Theoretical and Empirical Discussions on Endogeneities of OCA Criteria
—A Literature Review

Xing-kun Liu¹,²
1. School of Economics, Renmin University of China
2. Graduate School of Commerce and Management, Hitotsubashi University

Abstract.

The optimum currency areas (OCA) theory deals with the criteria as well as the costs and benefits of for countries to enter/form a common currency area. The traditional OCA theory explores the economic variables determining the boarders for OCA, and whether a single country fulfills the requirements to join an OCA by employing the static costs and benefits analysis. The endogenous OCA theory introduces the long-run dynamic equilibrium analysis into the cost-benefit balance model and suggests that economic and monetary integration are self reinforcing processes, i.e., the endogenous nature of OCA criteria may make a country be more likely to satisfy the criteria for the entry into a currency union ex post though it fails ex ante, which in turn reduces the costs of a currency union by increasing the symmetry of disturbances. Although the creation of the euro is often cited as the most modern and largest-scale case study of OCA, the evolvement of economic integration in other regions, especially East Asia, has increased interest in the viability of a common currency for economies in these regions. The previous studies in Euro Union could provide us new perspective and useful instruments of analysis with respect to the study on other regions. This paper surveys the evolution of the theoretical and empirical studies on endogeneities of OCA criteria in order to draw inferences for the prospects and challenges of greater monetary cooperation in other regions.

Key Words: optimum currency areas, endogenous OCA theory, economic integration

1. Introduction
The theory of Optimum Currency Area (OCA) deals with the criteria as well as the costs and benefits of entering/forming a common currency area, and it is an important guideline for assessing the suitability of forming an OCA for a potential region. In early 1960s, the OCA theory emerged from the debate on the merits of fixed versus flexible exchange rate regimes. In the traditional contributions to the OCA theory, Mundell (1961) pioneered to suggest that factor mobility provides a substitute
mechanism for exchange rate flexibility in restoring internal and external equilibriums when asymmetric shocks occur in a region. Ingram (1962), McKinnon (1963), Kenen (1969) and Grubel (1970) followed Mundell (1961) to investigate the crucial economic characteristics determining the borders for OCA. Since the 1970s, the literature began to explore whether an individual country fulfills the requirements to join an OCA by trade-off between the potential costs and benefits of participating in a common currency area. The empirical studies on the diverse OCA criteria flourished in 1980s but most of them are limited in static analysis. Since the economic performances of different countries tend toward endogenous convergence, in essence forming a world business cycle, some economists then questioned the static analysis and began to investigate the possible interacts among various OCA criteria, and found that the business cycles in any region is likely to become convergent through several transmission channels, such as trade linkages, economic structural similarities, product factors flows (capital, information etc.), macroeconomic policies similarity or coordination, which is the “endogeneity of OCA” paradigm (Frankel and Rose, 1997 and 1998). The endogenous OCA theory introduce the long-run dynamic equilibrium analysis into the cost-benefit balance model for a potential region to form an OCA, and make it be possible to measure the benefits quantitatively rather than only descriptively. Some authors believe that the endogenous nature of OCA criteria makes a country be more likely to satisfy the criteria for the entry into a currency union ex post though it fails ex ante because its economic performance may change as a result of entry, which in turn reduces the costs of a currency union by increasing the symmetry of disturbances. However, this paradigm has caused skepticism: Do partner countries form currency unions because they trade a lot, or trade more because they form a currency union? (Mongelli, 2002) The intuition behind this paradigm and its effect need to be better understood.

The previous studies mainly focus on the endogeneities of OCA criteria in Euro Union since it provides a “laboratory” to assess OCA properties and monitor the effects of deepening economic, financial and monetary integration (Mongelli, 2002). The success of the Euro and the evolvement of economic integration in other regions such as North America, Africa, MERCOSUR (Mercado Común del Sur) countries, states in the United States, especially East Asia—one of the most dynamic regions in terms of increasing economic integration, have also increased interest in the viability
of a common currency for economies in these regions in both academic and policy circle and some steps to form closer monetary integration have been taken. The global financial crisis triggered by the “Subprime Crisis” has renewed calls for greater monetary integration within these economies. Although not only on the level of integration but also the integration process in Europe and other regions are much different, the previous studies in Euro Union could provide us new perspective and useful instruments of analysis. This paper surveys the evolution of the studies on endogenous OCA theory in order to draw inferences for the prospects and challenges of greater monetary cooperation in other regions.

