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# The endogeneity of optimum currency area criteria, intraindustry trade and EMU enlargement

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**Jarko Fidrmuc**

# The Endogeneity of optimum currency area criteria, intraindustry trade and EMU enlargement

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# The Endogeneity of optimum currency area criteria, intraindustry trade and EMU enlargement

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All opinions expressed are those of the authors and do not necessarily reflect the views of the Bank of Finland.

Jarko Fidrmuc*

# The Endogeneity of optimum currency area criteria, intraindustry trade and EMU enlargement **

## Abstract

This paper tests an endogeneity hypothesis of optimum currency area (OCA) criteria (Frankel and Rose, 1998) on a cross-section of OECD countries between 1990 and 1999. The findings indicate that convergence of business cycles relates to intra-industry trade, but has no direct relation between business cycles and bilateral trade intensity. As far as intra-industry trade is positively correlated with trade intensities, this result confirms the OCA endogeneity hypothesis. The endogeneity of OCA linkage criteria implies extensive business cycle harmonization between CEECs and EU countries in the medium term.

**Key words**: Optimum currency area, EMU, trade, business cycle, CEECs.
**JEL classification:** F15, F41.

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# 1 Introduction

Countries participating in a currency area enjoy benefits and incur costs from their common currency. The benefits mainly derive from lower transaction costs in trade within the currency area, so countries with intensive trade relations are likely to gain most from monetary integration. In addition, Frankel and Rose (1997 and 1998) hypothesize that business cycles also converge among countries with close trade links. This hypothesis is supported by cross-section estimates of the correlation of business cycles and trade intensity among OECD countries between 1959 and 1993. Fatas (1996), Artis and Zhang (1995) and Hochreiter and Winckler (1995) show, for example, that a common European cycle has emerged as predicted by the endogeneity hypothesis of OCA criteria.

Nevertheless, considerable doubt persists as to the existence of a causal relationship between trade links and correlation of business cycles of the involved countries. Kenen (2000) notes that while the correlation of business cycles may increase with the intensity of trade links between countries, it does not necessarily mean that asymmetric shocks are reduced. Hughes Hallett and Piscitelli (2001) show that a currency union increases cyclical convergence only after there is sufficient symmetry in the shocks and institutional structure across the countries. These findings support Krugman's (1993) discussion of the implications from the US currency union for the European Monetary Union (EMU). In Krugman's view, trade liberalization should encourage increased specialization among countries according to comparative advantage, which in turn might cause a divergence of business cycles.

Indeed, the two papers of Frankel and Rose mention no relation to structural indicators that might explain the similarity of business cycles. Therefore, I test here for OCA endogeneity using bilateral levels of intra-industry trade between OECD countries in the 1990s, and show that the convergence of business cycles between trading partners is related to intra-industry trade. Borrowing on Krugman's (1993) argument, the tests confirm the OCA endogeneity hypothesis where intra-industry trade positively correlates with trade intensities.

Finally, I ask whether the Central and Eastern European Countries (CEECs) should introduce the euro as soon as possible after accession to the EU or whether they should wait. This question is addressed by applying the

endogeneity hypothesis of OCA criteria to five advanced transition economies (the Czech Republic, Hungary, Poland, Slovakia, and Slovenia). This paper applies the relation between the degree of trade integration, the shares of intra-industry trade, and the convergence in business cycles to CEECs and EU countries in order to predict the degree of business cycle harmonization of CEECs with EU countries in the medium term. Alternatively, these predictions can be interpreted as 'Indices of Endogenous Optimum Currency Area' (EOCA indices) similar to those introduced by Bayoumi and Eichengreen (1997).

The paper is structured as follows. Section 2 tests the endogeneity hypothesis of OCA criteria. Section 3 applies the revealed relation between the correlation of business cycles, on one hand, and trade intensity, on the other, for the computation of a potential correlation of business cycles (indices of an endogenous optimum currency area) in selected CEECs. The last section concludes.

