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Is Slovakia making headway towards constituting an OCA with the EMU?

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Declaration

I hereby declare that this diploma thesis entitled with

"Is Slovakia making headway towards constituting an OCA with the EMU?"

is my own work, except where explicitly stated otherwise

in the text or in the bibliography.

Prague, 17th November 2006

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Author's signature

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ABSTRACT

The goal of this diploma thesis is to assess the suitability and readiness of the Slovak Republic to adopt a single European currency. In analyzing the costs and benefits relating to Slovakia's accession to the European Economic and Monetary Union, this thesis is guided by the theory of the optimum currency areas (OCA).

The thesis provides a survey of the optimum currency area theory, estimate the degree to which variables pointed by the OCA theory help to explain patterns of exchange rate variability, and finds that the traditional OCA criteria explain the dynamics of exchange rates to a large extent. The thesis attempts to measure some of the optimum currency area indicators and calculate OCA index for the case of the Slovak Republic. The results suggest that Slovakia fulfils the necessary condition for joining the monetary union, i.e. it is relatively well aligned with the euro area, implying that the costs of euro adoption in Slovakia may be relatively low. From a long-term prospect, advantages of euro adoption significantly prevail over disadvantages. The diploma thesis concludes that Slovakia is relatively suitable and well-prepared to join the euro area in 2009. With economic policies appropriately set, there are no serious obstacles against the euro introduction in Slovakia.

Though the findings do not fully confirm that the Slovak Republic already constitute an optimum currency area with the EMU at present, it seem to be making headway to fulfil the OCA criteria to the same degree as old EU Member States in the future.

Keywords: Optimum Currency Area, Monetary Integration, Slovak Republic, Euro adoption, OCA index, convergence, exchange rates.

ABSTRAKT (IN CZECH)

Cílem této diplomové práce je zhodnotit vhodnost a připravenost Slovenské Republiky pro přijetí jednotné evropské měny. Analýza nákladů a přínosů souvisejících se vstupem Slovenské Republiky do eurozóny se opírá o teorii optimálních měnových oblastí (OCA – Optimum Currency Area Theory).

Diplomová práce poskytuje přehled teorie optimálních měnových oblastí, v empirické části zkoumá schopnost OCA charakteristik předpovídat variabilitu měnových kurzů, a pomocí regresní rovnice konstruuje tzv. OCA index pro Slovenskou Republiku, který indikuje míru připravenosti ekonomiky na přijetí společné měny. Výsledky potvrzují značnou schopnost tradičních OCA charakteristik vysvětlovat dynamiku měnových kurzů. Na základě podrobného testování základních OCA kritérií je přijat závěr, že Slovenská Republika splňuje nezbytnou podmínku pro vstup do eurozóny, tj. ekonomika je relativně dobře sladěná s členskými zeměmi eurozóny, což implikuje relativně nízké náklady z přijetí eura. Diplomová práce dospívá k závěru, že z dlouhodobého hlediska výhody z přijetí eura výrazně převyšují nevýhody. Při správném nastavení všech politik by Slovenská Republika měla být relativně dobře připravena a schopna přijmout euro (v roce 2009) bez závažných problémů, plně využít jeho výhody a omezit nevýhody.

Výsledky potvrzují, že Slovenská Republika v současnosti nevytváří optimální měnovou oblast se zeměmi eurozóny, ale v budoucnosti můžeme očekávat splnění OCA kritérií srovnatelné s úrovní členských států EU 15.

Klíčová slova: optimální měnová oblast, měnová integrace, Slovenská Republika, zavedení eura, OCA index, měnové kurzy, konvergence.

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List of Abbreviations

CEECs	-	Central and East European Countries
CPI	-	Consumer Price Index
DOTs	-	Direction of Trade Statistics
EMU	-	European Economic and Monetary Union
E(M)U	-	EMU and/or EU
ERM (II)	-	Exchange Rate Mechanisms
EU	-	European Union
EU 15	-	Austria, Belgium, Denmark, Germany, Greece, Finland, France, Ireland, Italy, Luxembourg, Portugal, Spain, the Netherlands, United Kingdom
EU 25	-	EU 15 and Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia
FDI	-	Foreign Direct Investment
GDP	-	Gross Domestic Product
HCPI	-	Harmonized Consumer Price Index
IFS	-	International Financial Statistics
IMF	-	International Monetary Fund
NACE	-	Classification of Economic Activities in the European Community
NBS	-	National Bank of Slovakia
OCA	-	Optimum Currency Area
OECD	-	Organization for Economic Cooperation and Development
OLS	-	Ordinary Least Squares estimation
PPP	-	Purchasing Power Parity
SD	-	standard deviation
SITC	-	Standard International Trade Classification
SDY	-	business cycle synchronization
VAR	-	vector autoregression

1 Introduction

After the transformation of the Slovak economy into market economy and its accession to the European Union, a successful integration of the Slovak Republic into the European Economic and Monetary Union (EMU) is among the ultimate goals of the current monetary policy. Introduction of the European currency – euro – will represent the largest integration step in the coming decade, affecting all the inhabitants of Slovakia, bringing both benefits and costs.

Since no single path towards full monetary integration with the European Union (EU) can be identified or recommended, the appropriate time of euro adoption depends on the specific characteristics of each individual country. In this respect, convinced that the advantages of euro adoption will significantly prevail over disadvantages, the Slovak government together with the National Bank of Slovakia has set year 2009 as a target date for euro area accession, thus putting Slovakia ahead of its Central European neighbours.

Replacing a country's national currency is largely irreversible move; the timing and conditions of entry have far-reaching consequences. Thus, legitimate questions of economic consequences of a "too early" accession arise, as a conflict between strong adherence to the fulfilment of the nominal convergence criteria – thus "too early" euro adoption – and the process of catching-up in the income-per-capita and productivity levels with the old European Union member states may be seen.

In answering these questions, I investigate the readiness of the Slovak Republic to permanently fix the currency to the euro. I do so by analyzing Slovakia's convergence to euro area countries from the point of view of structural convergence based on the theory of optimum currency areas (hereafter referred to only as OCA). The traditional OCA criteria are employed in order to assess whether the theory suggest a case for fixing the koruna to euro.

The thesis is structured in the following manner. After this brief introduction, in the second chapter Slovakia's nominal convergence, real convergence, and non-exchange rate mechanisms of adjustment are briefly touched on. Though there are considerable advancements in nominal convergence, with a real possibility of meeting all Maastricht

criteria by the end of 2007 or the beginning of 2008, the Slovak Republic is still lagging behind in terms of real convergence with the income-per-capita and productivity levels still low relative to the euro area. Furthermore, well functioning non-exchange rate means for adjustment to real asymmetric shocks such as labour mobility, fiscal redistribution, and wage and price flexibility need to be established, since they are available only to a limited extent. Since monetary policy will lose its independence, strengthening the flexibility of economy and the role of fiscal policy is required for a successful functioning within the monetary union.

The third chapter defines an optimum currency area and presents a survey of the OCA theory and its criteria. Though the notion of an OCA was first formulated in the 60ties by Mundell, the OCA theory has become popular only recently, particularly due to the analyses of the benefits and costs of monetary integration mainly with reference to the EMU. Since the 60ties the OCA theory has evolved into a complex theory and significantly contributed to the theory of monetary integration.

The fourth chapter starts with the list of the main permanent and one-off costs and benefits associated with a currency area and then presents the summary of the estimated effects of the euro adoption on the Slovak economy, based on the study 'The effects of euro adoption on the Slovak economy' elaborated by the National Bank of Slovakia in 2006, which has come to the conclusion that the final effect of euro adoption on the Slovak economy will be positive. The section then introduces Krugman´s (1990) simple GG-LL model that can serve as a cost-benefit representation of the OCA criteria. Thereafter, the overall effect of trade integration on shock symmetry is discussed from the two alternative viewpoints: the modern "endogenous view" of the OCA theory and the "Krugman specialization hypothesis." The chapter also presents some views on the euro area as an OCA and comes to the conclusion that only certain parts of the euro area meet the set criteria.

The fifth chapter describes the data and empirical methodology, as well as possible methodological problems of measurement. The sixth chapter applies the OCA theory to the case of the Slovak Republic by providing discussion on the evolution of the traditional OCA criteria in time, thus enabling us to better evaluate the degree of structural convergence of Slovakia to the E(M)U. Applying this approach to the Slovak Republic, the costs of joining

the Eurozone, in terms of macroeconomic policy independence foregone, are balanced against the benefits, which are directly related to transaction costs in countries' bilateral trade.

The seventh chapter starts with an illustration of the methodology of Bayoumi and Eichengreen (1997a,b and 1998a), which is used to analyse the determinants of bilateral exchange rate volatility for 20 developed countries. Following the methodology of Bayoumi and Eichengreen (1997a,b and 1998a), I find that the traditional OCA criteria explain the dynamics of exchange rates to a large extent. This being the case, I make use of them in constructing and estimating a compact measure of the readiness of the Slovak economy to adopt a common European currency ("OCA index"), which is elaborated in the next section. The results indicate that the Slovak Republic is relatively well aligned with the euro area countries, with the higher degree of structural convergence than that of the EU "peripheral" countries prior to their euro adoption.

The last chapter concludes and draws policy implications. Annexes with some additional results and description follow.

Overall, the results suggest that the Slovak Republic fulfils the necessary condition for joining the monetary union, i.e. it is relatively well aligned with the euro area, particularly in terms of its trade integration, similarity of export commodity structure and openness. Synchronization of business cycles is currently not very high; however, in the future an increased symmetry can be expected as the trade with euro area countries will develop fast, in particular intra-industry trade. This represents a sound base for business cycle convergence and approximation of the structure of the Slovak economy to the core of the euro area and thereby for a fulfilment of OCA criteria in the medium and long run. On these grounds, I may conclude that the costs of euro adoption in the Slovak Republic should be comparable to the costs within euro area countries. The findings imply that there are no serious obstacles against the euro introduction in the Slovak Republic.

However, appropriately set economic policies are inevitable for the full utilization of potential benefits and for limiting costs from euro adoption.

2 Nominal convergence, real convergence and non-exchange rate adjustment mechanisms

Thanks to recent far-reaching reforms the Slovak economy has evolved into one of the most competitive in Central and Eastern Europe. After having lagged in reforms behind its neighbours for most of the 1990s, the Slovak Republic was recently classified as the world's top reformer of its investment climate over the past 12 months.[1] It is commended mainly for its comprehensive tax and social welfare reform, public finance reform, and new regulations for the product, labour and capital markets, combination of which has reduced the time required to start a business, recover debt, and gain access to credit, improved legal rights, and has increased the pace with which the Slovak Republic is catching up to the living standards of wealthier countries.

As mentioned above, after the transformation of the Slovak economy into market economy and its accession to the European Union on May 1, 2004, a key objective of the Slovak Republic is to join the European Economic and Monetary Union. Euro introduction will represent the largest integration step in the coming decade, affecting all the inhabitants of the Slovak Republic.

With the status of 'Member State with derogation', the Slovak Republic is expected to follow macroeconomic policies consistent with the ultimate adoption of the euro. Thereafter, the question of sharing a common monetary policy emerges. Would it be beneficial for the Slovak Republic to join the Eurozone '*as soon as possible*', or to postpone adoption of the euro for a number of years? Obviously, there is no single path towards full monetary integration with the EU identified or recommended. The appropriate time of euro adoption depends on the specific characteristics of each individual country and thus country strategies have to be assessed on a case-by-case basis. In this respect, convinced that the advantages of euro adoption will significantly prevail over disadvantages, the Slovak government together with the National Bank of Slovakia has set year 2009 as a target date for euro area accession, thus putting Slovakia ahead of its Central European neighbours.

[1] World Bank (2004), In: Oomes (2005).

Specific characteristics of the Slovak economy will inevitably influence the policy path towards full monetary integration and its subsequent experience within the euro area. The reform process remains uncompleted, and the Slovak Republic is confronted with a number of serious challenges to continued success. Three key challenges may be identified: first, achieving a high degree of nominal convergence; second, establishing well functioning adjustment mechanisms; and, third, policies supporting economic growth in order to close the income-per-capita gap with the 15 EU Member States (EU 15).

2.1 Nominal convergence

A crucial precondition for euro adoption is the fulfilment of all Maastricht criteria on a healthy and sustainable basis, which require convergence in inflation, interest rates, exchange rates, government deficit and debt towards the EU averages. According to the predictions of the National Bank of Slovakia, all Maastricht criteria should be met by the end of 2007 or the beginning of 2008.[2]

The Slovak Republic has been able to achieve a high pace of nominal convergence in recent years. Slovakia has been already meeting two convergence criteria: the criterion for the level of long-term interest rate and the criterion regarding the level of government debt (34.5 % of GDP in 2005).[3] The criterion of the long-term interest rate has been quite long fulfilled and according to the estimates of the National Bank of Slovakia (2006) this criterion will be fulfilled also in 2006 and 2008. Government debt does not pose any risk either.

The fulfilment of the required Maastricht criteria requires the consolidation of the budget (in order to maintain the deficit under 3 % GDP), reduction of average inter-annual inflation under the reference value and the exchange rate stability within the Exchange Rate Mechanism II (ERM II).[4] Following the official documents of the National Bank of Slovakia, the Slovak Republic will be able to fulfil these criteria. Moreover, further progress in the real convergence is also a fundamental precondition for the fulfilment

[2] National Bank of Slovakia (2006): The Effects of Euro Adoption on the Slovak Economy.
[3] Source: Eurostat.
[4] National Bank of Slovakia (2006): The Effects of Euro Adoption on the Slovak Economy.

of the convergence criteria. Particularly, current fast economic growth based on the growth of productivity and competitiveness should be sustained.

The Slovak Republic has joined ERM II on 28 November 2005 and till the end of 2005 the nominal exchange rate remained within the appreciation zone. The condition of two-year membership in ERM II will have been fulfilled until 2007.

In 2005, the fiscal criterion was fulfilled for the first time, when general government deficit accounted for 2.9 % GDP. However, the level of general government deficit should decrease in the forthcoming years so that the fiscal criterion is fulfilled also including the pension reform effects.[5]

The Slovak Republic has made remarkable process in lowering high and volatile inflation rate to lower levels. The criterion of price stability is expected to be met until 2007, when the average inflation measured by harmonized CPI index should fall to 2.9 percent.[6] Despite good progress towards fulfilling the Maastricht criteria, some risks remain: an extremely large shock may pose risk to the fulfilment of inflation and exchange rate criteria.

2.2 Advancing real convergence

Despite progress in recent years, the income-per-capita and productivity levels are still low relative to the euro area. In 2005, the level of GDP per capita recalculated according to the purchasing power parity (PPP) accounted for a bit above a half-average of the EU member states.[7]

Figure 1 illustrates GDP per capita and Figure 2 shows real GDP growth for Slovakia and other selected new member state countries. It may be interesting to compare the value of the level of GDP per capita for the Slovak economy with the values of countries such as Greece or Portugal, taking the value of indicator at the same point prior to their euro area

[5] The pension reform itself raises the government deficit by 1.3 percent in 2006 and 2007, in 2008 by 1.4 percent. In: http://www2.euroskop.cz/data/index.php?p=ihned-detail&c-id=18995810&id=5352

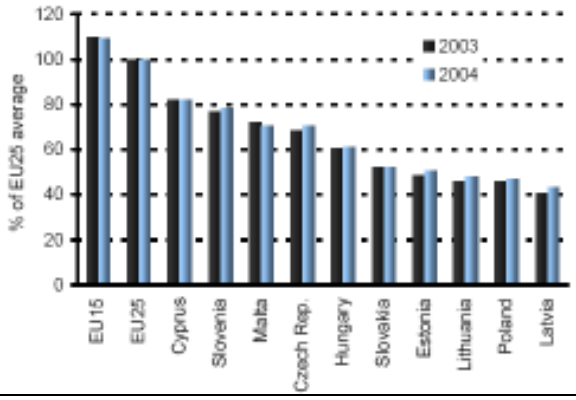
[6] Idem. Higher inflation rates (e.g., in 2003 8.5 %) reflect mainly increases in indirect tax and administered prices. The most frequently cited explanation for higher inflation in catching-up countries is the Balassa-Samuelson hypothesis. Annual rate of HICP inflation was 4.1 % in March 2006. Source: Eurostat.

[7] In 1995 the average GDP per capita accounted for 40 %. Source: Eurostat.

accession. Assuming that the target date for entry of the Slovak Republic into the EMU is the year 2009, then the Portuguese figure for the year 1994 and Greek figure for the year 1996 may constitute an appropriate basis for comparison with the Slovak figures for the year 2005. Slovakia's per capita GDP accounts only for 50 % of the average level of the euro area, comparing to the level reached by Portugal (70 %) and Greece (68 %) five years before their accession to the EMU.[8]

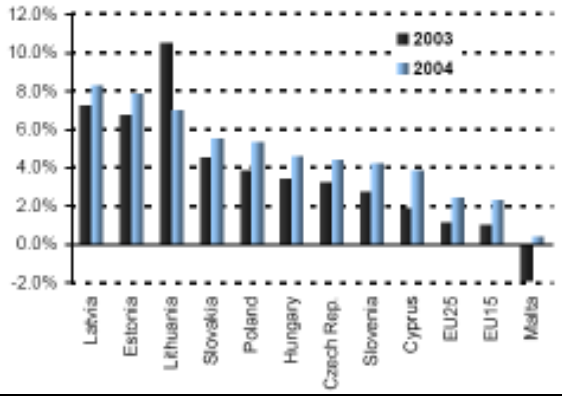
Generally, it is expected that the euro adoption will have positive impact on economic growth and thus facilitate faster approximation of the living standard of the Slovak citizens to the European average.