The remainder of the paper is organized as follows. Section 2 presents the theoretical frameworks of static cost-benefit analysis and the dynamic cost-benefit analysis. Section 3 discusses the effects of economic integration on business cycle synchronization between the specialization and endogeneity paradigms. Section 4 reviews empirical studies on endogenous OCA theory, i.e., identifying potential transmission channels affecting real business cycles convergence in certain region. Section 5 concludes.

2. The Static Cost-Benefit Analysis VS. The Dynamic Cost-Benefit Analysis

2.1 The Static Cost-Benefit Analysis Framework

Among the key criteria considered in the cost-benefit equilibrium analysis of OCA, the degree of economic integration among the potential members matters because the reduction in transaction costs associated with joining a common currency will induce larger trade and capital flows, and the synchronization of the business cycle plays a key role in determining the costs of sacrificing independent macroeconomic policies (Calderón et al., 2002). Krugman (2002) takes the former as the horizontal axis and the latter as vertical axis in the static cost-benefit framework, which constitutes the analytical core of the traditional OCA theories. The traditional cost-benefit analysis treats the degree of economic integration as the only endogenous variable, while treats other criteria, such as the symmetry in the shocks as the exogenous variables, and hypothesizes that the higher economic integration, the higher (lower) the benefits (costs) of a country to join a monetary union. Then, the GG schedule standing for the microeconomic efficiency benefits of a monetary union has positive slope in Figure 1-a. The macroeconomic costs is hypothesized to fall as
the degree of economic integration rises (Krugman, 2002), and hence LL -schedule standing for the macroeconomic stability sacrifice of the union has a negative slope as described in Figure 1-b.

![Diagram of the Static cost-benefit analysis framework of OCA](image)

**a. The static analysis**

**The comparative static analysis**

**Figure 1 Static cost-benefit analysis framework of OCA**

The intuition behind Figure 1-a is that one country should join an OCA if its degree of economic integration with other potential countries is at least equal to the critical level $\theta_0$ determined by the intersection $E_0$ of GG -schedule and LL -schedule. From a pure economic point of view, a country should join an OCA when the benefits exceed the costs, which is the so-called "OCA-Area" shaded in Figure 1-a. The GG – LL framework has also important implications about how the changes in a country's economic environment affect its willingness to join an OCA. If a sudden positive shifts in exogenous demand for a country's exports pushes LL downward to $LL_i$ in Figure 1-b, while the microeconomic benefit is constant. At any level of economic integration with the other potential countries, the extra macroeconomic costs the country suffers by joining an OCA is now smaller. As a result, the critical level of economic integration decreases from $\theta_0$ to $\theta_i$ and the "OCA-Area" becomes a larger shaded space showed in Figure 1-b.

**2. 2 The Dynamic Cost-Benefit Analysis Framework**

With a change from static analysis to dynamic analysis, the endogeneity theory focuses on the question whether and how fast an already established (potential) monetary union endogenously evolves into an OCA, and the dynamic cost-benefit analysis can be simplified as the analysis of the correlation between business cycle.
Economic integration mainly embodies in the degree of economic openness (McKinnon, 1963), and the business cycle synchronization mainly focus on the correlation of incomes. Grauwe and Mongelli (2005) developed the downward sloping equilibrium “OCA-line” (Figure 2-a) to demonstrate the collection of combinations of synchronization and integration among groups of countries on which the costs and benefits of a monetary union are just balanced. For example, both $Q_1$ and $Q_2$ are equally balanced between costs and benefits despite the fact that the former has a higher (lower) degree of income (openness) than the later.

The negative slope of the OCA-line suggests that the additional costs produced by less synchronization can be offset by the additional benefits produced by more economic integration (Grauwe and Mongelli, 2005), and the advantages of adopting a common currency depend positively on both economic integration and business cycles correlation. All points high up and to the right of the OCA-line show combinations of income correlation and openness for which the benefits of joining the monetary union exceed the costs, and vice versa. In Figure 2-b, both common currency area B and C are OCAs, while areas A' and A are not OCAs.

**Openness, Income Correlation and OCA**

**Figure 2 Openness, Income Correlation and OCA**

3. The Specialization and Endogeneity Paradigms

Both the degree of economic integration and business cycle synchronization evolve over time and interact with each other. Intuitively, one would be tempted to think that deeper economic integration contribute to the synchronization of business cycles. However, the theoretical literature proposes both endogeneity (or
substitutability effects) and specialization effects (or complementarity effects) of economic integration on the business cycles synchronization, which may counteract each other principally.

