

**Economics of Monetary Integration:
A Review of Recent Research**

by

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ABSTRACT

This article provides a selective survey of the accumulated theoretical and empirical works on monetary (or currency) union to date. Our major considerations are: the clear definition of monetary union and the OCA, the systematic classification of the necessary and sufficient conditions, examination of empirical findings, feedback issues from important statistical facts, remaining issues to be resolved, proposals for future research, etc. The most significant recent empirical finding is the endogeneity in the form of specialization in member countries, which may require a modification of our conventional understanding of monetary union, and may account for the possibility of its secession.

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Economics of Monetary Integration: A Review of Recent Research*

1. Introduction

This paper provides a selective survey of the literature on monetary or currency union. Although there have already been several celebrated survey articles containing a vast accumulation of both theoretical and empirical literature since the seminal article by Mundell (1961), we nonetheless present another survey article because of the following considerations.¹

Firstly, it seems to us that the two phrases, a monetary or currency union and an Optimum Currency Area (OCA, hereafter), have been used interchangeably without clear distinction between them in the literature. We will first make this distinction and hence clarify the definition, followed by a systematic examination on the necessary and sufficient conditions for the OCA, or monetary union in general.

Secondly, since some significant contributions have been made recently on the characteristics of monetary union both theoretically and empirically, we will not only introduce them, but also properly assess them, and discuss and criticize their significance and implications, together with proposals for some future research possibilities.

Thirdly, significant contributions have been particularly outstanding in empirical aspects, although recently theoretical contributions have also been progressing. One of the most significant recent contribution is, to our assessment, the empirical verification of the endogeneity of the so-called OCA criteria which will be elaborated on later. We find that the endogeneity actually modifies or sometimes overturns conventional theories and views of monetary union or regional integration in general, if assessed and fed back appropriately. Thus, the endogeneity actually requires a reformulation of the theories of OCA and of monetary union. An important consequence of the endogeneity necessarily compels a reexamination of the OCA conditions (or monetary union), especially the sufficient conditions, since the endogeneity manifests itself in some of them.

Fourthly, it would be high time to draw empirical assessments from the accumulated recent empirical research for future regional integration, especially for Asian countries. The exchange rate regimes for LDCs have been largely fixed systems, but there still remains some research possibilities in the future by exploiting appropriate methods or data sets.

And fifthly, we point out and also discuss at least three remaining but important issues to

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¹ For earlier surveys, see, e.g. Lafrance and St-Amant (1999) or Mongelli (2002).

be clarified and resolved in the future: welfare consideration, the optimum number of world currencies, and the possible future paths of the existing monetary unions, e.g. EMU.

The rest of this article is organized as follows. In section 2 we survey the OCA criteria by distinguishing them between the necessary and sufficient conditions as the criteria for monetary union, emphasizing the endogeneity phenomena. In section 3 we critically examine the empirical literature that “operationalized” the OCA theory to date and assess them from the standpoint of OCA. A final answer to the question about whether monetary union or OCA gives rise to non-negative total net benefits remains elusive, as empirical testing is undermined by the lack of agreed criterion to measure the net benefits, the scarcity of appropriately defined data, and the difficulty to control for all relevant factors that may influence the costs and the benefits. In the following main section (Section 4) we present a modified theory of monetary union, recognizing the fact that the possibility of endogeneity of OCA characteristics would dictate significant modification of the conventional understanding of monetary union, especially when endogeneity implies specialization in production. We also discuss several other issues that are fed back from the literature on the OCA or monetary union to date and raise some remaining issues to be resolved in the future. Since a monetary union is in general a “large” entity that can affect the terms of trade, we argue that the welfare levels for both members (“ins”) and non-members (“outs”) should, if possible, be assessed carefully. Section 5 concludes the paper and proposes potentially promising future research themes.

2. Theoretical analyses of monetary union

Before undertaking the present survey, the definition of monetary union must be clarified. There seems to be some confusion in the literature on the definition, and that may be the source of further unnecessary disagreements on important policy issues or the union’s future paths. The definition actually differs from one researcher to another, and there seems to be no common definition.

The most important two interrelated elements for monetary union seem to be (1) the number of currencies in the union, and (2) the number of monetary authorities (the central banks), although several other peripheral elements have also been discussed for specific themes in the literature. On the one hand, monetary (or currency) union is defined by a single currency in the zone issued (or managed) by only one monetary authority (e.g., Fabella, 2002). On the other hand, monetary or currency union is more broadly regarded as an exchange rate regime where the participating member countries use a “foreign” or one of the member’s currency as the common legal tender with the exchange rates being irrevocably pegged (e.g., Moosa, 2005, chap.4; Mongelli, 2005; Jovanović, 2006, chap.4).²

² Some of the empirical studies investigated the effects of monetary union without clearly

Table 1 below, known as the Balassa Stages, is extended by the authors using Table 1-1 of Nielsen, Heinrich, and Hansen (1992, p.4), Crowley (2006), and Jovanović (2006, p.23), which clarifies that a notion of monetary union appears when a common currency (and a common monetary policy) is considered, and that this type of union becomes a fiscal union when a common fiscal policy is considered. The reason for using the term “monetary union” or “common currency area” without clearly defining it may rest on the fact that a common currency is a central focal point of monetary policy.³

 Insert Table 1 around here

After monetary and currency crises experienced during the 1980s and 1990s, one of the central focal points has been on how to prevent potential future crises. According to the current research on exchange rate regimes, these are broadly classified in at least three categories: rigidly fixed corner, freely float corner, and others in between. Some examine the characteristics of these categories, and they regard a monetary union to be classified as a regime belonging to the subclassification of “hard peg” in the pegged systems (Ghosh, Gulde, and Wolf, 2002, chap.4).

However, instead of viewing monetary union from this perspective and comparing the *pros* and *cons* of exchange rate regimes, this paper directly examines the *creation* of (or new accession to) monetary union in emphasizing the necessary and sufficient conditions.⁴ More specifically, we consider the costs and benefits in forming monetary union, given the expected superiority of the rigidly fixed corner (including monetary union) over the other regimes as advocated by, e.g. Calvo and Reinhart (2000).

As will be discussed below, for monetary union to be sustainable, the net benefit from its creation must be non-negative, although it may not be necessarily maximized (i.e., “*optimum*”). This clearly means that the OCA belongs to a proper subset of the set of regional integrations including monetary union. Thus, in this section we consider the OCA criteria as the necessary conditions, followed by an examination of the costs and benefits related to the sufficient conditions. Although the conventional distinction between the necessary and

defining it. The reason for this may lie in the fact that the last two decades have witnessed a rapid progression of regional integration in Europe, and thus “monetary union” seems to have been accepted, consciously or not, as synonymous with the EMU. The first stage of EMU began in 1990, and passed through the second stage from 1994. The common currency Euro was introduced as a single currency at the third stage in 1999. At the time of writing (January 2009) the Euro becomes the legal tender for sixteen countries, and will be used by some of the other new accession members of EU (ten countries in 2004 and two more in 2007) in the future. Some papers discuss the effects of monetary union with a presumption of this EU enlargement. Baldwin and Taglioni (2004, p.6) state that the European monetary union became a currency union from 2001.

³ However, as long as the exchange rate is fixed rigidly, a common currency is not necessarily needed by monetary union (see, e.g. Aminian, 2005, p.99).

⁴ Using the sample data of 25 transition countries for the 1990s, von Hagen and Zhou (2005, p.697) found empirically that “the reasoning of optimal currency area literature provides considerable guidance for the choice of exchange rate regime”.

sufficient conditions is somewhat blurred because of the endogeneity characteristics of the OCA criteria, as will be discussed later in detail, we make such a distinction following the conventional arguments.

According to Baldwin (2006a, pp.8-10), there are at least three different types of currency unions; (1) the hub-and-spoke type, involving small nations (the spokes) adopting the currency of their dominant partner (the hub)(the anchor-client relationship in Tenreyro and Barro, 2003, hereafter T=B; Barro and Tenreyro, 2007, hereafter B=T), (2) the multilateral currency unions, involving economically "tiny" nations, and (3) the idiosyncratic currency unions, involving a very local hegemony. This distinction is important when considering the endogeneity of monetary unions later.

In sum, in this survey, unless otherwise stated, we define and deem monetary union as an exchange rate regime in a relatively broad sense such that a group of countries whose exchange rates are irrevocably pegged and might be unified, and monetary and external exchange rate policy as determined at the union level.⁵ In addition to the members of Euroland, there have been quite a large number of these monetary unions and monetary-union-like arrangements from 1970 onwards, and all of them are listed in Rose (2000, p.41).

2.1 Necessary conditions for monetary union

We first consider the necessary conditions for monetary union below with reference to the OCA criteria since, as discussed above, the OCA belongs to the set of economic integration including monetary union as a proper subset, and thus their necessary conditions are more stringent than those for monetary union.⁶ This point has rarely been recognized and mentioned in the literature. For example, Bayoumi and Eichengreen (1993, 1994, 1997; B=E hereafter) in examining members' characteristics of EU countries, statistically analyzed whether the monetary union (or EU) satisfies the OCA criteria.⁷ However, these criteria were irrelevant for some studies, e.g. Swofford (2000), in which he examines whether two (or more)

⁵ Ngiam and Yuen (2001, p.219) clearly distinguished a monetary (or exchange-rate) union and a currency union; the former is defined as "the most basic form of monetary integration... whereby countries join together in an attempt to irrevocably fix their exchange rates and follow a common monetary policy", while the latter "the most advanced form of monetary integration...which can be defined as an area with a single currency and a common central bank".

⁶ The OCA is sometimes equivalently called as the "*Optimal* Currency Area". For example, see Buigut and Tavev (2005) and Swofford (2000).

⁷ Tenreyro and Barro (2003) and Barro and Tenreyro (2007) statistically examine characteristics for adopting a third country's currency as an anchor currency with a gravity equation. They considered six characteristics as gravity variables: (1) the same language as the anchor, (2) geographically close to the anchor, (3) a former or current colony of the anchor, (4) poorer in terms of GDP per capita than the anchor, (5) smaller in terms of population size than the anchor, and (6) the anchor being richer.

countries with only one currency and checkable deposits are candidates for monetary union in the sense that they exhibit “homogeneity” in their preferences (see Section 2.2.1.a). It should be recalled that, as long as the exchange rates are rigidly fixed, a common currency is not necessarily needed by monetary union (Aminian, 2005).

Recognizing that the starting point for discussing the necessary conditions rests on the OCA criteria, the following three traditional but main characteristics are outstanding.⁸ In his seminal paper Mundell (1961) proposed that a country would find it advantageous to fix the external value of its currency to another country's currency if the business cycles of the two countries were highly correlated. Since such a correlation is never perfect in reality, he emphasized factor mobility between the countries or regions as one of the most important characteristics for the OCA to alleviate potentially serious problems arising from asymmetry of shocks. McKinnon (1963) argues openness as another main characteristic in forming the OCA, since prices and wages are more flexible for more open economies. Furthermore, Kenen (1969) considers diversification of economies for averaging out external shocks as an additional important characteristic. These characteristics have long been mentioned in the OCA literature in parallel fashion.

In his survey article Mongelli (2002) classifies the OCA criteria into four historical phases of OCA theory. He regards the early 1960's to the early 1970's as the pioneering phase, the 1970's as the reconciliation phase, the 1980's and early 1990's as the reassessment phase, and the 1980's to present as the empirical phase. The important criteria called the “prerequisites” (i.e. the *necessary* conditions) for OCA in the “pioneering phase” are briefly summarized as follows (for a detailed exposition, see Mongelli, 2002, pp. 8-10.):

- (N-1) Transactions costs
- (N-2) Price and wage flexibility
- (N-3) Mobility of factors of production including labor (Mundell, 1961)
- (N-4) Financial market integration
- (N-5) The degree of economic openness (McKinnon, 1963)
- (N-6) The diversification in production and consumption (Kenen, 1969)
- (N-7) Similarities of inflation rates
- (N-8) Fiscal integration
- (N-9) Political intention

The first condition (N-1) (not mentioned in Mongelli) follows from the definition of

⁸ The OCA literature has been on balance biased towards empirical analysis. For earlier surveys, see, e.g. Tavlas (1993), B=E (1994), among others. For recent surveys, see, e.g. De Grauwe (2003), Lafrance and St-Amant (1999), and Mongelli (2002). Hochreiter, Schmidt-Hebbel, and Winckler (2002, H=H=W hereafter) focus on Latin America, and Faruquee (2004) focuses on East Asia.

monetary union in which the exchange rate is either eliminated or irrevocably fixed. Thus, transactions costs are significantly reduced. The second condition (N-2) is straightforward, since more competition and factor mobility are expected within an OCA, making prices and wages more flexible.⁹ The third (N-3) and the fifth (N-5) have long been discussed in OCA literature (and briefly mentioned above), and thus needs no further explanation.