# 2 The Optimum Currency Area Theory

## 2.1 Endogeneity of Optimum Currency Area Criteria

The theory of optimum currency areas (OCA) developed by Mundell (1961), McKinnon (1963), and Kenen (1969) has been popular in analysis of the costs and benefits of monetary integration, particularly EMU. The thrust of OCA theory is that countries or regions exposed to symmetric shocks, or possessing mechanisms for the absorption of asymmetric shocks, may find it optimal to adopt a common currency. OCA literature thus typically focuses on assessing the symmetry of output shocks in monetary unions or evaluating absorption mechanisms such as labor mobility and fiscal transfers.

OCA theory considers the following linkage criteria.

1. Potential gains from the creation of an OCA are determined according to the *degree of openness*. A country where trade within the OCA

accounts for a high proportion in domestic output can profit from participating in a currency area.

2. OCA theory also stresses the importance of the *similarity of shocks and business cycles*. Asymmetric shocks and business cycles raise the need for country-specific adjustment policies, but in a single-currency area, country-specific monetary policy is, by definition, not possible.

3. Mundell (1961) points at the *international factor mobility* (especially migration) as an alternative adjustment channel. High labor mobility facilitates adjustment to the adverse effects of asymmetric shocks and thus reduces the pressure for exchange rate adjustments.

4. Kennen (1969) notes the importance of *product diversification*. A country exporting highly diversified products is less vulnerable to sector-specific shocks. Countries with a large product spectrum are thus less likely induced to use their exchange rate as an adjustment tool.

5. Kenen (1969) also mentions *fiscal transfers*, which can be used to counteract asymmetric shocks in a currency area.

6. The *degree of policy integration and similarity between rates of inf lation* has been introduced to OCA theory more recently (see, e.g., Dixit, 2000). On one hand, differences between rates of inflation cause a loss of competitiveness in high-inflation countries, which calls for external adjustments (see Carlin, Glyn and Van Reenen, 2001). On the other hand, a high degree of policy integration before the creation (enlargement) of a currency area is likely to result in lower costs for the participating countries.

The stronger the above-mentioned linkages between countries participating in a currency area, the greater the expected gains in the participating countries. Frankel and Rose (1998) show that the first two criteria are endogenous. Closer trade relations result in a convergence of business cycles. They also take the more controversial stance that similar business cycles create

good preconditions for policy integration and the creation of a currency area. Krugman (1993), for example, argues that as countries integrate, they also specialize. These diverging expectations regarding the relation between business cycles and trade integration are illustrated in Figure 1.

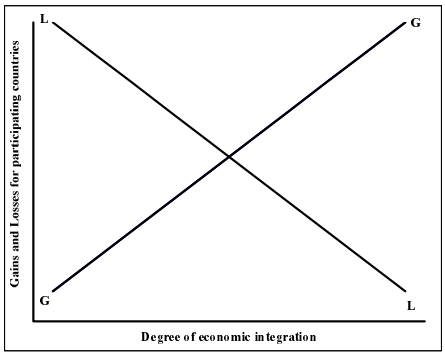
In line GG in Figures 1.A and 1.B, a positive relation of monetary efficiency gains to the degree of economic integration is generally expected. However, the classical and alternative views of the relation between the degree of economic integration and the losses resulting from the participation in a common currency area differ with respect to the shape of the LL curve. The traditional optimum currency area theory expects a negative relation, while the alternative view predicts a positive relation between economic losses and the degree of economic integration. There is the possibility that gains are higher than losses in the alternative view, where line GG is significantly steeper than the line LL (see De Grauwe and Aksoy, 1999), but the potential gains from participation in a currency area are much lower. Further, participating countries need to integrate to achieve positive gains from monetary integration.

