmonization. In contrast, the second called "Krugman View" developed by Krugman (1991, 1993) and Eichengreen (1992) affirms that higher trade intensity causes a potential increase in asymmetry shocks due to specialization. The industrial specialization resulting from trade is also confirmed by standard trade theory when trade is of the Heckscher-Ohlin or the Ricardian type. Then business cycles are less synchronized if they are hit by industry-specific shocks. In the empirical literature, studies have confirmed the fact that trade effect on income correlation is not only dependent on bilateral trade intensity but also on the structure of trade (intra- and inter-industry trade).

Frankel and Rose (1997, 1998)'s study is one of the most significant and influential papers in the area and widely cited in almost subsequent articles in the literature. Based on data collected from 21 OECD countries from 1959-1993, the authors aim to investigate the relationship between trade and business cycle synchronization as a criteria for entry to OCA. Their empirical study is just interested in the effect of bilateral trade intensity on income correlation although it mentions the possible different impacts of inter-industry and intra-industry trade on business cycle synchronization. Their measure for business cycle synchronization is the correlation of cycle components of real output, industrial production, employment and unemployment. Frankel and Rose also use two proxies for bilateral trade intensity, i.e. i) bilateral trade normalized by total trade and ii) bilateral trade normalized by nominal GDP. The IV regressions are implemented in their work because, according to them, countries tend to link their currencies with their larger trading partners to achieve the exchange rate stability in international trade. The monetary coordination with large trading partners may cause a positive correlation between trade and business cycle synchronization. Thus a simple OLS regression may result in a spurious association between trade and business cycles. Based on "gravity" trade model, the authors choose three instrumental variables to fix the spuriousness problem, such as i) the distance, ii) dummy variable for common border and iii) dummy variable for common language. The study finds a strong, significant and positive correlation between bilateral trade intensity and business cycle synchronization.

Although the theory on the relationship between bilateral trade and income correlation is ambiguous, empirics are rather consistent. Together with Frankel and Rose (1998), majority of the subsequent researches show that more trade intensity may cause more highly synchronized business cycles, regardless of different measures of trade intensity and the model specifications. The findings from some next studies on OECD countries are quite consistent with those from Frankel and Rose (1998), such as Otto et al (2001), Gruben et al (2002) and Calderon et al (2002). However, some works estimate somewhat lower effects of trade than Frankel and Rose (1998). For example, using the same 21 OECD countries as Frankel and Rose (1998), Gruben et al (2002) find a positive correlation between bilateral trade and business cycle synchronization but the trade effect is only half of Frankel and Rose's estimate. Some other seminar articles on developed countries have the same conclusion, such as Clark and van Wincoop (2001). Using data extracted from 9 US census regions and 14 EU countries, they conclude that the larger trade intensity and to a more extent the higher level of industrial specialization result in much higher degree of income correlation among US regions than among EU countries.

On the other hands, many studies on developed and developing countries also confirm the positive effect of bilateral trade. Based on 147 countries over the period 1960-1999, Calderon et al (2002) find that countries having higher bilateral trade level experience highly synchronized business cycles. This finding is quite robust to various measures of bilateral trade intensity and de-trending techniques. In addition, the trade effect seems to be higher for pairs of developed countries than both developing pairs and developed - developing pairs as well. Different from most empirical studies which have used cross-country correlation as proxy for business cycle synchronization, Kose et al (2003) compute the correlation of individual country's cycle with the "world aggregate". With data from 21 developed and 55 developing countries over the period 1960-1999, the authors seek the effect of rising trade and financial integration on international business cycle synchronization. They find the evidence that the global spillover of macroeconomic fluctuations enhanced by trade intensity is mostly limited to industrial countries, which is somewhat similar to Calderon et al (2002)'s findings. Baxter and Kouparitsas (2004), in a study to investigate the "robust" determinants of business cycle synchronization for over 100 countries both developed and developing, include not only bilateral trade intensity but also extent of total trade to examine. Bilateral trade effect is found to be robustly positive to the exclusion as well as inclusion of gravity variables in the model. This also implies that the impact of bilateral trade on business cycle co-movement is independent of the impacts on trade "occurring through gravity variables". Meanwhile, the total trade extent is found to be negatively and significantly associated with business cycle synchronization. The study, nevertheless, presents that this variable is actually not robust regardless of inclusion or exclusion of gravity variables.

There have been some recent studies on East Asian countries in the empirical literature, but their results are not strong and clear compared with those on developed countries. Choe (2001) examines the impact of bilateral trade on the co-movement of macroeconomic fluctuations in 10 East Asian countries and finds that more synchronized business cycles result from deeper trade interdependence in the region. The trade dependence effect is, nevertheless, is not uniform across all countries. It is just quite strong among ASEAN members. Meanwhile, Crosby (2003)'s study, with data from 13 Asia-Pacific countries from 1980-1999, shows no discernible and robust association between bilateral trade and business cycle co-movement. Kumakura (2005) applies the basic framework by Frankel and Rose (1998) with attention to the structural features in Asia-Pacific to investigate the relation between bilateral trade and income correlations among 13 countries in the region over the period 1984-2003. The study exhibits a positive association between the two, confirming the trade channel through which macroeconomic fluctuations in countries are more synchronized. However, trade channel of what countries produce and export rather than the geographical trade structure is the most important determinant of business cycle synchronization. Accordingly, those countries specializing in the electronics sector tend to have higher degree of cycle co-movement.

If all above mentioned works just focus on the effect of bilateral trade, some others have tried to test the different possible impacts of intra- and inter- industry trade on business cycle correlation. Various approaches to disentangle those two effects have been applied in the empirical literature. *A direct approach* is used in Gruben et al (2002)'s paper, where both intra- and inter- industry trade variables are included in the model together with gravity variables as independent variables. Their result is consistent with theory when the intra-industry trade largely contributes to income correlation. They also find a positive impact of inter-industry trade on business cycle co-movement. The culprit, according to them, could be attributed to high share of intra-industry trade in total trade, thus industry-specific shocks, through specification, do not overweight the common demand shocks or productivity spillovers.

Another direct approach is conducted in Kirdmuc (2004). Researching on OECD countries from 1990-1999, Kirdmuc augments Frankel and Rose's basic empirical model by including intra-industry trade variable and finds no clear association between bilateral trade intensity and income synchronization. The intra-industry trade, nevertheless, is found to be statistically significant and positive impact on macroeconomic co-movement. Also adding intra-industry variable in the model with bilateral trade and policy coordination variables, Shin and Wang (2004) focus on 12 countries in East Asia over the period of 1976-1997. Their estimation results exhibit that bilateral trade variable appears statistically significant just when intra-industry is not included in the model. Otherwise, the significance of the variable's coefficient drops substantially, implying that intra-industry trade is the important determinant of business cycle synchronization rather than inter-industry trade or total bilateral trade itself.

In an indirect approach, Inklaar et al (2005) include specification variables, one of which is share of intra-industry trade to capture the impact of intra-industry trade on business cycle synchronization for 21 OECD countries during 1970-2003. In their work, variables are measured in a different way from prior studies. They use Fisher's z-transformations of correlation coefficients as business cycle co-movement because they claim that simple bilateral correlation of some real economic activities lies between -1 and 1, making the error terms in the regressions not be normally distributed. In addition, bilateral trade intensity is computed by a common variation of the six individual trade intensity measures. Similar to most empirical studies, intra-industry trade may result in income co-movement and trade intensity is found to be positively correlated with business cycle synchronization, but at much smaller degree than Frankel and Rose (1998)'s research.

Meanwhile, Cortinhas (2005) just concentrates on the impact of intra-industry trade on business cycle synchronization in ASEAN countries. Based on annual data over the period 1962-1996, the author estimates two separate models. The first is the replication of Frankel and Rose's basic model and the second is the model where he uses the square of the difference in the growth rate of detrended real output as the proxy for business cycle harmonization. Both two specifications produce the expected signs for intra-industry trade coefficients but they appear not very statistically significant except when Indonesia is excluded from the regression. That is because, according to the author, Indonesia is the largest and least open economy in the region.

Though most of the studies have exhibited quite similar results on the impact of trade intensity on income correlation, no consensus of methodology has been observed in the empirical literature. Some works make use of IV regressions to fix the endogeneity and measurement error problems, namely Frankel and Rose (1997, 1998), Otto et al (2001), Calderon et al (2002), Cortinhas (2005), etc. Some other authors, such as Crosby (2003), Inklaar et al (2005), etc, …claim that IV approach is not appropriate because the gravity variables used as instrumental variables may not only have impact on trade intensity but also on other variables that determine business cycle synchronization and thus they advocate OLS regressions in the studies.

Meanwhile, Imbs (1998) and Shin and Wang (2004) believe that all possible troubles can be fixed by applying panel regressions with fixed effects. A more detailed discussion on different estimation methodologies will be presented in the next section.

- **Financial Integration**

Most of the empirical studies confirm the positive effects of financial integration on business cycle synchronization. Kose et al (2003) find that, together with trade integration, the financial integration enhances the global spillovers of macroeconomic fluctuations. Imbs (2004)'s study shows that economic activities in regions having strong financial connections are more harmonized. According to the author, due to higher specialization, the positive direct impact of financial integration on business cycle co-movement outweighs the negative indirect impact. In using the same measures for financial integration as Imbs (2004), Inklaar et al (2005) do not find a robust effect on business cycle synchronization. However, the correlation of changes in the stock market is found to be robust and positive associated with income correlation. Jansen and Stokman (2004) suggest the same conclusion with the measure of capital flows as financial linkage. Otto et al (2001), nevertheless, do not find a significant impact of financial integration in their seminal article.

- **Similarity of Industrial Structure**

Similar to effect of intra-industry trade, countries with greater similarity of sectoral structure tend to have more-synchronized business cycles if the primary shocks are industry-specific. Clark and van Wincoop (2001), in a study to compare US and EU, find that one of the reasons why cycle co-movement in US regions is much higher than EU countries is a higher level of sectoral specialization in the latter. Imbs (2001, 2004), Calderon et al (2002), Crosby (2003) also confirm the evidence that the similarity of economic structure between countries can lead to more business cycle synchronization among them. Especially, Imbs (2004)'s work shows very strong specialization effect on cycle harmonization, and most of this impact is not dependent on financial or trade policies. Similarly, Inklaar et al (2005) with different measures for specialization such as industrial similarity, export similarity and share of intra-industry trade confirm a significant association between those variables and business cycle co-movement. However, in some studies, symmetric industrial structure does not appear significantly and robustly correlated with business cycle synchronization, such as those by Otto et al (2001), Baxter and Kouparitsas (2004).

- **Fiscal Policy Similarity**

The effect of fiscal policy similarity is theoretically ambiguous. If fiscal shocks drive business cycles, the factor can be associated with income co-movement. However, if fiscal policies are implemented to respond asymmetric shocks, the effect may be opposite. Empirically, Clark and van Wincoop (2001) do not find any relationship between degree of fiscal policy coordination and business cycle correlation. Similarly, Shin and Wang (2004) find positive but not significant effect of fiscal policy similarity on income synchronization. However, in Inklaar et al (2005)'s study, this effect is strongly significant and even as large as the effect of trade intensity. Darvas et al (2005), based on 21 OECD countries over the period 1964-2003, conclude that fiscal convergence as measured by persistent similarity of ratio of government surplus/deficit to output tends to make business cycles fluctuate more closely.

In brief, trade intensity has been attracted to many attentions in literature. Most of empirical works find positive association between bilateral trade and business cycle synchronization. However, the trade effect in developing countries seems to be lower than developed countries. Some other studies include intra-industry trade intensity and exhibit a quite strong impact of this factor on business cycle harmonization. However, a few works investigate the effect of inter-industry trade directly in the analysis. The effects of financial integration, similarity of industrial structure and fiscal policy convergence on cycle coherence are not very strongly consensus across empirical studies compared to the effect of trade intensity. The estimation methodologies are also controversial in the empirical literature. There are three main regression strategies applied so far, such as IV, OLS and panel techniques, in which IV regressions are more widely used in empirics. In addition, nearly none of studies investigates determinants other than intra-industry trade of business cycle synchronization in ASEAN-5 countries. This critical gap will be filled in this study. More information on the relevant researches can be seen in Table 1 as follows.