3.1 The specialization paradigm

Based on trade theory, Krugman (1991 and 1993) and Eichengreen (1992) put forward the specialization hypothesis which states that when countries are more integrated, they become increasingly specialized in the production of the goods and services for which they have comparative advantages following comparative advantage theorem (Ricardo model), factor endowments theorem (Heckscher-Ohlin model), economies of scale (new trade theory) or economies of location (new economic geography). If increasing specialization in production leads to inter-industry trade, which in turn leads to asymmetric effects of industry-specific shocks, member countries of a currency area would become more diversified and hence more vulnerable to asymmetric shocks as the trade integration process evolves, resulting in less synchronization of business cycles in long run.

Finance integration may prompt the degree of specialization effects of trade integration. Employing two country International Real Business Cycle (IRBC) model, Backus et al. (1992), Baxter and Crucini (1995) confirmed that bilateral trade effectively acts as a resource-shifting mechanism between countries in response to technological shocks under the framework of complete asset market and perfect substitutability of goods, which can decrease output correlations. Obstfeld (1994) found that financial integration shifts investment towards risky projects, which enable countries to specialize according to their comparative advantage. Kalemli-Ozcan and Sørensen (2001), Kalemli-Ozcan et al. (2003) concluded that the diversification of ownership led by the international financial markets can increase the possibility of insuring regions and countries against idiosyncratic shocks (i.e., the production risk), which is better to exploit comparative advantages. Such specialization of production structure would lead to less synchronization of business cycles (Heathcote and Perri, 2004).

The traditional GG–LL framework of OCAs in Figure 2-a holds only when intra-industry trade dominates (Fidrmuc, 2001), which suggests that the integration benefits can not only offset the macroeconomic costs, but also cause surplus as economic integration increases. The consequence of production specialization is that a
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group of countries that are already in the currency area may move outside this area, or a group of potential member countries may become more unfit to form an OCA as economic integration increases, which illustrated by the downward arrows in Figure 2-b. The specialization paradigm changes the traditional costs of joining an OCA for a country, which is followed by the changes in the slopes of $LL_1$-schedule in Figure 3-a, while GG-schedule is assumed to be unchanged. This is different from the main part of static endogeneity analysis of OCA, which directly add one endogenous symmetry of shocks to the other symmetry of shocks resulting the shift of $LL$-schedule (Artis, Kohler and Méltiz, 1998; Loechel and Baumann, 2006). If the share of inter-industry trade increases, $LL$-schedule in Figure 3-a would become flatter, for instance $LL_2$-schedule, which is followed by new equilibrium level $E_2$. Now, if economic integration increases the same degree, for instance $(\alpha_2 - \theta_2) = (\alpha_1 - \theta_1)$, the macroeconomic costs will decrease less because of the existence of production specialization, i.e., $(\lambda_2 - \beta_2) = (\lambda_1 - \beta_1)$. The surplus of integration benefits after offsetting the macroeconomic costs will decrease, which indicated by the smaller OCA-Area (b) in Figure 3-a.

When inter-industry trade becomes sufficiently tremendous as the process of economic integration, the relation between losses for member countries and the degree of economic integration become positive, as indicated by $LL_3$-schedule in Figure 3-b, which differs from the traditional view. In Figure 3-b, there are possible net gains when GG-schedule is significantly steeper than $LL$-schedule, but they are much lower (Fidrmuc, 2001). In the process of enlargement of inter-industry trade, OCA-Area (b) is smaller than OCA-Area (a), and OCA-Area (c) is smaller than OCA-Area (b). If the inter-industry trade continues expanding as the evolution of economic integration, the macroeconomic costs including those due to production specialization exceed the integration benefits, $LL$-schedule become steeper as indicated by $LL_4$-schedule in Figure 3-b, and surpass GG-schedule. The new equilibrium become to $E_4$, now there is not any benefit from participating in an OCA for a country at the higher degree of economic integration $\theta_4$. 