In any case, good tools exist to apply either the conventional or the alternative view of OCA theory. The former is applicable when intra-industry trade is high, while the alternative view is appropriate when intra-industry trade is low. Therefore, this paper discusses the structure of trade between the EU and the CEECs to establish whether the conventional view is appropriate for monetary integration of the CEECs, or whether the alternative view of OCA should be applied.

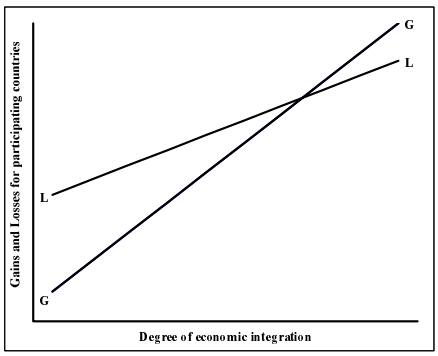
Kenen (2000) and Hughes Hallett and Piscitelli (2001) warn, however, that Frankel and Rose's results should be interpreted cautiously. Kenen (2000) shows in a Keynesian model framework the correlation between two countries' output changes increases unambiguously with the intensity of trade links between these countries, but does not necessarily mean that asymmetric shocks are reduced. Therefore, it is important to keep in mind that it is not trade relations alone that imply convergence of business cycles in an OCA. Indeed, Frankel and Rose's hypothesis stresses that bilateral trade is mainly intra-industry trade, although this indicator does not enter their analysis directly.

Figure 1: Optimum Currency Area Theory

A: Conventional View of an OCA




B: Alternative View of an OCA




## 2.2 Trade Integration and Business Cycles

Frankel and Rose (1998) argue that, if intra-industry trade accounts for a high share of bilateral trade, this intensity increases the convergence of business cycles. They report a significant and positive relation between trade intensity and the correlation of business cycles as measured by various indicators of economic activity in a cross-section of OECD countries between 1959 and 1993. For empirical tests, the endogeneity hypothesis of OCA criteria may be stated as

$$\mathrm{Corr}(Q_{\mathrm{i}}, Q_{\mathrm{j}}) = \alpha + \beta \log(TI_{ij}^{T}), \quad \text{where} \quad TI_{ij}^{T} = \frac{T_{ij}}{T_i + T_j} \tag{1}$$

where Corr($Q_i$,$Q_j$) stands for the correlation of detrended (fourth differences of logs) indicator of economic activity and *TI* denotes the natural logarithm of bilateral trade intensity between countries *i* and *j*. Trade intensity may be defined in relation to exports, imports, or trade turnover.[1]

Table 1 gives several specifications of (1) for OECD countries between 1990 and 1999,[2] so the OLS regression of bilateral economic activity on trade indicators may be inappropriate. Countries are likely to orient their monetary policy and fix the exchange rates toward their most important trading partners. Bilateral trade may thus reflect adoption of a common exchange rate policy and not vice versa.[3] Therefore, regressions have to be instrumented by exogenous determinants of bilateral trade flows. Such instruments are

provided by the 'gravity models' that include the log of distance between trading partners, a dummy for geographic adjacency and a dummy for the 12-member states of the EC, aggregate income, and income per capita (in logs) of the included countries.

Trade intensity is revealed to have a significant and positive effect on the correlation of business cycles. This result is robust to the selection of the indicator of economic activity and the particular definition of trade intensities. The business cycles of industrial production seems to be better explained by trade than the business cycles as defined by the correlation of countries' real GDP. This corresponds to the high share of tradables in the industry. However, the adjusted coefficient of determination is relatively low for all specifications of (1). As might be expected, the coefficients estimated for trade intensity indicators are slightly higher in the 1990s than in the previous decades as reported by Frankel and Rose (1998). This could indicate that the role of trade relations has increased recently.