Figure 1 GDP per capita (in PPP)



Source: National Bank of Slovakia (2006)

Figure 2 Real GDP growth



Source: National Bank of Slovakia (2006)

2.3 Adjustment mechanisms

Enhancing the efficiency of adjustment mechanisms for absorbing asymmetric shocks in the absence of an independent monetary policy is also required for a successful participation in the euro area. In this respect, fiscal policy consolidation, wage and price flexibility, and an appropriate level of competitiveness need to be maintained.

[8] National Bank of Slovakia (2002).

In connection with entry to the euro area it is required to complete budget consolidation and create the scope for discretionary interventions of the fiscal policy in the case of occurrence of unfavourable shocks. At present, budget plays the role of an automatic stabiliser of shocks only to a limited extent. Therefore, to support stabilization of real economy, it is necessary to strengthen automatic stabilization by appropriate measures.

By assessing the characteristics of labour market flexibility, extent to which the labour market in the Slovak Republic is prepared for absorbing potential shocks can be estimated. Both nominal and real wages are characterized by certain rigidity; however, they are on average more flexible than those of the euro area countries. Ideally, this higher wage flexibility may compensate low labour force mobility. These two features together with more flexible institutional environment should bring about more effective stabilization through the labour market after entry to the euro area in case of a demand or supply shock.

In spite of a range of labour market reforms which have clearly enhanced flexibility, improved work incentives and facilitated conditions for job creation, labour market in the Slovak Republic remains still burdened with certain structural problems. Despite recent employment growth the employment rate is still low and the unemployment rate remains unacceptably high, particularly for the low-skilled and in the eastern regions.[9] This implies that there are still some structural rigidities impeding the smooth functioning of the labour market. This being the case, additional reforms focused on improving incentives for job creation and for better inter-regional labour mobility will be required to bring about a considerable fall in the unemployment.

Thus, to ensure smooth path to euro area accession, labour market policies should be aimed at preserving wage flexibility and promoting greater labour mobility, which will help to ensure that real wages do not grow at a faster rate than productivity, thereby preventing a loss of competitiveness.[10] Housing policies should be focused on removing housing market rigidities which seem to pose a principal obstacle to workforce mobility and, consequently, contribute to high unemployment.

[9] Level of unemployment in 2005 amounted to 17 %.
[10] Brook (2005).

It should be noted, that this thesis looks at euro adoption as a purely economic issue; it does not analyze political, sociological and cultural aspects of the European common currency, though they are for certain also very important. However, adopted economic and political decisions which will influence economic benefits as well as costs of the euro are taken into consideration. Additionally, in this thesis I assume that no single country fulfils completely the requirements for an optimal member of a currency area[11] and thus put an emphasis on the analysis of the benefits and costs from monetary integration.

[11] Which is in line with the second stream of the OCA theory.

3 Optimum Currency Area Theory and its Criteria

The theory of optimum currency area is a unique approach that arose out of debates about exchange rate regimes and adjustments under balance of payments disequilibria. Though the notion of an OCA was first formulated in the 60ties by Mundell, the OCA theory has become popular only recently, particularly due to the analyses of the benefits and costs of monetary integration. In this way the OCA theory has significantly contributed to the theory of monetary integration and has been fundamental in design of the EMU.

Though some relevant ideas are already present in Friedman (1953) and Meade (1957), bases of the OCA theory have been founded by Mundell (1961), McKinnon (1963) and Kenen (1969), including important extensions attributed especially to Ingram (1973) and Krugman (1991). After many amendments the OCA has evolved into a complex theory associating and mixing various facets of international macroeconomic processes.

Within the OCA literature two major streams can be distinguished. The first stream (1960s) attempts to find the crucial characteristics to delineate the (illusionary) borders of a currency area and put forward the OCA criteria. The second stream (1970s-till now) stops searching for a single criterion, under assumption that no single country fulfils completely the requirements for an optimal member of a currency area. This part of the OCA literature put an emphasis on the analysis of the benefits and costs from monetary integration.[12] Later on, the discussion has turned to issues like time inconsistency, credibility, and expectation formation, the Monetarist Critique of the short-term Phillips Curve ("Lucas critique")[13] and endogeneity of OCA criteria.[14]

The basic idea of the OCA theory is that, for countries or areas exposed to asymmetric shocks or possessing mechanisms for the absorption of such shocks, the adoption of a common currency is an optimum solution. The theory puts therefore an emphasis

[12] The distinction of both streams of literature is not clear-cut. The analysis of the costs and benefits was initiated by the early literature contributors but the second stream literature start to analyze properties jointly, weight them with one another to gauge their relative importance.

[13] In the long run, monetary policies are not effective in controlling unemployment as the Phillips Curve becomes vertical and inflation can be controlled without detrimental impact on the level of long run unemployment. Hence, the costs from losing monetary independence are reduced.

[14] Horvath and Komarek (2002a).

on analyzing the symmetry of output shocks in monetary union, and evaluating the absorption mechanisms, such as mobility of labour or fiscal transfers.[15]

Before considering optimality of the currency area one needs to limit the currency area itself. A currency area is an area which has a common currency, or in which exchange rates are irrevocably fixed. Mongelli (2005, p. 608) defines an optimum currency area as *"the optimal geographic domain of a single currency, or of several currencies, whose exchange rates are irrevocably pegged and will be unified."*[16] The *domain* of an OCA is delineated by the sovereign countries choosing to adopt a common currency or to irrevocably peg their exchange rates. This brings forward the question as to what is the "optimal" domain of a currency area. *Optimality* in the context of the OCA theory is defined in terms of the several OCA criteria. Sharing these criteria reduces usefulness of nominal exchange rate adjustments within the currency area by fostering both internal and external balance, and lowering the impact of some types of shocks.[17]

Within OCA theory various authors put an emphasis on various OCA properties, including the mobility of labour and other factors of production, price and wage flexibility, economic openness, diversification in production and consumption, similarity in inflation rates, fiscal integration and political integration. The suggested single criteria are discussed below in more detail.

3.1 Mundell (1961) and the labour mobility criterion

Mundell (1961) in his seminal work on OCA proposed the mobility of labour and other factors of production as the relevant criterion to be used in determining the optimal currency area. In his view, the optimum currency area is an area with internal factor mobility (both interregional and inter-industrial) and external factor immobility. Mundell advocates the division of the world into *"regions within each of which there is [high] factor mobility*

[15] Fidrmuc and Schardax (2000).
[16] Mongelli (2005).
[17] Idem.

and between which there is factor immobility…each of these regions should have a separate currency which fluctuates relative to all other currencies."[18]

The choice of the exchange rate plays an important role in this theory. In his model of an asymmetric shift in demand between two countries Mundell (1961) stressed that the floating exchange rate regime might be unable to cushion the shock and stabilize the economy if the national currency area does not geographically coincide with the optimum currency area. That is why Mundell (1961) introduces non-exchange rate means of adjustments, such as high labour mobility and flexibility of wages and prices, which facilitate adjustment to the adverse effects of asymmetric shocks (stabilize prices and employment), and thus curtail the pressure on exchange rate.[19]

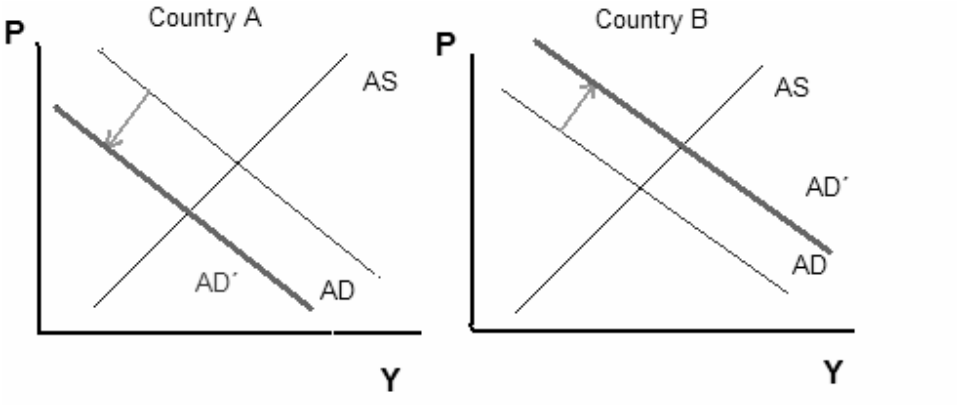
Mundell's model of an asymmetric shift in demand between two countries is illustrated in Figure 3. Assume two countries called A and B, initially in their equilibrium (full employment and balanced trade), consider forming a currency area. Suppose both countries A and B are hit by the same adverse shock. In the presence of symmetric shocks, both countries simply adjust their exchange rates vis-à-vis the rest of the world without changing their bilateral exchange rate. Therefore, waiving the exchange rate within a currency union is of no consequence, provided all member countries face the same shocks.[20]

With asymmetric shocks, the situation is different. Suppose the shift in demand away from the products of country A to country B as depicted in Figure 3 (prices are assumed to be sticky). If no policy is used, the likely outcome of such a shift for country A is the decline in output and the price level and unemployment. The opposite is true for country B. Without a common currency (in the case that countries use flexible exchange rate regimes) the whole adjustment can be solved through the depreciation of the country A's currency to restore demand in country A, while the appreciating exchange rate of country B will prevent inflationary pressures in country B. With a common currency, no devaluation can take place. There is an excess supply in country A, which will lead to unemployment and excess demand in country B which will cause inflation. Both problems could be solved by a reallocation

[18] Mundell's definition of region is neither geographical nor political. He defines region in terms of factor mobility. (Mundell 1961, p. 663).
[19] Similar effects can be also ascribed to high capital mobility; however, there is a substantial difference between the capital mobility and the labour mobility.
[20] Baldwin and Wyplosz (2000).

of the idle production factors from country A to country B (where they are in short supply). Thus, more output can be produced in country B without causing inflation and prevent unemployment from rising in country A. Besides, price and wage changes in either country are not necessary.[21] It follows that high factor mobility in a currency area with sticky prices and wages is vital for maintenance of national full employment. Otherwise, unemployment in some countries and inflation in others will persist.

Figure 3 Asymmetric Shifts in Demand



Note: AD-aggregate demand, AS-aggregate supply, P-price level, Y-output.
Source: Horvath and Komarek (2002).

3.2 McKinnon (1963): degree of economic openness[22]

McKinnon (1963) suggested a second criterion for membership of an OCA: the openness of economy defined as the ratio of tradables to non-tradables. According to McKinnon (1963), a monetary union is optimal if the countries forming the union are open to trade and trade heavily with each other.

The crucial question is whether the exchange rate is useful instrument for dealing with an asymmetric shock. Any exchange rate variation in a highly open country affects the price level and has no impact on the real economy (the terms of trade and real wages)

[21] Pentecost (2001).
[22] There are various dimensions of economic openness which are not necessarily synonymous: the degree of trade integration (i.e., the ratio of reciprocal exports plus imports over GDP) with the partner countries, the share of tradables versus non-tradable goods and services in production and consumption; the marginal propensity to import; and international capital mobility. In: Mongelli (2002).

because both the export price of domestic products and the import price of foreign products will be affected by the change in the price of the currency. Thus, according to McKinnon (1963), the more open the economy, the lower the benefits of flexible exchange rates, i.e., the benefits from a monetary integration increase with the degree of openness. Thus, small open economies find it beneficial to join currency areas. In McKinnon's words, *"...if we move across the spectrum from closed to open economies, flexible exchange rates becomes both less effective as a control device for external balance and more damaging to internal price level stability."*[23]

3.3 Kenen (1969): degree of product diversification

Kenen (1969) considers the similarity of the trading structure as the crucial criterion of the optimality of currency areas. This criterion states that an optimum currency area is formed by countries whose production and exports are well-diversified and similar in structure.

A country with high product diversification is less exposed to specific shocks within a particular sector and it is unlikely that, in the case of such a shock, the country would use the exchange rate actively as an adjustment tool. In Kenen´s words, *"economic diversification, reflected in export diversification, serves, ex ante, to forestall the need for frequent changes in the terms of trade and therefore, for frequent changes in national exchange rates."*[24] On these grounds, Kenen concludes that fixed exchange rates are most appropriate to well-diversified economies, which may find it beneficial to form a monetary union, while less-diversified economies should be independent currency areas under flexible exchange rates in order to cushion them from outside shocks.[25]

[23] McKinnon, R. (1963), p. 719.
[24] Kenen, P. (1969), p. 49.
[25] Horvath, J. (2003).

3.4 Ingram(1962): degree of financial market integration

Contrary to ideas presented by Mundell, McKinnon and Kenen, Ingram (1962) considers financial instead of real characteristics of economies to be the main criterion with respect to an optimum monetary area.[26]

Ingram (1962) states that a stable and developed financial system can reduce the need for exchange rate adjustments. It facilitates the absorption of asymmetric shocks through capital inflows (for example, by borrowing from surplus areas). There is no need for flexible exchange rates in an area with a high degree of integration in the financial capital market as even small changes in interest rates would bring about sufficient equilibrating capital movements across partner countries. Thereby, differences in long-term interest rates would be reduced, easing the financing of external imbalances.[27]

3.5 Fleming (1971): Similarity in rates of inflation

Fleming (1971) chooses the criterion of similar inflation rates and claims that it is at least as important as any of the characteristics discussed above. The argument is based upon the assumption that the principal source of the payments imbalance are not microeconomic disturbances is demand and supply conditions but macroeconomic phenomena.

External imbalance may stem from persistent differences in national inflation rates that are likely to be the result of: disparities in structural developments; differences in national monetary policies; diversities in labour market institutions (differences in trade union aggressiveness); and diverse social preferences (such as inflation aversion). Fleming (1971) claims that if there are low and similar inflation rates between countries, then terms of trade will remain fairly stable as well. Thus, the need for nominal exchange rate adjustments is reduced, through more equilibrated current account transactions and trade.[28]

[26] Ishiyama (1975).
[27] Nevertheless, financial integration can not serve as a substitute for a permanent adjustment when necessary: it can just smooth the long-term adjustment process. In: Mongelli (2002).
[28] However, not all inflation differentials are necessarily problematic. In less developed countries, some "catching up" process could lead to "Balassa-Samuelson" types of effects until the process is completed. In: Mongelli (2002).

3.6 Price and wage flexibility

Flexible nominal prices and wages between and within countries considering a common currency imply that the transition towards adjustment following a shock is less likely to be associated with sustained unemployment in one country and/or inflation in another country. Thus, the need for nominal exchange rate adjustment will be reduced.[29] In this case the loss of direct control over the nominal exchange rate tool need not represent a cost. Flexible prices and wages are especially important in the very short run (when the factor mobility is partly restricted) to alleviate the adjustment process following a shock.

3.7 Fiscal integration

As an alternative to other adjustment mechanisms such as exchange rate or labour mobility, fiscal transfers can be used to counteract to asymmetric shocks in a monetary union. Thus, in the field of fiscal policy, an optimum currency area is supposed to be formed by countries that agree to compensate each other for adverse shock.

If countries share a supra-national transfer system and redistribute the funds to those member states hit by an adverse asymmetric shock in order to alleviate the impact of the shock, then less nominal exchange rate adjustments might be needed (Kenen (1969)). Such transfers mitigate both the recession in depressed country (payments deficit) and the boom in prosperous country (payment surplus) and may serve as a common insurance against adverse shocks.[30] However, high degree of political integration and willingness of member countries would be required for such fiscal integration to come into existence.[31]

3.8 Similarity of supply and demand shocks and business cycles

The asymmetry of shocks and business cycles raise the need for country-specific adjustment policies, which are, however, not possible in a single-currency area. Hence,

[29] See Friedman (1953).
[30] However, there is a certain degree of inconsistency as a country hit by a positive shock could be at the same time a relatively poorer country.
[31] Mongelli (2005).

business cycles of countries considering forming a currency area have to be correlated to a maximum extent (i.e. countries are exposed to symmetric shocks and exhibit similar responses to these shocks). Put differently, a higher synchronization of shocks between countries, among other things, entails a lower cost of sharing a common currency.[32]

3.9 Political Integration

Some authors take the view that an optimum currency area may be more about long-term political commitment than economic criteria such as degree of labour mobility or homogeneity of output. What matters is the political will to integrate, which encourages more institutional linkages, and foster compliancy with joint commitments; the similarity of policy attitudes among member countries, and a reasonable degree of compatibility in preferences toward growth of inflation and unemployment and policy-makers´ abilities to "trade-off" between these objectives.

[32] Babetskii (2004).

4 The main costs and benefits associated with a currency area

4.1 Costs and benefits – Static View

Adoption of a single currency brings both benefits and costs. Hence, countries considering monetary integration should form a currency area in expectation that current and future benefits prevail over costs. The literature on OCA theory has analyzed both permanent and one-off costs and benefits from participating in a currency area. Throughout this section I follow the classification of the main costs and benefits as stated in Mongelli (2002).

4.1.1. Benefits of a common currency

First group of **benefits** stems **from improvements in microeconomic efficiency** resulting mainly from the increased usefulness of money as a unit of account, medium of exchange, store of value, and standard for deferred payments. Moreover, greater price transparency will exist, fostering competition, reducing market segmentation, discouraging price discrimination, and improving resource allocation. Intra-area nominal exchange rate uncertainty[33] and intra-area exchange rate risk will be eliminated leading to savings in hedging and transaction costs. This will also lower investment risks, strengthen the internal market, foster trade, promote cross-area foreign direct investments, and improve resource allocation.[34]

Secondly, **benefits from increased macroeconomic stability and growth** come into existence. They result from the access to broader and more transparent financial markets, enhanced overall price stability; credibility gains for the member countries with a history of higher inflation; the reduction of several types of fluctuations of output and employment

[33] Exchange rate uncertainty vis-à-vis the rest of the world remains and can give rise to both trade creation and trade diversion. There may also still exist real exchange rate uncertainty (due to a lack of price flexibility), which may act s a barrier to trade. The decline in the uncertainty of the evolution of exchange rates also lowers the expected profit of investment, which could subsequently affect output.