Table 1. Summary of Relevant Studies on Determinants of Business Cycle Synchronization

Authors	Countries and Period	Business Cycle Sync. Measures	Methodology	Main Conclusions
Frankel and Rose (1998)	21 OECD countries, 1959-1993	Bilateral correlation of detrended GDP, IP, employment and unemployment	Instrumental Variables regression	Bilateral trade intensity has a positive and significant effect on business cycle synchronization
Otto et al (2001)	17 OECD countries, 1960-2000	Bilateral correlation of GDP growth rate	Instrumental Variables regression	Trade intensity, FDI impact positively business cycle harmonization. Meanwhile, spreads, volatility of interest rates and exchange rates and industrial structure have a negative association with income correlation.
Clark and van Wincoop (2001)	9 US regions and 14 EU countries, various sample periods	Bilateral correlation of GDP and employment, using HP detrending and percentage changes	Instrumental Variables regression	US regions have more harmonized business cycles than EU countries. Trade intensity has significant impact on cycle co-movement while policy similarity does not affect synchronization.
Calderon et al (2002)	147 developing and developed countries, 1960-1999	Bilateral correlation of detrended output	Instrumental Variables regression	Bilateral trade intensity and more symmetric production structure have positive effect on business cycle synchronization. The effect of trade is smaller when production structure is more different. The impact of trade is also smaller in developing countries.
Gruben et al (2002)	21 OECD countries, 1965-1998	Bilateral correlation of detrended GDP, IP, employment and unemployment	Ordinary Least Square	Intra-industry trade has the positive and significant effect on business cycle synchronization. He impact of inter-industry trade is not clear
Kose and Yi (2002)	21 countries, 1970-2000	Bilateral correlation of detrended output	Instrumental Variables regression	Bilateral trade intensity influences positively business cycle harmonization.
De Haan et al (2002)	18 OECD countries, 1961-1997	Bilateral correlation of detrended output	Ordinary Least Square	Trade intensity and exchange rate volatility have positive effect on income correlation
Crosby (2003)	13 Asian countries, 1980-1999	Bilateral correlation of detrended output	Ordinary Least Square	Trade is not strongly associated with business cycle synchronization but similarity of industrial structure have significantly positive impact on income correlation.
Kose et al (2003)	76 countries, 1960-1999	Correlation of individual country's output and consumption	Instrumental Variables regression	Trade intensity with G7 countries has the positive impact while capital account restrictions and terms of trade volatility have

		growth with the world aggregates		negative effect on cycle co-movement
Shin and Wang (2004)	12 East Asian countries, 1976-1997	Bilateral correlation of detrended output	Panel regression with fixed effects	Intra- rather than inter-industry trade nor the volume of trade itself is the main channel through which the business cycles become synchronized
Imbs (2004)	24 countries, 1980s-1990s	Bilateral correlation of detrended output	Three-Stage Least Square	Specialization and trade intensity have opposite effects on business cycle synchronization. Financial integration not only affects income correlation but also directly influence specialization.
Baxter and Kouparitsas (2004)	Over 100 countries, 1970-1995	Bilateral correlation of detrended output	Extreme Bound Analysis (EBA) to test robustness of explanatory variables	Robust variables are trade intensity. The variables which are not robust are currency union, total trade extent, industrial similarity, factor intensity, similarity of import and export baskets…
Camacho et al (2005)	EU countries, Canada, Japan, Norway and US, 1965-2003	A combined measure of three measures of synchronization	Instrumental Variables regression	Specialization, trade intensity, fiscal policy, labor productivity has significant effect on business cycle synchronization. Monetary policy is not related to income correlation
Inklaar et al (2005)	21 OECD countries	Bilateral correlation of detrended output and industrial production	Instrumental Variables regression and Ordinary Least Square	Trade intensity, specialization, similarity of fiscal and monetary policies and common currency have positive and significant impact on business cycle co-movement.
Cortinhas (2005)	5 ASEAN countries, 1962-1996	Squared difference in growth rate of detrended real output	Instrumental Variables regression	The effect of intra-industry trade on business cycle synchronization in the region is not very significant but it becomes highly significant if Indonesia is excluded from analysis.
Davas et al (2005)	21 OECD countries, 1963-2003	Bilateral correlation of detrended output and unemployment.	Instrumental Variables regression and Ordinary Least Square	Fiscal convergence (in form of persistently similar ratio of government surplus/deficit to GDP) is systematically associated with more harmonized business cycles.
Kamakura (2005)	13 East Asian countries, 1984-2004	Bilateral correlation of detrended output	Instrumental Variables regression and Ordinary Least Squar	The primary determinant of the business cycle synchronization across countries is not the geographical structure of their trade but what they produce and export. The income harmonization is quite high among those specializing in the electronics industry.

3. Data and Methodology

3.1. Theoretical Framework

In order to investigate determinants of business cycle synchronization in ASEAN-5 countries, we will follow Stockman (1988) and Frankel and Rose (1998) to construct a model, where output correlation can be attributed to industry-specific shocks and country-specific aggregate shocks. The model will then provide some ideas about the channels through which some factors can have impacts on business cycle co-movement.

The growth rate of real output for home country can be decomposed in the following equation:

$$d\ln y_t = \sum_i \mu_i d\ln y_{it} \quad (1)$$

where $d\ln y_t$ is the growth rate of real output at time t, μ_i is the weight of industry i in total output ($\sum_i \mu_i = 1$), $d\ln y_{it}$ is the growth rate of output in industry i at time t. On the other hand, growth rate of output can be expressed as the weighted average of the growth rate of output in different sectors of the economy.

We can express equation (1) in a different way as following

$$d\ln y_t = \sum_i \mu_i \theta_{it} + \xi_t \quad (2)$$

where θ_{it} is the industry-specific deviation of the growth rate of output in industry i from the average growth rate of total output at time t (ξ_t). Therefore, the growth rate of real output at time t consists of weighted average of industry-specific deviations of the growth rate of output in each sector ($\sum_i \mu_i \theta_{it}$) and the country's average growth rate at time t (ξ_t).

Similarly, the growth rate equation for foreign country can be presented as

$$d\ln y^*_t = \sum_i \mu_i^* \theta^*_{it} + \xi^*_t \quad (3)$$

where the asterisk expresses the value for foreign countries.

Following Stockman (1988), some following assumptions are imposed

i) Industry-specific shocks are common across countries. Equivalently, $\theta_{it} = \theta^*{}_{it}$ and they have the same variance $\sigma_i{}^2$

ii) $\{\theta_{it}\}$ is distributed independently of each other across sectors and time as well.

iii) $\{\xi_t\}$ is distributed independently over time

iv) $\{\theta_{it}\}$ and $\{\xi_t\}$ are distributed independently of each other.

With above assumptions, the cross-country covariance of output growth rate is shown as follows

$$\text{cov}\,(d\ln y_t, d\ln y^*{}_t) = \sum_i \mu_i \mu_i{}^* \sigma_i{}^2 + \text{cov}\,(\xi_t, \xi^*{}_t) \quad (4)$$

The equation can be rearranged in terms of correlation of cross-country output growth rate as bellows

$$\rho_{yy^*} = \sum_i \breve{\mu}_i \breve{\mu}_i{}^* \sigma_i{}^2 + \omega_{\xi y} \rho_{\xi\xi^*} \quad (5)$$

where ρ_{yy^*} is cross-country output growth correlation, $\breve{\mu}_i = \frac{\mu_i}{\sigma_y}$ and then the direct function of share of industry i in total output, $\omega_{\xi y} = \frac{\sigma_{\varsigma}\sigma_{\xi^*}}{\sigma_y \sigma_{y^*}}$ and $\rho_{\xi\xi^*}$ is the correlation between country-specific aggregate shocks. So $\breve{\mu}_i \breve{\mu}_i{}^*$ and $\omega_{\xi y}$ are the weights for the variance of industry-specific shocks ($\sigma_i{}^2$) and the correlation of country-specific aggregate shocks.

The equation (5) implies that the cross-country output growth correlation or business cycle synchronization depends on the effect extent of industry-specific shocks and country-specific aggregate shocks. The impact of some factors on business cycle synchronization can be explained through these two channels. Following is the detailed discussions on this issue

3.1.1. Effect of Trade Intensity

Theoretically, trade integration can have positive impact on the correlation of country-specific aggregate shocks. There are two main channels. *The first* is the spillover of demand aggregate shocks. For instance, if aggregate demand shocks drive a surge in one country, the effect can spill over to trading partners due to an increased demand for both foreign and domestic goods. The spillover impact is even larger if it is accomplished with more policy coordination resulting from trade integration. *The second* channel is a more rapid spread of productivity shocks via inward FDI and technology sourcing (as suggested by Lichtenberg and Pottelsberghe (1998)) and through the spillover of knowledge and technology (as suggested by Coe and Helpman (1995)). Therefore, through aggregate demand shock spillower and productivity diffusion, bilateral trade intensity is positively correlated with the second element of the equation (5) regardless of its composition (intra- or inter-industry trade). However, the total effect on business cycle is ambiguous because trade components have different possible effects on the first element of the equation (5). The mechanism of trade affect on business cycle synchronization will be clearer if intra and inter- industry trade effects are examined separately.

- **Effect of inter-industry trade intensity**

According to the standard trade theory, inter-industry trade patterns of international trade is accompanied with an increasing specialization in production resulting from removal of tariff barriers. Therefore, a negative correlation between $\breve{\mu}_i$ and $\breve{\mu}_i^*$ is expected. Given that σ_i^2 is always positive, the first element of the equation (5) may be negative. However, as stated before, the effect of inter-industry trade on the second element is still positive. If the industry-specific shocks (θ_{it}) dominate common demand shocks and productivity spillovers, inter-industry trade is expected to have negative effect on business cycle harmonization[1]. Otherwise, if business cycles are not dominated by industry-specific shocks, the positive impact of inter-industry trade can be expected.

[1] Kalemli-Ozcan et al (2001) suggest another channel to explain the negative effect of trade. According to them, countries may insure against asymmetric shocks in face of integration of both financial and good markets by diversify the ownership, then can afford to specialize the production structure, creating better opportunities for income diversification, which are associated with less business cycle synchronization.

- **Effect of intra-industry trade intensity**

The intra-industry trade does not necessarily cause the specialization effect as stated in standard trade theory. Then industry-specific shocks might affect trading partners symmetrically because they are more integrated[2]. Therefore, in the model, intra-industry trade does not necessary create negative correlation between $\breve{\mu}_i$ and $\breve{\mu}_i^*$, so the net effect on business cycle co-movement is expected to be positive[3].

In brief, the impact of bilateral trade on income correlation is not only dependent on the structure of trade but also on the relative importance of industry-specific shocks and aggregate shocks in driving business cycles.

3.1.2. Effect of Financial Integration

The financial integration may stimulate production specialization through the channel of capital reallocation so that it is consistent with countries' comparative advantages. In the same explanation manner as the previous sub-section, the net effect of financial integration on business cycle synchronization may be negative if the industry-specific industry shocks are dominant.

However, the financial links can generate a large aggregate demand side effect and then have positive effect on the second element of the equation (5), contributing to business cycle co-movement. For example, if customers in other countries make a significant investment in a particular stock market, a decline in that stock market could result in a simultaneous decrease in the demand for investment and consumption in those countries. Moreover, cross-country spillover of business cycles could be resulted from the contagion effects which are transmitted via the international financial link. In addition, in case international financial markets are used to diversify the consumption risk, the consumption across countries can be more strongly correlated. This effect is even stronger among developing countries given their more volatile output and less diversification of endowment and production structure.

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[2] See Krugman (1993) for more details.

[3] The positive correlation between trade intensity and income synchronization is explained differently in Kose and Li (2001). The authors argue that the international trade observed exhibits increasing portion of vertical or fragmented trade, i.e. countries now tend to specialize in particular stages of a good's production sequence rather than the entire good. This is likely to create more synchronized business cycles in response to higher trade integration.

3.1.3. Effect of Similarity of Industrial Structure

Countries with similar industrial structure or producing similar type of goods and commodities seem to have similar stochastic developments in case of industry-specific shocks (Imbs, 2004). In the model, similarity of industrial structure results in a positive correlation of between $\breve{\mu}_i$ and $\breve{\mu}_i^*$ and then the first element of the equation (5). Further more, as mentioned in Kraay and Venture (2001), the countries with similar production pattern can be more synchronized even though shocks are purely aggregate regardless of sectors differing in their response to monetary shocks. Therefore, the effect of this factor is not ambiguous. We expect a positive relationship between structural similarity with business cycle harmonization.

3.1.4. Effect of Similarity of Fiscal Policy

Theoretically, the effect of fiscal policy similarity on income correlation is not clear. Countries may be subject to asymmetric shocks or symmetric shocks may have asymmetric effects due to different propagation mechanism across countries. If this asymmetry is persistent and compensated partially by discretionary fiscal policy, fiscal divergence or fiscal policy dissimilarity can result in business cycle co-movement. In contrast, without shocks with persistent effects or persistent shocks, the factor could have no impact on business cycle co-movement. However, fiscal policy, as mentioned in study3, normally pro-cyclical and can be a source of shocks. So if fiscal shocks themselves drive business cycles, the positive relationship between fiscal policy similarity across countries and business cycle synchronization can be expected.

3.2. Data and Variable Definitions

As previously mentioned, in addition to bilateral trade intensity which has received great attention in both theoretical and empirical works, there are some major determinants of business cycle synchronization such as financial integration, specialization or structural similarity and similarity of fiscal policy. However, bilateral financial integration is notoriously difficult to measure, even for developed countries (Imbs, 2004). In addition, in case of ASEAN-5, the data on effective bilateral capital flow - one of two main indices capturing financial integration, together with restrictions on capital flows – is not available for long time. Therefore, this factor is excluded, leaving others namely trade intensity, similarity of industrial structure and fiscal policy coordination to play in the study. Following are details of variable measurement, data sources and some initial statistic descriptions

3.2.1. Business Cycle Synchronization

Standard measure for business cycle synchronization in the literature is the correlation coefficient of cyclical component of economic activities (GDP, industrial output, employment, unemployment, etc…). It is also used in a majority of empirical works such as Frankel and Rose (1998), Baxter and Koupatritsas (2004), Shin and Wang (2004). Following them, the study's measure for business cycle co-movement is the bilateral correlation of detrended real output. The technique to isolate the cyclical component of output is HP filter. The source of data is World Development Index (WDI), September 2005, where the data is annually available from 1960-2004 for ASEAN-5 countries. As mentioned bellows, the data availability for other variables is yet shorter, thus the period for analysis is cut to 1972-2000 to achieve data symmetry. In the empirical literature, there is no consensus and obvious way to split the sample period into particular sub-periods to compute the correlation coefficients, so we divide the whole sample into 7 sub-periods of equal length. The reason is to get sufficient observations to run regressions given a short length of data. Since the sample includes 5 countries, the number of observations is 70 (10 country pairs each with 7 sub-period observations).

3.2.2. Trade Intensity

The study investigates not only the effect of bilateral trade intensity but also the effect of intra-industry and inter-industry trade on business cycle synchronization. Therefore, 4 measures for this determinant will be computed in the study.