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3.2 The endogeneity paradigm

The Eichengreen-Krugman’s specialization is quite a corner solution, i.e., two or more regions forms a larger unit tends to be more highly diversified as a whole than individually, and this process will continue until the entire world employing one currency; hence the intermediate-sized units, i.e., regions may be better candidates for an OCA (Frankel, 1999). The endogeneity approach was then developed with the inherent mechanism is that a currency union could promote reciprocal economic integration by reducing trade barriers (Grauwe and Mongelli, 2005). Theoretical literatures confirmed that economic integration impacts business cycle synchronization through the channels of demand shocks, supply shocks, policies shocks and structural shocks.
Through demand effects, stronger trade linkages can result in more highly correlated business cycles across countries. Joining an OCA could reduce the transactions costs associated with goods and services trade between countries with different moneys and the costs from giving up independent counter-cyclic macroeconomic policies to dampen business cycle disturbances, all which will allow demand shocks to more easily spread across national borders (Frankel and Rose, 1997 and 1998). Then there is a positive link between trade integration and the demand shocks convergence in general (Corsetti and Pesenti, 2002; Babetski, 2003).

There is a positive relationship between bilateral trade and output growth correlations through supply spillover effects. Trade acts as an important transmission mechanism to deliver a country’s productivity gains to its trade partners’ economic developments (Coe and Helpman, 1995; Frankel and Rose, 1997 and 1998; Corsetti and Pesenti, 2002). With the development of globalization, final goods now are produced by combining domestic and foreign intermediate goods, so that increased output (investment or consumption boom) in one country can generate increased demand for the other country’s output, then the production in the partner countries may also rise (Backus et al., 199; Otto et al., 2001; Kose and Yi, 2002, Kose et al., 2003).

Increased trade integration may create a greater need for more coordinated macroeconomic policies, which serve as a transmission channel for idiosyncratic shocks and also ensure a common response to common shocks (Frankel and Rose, 1997 and 1998; Otto et al., 2001). Policy commitment to currency union itself could act as a catalyst of business cycle convergence leading to a change in pricing strategies and reduce the scope for asymmetric policy responses to the disturbances, which finally makes a currency union be an OCA in a self-validating way (Corsetti and Pesenti, 2002).

The new trade theory emphasizes that more trade takes place within the same industries, which is likely to concern goods that are more income elastic and price-elastic in demand. If intra-industry trade is more pronounced than inter-industry trade, industry shocks would become increasingly common shocks and spread more rapidly, and the trade integration would lead to the convergence in economic performance (Bayoumi and Eichengreen, 1997; Calderón et al, 2002; Grauwe and Mongelli, 2005). In the case of production fragmentation, trade in complements can
potentially generate positive demand- and supply-side spillovers, which could lead to more correlated business cycles between countries (Ng, 2010).

Economists have presented the positive relationship between financial integration and business cycle co-movements (Bayoumi and Eichengreen, 1997; Kose and Yi, 2001; Tao and Abbott, 2007). As trade integration, financial integration, especially a common currency brings benefits such as lower transactions costs and elimination of risks of exchange rate changes associated with trading in financial instruments between countries with different moneys.

First, a fast adjustment to shocks helps an economy to mitigate the costs of relinquishing independent monetary policy. As one type of the factor flexibility, stronger financial links might allow the relocation of capital by comparative advantage, thus increases opportunities for trade (Garcia-Herrero and Ruiz, 2008).

Second, financial linkages and portfolio diversification encourage all countries to shift away from a low-return safe investment to a high-yielding risky one, which would result in increased similarity of their industrial structure as those sectors experience a generalized growth (Heathcote and Perri, 2002; Schiavo, 2008).

Thirdly, financial linkages could result in a higher degree of business cycle synchronization by generating large demand side effects. For instance, if consumers from different countries have a significant fraction of their investments in a particular stock market, then a decline in that stock market could induce a simultaneous decline in the demand for consumption and investment goods in these countries. Furthermore, contagion effects through financial linkages could also result in heightened cross-country spillovers of macroeconomic fluctuations (Kose et al., 2003).

The above findings revealed that OCA and the integrated market can constitute a virtuous, self-reinforcing circle, which adds to the trade channel of real economic cycles synchronization highlighted by Frankel and Rose (1997 and 1998), giving credit to the hypothesis that countries are better candidates to join a monetary union ex post rather than ex ante.

The endogeneity paradigm changes the traditional benefits of joining an OCA for a country, which is followed by the changes in the slopes of $GG$-schedule in Figure 1-a, while we assume that $LL$-schedule remains unchanged. Under the assumption that intra-industry trade dominates, and the share of intra-industry trade further increases as economic integration increases, $GG$-schedule in Figure 3-a would
become steeper, for instance GG, which is followed by the equilibrium level E. Now, if economic integration increases the same degree, i.e., \( (\alpha_3 - \theta_3) = (\alpha_1 - \theta_1) \), the microeconomic benefits because of economic integration will increase more, that is \( (\beta_4 - \lambda_4) = (\beta_3 - \lambda_3) \). At this time, the surplus of integration benefits after offsetting the macroeconomic costs will become more, which indicated by the larger triangle area formed by GG-schedule, LL-schedule and point \( E \) than OCA area (a) in Figure 3-a.

