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Optimum Currency Area Indices – How Close is the Czech Republic to the Eurozone?

Luboš Komárek, Zdeněk Čech, Roman Horváth*

Abstract

In this paper we provide a survey of the optimum currency area theory, estimate the degree of the explanatory power of the optimum currency area criteria, and also calculate the optimum currency area index in the case of the Czech Republic. The results indicate that the traditional optimum currency area criteria to certain extent explain exchange rate variability. Our results may be interpreted as an attempt to assess the benefit-cost ratio of implementing a common currency for a pair of countries. Our results also suggest that from the point of view of the optimum currency area theory the costs of adopting the euro for the Czech Republic may be relatively low, at least in comparison with other EMU member countries. We conclude that if the European Monetary Union is sustainable, the accession of the Czech Republic should not change it.

JEL Codes: E58, E52, F42, F33.
Keywords: Convergence, EU/eurozone, exchange rate, optimum currency area theory, transition.

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Nontechnical Summary

The exchange rate policies of the EU candidate countries, and the ERM2, in particular its effectiveness and wisdom, have been subject to a heated debate ever since the prospects of eurozone accession appeared. This discussion intensified in 2002 after statements made by several accession countries about "as-soon-as-possible" adoption of the euro.

We discuss exchange rate management from the point of view of the optimum currency area (OCA) theory, focusing on the case study of the Czech Republic. Since all candidate countries are expected sooner or later to fix their national currencies within the Eurosystem in, we employ "standard" OCA criteria in order to assess whether the theory suggests a case for locking the koruna into the eurozone. We operationalise the optimum currency area theory in connection with the EMU and Czech Republic. This theory tries to answer an almost prohibitively difficult question: what is the optimal number of currencies to be used in one region, or, alternatively, what is the optimal area in which one currency should be maintained. The difficulty of the question leads to low operational precision of OCA theory. Therefore, we argue that OCA theory is a framework for discussion about monetary integration.

Despite this difficulty, we assess the costs and benefits of euro adoption in the Czech Republic. The results suggest that the costs of adopting the common currency are comparable to the EU "peripheral" countries from the viewpoint of OCA theory, because there is sufficient trade integration, openness, symmetry of shocks and structural similarity of exports between the Czech economy and the EU. We conclude in this issue that if the eurozone is sustainable, the accession of the Czech economy should not change it. In other words, the costs of adopting the euro in the Czech Republic should be comparable to those costs within the eurozone countries.

By a slightly different method we compare the structural similarity of the Czech Republic and Portugal to the German economy and find that the Czech economy is closer. The results are reversed when the EU economy is considered as the benchmark country.

We turn our attention to eurozone, too. We do not find any striking difference between the so-called core of the EU (e.g. Germany and the Benelux countries) and the periphery (e.g. Portugal). We estimate a ranking of the European economies that are suitable for forming a monetary union between each other and find that the ranking stayed the same in the 1980s and in the 1990s.

Our empirical estimations show that the OCA criteria (e.g. symmetry of shocks and trade integration) explain exchange rate variability to a certain extent. We also provide the following short surveys: recent monetary integration processes around the world; monetary unions outside Europe; OCA theory; OCA studies relating to transition economies; and OCA studies relating to the Czech Republic.

1. Introduction – Optimum Currency Area Theory

This paper deals mainly with the calculation of optimum currency area (OCA) indices for industrial countries in an effort to estimate the cost-benefit ratio of adopting a common currency. We present the opinion that OCA theory has very limited scope in providing robust conclusions for policy makers on exchange rate issues in the run-up to eurozone accession. Moreover, we provide a short review of recent monetary integration processes, as well as a review of the optimum currency area theory.

The analysis concentrates on the wider perspective of the benefits and costs of the common currency, i.e. where the final goal of the candidate countries' exchange rate strategies should be. This means we assume by definition that no single country fulfils completely the attributes to make it an optimal member of a monetary union.

The optimum currency area (OCA) theory arose from debates about exchange rate regimes and adjustment under balance of payments disequilibria. Mundell (1961) in his seminal work on OCA theory challenged Friedman's (1953) view on the floating exchange rate regime as means of adjustment under balance of payments disequilibria due to exogenous shocks. Mundell (1961) in his model of an asymmetric shift in demand between two countries stressed that the optimum currency area can differ from the actual currency area. Such a difference could cause an inability of the floating exchange rate regime to cushion the shock and bring the countries back to equilibrium. That is why Mundell (1961) offered some non-exchange rate means of adjustment, such as labour mobility, nominal flexibility and fiscal transfers. Later, Ingram (in Kawai, 1987), McKinnon (1963) and Kenen (1969) extended the list of non-exchange rate means of adjustment by considering financial integration, openness and national product diversification.[1]

According to McKinnon (2000), Mundell presents a neo-Keynesian model, still in the belief that it is possible to eliminate the effect of shocks by national monetary and fiscal policies. There is also another neo-Keynesian relic: Mundell's implicit assumption of a downward-sloping and stable Phillips curve.

However, there are two other later articles by Mundell (1973a, 1973b) which present a completely different argumentation concerning the optimum currency area. This is his monetarist view on the subject: if countries can adopt a common currency without a substantial change in their purchasing parities, then they gain better allocation of capital, since they will get rid of the uncertainty in their exchange rates. Foreign reserves will have to increase less than proportionally with the size of the economy. Then, under asymmetric shocks in countries with a common currency, there will not be a decline in output, because the costs of absorbing the shocks will be effectively spread over time. The existence of two Mundell models – early and recent – explains why he is heavily quoted both by the proponents and by the sceptics of the Economic and Monetary Union.

[1] This search for optimum currency area characteristics is not exhausted by these examples. For a survey, see Horváth (2001) or Horváth and Komárek (2002a,b).

Moreover, there is a relevant question – in this context – of how much trade integration matters. There are at least two views on this issue. First, countries can benefit from greater trade integration, because it leads to more effective allocation of resources. With greater trade integration there will be further synchronisation of national business cycles, as trade among European countries is typically intra-industry trade based on economies of scale and imperfect competition. Thus, it will not lead to greater specialisation and – above all – it will not lead to a higher probability of asymmetric shock occurrence.