- **Bilateral Trade Intensity**

We use four proxies for bilateral trade intensity. The first variable (BTI_1) uses export data only, the second (BTI_2) uses import data only, the third (BTI_3) uses both export and import data and the fourth (BTI_4) use output data as well. They are defined as follows

$$BTI_1(i,j) = \frac{x_{ij}}{x_i + x_j}$$

$$\text{BTI}_2(\text{i,j})=\frac{m_{ij}}{m_i + m_j}$$

$$\text{BTI}_3(\text{i,j})=\frac{x_{ij} + m_{ij}}{x_i + m_i + x_j + m_j}$$

$$\text{BTI}_4(\text{i,j})=\frac{x_{ij} + m_{ij}}{y_i + y_j}$$

where x_{ij} is total value of nominal exports from country i to country j, m_{ij} denotes total value of nominal imports from country j to country i. x_i is the value of country i's exports to all countries. m_i is the value of country i's imports from all countries. y_i is the output of country i. The measures BTI_1 and BTI_2 are similar to Shin and Wang (2004) while BTI_3 and BTI_4 are used by Frankel and Rose (1998). The export and import data is collected from "World Trade Flows, 1962-2000" source complied by Feenstra et al (2005). The output data is extracted from WDI, September 2005.

Practically, as suggested by Feenstra (2000), we use only import data to compute all indices because reported data are more reliable for imports than exports. Accordingly, following are practical formulas for bilateral trade intensity:

$$\text{BTI}_1(\text{i,j}) = \frac{m_{ji}}{x_i + x_j}$$

$$\text{BTI}_2(\text{i,j})=\frac{m_{ij}}{m_i + m_j}$$

$$\text{BTI}_3(\text{i,j})=\frac{m_{ji} + m_{ij}}{x_i + m_i + x_j + m_j}$$

$$\text{BTI}_4(\text{i,j})=\frac{m_{ji} + m_{ij}}{y_i + y_j}$$

A higher value for any above index implies more intense bilateral trade across countries.

- **Intra-industry trade**

Intra-industry trade intensity is computed using the traditional Grubel-Lloyd (1975) Index.

$$\text{IIT(i,j)} = 1 - \frac{\sum_k |x_{ij}^k - m_{ij}^k|}{\sum_k (x_{ij}^k + m_{ij}^k)}$$

Or practically

$$\text{IIT(i,j)} = 1 - \frac{\sum_k |m_{ji}^k - m_{ij}^k|}{\sum_k (m_{ji}^k + m_{ij}^k)}$$

where x_{ij}^k is the nominal value of exports of product k from country i to country j and m_{ij}^k is the nominal value of imports of product k from country j to country i.

The index is calculated by using "World Trade Flows, 1962-2000" data by Feenstra et al (2005) at four-digit industry classifications following the Standard International Trade Classification, revision 2.

It should be noted that the higher the intra-industry trade, the lower the second element of the above formula. This element is subtracted from 1, implying that the index IIT will increase when more intra-industry trade occurs.

- **Disentanglement of bilateral trade into intra- and inter-industry trade**

Following suggestion from Gruben et al (2002), we decompose bilateral trade intensity into inter- and intra-industry trade by using another two variables: inter-industry trade component (Inter) and intra-industry trade component (Intra).

By multiplying intra-industry trade intensity (IIT) with bilateral trade intensity (BTI), we can get intra-industry trade component

Intra(i,j) = IIT(i,j) . BTI(i,j)

Thus the inter-industry trade component is defined as

Inter(i,j)=(1-IIT(i,j)) . BTI(i,j)

3.2.3. Similarity of Industrial Structure

The similarity of industrial structure is proxied by the correlation coefficient of sectoral shares, which is also computed in Imbs (1998) and Baxter and Kouparitsas (2004).

$$SIS(i,j) = \frac{\sum_k s_{ik} s_{jk}}{\sqrt{\sum_k s_{ik}^2}\sqrt{\sum_k s_{jk}^2}}$$

where s_{ik} is the output share of industry k in country i. The greater the similarity in sectoral structure, the higher the value of SIS. The data source for this variable is National Accounts Main Aggregate Database, UN Statistical Yearbook, where GDP is broken down to 7 sectors back to the year 1970.

3.2.4. Fiscal Policy Similarity

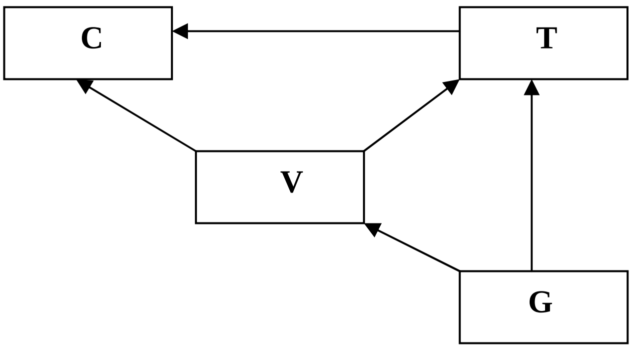
Following the suggestion by Shin and Wang (2004), in the study, fiscal policy similarity is measured by the correlation coefficients of the ratio of budget/deficit to GDP across each pair of countries. A higher value of this coefficient in a pair of countries implies more similarity in fiscal policy between those countries.

More details on variable definition and data sources can be found in Table A.1 (in Appendix)

3.3. Some Econometrics Issues

In the empirical literature, some studies advocate IV regressions. Frankel and Rose (1997, 1998) argue that countries seem to link their monetary policy and fix exchange rates towards their important trading partners, either explicitly or implicitly. Then the monetary coordination with large partners may result in a spurious correlation between trade intensity and business cycle co-movement. Some others argue that because trade intensity is endogenous, the explanatory variables may be correlated with the error terms, and OLS regressions can produce biased and inconsistent estimates. According to IV supporters, all above troubles can be addressed if instrumental variables for trade intensity are available. These variables should be exogenous determinants of bilateral trade but unaffected by other conditions influencing business cycle synchronization. Most of the authors choose instrumental variables provided by the gravity models, such as log of distance between two countries, dummy for geographic adjacency and dummy for common language. These gravity variables regarded as exogenous characteristics of country pairs are believed to explain great deal of bilateral trade.

However, some authors criticize the IV method and support the OLS technique. Gruben el al (2002) claim that IV is not appropriate solution as the gravity variables are likely to have effect on other variables that affect business cycle coherence. For instance, countries with common border are more likely to link their monetary policy or to join a common currency area than countries with a long distance. Furthermore, the implementation of single currency can stimulate trade intensity through reducing trading costs by removing exchange rate risks then the cost of hedging and decreasing information costs (De Grauwe and Mongelli, 2005). This relationship among business cycle synchronization, trade, gravity variables and other variables can be depicted as the following figure:



The regression equations corresponding to above figure are

$C = \alpha_1 T + \alpha_2 V + \varepsilon$

$T = \beta_1 V + \beta_1 G + \mu$ (6)

$V = \lambda G + \varphi$

where C is income correlation, T is trade variables, G is gravity variables and V is other variables. Therefore, according to Gruben et al (2002), in IV regression, the instruments to capture the effects of trade intensity could ultimately be seen as capturing the effects of last two equations in (6), then upwardly biasing the estimated effect of trade intensity alone.

Meanwhile, some empirical studies apply panel technique with fixed effect to examine the determinants of business cycle synchronization. Imbs (1998) argues that all stated problems could not be addressed just through instrumental variables because the authentic problem is not of endogeneity but of omitted variables. He believes that unobservable components of time-invariable characteristics for each country could be solved through panel estimations with fixed effects. In comparison between OLS and panel technique with fixed effects, Shin and Wang (2004) conclude that the latter can eliminates the unobserved country-specific components and it is more appropriate to analyze the effect of pattern of trade on business cycle synchronization.

In brief, since there is no consensus on the correct methodology to apply, all estimation methods will be implemented in this study for comparison and robustness check as well. In addition, another econometric method that has been not seen in empirical literature is also conducted in the study, i.e. panel-based IV regression. For all IV regressions, following Frankel and Rose (1998), we use some gravity variables as instruments for trade intensity, i.e. i) log of distance, ii) dummy variable for common language and iii) dummy variable for common border. All these variables are extracted from CEPII Database.

4. Estimation Results

4.1. Statistical Description of Variables

Before implementing the regression analysis, we present some statistical description and correlation analysis of variables used in the models (see Tables 2, 3, 4 and 5). This helps provide rough initial looks at variables and possible links between explanatory variables with business cycle synchronization.

- **Statistical Summary**

The mean value of bilateral correlation efficient between cycles in ASEAN-5 during the whole sample period (1972-2000) is 0.63 but quite high recently (0.88 and 0.89 for the latest sub-periods).

Table 2. Statistical Summary of Variables

Variables	Mean	Min	Max	Std. Dev.
Business Cycle Synchronization				
Corr(y_{it},y_{jt})	0.633	-0.954	0.999	0.436
Bilateral Trade Intensity				
BTI_1	0.021	0.000	0.129	0.031
BTI_2	0.014	0.001	0.054	0.013
BTI_3	0.017	0.002	0.080	0.021
BTI_4	0.022	0.001	0.166	0.039
Intra-Industry Trade Intensity				
IIT	0.12	0.001	0.459	0.123
Intra-Industry Trade Index				
$Intra_1$	0.005	0.000	0.050	0.010
$Intra_2$	0.003	0.000	0.024	0.005
$Intra_3$	0.004	0.000	0.035	0.007
$Intra_4$	0.006	0.000	0.076	0.015
Inter-Industry Trade Index				
$Inter_1$	0.017	0.000	0.105	0.024
$Inter_2$	0.011	0.001	0.048	0.010
$Inter_3$	0.014	0.002	0.065	0.015
$Inter_4$	0.017	0.001	0.110	0.026
Similarity of Industry Structure				
SIS	0.70	-0.12	0.968	0.254
Similarity of Fiscal Policy				
FPS	0.38	-0.98	0.985	0.491

Table 3. shows that bilateral trade intensity in ASEAN-5 is likely to rise over time, especially for measures of BTI_1 and BTI_4. This implies an increasing trade integration among countries. Contributing to higher degree of trade intensity, intra-industry trade is observed to go up rapidly in the region. This is reflected by a massive increase in intra-industry intensity index (IIT) over time: from 0.037 and 0.059 in the first two sub-periods to 0.199 and 0.281 in the last two sub-periods. As result, the intra-industry trade component (Intra) is seen to increase, especially in recent years. Meanwhile, although increasing early in the whole period, inter-industry trade component (Inter) is not likely to change much lately. Therefore it can be said that trade relationship among ASEAN-5 has been much tightened recently but the most important contribution is a boom in the intra-industry trade.

Table 3. Statistical Summary Over Time

Variables	1	2	3	4	5	6	7
Corr(y_{it},y_{jt})	0.580	0.622	-0.057	0.831	0.683	0.879	0.893
BTI_1	0.016	0.018	0.019	0.022	0.022	0.024	0.023
BTI_2	0.011	0.014	0.017	0.013	0.012	0.014	0.018
BTI_3	0.012	0.015	0.018	0.018	0.016	0.018	0.020
BTI_4	0.012	0.016	0.022	0.020	0.025	0.028	0.034
IIT	0.037	0.059	0.060	0.069	0.128	0.199	0.281
$Intra_1$	0.002	0.003	0.003	0.003	0.005	0.008	0.008
$Intra_2$	0.001	0.001	0.002	0.002	0.003	0.004	0.006
$Intra_3$	0.001	0.002	0.002	0.002	0.004	0.006	0.007
$Intra_4$	0.002	0.002	0.003	0.003	0.007	0.010	0.013
$Inter_1$	0.014	0.016	0.017	0.019	0.016	0.020	0.015
$Inter_2$	0.010	0.012	0.016	0.012	0.009	0.009	0.012
$Inter_3$	0.012	0.014	0.016	0.015	0.013	0.012	0.013
$Inter_4$	0.010	0.014	0.019	0.016	0.018	0.018	0.021
SIS	0.562	0.592	0.663	0.711	0.791	0.804	0.763
FPS	0.442	0.519	0.072	0.212	0.352	0.286	0.783

The mean value of SIS variable – the similarity of industrial structure is quite high: 0.70 for the whole period (1972-2000) and goes up across sub-periods, except the last one. This can be partly explained by the fact that countries in the region have quite similar factor endowments and development level. Meanwhile, the fiscal policy similarity seems to be loose. The variable FPS has the mean value of just 0.38 and is likely to have an unclear changing pattern over time.

Table 4 presents main variables (intra-industry trade intensity, bilateral trade intensity, similarity of industrial structure and similarity of fiscal policy) by country over time. For simplification, only the bilateral trade intensity using only export data (BTI_1) is chosen for computation. The findings are consistent for other measures for this variable. This will be available upon request.

Table 4 shows that all ASEAN-5 countries share the same increasing trend of intra-industry trade intensity over time, especially in late sub-periods. On average, Thailand, Malaysia and Singapore have the highest level of intra-industry trade ties while Indonesia lacks a strong intra-industry trade link with the remaining members. That might be because Indonesia is a more closed economy and less integrated with the rest of the region. This position is also confirmed in Cortinhas (2005)'s study, where the author excludes Indonesia from the regression and finds that the effect of intra-industry trade intensity on business cycle synchronization is much stronger.

Although, average bilateral trade in ASEAN-5 is likely to increase, esp. in recent years as stated previously, the changing pattern in each country is not very clear, implying that the inter-industry trade in these countries has not increased much. Thailand and Malaysia are observed to have the strongest bilateral trade intensity within the region.