The fourth condition (N-4) means that capital mobility in an OCA facilitates financial market integration that serves to cushion the potential adverse effects of exogenous shocks. This reduces the need for exchange rate adjustment. Thus, this condition mentioned in Mongelli (2002) has already been essentially considered by the preceding condition (N-3).

The sixth (N-6) has also been regarded as a plausible consequence in an OCA with a larger population with diversified tastes and technologies. However, recent empirical findings cast some doubt, supporting an opposite view put forth by Krugman (1991, 1993)(see also Myrdal, 1957, chapter 7). We will discuss this issue in detail in Section 4.

The seventh condition (N-7), “similarities of inflation rates”, means that, since the area-wide monetary policy is implemented in an OCA, the inflation rates will be symmetric between countries. Thus, adjustment by nominal exchange rate is likely to be unnecessary since the terms of trade is also likely to be relatively stable. However, if we recognize that the inflation rate sometimes reflects the consequences of more deep-rooted imbalances such as structural developments, diversities in labor market institutions, differences in economic policies, or diverse social preferences, this does not seem to constitute an important necessary condition.

The eighth (N-8), fiscal integration, has not been generally recognized as a necessary condition for monetary integration. If fiscal policy, in addition to monetary (and other) policies, is *fully* centralized, the union could be classified as a fiscal union (see Table 1). However, as will be discussed later (section 4.1.3), fiscal policy should be centralized to some extent, as Kenen (1969) stressed some time ago. It should be pointed out at this stage, as explained by Crowley (2006), that fiscal integration may not be linked “backward” with monetary integration in the sequence of economic integration, i.e. it is not a precondition for monetary integration.

It seems that the ninth, (N-9) political intention, has not been clearly understood in the literature. For example, although we have to distinguish the political intention from the political integration as in Crowley (2006), there seems to be confusion in the literature when discussing the future of the European monetary union. We have no definite idea to date what the future course (“forward” linkage) of existing monetary unions will be, i.e. to proceed to a “deeper” level of integration such as fiscal union or political union, or the present monetary unions stop at the present stage, or even whether there exists a “path dependence” (or

⁹ A related necessary condition for monetary union is the short-run volatility of GDP. However, Buch, Döpke, and Pierdzioch (2002) found no consistent relationship between financial integration and the volatility of GDP.

“spillover effect”) in the sequence of economic integration. We could conclude that, given such a sequence, political intention is an initial (necessary) condition for every stage of economic integration.¹⁰ This point, especially for monetary union, is emphasized by Eichengreen and Razo-Garcia (2006).¹¹

Among these nine conditions, Mongelli (2002) pointed out, from a historical perspective that (N-2), (N-3), (N-5) and (N-6) were examined in the initial phase as the necessary conditions. Later, since the 1980’s when the OCA criteria attracted empirical attention, (N-2), (N-3), (N-4) and (N-8) have been the main research themes. In addition, similarity of shocks, which reflects the interaction between some fundamental economic structures, is regarded as a precondition for those conditions (Mundell, 1961; Mongelli, 2002).

What we really want to know is: what conditions are actually important, and to what extent? Thus, we are asked if we can rank the importance of those necessary conditions. The first, (N-1), follows from the definition of monetary union. Without (N-2), no conditions may hold except (N-9). Thus, the condition (N-9) is crucial next to (N-1) and (N-2), given “path dependence” in the sequence of economic integration. Notice that the rank or the degree of importance for the rest of these conditions depends on the degree of “depth” in economic integration, and other characteristics such as historical, cultural, structural, geographical factors surrounding potential candidate countries and particular monetary integrations.

A slightly different but related question is asked by Mongelli (2002): He offered a yet unresolved issue, asking that, since the preceding OCA literature were in a sense largely “backward looking” in Crowley’s (2006) terminology, what the recently-recognized phenomena of “specialization versus endogeneity” imply for the future integration of existing monetary unions when viewed from a “forward looking” manner. We will come back to this topic later (section 4.2.3) and present our interpretation for it. But we now turn to examine the sufficient conditions for monetary union.

2.2 Sufficient conditions for monetary union

When a country considers joining in a monetary union, they expect that the benefits be greater than or at least equal to the costs. This condition for non-negative net benefits must be generally not static but rather dynamic in nature, implying that its present discounted value must be considered.¹² To assess the net benefits we need to know the costs and the

¹⁰ Political intention is found to be weak for an Asian MU. Aminian (2005, p.107) wrote that “Monetary unification of East Asia is rejected on political rather than strictly economic grounds.”

¹¹ Robert A. Mundell, known as the father of the Euro, replied in an interview by Vane and Mulhearn (2006, p.99) that “The Treaty of Maastricht (1991) established the goals of both monetary union and *political union* for Europe. Monetary union came first because it was easier, but greater political integration...is needed” (emphasis added).

¹² The dynamic nature of net benefits from an institutional (or policy) change reminds us of a

benefits in joining a monetary union. This subsection closely examines those costs and benefits mentioned in the preceding literature. We start with classifying the benefits from monetary union into two categories, microeconomic and macroeconomic benefits. Since the endogeneity has been emphasized in the recent literature, we have to pay careful attention and to give a close examination of the sufficient conditions. Put differently, we could see that some of the sufficient conditions to be examined below would actually involve the flavor of necessary conditions because of this endogeneity.

2.2.1 Microeconomic sufficient conditions

Within a group of microeconomic benefits, at least two different kinds of the benefits are identified: One is a possibility of the aggregation of benefits, and the other, an increase in efficiency.

2.2.1.a Aggregation condition

Let us suppose that the utility function of a representative agent residing in monetary union (or OCA) exhibits a form of the so-called money-in-the-utility. For any two countries there are two assets, currency and checkable deposits that can be used as “money”. Then, Swofford (2000) considered, under those assumptions, whether there exists a weakly separable, non-satiated continuous, concave, and monotonic utility function. A mathematical characteristic of weak separability is defined such that the MRS between any two monetary goods is independent of any other (consumption) commodity. Since the existence proposition has been known to be equivalent to the generalized axiom of revealed preference, he investigated the revealed preference characteristics for weak separability using data for 10 European countries and the Euro area. Using the three-step revealed preference test due to Varian, he found that only 6 of the total of 10 European countries showed the possibility of weak separability, and thus the utility function could be aggregated over agents.¹³ The six countries are tabulated in Table 2.

 Insert Table 2 around here

Since aggregation could only be possible for a subset of Euro zone countries, a potentially significant finding by Swofford (2000) is that the *area-wide* demand for the common currency Euro in the Euro zone could be unstable. Needless to say, the existence of stable demand for

similar problem in the Mill-Bastable, Kemp, and Negishi tests for the protectionism argument of an infant industry in international trade theory. Thus, we realize that the endogeneity problems are inevitably involved in the economic union argument.

¹³ The annual data were collected from IMF-IFS from 1988 to 1997, i.e. ending before the launch of Euro.

money has been recognized as the most important prerequisite for monetary policy to be effective since Milton Friedman. The unstable demand for money (Euro) thus suggests a potential source of macroeconomic instability for the Euro zone.

To assess the significance of Swofford's (2000) finding, it is interesting to compare his work with a more direct empirical investigation of the demand for a broader definition of the money balance (M3) of Euro by, e.g. Golinelli and Pastorello (2002). Since the official national data sources coherent with the aggregate stock of money is unavailable, they constructed a national database by comparing the aggregate Euro area data compiled by the ECB. Using these national data they empirically examined the "poolability" (p.381) of the long-run parameter estimates, i.e. they test the hypothesis that the long-run demand for M3 for all the subset of the countries in the Euro area coincide. Thus, it should be emphasized that they considered a different concept of "homogeneity" (p.393) for the national money demand functions, not "aggregation" *per se*. Using the quarterly data from 1980:3 to 1997:4 for 10 European countries, they found that, although each individual demand function for money was stable in the long-run, the homogeneity hypothesis was rejected for the 10 countries as a whole. However, the homogeneity was statistically vindicated for 6 countries tabulated in Table 2.¹⁴

It should be noted that the aggregation test is more stringent than the homogeneity test simply because the former test considers aggregation of not only monetary assets in the utility function, but also implicitly other consumption bundles as well, while the latter test examines only the individual demand for money. However, a quick glance at Table 2 reveals interestingly that both characteristics of aggregation and homogeneity are satisfied with four "core" countries or "D-Mark area" (Golinelli and Pastorello, 2002, p.395 and 397), except Belgium. More research is needed for the aggregation test with different samples and time periods, as more countries keep joining into the EMU and adopting the Euro as their single and common legal tender. Only after the aggregation test is ascertained, may it be concluded that the monetary policy implemented by the ECB is effective to stabilize the Euroland economy.¹⁵

¹⁴ They reported that the homogeneity is rejected once Italy is included. The reason they gave is that the income elasticity of money demand for Italy was negative, because of the monetary contraction required by the Maastricht Treaty criteria. They also noted that, in general, the sources of difference in money demand are differences in financial structures and markets.

¹⁵ There is another different issue of how to aggregate the individual demand for money functions. The basic idea is which exchange rate is to be used for aggregation to the area-wide demand for Euro. Bosker (2006) found that the variable aggregation method is better than the fixed aggregation method, because the former satisfies the Fisher equation, the significant (long-run) interest rate elasticity, and the positive impact of excess demand for money on inflation. Bruggeman, Donati, and Warne (2003) propose the fixed variable aggregation method and the "index" method. In the latter method all variables are aggregated by a weighted average where a weight being the share of each country's GDP in 2001 in Euro at the purchasing power parity exchange rate.

For comparison purposes, in Table 2 we also cite empirical research by B=E (1994) who examined whether 15 western European countries satisfy the OCA criteria using the annual data from 1963 to 1990. They considered three criteria: the size of shocks, their cross-country correlation, and the speed of domestic adjustment. According to their results, 5 out of the total of 15 countries may constitute a plausible monetary union because of their “relatively small disturbances, high correlations across economies, and rapid speed of adjustment” (p.29). As Table 2 reveals, the difference between the aggregation test and the OCA test results are larger than that of the homogeneity test and the OCA test results.

We briefly mention a related topic concerning the demand for the common currency Euro from a traditional macroeconomic point of view. There are several empirical literature on the theme, and the most of them found long-run stability. For example, von Hagen and Brückner (2002) used the ECB’s quarterly data from 1981 to 2001 and found that the real demand for Euro (M3) is stable in the long-run by an Error Correction Model (ECM).¹⁶ Kontolemis (2002) also estimated the demand for Euro (M3) by an ECM for the quarterly time period of 1980 to 1988, forecasted it for the out-of-sample period from 1999:1 to 2001:3, and confirmed its long-run stability.¹⁷

2.2.1.b Microeconomic Efficiency conditions

The following sufficient conditions have also been examined in preceding survey papers. This subsection discusses them by emphasizing their microeconomic aspects.¹⁸ However, since the endogeneity has been frequently mentioned, and actually seems to be confirmed in the recent literature as mentioned earlier, we will reconsider those sufficient conditions with the endogeneity in mind.

(S-1) Transactions costs

Let us consider in which cases transactions costs (measured by a smaller or no volatility of real exchange rates) between countries fall? Although the absolute measure of volatility cannot be gauged easily, it is not difficult to imagine the relative measure of volatility to fall. As countries are increasingly linked by reciprocal trade with a wide variety of countries using different currencies, the proportion of the total balance of trade to be settled by a particular currency is smaller. This means that the relative exchange risk with each currency is reduced,

¹⁶ The reason for using M3 for estimation rests on a fact that, under the so-called “two-pillar” strategy of the ECB’s monetary policy, the annual growth rate of M3 is announced under the first pillar as the “reference value”, i.e. a guidepost for developments in the monetary sector.

¹⁷ He stated that the stability for the area-wide demand for M3 “appeared to be more stable than any of the individual country money demand function” (p.21). In another recent paper Bruggeman, Donati, and Warne (2003) also confirmed that the stability of the area-wide demand for Euro (M3) is robust with several additional tests.

¹⁸ For surveys, see, for example, Mongelli (2002), Lafrance and St-Amant (1999), De Grauwe (2003), and Obstfeld and Rogoff (1996), chapter 9, among many others.

implying a fall in the transactions costs relatively for the particular currency, *ceteris paribus*. Thus, the relative fall in the transactions costs is a sufficient condition to make room for monetary union of those currencies. Actually, this is a necessary and sufficient condition for monetary union, since it also constitutes a necessary condition (N-1) as discussed earlier.