[34] The elimination of exchanging one currency for another is regarded as the most visible benefit of monetary union, however, the gain of the economic agents in the long run (after the adjustment to the new environment) is an empirical question. In: Horvath and Komarek (2002a).

within the currency area. However, menace of the detrimental effects of real economic shocks is not eliminated by the single currency.

Thirdly, adoption of a single currency brings **benefits from positive external effects** arising principally from savings on transaction costs due to a broader circulation of the single currency, revenues from international seigniorage, lower need for exchange rate reserves; and simplified international co-ordination.

4.1.2. Costs of a common currency

A common currency or an irrevocably fixed exchange rate is, of course, not associated only with advantages, costs and risks cannot be neglected. While the relevant benefits are usually found at the microeconomic level, the costs of a monetary union have much to do with macroeconomic management of the economy. Mongelli (2002) classifies the main costs as follows:

Costs from the deterioration in microeconomic efficiency encompass changeover costs from switching to a new currency, which include administrative, legal and hardware costs. There are also psychological costs arising from a new numèraire. Moreover, choosing the wrong nominal exchange rate parity at the onset of a currency area may harm country's competitiveness.

Another cost of joining a currency area is the **loss of seigniorage** – as national governments loose the option of "inflating away" their national debt.[35] The creation of a monetary policy implies that seigniorage becomes a matter for the union as a whole and its distribution is largely a policy question. The implication is that as inflation falls in the monetary union so will the potential revenue from seigniorage. Member countries previously dependent on seigniorage to finance budget deficits will either have to raise taxes or reduce spending (or borrow in the international capital market).

Costs from decreased macroeconomic stability. The obvious implication of membership in a currency area is the narrowing the menu of policy tools directly available to national governments. Participation in a currency union is associated with the loss

[35] Seigniorage is the revenue gained by the government from issuing money at almost zero cost which is used to finance budget deficit.

of autonomy in monetary policy exchange rate setting; this responsibility is transferred to a supranational central bank. The jointly controlled monetary policy is not necessarily beneficial to particular regions or nations as it is designed to serve the majority of interests of the member countries.[36] The surrender of the power to affect national money supply and loss of national control over the exchange rate may be regarded as dangerous as long as differences in national price, wage, and productivity trends persist. Moreover, if the prices and wages are downward sticky, countries can not follow real adjustment subsequent asymmetric shocks.[37]

The loss of control over the exchange rate and monetary policy as a stabilization tool is often regarded as the most important cost of joining a currency area. However, this is not true for small open economies, as it is impossible to maintain free capital mobility and an independent monetary policy together ("impossible trinity").

In addition, there is also an implication of a centrally created common currency for freedom in national **fiscal policy**. It is not clear how independent can fiscal policy be within a currency union. It is expected that even in the complete monetary union countries keep their fiscal policies independent to some degree; though some centralization of fiscal policies could be used as one of the instruments in cushioning the asymmetric shock. On the other side, the centralization of budgets is likely to result in an increase in spending.[38]

Costs from negative external effects, such as sharp drop of international confidence in the single currency, may possibly result from accumulation of an unsustainable public debt by one or more member countries.[39]

4.1.3. Benefits and costs of euro adoption in Slovakia

The study 'The effects of euro adoption on the Slovak economy' elaborated by the National Bank of Slovakia in 2006, has come to the conclusion that the final effect of euro adoption on the Slovak economy will be positive. From a long-term prospect, advantages of euro adoption significantly prevail over disadvantages. This section is based

[36] Ishiyama (1975).
[37] Mongelli (2002).
[38] Horvath and Komarek (2002a).
[39] Mongelli (2002).

on and summarizes the main findings of this study elaborated by the National Bank of Slovakia (2006).

Table 1 presents the summary of the estimated effects of the euro adoption on the Slovak economy, based on the aforementioned study. It shows that in the long-term horizon the euro adoption will lead to acceleration of GDP growth in line with a decline in real interest rates, but particularly due to the growth of foreign trade. In the long run, total increase of the Slovak gross domestic product is estimated at 7 to 20 %. However, this growth will be gradual; annually, euro will contribute to economic growth by 0.7 %.[40]

Table 1 Benefits of euro adoption in Slovakia

Benefits of euro adoption	**Estimated impact**
Reduction of financial transaction costs	Savings of 0.30% GDP
Reduction of administrative costs	Savings of 0.06 % GDP
Elimination of the exchange rate risks against euro	Savings due to risk elimination accounting for 0.02 % GDP (range 0.01-0.08 % GDP)
Reduction of exchange rate volatility against currencies of other trading partners	Reduction of the overall effective volatility to 0.35% (from 0.63 % in 2001-2005), after entry of all V4 countries to euro area to 0.17 %
Reduction of capital costs	Decrease of current real interest rates for business from approximately 2 % to 1 - 1.5 %.
Increase of foreign trade	Increase of foreign trade by 50 %
Increase of the GDP per capita due to increases in trade and FDI flows	Increase of the GDP per capita between 7-20 % In the long term. Increase of the annual GDP growth by 0.7%
Increase of price transparency and competition	Increase of pressure on prices and prevention of their growth
Increase of FDI	
Costs of euro adoption	**Estimated impact**
Technical and organizational costs	One-off costs of 0.3 % GDP
Specific costs of the banking sector	Accruing from providing free conversion of the domestic currency to euro and reduction of the range of activities and revenues of banks
Loss of the independent monetary policy	Approximately 0.04 % GDP
Possibly higher inflation rate in the long run	Additional contribution to the inflation in comparison with the EMU average:1.5 % annually

Source: NBS (2006).

[40] However, the estimated value involves high degree of uncertainty.

Immediately after the Euro adoption, some costs will be saved and some risks removed, which should increase the gross domestic product. The elimination of transaction costs on trade in euros is deemed to be the most important direct benefit. The Slovak Republic is one of the most open economies in the enlarged European Union, with more than 80 % of foreign trade with European countries. The financial transaction costs which will be saved after euro adoption are estimated at 0.3 % of GDP. Reduction of administrative costs including the costs of foreign currency management, accounting of foreign exchange gains and losses, additional reporting, etc., is estimated at 0.06 % of GDP. Overall, the savings in the transaction costs on trades in euros will amount to 0.36 % of GDP.

The estimated value of exchange rate risk against euro that will be eliminated by euro adoption is about 0.02 % of GDP. Moreover, the exchange rate volatility against other important currencies is also expected to decrease slightly after euro introduction.

Euro introduction should bring about lower cost of capital for enterprises and hence boost investment activities. Reduction of capital costs should decrease current real interest rates for business from approximately 2 % to 1 – 1.5 %. Nevertheless, decline in the costs of credit cannot be expected to lead to a considerable increase in the profits of enterprises, because the interest rates from deposits will also decrease, though by less than the interest rates on credit.

Benefits will bring wider indirect benefits. Foreign direct investment and foreign trade of the Slovak Republic is expected to increase, as entry to the euro area will increase the stability of the Slovak Republic as perceived by foreign investors. This will lead to faster growth of the gross domestic product and increase in the living standards.

Based on Rose and Stanley's cross-section analysis of 2005, the National Bank of Slovakia estimated that after entry of the Slovak Republic to the euro area its trade among its members will increase by 30 to 90 %. However, this growth will be gradual and will not come immediately; euro adoption will contribute in the long run to increase in the total foreign trade by around 50 %.

The benefits from the euro adoption should be balanced against the incurred costs. Estimates of one-off costs of currency conversion, such as costs on the adjustment of information systems, conversion of prices, currency exchange, dual prices etc, will be 0.3 %

of GDP. These technical costs of euro adoption in the Slovak Republic are expected to be lower than in the twelve euro area countries, owing partly to the "big bang" scenario of the euro changeover, short dual circulation period and a large number of the Slovak enterprises that have already been actively trading in euro.

The loss of independent monetary policy, an instrument for mitigation of asymmetric shocks, is often deemed to be the most serious disadvantage of entry to the euro area. However, the estimates of such costs for the Slovak Republic are relatively low, since currently the capability of the Slovak monetary policy to stabilize real economy is already very limited. The estimated loss of relinquishing independent monetary policy is approximately 0.04 % of GDP.

Increase in prices after euro adoption represents a great concern of most consumers. In the countries of the current euro area the overall impact of euro on the increase in prices was rather low (about 0.2 %).[41] Strong competition within retail trade in the Slovak Republic should block unreasonable increases of prices.

However, a concern about higher inflation after joining the euro area is justified. After irrevocable fixing the exchange rate, higher inflation will be the only channel for catching up with the EU in price levels. For several years after entry of the Slovak Republic to the euro area inflation is estimated to be on average by about 1.5 percentage point higher than the average inflation within the euro area. Higher inflation in the Slovak Republic will result mainly from faster productivity growth and Balassa-Samuelson effect, and by raising weight of services in the consumption basket. Such inflation should not represent a risk of loss of competitiveness for the Slovak economy nor a negative effect on the living standards. It should be noted, however, that the Slovak inflation would be also higher than in the euro area even in the case of non-adoption of euro.

Moreover, in relation to the euro adoption a concern about a decrease in the real value of savings and pensions may arise. However, as mentioned above, the currency conversion should not lead to increase in the price level and hence should not represent a risk of reducing the value of savings or pensions. Since the conversion rate will be the same for savings

[41] National Bank of Slovakia (2006).

and pensions as well as for goods and services, purchasing power of savings and pensions will remain unchanged.

Furthermore, the postponement of adoption of euro later than in 2009 would mean a loss of potential benefits of its adoption. According to the estimates of the National Bank of Slovakia (2006), the total amount of lost benefits when the adoption of the euro is postponed just by one year would amount to approximately 0.7 % of GDP per year, for the period of about 20 years (Figure 4 and Figure 5 illustrate GDP development and lost benefits under postponement or non-adoption of euro).[42] In particular, Slovak economy would not be able to use longer resources unleashed from the removal of transaction costs and costs of insuring against the exchange rate risk. Positive effects of the adoption of the euro on the Slovak economy would be postponed.

Figure 4 GDP development under postponement or non-adoption of euro

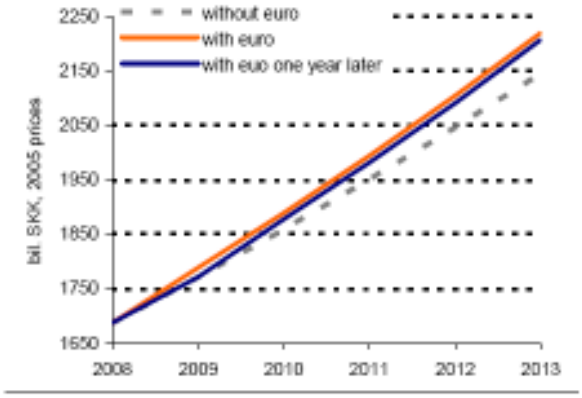
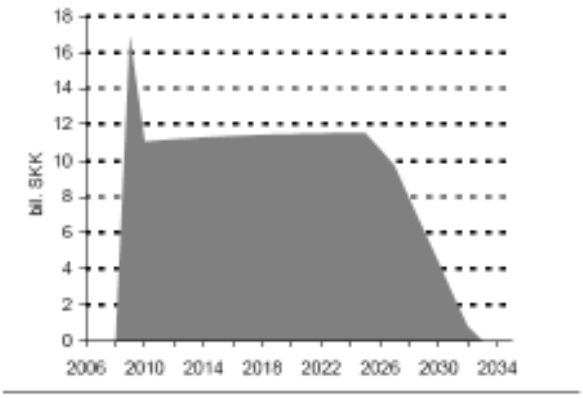


Figure 5 Lost benefits under postponement of euro adoption by one year



Source: National Bank of Slovakia (2006)

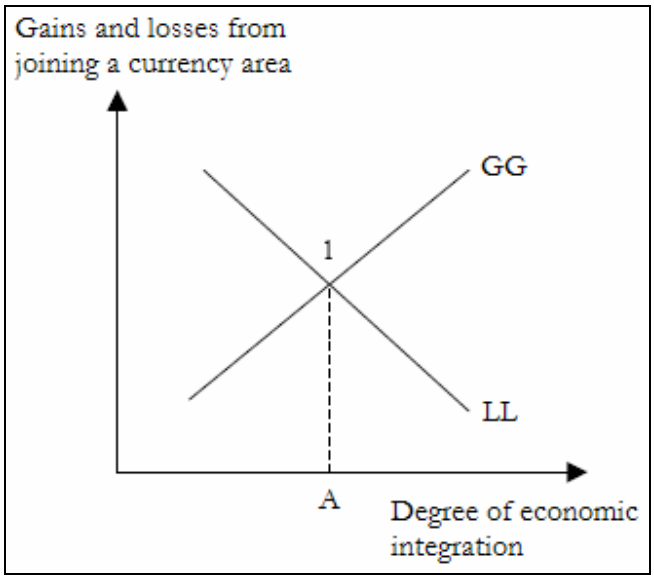
Overall, the main findings of the study elaborated by the National Bank of Slovakia (2006) show that in the case of the Slovak Republic the advantages accruing from the euro adoption in January 2009 will prevail over disadvantages and the postponement of adoption of euro later than in 2009 would be even less advantageous for Slovakia. However, it is necessary for policies to be set appropriately so that the Slovak Republic can be able to fully utilize the advantages from euro adoption and constrain its disadvantages.

[42] Given that the Slovak Republic is prepared for entry to the euro area within the meaning of the Strategy f adoption the euro. In: National Bank of Slovakia (2006).

4.1.4. Balancing the costs and benefits: The GG-LL Model

To weight the costs of fixed exchange rate (or monetary integration) against the benefits, Krugman (1990) developed a simple GG-LL model that can serve as a cost-benefit representation of the OCA criteria (Figure 6).

Figure 6 The GG-LL Model



Source: Obstfeld-Krugman (1994)

The upward-sloping *GG schedule* in Figure 6 shows how the potential gains from joining the currency area rise with the increasing degree of economic integration. The *LL schedule* is negatively sloped, indicating that a high degree of economic integration between a candidate country and the currency area member countries reduces the losses due to the restricted macroeconomic policy after joining the area.

For levels of economic integration equal to A or even higher, the gains (*GG schedule*) are greater than losses (*LL schedule*), the candidate country should join the currency area, as it would end up with net gain.

4.2 Two Paradigms: Specialization versus "Endogeneity of OCA"

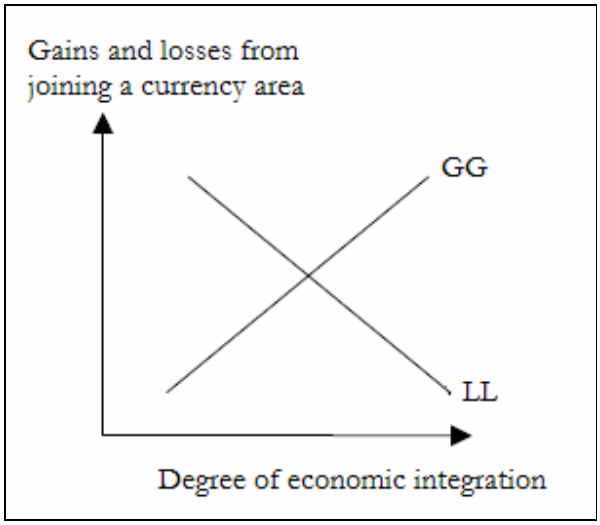
There is a large debate on the link between economic integration and business cycle synchronization. According to one point of view, closer trade links (closer integration) increase convergence as the asymmetric shocks become less frequent and business cycles between countries more synchronized (European Commission, 1990). This paradigm is referred to as the *"endogeneity hypothesis"* of Frankel and Rose (1998b). From the alternative viewpoint (e.g. Krugman, 1993) the opposite effect should dominate: closer integration increases specialization, which will reduce the international correlation of incomes, and result in higher risks of idiosyncratic shocks. Thus, from a theoretical point of view, the overall effect of trade integration on shock symmetry might be ambiguous.

4.2.1. The "Endogeneity of OCA" Hypothesis and The OCA Line

Contrary to the "traditional" OCA theory which was preoccupied with the preconditions that would enable a successful currency area, Frankel and Rose (1998b) provide a more forward looking outlook, maintaining that the international trade pattern and international business-cycle correlation is endogenous. In words of Frankel and Rose (1998b, p. 1010): *"...a naive examination of historical data gives a misleading picture of a country's suitability for entry into a currency union, since the OCA criteria are endogenous."* In their opinion, many of the preconditions for monetary union are actually reinforced by the creation of currency area. This is the *"endogeneity of OCA"* paradigm, stating that even if the OCA criteria are not fully satisfied *ex ante*, they could be satisfied *ex post*, as both monetary and trade integration deepens. Thus, joining a currency union increases the symmetry in the business cycle of the candidate country and moves the prospective member-country closer to fulfilling the OCA criteria. It should be noted that according to Frankel and Rose (1998b) it is necessary to distinguish between inter-industry and intra-industry trade when analyzing the role of international trade. Whereas intra-industry trade leads to business cycle synchronization, inter-industry trade reflects specialization, thereby potentially bringing about asymmetries.