Table 4. Statistical Summary of Variables by Country

Periods	1	2	3	4	5	6	7	Average
Intra-industry Trade Intensity								
Indonesia	0.005	0.021	0.018	0.036	0.063	0.123	0.149	0.059
Malaysia	0.058	0.087	0.074	0.106	0.154	0.246	0.346	0.153
Philippines	0.026	0.052	0.062	0.040	0.072	0.115	0.266	0.090
Thailand	0.077	0.099	0.108	0.124	0.212	0.283	0.317	0.174
Singapore	0.021	0.033	0.041	0.040	0.141	0.232	0.328	0.120
Bilateral Trade Intensity								
Indonesia	0.003	0.011	0.006	0.013	0.011	0.013	0.015	0.010
Malaysia	0.037	0.029	0.035	0.034	0.034	0.037	0.034	0.034
Philippines	0.003	0.006	0.005	0.007	0.005	0.045	0.010	0.012
Thailand	0.035	0.039	0.039	0.044	0.044	0.010	0.043	0.036
Singapore	0.003	0.006	0.011	0.013	0.015	0.013	0.014	0.011
Similarity of Industrial Structure								
Indonesia	0.576	0.624	0.686	0.735	0.815	0.803	0.750	0.713
Malaysia	0.711	0.731	0.784	0.822	0.869	0.892	0.860	0.810
Philippines	0.673	0.682	0.729	0.753	0.830	0.797	0.768	0.747
Thailand	0.153	0.237	0.406	0.466	0.605	0.659	0.628	0.450
Singapore	0.697	0.684	0.711	0.777	0.838	0.870	0.808	0.769
Similarity of Fiscal Policy								
Indonesia	0.434	0.526	0.130	0.487	0.538	0.478	0.838	0.490
Malaysia	0.443	0.538	0.289	0.307	-0.054	0.444	0.800	0.395
Philippines	0.673	0.528	0.333	0.507	0.535	0.547	0.826	0.564
Thailand	0.036	0.720	-0.388	-0.111	0.279	0.355	0.751	0.235
Singapore	0.624	0.284	-0.007	-0.129	0.463	-0.394	0.699	0.220

Similar to average movement of the whole region, the industrial structure of each country seems to be more similar over time with the partners except the last sub-period. The statistics exhibit that on average, Thailand's economic structure is the most different from the remaining countries although this economy has the highest degree of intra-industry trade intensity in the region. However, except for Thailand, it can be said that the more similar the industrial structure, the more intense the intra-industry trade. Finally, in line with the average trend, fiscal policy in each country of the region does not have a consistent changing pattern over time.

- **Correlation Analysis**

Correlation coefficients among variables used in the study are presented in Table 5. At the first look, the measure for business cycle synchronization is generally positive correlated with bilateral trade, intra-industry trade, inter-industry trade, similarity of industrial structure and fiscal policy similarity. However, the statistics reveal that the level of cycle co-movement is much more strongly associated with measures for intra-industry trade, structural similarity and fiscal policy coordination than bilateral trade intensity and inter-industry trade.

As expected, the correlation of similarity of industrial structure (SIS) with intra-industry trade intensity (IIT) is positive though at small value while that with inter-industry trade and bilateral trade is negative and at high magnitude. Meanwhile, the correlation between fiscal policy similarity and all trade variables is negative though the magnitudes are rather low for intra-industry trade variables. Finally, the correlation between different proxies for each trade variable is quite high, implying that different measures are consistent and trustful.

Table 5. Correlation Analysis among Variables

	Corr(y_{it},y_{jt})	BTI_1	BTI_2	BTI_3	BTI_4	IIT	$Intra_1$	$Intra_2$	$Intra_3$	$Intra_4$	$Inter_1$	$Inter_2$	$Inter_3$	$Inter_4$	SIS
BTI_1	0.09														
BTI_2	-0.01	0.62													
BTI_3	0.07	0.80	0.91												
BTI_4	0.10	0.75	0.86	0.96											
IIT	0.35	0.39	0.53	0.57	0.64										
$Intra_1$	0.16	0.38	0.77	0.90	0.97	0.70									
$Intra_2$	0.20	0.57	0.79	0.83	0.92	0.82	0.94								
$Intra_3$	0.17	0.64	0.79	0.89	0.96	0.75	0.99	0.98							
$Intra_4$	0.15	0.58	0.75	0.83	0.94	0.69	0.98	0.96	0.99						
$Inter_1$	0.06	0.98	0.56	0.73	0.66	0.29	0.57	0.45	0.53	0.46					
$Inter_2$	-0.10	0.56	0.96	0.82	0.71	0.31	0.59	0.58	0.59	0.54	0.53				
$Inter_3$	0.02	0.81	0.90	0.97	0.89	0.43	0.79	0.70	0.76	0.69	0.77	0.87			
$Inter_4$	0.08	0.81	0.87	0.98	0.98	0.57	0.91	0.84	0.90	0.85	0.74	0.77	0.95		
SIS	0.19	-0.24	-0.37	-0.32	-0.21	0.02	-0.12	-0.05	-0.09	-0.05	-0.26	-0.47	-0.41	-0.28	
FPS	0.23	-0.14	-0.22	-0.20	-0.13	-0.01	-0.06	-0.04	-0.05	-0.02	-0.15	-0.28	-0.25	-0.18	0.21

4.2. Regression Results

4.2.1. Replication of Frankel and Rose model (Model 1)

Firstly, the model specification proposed by Frankel and Rose (1998) will be replicated.

$Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Trade\ Intensity_{ijt} + \varepsilon_{ijt}$ (Model 1)

This specification is just used to examine the effect of trade intensity on business cycle synchronization. The effect of all other variables will be investigated in subsequent sub-sections. Different from Frankel and Rose (1998), we use not only bilateral trade intensity (BTI) but also intra-industry trade intensity (IIT) for the variable of Trade Intensity. This variable is taken natural logarithm in the model. Three gravity variables (log of distance, dummy variable for common language and dummy variable for common border) are used as instruments for Trade Intensity variable. These gravity variables are believed to affect the trade integration but not directly cause business cycle synchronization.

Both OLS and IV results are presented in Table 6. In IV regressions, the validity of instrumental variables is tested through Hansen test of overindentifying restrictions developed by Baum, Schaffer and Stillman (2003). With the null hypothesis that the instruments are uncorrelated with the error terms, Hansen J's statistics reveal that the null hypothesis can not be rejected at conventional significant in all 5 specifications, implying that the instrument variables are reasonably accepted as being valid.

Table 6 exhibits that when bilateral trade intensity is included in the model, its coefficients appear positive in both OLS and IV regressions but the result is weak, except the case of BTI_1 - its coefficient in OLS method is statistically significant at 10% level. This empirical result is similar to Frankel and Rose (1998), where the coefficients of bilateral trade intensity are also not significant when the authors also use HP technique to detrend the output. However, the positive sign, to some extent, suggests that the closer the cross-country trade relationship, the more synchronized business cycles. It also implies that the specialization effects of trade intensity seem not to be dominant and more intra-industry trade is observed in ASEAN-5. The insignificance of those coefficients may be attributed to the different effects of intra- and inter-trade intensity, that are not covered in this stage. In addition, in IV regression, the coefficients for trade intensity normalized by total trade (BTI_3) and normalized by output (BTI_4) are 0.04 and 0.03, smaller than those in Frankel and Rose (1998)'s work (0.09 and 0.05, respectively), where the authors use the same methodology and variables but apply for 21 OECD countries. This implies that the impact of trade integration on business cycle correlation is higher for OECD than ASEAN-5, consistent with Calderon et al (2002)'s conclusion that trade effect is lower in developing countries than in developed countries.

Table 6: Replication of the Frankel-Rose Model (Model 1)

Trade Intensity Measure	**Bilateral Trade Intensity**								**Intra-Industry Trade Intensity**	
	BTI_1 (1)		**BTI_2 (2)**		**BTI_3 (3)**		**BTI_4 (4)**		**III (5)**	
	OLS	*IV*	*OLS*	*IV*	*OLS*	*IV*	*OLS*	*IV*	*OLS*	*IV*
Constant	0.83^{***} (8.38)	0.81^{***} (5.17)	0.66^{***} (2.88)	0.90^{***} (4.60)	0.77^{***} (4.52)	0.83^{***} (5.30)	0.81^{***} (53)	0.76^{***} (33)	0.91^{***} (18.86)	0.82^{***} (11.41)
Trade Intensity (in log)	0.04^{*} (1.72)	0.04 (0.95)	0.01 (0.12)	0.06 (1.18)	0.03 (0.85)	0.04 (1.06)	0.04 (1.47)	0.03 (0.89)	0.09^{***} (4.46)	0.07^{**} (2.05)
Hansen J Statistic		2.17		1.59		1.94		2.24		2.12
Chi-square P-value		0.34		0.45		0.38		0.33		0.35

Note: Model 1: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Trade\ Intensity_{ijt} + \varepsilon_{ijt}$
(1) to (4) correspond to the regressions using different bilateral trade intensity measures as trade intensity variable. (5) corresponds to the regression using intra-industry trade intensity as trade intensity variable.
In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language
Absolute values of t-values computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation are in parenthesis.
$^{(*)},^{(**)},^{(***)}$: statistically significant at 10%, 5% and 1%, respectively

The estimation result turns to be very strong when intra-industry intensity (IIT) rather than total bilateral trade is used in the specification. Both OLS and IV results confirm a positive effect of this factor on business cycle co-movement and the effect is statistically significant at 1% or 5% level. The magnitude of coefficients of IIT is also quite high compared to those of BTI. All above imply a largely positive effect of intra-industry trade intensity on business cycle synchronization in the region. This finding is consistent with theory and empirical studies such as Gruben et al (2002) and Cortinhas (2005).

4.2.2. Model without Disentanglement of Trade Components (Model 2)

The inclusion of only trade intensity in the model as proposed by Frankel and Rose (1998) has received many criticisms. Based on three regression equations in (6) where the gravity variables (G) not only influence trade intensity (T) but also possibly affect some other variables (V) that could be related to income correlation (C), de Haan et al (2005) argue that if the other variables (V) are not included in the specification, the coefficient for trade intensity (T) will be biased and spurious.

Therefore, in this step, beside trade intensity, we augment the Frankel and Rose's model by including other two variables in the model, i.e. similarity of industry structure and fiscal policy similarity, which are theoretically possible explanations for business cycle synchronization. The specification to be estimated is defined as follows

$Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Trade\ Intensity_{ijt} + \beta_2.Similarity\ of\ Industry\ Structure_{ijt} + \beta_3.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$ (Model 2)

As mentioned in theoretical framework, the sign of β_1 is ambiguous. It depends on the degree of specialization stimulated by trade integration or the share of intra- and inter-trade in total bilateral trade and the relative importance of country-specific aggregate shocks and industry-specific shocks. The sign of β_3 is also uncertain while the β_2 is expected to be positive.

All possible regression strategies are applied for this model, i.e: i) OLS regression with pooled data, ii) IV regression with gravity variables used as instruments for trade intensity, iii) panel technique with fixed effect to control the unobserved components of time-invariant features for pair of countries and iv) panel-based IV regression with the gravity variables served as instruments for trade intensity. Similar to the model 1, Trade Intensity variables can be Bilateral Trade Intensity (BTI) or Intra-industry Trade Intensity (IIT).

Table 7. presents all results produced from all four estimation methods. Hansen tests are implemented to test the validity of instrumental variables in IV regressions. All Hansen J's statistics are quite below the Chi-squared critical values, showing the reasonability of including gravity variables as instruments for trade intensity in IV regressions.

Table 7. Model without Disentanglement of Trade Components (Model 2)

Trade Intensity Measure	Bilateral Trade Intensity				Intra-Industry Trade Intensity
	BTI_1 (1)	BTI_2 (2)	BTI_3 (3)	BTI_4 (4)	IIT (5)
1. OLS Regression					
Trade Intensity (in log)	0.06** (2.37)	0.06 (1.54)	0.09** (2.06)	0.08*** (3.55)	0.10*** (5.81)
Similarity of Industry Structure	0.29 (1.51)	0.35 (1.50)	0.38** (2.30)	0.43** (1.97)	0.26** (2.12)
Similarity of Fiscal Policy	0.19*** (2.64)	0.20* (2.81)	0.21 (1.55)	0.21*** (3.01)	0.21*** (3.35)
R–squared	0.10	0.09	0.11	0.14	0.20
2. Instrumental Variables Regression					
Trade Intensity (in log)	0.09*** (3.11)	0.14** (2.56)	0.12*** (3.01)	0.08*** (3.30)	0.11*** (4.75)
Similarity of Industry Structure	0.30* (1.69)	0.46* (1.79)	0.44* (1.94)	0.44** (2.28)	0.26** (2.34)
Similarity of Fiscal Policy	0.20*** (2.94)	0.23*** (2.87)	0.22*** (3.26)	0.21*** (3.10)	0.21*** (3.46)
Hansen J Statistic	1.27	0.81	0.65	0.93	1.48
Chi-square P-value	0.53	0.67	0.72	0.63	0.48
R–squared	0.09	0.06	0.11	0.13	0.20
3. Panel Regression with Fixed Effects					
Trade Intensity (in log)	0.06 (1.20)	-0.07 (0.69)	0.11 (0.80)	0.13 (1.31)	0.09** (2.02)
Similarity of Industry Structure	0.59 (1.45)	0.78** (1.96)	0.62 (1.48)	0.48 (1.09)	0.36 (0.85)
Similarity of Fiscal Policy	0.25** (2.08)	0.26** (2.13)	0.24** (1.97)	0.23* (1.90)	0.22* (1.83)
R–squared	0.10	0.05	0.11	0.13	0.20
4. Instrumental Variable Regression for Panel Data					
Trade Intensity (in log)	0.09 (1.36)	0.14 (1.38)	0.12 (1.54)	0.08 (1.49)	0.11* (1.71)
Similarity of Industry Structure	0.31 (1.44)	0.48* (1.81)	0.44* (1.85)	0.44* (1.85)	0.26 (1.34)
Similarity of Fiscal Policy	0.20* (1.89)	0.23** (2.04)	0.22** (2.03)	0.22** (2.02)	0.21** (2.06)
R–squared	0.10	0.08	0.11	0.14	0.20

Note: Model 2: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Trade\ Intensity_{ijt} + \beta_2.Similarity\ of\ Industry\ Structure_{ijt} + \beta_2.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to the regressions using different bilateral trade intensity measures as trade intensity variable. (5) corresponds to the regression using intra-industry trade intensity as trade intensity variable.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

Absolute values of t-values are in parenthesis. In OLS and IV, t-values are computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation.