In monetary union exchange rates are eliminated when a common currency is introduced as a legal tender. Even when national currencies are used, they are perfect substitutes for each other as long as exchange rates are irrevocably fixed. Therefore, transaction costs of international trade and financial trade for individual agents decrease (Alesina and Barro, 2001, 2002, A=B hereafter; Rose, 2000; McCallum, 2003). Thus, according to this interpretation, the expected (or *ex ante*) decrease in transactions costs (which is also a necessary condition (N-1)) is a sufficient condition for monetary union. A=B (2001, p.381) state that "the main force that favors a common currency is the transaction cost benefit. ... The expansion of world trade, or globalization has made this consideration increasingly important". Gains from monetary union in the form of lower transactions costs are limited to its members, however, and those outside the union may be harmed by losses in the form of lower output due to the interaction between the common exchange rate and the market imperfection (Bayoumi, 1994).

(S-2) Competition and Economic Growth

Competition and economic growth would foster more international trade among those countries that use different currencies. Then, for each of these countries, a similar explanation applies as in the previous sufficient condition. Thus, (S-2) is another sufficient condition.

Through a reduction in transactions costs (S-1), monetary union stimulates deeper and wider markets not only for commodity trades but also for financial transactions by individual agents. This in turn would enhance international competition and encourage economic growth by delivering a more efficient allocation of resources (Rose, 2000; Eichengreen, 2000). Thus, although competition and growth would also be necessary conditions, the expected (or *ex ante*) competition and economic growth would be another sufficient condition. However, using the annual panel data from 1976 to 2000 for 57 countries, Edison, Levine, Ricci, and Sløk (2002) failed to establish the macroeconomic view that financial integration promotes economic growth, although it is associated with higher level of per capita GDP.

(S-3) More Financial Markets Integration

As individual financial markets are more integrated internationally, a similar reasoning for (S-1) would apply for those countries involved with respect to financial transactions. Thus, financial market integration serves as a sufficient condition.

As more international competition is encouraged in wider and deeper markets, monetary union provides international arbitrage opportunities for individual agents. One is concerned

with the microeconomic law of one price established by free movements of goods and services. The other is the interest rate arbitrage by free capital movements by individual investors. If the two microeconomic arbitrage conditions are satisfied, then the purchasing power parity is expected to hold. As a result, a real interest rate parity condition should hold under perfect capital movement, as long as the exchange rate is irrevocably fixed in monetary union. Thus, financial market integration may also constitute a necessary condition, but the expected (or *ex ante*) financial market integration is a sufficient condition for monetary union, as it provides efficient allocation of financial resources union-wide. Since financial market integration has also been regarded as a necessary condition (N-4) for monetary union in the literature, together they imply a necessary and sufficient condition for monetary union.

However, empirical verification of this macroeconomic arbitrage condition called uncovered interest rate parity (UIP) has been caught in a trap, known as one of the remaining puzzles in empirical aspects of international finance.¹⁹ This puzzle, called as the "Forward Premium Puzzle", recently attracted attention from another issue regarding the precise meaning of the capital cost (for surveys, see, e.g., Engel, 1996; Sarno, 2005, among others). In international finance theory the real interest rate parity condition is particularly emphasized, because it implies international consumption *risk-sharing* under some additional assumptions (McCallum, 2003; Kearney, 1996; Chen and Knez, 1995; Fielding and Shields, 2005). Thus, this linkage between microeconomic and macroeconomic arbitrage remains a promising avenue for resolving this empirical puzzle.

(S-4) Real Exchange Rates Volatilities

Volatility in the real exchange rate has been regarded as a potential discouraging element for international trade. If volatility of the real exchange rate is reduced among countries using different currencies, the substitutability between them is higher for real and monetary transactions. Then, those countries could manage their monetary policy without exchange rate policy. Thus, the reduced volatilities would enhance the likelihood of forming monetary union among those countries involved, implying that this serves as another sufficient condition for it. As discussed later in assessing empirical works, the volatility has been defined as the "OCA Index" and regressed with the so-called OCA variables, including output changes, trade links, country size, structural differences, etc. (e.g. B=E, 1997, 1999).²⁰

This argument rests on the implicit assumption that the real exchange rate and "fundamentals" are closely related each other, in the sense that the exchange rate moves to dampen unexpected shocks and thus complement a stabilizing monetary policy (shock-absorber). However, according to the "exchange-rate disconnect puzzle" in

¹⁹ Kollmann (2004) uses the UIP condition as a condition of increase in national welfare as explained later.

²⁰ In other words, these OCA variables are regarded as the proxies of the *sufficient conditions* for the real exchange rate stability.

international macroeconomics, it has been known that "the exceedingly weak relationship (except, perhaps, in the longer run) between the exchange rate and virtually *any* macroeconomic aggregates" (Obstfeld and Rogoff, 2000, p. 373, emphasis in original) has been observed. If this is in fact the case, the (S-4) sufficient condition could be disregarded (Artis and Fellow, 2006).

Dellas and Tavlas (2005a) showed that a country with highly rigid nominal wages could gain by joining monetary union through a decrease in volatilities of real exchange rates. They construct an open economy model (belonging to the New Keynesian Model) with three countries, nominal wage rigidities, and two commodities (intermediate and final goods). The model highlights microeconomic foundations by representative agents who act optimally, i.e. maximizing utility and profits. Because of the dynamic nature and non-linear characteristics of the model, the equilibrium conditions do not yield the closed-form solutions. Thus, they calibrated the model with assumptions of appropriate parameter values, and found that global exchange rate volatility decreases by a regional pegged exchange rate under symmetry (i.e. equal degree of wage rigidity) and that some kinds of asymmetry (i.e. some difference in wage rigidity) affect the degree of decrease in volatility. In particular, when member countries have a more flexible labor market than that in countries outside of the common currency area, the decrease in volatility is stronger.

Since wage and price flexibility have been regarded as a necessary condition for monetary union as discussed in section 2.1 (condition (N-2)), their calibration results are interesting.²¹ It implies that if the real exchange rate becomes more volatile under wage flexibility and thus potentially harmful for both "ins" (i.e. members) and "outs" (i.e. non-members), then it may not be rational for outs with flexible wages to join the monetary union. The question arises whether there may be some trade-offs between this increase in volatility of the real exchange rate and other potential gains from monetary union, for example a decrease in volatility of inflation or output around the Phillips curve (Alesina and Grilli, 1994; Karras and Stokes, 2001), or decreases in other costs. Finally, there is another caveat that their conclusion nonetheless depends entirely on calibration, not on closed-form solutions. Different analyses with different models are expected in future research.

(S-5) Roles of Common Currency

If countries engaging in international trade use a particular (foreign) currency as a common vehicle currency, the transactions costs are greatly reduced. Then, because of the same reasoning put forth for (S-1), this serves as a sufficient condition.

From the standpoint of fulfilling the functions of money as unit of price quotation, unit of

²¹ Extending the model of Bayoumi (1994), Hughes Hallet and Jensen (2004) consider the interests and incentives for some of the northern, central, and eastern European countries to join the EMU to conclude that "the degree of labour market flexibility, hence labour market reform, both in and out of the union" (p.364) is imperative.

contract for current and deterred payments, medium of exchange, and store of values (Mundell, 2000), a more widely accepted currency would better serve as an international money that must play three roles as a reserve currency, a vehicle currency, and an invoicing currency for both governments and privates (McKinnon, 2000; H=H=W, 2002). For example the common currency Euro has successfully been launched and accepted as international money, which gives rise to benefits by reducing costs (Mundell, 2000). Thus, if a more important role of common currency is expected *ex ante*, it follows that it serves as a sufficient condition. This role is endogenously reinforced in monetary union, and thus a necessary condition. Although we admit that there are also macroeconomic benefits from seigniorage, how big the benefits are questionable (A=B, 2001; Berg and Borensztein, 2000).²²

Historically speaking both the sterling pound and the US dollar were used as international money until the pound crisis in 1967, while the use of the US dollar gradually dominated in international transactions since then. The use of the single most powerful international currency, the US dollar, has saved transactions costs significantly and thus contributed noticeable increase in international trade. If the Euro would be another international currency, this bipolar scenario would contradict “the first best solution” of a “single world currency” advocated by Mundell (2000) from the *global*, not regional, viewpoint (see also Eichengreen, 2000).

Whether introduction of the Euro has enhanced intra-European trade by reducing the transactions costs (N-1 and S-1) is controversial (Micco, Stein, and Ordoñez, 2003, hereafter M=S=O; Baldwin, 2006a,b; Baldwin and Taglioni, 2004; Lane, 2005; Artis and Fellow, 2006; Flam and Nordström, 2006). Baldwin (2006a,b) reviewed the empirical literature and found that the consensus estimate is that the Euro boosted intra-Euroland trade by 5 to 10 percent. However, while intra-Euroland trade rose steadily, countries in the EU but outside the Euroland also experienced significant increases in Euroland trade. Thus, how the move to the single currency, Euro, contributed to trade patterns is another issue (Dominguez, 2006). Another criticism mentioned by Artis and Fellow (2006) is related to an endogeneity issue to be discussed in detail later in Section 4.1.1.

(S-6) Risk Sharing

If international risk sharing (in either consumption or income, or both) is high among countries involved in international trade with each other, the transactions costs will be greatly reduced by using a common currency or fixing the exchange rate rigidly. Thus, risk sharing is another sufficient condition for monetary union.²³

²² Rogoff (1998) estimates that during the first half of the 1990s, U.S. and German seigniorage averaged 0.48 and 0.41 percent of GDP, respectively, which is quite a large sum. How to distribute those seigniorage benefits among member countries is another problem (see, e.g., A=B, 2001).

²³ International risk sharing (in consumption and income) was empirically shown to increase

Ching and Devereux (2003) examined the possibility of consumption risk sharing in a simple static, two-country model with microeconomic representative agents. The most significant finding is that monetary union permits some international consumption risk sharing through “implicit transfers of money between countries” (p.680), and thus welfare is higher with a single currency (p.682). Although the possibility of risk sharing in monetary union was pointed out in McKinnon (2000, 2002), Ching and Devereux (2003) was the first that clarified its existence in a utility-based model. Thus, if the consumption risk-sharing is expected *ex ante*, then it is a sufficient condition, although it may endogenously appear as a necessary condition.

The model features a single commodity in the world with identical preference across countries. The key assumption is that “there is only one period” (p.676). Then, if equilibrium for the commodity market is imposed as they did on page 686, it seems to be impossible, or there is no incentive, for those countries to respond to exogenous shocks for *intertemporal* consumption risk sharing. Although they mentioned that implicit transfer of money results in a surplus or a deficit in trade, this must cancel out for two countries in a single period world. Thus, since money supplies and labor endowments are unchanged, monetary union can enhance welfare only through trade between member countries. The source of the increase in welfare rests on the difference in the price level, one obtained in a world of independent national moneys and the other in monetary union, where the latter price level is shown to depend on the weighted average of two countries’ demands. The weight actually implies risk sharing, and it is a decreasing function of liquidity service from the real balance in the utility. This clarifies their conclusion of higher welfare because of international consumption risk sharing.

Although their contribution on characteristics of monetary union is significant, it should be pointed out (as they remarked) that the differences in welfare under monetary union and freely floating are likely to be “extremely small” (p.685). We suspect that the difference would be greater, once *intertemporal* risk sharing is also considered in a dynamic model.²⁴

We will take up the risk-sharing issue again with an endogeneity issue of an OCA criterion, and the business cycle synchronization, in a later section 4.1.1. There, we will discuss that risk insurance mechanisms for outputs within a monetary union could overturn the desirability of monetary union (or irrevocably fixed exchange rate regime) if monetary union fosters industrial specialization, rather than synchronization.

as international “Home Bias” in asset holdings decline (because of, e.g. more financial integration) by Sørensen=Wu=Yosha=Zhu (2007, SWYZ hereafter), using a data set of 24 OECD countries for the period 1993-2003. They clarified that consumption risk sharing is much larger than income risk sharing, and they attributed it to pro-cyclical saving behavior.

²⁴ Their result is also sensitive to the choice of parameter values of the elasticity of labor supply, implying that monetary union is favorable as the labor supply becomes more elastic. It is also shown numerically that, since risk sharing is decreasing in a utility measure of real balance, a rise (fall) in this parameter is associated to a rise (fall) in the risk sharing benefits from monetary union.

Although the risk-sharing issue has been discussed mainly on output (income) stabilization when an endogeneity issue is considered, the consumption side has not been neglected, since in a financially integrated area agents could offset the adverse effect of output shocks on consumption by holding diversified portfolios of assets to spread risk (Kalemli-Ozcan, Sørensen, and Yosha, 2001; Demyanyk and Volosvych, 2004; Lane, 2006; Artis and Fellow, 2006; SWYZ, 2007).²⁵ Thus, if financial integration is accelerated further by monetary union, the benefits are considerable. For example, Fonteyne (2006, p.50) proposes "the integration of payments and clearing and settlement systems" which are the most urgent challenge for financial integration.