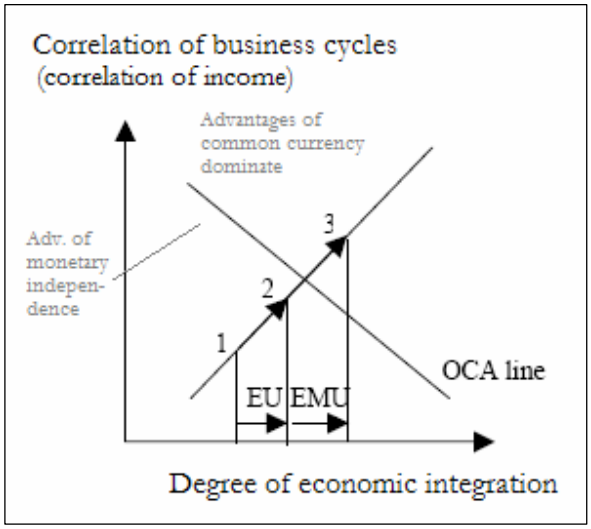
The idea of Frankel and Rose (1998b) is represented graphically in Figure 7 and Figure 8. **Figure 7** represents the GG-LL model discussed above, in which the gains from joining a currency area is depicted as a growing function of degree of economic integration. In **Figure 8** the downward sloping *OCA line* is introduced, showing the combination of degree of economic integration and correlation of business cycles beyond which benefits of joining a monetary union exceed the costs. It is the "break-even" line for the OCA: along this line, the costs and benefits of monetary union are exactly equal. To the left of the *OCA line* the disadvantages from monetary integration dominate and therefore countries are not good candidates for a currency union and should let their exchange rates float instead.

Figure 7 Conventional View of an OCA



Source: Obstfeld-Krugman (1994)

Figure 8 "Endogeneity Hypothesis"



Source: Mongelli (2005)

In **Figure 8** Frankel and Rose present a group of countries initially finding themselves at point 1, on the left of the OCA line. If these countries join together and constitute a "union," such as the EU, both income correlation and trade integration within this group will rise; these countries will gradually move to point 2. If the same group of countries decide to form a currency area (such as the EMU), the degree of trade integration and income correlation within this group would rise even further and the countries would subsequently find itself

in point 3 on the right of the OCA line. Thus, a country's suitability for entry into a monetary union may have to be reconsidered if satisfaction of OCA criteria is endogenous or countries may satisfy OCA criteria ex-post even if they do not ex-ante. In words of Frankel and Rose (1998b, p. 1024): *"...some countries may appear, on the basis of historical data, to be poor candidates for EMU entry. But EMU entry per se, for whatever reason, may provide a substantial impetus for trade expansion; this in turn may result in more highly correlated business cycles. That is, a country is more likely to satisfy the criteria for entry into a currency union ex post that ex ante."*

Frankel and Rose test the above outlined "endogeneity hypothesis" empirically and find a strong positive relationship between the cross-country bilateral correlation of business cycle activity and the degree of bilateral trade intensity among OECD countries between 1959 and 1993.

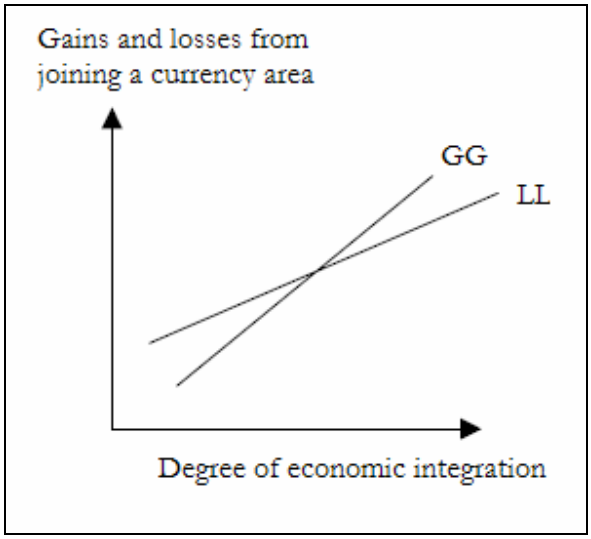
4.2.2. The "Krugman specialization hypothesis"

Another paradigm is the *"Krugman specialization hypothesis."* The argument from Krugman (1993) is that closer international trade might lead to looser correlations of national business cycles. Krugman (1993) argues that increased economic integration can lead to divergence and thus increase the costs from monetary integration. In particular, closer trade ties can lead to countries becoming more specialized according to their comparative advantage. Member countries of a currency area would then become less diversified and more sensitive to asymmetric shocks. Correspondingly, their international correlation of incomes will decrease, resulting in more idiosyncratic business cycles. Thus, if membership in a currency area does not seem to be optimal *ex ante*, it will be even less optimal *ex post*. This hypothesis is illustrated in Figure 9 and Figure 10.

In **Figure 9**, *LL schedule* is upward-sloping indicating that losses from joining a currency area are, contrary to the conventional model, an increasing function of degree of economic integration. Increased integration increases the costs of integration and could

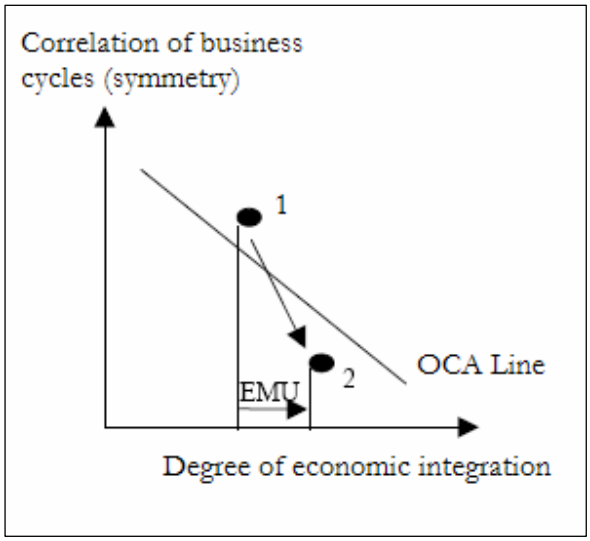
move a group of countries that are in the OCA-zone outside of this zone, e.g. from point 1 in **Figure 10** to point 2.[43]

Figure 9 Alternative view of an OCA



Source: Obstfeld-Krugman (1994)

Figure 10 Specialization hypothesis



Source: Mongelli (2005)

4.3 Is Europe an optimal currency area?

When analyzing Europe from the point of view of the OCA theory, it must be remembered that it is still heterogeneous formation of countries in several crucial aspects.

The perception of Europe as an optimum currency area is focused essentially on the issue of asymmetry of shocks. The notion is that if the occurrence of supply and demand shocks and the speed of adjustment are largely similar across partner countries, then the need for independent policy is reduced and the net benefits from adopting a common currency may be higher.

A recent study analyzing optimum level of the currency area in regard to the new EU Member States is elaborated by Fidrmuc and Korhonen (2001c). They find that the correlation of demand shocks varies from country to county. Their results suggest that while the "core"

[43] Whether this really occurs depends on the relative strength of two opposing forces brought about by increased integration: the increase in the efficiency gains of the currency area and the increase in asymmetry which raises the costs.

countries (Germany, France, Italy and Belgium) go in line with the EU economy, in the "peripheral" countries (Ireland and Mediterranean countries except Italy) idiosyncratic shocks with the EU as a whole seem to prevail. However, several new EU 25 Member States are at least as well synchronized with euro area shocks as the member states of the EMU.

Results of Babetski et al (2002) suggest that there is ongoing process of convergence of demand shocks and divergence of supply shocks. In a more recent study Babetski (2004) identifies the growing intensity of trade and decline of volatility of exchange rate as sources of convergence of demand shocks.

Bayoumi and Eichengreen (1996) find a positive correlation between the fundamental shocks among the "core" countries including Germany, Austria, France, Denmark, the Benelux countries and Switzerland. The correlation of shocks between these countries is higher than with the southern countries.

On the basis of several criteria Bayoumi and Eichengreen (1998b) identified three groups of countries according to their suitability for participation in the EMU. The first group comprises fully convergent countries around Germany including Austria, Belgium, Ireland, the Netherlands and Switzerland. Second converging group includes Mediterranean countries, and the third non-converging group consists of Great Britain, Denmark, Norway, Finland and France.

Factor mobility plays also an important role in sustaining the optimality of common currency area. Labour mobility does not play a role as an adjustment mechanism, mainly due to legal impediments and the nature of the labour market. Mobility of labour is quite low both across and within most European countries, mainly due to numerous restrictions. When shocks occur, inter-regional migration (within and between countries) is not significant. This being the case, European countries will not be able to substantially benefit from this attribute in the immediate future. Piracha and Vickerman (2002) estimated annual migration between Member States amounting to 0.75 per cent of the resident population and only 0.4 per cent of EU nationals. Several factors that may help to explain low labour mobility may be identified: quantity and price dimensions of labour market rigidity, social, and administrative determinants, inefficiencies in the inter-regional job matching process, high mobility costs, cultural and language barriers, barriers in the housing markets. A group of experts set up

by the EU Commission in 1996 partially assign low mobility of labour to a combination of administrative and institutional factors including: administrative difficulties and high costs of gaining legal resident status; lack of comparability and reciprocal recognition of professional qualifications; and limited cross border portability of social protection and supplementary pension rights.[44]

Wage flexibility across most European countries is also low, which can be explained by several labour market institutions such as wage bargaining arrangements, employment protection, unemployment insurance systems, and minimum wage provisions (see Blanchard (1999), EU Commission (1999), and IMF (1999)).[45] In spite of significant progresses in recent years, real wages remain still quite rigid and European labour market institutions are rather heterogeneous across most euro area countries.[46] As far as price flexibility is concerned, there is wide agreement that it is still low across European countries.

Most EU Member Countries enjoy high diversification in production. Besides, similarity in the structure of consumption has also increased in most of EU countries. Generally, European countries seem to have a significant share of product diversification and intra-industry trade in their total trade. Fidrmuc (2001b) reports that the "core" countries of the EU (Germany, France, Belgium) have remarkably high share of intra-industry trade and high degree of product diversification, while the share of the intra-industry trade is much lower in the EU "periphery" (Greece, Ireland, Finland).

As far as the McKinnon criterion is concerned, most European economies qualify for joining a monetary union. The degree of economic openness is quite high across most European countries; however, their trade with the other euro area countries is not always prevailing.[47] A high level of reciprocal trade in goods and services and also high factor market integration is present in the most industrialized regions of Germany, France, Italy, Spain, and northern Europe.

Looking at fiscal integration from the standpoint of fiscal convergence, achievement of the fiscal criteria of the Maastricht Treaty by the EMU countries, and deeper fiscal

[44] Mongelli (2002).
[45] In: Mongelli (2002).
[46] See Nickell (1997), Layard and Nickell (1998).
[47] For example, the ratio of EMU trade to the total trade for Germany was 43.8%, for France 51.9%, for Austria 63.2%. Source: Eurostat (1998).

convergence partly due to harmonisation in several areas of taxation, spending and fiscal legislation may be identified. On the other side, the lack of a supranational federal risk-sharing arrangement (i.e., a federal budget) could be quite costly for the euro area, if asymmetric shocks will prevail in the future. At present, this risk is in part mitigated by the relatively high similarity in the types of shocks and the strengthening of financial integration.

In general, inflation rates have declined and inflation differentials have narrowed down among all EU countries, especially euro area countries. Concerning factor market integration, it is evident that cross-country foreign direct investments have become more important in the euro area. However, some barriers to market access still remain and though foreign direct investment flows are on the rise, they are still modest when comparing to other financial flows. Furthermore, financial integration is raising fast in several areas, but it is still lower among European countries than among US States.[48]

Overall, most European economies do well on economic openness and diversification, two of the three traditional OCA characteristics. However, Europe fails on labour mobility and fiscal transfers criteria. Verdict of the remaining criteria is largely unclear. Nevertheless, it should be noted that the OCA criteria are rarely entirely satisfied or entirely violated. The OCA characteristics are not absolute and thus the decision to enter the monetary union or stay outside often rests on political considerations. The OCA criteria are not frozen either; various studies elaborated mainly by Frankel and Rose (Frankel and Rose (1998b), but also Babetski (2004)) provide reasons to believe that the degree to which the OCA criteria are fulfilled are endogenous. Several authors argue that the endogeneity of OCA should not be limited to only trade integration and income correlation and interpret "endogeneity of OCA" paradigm in a broader sense. Mongelli (2005) focuses on the endogeneity of economic integration, the endogeneity of symmetry of shocks, the endogeneity of product and labour market flexibility, and the endogeneity of financial integration and finds that EMU has already had a substantial effect on price changes in product markets, created additional trade among its members, contributed to greater depth and liquidity on financial markets, and has led to a higher degree of symmetry of shocks in the EMU.

[48] In: Mongelli (2002).

According to Artis and Zhang (1998), monetary integration in Europe has had a significant "disciplining effect" on participating economies which has been accompanied by an increasing synchronization of business cycles. Issing (2001) proposes the issue of the endogeneity of political integration and Blanchard and Wolfers (2000) discuss the endogeneity of labour market institutions.[49]

[49] In: Mongelli (2002).

5 Data and Methodology

5.1 Empirical Methodology

The methodology applied in this thesis originates in Bayoumi and Eichengreen (1997a,b and 1998a), who find out that the OCA theory explains well the variability of exchange rates and operationalize the OCA theory by constructing an OCA index, which indicates the readiness of the country to adopt the common currency. The dependent variable on which the OCA index is based is the variability of the nominal exchange rate, which can be considered as more accurate measure of the exchange rate behaviour *de facto*.

Bilateral exchange rate volatility is computed as follows:

$$SD(e_{ij}) = SD[\Delta(\log e_{ij})] \quad (1)$$

where $SD[\Delta(\log e_{ij})]$ is the standard deviation of the change (Δ) from quarter t to quarter $t+1$ in the logarithm of the nominal exchange rate (e_{ij}) between countries i and j[50]. I study the variability of nominal rather than real exchange rates because nominal rates provide an easier benchmark for comparison to a single currency, where the variability of the nominal exchange rate is zero.[51]

OCA index is the outcome from regressing nominal exchange rate variability on the OCA relevant criteria. In this respect, the explanatory variables included in the model are the following (Table 2 and Table 3 present the explanation and formal derivation of the variables employed):

(a) *the asymmetry of business cycles* ($SD(\Delta y_i - \Delta y_j)$) as measured by the standard deviation of the difference in the logarithm of real output between i and j;

(b) *the differences in trade structures* ($DISSIM_{ij}$) calculated as the sum of the absolute differences in the shares of agricultural, mineral and manufacturing trade in total merchandise trade;

[50] e_{ij} represents the number of units of currency i per unit of currency j.
[51] Bayoumi and Eichengreen (1998a).

(c) *the share of bilateral trade in total trade* ($TRADE_{ij}$) computed as the mean of the ratio of bilateral exports to domestic GDP for the two countries;

(d) a measure of *the relative size of countries* ($SIZE_{ij}$) calculated as the mean of the logarithm of the two GDPs measured in U.S. dollars.

These four variables stand for the basic OCA criteria and it is assumed that the more the OCA criteria are fulfilled among countries, the lower should be the variability of exchange rates, i.e. the better prepared they are to join the monetary union.

As a result, the model is empirically specified as follows:

$$\mathbf{SD(e_{ij}) = \beta_0 + \beta_1 SD(\Delta y_i - \Delta y_j) + \beta_2 DISSIM_{ij} + \beta_3 TRADE_{ij} + \beta_4 SIZE_{ij} + e_{ij}} \qquad \mathbf{(2)}$$

Following the line of Bayoumi and Eichengreen (1997a,b and 1998a), the OCA index is obtained from regression panel analysis using an annual data set for 20 developed countries over the periods 1980-1998 and 1990-1998. The period of 1990-1998 is analysed to test whether it is more relevant than the period of 1980-1998 from the monetary convergence perspective. The period of 1990-1998, though entailing lower data set refers to the pre-accession period to the EMU and it should be thus worthwhile examining this period rather than going further back.

The countries in the sample are as follows:[52] Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, and the USA.[53] The analysis takes into consideration all the relationship between each of the economies. Given the bilateral setting, the combination of 20 countries leads to 190 observations. In each row of the data matrix, there is a pair of countries. Since the relationship of the first country to the second is the same as that of the second to the first, the number of observations equals 20!/18!2!. When putting together the data matrix, I conform to the advice of Bayoumi and Eichengreen (1997a, b and 1998a). This allows for the comparison of the results for different time periods.

[52] See previous work of Bayoumi and Eichengreen for why they used this fairly homogenous sample of 21 industrial countries, including those non-European.

[53] Due to lack of data needed to calculate variable DISSIM for Greece, I exclude Greece from the analysis.

The country taken as a numèraire to estimate the suitability of a monetary union is Germany, because it is widely viewed as the core member of the euro area to which other potential participants need to converge.[54]

Table 2: Variables employed

Variable	Description
Exchange rate variablility: SD(e_{ij})	Standard deviation of the change in the logarithm of the end-year bilateral exchange rate.*
Business cycle synchronization: SD(Δy_i-Δy_j)	Standard deviation of the difference in the logarithm of real output between each country pair.
Dissimilarity of export commodity structure: $DISSIM_{ij}$	Sum of the absolute differences in the shares of agricultural, mineral and manufacturing trade in total merchandise trade.
Trade intensity: $TRADE_{ij}$	Mean of the ratio of bilateral exports to domestic GDP for the two countries.
Economic size: $SIZE_{ij}$	Mean of the logarithm of the two GDPs measured in U.S. dollars.