The location of OCA-line also changes following the change of cost-benefit equilibrium level accordingly. For example, in Figure 3-a, the microeconomic benefits of an OCA at equilibrium level \( E \) is larger than the traditional condition at equilibrium level \( E \). Therefore, the OCA-line (a) in Figure 2-a will shift to left until to OCA-line (c). In return, an established currency area may move up to an OCA, or a potential currency area may be more eligible to form an OCA as economic integration increases.

The economic integration affects both the costs and the benefits from joining OCA for a country, and the changes of equilibrium level depend on the relative strength between costs and benefits. Both degree of openness (trade intensity and finance integration) have potentially direct as well as indirect effects on synchronization of business cycles, and the total effects depends on the relative changes of specialization effects and endogeneity effects.

3.3 Endogeneity approach: business cycle synchronization and flexibility

Under the certain equilibrium level (for example, \( E \) in Figure 1-a), there are other exogenous variables as well which influence the evolution process towards an OCA. Mundell (1961) pointed out that factor mobility provides a substitute mechanism for exchange rate flexibility in restoring internal and external equilibriums when asymmetric shocks occur between economic regions. Kraay and Ventra (2000) concluded that a favorable capital-augmenting shock in one or more countries results in the changes in relative prices of labor-intensive products and, therefore, raises wages, employment and output in the rest countries, creates a channel of positive transmission of shocks across potential countries. In fact, any increase of factor flexibility will bring each potential group closer to an OCA as indicated by the downward shift of the OCA-line.

Taking flexibility as the endogenous variable to analyze the relation between
symmetry of shocks and flexibility, while taking the degree of economic integration as an exogenous variable, for example, $\theta$, the OCA-line would change as drawn by Figure 4. There are interactions among integration, flexibility and symmetry, i.e., economic integration has the effect of improving the symmetry-flexibility trade-off, the symmetry of disturbances improves the trade-off between flexibility and integration, and factor flexibility prompts the trade-off between integration and symmetry of shocks. The two-dimensional model cannot capture this feature, and we then quote De Grauwe and Mongelli’s (2005) model as Figure 5 to illustrate the three-dimensional trade-offs between: flexibility and integration, symmetry and flexibility, and symmetry and integration. Endogeneities among integration, symmetry and flexibility reinforce each other, and speed up the process into the OCA-space (shaded area in Figure 5).

![Diagram](image)

**a. The OCA-Line**

**b.**

**Flexibility, Income Correlation and OCA**

**Figure 4  Flexibility, Income Correlation and OCA**

**Figure 5  Economic Integration, Synchronization, Flexibility and OCA**

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Source: De Grauwe and Mongelli (2005).

The interactions between trade, financial integration, flexibility and business cycle synchronization are complex and whether increased economic integration leads to more or less business cycles correlation across countries depends on the trade-off between specialization paradigm and endogeneity paradigm. The endogeneity analysis makes a bridge between the two entirely separated groups of studies, i.e., some are focused on measuring static or dynamic correlation of shocks, and others are concentrated on assessing the feasibility for potential country to join an OCA, such as factor mobility, economic openness, economic diversification, exchange rate and other explanatory variables (Babetski, 2003).

4. Empirical Discussion of the Endogeneities of OCA Criteria

Following Frankel and Rose (1997 and 1998), a significant amount of economic work has discussed endogeneity hypothesis in different perspectives with a focus on transmission channels of trade integration and financial integration. Meanwhile, other potentially relevant determinants, such as the structure similarity, policy coordination and other bilateral characteristic variables on the synchronization of business cycles are also discussed.