2.2.2 Macroeconomic sufficient conditions

2.2.2.a Macroeconomic Efficiency

Since the macroeconomic efficiency gains have been extensively examined in the literature, our exposition below is also as brief as possible.

(S-7) Stabilization

Surely it would be true that the possibility of forming a monetary union is higher for more economically stabilized countries, including (but not limited to) a political sense. Thus, this is a sufficient condition.

Monetary union, or fixed exchange rate regimes in general, and freely flexible exchange rate regimes have been compared in terms of their macroeconomic stabilization performance. Although some of the literature (e.g. A=B, 2001, p.381) attributes the main reason that favors a common currency is the transactions costs benefit (N-1 and S-1) as explained earlier, Frankel and Rose (2002, p.437; F=R hereafter) noted that "a currency union ... is most frequently thought of as a time-consistent monetary policy rule that countries use to achieve low inflation". The latter argues that countries without credibility could gain by joining a currency union or pegging the nominal exchange rate to a lower inflation (anchor) country. Thus, if stabilization is expected *ex ante*, it is a sufficient condition for monetary union.

How a country attains credibility through time-consistent monetary policy is formally shown by extending the closed-economy version of the well-known Barro-Gordon model to an open-economy model (A=B, 2002). A similar formal analysis is also given in Ghosh, Gulde and Wolf (2002, Ch. 2) who clarified that the lower inflation under monetary union (or pegged

²⁵ Artis and Fellow (2006, p.250) mention that consumption risk-sharing between regions is much larger than that between countries. Hence, to the extent that a monetary union automatically reduces the home bias, more risk-sharing is expected among "ins" (see also SWYZ, 2007). They also mention the feasibility of the fiscal channel to promote inter-regional risk-sharing in a monetary union.

regimes) reflects two different effects, one is a “*discipline*” effect operating through monetary growth, and the other is a “*confidence*” or “*credible*” effect working through inflation expectations.²⁶ Lower inflation may in turn, promote higher GDP growth through a variety of channels, especially including the development of capital market (F=R, 2002), as well as an increase in the volume of international trade (to be discussed later).

Gains from lower inflation rate has also been analyzed by Cooper and Kempf (2003) who constructed an overlapping generation, general equilibrium, two-country model with governments under cash-in-advance constraints. Optimization independently by representative agents yields the equilibrium conditions, and using them the steady state is defined. Then, they compared the optimal inflation rates between the local currencies’ case and the monetary union’s case, and proved that the inflation rate in the latter case could be zero, and hence utility is higher. Thus, although their finding is concerned with a necessary condition for monetary union, their true contribution, however, rests on their new, albeit disappointing, finding that the strategic interaction of adopting a common currency has a prisoners’ dilemma structure, and thus implies that there is a unique Nash equilibrium that delivers to each country a lower welfare than is obtained by cooperation. More research is needed whether, for example, some plausible punishment devices are found in this strategic game to retain the gains from cooperation in monetary union.

(S-8) Business Cycles Synchronization

Another sufficient condition mentioned in the literature is synchronization of business cycles between candidate countries of monetary union. Since monetary independence of member countries is abandoned in monetary union, the cost is less to cope with business cycles with a common monetary policy if the degree of synchronization of business cycles is high (A=B, 2001). Thus, this synchronization is another possible sufficient condition.

This condition has been known to be time-varying, or endogenous, in the literature, e.g. F=R (1998). However, unfortunately, the direction of endogeneity is different in two distinct thoughts: In one line of thought, the correlation between members’ outputs is increasing. For example, Hochreiter and Siklos (2002, p.201; H=S hereafter) stated that “fixed exchange rates, including currency union, promote economic integration and thereby increase correlations among members’ business cycles”. However, following another line of thought put forth by Krugman (1991, 1993), B=T (2007, p.3) stated that “currency unions enhance sectoral specialization, and shocks tend to affect sectors asymmetrically”.²⁷

²⁶ Some supportive empirical assessment for the two effects is also provided in Chapter 6 of Ghosh, Gulde and Wolf (2002). F=R (2002, Sec. III), however, found no clear-cut supportive evidence for a credibility effect using a gravity model. Similar but more extended discussions are given in Masson (2007) who also considers the welfare implications of the interactions between the monetary and fiscal authorities.

²⁷ T=B (2003, p.16) also stated that “by lowering transactions costs and eliminating exchange rate uncertainty, currency unions might lead to greater specialization.” Mainly because of the

Glancing at the empirical quarterly time-series results provided by Karras and Stokes (2001) for 13 European countries' output correlations from 1961 to 1997, each country's correlation with Europe is positive for every country over the entire period. A decline in the correlation was observed during the late 1980s and early 1990s, and they attributed it to the economic consequences of the German unification and the EMS crisis of 1992. A rising trend seems to be observed for most of the countries from the second half of 1990s.

Shin and Sohn (2006) examined how trade and financial integration affects business cycle co-movements, price co-movements, and the extent of consumption risk sharing for 9 East Asian countries from 1971 to 2003. They found weak evidence of endogeneity in the sense that trade integration enhances output co-movements across countries.²⁸ Sato and Zhang (2006) employed the cointegration and the common features techniques to examine the long-run relationships in real outputs for 9 East Asian countries for the quarterly data from 1978 to 2004. They also found weak evidence of endogeneity, as some pairs of countries share both long-run and short-run output co-movements.

Since this endogeneity issue has some serious implications for economic integration and monetary union, we will come back to this important issue later in section 4.1.1.

(S-9) Volume of International Trade

It has been argued that "importance of commercial links between each pair of countries" (Eichengreen and Bayoumi, 1999, p.352) increases the desirability of stable exchange rates and monetary unification. Thus, if commercial link through international trade is strong, or if it is expected *ex ante*, it is a sufficient condition for monetary union.

This condition has also been known as time-varying, or endogenous in nature; for example, Rose (2000) found that, using data for a large number of countries between 1970 and 1990, bilateral trade was 3 times higher for countries using the same currency than those with their own sovereign monies. In a subsequent study, Rose and van Wincoop (2001, p.387) reported that "currency union is associated with an increase in trade of almost 400 percent." A similar estimate is obtained in F=R (2002). This is a striking finding, but this large trade enhancing effect (known as the "Rose effect") of monetary union seems to be robust, albeit more moderate increase than 3 or 4 times is reported in the subsequent studies (more than 2 times in Glick and Rose, 2002. See also T=B, 2003; B=T, 2007; de Grauwe and Mongelli, 2005). Even the harshest critics, Baldwin (2006a, p.48), admits that "the Rose effect is for real in Euroland".²⁹ As evident from the discussion so far, the "Rose effect" is concerned with a

latter reason, "the fluctuations in relative prices can lead to higher price co-movement". See also B=E, 1993. For a brief survey of European experience, see Artis and Fellow (2006).

²⁸ They also found that deeper financial integration weakly improves price co-movements, but does not enhance output or consumption co-movements at all.

²⁹ The literature on the effects of currency unions on trade is surveyed in Rose (2004), and Rose and Stanley (2005), summarizing that currency union has a positive effect on trade. Baldwin (2006a), however, strongly criticizes a series of empirical research by Rose and his

necessary condition for monetary union.

To the authors' knowledge, no compelling *theoretical* analysis has been presented to date to offer clear reason(s) and channel(s) as to why bilateral trade increases with the use of common currency, except Baldwin and Taglioni (2004). These last authors formalized a simple maximizing microeconomic model of a firm under exchange rate uncertainty, and derived a testable hypothesis that the effect of a reduction of uncertainty in the exchange rate on trade volume is larger as the volatility falls; i.e. the relationship between trade volume and the volatility (uncertainty) of the exchange rate is *convex*, and hence the Rose effect. They estimated the convex relationship using the same sample countries as M=S=O (2003) for the period of 1992-2002 with partial success. (See also Baldwin, Skudelny, and Taglioni, 2005).

It should be mentioned that most of those significant increases in bilateral trade have been confirmed from empirical research that assumes the "gravity model" without exception. Baldwin (2006a,b) discusses the characteristics inherent to the gravity equation in Rose (2000), and criticizes it by highlighting the possibility of an upward bias because of three sources: the omitted terms, a spurious correlation with US prices, and the mistaken measure for bilateral exports. It may be unimaginable that a decrease in transactions costs alone is entirely responsible for this large increase in trade (Baldwin and Taglioni, 2004). For example, F=R (2002, pp.442-3) alternatively suggest an eminently plausible explanation that "massive 'home bias' toward domestic trade" is reduced by a common currency (see also A=B (2001), p.382). Baldwin (2006a, p.63) highlights the international fragmentation of trade as a possible source of the Rose effect. Needless to say, these are only plausible explanations, and they point to other gravity variables such as common language, trade policy, and so forth, as possibly responsible for increases in trade volume.

It has been recognized that the volume of international trade between member countries in monetary union is also subject to an endogeneity problem mentioned in the previous sufficient condition (S-8). There seems to be at least two different, but somewhat related, sorts of endogeneity recognized in empirical research. We label the first endogeneity the "*cross-section endogeneity*", and the other, the "*time-series endogeneity (or simultaneity)*".

The first, cross-section, endogeneity is somewhat similar to the traditional issue of omitted

co-researchers because of the positive bias generated by the methodology (a gravity equation), the specification (a linear model), the endogeneity issue, and so on, and recommends the Flam and Nordström (2006) robust procedures for further research. Langhammer and Schweickert (2006, p.400) also survey the literature and mention some studies that found *negative* or insignificant trade effects, in spite of the lower trading costs resulting from declining real exchange rate instability in the EMU countries. They conclude that the empirical verification of the trade effects is subject to the time horizon, the control variables, the country sample, or the specification of the regression equation. This confirms that a fall in transactions costs is not the sole determinant of international trade, as the gravity model suggests. The latter model rather emphasizes geographic proximity (Baldwin and Taglioni, 2004).

variables in OLS estimation, as pointed out by T=B (2003) and B=T (2007). They recognize (pp.3-4) that the empirical work on the effects of currency union on international trade has been framed within the standard gravity equation model, and thus we have to be cautious about the “unmeasured characteristics” that will bias OLS estimates of the currency union effect. Specifically, countries that decide to join a currency union might also be more likely to foster integration through other means, for example, by encouraging the harmonization of standards to enhance competition and trade and by reducing regulatory barriers. Thus, it is apparent that they rest their model on the client-anchor (or hub-and-spoke) type of currency union, and postulate that “the bilateral trade between countries i and j depends on gravity variables for countries i and j but not on gravity variables involving third countries” (B=T, 2006, p.5).³⁰

The other, time-series, endogeneity (or simultaneity) concerns with the time-varying nature of the OCA criteria remarked earlier. To the authors’ knowledge, B=E (1994) is the first to point out the potential significance of endogeneity. In their empirical estimation the United States of America, which is “a smoothly functioning continental monetary union” (p.30), is divided into 7 regions to investigate the cross-region correlation of demand and supply disturbances. Using data from 1972 to 1989, they found differences in the correlations across regions, stating that those differences are “not necessarily exogenous”, but rather turn up “over time” (p.32; See also Karras and Stokes, 2001, and Fujiki and Otani, 2002).³¹ Subsequently, F=R (2002) recognized that, while monetary union stimulates international trade and hence leads to an increase in openness, this does not necessarily imply an increase in the growth rate or level of income (p.444). Rather, they point out the possibility of reverse causality from growth to trade over time, and thus this simultaneity would bias the estimation results by the gravity equation model. They also note that this simultaneity may depend on domestic (trade) policies, and thus the relationship between closer trade link and tightly correlated business cycles is subject to the famous Lucas critique (F=R, 1998, p.1023; Saxena, 2005, p.639). If the simultaneity actually results from this change in policy, it would be difficult, if not impossible, to cope with it (Baldwin, 2006a).

In order to deal with the first endogeneity bias, T=B (2003) and B=T (2007) adopted the Instrumental Variable (IV) method, in which they constructed the instrument variable as a

³⁰ T=B (2003, p.4) mention that *positive* bias results from those unmeasured characteristics such as “compatibility in legal systems, greater cultural links, better infrastructures for bilateral transportation and tied bilateral transfers”, but *negative* bias from “higher levels of monopoly distortions” may lead to higher mean markups or higher inflation rates. However, based on the underlying characteristics of the gravity equation, Baldwin (2006a, pp.33-34) is skeptical about the validity of their assumption.