Table 1: Trade Integration and Business Cycles

| | **Industrial Production** | | | **Real Gross Domestic Product** | | |
|---|---|---|---|---|---|---|
| | **Exports** | **Imports** | **Total** | **Exports** | **Imports** | **Total** |
| | **(1.a)** | **(1.b)** | **(1.c)** | **(1.d)** | **(1.e)** | **(1.f)** |
| Constant | 0.683 | 0.686 | 0.715 | 0.688 | 0.681 | 0.705 |
| | (8.005) | (8.517) | (8.355) | (6.832) | (7.064) | (6.939) |
| Trade Intensity | 0.084 | 0.084 | 0.091 | 0.086 | 0.083 | 0.090 |
| | (5.378) | (5.632) | (5.683) | (4.655) | (4.780) | (4.782) |
| No. of observations | 253 | 253 | 253 | 231 | 231 | 231 |
| SER | 0.287 | 0.284 | 0.284 | 0.326 | 0.331 | 0.327 |
| Adjusted $R^2$ | 0.099 | 0.117 | 0.117 | 0.098 | 0.068 | 0.089 |

Note: The dependent variable is the index of correlation of detrended indicator of economic activity (fourth difference of logs) between trading partners. Trade intensity is measured as a share of bilateral trade aggregate in total trade aggregates of both countries as indicated by the column headings. The instrumental variables in the two-stage OLS include the log of distance, a dummy for geographic adjacency, a dummy for EC12, the log of aggregate income and the log of income per capita. Heteroscedasticity-robust t-statistics are in parentheses. Adjusted $R^2$ and standard errors of regression (SER) are computed using the structural residuals (not second stage residuals).

## 2.3 Intra-industry Trade and Business Cycles

Equation (1) omits structural variables to explain the similarity of business cycles, although trade structure (e. g. the level of intra-industry trade) may be viewed as a major adjustment force inducing the convergence of business cycles between trading partners. Frankel and Rose (1998), Krugman (1993) and Hughes Hallett and Piscitelli (2001) use structural arguments for and against the endogeneity hypothesis of OCA criteria. Therefore, I estimate the relation between the correlation of business cycles, trade integration, and the bilateral level of intra-industry trade,

$$\mathrm{Corr}\left(Q_{\mathrm{i}}, Q_{\mathrm{j}}\right) = \alpha + \beta \log\left(TI_{ij}^{T}\right) + \gamma IIT_{ij} \tag{2}$$

where $Q$ and $TI$ are defined in the same way as in the corresponding formulations of (1) and $IIT_{ij}$ stands for intra-industry trade.[4] Equation (2) is again estimated by two-stage OLS. Note that the selected instrumental variables are also highly correlated with intra-industry trade (see Hummels and Levinsohn, 1995, Loertscher and Wolter, 1980).

In this specification (see Table 2), the coefficients of intra-industry trade are significant if estimated for the industrial production, although they are insignificant (but positive) for two specifications applying real GDP. By contrast, the coefficients of bilateral trade intensity are close to zero (indeed, they have wrong signs in several specifications) and insignificant for both indicators of economic activity. This pattern is very robust with respect to the choice of instrumental variables and country sample. This indicates that trade intensities have no direct effect on the correlation of business cycles. Therefore, I drop $TI_{ij}$ from estimated equations,

$$\mathrm{Corr}\left(Q_{\mathrm{i}}, Q_{\mathrm{j}}\right) = \alpha + \gamma IIT_{ij} \tag{3}$$

These are reported in the last column of the particular blocks of Table 2. The coefficients of intra-industry trade are highly significant in both specifications of (3).