The coefficients for constant variables are not reported to save the space

(*),(**),(***): statistically significant at 10%, 5% and 1%, respectively.

Intra-industry trade intensity appears to be positive and statistically significant at conventional level in all estimation approaches, once again confirming a strong impact of this factor on business cycle harmonization in ASEAN-5. The magnitude of the impact is quite consistent across approaches, implying the result is robust. The effect of bilateral trade intensity is found to be positive, more over it is highly significant at 5% or even 1% in OLS and IV regressions. A positive association between bilateral trade and income correlation may be attributed to an increasing share of intra-industry in the trade links. Bilateral trade variables appear statistically insignificant in both panel regression and panel-based IV estimation but they are all positive and have similar magnitudes with the remaining estimation techniques.

Table 7 also exhibits that similarity of industrial structure has the expected positive sign with business cycle co-movement and most of the coefficients are statistically significant at conventional level, especially in IV regression. This means that the more the symmetry of economic structure, the more synchronized the business cycles across countries, reflecting the fact that the countries having similar production patterns are likely to respond similarly to not only industry-specific shocks but also productivity shocks or shocks to the composition of import demand from other countries, contributing to more business cycle coherence.

The estimation results also show robust evidence that fiscal policy similarity across ASEAN-5 countries explains the cycle co-movement in the region because the coefficients of this variable are found to be positive at quite similar magnitudes (around 0.20) and strongly significant in almost specifications. In the study, the fiscal policy similarity which is proxied as the correlation of government budget position measured as a percentage of the national output can be understood as fiscal convergence across countries. So the evidence observed could be explained through the theory that fiscal divergence is likely to take place if one country suffers from a persistently higher budget deficit than other countries and this causes fiscal shocks, resulting in idiosyncratic (fiscal) instability and volatility and thus business cycles tend to be less harmonized. Otherwise, when the budget deficit discrepancy is diminished (fiscal convergence), the fiscal shocks decline and then business cycles are like to be more synchronized. (see more in Fatas and Mihov (2003, 2004) and Darvas et al (2005)).

In brief, the extended model without disentanglement of trade components confirms positive effects of bilateral trade intensity, intra-industry trade intensity, cross-country sectoral similarity and fiscal policy convergence on business cycle synchronization in ASEAN-5 countries. The findings appear quite robust across estimation strategies and most significant in OLS and IV approaches.

4.2.3. Model with Disentanglement of Trade Components. (Model 3)

As stated in the theoretical framework, closer bilateral trade itself does not necessary lead to more business cycle synchronization. The effect of increasing trade on income correlation is not only dependent on the intensity of trade links but also on the structure of bilateral trade. So it is more appropriate to separate the effect of each trade intensity component to gain a comprehensive picture of trade impact in ASEAN-5. In this stage, we include both intra- and inter-industry trade intensity components in the model:

$Corr(y_{it}, y_{jt}) = \beta_0 + \beta_1.Intra\text{-}Industry\ Trade\ Component_{ijt} + \beta_2.Inter\text{-}Industry\ Trade\ Component_{ijt} + \beta_3.Similarity\ of\ Industry\ Structure_{ijt} + \beta_4.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$ (Model 3)

All regression techniques are implemented. In IV and panel-based IV regressions, gravity variables are still used as instruments for both intra- and inter-industry trade. Hansen tests are also conducted and the J statistics once again confirm that the instrumental variables in IV regressions are valid as the null hypothesis that the instrumental variables are not correlated with the error term can not be rejected.

As mentioned in theoretical framework, the sign of β_2 is uncertain. If business cycles in ASEAN-5 are driven dominantly by industry-specific shocks, β_2 is expected to be negative. If common demand shocks or productivity spillover dominate, β_2 is expected to be positive. Meanwhile, as more intense intra-industry trade is likely to lead to more business cycle harmonization regardless of the nature of shocks, β_1 is expected to be positive. β_3 should be positive while β_4 can be negative (if fiscal policy is used to respond to persistently asymmetric shocks) or positive (if fiscal policy itself drives business cycle).

Table 8. Model with Disentanglement of Trade Components (Model 3)

	(1)	(2)	(3)	(4)
1. OLS Regression				
Intra-Industry Trade Index (in log)	0.08*** (5.17)	0.10*** (4.44)	0.09*** (4.69)	0.09*** (3.61)
Inter-Industry Trade Index (in log)	-0.07* (1.67)	-0.11* (1.78)	-0.09 (1.56)	-0.09 (1.42)
Similarity of Industry Structure	0.30** (2.48)	0.23 (1.52)	0.27* (1.94)	0.27* (1.91)
Similarity of Fiscal Policy	0.21** (3.57)	0.20*** (2.97)	0.21** (2.01)	0.21*** (3.18)
R–squared	0.19	0.22	0.20	0.20
2. Instrumental Variables Regression				
Intra-Industry Trade Index (in log)	0.12*** (2.77)	0.02 (0.08)	0.002 (0.01)	0.07 (0.37)
Inter-Industry Trade Index (in log)	-0.15 (1.56)	0.12 (0.22)	0.14 (0.18)	-0.05 (0.12)
Similarity of Industry Structure	0.29*** (3.49)	0.46 (0.73)	0.47 (0.69)	0.32 (0.08)
Similarity of Fiscal Policy	0.22*** (3.79)	0.23* (1.77)	0.23 (1.44)	0.21*** (3.69)
Hansen J Statistic	1.08	0.79	0.64	1.22
Chi-square P-value	0.30	0.37	0.43	0.27
R–squared	0.15	0.08	0.08	0.20
3. Panel Regression with Fixed Effects				
Intra-Industry Trade Index (in log)	0.05 (1.30)	0.09** (2.16)	0.08** (1.97)	0.08* (1.70)
Inter-Industry Trade Index (in log)	-0.01 (0.13)	-0.18* (1.68)	-0.07 (0.45)	-0.05 (0.37)
Similarity of Industry Structure	0.37 (0.82)	0.32 (0.74)	0.36 (0.82)	0.35 (0.78)
Similarity of Fiscal Policy	0.23* (1.91)	0.21* (1.77)	0.22* (1.79)	0.22* (1.79)
R–squared	0.17	0.19	0.20	0.20
4. Instrumental Variable Regression for Panel Data				
Intra-Industry Trade Index (in log)	0.12 (0.96)	0.07 (0.20)	-0.01 (0.05)	0.06 (0.22)
Inter-Industry Trade Index (in log)	-0.15 (0.56)	-0.02 (0.02)	0.18 (0.23)	-0.03 (0.05)
Similarity of Industry Structure	0.29 (1.45)	0.38 (0.29)	0.51 (0.72)	0.34 (0.54)
Similarity of Fiscal Policy	0.22** (2.07)	0.22 (1.25)	0.23* (1.77)	0.21* (1.94)
R–squared	0.17	0.20	0.07	0.20

Note: Model 3: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Intra\text{-}Industry\ Trade\ Index_{ijt} + \beta_2.Inter\text{-}Industry\ Trade\ Index_{ijt} + \beta_3.Similarity\ of\ Industry\ Structure_{ijt} + \beta_4.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to regressions of using different bilateral trade intensity measures (BTI_1, BTI_2, BTI_3, BTI_4) to compute intra (inter)-industry trade index.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

Absolute values of t-values are in parenthesis. In OLS and IV, t-values are computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation.

The coefficients for constant variables are not reported to save the space

(*),(**),(***): statistically significant at 10%, 5% and 1%, respectively.

The estimation results presented in Table 8 exhibit that 15 out of 16 estimated coefficients for intra-industry trade are positive and 8 out of 18 estimates are statistically significant at conventional level, esp. in all OLS estimations, where they are significant at 1% level. In addition, the magnitudes of the significant coefficients are quite similar. This finding implies a positive effect of intra-industry trade on business cycle coherence in the region, which is consistent with theory and many empirical studies in literature (Gruben el al (2002), Shin and Wang (2004) and Cortinhas (2005)).

Meanwhile, 13 out of 15 estimated coefficients for inter-industry trade are negative. Though only 3 of them are statistically significant but these estimates are all negative, implying that in ASEAN-5, inter-industry trade intensity is like to de-harmonize the business cycles. This finding could be explained by the domination of industry-shocks over country-specific aggregate demand and the productivity spillover in ASEAN-5 countries. This explanation is plausible because the demand shocks and external shocks are not major contribution to macroeconomic fluctuations in ASEAN-5 as stated in Study4. This evidence contradicts Gruben et al (2002)'s study for 21 OECD countries advocating the idea that world common shocks play important roles in business cycles in these countries. However, the estimation result in this study is in line with Backus et al (1992) that suggests the elimination of trading frictions may result in less business cycle synchronization.

Similarity of industrial structure seems not to be very significant in this extended model, which is in contrast with the previous model (Model 2). Only 4 out of 16 coefficient estimates for this variable is statistically significant. However, all estimates have the expected positive sign, which is consistent with theory and empirics as well (Shin and Wang (2004), Baxter and Koupatritsas (2004), Imbs (2004)).

The effects of fiscal policy similarity on business cycle co-movement, nevertheless, are very strong when almost estimated coefficients for this variable is positive at nearly the same magnitude and statistically significant in all specifications. This finding once again confirms a significant contribution of policy similarity in creating cross-country correlation as stated in Darvas et al (2005) and Inklaar et al (2005).

4.2.4. Relative Importance of Determinants

To get the idea of economic interpretation of the magnitudes of coefficients, following Frankel and Rose (1998), we estimate the increase in business cycle synchronicity in response to a surge in determinants of one standard deviation starting from the mean. For simplicity, models using BTI_1 (bilateral trade intensity using only export data) as explanatory variable or to calculate other variables are used for this purpose. The coefficients of variables in the opted specifications to be used for computation are the average values of statistically significant coefficients appearing in all four estimation approaches.

Table 9. The Effect of One Standard Deviation Shock to Determinants on the Change in Business Cycle Synchronization.

	Bilateral Trade Intensity	Intra-industry Trade Intensity	Intra-industry Component	Inter-industry Component	Similarity of Industrial Structure	Similarity of Fiscal Policy
Model 2 – Using BTI_1	+ 0.100				+ 0.076	+ 0.103
Model 2 – Using IIT		+ 0.158			+ 0.066	+ 0.104
Model 3 – Using BTI_1			+ 0.262	- 0.090	+ 0.075	+ 0.108

Note: The statistics are computed by the coefficients estimated multiplied by the standard deviation of the variable measures. They express the change in the average of cross-country correlation coefficients of business cycles.

The results imply that the effect of trade intensity is like to be largest among determinants, especially the effect of intra-industry trade. In the model 2, the statistics show that the impact of bilateral trade intensity on business cycle synchronization in ASEAN-5 is smaller than in Frankel and Rose (1998)'s study, where one standard deviation increase in bilateral trade intensity raise cycle correlation by 0.15 compared to only 0.10 in this study. This finding is similar to Calderon et al (2002), who believe that the trade effect may be smaller in groups of developing countries than in groups of developed countries.

The effect of intra-industry trade component is much larger than that of inter-industry trade component in model 2 using IIT. That is explained why an increase of one standard deviation of intra-industry trade intensity from the mean value can create higher rise in the output correlation than that of bilateral trade intensity (0.158 compared to 0.1, respectively). The evidence also exhibits that the impact of fiscal policy convergence on business cycle co-movement is, though smaller than intra-industry trade, but somewhat similar to bilateral trade intensity and larger than similarity of sectoral structure, which is similar to findings by Inklaar et al (2005).

In brief, business cycles in ASEAN-5 are likely to move harmoniously in response to increasing intra-industry trade, more symmetry of economic structure and more similarity of fiscal policy. However, inter-industry trade intensity seems to de-synchronize the business cycle, implying the dominant role of industry-specific shocks in the region. Among the determinants, intra-industry trade has the largest impact on business cycle synchronization. In addition, it should be noted that the sign and the magnitude of the effects are quite consistent across specifications estimated in the study.

4.3. Robustness Analysis

In order to get further robustness checks of estimation results, we change the measures of similarity of industrial structure and then exclude the crisis period from the sample to examine the results.

4.3.1. Other Measures for Similarity of Industrial Structure

The first robustness check is conducted by using another two measures for similarity of industrial structure.

$$\text{SIS}_2(\text{i,j}) = 1 - \sum_k (s_{ik} - s_{jk})^2$$

$$\text{SIS}_3(\text{i,j}) = 1 - \sum_k | s_{ik} - s_{jk} |$$

where s_{ik} is the output share of industry k in country i. The more similar the industrial structure, the lower the second element of the above definitions. This element is subtracted from 1, meaning these two variables will increase when more symmetry of sectoral structure occurs.

Model 2 and model 3 are re-estimated with these measures and the results are presented in Table A.2 to A.5. (in Appendix). It can be seen that all coefficients keep the same expected sign and statistical significance, especially, all appear at quite similar magnitude to the baseline models except those of structural similarity variables due to different measurement.