³¹ Thus, this endogeneity depends partly on the speed of response to disturbances (p.32). Fujiki and Otani (2002, p.48) remarked that the endogeneity depends not only on economic conditions, but also cultural, historical, and political conditions. They also mentioned that “how quickly such endogenous changes in country characteristics occur is open to question”. See also Baldwin (2006a, Sections 4 and 5).

joint probability for all sample countries in adopting a common currency among 6 major, potential anchor currencies by a probit analysis with data from 1960 to 1997. From their IV estimation, their 2007 paper reports that currency unions significantly increase bilateral trade by about 2 times (p.12).³² Hence, their “results indicate that endogeneity is not the reason for the large effects found in the previous studies”.³³ As byproducts, they also found that currency unions significantly increase the extent of price co-movement, and they attributed it to “the decrease in nominal exchange volatility stemming from the use of a common currency” (p.19). In addition, they also found “the negative effect of currency union on the extent of co-movement of output that could reflect a positive effect of currency unions on *sectoral* specialization” (p.19, emphasis added).

A way out for the second endogenous bias issue was considered by F=R (2002) who resolved it with a traditional IV (or 2SLS) method (p.445) to investigate the effects of trade on income. Specifically, in the first stage they estimated bilateral trade equations with exogenous variables in a gravity model, and then in the second stage they aggregated the fitted values of bilateral trade across a country’s trading partners, and used it (“openness”) as the instrument for estimation of output equation. With the data set of 186 countries with observations of every 5 years from 1970 to 1995, they reported that “openness” through currency unions significantly increased trade volume by 3.9 times (p.442) and the steady-state per capita GDP by 1.6 times (p.450).³⁴

As we mentioned in the last condition (S-8), we will return to this endogeneity issue and discuss the consequences and the implications of the related findings for the development of monetary union in the future later in section 4.1.1.³⁵

(S-10) Gains from International Trade

The fact that countries are increasingly linked by international trade and possibly with different currencies implies that they gain from trade. Then, following the same reasoning as for the case of (S-1), the relative exchange risk with each currency is reduced, implying a fall in the transactions costs, *ceteris paribus*. Thus, the existence of gains from trade is a sufficient condition to make room for monetary union for those currencies.

³² They included the same language, geographic distance, a former or current colony of the anchor country, per capita GDP, population size, and so forth as the independent variables in their gravity equation. Since their estimated coefficient is 1.899, $\exp(1.899)$ means 6.68, i.e. monetary union enhances trade by 6 to 7 times.

³³ After several robustness tests, they reported that the estimated coefficient of currency-union effect on trades varies between 1.02 and 2.00 (p.16), implying that trade increases by 2.8 ($\exp(1.02)$) to 7.4 ($\exp(2.00)$) times.

³⁴ They also reported that currency unions significantly increase bilateral trade by more than 3.9 times (p.442).

³⁵ This endogeneity issue is related to the growing literature on business cycle synchronization. Most of the literature find a positive, strengthening business cycle linkage because of a common world factor. For recent studies, see, e.g. Otto, Voss, and Willard (2001), Imbs (2004), Kose, Otrok, and Whiteman (2003), and Baxter and Kouparitsas (2005).

As the previous sufficient condition (S-9) clarifies, bilateral trades would significantly increase per capita GDP, which means that gains from trade are reaped in the long-run from monetary unions and the gains in turn stimulate growth endogenously. F=R (2002) asked if the growth effect is materialized via a completely different channel which may also possibly enhance trade. Thus, it follows that if such a channel is found, it could be another sufficient condition for monetary union.

In most of the literature on currency unions the credibility benefits are emphasized as examined in condition (S-7) above. F=R (2002) looked for possible nontrade effects with several robustness tests, and drew the conclusion that the currency union effect on income comes through the trade route (*ibid.*, p.455).

Following Rose (2000), F=R (2002), and Rose and van Wincoop (2001), Aristotelous (2006) estimated an augmented gravity model with panel data for 11 EMU countries and 20 developed countries for the period 1992 to 2003. Although the previous literature examined the overall effects of EMU on trade at the EMU group level, Aristotelous (2006) analyzed the EMU effect on the bilateral trade of each EMU country separately. He statistically confirmed that the impact of EMU on bilateral trade is not the same for all EMU countries (p.25), and offered four possible sources for the observed difference: difference in trade composition, different level of economic development, different level of integration, and different degree of trade openness. Of the four sources, he inferred that the first two cannot be the sources, but the third one could be. Finally, he drew the conclusion that a country's degree of trade openness is the most likely source, which in turn is the result of three sufficient conditions for monetary union: the lower transactions costs (N-1 and S-1), reduced exchange rate uncertainty (S-4), and enhanced competition through greater price transparency (S-2). Thus his conclusion is completely in line with our survey up to now, because we have classified openness as a necessary condition, and the three possible sources for openness as sufficient conditions in the above.³⁶

Another possibility for the gains from trade through the elimination of exchange rate risk was examined by Allington, Kattuman, and Waldmann (2005) who investigated price dispersion of national CPI and 115 tradable products for 15 EU countries over the period 1995-2002. They found that, although the degree of price convergence has been modest, the price dispersion in many product categories significantly declined among the member countries, and the decline among them has been greater for the peripheral countries (i.e. Denmark, Finland, France, Greece, Ireland, Italy, Portugal, Spain, Sweden, and U.K.). These results suggest that the elimination of exchange rate risk is a dominant factor through which the Euro promotes cross-border arbitrage. However, the decline in price dispersion has not

³⁶ Fountas and Aristotelous (2005), using multivariate cointegration and error-correction models, investigated the volume of intra-European union exports for 8 EU countries and found the somewhat discouraging result that the EMS led to a *decline* in exports for 3 countries (but boosted exports for only 1 country).

markedly changed the relative share of intra-EU trade as indicated in Lane (2006).

(S-11) Productivity Convergence

Since the exchange rate is eliminated within a monetary union with a single legal tender, it can only be used to gain competitiveness against the "outs" (i.e. the third country). Therefore, the relationship between wages and productivity is one of the determinants in keeping the sustainable regional equilibrium, in terms of economic activity and employment, inside the union. If (the long-run) productivity paths of "ins" are divergent, they can only be offset by increasing wage differentials, something that could only be accomplished to a limited extent, especially for the short-run (see the necessary condition (N-2)).

Thus, productivity convergence among member countries constitutes another sufficient condition for the success of a monetary union besides macroeconomic policy coordination. Although the convergence hypothesis has been examined empirically in terms of per capita GDP, labor productivity or total factor productivity in the growth literature, to the authors' knowledge, it has been somewhat overlooked and disregarded as a sufficient condition for *monetary union*, except by a few researchers. Buiter and Grafe (2001, pp.31-36; 2002, pp.131-136) implied that, in order for the potential "ins" candidates to satisfy the inflation target (criterion) as a condition for stability (as required by the Maastricht Agreement), the growth rates of sectoral productivity across "ins" must converge, as the Balassa-Samuelson hypothesis dictates. Using the annual data of the Mercosur countries (a common market, see Jovanović, 2006; pp.684-689) from 1960 to 1999, Camarero, Flôres, and Tamarit (2006) found some support for the productivity convergence hypothesis among those countries, implying that some of the Mercosur members are candidates for a future monetary union. Sohn and Lee (2006) also conducted an empirical verification of the convergence hypothesis using the annual data from the Penn World Tables for the samples of European Union, NAFTA, AFTA and Mercosur. The estimation method was the system GMM, and the periods differed depending on availability of the data. Distinguishing the income convergence between the β -convergence (conventional convergence) and the accelerating convergence (resulting from economic integration), they confirmed not only the existence of the former convergence, but also the latter convergence in the long-run. This implies that a monetary union accelerates productivity convergence among members in the long-run.

Although Sohn and Lee (2006) interpreted that their empirical results were supportive for the neoclassical growth model, they gave no clear clues to the precise mechanism of how the convergence process is accelerated among member countries.

This completes our list of sufficient conditions for monetary union. Before leaving this section, we remind that, as remarked at the outset of this section, some of the conditions are satisfied *ex post*, even though they fail *ex ante*, because of endogeneity (Frankel, 1999). This signifies that all of the sufficient conditions sometimes give signs of necessary conditions for

monetary union. Section 4.1.1 discusses endogeneity and the related issues in greater detail.

2.2.2.b Increases in Costs

Although monetary union could be beneficial for member countries if all or some of the necessary and sufficient conditions are satisfied, it nonetheless entails costs. The costs are either direct or indirect in nature, and ranges from prohibitively high to negligibly low.³⁷ The following is the (non-exhaustive) list of important costs examined in the literature.

(C-1) Abandonment of Monetary Policy

(C-2) Asymmetric Shocks

(C-3) Real Exchange Rate Persistence

(C-4) Loss of Seigniorage

(C-5) Repurchase of Monetary Base

(C-6) Debt Deflation Risk

(C-7) Political Tension

(C-1) is the most obvious and hence widely recognized cost. This means that member countries lose direct control over national monetary policy, and hence prevents them from undertaking business cycle stabilization. For example, in some form of monetary union, there is no union-wide central bank that fulfills the function as the lender of last resort (LLR), and therefore the costs to deal with unexpected shocks are higher (Calvo, 2002).³⁸ A=B (2001) discussed the costs from macroeconomic aspects within the anchor-client framework.³⁹ As they emphasized, the cost from losing independent monetary policy is higher the less correlated the business cycle of the client country is with that of the anchor, as our sufficient condition in (S-8) in section 2.2.2.a implies. However, they mentioned that two types of co-movements matter to calculate the costs. As shown in T=B (2003) and B=T (2007), they examined the relative price and relative output movements in AR(2) models, and measure the extent of co-movements by the negative of the RMSEs. If both of them do not co-move, it implies that the costs rise from the monetary union. Using the data set from 1960 to 1997, they estimated the AR(2) equations by both OLS and IV methods and found that, while the

³⁷ Although some costs are just the other side of the same coin of benefits, we do not compare them with each other. For example, the costs (C-1) and hence (C-2), reflect the reverse side of the macroeconomic sufficient conditions (S-7) and (S-8).

³⁸ Calvo (2002) mentions that the preceding studies of the OCA fail to discuss financial issues, and offers some counterarguments to (C-1), (C-2), and (C-6) in support of dollarization for emerging market economies.

³⁹ They examined co-movements of output and prices, and asked if three currencies, the U.S. dollar, the euro, and yen, are potential nominal anchors. They found that, while yen does not look appealing as a potential anchor, the U.S. dollar could be an anchor for Canada, Mexico, most of the Central and South America, and the euro for all Western Europe and most of Africa.

extent of price co-movement significantly rises with the presence of a currency union, output co-movement tends to decline.⁴⁰

The second costs (C-2) of asymmetric shocks are a natural consequence of the costs (C-1). If member countries abandon independent monetary policies, they would experience difficulty once asymmetric shocks hit them (Calvo, 2002). For example, when an asymmetric shock that calls for depreciation of the real exchange rate hits a client country, but the shock has no effect on the anchor country, real depreciation will lower the price level in the client country without affecting the anchor country. This results in an increase in the unemployment rate if prices are downwardly inflexible in the client country. This is one of the costs from monetary union that could be avoided if the client country conducts its own monetary policy.⁴¹

When the autoregressive coefficient in an AR(1) regression for the (log of the) real exchange rate is estimated, a large value for monetary union (albeit marginally significant) is usually observed, implying that currency union membership increases persistence of real exchange rate. The slow adjustment of the real exchange rate is costly (C-3), because it implies a longer period of the balance of payment imbalance. (H=H=W, 2002).

Loss of seigniorage may also be a cost for member countries, if monetary union adopts a single common currency instead of national currencies. These costs (C-4) have been widely recognized in the literature (H=H=W, 2002; A=B, 2001, Calvo, 2002; Corbo, 2002; Berg and Borensztein, 2000; Obstfeld and Rogoff, 1996, among many others).⁴²

Although the cost (C-4) represents flow costs, (C-5) is regarded as stock costs when client countries adopt the single common currency of the anchor country as a legal tender, since they have to buy back the monetary base (Corbo, 2002, p.104). These costs could be potentially high if the large part of national monetary base consists of domestic credits extended by the national currency. Corbo (2002) mentioned that, for "countries with a record of poor monetary management and price stability, the cost could be worthwhile". The penultimate costs, (C-6), are mentioned in Calvo (2002) who emphasized that an unanticipated collapse in prices may lead to bankruptcies, even though the borrowing firms are efficient, under fixed interest rates. He believes that this Keynes-Fisher debt deflation is

⁴⁰ The latter decline in the output co-movement reflects sectoral specialization by currency unions (T=B, 2003, p.21; B=T, 2007, p.19).

⁴¹ It was implicitly assumed in the OCA literature that asymmetric shocks occur exogenously. However, using the data of bilateral imports of the EMU members from other countries, Sekkat and Mansour (2005) demonstrated empirically that exchange rate fluctuations (the euro against the US dollar) had different impacts across sectors. With this empirical fact, together with the pattern of observed industrial specialization in Europe, they concluded that the occurrence of *endogenous* asymmetric shocks within the euro area is expected. Also see section 4.1.1 later for further discussion on the endogeneity issue. A formal proof in reducing or offsetting the costs of monetary union by symmetric, equal, and positively correlated shocks is implied in Bayoumi (1994).