Notes: The data underlying the variable SD(e_{ij}) were obtained from the IMF´s International Statistics (IFS). BSC_{ij}, $SIZE_{ij}$ and $OPEN_{ij}$ were computed from the World Bank databases. $TRADE_{ij}$ was calculated using data from IMF Directions of Trade and World Bank databases, and variable $DISSIM_{ij}$ was sourced from the Monthly Statistics of Foreign Trade (OECD). * Nominal exchange rate.

Table 3: Formal derivation of the variables employed

Variable	Formal derivation
Exchange rate variablility	SD(e_{ij}) = SD[$\Delta(\log e_{ij}$]
Business cycle synchronization	BSC_{ij} = SD(Δy_i-Δy_j)
Dissimilarity of export commodity structure	$DISSIM_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left[\left\|A_{it}-A_{jt}\right\|+\left\|B_{it}-B_{jt}\right\|+\left\|C_{it}-C_{jt}\right\|\right]$
Trade intensity	$TRADE_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{ex_{ijt}}{y_{it}}+\frac{ex_{jit}}{y_{jt}}\right)$
Economic size	$SIZE_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left(\log y_{it}+\log y_{jt}\right)$

[54] Alternatively, the EU averages could be looked at, however, such data would tend to contain more noise that using a single frontrunner country as a comparative reference (In: Costa-i-Font and Tremosa-i-Balcells 2003).

The data underlying the variable $SD(e_{ij})$ were obtained from the IMF´s International Statistics (IFS). BSC_{ij}, $SIZE_{ij}$ and $OPEN_{ij}$ were computed from the World Bank databases. $TRADE_{ij}$ was calculated using data from IMF Directions of Trade and World Bank databases, and variable $DISSIM_{ij}$ was sourced from the Monthly Statistics of Foreign Trade (OECD).

5.2 Methodological Problems of Measurement

A few caveats concerning the measurement may be identified. Firstly, it should be noted that the OCA theory is a long run theory; it does not have operational precision for decision making in the short run.

Secondly, the transition process generates specific problems not considered in the OCA theory. The applicability of the OCA theory, particularly in the early stages of transition (1990-1992), may be thus lower.[55]

Thirdly, to predict the costs and benefits of euro adoption, various proxies are used. These may be inter-related between each other and inaccurate. For example, when measuring the symmetry of shocks, the nature of the shock (demand or supply shock, transitory or persistent) is unknown.

Lastly, a potential concern with the specification is that the independent variable may influence the dependent variable, i.e. there is a potential influence of exchange rate variability on the volume of trade or growth. To reduce such influence, standard deviation of the volume of bilateral trade and output is taken.[56]

Overall, though operational precision of OCA theory is lower, it still serves as a suitable framework for thinking about monetary integration and provides an explanation for the recent monetary integration processes in Europe.

[55] For more information about specificity of the transition process concerning the OCA theory see Goldberg (1999), Horvath and Komarek (2002a), and Schweickert (2001).

[56] While changes in bilateral rates are not independent, the standard deviations of these rates are independent as the covariances can differ across pairs of countries. In: Bayoumi and Eichengreen (1998a).

6 Exchange Rate Variability and the OCA Criteria: Static Analysis

This chapter provides discussion on the evolution of the traditional OCA criteria in time thus enabling us to better evaluate the degree of structural convergence of the Slovak Republic to the E(M)U.

At present, the Slovak koruna participates in the ERM II. Table 4 provides the information about the exchange rate regime in Slovakia over the last decade and Table 5 presents the evolution of the exchange rate variability from 1994 to 2004.

Table 4 Exchange rate regime in the Slovak Republic over the last decade

Date	Exchange Rate Regime	Currency Basket/ Target Currency	Fluctuation Band
14-Jul-94	Peg	DEM(60%), USD(40%)	±7%
01-Jan-96	Peg	DEM(60%), USD(40%)	±3%
31-Jul-96	Peg	DEM(60%), USD(40%)	±5%
01-Jan-97	Peg	DEM(60%), USD(40%)	±7%
02-Oct-98	Managed Float	Reference currency euro since 1999	
25-Nov-05	ERM II		±15%

Source: Babetskii (2004).

From Table 5 it is clear that the actual volatility of exchange rates has been decreasing over time and a substantial convergence of exchange rates with the euro has taken place. The only exception is the year 1999, which can be explained by the substantial nominal exchange rate depreciation in the period mid-1998 through mid-1999, following the transition from a fixed to a managed floating exchange rate regime in October 1998.

Table 5 Volatility of nominal exchange rates[1]

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	1994-2004
SR-Germany	0.026	0.021	0.008	0.021	0.014	0.343	0.016	0.008	0.006	0.012	0.015	0.045

Note:[1] Own computations based on estimating equation (1) using quarterly data.
Source: IMF International Financial Statistics.

The following part provide an analysis of the structural similarity between the Slovak Republic and Germany (and/or the EU/EMU) using the criteria proposed by the OCA theory. Hence, the evolution of the economic processes and structures in the Slovak Republic and the probability of the Slovak economy being hit by real asymmetric shocks can be assessed.[57]

6.1 Synchronization of Business Cycles

In relation to euro adoption and simultaneous surrender of independent monetary policy, it is essential to assess the degree of synchronization of the economic development in Slovakia with the development in the euro area. Precisely, it is advantageous to adopt single currency if the business cycle of the country concerned is similar to that of the rest of the union and if a similar cyclic development is sustainable in the future.[58]

Bayoumi and Eichengreen (1997a,b and 1998a) propose to measure the business cycle correlation by the variable SDY, which represents the standard deviation of percentage changes in the relative output of the Slovak Republic and Germany, and EMU. Thus, a low value of this variable indicates a relative symmetry in business cycles, and vice versa. This measure is computed from annual data and the period under analysis was divided into two time sections, i.e. 1993-1997 and 1998-2004 with respect to Germany and the EMU (Table 6).[59]

According to the results reported in Table 6, we can state, that business cycles of the Slovak Republic and euro area are slightly, but still synchronized. Increased convergence was achieved during the period 1993-1997, whereas the business cycles began to diverge slightly over the years 1998-1999 and 2002. Since the mid 1990s, the Slovak Republic has experienced stronger real GDP growth, and wider output fluctuations than the euro area. Additionally, this different cyclic development may be attributed partly to various reforming and stabilization programs: in the period of 1998 – 1999 the growth

[57] I use yearly data for the following estimations. Data for the Slovak Republic are available only for 1993-2004.
[58] NBS (2006). For an overview of literature dealing with the business cycle synchronization of the Slovak economy and the euro area see also Artis et al. (2004), Boone and Maurel (1999), Komarek et al. (2002).
[59] The period is divided here into two sub-periods to provide more compact evolution of business cycle synchronization; year 2002 is depicted to show the impact of different growth rates between Slovakia and the euro area.

in the Slovak Republic decreased (due to economic restructuring, consolidation of public finances) while the euro area was experiencing stagnation; in 2002 (expansive policy, slowdown of reforms) growth in the Slovak Republic was high while the euro area stagnated. Nevertheless, stronger synchronization of cycles can be expected in the future, after finalization of essential reforms.[60]

Table 6 Variable SDY:Synchronization of business cycles of Slovakia and Germany/EMU

	1993 -1997	2002	1998 – 2004	1993 – 2004
SR – Germany	0.031	0.045	0.023	0.026
SR – EMU	0.030	0.036	0.023	0.025

Source: IMF IFS, own calculations.

Overall, the asymmetry is significantly lower for the second period (1998-2004), indicating a certain degree of structural convergence to Germany. Surprisingly, variable SDY does not reveal any significant difference in relation to EMU: the symmetry is only marginally better than that of Germany. Gradual integration with the EU has contributed to higher synchronization of the business cycles between the areas under analysis, and this trend is likely to continue in the future. [61]

On the basis of business cycle synchronization criterion the suitability of monetary union between Slovakia and the said areas cannot be excluded; costs of introducing a single currency should not be high.

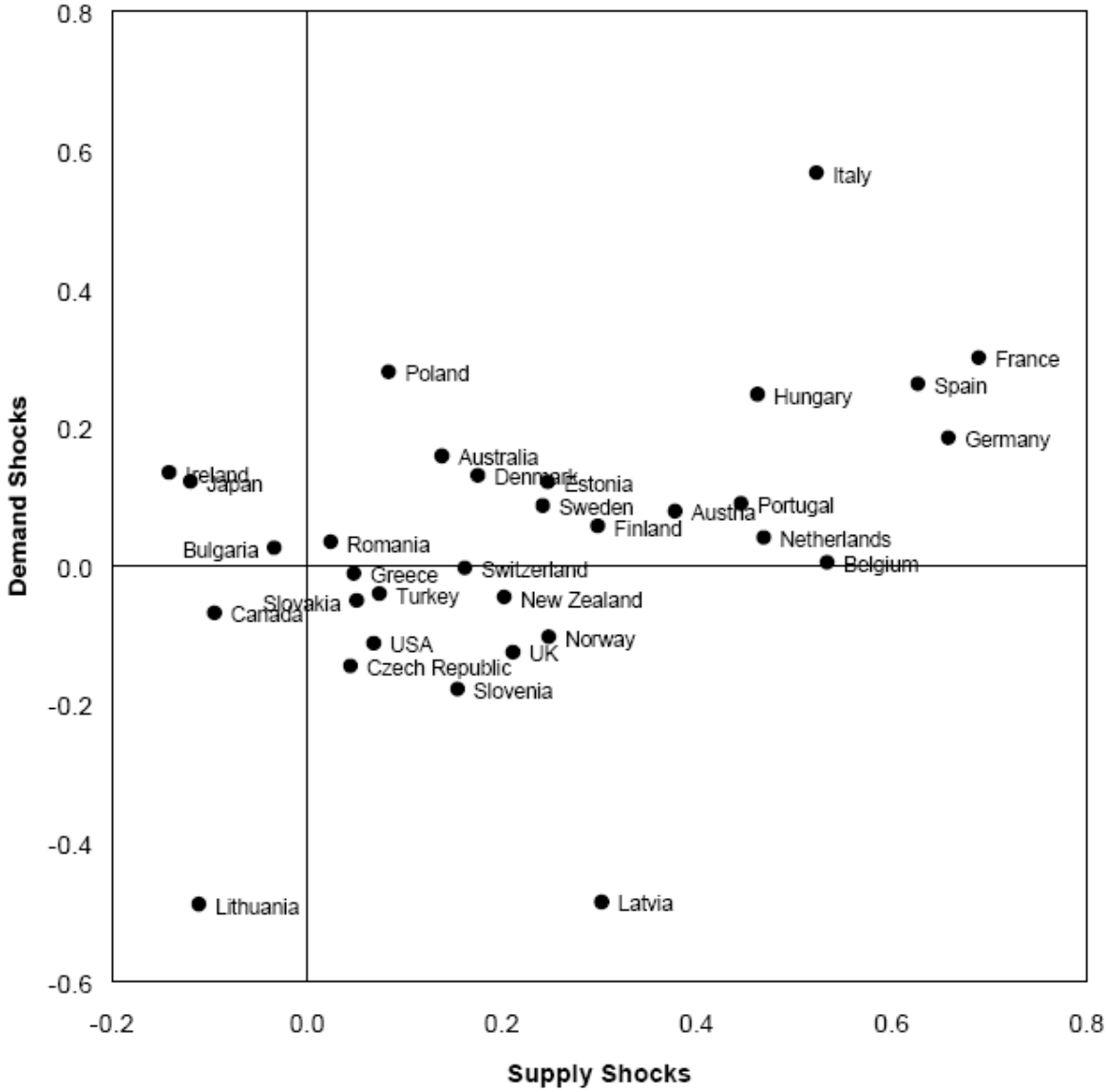
6.2 Symmetry of Shocks

The response of two economies to demand and supply shocks has a crucial impact on the direction of the development of synchronization of business cycles of such economies in the future. If they respond symmetrically, they are likely to get synchronized in the course of time. The level of correlation of demand and supply shocks between the countries of the euro area and the new EU member countries in the 1990s is depicted in Figure 9.

[60] NBS (2006).
[61] See Frankel (2004).

From Figure 11 it follows that the correlation of supply and demand shocks between the Slovak Republic and the euro area was close to zero in the 1990s, suggesting that Slovak

Figure 11 Correlation of Supply and Demand Shocks with Euro Area



Note: Shocks are recovered from estimated structural VAR models of output growth and inflation.
Source: Fidrmuc, J. and Korhonen, I. (2001).

economy responded rather neutrally to both supply and demand shocks. However, responses of nearly all new EU member states (except for Poland and Hungary) are largely similar. Behaviour of Spain (or Portugal and Greece to a certain extent), on the other side, is currently

in strong symmetry with the euro area even though at the time of its entry to the euro area its behaviour was similar to the Slovak Republic at present.[62] Thus, closer cooperation and more intensive trade may bring about even higher symmetry of responses to shocks and higher synchronization of business cycles between the euro area and Slovakia in the future, as proclaimed by the "endogenous view" of the OCA theory.

Fidrmuc and Korhonen (2003) study symmetry of shocks in Slovakia and euro area using the VAR method for GDP growth and growth rate of GDP deflator and find that correlations for the Slovak Republic are close to zero, demand shocks are very moderately symmetric and supply shocks are symmetric.[63] On the contrary, study elaborated by the National Bank of Slovakia (2006) finds using the VAR method for GDP growth rate, rate of real appreciation and inflation rate that correlation of supply shocks between the Slovak Republic and the euro area is significantly positive while correlation of real and nominal demand shocks is weaker.[64]

6.3 Economic Openness and Foreign Trade Orientation

The Slovak Republic is small, highly open economy, with a share of foreign trade (the sum of export and import) to GDP raising from 118 % in 1993 to 162 % in 2005 (Table 7). The indicator of economic openness shows that the Slovak economy is highly integrated into the international economy, with this indicator being greater than e.g., in Portugal or Greece at the same point of time prior to their euro area accession.[65]

Table 7 Variable OPEN: Openness of the Slovak economy

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
EMU	52	54	57	58	62	63	64	73	72	70	68	71
Germany	45	46	47	49	54	56	58	66	68	67	67	71
Slovakia	118	114	114	119	123	130	127	144	155	151	157	156

Source: IMF IFS.

[62] National Bank of Slovakia (2006).
[63] Using quarterly data, 1991 – 2002 for euro area and 1993 – 2002 for Slovakia.
[64] Using quarterly data for the period of 1994 – 2005.
[65] The value of the indicator of economic openness for Portugal was 80 % in year 1994 and for Greece it accounted for around 45 % in 1996.

According to McKinnon (1963), the more open the economy, the lower the benefits of flexible exchange rates, i.e., the benefits from a monetary integration increase with the degree of openness. In this respect, Slovakia as a small highly open economy is assumed to find it beneficial to join euro area.

Clearly, the Slovak Republic has a greater degree of trade openness than the euro area average; with the major part of its trade occurring with the EU - Slovakia's most important business partner whose importance continues to increase (Tables 8 – 10). Since the entry of the Slovak Republic and neighbouring countries to the EU, share of foreign trade has constituted around 85 %.[66]

Table 8 Structure of Slovak exports by territory (%)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Germany	18.8	21.2	23.7	28.8	27.7	26.8	27.0	26.0	30.8	28.7	26.1
EMU	34.8	38.6	44.3	52.8	56.0	55.5	55.5*	56.2	56.8	54.6	52.5
EU 15	37.4	41.3	47.1	55.7	59.4	59.0	59.9	60.6	60.6	59.6	57.77
EU 25										85.2	85.4
EU15+CR,HU,PL**	81.6	81.7	82.3	86.3	87.3	87.1	87.7	86.5	83.2	83.7	83.8

Note: *including Greece
Source: Slovak Statistical Office.

Table 9 Structure of Slovak imports by territory (%)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Germany	14.3	14.6	19.7	25.7	26.1	25.1	24.7	22.6	25.5	23.4	21.0
EMU	31.2	33.9	29.7	46.5	48.0	45.1	46.0*	46.4	47.8	48.1	46.3
EU 15	34.8	37.3	43.8	50.1	51.7	48.9	49.8	50.3	51.4	51.3	49.3
EU 25										73.6	71.1
EU15+CR+HU+PL**	67.5	66.1	69.8	73.5	73.5	68.8	70.7	71.4	72.6	72.1	69.7

Note: *including Greece
Source: Slovak Statistical Office.
Note to tables 8 – 9: ** EU15 + Czech Republic, Hungary, Poland

In connection with entry of the Slovak Republic to the EMU it is also important to take into consideration the share of the EU in foreign trade of Slovakia, since it is foreign trade through which disturbances can be imported into the economy. As the asymmetric orientation

[66] However, the higher economic openness and closer economic cooperation does not automatically lead to the convergence of business cycles. This Krugman´s specialization hypothesis may be possibly offset by flexibility of labour market and the development of intra-industry foreign trade.

of foreign trade stands for a typical source of real idiosyncratic shock, countries whose trade orientation differs substantially may be hit by various shocks at different times.

The differences for the Slovak and E(M)U economies can be attributed mainly to relatively high economic linkages of the Slovak economy to the Central and Eastern European Countries (CEECs)[67] compared to its little impact on the E(M)U. Whilst in 2005 85 % of Slovak export was directed into the EU members states, Slovakia's share in the total exports of the EU is only 0.3 %. The same is true for imports: in 2005, imports from the EMU constituted 46 % and import from the EU member states constituted around 70 % out of the total import into the Slovak Republic (See Tables 9-10).[68] Under such conditions, a sudden crisis in the region would stand for a much bigger shock for Slovakia than for Germany, the EMU or the EU.