Proponents of the second view[2] argue that greater trade integration will lead to higher specialisation. Because of economies of scale, greater integration will lead to regional concentration of industrial activity. Thus, asymmetric shocks are more likely to occur in the future (since output is less diversified), and this will bring extra costs to the monetary union.

Frankel and Rose (1998a,b) show that the greater the trade integration, the higher the correlation of business cycles among countries. Furthermore, they emphasise that business cycles and trade integration are interrelated and endogenous processes to establishing a currency union. Thus, they demonstrate that countries may fulfil the OCA criteria ex post, even though they did not fulfil them ex ante. Monetary union entry increases trade linkages among the countries, and this causes the business cycle to be more symmetric among the participants of the union.[3] The arguments of Frankel and Rose (1998a,b) lead to a conclusion that the costs of implementing a common currency are relatively low. However, there are some doubts about the validity of the endogenous OCA criteria. In a theoretical model Hallett and Piscitelli (2001) show that the validity of the endogenous OCA hypothesis is uncertain and dependent to a large extent on structural convergence in the beginning phase of the monetary union. Without sufficient structural convergence, implementing the common currency would cause greater divergence.

Maybe a more interesting question is not the search for the optimal exchange rate regime, but the search for the optimal variability of the exchange rate. Bayoumi and Eichengreen (1997a,b and 1998) suggest an approach for modelling exchange rate variability which takes into account multiple interdependency of the economies. The empirical part of this paper follows on from Bayoumi and Eichengreen. Thus, the purpose of this part is to estimate the degree to which exchange rate variability may be explained by the traditional OCA criteria, as defined in the classical OCA literature in the 1960s. Also, we attempt to determine "OCA indices", which for given pairs of countries assess the benefit-cost ratio of adopting a common currency.

[2] Krugman (1993). De Grauwe (1997) discusses the limitations of Krugman's view. He shows that Krugman assumes that the regional concentration of industry will not cross the borders of the member countries, while borders will be less relevant in influencing the shape of these concentration effects. If so, then asymmetric shocks will not be country specific and the floating exchange rate cannot be used to deal with asymmetric shocks anyway. In addition, there will be trade creation among the monetary union countries.

[3] According to Fidrmuc (2001), the intensity of intra-industry trade is another variable with a positive impact on the synchronisation of the business cycle.

2. A Survey of Regional Monetary Unions

Regional currency areas have various roots, such as historical, "existential", economic and, especially, political. The importance of political factors can be found, for instance, in the process of creating an independent Germany in 1871 (as well as in 1990, when the eastern and western parts of Germany were unified) and many other states (e.g. Switzerland and Italy). Existential reasons are characteristic of geographically small countries (such as El Salvador, Kiribati, Liechtenstein, Monaco, Nauru and the Vatican), where the acceptance and legalisation of a foreign trading partner's currency were a necessity. For the sake of completeness, there are also states where more than one currency circulates within their borders. These include Hong Kong and Macao.

The best known and economically strongest currency area is certainly the eurozone, which was founded in cashless form in 1999.[4] Table 2.1 provides a survey of other, non-European regional monetary unions.

Table 2.1: Monetary Unions Outside Europe

MONETARY UNION	CURRENCY	CENTRAL BANK
Eastern Caribbean Currency Area (1950)	Eastern Caribbean dollar (pegged to the USD; prior to 1976 pegged to GBP)	Eastern Caribbean Currency Authority (1950–1982) Eastern Caribbean Central Bank (1983)
Central African Economic and Monetary Community (1945)	Franc de la cooperation financière en Afrique centrale (pegged formerly to FRF and now to EUR) (i)	Banque des Etats de l'Afrique
West Africa Economic and Monetary Union (1945)	Franc de la communauté financière d'Afrique (pegged formerly to FRF and now to EUR) (ii)	Banque Centrale des Etats de l'Afrique de l'Ouest

Note: *(i) and (ii) are commonly called the CFA Franc.*

Table 2.2 shows the main directions and discussions in the terms of existence, enlargement and creation of monetary unions. Potential monetary integration processes are being considered on every continent. Masson and Patillo (2001) discuss the integration efforts in West Africa in the countries of ECOWAS (Economic Community of West African States), which should introduce a common currency in the near future (probably in 2004).

[4] Cash was introduced on 1 January 2002. Generally, it is possible to introduce a common currency in cash and cashless form simultaneously, but it is impossible to introduce cash before cashless transactions.

Table 2.2 – Current Directions and Discussions on Creating New Monetary Unions

Potential Monetary Unions / Enlargement of Current Monetary Unions	Country	Further Information
EUROPE	Current eurozone (12) + countries outside eurozone (3) + candidate countries (10) (i)	http://europa.eu.int
EAST AFRICA	Kenya, Tanzania, Uganda	Signed a treaty (in 1999) forming an economic bloc and monetary union, which revives their former currency union. Mkenda (2001).
WEST AFRICA	Economic Community of West African States (ECOWAS: i.e. Benin, Burkina Faso, Guinea-Bissau, Mali, Niger, Cote d'Ivoire , Senegal and Togo) + Gambia, Ghana, Guinea, Liberia, Nigeria and Sierra Leone	Declared (in April 2000) the intention to form a broader monetary union. Monetary union of ECOWAS countries would be created in 2004. Masson and Pattilo (2001).
ARABIAN GULF	Gulf Co-operation Council (Bahrain, Qatar, Kuwait, Oman, Saudi Arabia and United Arab Emirates)	Announced (in early 2002) a plan for a customs union by 2003 and a common currency by 2010. New currency, possibly to be called the Gulf dinnar, will be established and is likely to be pegged to USD. Jadresic (2000).
ASIA	ASEAN (Brunei, Burma, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand and Vietnam)	Leaders of ASEAN endorsed (in December 1988) a project to study the feasibility of their currency, "ASEAN currency". Yam (1999).
AUSTRALIA AND NEW ZEALAND	Monetary integration between Australia and New Zealand, or adoption of Australian dollar by New Zealand (ii)	Coleman (2001) provides a discussion of the suggestion for an "Anzac dollar".
SOUTH AMERICA	MERCOSUR (Argentina, Brazil, Paraguay and Uruguay) + associate members (Bolivia and Chile)	Two strategies discussed: (i) adoption of USD as common currency, or (ii) creation of regional "Mercosur" currency. Currently, due to the crisis in Argentina, this project is oriented more towards the medium term.
NORTH AMERICA	NAFTA (Canada, Mexico and USA)	Given the high proportion of Canadian and Mexican trade with the USA, a NAFTA dollar, or "Amero", has been proposed by Grubel (1999).