⁴² However, A=B (2001), Calvo (2002), Obstfeld and Rogoff (1996) all mentioned that these are not costs for society, but rather the redistribution by the anchor country to the client countries is the more important issue. H=H=W (2002) also consider these costs as negligible.

the most serious threat to monetary unions. Finally the seventh, (C-7) political tension, could be another threat to monetary unions. Although this threat could arise from a conflict of interests among member countries, H=H=W (2002) mention that even civil war is not excluded.⁴³

How can we order the importance of these costs? We believe the first (C-1), and hence the second (C-2), are the most important costs for monetary union. The third (C-3) is a cost, but we believe it may not be a crucial cost for members, simply because it must be borne equally by the partner countries as well. The costs (C-5) and (C-7) could be relatively high if it is actually incurred in the case of monetary union where a single common currency is adopted as the legal tender. Other costs should be counted cautiously, since they are either just potential threats with low probabilities, or they could be either high or low, depending on exogenous changes in e.g. economic, historical, cultural, or political situations.

3. Empirical facts of monetary union

Strictly speaking, the existence of (or new accession to) monetary union could be empirically justified if a hypothesis of the (present discounted value of) net benefits being non-negative is statistically accepted. However, to the best of the authors' knowledge, no single empirical study with an aim of establishing this non-negativity exists to date, and thus, whether monetary union or OCA gives rise to non-negative total net benefits remains elusive. We admit that the calculation of non-negative net benefits from empirical observation is difficult (Wyplosz, 1997, p.18), if not impossible, as empirical testing is undermined by the lack of agreed criterion to measure the *total* net benefits as a whole, the scarcity of appropriately defined data, and the difficulty to control for all relevant factors that may influence the costs and the benefits. Thus, empirical investigation has inevitably been directed to show whether only a *part* of benefits and costs, or the OCA criterion, is in fact at an "acceptable" level that could be loosely defined as the same or equivalent level of the existing monetary unions.⁴⁴

⁴³ H=H=W (2002) summarized the costs and benefits of monetary union in the preceding literature, and classified (C-1), (C-2), (C-4) in addition to (C-3) and (C-6) into the costs of monetary union.

⁴⁴ A recent example is Furceri and Karras (2006) who considered only "two particular determinants of benefits and costs" (p.26), i.e. the business-cycle correlation and the inflation bias for a sample of 30 European countries. They concluded that "the evaluation of net benefits" is particularly difficult (p.37), because of the two particular determinants indicating a "positive relation" (p.36). Another example is Hughes Hallet and Weymark (2006) who considered the costs of heterogeneity in (1) asymmetries in transmission of monetary and fiscal policies, and (2) difference in national preference for price stability, output growth, and income redistribution for 16 European countries. They found that the welfare costs can "be considered to be quite large" (p.143). Using the Generic Algorithm with a stochastic production function, Ghosh and Wolf (1994) estimated the cost of adopting a single currency for the United States and the then twelve EU members were 2.6% (p.13) and 2.5% (p.15) of the

Thus, most of empirical investigation to date has been motivated to find whether a group of countries can be candidates for a monetary union, or whether monetary union under examination could be interpreted as an OCA, or whether their particular "OCA index" (elaborated below) is statistically comparable with (or equivalent to) the existing monetary union such as the EMU (or the USA).⁴⁵ Specifically, the empirical works at the present stage may be classified into at least two broad directions of research. On one hand, many researches are concerned with whether business cycle synchronization (or co-movement of output and inflation) is shown within monetary union and/or the candidate countries. If synchronization is statistically vindicated for some countries or a group of countries, it implies that, according to the OCA theory, the cost of forgoing independent monetary policy after joining monetary union is lower, and therefore, those countries could be qualified as (potential) members of monetary union.⁴⁶

For example, Masson and Taylor (1993, p.17) mentioned several characteristics of shocks and emphasized the shock-absorption function of monetary union which "combines the *net* influence of several of the traditional criteria". B=E (1993,1994) considered whether shocks (or disturbances) are symmetrically distributed, with particular emphasis on macroeconomic sufficient conditions of benefits of stabilization (S-7), business cycle synchronization (S-8), and international trade (S-9), as well as on macroeconomic costs of forgoing independent monetary policy (C-1) and asymmetric shocks (C-2) examined above. They hypothesized that changes in both output and price are subject to two different shocks, one is the demand shocks and the other is the supply shocks, and that, while the former is temporary, the latter is permanent in nature. Using a structural VAR model to estimate changes in output and price for 11 EC countries and the 7 divided regions in the U.S.A. for the period 1960 to 1988, calculating the residuals, and recovering the unobservable shocks with the identification restrictions imposed by the aforementioned assumption of temporary nature of demand shocks, they found several interesting characteristics for the sample countries and regions.⁴⁷ Most importantly, they found that the supply shocks are larger in magnitude and less correlated across regions in Europe than in the U.S.A. This implies that "the European Community may find it more difficult, initially, to operate a monetary union than the United

total GDP, respectively. They also estimated that the expected outright benefits would be in the order of around 0.5% of the total GDP (p.10).

⁴⁵ Although both the EMU and the USA have been regarded as monetary unions, they are different in the degree of political integration viewed from an institutional and a functional dimension. As a consequence, they are different in the seceding possibility and an (automatic) income redistributive device (De Grauwe, 2006). See also Section 4.2.3 below.

⁴⁶ The degree of price convergence within the Euro area has been modest, as shown in Allington, Kattuman, and Waldmann (2005). This implies the persistence of a relatively wide differential in inflation rate, suggesting that fulfillment of the necessary condition, (N-7), may not be easy.

⁴⁷ The sample period for the latter study (B=E, 1994) is from 1963 to 1990 for European samples and 1972 to 1989 for the regions of the U.S.A.

States" (p.223).

On the other hand, another direction towards empirical verification focuses on the expected stability of the (real) exchange rate, predicted by several "OCA variables". A lower expected level of the estimated "OCA index" implies greater ability to forgo independent or flexible use of monetary policy, or the advantages of a flexible exchange rate. In their successive empirical studies, B=E (1997, 1999), "operationalizing" (p.762 in the former and p.351 in the latter) the OCA theory or the characteristics of monetary union more directly, constructed the "OCA index" as defined by the forecasted standard deviation of the nominal exchange rate. The index is assumed to be estimated (and forecasted) by the following sufficient conditions, and then forecasted: the difference in changes in output (i.e. synchronization of business cycles (S-8)), international link of trade (i.e. trade link (S-9)), difference in industrial composition (i.e. costs of forgoing monetary policy (C-1)), and country size (i.e. real exchange rate volatility (S-10)).⁴⁸ The underlying idea is to ask, under the assumption that those benefits and costs reflect the desirability of forming a monetary union to stabilize the nominal exchange rate, whether the European or East Asian countries (or any other group of countries) are as well integrated and thus considered as an existing monetary union, the U.S.A. Smaller values of the index would thus suggest that a group of these countries better approximates an OCA. It should be stressed that they never calculated (the present discounted value of) the net benefits from monetary union.

A vast amount of similar literature with different samples of monetary unions (country groups or regions), different estimation techniques, and different time periods has sprung up after these empirical studies.⁴⁹ For example, Buigut and Valev (2005), Hallwood, Marsh, and Scheik (2006), Saxena (2005) and Chaplygin, Hughes Hallet, and Richter (2006) all applied the technique employed by B=E (1993, 1994) to East African countries, South American countries, Asian countries, and ex-Soviet Union countries, respectively. They estimated a similar VAR model to compare the correlation coefficients of demand and supply (and sometimes monetary) shocks with those of European countries and the United States of America to see if the countries under investigation are candidates for forming a monetary union, with an implicit assumption that the EMU is an OCA or a monetary union.^{50 51} Chow

⁴⁸ A positive sign is expected for the coefficient of the first variable, since the smaller this variable, the more synchronized the business cycle is and thus the lower variability exchange rates exhibit. A slightly different but similar reasoning applies to a positive (the larger this is, the higher the variability of exchange rates), negative (the larger this is, the more stable the exchange rates), and positive coefficients (smaller a country is, the more gains from a common currency, i.e. the more stable exchange rates) are expected for the second, the third, and the fourth variable, respectively.

⁴⁹ For other empirical literature, see the surveys of recent empirical investigation on the OCA, e.g., Mongelli (2002) or Lafrance and St-Amant (1999). Fabella (2002, for Asian countries), and literature cited therein. Fidrmuc and Korhonen (2006) present empirical assessment of the literature based on the business cycle correlation between the Euroland and the CEECs.

⁵⁰ Saxena (2005) also considered the necessary conditions for the OCA examined earlier, i.e.,

and Kim (2003) and Ng (2002) augmented the VAR model by including a change in the world output, but otherwise applied a similar technique to consider if the south Asian countries and those belonging to the South Asian Association for Regional Cooperation, respectively, can be candidate for a monetary union, based on the same criterion of positive correlation coefficients of demand and supply shocks. Ward and Jayaraman (2006) considered the same issue with the same technique for 14 Pacific Island countries for the period 1979-2003, and derived a negative conclusion.⁵²

Although this empirical literature also “operationalizes” the theory of OCA, it is very disappointing to realize that they nonetheless could never calculate (the present discounted value of) the *whole* net benefit from a monetary union.⁵³ What they did find is that some benefits could be derived from decreases in the transactions costs and the volatility of nominal exchange rates from monetary union, which may possibly be only a small *part* of its benefits. However, we could find something positive in this literature, i.e., at least the rank (or equivalence) of desirability for a group of candidate countries in forming a monetary union could be judged from these literature, assuming that the European Union or the U.S.A. serves as a benchmark monetary union.

4. Feedback and Remaining Issues

This section is divided into two subsections. In the first subsection, the feedback issues including the endogeneity, economic policies and supra-national organizations, and implications for other prospective monetary unions are examined. The following second subsection considers the remaining issues, including changes in the welfare level, the optimal number of world currencies, and the future steps towards higher integration. Needless to say, this is not an exhaustive list of issues surrounding monetary unions, but only a short list of issues that may possibly have significant impacts on future research agenda.

4.1 Feedback issues

(N-3) international labor mobility, (N-5) openness, (N-6) diversification in production, (N-8) fiscal integration, and (N-9) geo-political integration. In examining (N-6) he calculated the Herfindahl index as a measure of specialization for each country.

⁵¹ Chaplygin, Hughes Hallet, and Richter (2006) considered non-contemporaneous correlations to investigate the possibility of a unilateral (but non-multilateral) monetary union among ex-Soviet Union countries with Russia. They augmented the structural VAR model with relative prices.

⁵² For further empirical assessment of this literature, see the discussions in the next section.

⁵³ Another proposal for “operationalizing” the OCA theory is to examine shock symmetry through the theory of generalized purchasing power parity (G-PPP) developed by Enders and Hurn (1994). A positive evidence of G-PPP can be interpreted as evidence that economic fundamentals across countries share a common stochastic trend, and hence that shocks are symmetric. This technique, however, masks the real economic factors responsible for G-PPP.

4.1.1 Endogeneity and the related issues

One problem inherent in the theory of OCA has been the endogeneity of the OCA criteria. As we have examined earlier in section 2.2.2.a, at least two different but related endogeneity have been examined in the literature. But what concerns most of the recent empirical research is centered on the “time-series endogeneity”: Whether monetary union facilitates more synchronization of business cycles (or outputs). Put differently, whether a country joining a monetary union “would satisfy the OCA criterion (in terms of the correlation between outputs) *ex post*, even though it fails *ex ante*” (Frankel, 1999, p.25, insertion added).⁵⁴

There are at least two “paradigms”, one is the “**Krugman specialization hypothesis**” and the other is the “**endogeneity of OCA hypothesis**” (Mongelli, 2002, pp.28-29). As is well-known by now, the first hypothesis which was put forth by Krugman (1991, 1993) postulates that, as countries become more integrated, their reciprocal volume of trade increases (macroeconomic sufficient condition (S-9)), implying an increase in the necessary condition (N-5) “openness”. The latter increase in turn encourages specialization of production in commodities, for which the exporting countries have a comparative advantage, and thus undermines the necessary condition of (N-6) “diversification”. Countries in a monetary union are vulnerable to asymmetric shocks because the correlation coefficient of outputs tends to fall.⁵⁵

On the contrary, the second hypothesis postulates that integration fosters a higher and positive correlation between members’ outputs, implying more synchronization of business cycles. The reasons for this lies in the most basic microeconomic (sufficient) conditions for OCA, a decrease in transactions costs (S-1),⁵⁶ more efficient allocation of scarce resources for economic growth (S-2), an increase in capital mobility through wider arbitrage opportunities in financial market integration (S-3), and a decrease in the real exchange rate volatility by more flexible wages and prices (S-4). All of them contribute to promote trade, and further integration and synchronization of outputs. Thus, according to this hypothesis, even if member countries fail to satisfy the OCA properties *ex ante*, they may satisfy them *ex post*, as mentioned before.