Table 2: Intra-industry Trade, Trade Integration, and Business Cycles

| | Industrial Production | | | | Real Gross Domestic Product | | | |
|---|---|---|---|---|---|---|---|---|
| | Exports | Imports | Total | Only IIT | Exports | Imports | Total | Only IIT |
| | (2.a) | (2.b) | (2.c) | (3.a) | (2.d) | (2.e) | (2.f) | (3.b) |
| Constant | 0.259 | 0.468 | 0.379 | 0.499 | 0.444 | 0.578 | 0.543 | 0.476 |
| | (1.598) | (4.325) | (2.576) | (11.934) | (2.361) | (4.381) | (4.038) | (9.636) |
| Trade Intensity | -0.085 | -0.011 | -0.042 | | -0.011 | 0.038 | 0.021 | |
| | (-1.619) | (-0.323) | (-0.879) | | (-0.188) | (0.913) | (0.468) | |
| Intra-industry Trade | 0.335 | 0.207 | 0.257 | 0.187 | 0.195 | 0.103 | 0.095 | 0.175 |
| | (3.597) | (3.043) | (3.047) | (6.554) | (1.812) | (1.304) | (1.095) | (5.324) |
| No. of observations | 253 | 253 | 253 | 253 | 231 | 231 | 231 | 231 |
| St. Error of regression | 0.306 | 0.285 | 0.294 | 0.282 | 0.322 | 0.321 | 0.253 | 0.321 |
| Adjusted $R^2$ | -0.028 | 0.106 | 0.053 | 0.129 | 0.117 | 0.124 | 0.159 | 0.129 |

Note: The dependent variable is the index of correlation of detrended indicator of economic activity (fourth difference of logs) between trading partners. Trade intensity is measured as a share of bilateral trade aggregate in total trade aggregates of both countries as indicated by the column headings. The instrumental variables in the two-stage OLS include the log of distance, a dummy for geographic adjacency, a dummy for EC12, the log of aggregate income, and the log of income per capita. Heteroscedasticity-robust t-statistics are in parentheses. Adjusted $R^2$ and standard errors of regression (SER) are computed using structural residuals (not second stage residuals).

To the extent intra-industry trade is positively correlated with trade intensities, the endogeneity hypothesis of OCA criteria is confirmed by (2) and (3). However, our argumentation follows Krugman (1993). The degree of the business cycle coordination depends on the specialization pattern of the trading countries. Note, however, that OECD countries tend to be less specialized in foreign trade than US regions.

Table 2 shows that the coordination of the business cycles of trading partners is not driven by the simple aggregation of shocks transferred be-

tween countries via direct trade channels as argued by Kenen (2000). In contrast to this mechanistic view of an OCA endogeneity, equations (2) and (3) imply that the new structure of foreign trade – and not the direct effect of bilateral trade – is what induces the synchronization of countries' business cycles.

## 2.4 Sensitivity Analyses

The previous results are very robust with respect to the inclusion of other variables into (2). In particular, the countries wishing to participate in the EMU have tried to coordinate more their economic, fiscal and monetary policies during the 1990s. Therefore, a dummy for the EU countries that qualified for EMU in 1999 (the EU excluding Denmark, Greece, Sweden and the UK), denoted by *EMU*, is included. Further, neighboring countries are likely to influence each other much more than other countries. Therefore, a dummy for geographic adjacency, *B*, is included as well. Larger countries may also influence the business cycle of smaller countries. Therefore, GDP difference, $|Y_i - Y_j|$, is expected to have a positive sign. Thus, the augmented version of equation (2) may be stated as

$$\mathrm{Corr}\left(Q_{\mathrm{i}}, Q_{\mathrm{j}}\right) = \alpha + \beta \log\left(TI_{ij}^{T}\right) + \gamma IIT_{ij} + \delta EMU + \lambda B + \theta \left|Y_i - Y_j\right| \qquad (4)$$

Indeed, these variables exhibit the correct signs in nearly all specifications (see Table 3). Equation (4) shows institutional changes also matter. The eleven countries participating in the EMU have had higher correlation of business cycles by about 0.15 on average during the 1990s. This is relatively high compared to the sample's mean of 0.25 for both indicators of the economic activity.

However, the results for other additional variables are not so robust, nor did the inclusion of additional explanatory variables improve the goodness of fit. Importantly, intra-industry trade is positive and significant in nearly all specifications, while trade intensities have a negative sign in nearly all augmented specifications. Thus, the sensitivity analyses emphasize the importance of structural variables (both $IIT_{ij}$ and *EMU*) in the harmonization of business cycles between countries.