4.3.2. Excluding Crisis Period

The sample for study in this studycovers the crisis year (1997, 1998) until 2000 given shortage of observations for regressions. However, some concerns may be posed about the inclusion of crisis years in the sample period. Therefore, to check the consistence and robustness of empirical results, in this part, we exclude the last sub-period (1997-2000) and apply the same methodologies to this new sample. The results are shown in Table A.6 to A.11 (in Appendix).

It is clear that the signs of all coefficients are kept the same while their magnitudes are just slightly different. However, as expected, the t-statistics are lower, resulting relatively lower statistical significance and then R-square. The culprit can be attributed to a decrease in observations. This robustness check confirms the effects of trade, similarity of sectoral structure and fiscal policy convergence on business cycle synchronization as found in the baseline models.

5. Conclusion

This study seeks the determinants of business cycle synchronization in ASEAN-5 countries, based on data covering the period 1972-2000. With business cycle synchronization as proxied as the cross-country correlation of detrended real output, the study applies four estimation strategies (i.e. OLS, IV, panel technique and panel-based IV regression) to investigate the impacts of various measures of trade intensity, structural similarity and fiscal policy similarity.

For the *first research question*, the study found that business cycles in ASEAN-5 are likely to be more harmonized if more trade integration, especially more intra-industry trade intensity, more similarity of industrial structure and more fiscal policy convergence occur. However, more inter-industry trade intensity seems to de-synchronize the cycles due to specialization effect and the dominance of industry-specific shocks in the region. For *the second research question*, the study shows that the effect of intra-industry trade is largest among determinants. The effect of bilateral trade intensity is smaller due to a negative association between inter-industry trade and income correlation observed. Similarity of fiscal policy is at least as important as bilateral trade ties in shaping the business cycle co-movement. Meanwhile, the impact of sectoral structure similarity on income correlation is the lowest among the factors of interest.

The above findings propose some important implications for the prospect of a common currency area in ASEAN. As found in the study, the increase in trade intensity can lead to more business cycle synchronization, which is the most important criterion to form a common currency. This relationship will decrease the cost of joining a currency union by lowering asymmetric shocks through more intense trade. However, it should be noted that the business cycle harmonization is just enhanced if trade is in form of more intra-industry trade and the effect of intra-industry trade is the quite strong compared to other determinants. Thus, after the launch of a currency union, if the increase of trade is mainly created by inter-industry trade, the business cycle synchronization could be weakened and then make the joining of the union more costly. Therefore, the establishment of a common currency in ASEAN should be initiated for countries with high level of intra-industry trade links and let the remaining countries have enough adjustment time to enhance trade within the same industries. In the same token, a common currency should be introduced in a group of Malaysia, Thailand and Singapore in the first stage, which is followed by Philippines and then Indonesia.

6. Reference

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7. Appendix

Table A.1. Variable Definitions and Data Sources

Variable	Suggested by	Measurement	Sources
Business Cycle Synchronization	Frankel and Rose (1998), Baxter and Koupatritsas (2004), Shin and Wang (2004),	Correlation (y_i^*, y_j^*)	Output: World Development Index (WDI), September 2005
Bilateral Trade Intensity	Shin and Wang (2004), Frankel and Rose (1998)	$BTI_1(i,j) = \frac{x_{ij}}{x_i + x_j} = \frac{m_{ji}}{x_i + x_j}$ $BTI_2(i,j) = \frac{m_{ij}}{m_i + m_j}$ $BTI_3(i,j) = \frac{x_{ij} + m_{ij}}{x_i + m_i + x_j + m_j} = \frac{m_{ji} + m_{ij}}{x_i + m_i + x_j + m_j}$ $BTI_4(i,j) = \frac{x_{ij} + m_{ij}}{y_i + y_j} = \frac{m_{ji} + m_{ij}}{y_i + y_j}$	+ Export and imports: Feenstra, 2000, World Trade Flow (WTF)). Bilateral trade between Malaysia and Philippines in 1983 is not available. It is proxied by using average growth rate of bilateral trade from 1980-1985 + Output: WDI, September 2005
Intra-Industry Trade Intensity	Shin and Wang (2004), Gruben et al (2004)	$IIT(i,j) = 1 - \frac{\sum_k \lvert x_{ij}^k - m_{ij}^k \rvert}{\sum_k (x_{ij}^k + m_{ij}^k)} = 1 - \frac{\sum_k \lvert m_{ji}^k - m_{ij}^k \rvert}{\sum_k (m_{ji}^k + m_{ij}^k)}$	+ Export and imports: Feenstra, 2000, World Trade Flow (WTF)). Intra-industry trade between Malaysia and Philippines in 1983 is not available. It is proxied by using average growth rate of intra-industry trade between these two countries from 1980-1985

Inter-Industry Trade Component	Gruben et al (2004)	Inter(i,j)=(1-IIT(i,j)) . BTI(i,j)	
Intra-Industry Trade Component	Gruben et al (2004)	Intra(i,j) = IIT(i,j) . BTI(i,j)	
Similarity of Industry Structure	Baxter and Kouparitsas (2004), Imbs (2004)	SIS(i,j) = $\frac{\sum_k s_{ik}s_{jk}}{\sqrt{\sum_k s_{ik}^2}\sqrt{\sum_k s_{jk}^2}}$ $SIS_2(i,j) = 1-\sum_k (s_{ik}-s_{jk})^2$ $SIS_3(i,j) = 1-\sum_k \mid s_{ik}-s_{jk}\mid$	+ Sector shares: UN Statistical Yearbook, National Accounts Main Aggregate Database: http://unstats.un.org/unsd/snaama/dnllist.asp
Fiscal Policy Similarity	Shin and Wang (2004), Dravas et al (2005), Inclaar et al (2005)	FPS(i,j) = cross-country correlation of budget deficit as percentage to GDP	+ Budget deficit/surplus: WB, Government Financial Statistics (GFS). Data for Indonesia (1990, 2000) and Malaysia (1990-1995, 2004) are missing, which are replaced by data from ADB, Key Indicators 2005 + Output: WDI, September 2005
Log of distance	Frankel and Rose (1998)		+ CEPII Database, http://www.cepii.fr/anglaisgraph/bdd/distances.htm
Dummy variable for common language	Frankel and Rose (1998)		+ CEPII Database, http://www.cepii.fr/anglaisgraph/bdd/distances.htm

Dummy variable for common border	Frankel and Rose (1998)		+ CEPII Database, http://www.cepii.fr/anglaisgraph/bdd/distances.htm

Table A.2. Model without Disentanglement of Trade Components (Model 2) (SIS_2 as Similarity of Industry Structure)

Trade Intensity Measure	Bilateral Trade Intensity				Intra-Industry Trade Intensity
	BTI_1 (1)	BTI_2 (2)	BTI_3 (3)	BTI_4 (4)	IIT (5)
1. OLS Regression					
Trade Intensity (in log)	0.06 (2.50)	0.06 (1.57)	0.09* (2.33)	0.09** (3.79)	0.10*** (3.28)
Similarity of Industry Structure	1.54 (1.21)	2.01 (1.28)	2.36 (1.41)	2.79* (1.94)	1.48 (1.15)
Similarity of Fiscal Policy	0.20* (2.75)	0.21* (2.90)	0.22** (3.12)	0.22** (3.11)	0.21** (2.14)
R–squared	0.10	0.08	0.10	0.13	0.20
2. Instrumental Variables Regression					
Trade Intensity (in log)	0.09*** (3.11)	0.14*** (2.43)	0.13*** (2.87)	0.09*** (3.24)	0.11*** (5.18)
Similarity of Industry Structure	1.68* (1.43)	2.95* (1.71)	2.81* (1.88)	2.83** (2.30)	1.50*** (1.97)
Similarity of Fiscal Policy	0.21*** (3.04)	0.24*** (2.96)	0.23*** (3.36)	0.22*** (3.19)	0.22*** (3.56)
Hansen J Statistic	1.47	1.08	0.75	1.03	1.64
Chi-square P-value	0.50	0.58	0.69	0.60	0.44
R–squared	0.08	0.05	0.10	0.13	0.20
3. Panel Regression with Fixed Effects					
Trade Intensity (in log)	0.07 (1.21)	-0.05 (0.52)	0.13 (0.95)	0.15 (1.55)	0.10** (2.18)
Similarity of Industry Structure	3.36 (0.99)	4.99 (1.56)	3.84 (1.15)	2.84 (0.84)	1.65 (0.48)
Similarity of Fiscal Policy	0.26** (2.16)	0.27** (2.20)	0.25** (2.02)	0.24* (1.93)	0.22* (1.85)
R–squared	0.09	0.04	0.10	0.11	0.20
4. Instrumental Variable Regression for Panel Data					
Trade Intensity (in log)	0.09 (1.21)	0.14 (1.64)	0.13 (1.53)	0.90 (1.52)	0.11* (1.75)
Similarity of Industry Structure	1.74 (1.12)	2.95* (1.71)	2.84 (1.63)	2.85* (1.65)	1.50 (1.16)
Similarity of Fiscal Policy	0.22** (2.03)	0.24** (2.13)	0.23** (2.12)	0.22** (2.11)	0.22** (2.14)
R–squared	0.09	0.07	0.10	0.13	0.20

Note: Model 2: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Trade\ Intensity_{ijt} + \beta_2.Similarity\ of\ Industry\ Structure_{ijt} + \beta_2.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to the regressions using different bilateral trade intensity measures as trade intensity variable. (5) corresponds to the regression using intra-industry trade intensity as trade intensity variable.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

Absolute values of t-values are in parenthesis. In OLS and IV, t-values are computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation.

The coefficients for constant variables are not reported to save the space

(*),(**),(***): statistically significant at 10%, 5% and 1%, respectively.

Table A.3. Model with Disentanglement of Trade Components (Model 3)
(SIS_2 as Similarity of Industry Structure)

	(1)	(2)	(3)	(4)
1. OLS Regression				
Intra-Industry Trade Index (in log)	0.08***	0.10***	0.09***	0.09**
	(5.03)	(3.19)	(4.83)	(2.16)
Inter-Industry Trade Index (in log)	-0.07*	-0.11	-0.09	-0.09
	(1.67)	(1.42)	(1.62)	(0.93)
Similarity of Industry Structure	1.79**	1.32	1.59*	1.61
	(2.24)	(1.20)	(1.74)	(1.35)
Similarity of Fiscal Policy	0.22**	0.20***	0.21***	0.21*
	(3.66)	(3.19)	(3.20)	(1.68)
R–squared	0.18	0.21	0.20	0.20
2. Instrumental Variables Regression				
Intra-Industry Trade Index (in log)	0.12***	0.04	0.004	0.10
	(3.67)	(0.27)	(0.01)	(0.54)
Inter-Industry Trade Index (in log)	-0.16**	0.07	0.15	-0.10
	(2.07)	(0.17)	(0.19)	(0.27)
Similarity of Industry Structure	1.86***	2.55	2.98	1.56
	(3.27)	(0.81)	(0.66)	(0.58)
Similarity of Fiscal Policy	0.23***	0.23**	0.24***	0.21***
	(3.94)	(2.14)	(3.10)	(3.74)
Hansen J Statistic	1.28	1.01	0.63	1.47
Chi-square P-value	0.26	0.31	0.43	0.23
R–squared	0.15	0.13	0.08	0.20
3. Panel Regression with Fixed Effects				
Intra-Industry Trade Index (in log)	0.06	0.10**	0.08**	0.09*
	(1.54)	(2.37)	(2.14)	(1.79)
Inter-Industry Trade Index (in log)	-0.02	-0.18*	-0.07	-0.05
	(0.23)	(1.69)	(0.45)	(0.32)
Similarity of Industry Structure	1.34	1.26	1.62	1.55
	(0.36)	(0.37)	(0.46)	(0.45)
Similarity of Fiscal Policy	0.24*	0.21*	0.22*	0.22*
	(1.93)	(1.78)	(1.82)	(1.81)
R–squared	0.17	0.20	0.20	0.19
4. Instrumental Variable Regression for Panel Data				
Intra-Industry Trade Index (in log)	0.12	0.05	-0.02	0.09
	(1.14)	(0.22)	(0.06)	(0.26)
Inter-Industry Trade Index (in log)	-0.16	0.04	0.22	-0.09
	(0.67)	(0.07)	(0.22)	(0.12)
Similarity of Industry Structure	1.86	2.46	3.40	1.65
	(1.35)	(0.53)	(0.57)	(0.31)
Similarity of Fiscal Policy	0.23**	0.23	0.25	0.21*
	(2.15)	(1.64)	(1.62)	(1.85)
R–squared	0.17	0.15	0.04	0.20

Note: Model 3: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Intra\text{-}Industry\ Trade\ Index_{ijt} + \beta_2.Inter\text{-}Industry\ Trade\ Index_{ijt} + \beta_3.Similarity\ of\ Industry\ Structure_{ijt} + \beta_4.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to regressions of using different bilateral trade intensity measures (BTI_1, BTI_2, BTI_3, BTI_4) to compute intra (inter)-industry trade index.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

Absolute values of t-values are in parenthesis. In OLS and IV, t-values are computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation.

The coefficients for constant variables are not reported to save the space

$^{(*),(**),(***)}$: statistically significant at 10%, 5% and 1%, respectively.