Note: *(i) 10 countries are officially termed the "accession countries", i.e. Cyprus, Malta, the Czech Republic, Slovakia, Poland, Hungary, Slovenia, Estonia, Latvia, Lithuania, Bulgaria, Romania and Turkey); (ii) The Australian economy is roughly seven times bigger than that of New Zealand.*

Source: *See the right column of Table 2.2.*

3. OCA Theory and the Eurozone

In connection with European integration, dozens of studies have appeared attempting to assess the costs and benefits of adopting a common currency in Europe from the point of view of OCA theory.[5] Most of the empirical studies[6] focus on four relationships among the members of the potential monetary union, testing the characteristics of the OCA. They are: the degree of labour mobility, the system of fiscal transfers, the extent of trade, and the similarity of shocks and business cycles. These four characteristics are interrelated, which makes econometric testing difficult.

3.1 Ex Post Even if Not Ex Ante?

Based on empirical findings using the instrumental variables method,[7] Frankel and Rose (1998a, 1998b) argue that the greater the trade integration the higher the correlation of business cycles among countries. Furthermore, Frankel and Rose (1998a, 1998b) argue that business cycles and trade integration are interrelated and endogenous processes to establishing a currency union. Thus, Frankel and Rose (1998a) note that countries may fulfil the OCA criteria ex post, even though they did not fulfil them ex ante. Eurozone entry increases trade linkages among countries, and this causes the business cycle to be more symmetric among the participants of the union. Frankel and Rose (1998a) also note that because countries link their currencies to their most important trading partners in order to keep their exchange rates stable, they lose a certain amount of monetary policy independence.

Fidrmuc (2001) shows that the intensity of intra-industry trade is another variable that has a positive impact on the synchronisation of business cycles.

3.2 Methodological Problems of Measurement

The discussion on the eurozone could not come to a clear conclusion before the creation of the eurozone. This is partly because we are forced to use various proxies that are interrelated and inaccurate. For example, in our attempts to measure symmetry of shocks, we would like to know whether we are facing demand or supply shocks and whether the shocks are transitory or persistent. Another caveat is how to distinguish between shocks and the reactions to them.[8] Economies might face identical shocks, but the transmission would differ, and in measuring the correlation of business cycles we could obtain a correlation close to zero. By contrast, it can be argued that the difference in the speed of the transmission is caused by differences in labour market institutions or by rigidity.

It is also very important to consider the possibly high transaction costs and, of course, political issues, both of which can seriously reduce the attractiveness of a currency union. Owing to these high transaction costs, markets may come to view the currency union as unsuccessful. The

[5] Previously, there had been almost no empirical research done on OCA theory.

[6] See Bayoumi and Eichengreen (1996a) and Schelke (2001) for surveys.

[7] See Rodrick (2000) for a critique of the econometric methods used by Frankel and Rose (1998a, 1998b).

[8] Again, the Lucas critique could shed some light on this.

emerging lack of credibility because of the change in the expectations of the markets could be self-fulfilling and cause the break-up of the monetary union.

Empirical studies are only able to estimate the probability of the asymmetric shock (or other OCA criteria can be considered). Such results are also incomparable with existing monetary unions (the USA), because of the endogeneity of the OCA criteria. In other words there may be a further boost in convergence among the countries adopting a common currency.

3.3 Other Empirical Findings

To our knowledge, there are no serious studies providing a clear answer to the adoption of the common currency. Bayoumi and Eichengreen (1993) find a relatively high symmetry of shocks in the "core" of the EU[9] and a lower one for other western European countries, using the VAR approach. Applying different techniques, the difference between the core and periphery of the EU is smaller or even vanishes. Schelke (2001) argues that the first stream of OCA theory (1960s) is not appropriate for explaining economic phenomena.

Nevertheless, there seems to be a general understanding that the probability of asymmetric shocks is higher in the eurozone than in the USA (meaning that the costs of the common currency are higher), but for some eurozone countries the probability of asymmetric shocks may be close to that for the USA.[10] A striking difference between the eurozone and the USA can be seen in their adjustment to shocks such as the degree of labour mobility[11] or rigidity of prices. It can be expected for the eurozone that there will be a need for coordination of fiscal policies as a means of absorbing their potential asymmetric shocks.

4. OCA Theory and the Czech Republic

4.1 The Relevance of OCA Theory to Exchange Rate Regimes

OCA theory attempts to give an answer to the choice of regime based on the structural characteristics of the economy (notice that OCA theory only distinguishes between pure float and pure fixed, which is not often the case for economic policy makers[12]). Turning to the application of OCA theory to the Czech Republic in the 1990s, Horváth and Jonáš (1998) show that the Czech Republic faced strong asymmetric shocks with Germany at the beginning of the 1990s and that OCA theory would suggest that the right choice is a floating exchange rate. Also, there was strong

[9] Austria, Benelux, Denmark, France, Germany and Switzerland (this country is of course not a member of EU; see Bayoumi and Eichengreen (1993) for argumentation on why Switzerland was included in the sample).

[10] Fidrmuc and Korhonen (2001) argue that the extent of asymmetric shocks declined in the EU economies during the 1990s.

[11] See Obstfeld and Peri (1998) for a comprehensive discussion and empirical comparison between the EU and the USA.

[12] Willett and Wihlborg (1999) suggest considering other exchange rate regimes for further research.

dissimilarity in inflation rates between the Czech Republic and its trading partners, which would undermine Czech competitiveness under a fixed exchange rate regime in the long run.[13]

On the other hand, the Czech economy's low financial integration with its western European trading partners and its relatively high openness is an argument for fixing the currency in order to eliminate potentially high volatility in the financial markets. As a result, we can see that OCA theory does not have operational precision for decision-making in the short term and that it is a long-run theory. Goldberg (1999) argues that OCA theory is less suitable for transition economies, owing to some specific stabilisation and transition problems. Often, when studying transition economies, one has to take into account their specific characteristics due to stabilisation and institutional aspects.