The two conflicting “paradigms” may be succinctly summarized as in the following Table 3.

⁵⁴ For a rather comprehensive survey of diverse endogeneity issues of monetary integration, see de Grauwe and Mongelli (2005).

⁵⁵ Dixit (2001, p.593) also summarizes succinctly that “more trade can create more specialization and therefore more asymmetric econometric structures and different susceptibility to supply shocks.” For the endogeneity aspect of asymmetric shocks, see the remark on (C-2) in section 2.2.2.b.

⁵⁶ Chaplygin, Hughes Hallet, and Richter (2006, p.56) mentioned that “a necessary and sufficient condition for low costs is both a high positive correlation between the shocks..., and shocks of similar size.”

Insert Table 3 around here

As stated at the beginning of Section 2, the conventional distinction between necessary and sufficient conditions for OCA is somewhat obscured because of endogeneity. As Table 3 shows, not only does (S-8) for business cycle synchronization appear, but also the rest of the sufficient conditions enumerated in Section 2 also appears successively as monetary integration proceeds, implying that they have the flavor of necessary conditions. An important implication derived from the endogeneity issue is the last column in Table 3. Kalemli-Ozcan, Sørensen and Yosha (2001), in their discussion of the welfare gains from monetary union, showed that the welfare level may be *higher (lower)* if business cycle synchronization (i.e. output correlation) is decreased (increased) for the "endogeneity of OCA hypothesis" ("Krugman specialization hypothesis"). Constructing a multi-country, intertemporal, CRRA consumption utility model with a consumption risk-sharing arrangement under uncertainty in state of nature and random walk per capita GDP with drift, they derived the country-by-country measure of fluctuations asymmetry as:

$$G^i = \frac{1}{\delta} \left(\frac{1}{2} \sigma^2 + \frac{1}{2} \sigma_i^2 - \text{cov}^i \right) \quad (1)$$

where δ is the intertemporal discount rate, σ^2 is the variance of the aggregate GDP of the group, σ_i^2 is the variance of country i 's GDP, and cov^i is the covariance between the aggregate GDP and the i 's GDP. One important implication is that the gains from sharing risk are higher for countries with a *lower* covariance. The interpretation is that countries with "counter cyclical" output provide insurance to other countries by stabilizing aggregate output and thus such countries are compensated accordingly in the income risk-sharing agreement (Demyanyk and Volosovych 2005).⁵⁷

Since there are no compelling theories to prove which of the aforementioned two hypotheses is correct (e.g. Kose, Prasad and Terrones, 2003), we have to seek the answer in empirical investigation.⁵⁸ Although most empirical researches have not explicitly investigated whether synchronization of business cycles (or correlation coefficients between outputs of monetary union's member countries) increases or decreases over time, but rather just mentioned the possibility of such endogeneity, there are a few important recent contributions on this empirical issue. According to the empirical study by Karras and Stokes (2001) mentioned earlier, the correlation coefficients of outputs seem to increase for most of their 13 European sample countries since the second half of 1990s, thus supporting the endogeneity of OCA hypothesis. However, B=E (1994), also mentioned earlier, found that

⁵⁷ In the empirical part of Kalemli-Ozcan, Sørensen and Yosha (2001), they demonstrated that OECD countries and US states with higher industrial specialization exhibit output shocks that are less correlated on average with aggregate OECD output and US output, respectively.

⁵⁸ A notable theoretical approach challenged with a NOEM model to show the "endogeneity of OCA hypothesis" is given by Corsetti and Pesenti (2002).

eight coefficients of correlation of supply shocks for the regions of the United States and Canada and for the United States and Mexico were significantly negative, lending statistical support for the Krugman specialization hypothesis. Using a large data set of 217 countries from 1948 to 1997 (used by Glick and Rose, 2002) T=B (2003) and B=T (2007), also mentioned earlier, found that the coefficients of correlation is also negative, but insignificant. This latter finding suggests that the specialization hypothesis seems to be weakly supported. Using sectoral data, Baldwin, Skudelny, and Taglioni (2005) and Flam and Nordström (2006) found that the introduction of the common currency Euro has not only significantly enhanced trade in Euroland (see the discussion on *the Rose effect* in section 2.2.2), but their sectoral investigation also reveals that the sectors with a Rose effect tend to be those marked by fairly non-homogeneous (or *specialized*) products (see Baldwin, 2006a,b).⁵⁹

Based on their recent empirical investigation of the statistical relationship between business cycle correlation and bilateral trade intensity using the European Union and Euro zone data (Frankel and Rose, 1998), Silvestre and Mendonça (2007) argued that the endogeneity of OCA hypothesis was supported. However, as they also remarked, such supportive evidence was only shown with the annual data up to 1985. In fact, from their OLS (Tables 6, 7, 11, and 12) and 2SLS (Tables 17 and 18) results, the definite conclusions could not be drawn for the data after 1986, because most of the estimated parameters were statistically insignificant. Some of the parameters were even negative, although insignificant, implying that the opposite possibility of "Krugman specialization hypothesis" seems to be more likely from the more recent experience in Europe.

Thus far, recent empirical finding seems to support the specialization hypothesis, but it seems to the authors that the significance of its implication has not been legitimately assessed in the literature. Below, we will explore the significance of empirical support for the specialization hypothesis and discuss its implications for the OCA theory.

First, we will examine what the empirical finding of specialization by integration implies for the theory of OCA within the framework of Krugman and Obstfeld (2003, pp.617-624; K=O hereafter) by modifying their theory with emphasis on specialization (see Figure 1).

 Insert Figure 1 around here

The upward sloping GG schedule shows that a country's monetary efficiency gains from joining a monetary union rise as the country's economic integration with the union rises. The U-shaped LL₀ schedule shows that a country's economic stability loss from joining a monetary union first falls as the country's economic integration with the union rises (see also Krugman, 1993, pp.244-245). But after the degree of economic integration passes the threshold level θ^* , the slope turns upward because of *specialization* in production that may have potentially

⁵⁹ As mentioned in section 2.2.2.a, however, Shin and Sohn (2006) and Sato and Zhang (2006) both found weak evidence of the "endogeneity of OCA hypothesis" for some East Asian countries.

undesirable side effects by asymmetric shocks, making the country vulnerable to them.⁶⁰ It is clear from the figure that, in between points A and B, gains exceed losses, and thus the country has an incentive to join the monetary union once the degree of integration reaches and passes θ_1 . However, once θ passes θ_2 , the country loses its incentive to stay the union, as losses exceed gains.

Let us consider here the effects of “an increase in the size and frequency of sudden shifts in the demand for the country’s exports” (K=O, 2003, p.662). Such a shock pushes the LL_0 schedule upward to LL_1 . Thus, the domain of θ where gains exceed losses shrinks to A' and B' .

We think at least two important messages can be deduced from the above analysis of the OCA theory with the aid of the modified Figure due to specialization. First, there are the lower and the upper bounds of the degree of integration for monetary union. Only when the degree of integration lies in between them, does a country have an incentive to join a monetary union. Thus, even if the degree of integration is higher, a country may find it beneficial to stay outside a (existing) monetary union. Second, when a country experiences an increase in size and frequency of asymmetric shocks, not only does a country within a monetary union with a *lower* degree of integration in between A and A' , but also countries with a *higher* degree in between B and B' , have an incentive to secede the union.⁶¹ Would it be meaningful to consider the degree of economic integration beyond θ_2 ? We will offer an interesting answer to this question in section 4.2.2, and now turn to another implication.

Secondly, we will also show that empirical support for the induced specialization by integration requires a generalization of the theory of OCA by Frankel (1999). Specifically, we will discuss and prove below that a modification of the slope of the “OCA line” defined by Frankel is necessary in a rigorous manner (see Figure 2).

 Insert Figure 2 around here

Frankel (1999) defined the uniformly downward sloping “OCA line” as reflecting a trade-off between the correlation of incomes and the extent of trade (openness). An example of the line is depicted and labeled as the “OCA line (z_0)” in Figure 2, signifying that the configuration depends on the degree of integration denoted by z_0 . Since the extent of trade (T) and the correlation of incomes (Y) both depend, in general, on the degree of integration (z), as suggested in the literature on the endogeneity of the OCA characteristics, the OCA line can be expressed in an implicit function form as:

$$B(T, Y, z) = 0 \tag{2}$$

Assuming that (2) can be solved explicitly for the degree of integration, z :

⁶⁰ In other words, beyond the threshold level θ^* , the increased loss from specialization dominates the decreased loss by integration. Artis and Fellow (2006, p.245) also briefly mention this possibility due to specialization.

⁶¹ A member country with the degree of integration beyond θ_2 or below θ_1 will secede the union. A=B’s (2001, p.384) case may correspond to the former. See also H=H=W (2002, p.304).

$$z = H(T, Y) \quad (3)$$

Thus, a combination of, or trade-off between T and Y corresponds to a particular degree of z.

For a given $z = z_0$, the trade-off between T and Y is derived as:

$$dY/dT = - H_T/H_Y \quad (4)$$

where H_T (H_Y) denotes the partial derivative of H with respect to T (Y), meaning the marginal cost for attaining z_0 in terms of Y (H). The trade off means that (4) is in general negative. Applying the inverse function rule yields:

$$\partial T/\partial z = 1/H_T, \quad \partial Y/\partial z = 1/H_Y \quad (5)$$

Upon substitution of (5) into (4) yields:

$$dY/dT = - H_T/H_Y = - [\partial Y/\partial z]/[\partial T/\partial z] \quad (6)$$

where $\partial Y/\partial z$ ($\partial T/\partial z$) means the marginal contribution of z for Y (T). It should be noted that, while $\partial Y/\partial z > 0$ for the “endogeneity of OCA” hypothesis, $\partial Y/\partial z < 0$ for the “Krugman specialization” hypothesis. Thus, it is formally proved that, as the degree of integration (z) increases, the slope of the OCA line turns to *positive* under the latter, specialization hypothesis, given $\partial T/\partial z > 0$.⁶²

In Figure 2, the OCA line is drawn when the degree of integration is initially z_0 . As the degree increases from z_0 to z_1 , the OCA line shifts outward, but its slope changes: it becomes steeper under the “endogeneity of OCA” hypothesis, but turns to positive under the “Krugman specialization” hypothesis. Thus, we can find from this modified figure that a potentially significant implication of the specialization is that a country, characterized by a combination of T and Y and represented by point X in the figure, will find itself more advantageous with monetary independence under specialization, as the degree of integration increases to z_1 . The situation also has some implications for the case mentioned in A=B (2001, p.384) in which the country may secede the monetary union because of smaller marginal benefits from politically large integration.

4.1.2 Breaking Up (Unsustainability)

A somewhat related issue to endogeneity is the possibility of the break up of monetary unions. The possibility inferred from a variety of reasons has been mentioned in the OCA and the related literature. They are: Smaller marginal benefits from politically larger integration (A=B, 2001), disagreement over the common inflation rate and fiscal problems (Mundell, 2000), political tensions, possibly resulting in civil war (H=H=W, 2002; Thom and Walsh, 2002), differences in industrial structure (Hughes Hallet and Piscitelli, 2002), and specialization (Frankel, 1999).

Aristotelous (2006) found that some European countries (Austria, France, and Greece)

⁶² Under the “endogeneity of OCA” hypothesis, the curvature of the OCA line is shown to be in general concave. However, if the sign of $H_{TY} \equiv \partial^2 H / \partial Y \partial T$ is positive and large enough to make $d^2 Y / dT^2 > 0$, then the OCA line is convex to the origin.

have not gained from reciprocal trade by joining the EMU. This implies that the effect of EMU on their trade to the euro area is detrimental. As suggested earlier, K=O's (2003) analysis of specialization implies, although not explicit, that a large sudden demand shock may be a source for a member country to secede monetary union. Along the Frankel's (1999) analysis of specialization, our second analysis in the previous subsection may have a similar implication as that of K=O (2003).

Although, according to A=B (2001, p.384), the Euroland has almost been at the point where member countries may not benefit from a larger political union, we find that an integration-openness(trade)-specialization nexus in the endogeneity (specialization) of the theory of OCA is an important possible source of unsustainability in monetary union.⁶³

Then, the next question is from where such specialization arises. Hughes Hallet and Piscitelli (2002) constructed a simple two-country dynamic model for consumption and production, and found that the correlation of outputs (or incomes) falls if a country increases the import rate when the level of the country's imports is already high. Their analysis emphasized the importance of size, implying that "large, stable, well integrated economies" are likely to exhibit a fall in the correlation of outputs, i.e. specialization, but "small, volatile and less well integrated economies" are likely to exhibit a rise in the correlation. This theoretical proposition is an empirical subject to be statistically vindicated in the future.