Table A.4. Model without Disentanglement of Trade Components (Model 2)
(SIS_3 as Similarity of Industry Structure)

Trade Intensity Measure	**Bilateral Trade Intensity**				**Intra-Industry Trade Intensity**
	BTI_1 (1)	**BTI_2 (2)**	**BTI_3 (3)**	**BTI_4 (4)**	**IIT (5)**
1. OLS Regression					
Trade Intensity (in log)	0.06*** (2.62)	0.07 (1.49)	0.11** (2.21)	0.10*** (3.75)	0.11*** (3.34)
Similarity of Industry Structure	0.35 (1.13)	0.48 (1.16)	0.58 (1.36)	0.70** (1.99)	0.35 (1.20)
Similarity of Fiscal Policy	0.20*** (2.76)	0.21*** (2.97)	0.21*** (3.23)	0.21*** (3.17)	0.21** (2.06)
R–squared	0.10	0.08	0.11	0.13	0.20
2. Instrumental Variables Regression					
Trade Intensity (in log)	0.10*** (3.09)	0.17** (2.22)	0.16*** (2.88)	0.11*** (3.42)	0.12*** (6.02)
Similarity of Industry Structure	0.42 (1.44)	0.78* (1.69)	0.75* (1.93)	0.74** (2.40)	0.36** (2.38)
Similarity of Fiscal Policy	0.20*** (3.04)	0.23*** (3.04)	0.22*** (3.54)	0.21*** (3.31)	0.21*** (3.65)
Hansen J Statistic	1.28	1.05	0.50	0.79	1.62
Chi-square P-value	0.53	0.59	0.78	0.67	0.44
R–squared	0.08	0.05	0.10	0.13	0.20
3. Panel Regression with Fixed Effects					
Trade Intensity (in log)	0.07 (1.25)	-0.03 (0.29)	0.14 (1.07)	0.15 (1.61)	0.10** (2.15)
Similarity of Industry Structure	0.95 (1.27)	1.20* (1.67)	1.05 (1.44)	0.88 (1.20)	0.59 (0.78)
Similarity of Fiscal Policy	0.25** (2.09)	0.26** (2.10)	0.24* (1.95)	0.23* (1.88)	0.22* (1.83)
R–squared	0.08	0.04	0.10	0.13	0.19
4. Instrumental Variable Regression for Panel Data					
Trade Intensity (in log)	0.10 (1.40)	0.17 (1.48)	0.16* (1.82)	0.11* (1.73)	0.12* 91.86)
Similarity of Industry Structure	0.43 (1.24)	0.83* (1.65)	0.75* (1.81)	0.74* (1.78)	0.36 (1.22)
Similarity of Fiscal Policy	0.21* (1.94)	0.23** (2.04)	0.22** (2.04)	0.21** (2.03)	0.21** (2.07)
R–squared	0.09	0.07	0.10	0.13	0.20

<u>Note</u>: Model 2: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Trade\ Intensity_{ijt} + \beta_2.Similarity\ of\ Industry\ Structure_{ijt} + \beta_2.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to the regressions using different bilateral trade intensity measures as trade intensity variable. (5) corresponds to the regression using intra-industry trade intensity as trade intensity variable.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

Absolute values of t-values are in parenthesis. In OLS and IV, t-values are computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation.

The coefficients for constant variables are not reported to save the space

(*),(**),(***): statistically significant at 10%, 5% and 1%, respectively.

Table A.5. Model with Disentanglement of Trade Components (Model 3) (SIS_3 as Similarity of Industry Structure)

	(1)	(2)	(3)	(4)
1. OLS Regression				
Intra-Industry Trade Index (in log)	0.08*** (5..30)	0.10*** (4.62)	0.09*** (4.75)	0.09** (2.51)
Inter-Industry Trade Index (in log)	-0.07+* (1.69)	-0.11 (1.52)	-0.08 (1.32)	-0.08 (0.95)
Similarity of Industry Structure	0.43** (2.51)	0.33 (1.24)	0.41* (1.75)	0.42 (1.12)
Similarity of Fiscal Policy	0.21*** (3.72)	0.20*** (3.06)	0.21*** (3.26)	0.21** (2.04)
R–squared	0.18	0.22	0.20	0.20
2. Instrumental Variables Regression				
Intra-Industry Trade Index (in log)	0.12*** (3.48)	0.05 (0.48)	-0.09 (0.26)	0.06 (0.23)
Inter-Industry Trade Index (in log)	-0.15* (1.65)	0.05 (0.16)	0.42 (0.47)	-0.005 (0.01)
Similarity of Industry Structure	0.47*** (4.08)	0.62 (0.96)	1.11 (0.87)	0.57 (0.60)
Similarity of Fiscal Policy	0.22*** (4.12)	0.23*** (2.59)	0.24*** (3.44)	0.21*** (3.76)
Hansen J Statistic	1.01	0.91	0.23	1.08
Chi-square P-value	0.31	0.34	0.63	0.30
R–squared	0.15	0.16	0.15	0.19
3. Panel Regression with Fixed Effects				
Intra-Industry Trade Index (in log)	0.06 (1.48)	0.10** (2.38)	0.09** (2.08)	0.08* (1.69)
Inter-Industry Trade Index (in log)	-0.01 (0.20)	-0.17 (1.56)	-0.06 (0.39)	-0.04 (0.27)
Similarity of Industry Structure	0.60 (0.76)	0.40 (0.53)	0.59 (0.78)	0.59 (0.78)
Similarity of Fiscal Policy	0.23* (1.91)	0.21* (1.76)	0.22* (1.79)	0.22* (1.79)
R–squared	0.17	0.19	0.20	0.20
4. Instrumental Variable Regression for Panel Data				
Intra-Industry Trade Index (in log)	0.12 (1.14)	0.07 (0.40)	-0.07 (0.16)	0.05 (0.15)
Inter-Industry Trade Index (in log)	-0.15 (0.62)	0.01 (0.03)	0.38 (0.32)	0.02 (0.02)
Similarity of Industry Structure	0.47 (1.45)	0.58 (0.59)	1.12 (0.61)	0.61 (0.47)
Similarity of Fiscal Policy	0.22** (2.09)	0.22* (1.77)	0.25 (1.50)	0.22* (1.93)
R–squared	0.17	0.18	0.007	0.18

Note: Model 3: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Intra\text{-}Industry\ Trade\ Index_{ijt} + \beta_2.Inter\text{-}Industry\ Trade\ Index_{ijt} + \beta_3.Similarity\ of\ Industry\ Structure_{ijt} + \beta_4.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to regressions of using different bilateral trade intensity measures (BTI_1, BTI_2, BTI_3, BTI_4) to compute intra (inter)-industry trade index.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

Absolute values of t-values are in parenthesis. In OLS and IV, t-values are computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation.

The coefficients for constant variables are not reported to save the space

(*),(**),(***): statistically significant at 10%, 5% and 1%, respectively.

Table A.6. Model without Disentanglement of Trade Components (Model 2) (Excluding Crisis Period)

Trade Intensity Measure	Bilateral Trade Intensity				Intra-Industry Trade Intensity
	BTI$_1$ (1)	BTI$_2$ (2)	BTI$_3$ (3)	BTI$_4$ (4)	IIT (5)
1. OLS Regression					
Trade Intensity (in log)	0.05* (1.82)	0.05 (0.92)	0.08 (1.61)	0.08*** (2.85)	0.10*** (5.46)
Similarity of Industry Structure	0.26 (1.32)	0.31 (1.25)	0.35 (1.33)	0.40* (1.69)	0.25** (1.98)
Similarity of Fiscal Policy	0.15* (1.65)	0.15 (1.61)	0.16* (1.85)	0.18** (2.05)	0.20*** (2.81)
R–squared	0.07	0.05	0.07	0.09	0.15
2. Instrumental Variables Regression					
Trade Intensity (in log)	0.09*** (2.70)	0.17** (2.29)	0.13*** (2.80)	0.09*** (3.05)	0.12*** (4.69)
Similarity of Industry Structure	0.28 (1.50)	0.49 (1.59)	0.43* (1.75)	0.44** (2.10)	0.26** (2.30)
Similarity of Fiscal Policy	0.17* (1.94)	0.22** (2.13)	0.19** (2.33)	0.19** (2.27)	0.22*** (2.96)
Hansen J Statistic	1.33	0.48	0.62	0.91	1.57
Chi-square P-value	0.51	0.79	0.73	0.64	0.46
R–squared	0.05	0.02	0.06	0.09	0.15
3. Panel Regression with Fixed Effects					
Trade Intensity (in log)	0.06 (1.03)	-0.12 (0.99)	0.06 (0.32)	0.08 (0.55)	0.07 (1.14)
Similarity of Industry Structure	0.79** (1.65)	0.96** (2.05)	0.85* (1.70)	0.74 (1.34)	0.57 (1.05)
Similarity of Fiscal Policy	0.24** (1.68)	0.23 (1.60)	0.23 (1.60)	0.24 (1.64)	0.23 (1.62)
R–squared	0.06	0.03	0.05	0.08	0.12
4. Instrumental Variable Regression for Panel Data					
Trade Intensity (in log)	0.09 (1.23)	0.17 (1.23)	0.14 (1.29)	0.09 (1.37)	0.12 (1.57)
Similarity of Industry Structure	0.28 (1.22)	0.54* (1.66)	0.47 (1.64)	0.05* (1.66)	0.26 (1.19)
Similarity of Fiscal Policy	0.17 (1.31)	0.22 (1.56)	0.20 (1.54)	0.20 1.53	0.22* (1.67)
R–squared	0.06	0.04	0.07	0.09	0.15

Note: Model 2: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Trade\ Intensity_{ijt} + \beta_2.Similarity\ of\ Industry\ Structure_{ijt} + \beta_2.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to the regressions using different bilateral trade intensity measures as trade intensity variable. (5) corresponds to the regression using intra-industry trade intensity as trade intensity variable.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

Absolute values of t-values are in parenthesis. In OLS and IV, t-values are computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation.

The coefficients for constant variables are not reported to save the space

(*),(**),(***): statistically significant at 10%, 5% and 1%, respectively.

Table A.7: Model with Disentanglement of Trade Components (Model 3) (Excluding Crisis Period)

	(1)	(2)	(3)	(4)
1. OLS Regression				
Intra-Industry Trade Index (in log)	0.08^{***} (4.10)	0.10^{***} (4.85)	0.09^{***} (4.71)	0.09^{**} (2.16)
Inter-Industry Trade Index (in log)	-0.07 (1.43)	-0.11^{*} (1.73)	-0.09 (1.55)	-0.09 (0.99)
Similarity of Industry Structure	0.29^{**} (2.23)	0.24 (1.49)	0.27^{*} (1.88)	0.27 (1.11)
Similarity of Fiscal Policy	0.20^{***} (2.88)	0.20 (1.58)	0.21^{***} (2.72)	0.21^{*} (1.70)
R–squared	0.13	0.17	0.15	0.15
2. Instrumental Variables Regression				
Intra-Industry Trade Index (in log)	0.16^{***} (3.31)	-0.003 (0.01)	0.06 (0.17)	0.19 (1.34)
Inter-Industry Trade Index (in log)	-0.23^{**} (2.41)	0.20 (0.26)	0.008 (0.01)	-0.26 (0.90)
Similarity of Industry Structure	0.31^{***} (3.93)	0.53 (0.62)	0.35 (0.56)	0.13 (0.45)
Similarity of Fiscal Policy	0.26^{***} (3.85)	0.22^{*} (1.86)	0.21^{*} (1.70)	0.23^{***} (3.00)
Hansen J Statistic	0.62	0.44	0.92	1.00
Chi-square P-value	0.43	0.51	0.34	0.32
R–squared	0.02	0.05	0.13	0.08
3. Panel Regression with Fixed Effects				
Intra-Industry Trade Index (in log)	0.01 (0.22)	0.07 (1.15)	0.07 (1.11)	0.06 (1.05)
Inter-Industry Trade Index (in log)	0.04 (0.45)	-0.18 (1.40)	-0.05 (0.27)	-0.04 (0.24)
Similarity of Industry Structure	0.74 (1.23)	0.52 (0.92)	0.56 (1.00)	0.55 (0.94)
Similarity of Fiscal Policy	0.24^{*} (1.65)	0.22 (1.60)	0.23 (1.62)	0.23 (1.62)
R–squared	0.07	0.10	0.12	0.13
4. Instrumental Variable Regression for Panel Data				
Intra-Industry Trade Index (in log)	0.16 (0.99)	0.10 (0.00)	0.002 (0.00)	0.17 (0.35)
Inter-Industry Trade Index (in log)	-0.24 (0.68)	-0.09 (0.00)	0.15 (0.11)	-0.24 (0.25)
Similarity of Industry Structure	0.31 (1.30)	0.37 (0.00)	0.47 (0.43)	0.15 (0.15)
Similarity of Fiscal Policy	0.26 (1.61)	0.22 (0.03)	0.20 (1.18)	0.23 (1.48)
R–squared	0.11	0.17	0.05	0.14

Note: Model 3: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Intra\text{-}Industry\ Trade\ Index_{ijt} + \beta_2.Inter\text{-}Industry\ Trade\ Index_{ijt} + \beta_3.Similarity\ of\ Industry\ Structure_{ijt} + \beta_4.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to regressions of using different bilateral trade intensity measures (BTI_1, BTI_2, BTI_3, BTI_4) to compute intra (inter)-industry trade index.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

Absolute values of t-values are in parenthesis. In OLS and IV, t-values are computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation.

The coefficients for constant variables are not reported to save the space

$^{(*),(**),(***)}$: statistically significant at 10%, 5% and 1%, respectively.