Nevertheless, even if OCA theory is not operationally precise, we can monitor the OCA criteria over time, as was done by Cincibuch and Vávra (2001), who find strong convergence of the Czech OCA criteria to Germany and the EU.[14] In particular, Cincibuch and Vávra (2001) construct an "OCA index"[15] predicting the variability of the nominal exchange rate for the Czech Republic using a regression equation estimated by Bayoumi and Eichengreen (1998a). The estimation yielded the following for the 1983–1992 data[16] (with standard errors in parentheses):

$$SD(e_{ij}) = \underset{(0.02)}{-0.09} + \underset{(0.21)}{1.46}SD(\Delta y_i - \Delta y_j) + \underset{(0.006)}{0.022}DISSIM_{ij} - \underset{(0.006)}{0.054}TRADE_{ij} + \underset{(0.001)}{0.012}SIZE_{ij} \quad (1)$$

$$n = 210 \quad R^2 = 0.51 \quad S.E. = 0.027$$

Bayoumi and Eichengreen (1998a) suggest how to calculate the relevant variables. $SD(e_{ij})$ is the standard deviation of the change in the logarithm of the end-year bilateral exchange rate[17] between countries i and j, $SD(\Delta y_i - \Delta y_j)$ is the standard deviation of the difference in the logarithm of real output between i and j, $DISSIM_{ij}$ is the sum of the absolute differences in the shares of agricultural, mineral and manufacturing trade in total merchandise trade, $TRADE_{ij}$ is the mean of the ratio of bilateral exports to domestic GDP for the two countries, and $SIZE_{ij}$ is the mean of the logarithm of the two GDPs measured in U.S. dollars. These four variables represent the basic OCA criteria, and it is believed that the lower the volatility of exchange rates is among countries, the better prepared they are to join the monetary union.[18]

Cincibuch and Vávra (2001) show that the Czech Republic achieved a higher degree of structural convergence to Germany than Portugal or Greece during the 1990s. However, one problem with this analysis is that the equation is assumed to be stable over time. The original regression

[13] In the short run there may be some credibility gains from fixing exchange rates for a higher inflation country.

[14] The variables considered were: correlation of business cycles, trade linkages, difference in the commodity structure of bilateral exports, and size of the economies

[15] For the OCA index for Slovakia, see the National Bank of Slovakia website, but notice that some results have to be interpreted very carefully, since they measure, for example, the correlation of business cycles on data for 1997–1998.

[16] The countries included in the regression are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, the United Kingdom, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland and the USA.

[17] Nominal exchange rate.

[18] For a broader description of the regression and the computation of the OCA index, see section 5.1.

equation used data for 1983–1992. There were financial crises in Western Europe in 1992–1993 and financial flows were much more important in the 1990s than in the 1980s. These facts could strongly influence the stability of the equation. Another problem could arise from the fact that there are several non-European industrial economies included in the sample, namely Australia, Canada, Japan, New Zealand and the USA.

Bayoumi and Eichengreen (1997a) also estimated the regression with European economies only, in the same way as described above, and the regression was to a certain extent different.[19] They present regressions for the variability of real exchange rates, too.

Table 4.1: OCA Index, Structural Similarity with Germany

Exchange rate variability	**Nominal**	**Real**	**Nominal**	**Real**	**Nominal**	**Nominal**
Data/Country	**Europe**	**Europe**	**World**	**World**	**World**	**World**
Czech Republic	0.022	0.071	0.193	0.194	0.023	0.035
Austria	0.006	0.057	0.185	0.187	0.003	0.008
Portugal	0.022	0.072	0.201	0.202	0.029	0.062

Source: *Bayoumi and Eichengreen (1997a, 1998a), Cincibuch and Vávra (2001), own calculations.*

We can compare the results of Cincibuch and Vávra (2001) with the other four regression equations estimated by Bayoumi and Eichengreen (1997a, 1998a).[20] We present the results for the data from 1993 to 1998 in Tables 4.1 and 4.2. The structural convergence of Austria, the Czech Republic and Portugal with Germany as the benchmark country is shown in Table 4.1, while the EU is considered as the benchmark country in Table 4.2. We chose Austria, the Czech Republic and Portugal because they represent examples of a converged (or core), transition and peripheral economy respectively.[21]

Except for the last column, the results are the calculation of the authors. The first line indicates whether we are considering the variability of the nominal or real exchange rate. The second line indicates whether we are dealing with the sample of European economies or all industrial economies. The results are of Cincibuch and Vávra (2001) for the Czech Republic using data from 1993 to 1998 and the forecast of Bayoumi and Eichengreen (1998a) using the data for 1971–1987 to the year 1995 in the last column. The results are not fully comparable across the columns.

As can be seen in Tables 4.1 and 4.2, the OCA index for Austria is much lower than those for the other two economies. The results for the Czech Republic and Portugal look quite similar. The Czech Republic has a lower OCA index than Portugal when Germany is considered as the benchmark country; the opposite is true when the EU is the benchmark country.

[19] See the Appendix for a comparison.

[20] Variability of nominal exchange rates and variability of real exchange rates with European economies only, and the same when some other non-European industrial countries are included. This means the sample consisted of 16 European economies (which is what we mean by Europe in Tables 4.1 and 4.2) or 16 European economies plus 5 non-European economies (which is what we mean by World in Tables 4.1 and 4.2).

[21] We cannot report the results for Greece (as is done by Bayoumi and Eichengreen, 1998a), since the data needed to calculate variable DISSIM were impossible to obtain.

Table 4.2 – OCA Index, Structural Similarity with EU[22]

Exchange Rate Variability / Data/Country	Nominal Europe	Real Europe	Nominal World	Real World	Nominal World	Nominal World
Czech Republic	0.0203	0.073	0.205	0.206	0.025	0.034
Austria	0.0035	0.056	0.191	0.194	0.003	-----
Portugal	0.0127	0.065	0.198	0.199	0.014	-----

***Source**: Bayoumi and Eichengreen (1997a, 1998a), Cincibuch and Vávra (2000), own calculations.*

4.2 Empirical Studies on OCA Theory and Transition Economies

Other empirical studies,[23] such as Boone and Maurel (1998), Horváth (2001), Fidrmuc and Korhonen (2001) and Schweickert (2001), focus not only on the Czech Republic, but also on other transition economies.