4.1 The effects of trade integration on business cycles synchronization

4.1.1 The net effects of trade linkages on business cycles convergence

Frankel and Rose (1997, 1998) originally empirically confirmed the endogeneity between bilateral trade intensity and the bilateral correlation of business cycles as for the main benefits and costs from an OCA respectively, in order to identify the ideal participants among 21 countries in European Union during the period of 1959-1999. They found that higher economic integration historically has resulted in more highly synchronized cycles, and a potential country is more likely to satisfy the criteria for joining a currency union ex post than ex ante. Extending the sample period, Kose and Yi (2002), Silvestre and Mendonca (2007) reconfirmed the endogeneity hypothesis defended by Frankel and Rose (1997 and 1998). Building a non-linear model rather than linear model of Frankel and Rose (1997 and 1998), Silvestre et al. (2007) further examined the case among 10 countries in Euro zone during the same time, and found that the effects of trade on business cycles synchronization are increasing. Employing
not only OLS and IV Estimate but also fixed effects (FE) and random effects (RE) estimation of panel data, Abbott et al. (2008) identified a positive relationship between trade intensity and the business cycle correlation for 16 European countries during the period of 1959-2003, but a statistically significant negative relationship for the USA, Hong Kong and Mexico. The gravity model analysis of Ritschl and Wolf (2003) strongly supported the view that not only do currency areas create trade but that trade also creates currency areas. Artis and Okubo (2009 and 2011) developed a year-by-year measure of business cycle synchronicity to exploit long runs of data without compromise and the results go far to sustain and strengthen the importance of trade linkages to bring out business cycle synchronization among 19 major developed countries during 1870-2005.

In addition, some studies also investigated the relation between trade and output correlation, although some of them stressed that other factors such as policy coordination, specialization, financial integration are equally important (Fontagne and Freudenberg, 1999; Kaleml-Ozcan et al., 2001; Otto et al., 2001; Fidrmuc, 2001 and 2004; Clark and van Wincoop, 2001; Calderón et al., 2002; Kose et al., 2003; Bordo and Helbling, 2003; Imbs, 2003 and 2006; Baxter and Kouparitsas, 2004; Böwer and Guillemineau, 2006; Tao and Abbott, 2007; Schiavo, 2008; García-Herrero and Ruiz, 2008; Kaleml-Ozcan et al., 2009; Dées and Zorell, 2011). In general, these studies provide evidence of a positive and significant link between trade integration and business cycle synchronization, although the significances are different due to the differences in empirical methods, measurement of involved variables, sample countries and sample period.

4.1.2 The structural effects of trade linkages on business cycles convergence

As the evolvement of communications and transportation technology, it is feasible and profitable for multi-national enterprises to slice-up the whole production process into separate parts or stages, and fragment them in different locations to capture local comparative advantages, which is followed by the further enlargement of intra-industry trade. Taking the total trade as the independent variable implicitly assumes that the coefficients of intra- and inter-industry trade are the same, which may result in estimation bias due to misspecification (Gruben et al., 2002). The studies subsequently noticed the need to incorporate the effects of trade structure into the analysis, and by extension, the role of production fragmentation. The results...
generally confirmed that structure of trade rather than total trade volume is important to prompt the convergence of real economic performance

Based on a cross-section analysis of OECD countries during 1990 and 1999, Fidrmuc (2001) tested the endogeneity hypothesis for OCA between EU and CEEC, and found there is a positive relationship between intra-industry trade and business cycles correlation which is in line with the argument of Krugman (1993). Gruben et al. (2002) separated the trade intensity measures of Frankel and Rose (1997, 1998) into intra-industry trade intensity and inter-industry trade intensity, and confirmed that the big share of intra-industry trade make industry-specific shocks through specialization not exceed common demand shocks and productivity spillovers, and hence could contribute to more cyclical convergence. Silvestre and Mendonça (2007) and Inklaar et al. (2008) introduced the share of intra-industry trade as one of the index of economic specialization, and found that more intra-industry trade are related to more similar business cycles for 21 OECD countries during the period of 1970-2003. Working on a sample of 147 industrial and developing countries during 1960-1999, Calderón et al. (2002) found that the positive impact of trade integration on output fluctuations among industrial countries is higher than the case among developing countries and industrial-developing country pairs due to the differences in trade patterns between them, i.e. intra-industry trade dominates among industrial countries while inter-industry trade dominates among developing countries and among industrial-developing country pairs.

Fontagne and Freudenberg (1999) distinguished the total effects of intra-industry trade into horizontal and vertical intra-industry trade using EU as the sample, and they found that increasing horizontal intra-industry trade prompts the symmetry of business cycles, while vertical intra-industry trade deepens the industrial specialization. By incorporating the production fragmentation arrangement into the standard IRBC model, Burstein et al.(2008) and C.Y.Ng (2010) further documented the importance of production sharing in international business cycles convergence, and found a higher positive relationship between bilateral trade flows induced by production fragmentation and bilateral manufacturing output correlations relative to non-production-sharing trade flows, since the complementarity effects of the vertically integrated production mutes substitution effects stemming from aggregate shocks to relative costs across countries.
4.2 The effects of economic structural similarity on the synchronization of business cycles

While globalization forces have made countries more inter-connected, structural diversification among various economies might have generated idiosyncratic shocks on business cycles. Some studies have introduced the industry structure into the framework of Frankel and Rose (1997, 1998) to investigate the importance of the degree of similarity in production structure across countries to study the propagation of business cycles.