Table 3: Sensitivity Analyses

| | Industrial Production | | | Real Gross Domestic Product | | |
|---|---|---|---|---|---|---|
| | **Exports** | **Imports** | **Total** | **Exports** | **Imports** | **Total** |
| | **(4.a)** | **(4.b)** | **(4.c)** | **(4.d)** | **(4.e)** | **(4.f)** |
| Constant | -0.327 | 0.046 | -0.214 | 0.257 | 0.610 | 0.484 |
| | (-1.872) | (0.283) | (-1.060) | (1.131) | (3.361) | (2.127) |
| Trade Intensity | -0.185 | -0.062 | -0.138 | -0.068 | 0.037 | 0.002 |
| | (-3.891) | (-1.802) | (-2.796) | (-1.085) | (0.953) | (0.041) |
| Intra-industry Trade | 0.415 | 0.220 | 0.328 | 0.245 | 0.081 | 0.136 |
| | (5.165) | (3.796) | (4.277) | (2.428) | (1.257) | (1.631) |
| Dummy: Geographic | 0.231 | 0.136 | 0.192 | 0.095 | 0.024 | 0.046 |
| Adjacency | (3.083) | (1.910) | (2.540) | (0.968) | (0.260) | (0.477) |
| Dummy: EMU 11 | 0.163 | 0.154 | 0.164 | 0.153 | 0.139 | 0.145 |
| | (3.950) | (3.760) | (3.947) | (2.722) | (2.533) | (2.608) |
| GDP Difference | 0.020 | 0.022 | 0.023 | -0.011 | -0.015 | -0.013 |
| | (1.876) | (1.964) | (2.146) | (-0.910) | (-1.179) | (-0.978) |
| No. of observations | 253 | 253 | 253 | 231 | 231 | 231 |
| SER | 0.269 | 0.275 | 0.272 | 0.325 | 0.325 | 0.326 |
| Adjusted $R^2$ | 0.201 | 0.172 | 0.187 | 0.103 | 0.101 | 0.099 |

Note: The dependent variable is the index of correlation of detrended indicator of economic activity (fourth difference of logs) between trading partners. Trade intensity is measured as a share of bilateral trade aggregate in total trade aggregates of both countries as indicated by the column headings. Trade intensity and intra-industry trade are instrumented by the log of distance, a dummy for geographic adjacency, a dummy for EC12, the log of aggregate income, and the log of income per capita. Heteroscedasticity-robust t-statistics are in parentheses. Adjusted $R^2$ and standard errors of regression (SER) are computed using second stage residuals.

# 3 The Endogeneity Hypothesis of OCA Criteria and EMU Enlargement

CEECs have pursued membership in the European Union since the early 1990s. After ten years of economic reform, these countries have largely succeeded in adjusting their economies to market principles. As a result, the EU initiated membership talks with five CEECs in 1998, and extended those talks to all ten associated countries two years later.