They show that the structural convergence of the Czech Republic does not differ considerably from the convergence of other Central European countries. But a difference can be seen between the Czech Republic on the one hand, and Romania and Bulgaria on the other.

Schweickert (2001) compares transition economies with a reference group (Greece, Portugal and Spain) using a "comparative indicator", where he tries to capture the Maastricht criteria, institutional development, the development of capital markets, and the OCA criteria. Schweickert (2001) shows that adopting the euro will bring more net benefits to the transition economies than to the reference group from the point of view of OCA theory. On the other hand, the transition economies were doing worse than the reference group when compared by the other indicators.

Boone and Maurel (1998) show that a large part of the output variability of the transition economies can be explained by variation in German output or EU output, and that reactions to the changes in output are positively correlated.

Fidrmuc and Korhonen (2001) find a much lower correlation between the Czech business cycle and the EU's cycle than the correlation between the Hungarian or Estonian business cycles and the EU's.

Horváth (2002) in his empirical study argues that shocks between the transition economies and the EU are, to a large extent, still idiosyncratic (correlation of demand or supply shocks between the transition economies and the four biggest European countries is rather exceptional). As a result, the adoption of the common currency may be relatively costly. Hornikova (2003) further supports these results by showing the low correlation of shocks between the Czech economy and the eurozone.

[22] Since DISSIM for the EU is unknown, at least as far as we know (and Cincibuch and Vávra, 2001, say the same), we took Germany's DISSIM as a proxy.

[23] The problem with all empirical studies dealing with business cycles is short time series.

Empirical analyses do not come to a definite conclusion concerning the structural convergence of the transition economies to the EU/eurozone from the point of view of OCA theory (the best performers are usually Slovenia, Hungary, Estonia and the Czech Republic). Fidrmuc (2001) argues that the most important roles in convergence are played by the intensity of intra-industry trade, foreign direct investment, and the commodity and geographical structure of exports.

5. Measuring OCA Indices in Europe

In this section we elaborate the analysis of section 4.1. Since assuming stability of the regression equation (1) over time might be restrictive, we recalculate equation (1) for newer data than those used by Bayoumi and Eichengreen (1997a,b and 1998). Then our analysis proceeds in a similar way, in an attempt to assess the cost-benefit ratio for adopting the common currency. We focus on the Czech Republic, but the argumentation can be generalised to the other transitional countries as well.

5.1 Methodology

Countries experiencing symmetric shocks or high trade linkages tend to have stable exchange rates. In other words, the more the OCA criteria are fulfilled among the countries, the lower should be the exchange rate variability among them. Under this assumption we estimate the equation:

$$SD(e_{ij}) = a + b_1 SD(\Delta y_i - \Delta y_j) + b_2 DISSIM_{ij} + b_3 TRADE_{ij} + b_4 SIZE_{ij} \quad (2)$$

$SD(e_{ij})$ measures the volatility of bilateral nominal exchange rates, $SD(\Delta y_i - \Delta y_j)$ captures the asymmetric shocks at national level, $TRADE_{ij}$ is the proxy for the intensity of trade linkages, $DISSIM_{ij}$ assesses the asymmetric shocks at industrial level, and $SIZE_{ij}$ measures the size of the economy and assesses utility from maintaining the national currency.[24]

The proxies are computed as follows: $SD(e_{ij})$ is the standard deviation of the change in the logarithm of the bilateral exchange rate between countries i and j on a monthly basis, $SD(\Delta y_i - \Delta y_j)$ is the standard deviation of the difference in the logarithm of real output between i and j, $DISSIM_{ij}$ is the sum of the absolute differences in the shares of agricultural, mineral and manufacturing trade in total merchandise trade, $TRADE_{ij}$ is the mean of the ratio of bilateral exports to domestic GDP for the given two countries, and $SIZE_{ij}$ is the mean of the logarithm of the two GDPs measured in U.S. dollars.

The data sample contains 21 industrial countries for the period from 1989 to 1998. These are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, the United Kingdom, Greece, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden,

[24] The lower the size, the lower the relative utility of maintaining the national currency. $SIZE_{ij}$ can possibly capture the effect of adjustment costs, too. The bigger the countries are in economic terms, the higher the costs of transition to the common currency.

Switzerland and the USA. For convenience we label these data as representing the 1990s. When calculating variable $SD(e_{ij})$ we used the data from the IFS (IMF); the data for $SD(\Delta y_i - \Delta y_j)$ were calculated from the World Bank; $TRADE_{ij}$ was calculated using data from Directions of Trade (IMF and World Bank); variable $DISSIM_{ij}$ was calculated with the use of data from the Monthly Statistics of Foreign Trade (OECD); and $SIZE_{ij}$ was computed from World Bank data. When putting together the data matrix, we follow the advice of Bayoumi and Eichengreen (1997a,b and 1998). This allows us to compare the results for different time periods.

Since we are interested in whether exchange rate variability can be explained by the traditional OCA criteria, we consider the variables with a cross-border impact in all the equations. Bayoumi and Eichengreen (1997a,b and 1998) find little evidence that a more open economy tends to fix its currency. But since openness is also one of the traditional OCA criteria, we include a proxy for openness, too.[25] This means that we estimate the following equation:

$$SD(e_{ij}) = a + b_1 SD(\Delta y_i - \Delta y_j) + b_2 DISSIM_{ij} + b_3 TRADE_{ij} + b_4 OPEN_{ij} \quad (3).$$

The analysis takes into account all the relationships between each of the economies. There is a pair of countries in each row of the data matrix. Given 20 countries, we obtain 190 observations.[26] The expected signs of the explanatory variables are as follows: the exchange rate volatility is expected to depend positively on the business cycle and on the dissimilarity in the commodity structure of exports, and negatively on the trade linkages. The expected sign of openness is theoretically indeterminate.[27]

We are aware that there is a possibility that the independent variable influences the dependent variable, i.e. there is a potential influence of exchange rate variability on growth or the volume of trade. However, taking the standard deviation of output and the volume of bilateral trade considerably reduces this influence.