Employing a measure of economic similarity that depends on the shares of employment in each sector of the economy in each country, Imbs (2001) found that sectoral structural similarity is able to explain much more of the cross country variability in business cycle correlation than trade. Kalemli-Ozcan et al. (2001) investigated the effects of production specialization on the symmetry of output fluctuations among 50 US states (1977-1994) and some of OECD countries (1977-1990) and found that production specialization will not have as large effect on the asymmetry of business cycles, if economies choose to specialize in production after having spread the risk of specialization in capital market. Chih et al. (2011) confirmed that specialization in production also has an indirect effects on the business cycle synchronization through other channels, such as trade and FDI. The studies such as Clark and van Wincoop (2001), Imbs (2001, 2003 and 2006), Calderón et al.(2002), Böwer and Guillemineau (2006), Schiavo (2008), Inklaar et al.(2008), Garcia-Herrero and Ruiz (2008); Dées and Zorell(2011), adopted Herfindahl indexes of concentration originated by Krugman (1991), and confirmed that the economic structural similarity presents a significantly positive effects on the convergence of economic performance. Chih et al. (2011) found that specialization in production also has an indirect effect on the business cycle synchronization through trade and FDI.

4.3 The effects of financial integration on the synchronization of business cycles

In the process of globalization, trade linkages don’t seem large enough to produce all the economic inter-dependence, and cross-border capital flows (in particular, FDI) surging over the last three decades provide a more dramatic element. The empirical results on the effects of the financial integration on propagation of business cycles are more unfixed than the case of trade integration. Some studies, such as Kalemli-Ozcan et al. (2001, 2003), Otto et al. (2001) , Bordo and Helbling...
Pearce et al. (2003) found that the specialization hypothesis of financial integration is conducive to less synchronized cycles among developed economies. Kose et al. (2003) introduced the variable of financial integration into Frankel and Rose (1997, 1998) model and found that financial market integration enhance global spillovers of macroeconomic fluctuations.

The previous studies on the endogeneity of OCA criteria are mainly based on Frankel and Rose (1997 and 1998) model and employ one-equation panel estimation (OLS, IV and those with fixed effects and random effects). However, in the OLS estimation, estimation bias may occur as a result of an endogeneity problem, i.e., a positive relationship between bilateral trade linkages and output correlation could potentially affected by a third factor that explains both variables. For example, countries with intense trade relations are more likely to link their currencies either explicitly or implicitly in order to capture greater exchange rate stability gains, which will result in the similar macroeconomic policies between them that may correlate their business cycles. Frankel and Rose (1997 and 1998) and most the subsequent studies therefore employed instrumental variables (IV) estimation in order to overcome this problem. However, using the estimation of a single equation will still give the wrong answer. For example, the gravity variables used broadly as instrumental variables of trade integration are likely to affect other transmission mechanisms of business cycle convergence as well (Gruben et al., 2002). In addition, all the coefficients of time-varying variables can not be estimated, since the instrumental variables do not change over time. So, the above problem cannot be solved through IV estimation because the real problem is not an endogeneity problem but one of omitted variables. On the other hand, the complex interactions among potential transmission mechanisms on business cycle might generally impact the results found.

Imbs (2003) tentatively incorporated trade, financial integration, production specialization into the system as independent variables, to examine the synchronization of business cycles among 18 OECD economies during 1977-2001. The results show that trade linkages impact business cycles synchronization significantly positively through two propagation processes, i.e., intra-industry trade, and trade-induced specialization. Economic performances in financially integrated regions are significantly more correlated, ceteris paribus, even though the finance-induced
specialization would result in less synchronized cycles. Finally, two economies with a similar economic structure are significantly more correlated, ceteris paribus. Following Imbs (2003 and 2006), Böwer and Guillemineau (2006) confirmed that financial integration would lead to greater cycle symmetry in 12 Euro area countries during 1980-2004. Tao and Abbott (2007) disentangle the complex interactions between trade, financial integration, specialization and business cycle synchronization among 15 OECD countries during 1984-2003. The overall effects of these channels are confirmed to be strong. Additionally, trade-induced specialization has a significant effect on business cycles convergence, while the finance-induced specialization would lead to more idiosyncratic business cycles. It was also found that trade linkages and financial integration promote mutually. Dées & Zorell (2011) confirmed that financial integration affects business cycle synchronisation indirectly by inducing production structures similarity. Schiavo (2008) pointed that monetary integration may affect significantly the convergence of economic performance through the potential effects on monetary policy.