However, these large asymmetries of the trade orientation between the Slovak and E(M)U economies appear to decline over time as the Slovak economy structurally converges with the E(M)U. This proposition is supported with the increasing share of mutual trade in GDP. Table 10 reports the development of such measure - TRADE (Bayoumi and Eichengreen, 1997a,b and 1998a), which expresses the mean of the ratio of bilateral exports to GDP for the three areas concerned: the Slovak Republic and Germany (the EMU, the EU). The individual values of this variable have no informative value (apart from being a means of cross-country comparisons), but their upward trend clearly demonstrates continued convergence in all areas under analysis.

Table 10 Variable TRADE: average share of bilateral exports in GDP

	1999	2000	2001	2002	2003	2004	1993-1998	1999-2004	1993-2004
SR-Germany	0.140	0.159	0.166	0.156	0.232	0.212	0.125	0.177	0.136
SR-EU 15	0.299	0.348	0.364	0.360	0.391	0.366	0.242	0.354	0.269
SR-EMU 12	0.283	0.328	0.341	0.337	0.372	0.348	0.231	0.335	0.254

Source: DOTS OECD, own calculations.

[67] The Czech Republic, Poland and Hungary accounts for almost 25 % of Slovak exports.
[68] Data for year 2005.

6.4 Commodity structure of foreign trade

The commodity structure of foreign trade is another factor indicating the structural similarities or dissimilarities between the economy of the Slovak Republic and those of Germany, the EU and EMU. If the existing bilateral trade is based on comparative advantage (inter-industry trade) then the tradable sector of the Slovak economy is forced to specialize and becomes more vulnerable to various fluctuations. If, on the other side, the majority of trade is based on intra-industry exchange, the economies are converging in terms of structure.[69]

Since it is difficult to compute the actual proportion of inter- versus intra-industry trade, I provide a simplier measure of the structural similarity or difference between the Slovak and German economies, expressed in terms of the DISSIM variable (Bayoumi and Eichengreen, 1997a,b and 1998a). This variable serves as a second proxy for the asymmetry of shocks based on the fact that industry-specific shocks are more symmetric when two countries have a revealed comparative advantage in the same export sectors.[70] It is defined as the sum of the absolute differences between the weights of agricultural products, mineral raw materials, and manufactured goods in total exports (SITC classification). The sum of the absolute differences of the shares of these categories in the total of the two economies represents a measure of similarity of trade commodity structures. Computation of this measure between the Slovak economy and the E(M)U requires the commodity structure of the total E(M)U trade, which is however not available.

Table 11 shows evolution of the DISSIM variable, absolute values of which are again difficult to interpret, but the movement in time (up to 1998) reflects convergence. Even though the values of this variable have been rising over the period 1999-2000, subsequent downward trend seems to show that the structure of the Slovak economy is again getting adapted to economy of Germany. Though it might be only temporary change, it is necessary to take into consideration possible risks arising from narrow specialization of the Slovak economy on automobile industry.[71]

[69] Cincibuch and Vávra (2002) .
[70] Bayoumi and Eichengreen (1998a).
[71] The results may be, however, different for the E(M)U as a whole, but the data are not readily available.

Table 11 Variable DISSIM: dissimilarity of export commodity structure

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SR-Germany	0.158	0.143	0.151	0.129	0.119	0.089	0.120	0.145	0.142	0.126	0.094	0.117

Source: Monthly Statistics of Foreign Trade (OECD), NBS, calculation on the basis of SITC nomenclature at one digit level; own calculations.

The following table (Table 12) may shed more light on above mentioned sudden rise in dissimilarity by providing more detailed information of the structure of trade of the Slovak Republic. It represents commodity structure according to the classes of SITC nomenclature and its evolution in time. Clearly, the highest change since 1993 has been reported within the class of SITC 7 (almost 25% rise from 1993 to 2004), which may be attributed to the rising share of the automobile sector in the total exports of the Slovak Republic. This issue is briefly touched on in the text below.

Table 12 Commodity structure of Slovak foreign trade (in %)

Commodity type	Import			Export		
	1993	2001	2004	1993	2001	2004
Food and live animals	7.3	4.6	4.0	5.5	2.7	2.9
Beverages and tobacco	1.5	0.8	0.6	0.9	0.4	0.3
Crude materials, inedible, Except fuels	5.2	3.7	3.7	4.9	3.3	2.6
Mineral fuels and Lubricants	20.9	15.2	12.4	4.9	6.6	6.7
Animal and vegetable oils	0.2	0.3	0.2	0.1	0.1	0.2
Chemicals	11.4	10.3	9.8	12.0	7.3	5.4
Manufactured goods	15.1	18.5	19.0	38.8	27.3	24.9
Machinery and transport Equipment	29.3	37.6	39.7	19.4	38.5	46.0
Miscellaneous manufactured articles	9.0	9.0	10.4	13.4	13.5	11.0
Others	0.2	0.0	0.1	0.1	0.1	0.1

Source: Slovak Statistical Office, NBS.

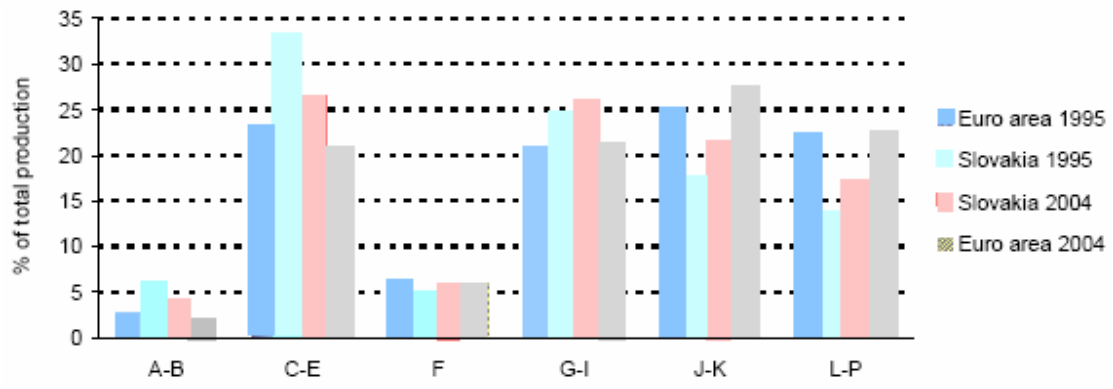
6.4.1. Economy Structure

Structure of economy is another factor influencing the probability of asymmetric shocks or asymmetric impact. If the structure of the Slovak economy is substantially different

from the euro area, even the same shocks may have different impact on the Slovak Republic and elicit asymmetric business cycles. Likewise, with a different structure of the economy it is more likely that shocks from domestic environment will be different from those taking place outside Slovakia.

Figure 12 shows the proportion of individual sectors in NACE-6 classification. Over the last 10 years the structure of Slovak economy has markedly approximated the structure of the euro area, particularly in agriculture, industry, financial and public services, and also building industry. However, in some private services differences have even deepened. In the future, a certain divergence of industry is expected, due to anticipated growth of car production in the Slovak Republic. In 2004, automobile sector constituted 30.7 % of total exports and in the same year the Slovak Republic has become a number one car producer per capita in the world.[72] From 2006, the share of car production in GDP in the Slovak Republic will be three times higher than in the euro area. However, considering the fact that the Slovak automobile sector has relatively good capacity to cope with possible negative shock without reducing output and employment and since monetary policy is not able to influence (help) this sector, the waiver of independent monetary policy should not represent higher exposure to the shocks in the Slovak automobile industry.[73]

Figure 12 Comparison of economic structure of Slovakia and euro area



Note: A-B: agriculture, hunting and fishing, C-E: manufacturing total, F: construction, G-I: services – wholesale and retail trade, repairs, hotels and restaurants, transport, storage, communication, J-K: financial intermediation, real estate, renting, L-P: public administration, defence, social security, education, health care, social services. Source: NBS (2006).

[72] In: http://www.financnik.sk/financie.php?did=243&article=82
[73] National Bank of Slovakia (2006).

On the whole, structure approximation continues and Slovakia should become even more synchronized with euro area.

6.5 Economic size

All the above discussed variables[74] measure the probability of real asymmetric shocks between concerned economies, which would transform themselves into macroeconomic costs in the absence of flexible exchange rates.

Benefits, on the other hand, stemming from the adoption of a single currency may be approximated by the relative size of the Slovak economy (Bayoumi and Eichengreen, 1997a,b and 1998a). These benefits are the greatest for small countries where there is least scope for utilizing a separate national currency in transactions. Small economies should benefit the most from unit of account, means of payment, and store of value services provided by a common currency.[75] Such advantages are expressed in terms of the SIZE variable, which is defined as the arithmetical average of the logarithms of real GDP in the Slovak Republic and the areas concerned (Table 13). The upward trend in the absolute values of this variable reflects increasing transaction values for the use of national currencies over time. Comparing the transaction values for Germany, EMU and the EU shows that the transactional advantages of using a common currency are greater for smaller areas (Slovakia and Germany) than those for larger ones (Slovakia and the EU or Slovakia and EMU).

Table 13 Variable SIZE: relative size of the Slovak economy and related areas

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SR – Germany	4.39	4.43	4.46	4.49	4.52	4.55	4.56	4.58	4.61	4.63	4.65	4.68
SR – EMU	4.88	4.92	4.96	4.99	5.02	5.05	5.07	5.09	5.12	5.14	5.16	5.19
SR – EU	4.99	5.03	5.07	5.10	5.13	5.16	5.18	5.21	5.23	5.26	5.28	5.31

Source: IMF IFS, own calculations.

[74] Except for the degree of openness.
[75] Bayoumi and Eichegreen (1998a).

6.6 Cross-country comparison of the selected OCA criteria

Table 14 shows the degree to which the relevant OCA criteria were fulfilled by the selected EU countries and Slovakia over the years 1990-2004.

Table 14 Selected OCA criteria in the EU and Slovakia, 1990-2004

Country	Exchange rate Variability*	Business cycle synchronization*	Trade links*	Dissimilarity of export com.structure*	Inflation	Openness
Austria	0,002	0,009	0,119	0,059	2,3	80
Belgium	0,004	0,014	0,154	0,171	2,1	146
Denmark	0,005	0,020	0,064	0,497	2,1	72
Finland	0,020	0,044	0,042	0,159	2,0	64
France	0,005	0,015	0,061	0,216	1,9	48
Greece	0,011	0,026	0,017		8,5	48
Germany					2,0	56
Ireland	0,011	0,033	0,082	0,202	2,9	145
Italy	0,020	0,014	0,052	0,045	3,6	47
Netherlands	0,001	0,015	0,152	0,484	2,6	113
Portugal	0,011	0,016	0,042	0,151	5,1	68
Spain	0,013	0,017	0,032	0,245	3,9	48
Sweden	0,020	0,027	0,043	0,137	2,7	72
United Kingdom	0,020	0,027	0,043	0,155	3,3	54
EMU	0.0098	0,010	0.062	0.173	3.35	62
Slovakia	**0.018**	**0,069**	**0,136**	**0.132**	**8,3**	**127**

Note: * vis-à-vis Germany. Based on yearly data. Data for Slovakia are available only for 1993-2004. Exchange rate variability estimations are based on quarterly data, estimated for 1990-1998. Annual CPI Inflation averaged over 1990-2004, in percentage points. Openness is expressed in percentage points and is calculated for each economy as the average of the fifteen annual ratios in the 1990-2004 period. For details on how the variables have been calculated, see Appendix 1. Averages for the EMU are simple and not weighted.

Clearly, very low actual exchange rate variation persists in the core EU countries. The Slovak Republic, however, together with Sweden and United Kingdom form a sort of periphery. Symmetry of the shocks in the EU core is relatively high. Asynchrony of the shocks between Slovakia and Germany is above the EMU average, with value of 0.069. TRADE values reach hights of 12-15 percent in cases such as Austrian-German, Belgian-German and Dutch-German trade, thus distinguishing core from periphery countries. In the Slovak Republic, trade integration is very high, reaching level typical for the EU core.

This extensive trade implies that the Slovak Republic is likely to benefit more from stability of exchange rates, and according to the endogenous view of the OCA theory their business cycles are more likely to become more correlated.

Distinguishing core from periphery is more difficult when it comes to dissimilarity in export commodity structure compared with the business cycles. Nevertheless, the dissimilarity of exports of the Slovak Republic is lower than the EMU average. Concerning the average annual consumer price inflation, it comes as no surprise that Austria, Germany, France, Denmark and Finland form a core, while the Slovak Republic is an outer periphery, though it did slightly better than Greece.

7 Exchange Rate Variability and the OCA Criteria: Dynamic Analysis

7.1 Dynamic analysis

So as to test empirically the relationship between the nominal exchange rate variability and the OCA criteria discussed above, I make use of a simple econometric model:

$$\mathbf{SD(e_{ij}) = \beta_0 + \beta_1 SD(\Delta y_i - \Delta y_j) + \beta_2 DISSIM_{ij} + \beta_3 TRADE_{ij} + \beta_4 SIZE_{ij} + e_{ij}} \quad \mathbf{(2)}$$

All of the above series of variables are stationary (variables $SD(e_{ij})$ and variability of output corrected for stationarity). The data does not show significant multicollinearity problems.[76] The estimation method is the standard OLS using panel data analysis.

Before continuing with the statistical analysis, it is important to analyse to what extent the assumptions regarding the classical linear regression model are satisfied. For the standard errors and statistical tests to be valid, we need to exclude both autocorrelation and heteroscedasticity. Autocorrelation is not an issue, given that there is no natural ordering in the data and countries are randomly sampled. The normality assumption holds, the results of Ramsey's RESET test do not indicate serious model mis-specification. The assumptions of linearity of parameters, normally distributed and homoscedastic residuals are fulfilled on an acceptable level of significance of at least 5 or 10 %.[77]

Conforming to the economic theory, the expected signs of the explanatory variables are as follows: the exchange rate variability is expected to be positively dependent on the business cycle synchronization, size of the economy and on the dissimilarity in the commodity structure of exports, and negatively dependent on the trade linkages.

Estimation results from equation (2) are shown in Table 15 for the period 1980-1998 (1980s-1990s) and 1990-1998 (1990s) for 20 industrial countries. Results confirm the initial predictions; all four variables have the anticipated signs and coefficients differ from zero

[76] For details see Appendix 2, Table 22. For descriptive statistics see Appendix 2, Table 21. For unit root tests see Appendix 2, Table 23.

[77] Heteroscedasticity does not seem to be a problem. Nevertheless, it is appropriate to check for heteroscedasticity. White´s general test for heteroscedasticity was conducted. Provided results of the test, I may conclude that there is homoscedasticity in the error variance. The results are available upon request.

at the one percent confidence level in both specifications. This can be deemed as strong support of the empirical implications of the OCA theory. Greater trade linkages robustly decrease bilateral exchange rate variability, while variability of output and dissimilarity in the commodity structure of bilateral exports tends to increase it. The most important variables for determining the OCA index are variability of output and trade linkages. Trade linkages, for example, are influential as a rise of one percentage point in the mean of the ratio of bilateral exports to domestic GDP for the two countries reduced the exchange rate variability in the 1990s by almost 12 %. Moreover, there is some tendency for this coefficient to grow over time. A positive sign on the variable *SIZE* demonstrates that the lager the size of the country, the greater the exchange rate variability. The results suggest that the factors that exercise pressure on the nominal exchange rate (especially variability of output) are more important than the factors that normally tend to stabilize (such as trade linkages).

Table 15 Variability of actual exchange rates, results of estimation of equation (2)

	20 Industrial countries		**EU**	**EU**
	1980-1998	**1990-1998**	**1980-1998**	**1990-1998**
Variability of output	0.342	0.325	0.265	0.226
	(0.061)*	(0.049)*	(0.079)*	(0.064)*
Dissimilarity of	0.008	0.007	-0.007	-0.006
Exports	(0.001)*	(0.001)*	(0.004)**	(0.005)
Trade linkages	-0.097	-0.115	-0.045	-0.056
	(0.017)*	(0.026)*	(0.015)*	(0.018)*
Size of economy	0.005	0.005	0.003	0.003
	(0.0004)*	(0.0006)*	(0.001)*	(0.001)*
Number of observations	190	190	78	78
R-squared	0.50	0.46	0.26	0.28
S.E.E.	0.005	0.007	0.004	0.005
F-statistic	47.15	39.04	6.6	7.03

Note: EU – Luxembourg was excluded from the sample for lack of an independent currency and exchange rate. Austria, Finland and Sweden were counted as EU member states for the entire sample period, though they became member states only in January 1995. Thus, the sample embodies 14 EU countries.
Standard errors reported in parenthesises. *,** denotes significance at 1 and 5 % level respectively.