Table A.8: Model without Disentanglement of Trade Components (Model 2)
(Excluding Crisis Period and SIS_2 as Similarity of Industry Structure)

Trade Intensity Measure	Bilateral Trade Intensity				Intra-Industry Trade Intensity
	BTI_1 (1)	BTI_2 (2)	BTI_3 (3)	BTI_4 (4)	IIT (5)
1. OLS Regression					
Trade Intensity (in log)	0.05^{*} (1.85)	0.05 (0.92)	0.08 (1.62)	0.08^{***} (2.98)	0.10^{***} (5.42)
Similarity of Industry Structure	1.45 (1.10)	1.85 (1.10)	2.16 (1.22)	2.60^{*} (1.65)	1.45 (1.61)
Similarity of Fiscal Policy	0.15^{*} (1.68)	0.15 (1.62)	0.17^{*} (1.86)	0.18^{**} (2.06)	0.21^{***} (5.42)
R–squared	0.06	0.05	0.06	0.08	0.15
2. Instrumental Variables Regression					
Trade Intensity (in log)	0.09^{**} (2.53)	0.17^{**} (2.18)	0.14^{***} (2.71)	0.09^{***} (3.02)	0.12^{***} (4.86)
Similarity of Industry Structure	1.57 (1.30)	3.17 (1.55)	2.81^{*} (1.72)	2.84^{**} (2.13)	1.47^{*} (1.88)
Similarity of Fiscal Policy	0.17^{*} (1.94)	0.22^{**} (2.13)	0.20^{**} (2.33)	0.20^{**} (2.27)	0.22^{***} (2.96)
Hansen J Statistic	1.50	0.65	0.68	0.97	1.76
Chi-square P-value	0.47	0.72	0.71	0.62	0.42
R–squared	0.04	0.02	0.05	0.08	0.14
3. Panel Regression with Fixed Effects					
Trade Intensity (in log)	0.06 (0.93)	-0.11 (0.89)	0.07 (0.39)	0.11 (0.71)	0.08 (1.20)
Similarity of Industry Structure	5.09 (1.30)	57^{*} (1.78)	5.77 (1.46)	4.73 (1.10)	3.08 (0.68)
Similarity of Fiscal Policy	0.23 (1.63)	0.22 (1.55)	0.22 (1.56)	0.23 (1.62)	0.23 (1.59)
R–squared	0.05	0.02	0.05	0.08	0.12
4. Instrumental Variable Regression for Panel Data					
Trade Intensity (in log)	0.09 (1.13)	0.17 (1.49)	0.14 (1.43)	0.10 (1.36)	0.12 (1.57)
Similarity of Industry Structure	1.63 (1.01)	3.18 (1.58)	2.87 (1.51)	2.91 (1.51)	1.47 (1.01)
Similarity of Fiscal Policy	0.17 (1.36)	0.22 (1.57)	0.20 (1.52)	0.20 (1.54)	0.22^{*} (1.69)
R–squared	0.05	0.03	0.06	0.08	0.14

Note: Model 2: $Corr(y_{it}, y_{jt}) = \beta_0 + \beta_1.Trade\ Intensity_{ijt} + \beta_2.Similarity\ of\ Industry\ Structure_{ijt} + \beta_2.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to the regressions using different bilateral trade intensity measures as trade intensity variable. (5) corresponds to the regression using intra-industry trade intensity as trade intensity variable.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

Absolute values of t-values are in parenthesis. In OLS and IV, t-values are computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation.

The coefficients for constant variables are not reported to save the space

$^{(*),(**),(***)}$: statistically significant at 10%, 5% and 1%, respectively.

Table A.9: Model with Disentanglement of Trade Components (Model 3)
(Excluding Crisis Period and SIS_2 as Similarity of Industry Structure)

	(1)	(2)	(3)	(4)
1. OLS Regression				
Intra-Industry Trade Index (in log)	0.08*** (3.96)	0.10*** (4.85)	0.09*** (4.73)	0.09** (2.17)
Inter-Industry Trade Index (in log)	-0.07 (1.43)	-0.11* (1.74)	-0.09* (1.65)	-0.09 (0.99)
Similarity of Industry Structure	1.76** (1.97)	1.33 (1.19)	1.57* (1.66)	1.58 (0.92)
Similarity of Fiscal Policy	0.21*** (2.88)	0.21*** (2.57)	0.21*** (2.71)	0.21* (1.72)
R–squared	0.13	0.16	0.15	0.15
2. Instrumental Variables Regression				
Intra-Industry Trade Index (in log)	0.16*** (4.11)	0.02 (0.15)	0.01 (0.02)	0.31 (0.82)
Inter-Industry Trade Index (in log)	-0.24*** (3.09)	0.12 (0.25)	0.12 (0.08)	-0.51 (0.68)
Similarity of Industry Structure	1.98*** (3.57)	2.96 (0.75)	2.81 (0.33)	-1.16 (0.23)
Similarity of Fiscal Policy	0.26*** (3.95)	0.22** (2.18)	0.20 (1.10)	0.26*** (2.72)
Hansen J Statistic	0.86	0.65	0.60	0.59
Chi-square P-value	0.35	0.42	0.44	0.44
R–squared	0.02	0.03	0.06	0.08
3. Panel Regression with Fixed Effects				
Intra-Industry Trade Index (in log)	0.03 (0.41)	0.09 (1.27)	0.08 (1.18)	0.07 (1.11)
Inter-Industry Trade Index (in log)	0.02 (0.26)	-0.18 (1.40)	-0.05 (0.28)	-0.03 (0.17)
Similarity of Industry Structure	4.07 (0.79)	2.43 (0.52)	2.94 (0.62)	2.74 (0.57)
Similarity of Fiscal Policy	0.23 (1.60)	0.22 (1.57)	0.23 (1.59)	0.23 (1.61)
R–squared	0.08	0.12	0.13	0.14
4. Instrumental Variable Regression for Panel Data				
Intra-Industry Trade Index (in log)	0.16 1.10	0.07 (0.33)	-0.22 (0.16)	0.40 (0.28)
Inter-Industry Trade Index (in log)	-0.23 0.76	-0.01 (0.01)	0.71 (0.20)	-0.69 (0.25)
Similarity of Industry Structure	1.98 1.22	2.51 (0.34)	28 (0.31)	-2.72 (0.13)
Similarity of Fiscal Policy	0.26 1.68	0.22* (1.66)	0.16 (0.49)	0.26 (0.97)
R–squared	0.10	0.14	0.01	0.09

Note: Model 3: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Intra\text{-}Industry\ Trade\ Index_{ijt} + \beta_2.Inter\text{-}Industry\ Trade\ Index_{ijt} + \beta_3.Similarity\ of\ Industry\ Structure_{ijt} + \beta_4.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to regressions of using different bilateral trade intensity measures (BTI_1, BTI_2, BTI_3, BTI_4) to compute intra (inter)-industry trade index.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

Absolute values of t-values are in parenthesis. In OLS and IV, t-values are computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation.

The coefficients for constant variables are not reported to save the space

(*),(**),(***): statistically significant at 10%, 5% and 1%, respectively.

Table A.10: Model without Disentanglement of Trade Components (Model 2) (Excluding Crisis Period and SIS_3 as Similarity of Industry Structure)

Trade Intensity Measure	Bilateral Trade Intensity				Intra-Industry Trade Intensity
	BTI_1 (1)	BTI_2 (2)	BTI_3 (3)	BTI_4 (4)	IIT (5)
1. OLS Regression					
Trade Intensity (in log)	0.05* (1.93)	0.06 (0.94)	0.09 (1.58)	0.09*** (2.81)	0.10*** (2.68)
Similarity of Industry Structure	0.33 (1.08)	0.44 (1.03)	0.54 (1.20)	0.65* (1.70)	0.34 (1.03)
Similarity of Fiscal Policy	0.14 (1.64)	0.15 (1.62)	0.16* (1.87)	0.18** (2.04)	0.20* (1.66)
R–squared	0.06	0.05	0.07	0.09	0.15
2. Instrumental Variables Regression					
Trade Intensity (in log)	0.10** (2.56)	0.19** (1.95)	0.16*** (2.68)	0.11*** (3.11)	0.13*** (5.24)
Similarity of Industry Structure	0.40 (1.39)	0.86 (1.54)	0.75* (1.82)	0.75** (2.27)	0.35** (2.25)
Similarity of Fiscal Policy	0.16* (1.92)	0.21** (2.13)	0.19** (2.38)	0.19** (2.30)	0.22*** (3.02)
Hansen J Statistic	1.30	0.59	0.45	0.74	1.77
Chi-square P-value	0.52	0.75	0.80	0.69	0.41
R–squared	0.04	0.04	0.05	0.08	0.14
3. Panel Regression with Fixed Effects					
Trade Intensity (in log)	0.06 (0.96)	-0.08 (0.65)	0.08 (0.46)	0.09 (0.65)	0.07 (0.99)
Similarity of Industry Structure	1.48* (1.73)	1.67** (2.01)	1.60* (1.85)	1.43 (1.53)	1.11 (1.09)
Similarity of Fiscal Policy	0.22 (1.52)	0.20 (1.42)	0.21 (1.44)	0.22 (1.50)	0.21 (1.50)
R–squared	0.04	0.02	0.04	0.07	0.08
4. Instrumental Variable Regression for Panel Data					
Trade Intensity (in log)	0.10 (1.30)	0.20 (1.27)	0.16 (1.62)	0.11 (1.51)	0.13* (1.67)
Similarity of Industry Structure	0.40 (1.11)	0.97 (1.58)	0.75* (1.65)	0.77 (1.63)	0.35 (1.07)
Similarity of Fiscal Policy	0.16 (1.28)	0.21 (1.48)	0.19 (1.46)	0.19 (1.50)	0.22* (1.67)
R–squared	0.05	0.03	0.06	0.09	0.15

Note: Model 2: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Trade\ Intensity_{ijt} + \beta_2.Similarity\ of\ Industry\ Structure_{ijt} + \beta_2.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to the regressions using different bilateral trade intensity measures as trade intensity variable. (5) corresponds to the regression using intra-industry trade intensity as trade intensity variable.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

Absolute values of t-values are in parenthesis. In OLS and IV, t-values are computed with robust standard errors to both heteroskedasticity and arbitrary intra-group correlation.

The coefficients for constant variables are not reported to save the space

(*),(**),(***): statistically significant at 10%, 5% and 1%, respectively.

Table A.11: Model with Disentanglement of Trade Components (Model 3) (Excluding Crisis Period and SIS_3 as Similarity of Industry Structure)

	(1)	(2)	(3)	(4)
1. OLS Regression				
Intra-Industry Trade Index (in log)	0.08*** (4.17)	0.11*** (4.80)	0.10*** (4.62)	0.09*** (3.48)
Inter-Industry Trade Index (in log)	-0.07 (1.45)	-0.10 (1.49)	-0.08 (1.36)	-0.08 (1.19)
Similarity of Industry Structure	0.42** (2.17)	0.33 (1.19)	0.39* (1.66)	0.40 (1.61)
Similarity of Fiscal Policy	0.20*** (2.87)	0.20*** (2.59)	0.20*** (2.73)	0.20*** (2.74)
R–squared	0.13	0.17	0.15	0.15
2. Instrumental Variables Regression				
Intra-Industry Trade Index (in log)	0.17*** (4.50)	0.05 (0.39)	-0.22 (0.18)	0.22 (0.56)
Inter-Industry Trade Index (in log)	-0.24*** (3.02)	0.09 (0.25)	0.76 (0.24)	-0.34 (0.40)
Similarity of Industry Structure	0.48*** (4.17)	0.71 (0.89)	1.61 (0.36)	-0.005 (0.01)
Similarity of Fiscal Policy	0.25*** (4.30)	0.21** (2.46)	0.14 (0.36)	0.24** (2.09)
Hansen J Statistic	0.58	0.58	0.03	1.33
Chi-square P-value	0.45	0.45	0.85	0.25
R–squared	0.05	0.08	0.02	0.07
3. Panel Regression with Fixed Effects				
Intra-Industry Trade Index (in log)	0.01 (0.15)	0.08 (1.14)	0.06 (0.95)	0.06 (0.87)
Inter-Industry Trade Index (in log)	0.04 (0.46)	-0.16 (1.19)	-0.03 (0.15)	-0.02 (0.10)
Similarity of Industry Structure	1.45 (1.32)	0.82 (0.76)	1.10 (1.05)	1.07 (1.01)
Similarity of Fiscal Policy	0.21 (1.49)	0.21 (1.50)	0.21 (1.50)	0.22 (1.51)
R–squared	0.04	0.10	0.10	0.10
4. Instrumental Variable Regression for Panel Data				
Intra-Industry Trade Index (in log)	0.17 (1.06)	0.10 (0.56)	-0.29 (0.24)	-0.57 (0.13)
Inter-Industry Trade Index (in log)	-0.24 (0.71)	-0.06 (0.09)	0.96 (0.31)	1.35 (0.14)
Similarity of Industry Structure	0.48 (1.28)	0.57 (0.32)	2.08 (0.42)	3.29 (0.17)
Similarity of Fiscal Policy	0.25 (1.62)	0.21 (1.62)	0.13 (0.38)	0.12 (0.16)
R–squared	0.11	0.16	0.01	0.02

Note: Model 3: $Corr(y_{it},y_{jt}) = \beta_0 + \beta_1.Intra\text{-}Industry\ Trade\ Index_{ijt} + \beta_2.Inter\text{-}Industry\ Trade\ Index_{ijt} + \beta_3.Similarity\ of\ Industry\ Structure_{ijt} + \beta_4.Similarity\ of\ Fiscal\ Policy_{ijt} + \varepsilon_{ijt}$

(1) to (4) correspond to regressions of using different bilateral trade intensity measures (BTI_1, BTI_2, BTI_3, BTI_4) to compute intra (inter)-industry trade index.

In IV regressions, instrumental variables for trade intensity are i) log of distance, ii) dummy variable for common border and iii) dummy variable for common language

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