4.4 The effects of macroeconomic policies coordination on the business cycles synchronization

The founders of the theory of regional integration, such as Tinbergen (1954) and Balassa (1962) noted that regional integration always works in the tense relationship between political and economic integration. In his ‘triangle of European integration’, Mongelli (2002) pointed out that monetary integration triggers economic integration which in turn leads to the final goal of more political integration. Factually, an important question faced by European Monetary Union is the impact of monetary and fiscal policy coordination on business cycle synchronization.

Some studies focus on the effects of political integration on the synchronization of business cycles among developed countries and generally presented the positive effects of policies coordination on business cycles convergence. Including the variable of policy coordination in to the empirical model, Clark and Wincoop (2001) confirmed that there is no evidence that more coordinated macroeconomic policies lead to either higher or lower business cycle synchronization, but it does not mean that macroeconomic policies have no effect on business cycles because that the net effect on correlations would be weak when country-specific policy is both a source and a stabilizer of business cycles. It is also found that there is a direct positive link
between the degree of macroeconomic policy coordination among the U.S. regions and their business cycle correlations. Otto et al. (2001), Bower and Guillemineau (2006) confirmed that the similarity of monetary policy have significantly positive effects on output growth correlations across 17 OECD countries and 12 euro countries respectively. Inklaar et al. (2008) presented that more similar in fiscal policy, more correlated monetary policy, less exchange rate variability across 21 OECD countries are related to more synchronized business cycles.

5. Conclusions

The studies on the endogenous OCA theory have made a series of contributions theoretically and empirically. On the bases of theories, the similarity of economic structural similarity and macroeconomic policies coordination would result in convergence of economic performance, while trade linkages and financial openness present both positive and negative effects on this propagation process, which may, in principle, counteract each other. Because of the ambiguousness between production specialization effect and endogeneity effect of economic integration, whether one certain currency union will evolve towards an OCA is unclear theoretically and poses a question that could only be solved empirically. The previous literature on the endogeneity of OCA criteria show that the Euro zone evolved towards an OCA through trade integration, structure integration, financial integration and policy integration directly and indirectly, though there are some difference voice due to the different sample countries, sample period and different empirical methods and data sources.

The previous studies mainly focused on the established Euro union. As the evolvement of economic integration in other regions, the importance and the possibility of other regions in the world, such as North America, Africa, MERCOSUR countries, states in United States, especially East Asia, as one of the most dynamic regions in terms of increasing economic integration, to form currency union has attracted much attention. In the case of East Asia, many studies confirmed the positive relationship between trade integration and business cycle correlation, and the structure of trade, and by extension, the international production and distribution networks which are responsible for a large part of intra-industry trade, rather than total trade volume is key in determining the extent of business cycle convergence (Shin and
Wang, 2003 2004 and 2005; Rana, 2007a and 2007b; Rana et al., 2011; Kumakura, 2006; Takeuchi, 2011; Allegret and Essaadi, 2011, etc.). These previous studies do not explicitly consider the role of other channels, such as economic structural similarity and financial integration on business cycle synchronization in East Asia mainly except for Lee and Azali (2010) because of the economic diversification and the lack of data of financial openness for this region, This is leave room for us to make further rigorous empirical study on the endogeneity of OCA criteria in East Asian economies.

However, it should be noted that not only on the level of integration but also the integration process in Europe and East Asia is much different.

Firstly, integration in Europe is mainly politically driven, while it is more or less a spontaneous as result of economic developments in East Asia, though East Asia started to supplement market-led integration with various official schemes to promote regional integration after the Asian financial crisis (Rana et. al., 2011).

Secondly, the integration in East Asia is vertical due to the international production/distribution networks, while Europe structures are more homogeneous and less vertically integrated.

Thirdly, East Asian countries are much more diversified in tradition, religious and political systems as well as in the developmental stages of the economies than European countries.

The studies on endogeneities of OCA criteria in East Asia and other regions need to investigate the unique features of the region with the new analysis perspective and useful analysis instruments provide by the previous studies in Euro union and developed economies.

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