5.2 Results

We begin by exploring some basic descriptive characteristics of the data set. As we can see in Table 5.1, there is a tendency towards increasing volatility in the exchange rate data. The low variability in the 1960s was due to the Bretton-Woods system, while the higher volatility in the 1970s was maybe the consequence of the failure of Bretton-Woods and the oil shocks. In the 1980s there was a slow return to equilibrium and exchange rate variability was again declining. The high volatility of exchange rates in the 1990s was caused by numerous financial crises and, more generally, by the rising financial flows among the countries and their spillover effects. However, the variability in the second half of the 1990s is decreasing, quite understandably as a

[25] The proxy was calculated as the arithmetic mean of the i-th and j-th country's ratio of trade (export + import) to its GDP.

[26] The relationship of the first country to the second one is the same as that of the second to the first. That is why the number of observations equals 20!/18!2!. Since the data for the calculation of the variable DISSIM were not available for Greece (except in 1997), we finally excluded Greece from the analysis. At first, we took the data for 1997 as an average measure of Greece's $DISSIM_{ij}$ for the period 1989–1998, but tests on the outliers using studentised residuals showed that many of the observations for Greece were outliers even at a p-value lower than 0.01. It is uncertain whether this was due to the lack of data or to some other reason.

[27] See Isard (1995).

consequence of the institutional arrangements of the EU[28] and the progress with EU monetary integration. This conclusion is supported by both the monthly and yearly data, as depicted in Tables 5.1 and 5.2.

Table 5.1: Exchange Rate Volatility Based on Yearly Data

Exchange Rate Volatility	
1960s	0.033
1970s	0.086
1980s	0.076
1990s	0.094
1989–1993	0.082
1994–1998	0.048

***Note**: "Volatility" in this table means the average of the standard deviations of the change in the logarithm of the bilateral exchange rate, based on yearly data.*

Table 5.2: Exchange Rate Volatility Based on Monthly Data

Exchange Rate Volatility	
1990s	0.024
1989–1993	0.025
1994–1998	0.022

***Note:** "Volatility" in this table means the average of the standard deviations of the change in the logarithm of the bilateral exchange rate, based on monthly data.*

Very low exchange rate volatility persists in the core EU countries. However, it is difficult to find criteria which would clearly distinguish the core from the remaining countries, as presented in the text below. We present the exchange rate variability in Table 5.3.[29]

Another concern is symmetry of shocks (variable $SD(\Delta y_i - \Delta y_j)$), as Table 5.4 depicts. If the national business cycle were fully synchronised, the value would be zero. Again, the shocks in the EU core are relatively low, but here the difference between the core and other EU countries is not so striking as for exchange rate volatility.

One can expect the OCA criteria to explain less of the exchange rate variability in the 1990s than for example in the 1980s, due to the advances in monetary integration in the EU and also to the EMS financial crisis in 1992–1993.

[28]See Čech and Komárek (2002a) for a survey of the EU's institutional arrangements concerning exchange rate issues.

[29] We present in Table 5.3 only the countries having the lowest exchange rate volatility. A full table of all the possible pairs of the twenty countries in our sample is available from the authors upon request.

Table 5.3: Exchange Rate Volatility for Selected Countries of the EU in the 1990s

	Austria	Belgium	Germany	Denmark	Switzerland	Ireland
Belgium	0.005					
Germany	0.003	0.005				
Denmark	0.008	0.006	0.007			
Switzerland	0.014	0.013	0.013	0.015		
Ireland	0.014	0.014	0.014	0.014	0.020	
Netherlands	0.005	0.006	0.004	0.008	0.014	0.014

***Note**: "Volatility" in this table means the standard deviation of the change in the logarithm of the bilateral exchange rate between countries i and j; based on monthly data.*

Table 5.4: Symmetry of Shocks for Selected Countries in the 1990s

Germany	**France**	0.0053
France	**Italy**	0.0059
Germany	**Italy**	0.0071
Belgium	**France**	0.0076
Belgium	**Italy**	0.0091
Denmark	**UK**	0.0100
Belgium	**Germany**	0.0113
Austria	**Germany**	0.0120
Spain	**Portugal**	0.0128

***Note**: Symmetry of shocks in this context is measured as the standard deviation of the difference in the logarithm of real output between countries i and j.*[30]

The results for trade linkages ($TRADE_{ij}$) are straightforward. Clearly, countries such as Austria, Belgium, Germany and the Netherlands have strong bilateral trade with each other. The Czech Republic is also closely tied to Germany by trade. However, the dissimilarity of exports ($DISSIM_{ij}$) of the countries presented in Table 5.5 is around the European average. The trade linkages of the Czech economy with other EU countries are not as strong as with Germany. For example, the value for another geographical neighbour – Austria – is 0.016, just over twice the European average.

The descriptive statistics results for the Czech Republic are evidence of strong linkages with Germany, and one may put forward the view that its economy should not encounter difficult problems when adopting euro. However, as shown in section 4.1, the results can be slightly different when the whole of the EU, instead of Germany, is considered as the benchmark. We compared the structural similarity of the Czech Republic and Portugal to the German economy and found that the Czech economy is closer. The results are reversed when the EU economy is taken as the benchmark country.

[30] Ireland has relatively high asymmetric shocks with most of the EU countries. For example, the asymmetry of the shocks with Germany was one of the highest in our data sample, at 0.1311. This is partially caused by the high growth rates in Ireland. The shocks of the Czech Republic with Germany are below the European average, with a value of 0.0298. The European average was 0.046. However, the asymmetry of shocks between the Czech Republic and Austria is very high, at 0.1344 being roughly three times the European average.

Table 5.5: Trade Linkages and Dissimilarity of Exports for Selected Countries

		A	B
Belgium	**Netherlands**	0.0689	0.287
Belgium	**Germany**	0.0687	0.129
Germany	**Netherlands**	0.0676	0.416
Germany	**Czech Republic**	0.0665	0.131
Belgium	**France**	0.0646	0.078
Austria	**Germany**	0.0529	0.052
Germany	**Ireland**	0.0426	0.304
Average in EU		0.007	0.293

Notes: *A - the mean of the ratio of bilateral exports to domestic GDP for the given two countries*
B - the sum of the absolute differences in the shares of agricultural, mineral and manufacturing trade in total merchandise trade.