All variables are jointly significantly different from zero, suggesting that the OCA criteria do explain some of the variability of exchange rates. The strength of the regressions in terms of their predictive power compares fairly well with the results find by Bayoumi and Eichengreen (1997a,b and 1998a). For the period of 1980-1998 the equation explains

50 % of variation in exchange rates whilst Bayoumi and Eichengreen (1997a) find an R^2 of 51 %.[78] However, the value of R^2 for the 1990s is lower than for the 1980s-1990s, which may support the hypothesis that traditional OCA criteria explain less of the variability of the exchange rates in the 1990s than 1980s. A possible explanation for this may be found in the advances in monetary integration in the EU and the financial crisis of the European Monetary System in 1992-1993.[79]

Table 15 presents also estimates for the sub-sample of the EU countries only. The strength of the regressions in terms of their predictive power is lower and dissimilarity of export commodity structure has negative sign; however, this complies fairly well with the results find by Bayoumi and Eichengreen (1997a).[80]

As an alternative to variable $SIZE_{ij}$, I include a proxy for openness to international trade ($OPEN_{ij}$), as suggested by McKinnon. This variable (likewise the size of the economy) measures the benefits from stabilizing the exchange rate. Variable $SIZE_{ij}$ is not used in the following model due to its close theoretical and empirical correlation with the degree of openness measure. In addition, it can be tested whether openness is a better measure of the benefits from a stable currency. The proxy for openness is calculated as the arithmetic mean of the i-th and j-th country's ratio of trade (export + import) to its GDP:

$$\mathrm{OPEN}_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{ex_{it}+im_{it}}{y_{it}}+\frac{ex_{jt}+im_{jt}}{y_{jt}}\right),$$

where ex_{it} and im_{it} are exports and imports of country i, and y_{it} is i-th country GDP at time t, all at current prices (analogously for country j). Variable $OPEN_{ij}$ was computed from the World Bank database. The expected sign of openness is said to be theoretically indeterminate.[81]

The estimated equation is as follows:

$$\mathbf{SD(e_{ij}) = \beta_0 + \beta_1 SD(\Delta y_i - \Delta y_j) + \beta_2 DISSIM_{ij} + \beta_3 TRADE_{ij} + \beta_4 OPEN_{ij} + e_{ij}} \qquad \mathbf{(3)}$$

[78] Nominal variability for the 1980s, for details see Appendix 2.
[79] See Horváth, R. (2005).
[80] See Appendix 3, Table 26.
[81] See Isard (1995) In: Horvath et al. (2003)

The results of the estimation of equation (3) are in Table 16, column I and II. The explanatory variables are typically significant with the expected signs in both specifications. Furthermore, the value of the coefficients is to a large extent stable, when comparing results from estimation equation (2) and (3) for both periods. Output variability and trade linkages are becoming increasingly significant over time. Greater openness is associated with smaller exchange rate variability. This may suggest that more open economies fear floating.[82]

Table 16 Variability of actual exchange rates, results for estimation of equation (3)

	21 Industrial Countries		EU	EU
	(I) 1980-1998	(II) 1990-1998	(III) 1980-1998	(IV) 1990-1998
Variability of output	0.226	0.250	0.188	0.174
	(0.062)*	(0.050)*	(0.069)*	(0.062)*
Dissimilarity of	0.005	0.004	-0.007	-0.006
Exports	(0.001)*	(0.001)*	(0.004)**	(0.004)
Trade linkages	-0.069	-0.867	-0.024	-0.034
	(0.016)*	(0.023)*	(0.016)	(0.017)**
Openness	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0001)*	(0.0001)*	(0.0000)*	(0.0000)**
Number of observations	190	190	78	78
R-squared	0.46	0.41	0.25	0.26
S.E.E.	0.006	0.007	0.004	0.005
F-statistic	39.03	32.43	6.21	6.44

Note: EU – Luxembourg was excluded from the sample for lack of an independent currency and exchange rate. Austria, Finland and Sweden were counted as EU member states for the entire sample period, though they became member states only in January 1995. Thus, the sample embodies 14 EU countries.
Standard errors re ported in parenthesises. *,** denotes significance at 1 and 5 % level respectively.

Contrary to the estimations of Bayoumi and Eichengreen (1997a,b), the variable openness is significant and explains a considerable degree of the exchange rate variability, indicating that a more open economy is inclined to fix its currency in the 1990s. Interestingly, the usage of openness as a proxy for explaining the exchange rate variability rather than the size of the economy does not increase the explanatory power of the model; on the contrary, the R^2 and the joint significance of the variables diminishes. It is thus

[82] Calvo and Reinhart (2002). In: Horvath, J. (2005).

ambiguous whether openness is a better proxy for explaining the exchange rate variability in the 1990s rather than the size of the economy. Table 16, column III and IV show estimates for the sub-sample of the EU countries. Again, the strength of the regressions in terms of their predictive power is lower than for the sample of developed countries; dissimilarity of export commodity structure has negative sign.[83]

7.2 Sensitivity analysis

In order to assess the robustness of the above relationship and give some insights into the sensitivity of the estimates, I control for several additional factors and test various alternative specifications. Thus, besides the set of "traditional" OCA criteria, other relevant factors explaining exchange rate volatility are employed and these are as follows:

(a) the level of financial development (FIN_{ij}), capturing Ingram´s (1962) criterion of OCA stating that a stable and developed financial system should reduce the need for exchange rate adjustments,

(b) the inflation rate differential ($INFL_{ij}$), representing the criterion of similarity of inflation rates proposed by Fleming (1971), according to which with low and similar inflation rates between countries terms of trade remain fairly stable as well. Thus, the need for nominal exchange rate adjustments is reduced, through more equilibrated current account transactions and trade.

(c) the proxy $DOLVAR_{ij}$ for international regime, which captures the influence of the variability of U.S. dollar exchange rate on the exchange rates variability in the countries under analysis,

(d) a dummy variable that takes a value of 1 if countries i and j are both European ($EUROPE_{ij}$), capturing the potential difference in terms of exchange rate volatility between European and non-European countries,

[83] All the abovementioned estimations can be compared with the results of Bayoumi and Eichengreen (1997a), which are based on the data from 1960s to 1980s and reported in Appendix 3 – Table 25 for 21 developed countries and Table 26 for European economies.

(e) a dummy variable EUcore*ij* that tests the hypothesis of significantly higher real convergence among Germany, Austria, Belgium, the Netherlands and Switzerland.[84]

Table 17 presents description and measurement of the additional variables.

Table 17 Description and measurement of the additional variables

Variable	Description and formal derivation
Inflation differential: $INFL_{ij}$	Mean of the difference in the year-on-year CPI inflation rates for the two countries. $INFL_{ij} = \frac{1}{T}\sum_{t=1}^{T}(\pi_{it} - \pi_{jt})$
Financial development: FIN_{ij}	Mean of the M2 to GDP ratios of each country pair. $FIN_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{M2_{it}}{y_{it}} + \frac{M2_{jt}}{y_{jt}}\right)$
USD variability: $DOLVAR_{ij}$	$DOLVARij = \begin{cases} \psi \; if \; i \vee j \neq USA \\ 0 \quad otherwise \end{cases}$, where $\psi = \frac{1}{2}(SD[\Delta(\log e_{it})] + SD[\Delta(\log e_{jt})])$ SD denotes sample standard deviation, e_{it} represents the exchange rate of country *i* against the USD, and Δ is the change in the given variable from time *t* to *t+1* (analogously for country *j*).

Note: The data underlying the variables $DOLVAR_{ij}$ and FIN_{ij} were obtained from the IMF´s International Statistics (IFS). $INFL_{ij}$ was computed from the World Bank databases.

This means that I estimate the following equation:

$$\mathbf{SD(e_{ij}) = \beta_0 + \beta_1 SD(\Delta y_i - \Delta y_j) + \beta_2 DISSIM_{ij} + \beta_3 TRADE_{ij} + \beta_4 SIZE_{ij} + \beta_5 OPEN_{ij} + \beta_6 INFL_{ij} + \beta_7 FIN_{ij} + \beta_8 DOLVAR_{ij} + \beta_9 EUROPE_{ij} + \beta_{10} EUCORE_{ij} + e_{ij}} \quad \mathbf{(4)}$$

Concerning the expected signs of the additional variables, it is expected that the variable $DOLVAR_{ij}$ will take positive value as the higher variability of U.S. exchange rate should yield higher actual bilateral exchange rate for all the countries in the sample. Variable FIN_{ij} should be negatively related to the exchange rate variability, as financially developed countries are likely to exhibit more stable exchange rates. Since greater inflation differentials tend to be associated with less stable exchange rates, the exchange rate variability is expected to be positively dependent on the variable $INFL_{ij}$.

[84] See Bayoumi and Eichengreen (1993) for reasoning on why Switzerland was included in the sample.

The results are reported in table 18, together with sub-sample of the EU countries.[85] Generally, the variables have the expected signs and are jointly significantly different from zero. R^2 is also relatively high. The F tests indicate that the model is statistically significant throughout the specifications. The models appear well specified; high adjusted R^2 for 1980s-1990s suggests that around 76.0 % of variation in exchange rates can be attributed to variations in all explanatory variables acting together. However, the general quality of the regression declines, as several variables are no longer significant when the dummies are included. In remaining specifications, the additional variables add little to the explanatory power of the regression (as measured by the R^2).

Again, as the R^2 is lower for the 1990s only, the results confirm the hypothesis that the model explains more of the exchange rate variability in the 1980s than in the 1990s.

Table 18 Variability of actual exchange rates

	1980-1998	1990-1998	1990-1998	1990-1998	EU 1990-1998	EU 1990-1998
Output disturbances	0.104	0.299	0.296	0.332	0.191	0.097
	(0.047)**	(0.055)*	(0.057)*	(0.057)*	(0.066)*	(0.053)***
Dissimilarity of exports	0.0014	0.006	0.0035	0.0059		0.001
	(0.001)	(0.001)*	(0.001)*	(0.002)*		(0.003)
Trade linkages	-0.036	-0.083	-0.083	-0.099	-0.023	-0.025
	(0.012)*	(0.017)*	(0.017)*	(0.017)*	(0.019)	(0.014)***
Size of economy	7.71E-04	0.0038		0.003	0.003	0.003
	(0.0006)	(7.4E-4)**		(0.001)*	(0.001)*	(8.25E-4)*
Openness	-5.61E-06		-1.21E-04	-3.73E-05		
	(1.02E-5)		(2.5E–5)*	(3.5E-5)		
Financial development	7.32E-04	-0.02	-0.091	-0.035	1.32E-4	
	(9.35E-4)	(0.04)	(0.037)**	(0.041)	(0.002)	
Inflation differential	1.59E-04	1.84E-4		4.60E-04	8.81E-4	8.35E-4
	(1.65E-4)	(5.2E-4)		(5.4E-4)	(5.3E-4)	(4.4E-4)***
Variability of dollar	0.037	0.005	0.004	0.004		0.844
	(0.021)**	(0.001)*	(0.001)*	(0.001)**		(0.124)*
Europe dummy	-0.011					
	(8.36E-4)*					
EU core dummy	-0.005	-0.009			-0.007**	
	(0.001)*	(0.002)*			0.002	
R^2	0.77	0.51	0.45	0.48	0.39	0.59
S.E. of Regression	0.0037	0.006	0.007	0.0067	0.004	0.004
F-statistics	61.75	23.82	25.01	21.01	7.69	17.00

Note: standard errors reported in parenthesises. *,**,*** denotes significance at 1%, 5% and 10% level respectively. Unless specified otherwise, estimates are for 20 developed countries.

[85] For details about OLS estimation results and diagnostic tests for the EU sub-sample, see Appendix 2, Table 24.

The asymmetry of business cycles is always significant at an acceptable level in explaining exchange rate variability. The coefficient on the dissimilarity of exports is not significant for the EU countries only, probably due to the fact that the EU countries exhibit both a large similarity in their output cycles and export structures. Hence, these two variables may convey the same information, which can explain the fact that the dissimilarity of exports is not significant.

Including the additional regressors does not change much the estimates of the traditional OCA variables, though their coefficients become somewhat less well defined. Nevertheless, a few of the new results are informative. As expected, greater variability of the U.S. dollar increases the exchange rate variability. Contrary to the findings of Horváth, R. (2005) and Fidrmuc and Korhonen (2003), the results suggest that the economic structure of the EU core countries (such as Germany and Austria) is significantly more similar than the economic structure of the "peripheral" countries. The coefficient of the European dummy is significantly negative, suggesting that the variability of exchange rates is lower in European countries, reflecting the existence of the ERM.

In general, the coefficients of the traditional OCA criteria retained their original signs and their magnitudes have changed only slightly due to specification. Estimating equation (4) based on different specifications, gives residuals improved diagnostics for normality and the results of Ramsey's RESET test improved as well. However, diagnostics for heteroscedasticity indicates some problems.[86]

On the whole, the variables proposed by the OCA theory seem to play a sufficient role in determining the bilateral exchange rate variability in the 1980s and 1990s. The empirical model used generates robust results in terms of the size and sign of the estimated parameters. Consequently, the robustness of the results allows applying it to the Slovak Republic, which is the purpose of the next section.

[86] Different institutional arrangements of the exchange rate regimes in the EU and high heterogeneity of exchange rate variability across countries provide good ground for heteroscedasticity. Where obtained, White´s method is used to obtain heteroskedastic-consistent standard errors.

7.3 The OCA index estimation for Slovakia

In chapter 6, the basic OCA features for the economies of the Slovak Republic, the EU and EMU were tested. Within the scope of individual OCA criteria, rather ambiguous results were obtained.[87] In case of the foreign trade orientation, persistent asymmetry was confirmed; this is, however, a sign of a benefit of EMU membership.[88] The correlation between the business cycles do indicate a convergence between the economies, which was however, slowed down by the structural changes that affected the Slovak economy in the years 1998, 1999 and 2002. The similarity in the commodity structure of foreign trade points to a structural convergence between the Slovak economy and the areas under analysis.

Hence, due to fairly ambiguous results obtained in chapter 6, I will make use of the econometric model outlined in foregoing section, which proved to be sufficiently stable and robust to support simple forecasting. This allows the relation to be used for predictions about the appropriateness of a single currency between any pair of countries. Exchange rate volatility is thus predicted using so called "out-of-sample approach" which is based on a two-step procedure.[89] First, the relationship between exchange rate variability and fundamentals is estimated for the developed countries (as done in section 7.1 and 7.2). Then, as a second step the predicted exchange rate variability for the Slovak Republic can be calculated on the basis of the estimated relationship from the first step.

In this respect, the values of individual variables will be combined for the calculation of a single variable, i.e. the OCA index, indicating the degree of the country's readiness for the adoption of a single currency (Bayoumi and Eichengreen, 1997a,b and1998a). These authors postulate that the long-term variability of bilateral exchange rates should reflect the level of fulfilment of the OCA criteria irrespective of the actual exchange rate arrangement. Thus, the countries meeting the OCA criteria are expected to experience low volatility of bilateral exchange rates and vice versa.

[87] The shortness of the time series applied may be one of the factors throwing doubts on the conclusions.
[88] Open Questions of Monetary Integration (2002).
[89] See Horváth, R. (2005).

The OCA index of Bayoumi and Eichengreen (1997a,b and1998a) is an attempt to operationalize the foremost theoretical criteria proposed by the literature of optimal currency areas. The OCA index is the predicted value of exchange rate variability in the given period adjusted for exchange rate variability based on the OCA criteria. It is calculated here from the regression equation (3). The result is interpreted as a measure of the readiness for the adoption of a single currency (euro).The lower is the value of the OCA index; the higher is the benefit-cost ratio for monetary integration for the given pair of countries.

However, the results have to be interpreted with caution, at least for two reasons. First of all, the OCA criteria may be endogenous, as proposed by Frankel and Rose (1998b). Nevertheless, this "OCA endogeneity" effect may be rather small for the Slovak Republic, since its economy is highly open and its trade is already to a large extent oriented to the countries of the Eurozone. Secondly, the exchange rate itself may induce rather than mitigate shocks. The exchange rate of koruna is often affected by foreign impulses, particularly from the neighbouring countries; the exchange rate is rather a source of shocks than their absorber. This being the case, the net benefits of a country keeping its own currency are reduced.[90]

Since the OCA index is meaningful only when compared over time or for a set of countries, I use the aforementioned relationship for testing the readiness of the Slovak Republic to form a monetary union with Germany (as a benchmark). The data for the Slovak economy are available only for the period 1993-2004, and I decompose this era into 3 periods 1993-1996, 1997-1998 and 2000-2004 and compute the OCA index for each, using the values shown in chapter 4 when discussing individual factors.

Finally, I proceed with actual constructing of the OCA index along the lines of Bayoumi and Eichengreen (1997a,b and1998a) for the Slovak Republic. Own estimates of the OCA index are reported in Table 19 (column 1), together with the original 1995 estimates of Bayoumi and Eichengreen for some countries of interest (column 2 – 6).[91] Column 1 shows own OCA index estimations, for which the estimation results from Table 16, column 2 are taken as deterministic, because this covers the whole sample of countries, does

[90] See Horváth, R. (2005).
[91] The OCA index values from 1995 cannot be directly compared with the results presented in column 1, since I have different data matrix. For OCA indices for 1987 estimated by Bayoumi and Eichengreen see also Appendix 3, Table 27.

not include extra-OCA dummies and provides high value of F statistic as well.[92] Moreover, Slovakia as a small, highly open economy is quite sensitive to the inclusion of the variable $OPEN_{ij}$. Based on the strong theoretical and statistical significance of this estimation, the equation is therefore relating nominal bilateral exchange rate variability with four aspects of OCA theory: variability of output, dissimilarity of exports, trade linkages and openness. The equation is therefore:

$$\mathbf{SD(e_{ij}) = \beta_0 + 0.25\ SD(\Delta y_i - \Delta y_j) + 0.004\ DISSIM_{ij} - 0.867\ TRADE_{ij} - 0.0001\ OPEN_{ij}}$$

The resulting OCA index for the period of 2000-2004 is relatively low reflecting sufficient convergence of the Slovak economy. According to the results reported in Table 19, column 1, the value of the OCA index is decreasing over time. These results imply that the economies of Slovakia and Germany are converging and the Slovak Republic is thus becoming more suitable for monetary integration. The costs stemming from euro adoption should not be so high, based on the view of the OCA theory.