Krugman (1993), T=B (2003), and B=T (2007) identified another possible source of specialization. If reciprocal trade is more heavily concentrated on *inter-industry* rather than *intra-industry* level, then, to the extent that shocks are industry specific and common to all countries concerned, specialization between industries will lead to less co-movement of shocks, i.e. a fall in the correlation of outputs. The reason that this could be a possible source of the break up of monetary union is clear, since concentration on inter-industry trade would be incompatible with the necessary condition (N-6), diversification. This seems to be another promising subject to be empirically clarified.

4.1.3 Economic Policies and Supra-National Institutions

The autonomy of independent monetary policy is sacrificed by joining monetary union, and monetary policy is centralized by a single central bank. As a consequence, the responsibility of union-wide monetary policy rests on a supra-national institution, e.g. the European Central Bank (ECB) in the Euroland (see De Grauwe, 2003; chaps.6-8; Baldwin and Wyplosz,

⁶³ Eichengreen and Razo-Garcia (2006) concluded that, based on their forecast by a Markov chain model, "no country that joined EMU since 1999" will leave by 2025. The economic reasons behind their conclusion are not clear, since the forecast only depends on transition probabilities, with the assumption that the past is a guide to the future. However, they also pointed out the possibility of the dissolution of the Euroland with a citation of an Italian Welfare Minister's statement that Italy should consider leaving the single currency and reintroduce the lira (*Reuters*, 3 June 2005).

2004, chaps. 14-15). Then, flexible use of fiscal policy, that is still decentralized (or nationalized, but sometimes regionalized) is called for to cope with unexpected negative asymmetric shocks as the only available policy instrument left (De Grauwe, 2003, p.222).⁶⁴ Several interesting issues surrounding economic policies and the supra-national institutions such as the characteristics of the ECB, stabilization policy under asymmetric shocks, evaluation of the Stability and Growth Pact (SGP), etc. have been examined; see De Grauwe (2003), Baldwin and Wyplosz (2004), von Hagen and Brückner (2002), H=H=W (2002) and the literature cited therein.⁶⁵

For the EMU as a monetary union, although the government budget deficits and the government debts have been subject to the “convergence criteria” agreed by the Maastricht Treaty, fiscal policy has still been decentralized with only a relatively limited role played by the European Commission.⁶⁶ In this sense, there has been no full-fledged supra-national institution for fiscal policy in the EMU. Indeed, if the EMU has such a supra-national institution for fiscal policy, it should be labeled as a fiscal union. Thus, the lack of such an institution follows from the definition of monetary union, as summarized in Table 1. Then we can return to the old question of, to what extent fiscal policy should be centralized in monetary union (Kenen, 1969).

According to the “debt dynamic problem” for convergence of the ratio of the government debt to GDP (see De Grauwe, 2003, chap.9 and Baldwin and Wyplosz, 2004, chap.14), the government budget constraint, $\dot{b} - (r - x)b = g - t$, is solved for the debt/GDP ratio, denoted by b as:⁶⁷

$$b_t = \left[b_0 - \frac{g - t}{x - r} \right] e^{-(x-r)t} + \left(\frac{g - t}{x - r} \right) \quad (7)$$

where x is the (constant) growth rate of GDP, r is the (constant) interest rate, $g = G(\text{government expenditures})/\text{GDP}$, and $t = T(\text{tax revenue})/\text{GDP}$. The necessary *and* sufficient condition for convergence of b is $x > r$, *regardless* the sign of the first bracket term. Thus, in the long-run, the growth rate of GDP must exceed the interest rate. Even if $g - t < 0$ (as

⁶⁴ Given decentralized national fiscal authorities, an interesting analytical examination of monetary union is presented by Masson (2007, chapters 6 and 7). Using a traditional static Barro-Gordon model, he considers a welfare problem of new accession to monetary union by monetary and fiscal policies. The welfare criterion is expressed by the trade volume with monetary union and financing need. However, international income risk sharing and hence dynamic consideration are disregarded.

⁶⁵ For a review of recent literature on the issues of interaction between monetary and fiscal policies in a monetary union, see Beetsma and Debrun (2004) and the literature cited therein.

⁶⁶ H=H=W (2002, p.306) mention that fiscal rules in monetary unions are necessary, but that does not imply a formal SGP. They also note that the SGP is sufficient to maintain a monetary union. For the reform of the SGP, see, e.g. Heipertz and Verdun (2005) and De Grauwe (2003), pp.240-244.

⁶⁷ The monetary financing is disregarded, because it “constitutes such a small part of the financing of the government budget deficit in the European countries” (De Grauwe, 2003, p.225).

suggested by De Grauwe) at some point in time, it may not be possible to prevent b from exploding, unless $x > r$. Only if fiscal policy and monetary policy together are managed to bring $x > r$, does b converge in the long-run.⁶⁸

Since a continuous increase in the debt-GDP ratio would have two negative “spillover effects”, one on other member countries and the other on the ECB (De Grauwe, 2003, p.230), some restrictions on it are imperative. The bottom line of equation (7) shows that appropriate policy mix is necessary for each member country to maintain $x > r$ to bring down b to an acceptable level as agreed by the Maastricht Treaty or the SGP. The European Council agreed to a reform of the SGP for a temporarily flexible use of the rule imposed on the upper limit of b , but we should look at the other side of the government budget constraint, i.e. the tax and the transfer systems. If the government budget is centralized too far, as the OCA theory suggests its desirability, then the social security system including the unemployment benefits system may create a moral hazard problem for the inter-regional transfers. According to the necessary condition (N-3) for OCA, harmonization of the social security system to some extent is desirable for factor mobility in monetary union to cope with temporary shocks. However, ironically, limited centralization is sometimes proposed for its effectiveness, simply because of low labor mobility and (downward) inflexible wages in Europe (De Grauwe, 2003, chap. 9). Thus, the problem raised by Kenen (1969) has not yet been resolved.

4.1.4 Prospective Monetary Unions

This subsection, divided into two parts, summarizes what we have learned from empirical investigation of prospective monetary unions.

4.1.4.a OCA for Asia

After the publication of the seminal paper by B=E (1994) which “operationalized” the OCA theory for empirical implementation, similar articles with similar motivations have sprung up, with samples of different groups of candidate countries and different time periods. Since the possibility of the Asian monetary union has been discussed extensively in several comparable empirical studies (see, e.g. de Grauwe and Zhang, 2006), we will focus on this

⁶⁸ The optimum combination of monetary and fiscal policy in monetary union has attracted theoretical attention. For example, Benigno (2004) and Beetsma and Jensen (2005) constructed a two-country optimizing model with sticky prices (i.e. New Open Economy Macroeconomics model) for monetary union and investigated the efficient policy, the optimal inflation targeting policy, the first best optimal policy, and fiscal policy under various rules and prices (flexible or sticky). Dixit (2001) provides several simple but interesting examples of interactions between the common market policy, the exchange rate policy, and domestic fiscal and monetary policies to assess the costs and the benefits of Economic and Monetary Union in game theoretic models. We are deterred from surveying this literature, as such research has been under way.

literature and present our assessment.⁶⁹ Table 4 summarizes these empirical literatures which investigated whether some of the Asian countries could constitute a monetary union according to the OCA theory.

Insert Table 4 around here

A quick glance at the table implies, as is usually the case for most empirical literature, that the possibility of an Asian monetary union is at best mixed. Eichengreen and Razo-Garcia (2006) summarized that comparisons of the symmetry of disturbances and labor mobility (N-3) between Europe and Asia do not point to significant differences. With more recent data, however, the OCA criteria are unlikely to be satisfied, although they seem to have “progressively approached European levels of integration” (Larrain and Tavares, 2003, p.47). Only a subset of South Korea and Japan seems to be promising candidates for an Asian monetary union to date. However, according to a simulation study by parametrizing the social loss functions with the inflation rates and the levels of unemployment for 1981-1996, Kim, Ryou, and Takagi (2005) found that, while Korea always benefits from monetary integration with Japan, the latter does so only if the monetary union is asymmetric, i.e., the integration is a peg to a common basket or yenization. Thus, they concluded that Japan otherwise prefers some monetary autonomy.

A warning about the empirical literature examined above is concerned with the data themselves. According to the OCA theory (e.g. Eichengreen and Bayoumi, 1999), the variability of the officially announced exchange rate is regressed by the so-called OCA variables to examine the effects of asymmetric shock (and others such as trade, size, etc. See the sufficient condition (S-4) in Section 2.2.1.b.). However, most of the East and the South East Asian countries before the Asian currency crisis from 1997 have had a perfectly fixed, crawling peg, or a heavily managed floating exchange rate system. Thus, the exchange rate variability for the OCA Index should be estimated with caution, because the OCA variables (i.e. regressors) do never account for these policy-related decisions by the monetary authorities. Since the official exchange rates are somewhat arbitrarily determined under the fixed system, it is unlikely that they correctly reflect the fundamental determinants. Under those systems, the exchange rate variability may show the effects of a wider range of policies by the authority, including intervention necessary to maintain *orderly* conditions in the markets.

⁶⁹ For similar empirical literature on the OCA theory for CEEC countries, see Kozluk (2005), Bénassy-Quéré and Lahrière-Révil (2000) and Furceri and Karras (2006); for African countries, see Buigut and Valev (2005) and Fielding and Shield (2005); and for Latin American countries, see H-S (2002) and Hallwood, Marsh and Schreibe (2006). Only a small number of empirical literature, compared with Asian samples, precludes comparison for African and Latin American regions. Langhammer and Schweckert (2006) presented a survey of the literature on growth and trade creation effects of EU integration on Asian countries. A rather comprehensive survey of empirical literature on business cycle correlation for CEEC countries is given in Fidrmuc and Korhonen (2006).

Thus, ideally, the sample exchange rate for regression of the OCA index is market determined, and fortunately it is available for some Asian countries, known as a black market (or parallel) exchange rate.⁷⁰ Along with this line of thought, an important attempt was made by Gounder and Sen (2002) who tested a null hypothesis that inter-linkages between exchange rate markets are independent from capital and commodity market liberalization in selected Asian countries. Using a Vector Error Correction Model with monthly observations from January 1970 to December 1985 for 5 economies (Indonesia, Malaysia, Philippines, Thailand, and Hong Kong), they failed to reject the null. Their finding suggests that there has been “a greater integration amongst foreign exchange markets” and this in turn implies “stronger co-movements between these markets, with shock to one market being transmitted rapidly to other markets in the region” (p.725). In other words, the Asian foreign exchange markets have long been integrated in the sense that they have been subject to symmetric shocks, known as *contagion* (or *spill-over*) effects. We conjecture that an estimation for the OCA Index with the variability of market determined exchange rates as the regressand would give us a significantly different picture, and in this regard, such estimation would be a promising future research possibility.⁷¹

A somewhat different implication has been derived from a different approach originally considered by B=E (1994) with the structural VAR model to examine the shock similarity for the OCA criterion. They analyzed the correlations of supply and demand shocks in East Asia with the VAR model. The identification methodology rests on an AD-AS model with the assumption that supply disturbances affect long-run output and prices, while demand disturbances only affect long-run prices. Thus, they interpreted that a high correlation in disturbances implies that the countries in question experience symmetric shocks and hence a monetary union between them would likely impose lower costs. Based on the correlations of supply disturbances, they revealed that three groups of Asian countries are qualified to form monetary unions, since their correlations are comparable with those for Europe: (1) Taiwan and Hong Kong, (2) Japan and Korea, and (3) Singapore, Malaysia, and Brunei. Bayoumi, Eichengreen, and Mauro (2000) updated the B=E's estimation for the period from 1968 to 1998 and concluded that there is a reasonable correlation between a group of three countries (Indonesia, Malaysia, and Singapore), and thus they are candidates for a monetary union. Their conclusion is based on their finding that the level of correlations of supply shocks as experienced by Asia is again similar to that for Europe. However, they mentioned that, while the speed of adjustment is much faster, the size of disturbances is larger in Asia. They conjectured that the reason for the faster adjustment is due to the region's more flexible labor

⁷⁰ A black market (or parallel) exchange rate is defined as unofficial, usually illegal, price of a particular currency in terms of the US dollar (Gounder and Sen, 2002, p.726).

⁷¹ Chaplygin, Hughes Hallet, and Richter (2006, p.65) state that, for countries with inflexible markets, “the extension of black market activities may be the biggest factor working towards the possibility of currency union.”