The estimation of equation (2) yields the following:

Table 5.6: Results of Estimation of Equation (2)

	Coefficient	t-statistic
Variability of output	0.089	2.7
Trade ratio	-0.121	-5.6
Size of economy	0.016	4.15
Dissimilarity of exports	0.016	1.9
Number of observations	190	
R-squared	0.41	
S.E.E.	0.008	
F-statistic	31.86	

Bayoumi and Eichengreen (1997a) point out that equation (2) has the more significant power the lower is the government interference in the exchange rate market. The data from the 1960s to the 1980s support their hypothesis. Our estimation does not contradict this hypothesis either. All variables are jointly significantly different from zero, suggesting that the OCA criteria do explain some of the variability of exchange rates.

Table 5.7: Results of Estimation of Equation (3)

	Coefficient	t-statistic
Variability of output	0.0369	1.25
Trade ratio	-0.023	-6.23
Openness	-0.0002	-7.54
Dissimilarity of exports	0.0052	3.67
Number of observations	190	
R-squared	0.44	
S.E.E.	0.008	
F-statistic	35.67	

Note*: Exclusion of the variable $SD(\Delta y_i - \Delta y_j)$ changes the results only minimally.*

As the last step we include the proxy for openness. The results of the estimation of equation (3) are in Table 5.7. Contrary to the estimations of Bayoumi and Eichengreen (1997a,b), this variable is significant and explains a large degree of the exchange rate variability, suggesting that more open economies tended to fix their currencies more in the 1990s. It seems that openness is better proxy for explaining the exchange rate volatility in the 1990s by the traditional OCA criteria measured by R^2 or by the joint significance of the variables rather than the size of the economy. Also, R^2 increased from 0.41 to 0.44.

From the above regression equations we calculate the OCA index, which is the predicted value of exchange rate variability.[31] The lower is the OCA index, the higher is the benefit-cost ratio for monetary integration for the country pair. The resulting ranking of the economies, as well as the joint significance and the satisfactorily high R^2 of all of the regressions, strongly supports the idea that OCA indices have some explanatory power.

All our estimations can be compared with the earlier rankings of Bayoumi and Eichengreen (1997a) on the data from 1960s to 1980s reported in Table 1 of the Appendix for 21 industrial countries.

Table 5.8: OCA Indices versus Germany

Belgium	0.004
Netherlands	0.009
Austria	0.013
Ireland	0.013
Switzerland	0.019
Czech Republic	0.019
Denmark	0.022
Portugal	0.023
Sweden	0.024
France	0.024
Italy	0.024
Norway	0.025
Finland	0.025
UK	0.025
Spain	0.027

***Note**: The OCA index represents the predicted value obtained from estimating equation (3).*

It is interesting to have a look at the OCA indices for the recent eurozone members. The eurozone countries are closer to each other than to the other industrial countries. We present OCA indices calculated using the estimation results from Table 5.7, i.e. from estimation of equation (3), because this provides the highest F-statistic. The OCA indices resulting from the other tables, i.e. from estimation of equation (2), differ to only a small extent and are therefore not reported. The exception was the OCA index for Australia with New Zealand, which was very sensitive to the inclusion of the variable $OPEN_{ij}$. These two countries are relatively closed, which may explain why their OCA index is at the average level. Using variable $SIZE_{ij}$, instead of variable $OPEN_{ij}$

[31] If the difference in the economic size of the particular countries is huge, then our underlying assumption of independent exchange rate policy might be problematic to some extent.

changes (lowers) the OCA index for Australia and New Zealand, suggesting relatively low costs for implementing a common currency from the point of view of OCA theory.

We present the OCA indices versus Germany since obviously we need a metric, and Germany is the most straightforward one. The data available for the Czech Republic are only for the period 1993–1998. The applicability of OCA theory in the early stages of transition, e.g. in 1990–1992, is rather low, since there are specific transitional problems which are not considered in OCA theory. See Goldberg (1999), Horváth and Jonáš (1998), Horváth and Komárek (2002), and Schweickert (2001) for a discussion of the specificity of the transition processes concerning OCA theory. However, the inclusion of the Czech Republic in the data sample changed the estimations minimally.

Table 5.9: OCA Indices for Specific Relationships

Belgium	**Netherlands**	-0.0001
UK	**Ireland**	0.001
Canada	**USA**	0.002
Belgium	**France**	0.005
Belgium	**Ireland**	0.01
Belgium	**UK**	0.011
Austria	**Belgium**	0.015
Austria	**Netherlands**	0.017
Netherlands	**Portugal**	0.02
Austria	**Czech Republic**	0.024
Average of the sample		0.025

***Note**: The OCA index represents the predicted value obtained from estimating equation (3).*

There is a significant difference between the values of the OCA indices for Austria, Belgium, Germany and Netherlands and the other European countries. The value of their OCA indices was often less than one standard error for the regression and clearly there are no doubts about the beneficial consequences of adopting the common currency from the point of view of the structural characteristics of these economies. The resulting OCA indices for Ireland with these economies are also relatively low, reflecting the fact of sufficient convergence of the Irish economy. Portugal does not have high OCA indices with these countries, suggesting that there is no evidence of a sorting-out of the countries at the core and the periphery.[32] The results for Germany vis-à-vis France imply that euro adoption may be relatively costly, according to OCA theory. The high values of the OCA index and the size of the economy for the United Kingdom – not only with Germany – offer arguments for not joining the eurozone immediately after its creation.

The other results are intuitively appealing, too. The values for Canada vis-à-vis the USA, the UK vis-à-vis Ireland and Australia vis-à-vis New Zealand are very low, indicating that these country pairs are structurally very similar, as expected. Considerations of these economies' adopting a common currency occur in literature largely in the 1990s. Willett (2001) discusses the option of a common currency for the USA and Canada, and Grubel (1999) for the NAFTA countries. Coleman (2001) considers the implementing of a common currency in Australia and New Zealand. Bayoumi and Eichengreen (1996) provide a survey of the operationalising of OCA

[32] See, for instance, Bayoumi and Eichengreen (1993). Our finding corresponds to the results of Fidrmuc and Korhonen (2001).

theory. The most important variables for determining OCA indices are trade linkages and variability of output, and also openness for very open economies. If we compare the OCA indices versus Germany from our results with the results of Bayoumi and Eichengreen (1997b), we find that the ranking of the economies has changed little since 1987 (compare Table 5.9 and Table 3 in the Appendix).[33] This is also true for the OCA indices of the Czech Republic and Portugal with Germany in the 1990s, as we showed in section 4.1.