Table 19 OCA index versus Germany

Period	Slovakia-Germany*	Slovakia-Germany***	Greece-Germany	Portugal-Germany	Belgium-Germany	Austria-Germany
1993-1996	**0.015**	0.044				
1997-1998	**0.004**	0.008				
2000-2004	**-0.002**	0.018				
1995**			0.054	0.062	0.013	0.008
2004		0.036				

Note: *The OCA index represents the predicted value based on Table 16, column II.
Source: **Bayoumi and Eichengreen 1998a. ***own computations based on the regression equation estimated by Bayoumi and Eichengreen, 1998a.

Table 19, column 2 presents the OCA index estimates of the Slovak Republic vs. Germany based on the actual regression relationship estimated by Bayoumi and Eichengreen 1998a, so that the OCA indices can be compared. As can be seen, the readiness of the Slovak economy for a common currency with Germany in the period of 1993-1996 was quite low, approximately on the level of Greece with respect to Germany in 1995. In the second period, however, the Slovak economy accomplished remarkable

[92] OCA indexes resulting from other tables are largely similar and therefore not reported.

convergence, with the value of the OCA index comparable to those of Austria or Belgium, i.e. the core of the EMU, in 1995. The profound drop in the value of the index is mainly due to a greater trade linkages and higher synchrony of business cycles[93] in the second period, but fast convergence was also achieved in the commodity composition of exports and trade orientation. However, due to the higher asymmetry of business cycles and rising dissimilarity of export commodity structure in the period of 2000-2004, the OCA index increased to 0.018. Since Greece has entered EMU in 2001 and the Slovak Republic plans to adopt common European currency in 2009, by comparing the OCA index for Greece in 1995 and for the Slovak Republic in 2004 we may conclude that the Slovak Republic fulfils the OCA criteria more and its benefit-costs ratio for monetary integration is expected to be higher than in case of Greece when entering EMU.

On the whole, the results indicate structural convergence of Slovakia with the tested regions, which is expected to continue.

Yet, the results displayed in Table 19 (column 1) cannot be interpreted unambiguously: the OCA index should take only positive values, which is not confirmed in the period of 2000 2004. This is in line with the OCA index estimation computed by the National Bank of Slovakia (2002), which is also negative. Horvath R. (2005) find out the OCA index for Slovakia reaching -0.001.[94]

In order to characterise past behaviours, Table 20 compares OCA indexes to observed volatilities. Clearly, observed volatility is higher than the OCA standard would have predicted.

Table 20 Actual and predicted exchange rate volatility

	Exchange rate variability	
	Actual	**Predicted**
1993-1996	0.018	0.015
1997-1998	0.018	0.004
2000-2004	0.012	-0.002

Note: The predictions are based on Table 16, column II.
Year 1999 with the value of exchange rate variability reaching to 0.343 was finally dropped from the analysis, as the change in the exchange rate regime in 1998 which generated this excessive variability is not representative here.

[93] As mentioned above, the index is very sensitive to the variable capturing the business cycle synchronization.
[94] For the period of1999-2004, using similar methodology.

The analysis of the basic criteria identified by the OCA theory as determinants of the usefulness of a common currency between the Slovak and euro area economies, leads to the conclusion that the Slovak economy has achieved a certain level of structural convergence over the recent period. Despite some important differences remain, the probability of real asymmetric shocks has fallen to certain extent and continues to decline further. By computing the OCA index I find that the Slovak economy is structurally (in the OCA sense) very close to Germany. These findings imply that the benefits assumed to accrue from a common currency appear to outweigh the danger of an external idiosyncratic shock. The results seem to favour a fixed exchange rate regime between the Slovak and euro area economies.

8 Conclusion

This thesis tries to assess whether it would be optimal for the Slovak Republic to form a monetary union with the EU. In an effort to assess the suitability of a single European currency for the Slovak economy, the thesis addresses the overall assessment of the costs and benefits relating to Slovakia's accession to the European Economic and Monetary Union. As it is difficult to assess the relative readiness and suitability of individual country for monetary integration, some combination of nominal and real convergence criteria and optimum currency area consideration are employed as well.

Assessing the optimality of Slovakia's entry to the EMU cannot be done without discussing first the Maastricht criteria, which are the prerequisite for a country to be eligible. I find that there are considerable advancements in nominal convergence, with a real possibility of meeting all Maastricht criteria by the end of 2007 or the beginning of 2008. However, Slovakia is still lagging behind in terms of real convergence with the income-per-capita and productivity levels remain still low relative to the euro area.

Next, I turn to the question of the efficiency of non-exchange rate adjustment mechanisms for absorbing asymmetric shocks in the absence of an independent monetary policy, as it is also required for a successful participation in the euro area. Yet, such mechanisms (labour mobility, fiscal redistribution, and wage and price flexibility) are found to be available only to a limited extent. Although both nominal and real wages are on average more flexible than those of the euro area countries and may ideally compensate low labour force mobility, budget still plays the role of an automatic stabiliser of shocks only to a limited extent. Therefore, to support stabilization of real economy after entry to the euro area, it is necessary to strengthen flexibility of economy and the role of fiscal policy by appropriate measures.

After addressing the issues of nominal and real convergence and the presence of adjustment mechanism, I analyze Slovakia's structural convergence to the euro area from the point of view of the optimum currency areas (OCA) theory. In doing so, the traditional OCA criteria are employed in order to assess whether the theory suggest a case for fixing the koruna to euro.

Applying this approach to the Slovak Republic, the costs of joining the Eurozone, in terms of macroeconomic policy independence foregone, are balanced against the benefits, which are directly related to transaction costs in countries' bilateral trade. Overall, the results suggest that the Slovak Republic fulfils the necessary condition for joining the monetary union, i.e. it is relatively well aligned with the euro area, particularly in terms of its trade integration, similarity of export commodity structure and openness. Synchronization of business cycles is currently not very high; however, in the future an increased symmetry can be expected as the trade with euro area countries will develop fast, in particular intra-industry trade. This represents a sound base for business cycle convergence and approximation of the structure of the Slovak economy to the core of the euro area and thereby for a fulfilment of OCA criteria in the medium and long run. In this respect, I may conclude that the costs of euro adoption in the Slovak Republic should be comparable to the costs within euro area countries.

Following the methodology of Bayoumi and Eichengreen (1997a,b and 1998a), I find that the traditional OCA criteria explain the dynamics of exchange rates a large extent. This being the case, I make use of them in constructing and estimating a compact measure of the readiness of the Slovak economy to adopt euro ("OCA index"). The findings indicate that the Slovak Republic is relatively well aligned with the euro area countries, with the higher degree of structural convergence than that of the EU "peripheral" countries prior to their euro adoption. This implies that there are no serious obstacles against the euro introduction in the Slovak Republic.

Taking into consideration powerful implications stemming from the famous Lucas critique and the endogenous view o f the OCA theory, the intention Slovakia to join the euro area as soon as possible is quite understandable. Even if the OCA criteria are not wholly satisfied, given endogeneity of the openness to trade and similarity of business cycles, Slovakia may find it beneficial to join the EMU.

On the basis of above mentioned findings I conclude that from a long-term prospect, advantages of euro adoption significantly prevail over disadvantages, which is in line with the study elaborated by the National Bank of Slovakia (2006). However, appropriately set

economic policies are inevitable for the full utilization of potential benefits and for limiting costs from euro adoption.

On the whole my conclusion is one of moderate optimism. Though the findings do not fully confirm that the Slovak Republic already constitute an optimum currency area with the EMU at present, it seem to be well placed to fulfil the OCA criteria to the same degree as old EU Member States in the future.

All in all, there has been significant progress in the integration of the Slovak Republic but a lot remains to be done.

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Annexes

Appendix 1 – Formal derivation of the variables

In formal derivation of the variables employed, I closely follow Horváth (2005).

1. Bilateral exchange rate volatility: SD(e_{ij})

$$SD(e_{ij}) = SD[\Delta(\log e_{ij})]$$

where SD[Δ(log e_{ij})] is the standard deviation of the change (Δ) from quarter *t* to quarter *t+1* in the logarithm of the nominal exchange rate (e_{ij}) between countries *i* and *j*.

2. Business cycle synchronization: SD(Δy_{it}-Δy_{jt})

SD stands for sample standard deviation, Δy_i stands for the year-on-year real GDP growth of country i, *t* represents time (analogously for country *j*).

3. Dissimilarity of export commodity structure: $DISSIM_{ij}$

$$\text{DISSIM}_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left[\left(ABS\left(A_{it} - A_{jt}\right)\right) + \left(ABS\left(B_{it} - B_{jt}\right)\right) + \left(ABS\left(C_{it} - C_{jt}\right)\right)\right]$$

where *ABS* stands for the absolute value, A_{it} is the share of agricultural trade in total merchandise trade of country *i* at time *t*, B_{it} is the share of mineral trade in total merchandise trade of country *i* at time *t*, and C_{it} is the share of manufacturing trade in total merchandise trade of country *i* at time *t* (analogously for country *j*).

4. Trade intensity: $TRADE_{ij}$

$$\text{TRADE}_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{ex_{ijt}}{y_{it}} + \frac{ex_{jit}}{y_{jt}}\right)$$

where ex_{ijt} is the volume of exports at current prices from country *i* to country *j* at time *t*, and y_{it} is GDP at current prices for country *i* at time *t* (analogously for country *j*).

5. Economic size: $SIZE_{ij}$

$$\text{SIZE}_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left(\log y_{it} + \log y_{jt}\right)$$

where y_{it} is GDP in USD for country *i* at time *t* (analogously for country *j*).

6. Openness: $OPEN_{ij}$

$$\mathrm{OPEN}_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{ex_{it} + im_{ti}}{y_{it}} + \frac{ex_{jt} + im_{jt}}{y_{jt}}\right)$$

where ex_{it} and im_{ti} represent exports and imports of country i, and $it\ y$ is i-th country GDP at time t, all at current prices (analogously for country j).

7. Financial development: FIN_{ij}

$$\mathrm{FIN}_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left(\frac{M2_{it}}{y_{it}} + \frac{M2_{jt}}{y_{jt}}\right)$$

where $M2_{it}$ is monetary aggregate M2 in country i at time t, and y_{it} represents i-th country GDP at time t (analogously for country j).

8. Inflation differential: $INFL_{ij}$

$$\mathrm{INFL}_{ij} = \frac{1}{T}\sum_{t=1}^{T}\left(\pi_{it} - \pi_{jt}\right)$$

where π_{it} is year-on-year CPI inflation in country i at time t (analogously for country j).

9. USD variability: $DOLVAR_{ij}$

$$\mathrm{DOLVARij} = \begin{cases} \psi \ if\ i \vee j \neq USA \\ \\ 0 \quad otherwise \end{cases}, \text{ where } \psi = \frac{1}{2}\left(SD\left[\Delta(\log e_{it})\right] + SD\left[\Delta(\log e_{jt})\right]\right)$$

where SD denotes sample standard deviation, e_{it} represents the exchange rate of country i against the USD, and Δ is the change in the given variable from time t to $t+1$ (analogously for country j).

Appendix 2 – Additional results

Table 21 Descriptive Statistics

	Exchange Rate variability	Variability of output	Dissimilarity of exports	Trade links	Size of economy	Openness
Mean	0.02	0.02	0.46	0.02	5.00	125.33
Median	0.02					
Maximum	0.04	0.05	1.33	0.21	7.40	253.64
Minimum	0.00	0.01	0.04	0.00	3.26	41.39
St. Dev.	0.01	0.01	0.34	0.03	0.81	39.69
Skewness	-0.25	0.16	0.82	3.41	0.36	0.61
Kurtosis	-0.81	-0.56	-0.49	14.19	-0.33	0.01
Observations	190	190	190	190	190	190

Note: Data for 20 developed countries, 1980s- 1990s. Data for 1990s only are largely the same and for the sake of brevity are thus not presented.

Table 21 Descriptive Statistics (continued)

	Financial development	Inflation differential	USD variability	Europe dummy	EU core dummy
Mean	1.19	3.19	0.05	0.55	0.05
Median					
Maximum	2.15	10.30	0.07	1	1
Minimum	0.66	0.74	0.00	0	0
St. Dev.	0.31	1.87	0.01	0.5	0.22
Skewness	0.69	1.57	-2.11	-0.21	4.01
Kurtosis	-0.09	2.57	3.17	-1.95	14.06
Observations	190	190	190	190	190

Note: Data for 20 developed countries, 1980s- 1990s. Data for 1990s only are largely the same and for the sake of brevity are thus not presented.

Table 22 Correlation Matrix of Explanatory and Dependent Variables

	Diss. of exports	Var. of USD	EU core Dummy	Fin. develop.	Europe dummy	Open.	Ex. Rate Var.	Var. of output	Size of econ.	Trade links
Dissimilarity of exports	1.00									
Variability of USD	0.02	1.00								
EU core Dummy	-0.10	0.12	1.00							
Financial development	-0.01	0.02	0.11	1.00						
Europe Dummy	-0.37	0.56	0.21	-0.07	1.00					
Openess	-0.07	0.36	0.28	-0.03	0.44	1.00				
Exchange rate var.	0.39	-0.37	-0.39	0.10	-0.82	-0.44	1.00			
Variability of output	0.32	-0.04	-0.29	0.05	-0.23	0.06	0.34	1.00		
Size of Economy	-0.27	-0.50	-0.02	0.05	-0.29	-0.61	0.18	-0.40	1.00	
Trade Links	-0.21	-0.02	0.35	-0.12	0.28	0.15	-0.44	-0.27	0.22	1.00
Inflation Differential	0.03	0.21	-0.26	0.24	0.04	-0.04	0.12	0.23	-0.19	-0.20

Note: Data for 20 developed countries, 1980s- 1990s. Data for 1990s only are largely the same and for the sake of brevity are thus not presented.

Table 23 Unit root tests for variables employed

	SDE	SDY	DISSIM	TRADE	OPEN	SIZE	FIN	INFL	DOLVAR
DF	-11.00	-10.70	-6.66	-12.48	-8.77	-8.69	-13.08	-12.86	-8.81
ADF(1)	-6.21	-6.42	-7.06	-8.52	-5.97	-7.80	-8.94	-7.95	-7.18
ADF(2)	-5.35	-5.30	-5.50	-6.56	-3.68	-5.12	-7.30	-8.34	-5.42
ADF(3)	-4.88	-4.51	-5.34	-5.97	-3.46	-4.62	-6.58	-7.06	-4.84
ADF(4)	-5.23	-4.33	-4.82	-5.37	-3.09	-4.88	-5.38	-6.78	-4.30
95% critical value for the augmented Dickey-Fuller statistic = **-3.4350**									

Note: The Dickey-Fuller regressions include an intercept and a linear trend. Data for 20 developed countries, the period of 1990s. Tests for the 1980s-1990s are largely the same and for the sake of brevity are thus not presented.

Table 24 OLS Estimation results and diagnostic tests for the EU sub-sample

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
CONSTANT	-0.0036	0.0068	0.5362[.594]
SDY	0.1907	0.0657	2.9038[.005]
TRADE	-0.0230	0.0194	-1.1830[.241]
SIZE	0.0027	0.0010	2.6317[.010]
FIN	-0.1317E-3	0.0026	-0.0504[.960]
INFL	0.881E-3	0.5534E-3	1.5921[.116]
EUCORE	-0.0075	0.0026	-2.9079[.005]
R-Squared	0.394	R-Bar-Squared	0.34277
S.E. of Regression	0.005	F-stat. F(6, 71)	7.69[.000]
Diagnostic Tests (LM Version)			
A: Serial Correlation			CHSQ (1) = 1.11 [0.292]
B: Functional Form			CHSQ (1) = 0.09 [0.757]
C: Normality			CHSQ (2) = 4.11 [0.128]
D: Heteroscedasticity			CHSQ (1) = 0.37 [0.541]

Notes: 78 observations, data for the period of 1990-1998, based on Table 18, column V.
A:Lagrange multiplier test of residual serial correlation.
B:Ramsey's RESET test using the square of the fitted values.
C:Based on a test of skewness and kurtosis of residuals.
D:Based on the regression of squared residuals on squared fitted values.

Appendix 3 – Results of Bayoumi and Eichengreen (1997a)

Table 25 Results of equation (2) by Bayoumi, Eichengreen (1997a) for developed countries

	1960s	1970s	1980s
SDY	0.5**	0.49**	1.46**
TRADE(*10-2)	-0.13*	-0.46**	-0.54**
SIZE(*10-2)	0.13	1.7**	2.5**
DISSIM(*10-2)	1.03**	1.89**	2.24**
Observations	210	210	210
F-test	6.6**	25.5**	35.6**
R-squared	0.15	0.4	0.51

Source: Bayoumi, Eichengreen (1997a), **, * denotes significance at 5 % and 1 % respectively. Nominal exchange rate variability.

Table 26 Results of equation (2) by Bayoumi, Eichengreen (1997a) for European countries

	1960s	1970s	1980s
SDY	0.36*	0.53*	0.75**
TRADE(*10-2)	-0.18*	-0.2**	-0.26**
SIZE(*10-2)	0.37	0.32	0.31
DISSIM(*10-2)	1.17*	-2.01	-1.3
Observations	210	210	210
F-test	4.6**	2.8*	35.6**
R-squared	0.15	0.15	0.51

Source: Bayoumi, Eichengreen (1997a), **, * denotes significance at 5% and 1% respectively. Nominal exchange rate variability.

Table 27 Optimum Currency Area Indices vis-à-vis Germany in 1987

Austria	*0.008*	*Netherlands*	*0.003*
Belgium	*0.003*	Norway	0.078
Denmark	0.063	Portugal	0.063
France	0.068	Sweeden	0.068
Finland	0.098	*Switzerland*	*0.038*
Ireland	0.043	Spain	0.088
Italy	0.07	UK	0.099

Source: Bayoumi, Eichengreen (1997), "EU core" in italic.