Table 4: Similarity of Business Cycles of Selected Countries with Germany

| | Industrial Production | | Real Gross Domestic Product | |
|---|---|---|---|---|
| | 1991-1999 | 1993-1999 | 1991-1999 | 1993-1999 |
| **Austria** | 0.79 | 0.81 | -0.36 | 0.58 |
| **Belgium** | 0.26 | 0.25 | 0.02 | 0.88 |
| **Greece** | 0.34 | 0.48 | | |
| **Spain** | 0.84 | 0.92 | 0.01 | 0.79 |
| **Finland** | 0.39 | 0.69 | 0.68 | 0.79 |
| **France** | 0.87 | 0.91 | 0.19 | 0.83 |
| **Ireland** | 0.38 | 0.44 | 0.19 | -0.03 |
| **Italy** | 0.58 | 0.60 | 0.01 | 0.81 |
| **Netherlands** | 0.60 | 0.57 | 0.18 | 0.69 |
| **Portugal** | 0.59 | 0.56 | 0.01 | 0.78 |
| **Denmark** | 0.73 | 0.78 | 0.22 | 0.71 |
| **UK** | 0.46 | 0.56 | 0.41 | 0.76 |
| **Sweden** | 0.15 | 0.22 | 0.73 | 0.61 |
| **Czech Rep.** | | 0.37 | | 0.01[b] |
| **Hungary** | 0.30 | 0.63 | | 0.75[b] |
| **Poland** | 0.23[a] | 0.45[a] | | 0.38[b] |
| **Slovakia** | | 0.04 | | 0.74[b] |
| **Slovenia** | | 0.77 | | 0.80[b] |

Notes: The similarity of business cycles is measured by the correlation of detrended indicator of economic activity (fourth difference of logs). a – Data according to the Vienna Institute for Comparative Economics (WIIW); b – Correlation of GDP growth according to IMF (2000).

The European Union, including the Eurosystem, has outlined a three-step approach to the monetary integration for candidate countries from Central and Eastern Europe. Kopits (1999) and Backé (1999) describe this approach in detail. Basically, applicants first join the EU, then enter the EU's exchange rate mechanism (ERM II), and finally, after they meet the convergence criteria, accede to Economic and Monetary Union.[5]

### 3.1 Trade Integration between EU and CEECs

Since the opening-up of Eastern Europe, the importance of EU countries in CEECs' trade has increased dramatically. By 1998, the European Union was the most important trading partner of all CEECs. The EU accounted for between 40% (Lithuania) and 70% (Hungary) of total exports of the CEECs.[6] These export shares are comparable to or even higher than intra-EU shares for nearly all EU Member States. On the import side, the predominance of the EU is only slightly weaker. Furthermore, the shares of exports and imports going to and coming from an 'enlarged EU' (current EU members plus the ten accession countries) are even higher. According to this indicator, an enlarged Europe is the most important export market for Slovakia and the Czech Republic, followed by Portugal, the Netherlands, and Austria.

The CEECs are already relatively open economies. Exports account for about one third of GDP in Hungary, and more than 40% in the Czech Republic, Slovakia and Slovenia. Thus, these countries are relatively more open than nearly all EU countries. Only a few EU countries (notably Belgium, the Netherlands, and Ireland) are significantly more open than the smaller CEECs (export shares between 50% and 70% of GDP). Only Poland's exports, at 17% of GDP, are relatively low by EU standards. This partly reflects the larger size of the Polish economy. Buiter (2001) notes that the CEECs are also relatively open when comparing their trade to GDP at purchasing power parities.

From the point of view of the conventional OCA theory, if intra-industry trade accounts for a high share in trade, then, *ceteris paribus*, business cycles are expected to become more similar across countries as illustrated by Figure 1.A. By contrast, increased bilateral trade intensity may lead to divergence of business cycles if the increase in trade is due mainly to increased specialization as predicted by the alternative OCA view (Figure 1.B). There-

fore, intra-industry trade may be used to identify which model is more appropriate for a particular group of countries.

The growth of intra-industry trade, which is observed in intra-EU trade, also dominates recent East-West trade developments. This would increase net gains from the integration of CEECs into the euro area. According to Fidrmuc (1999), the shares of intra-industry trade in the EU's trade with the Czech Republic, Slovenia and Hungary, as computed by Grubel-Lloyd indices, *IIT*,

$$IIT = 1 - \frac{\sum_i |X_i - M_i|}{\sum_i (X_i + M_i)} \tag{5}$$

where $X_i$ and $M_i$ denote exports and imports by three-digit SITC commodity groups *i*, were already comparable to or even slightly larger than in EU trade with e.g. Spain and Sweden (that is, about 60%) in 1998. Poland and Slovakia report somewhat lower levels of intra-industry trade at about 50%. These levels are comparable to those of Ireland and Portugal. However, the shares of intra-industry trade in EU trade with Estonia, Lithuania, Latvia, Romania, and Bulgaria have still remained slightly above the level of EU intra-industry trade with Greece and Turkey (below 35%).