The resulting OCA indices for the Czech Republic cannot show that there are substantially bigger structural differences between the Czech Republic and Germany than between the eurozone member countries. We can argue that the costs of adopting the euro in the Czech Republic should be comparable to those costs within the eurozone countries. However, for the decision-making it is necessary to consider all the accession countries potentially adopting the euro together and not separately, due to their interdependence and economic size, as our analysis also suggests.

Finally, we provide evidence for the importance of considering the international monetary system. We include the proxy $DOLVAR_{ij}$ for the international regime, which captures the influence of the variability of the U.S. dollar exchange rate on exchange rate volatility in the remaining countries. The estimated equation then is:

$$SD(e_{ij})=a+b_1SD(\Delta y_i-\Delta y_j)+b_2DISSIM_{ij}+b_3TRADE_{ij}+b_4SIZE_{ij}+b_5OPEN_{ij}+b_5DOLVAR_{ij} \quad (4)$$

where $DOLVAR_{ij}$ is calculated as the arithmetic average of the variability of the U.S. dollar exchange rates for each country pair. The proxy takes on zero value when the USA is one of the pair of countries. We expect that the higher the variability of the U.S. exchange rate, the higher the actual bilateral exchange rate for all the countries in the sample. The results are reported in Table 5.10. All the variables yield the expected signs and are jointly significantly different from zero. R^2 is relatively high. Our results correspond to the findings of Bayoumi and Eichengreen (1997a, p. 201) for the 1960s (the sign was opposite for their estimation for the sample from the 1970s and 1980s).

Table 5.10 – Results of Estimation of Equation (4)

	Coefficient	t-statistic
Variability of output	0.06	2.00
Trade ratio	-0.03	-6.74
Openness	-0.0001	-3.86
Size of economy	0.02	2.18
Dissimilarity of exports	0.006	4.08
Variability of U.S. dollar	0.004	5.17
Number of observations	190	
R-squared	0.45	
S.E.E.	0.008	
F-statistic	25.28	

[33] We cannot compare the OCA index values from 1987 with ours, since we have different data matrices. However, this is not the case for the ranking of the economies.

6. Conclusion

In this paper we discuss the relevance of the optimum currency area (OCA) theory to the choice of exchange rate regime in relation to the Czech Republic and the eurozone. There are several variables to be considered regarding the choice of exchange rate regime, i.e. symmetry of shocks, intensity of trade linkages, degree of dissimilarity of exports, and openness of the economy. All these variables we take into account in the construction and estimation of the "OCA index". We follow the approach suggesting that the OCA criteria are to a large extent exogenous rather than endogenous. Then we calculate OCA indices for industrial countries in an effort to estimate the benefit-cost ratio of adopting a common currency between two countries and discuss the results for the Czech Republic. We find no support for the view that the economy of the Czech Republic could possibly structurally differ any more than the eurozone member countries differ from one another. We conclude that if the eurozone is sustainable, the accession of the Czech economy should not change it. In other words, the costs of adopting the euro in the Czech Republic should be comparable to those costs within the eurozone countries.

Moreover, we focused our attention on the eurozone in a similar way. The results correspond to the earlier estimation of Bayoumi and Eichengreen (1997b) and show that the ranking of the economies suitable for forming a monetary union stayed the same in the 1980s and in the 1990s. The economies that were structurally close to each other in the 1980s remain close in the 1990s, and the opposite is true for structurally different economies. This empirical estimation also provides no evidence for the views that emphasise the seemingly striking difference between the core and periphery of the European Union.

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Appendix

Results of Bayoumi and Eichengreen (1997a) for Industrial Countries and for European Economies

Table 1: Results of Bayoumi and Eichengreen (1997a) for Industrial Countries

Results for all countries using OCA variables						
	1960s		1970s		1980s	
Variability	**Nominal**	**Real**	**Nominal**	**Real**	**Nominal**	**Real**
SDY	0.5**	0.45**	0.49**	0.53**	1.46**	1.41**
TRADE(*10^{-2})	-0.13*	-0.14**	-0.46**	-0.37**	-0.54**	-0.46**
SIZE(*10^{-2})	0.13	0.11	1.7**	1.68**	2.5**	2.53**
DISSIM(*10^{-2})	1.03**	0.81**	1.89**	1.93**	2.24**	2.8**
Observations	210	210	210	210	210	210
F-test	6.6**	6.9**	25.5**	25.6*	35.6**	37.6**
R-squared	0.15	0.17	0.4	0.41	0.51	0.54

***Source**: Bayoumi, Eichengreen (1997a); ** and * indicate significance at 5% and 1% respectively.*

Table 2: Results of Bayoumi and Eichengreen (1997a) for European Economies

Results for all countries using OCA variables						
	1960s		1970s		1980s	
Variability	**Nominal**	**Real**	**Nominal**	**Real**	**Nominal**	**Real**
SDY	0.36*	0.37**	0.53*	0.69**	0.75**	0.97**
TRADE(*10^{-2})	-0.18*	-0.17**	-0.2**	-0.14*	-0.26**	-0.19**
SIZE(*10^{-2})	0.37	0.23	0.32	0.65*	0.31	0.71**
DISSIM(*10^{-2})	1.17*	0.91*	-2.01	-0.39	-1.3	-1.36*
Observations	210	210	210	210	210	210
F-test	4.6**	3.2*	2.8*	3.2*	4.2*	4.6**
R-squared	0.15	0.22	0.15	0.15	0.27	0.35

***Source:** Bayoumi, Eichengreen (1997a); ** and * indicate significance at 5% and 1% respectively.*

Table 3: Optimum Currency Area Indices vis-à-vis Germany in 1987

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

***Source**: Bayoumi, Eichengreen (1997).*

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