The convergence of the trade structure between the EU and the CEECs implies that we can apply the conventional view of an OCA (see Figure 1.A) at least to the Central European membership candidates (the Czech Republic, Hungary, Slovenia, and, to a lesser extent, Poland and Slovakia). Therefore, the application of the endogeneity of OCA criteria is restricted to these countries in further analysis.

## 3.2 Observed Convergence of Business Cycles in the EU and the CEECs

There is mixed evidence as to the convergence of business cycles in the EU and the CEECs. On the one hand, the level of GDP grew slowly in relation to the Western European countries during the period of the central planning system. The divergence of Western and Eastern Europe sped up in the 1970s and the 1980s. Thus, the increasing welfare difference between market and

central planning economies in Europe was one of the major reasons for the introduction of early reforms in Eastern Europe. There were few signs of convergence between Central and Eastern European countries in this period. Estrin and Urga (1997) find only limited evidence of convergence in the former Soviet Union or within various groups of Central European command economies. More surprisingly, Fidrmuc, Horvath, and Fidrmuc (1999) conclude that the Czech Republic and Slovakia did not converge between 1950 and 1990 or within a sub-sample from 1970 to 1990.

Several authors report increasing similarities of business cycles between the EU (mainly Germany) and the CEECs since the economic reforms were introduced. In particular, Boone and Maurel (1998 and 1999) find a significant convergence between business cycles (as measured by unemployment rates) in Germany and select CEECs (the Czech Republic, Hungary, Poland and Slovakia). According to Boone and Maurel (1999), between 55% (Poland) and 86% (Hungary) of the CEECs' cycles (detrended unemployment) are explained by German shocks. This figure is lower than the estimate for the French-German interdependence of business cycles (91%), but higher than the estimates for the German influence on Spanish (43%) and Italian (18%) business cycles. Therefore, the authors conclude that the benefits of joining the euro area could eventually outweigh the costs in the CEECs.

Indeed, business cycles in several CEECs have become strikingly similar to the business cycle of the EU (as proxied by Germany) since 1993 (see Table 4). At the beginning of the 1990s, the business cycles in the CEECs were determined by the "transitional" recession. Therefore, the correlation of business cycles was low between 1991 and 1999. The recovery in these countries has been strongly influenced by the growing exports to the EU. As a result, the business cycle of the EU has determined the developments in CEECs' economies since 1993. In particular, the correlation of growth of industrial production or GDP between Germany and Hungary (0.63 and 0.75, respectively), and Germany and Slovenia (0.77 and 0.80, respectively), has been higher than the corresponding correlations of EU countries with Germany on average (0.60 and 0.68, respectively) during this time.

However, six years may be too short a time to conclude that business cycles have already become similar, particularly as this period corresponds to only about one full business cycle. Moreover, this period was characterized by only few supply and demand shocks. Actually, the correlations of industrial production in Germany and that in the Czech Republic[7] and Slovakia

have remained relatively low. Insofar as the Czech Republic and Slovakia are quite similar to other CEECs (see previous section), this indicates that country-specific shocks may still have significant effects on these economies. The difference between the Czech Republic and Slovakia, on the one hand, and the remaining CEECs, on the other, indicates that asymmetric shocks are still likely in the EU and the CEECs.

### 3.3 Indices of Endogenous Optimum Currency Area

The revealed trend to the unification of business cycles in Europe is not surprising. It fully corresponds to the endogeneity of OCA criteria. Therefore, I use equations estimated in the previous section to evaluate the potential correlation of business cycles in Germany and the CEECs given the current integration of these countries and the current level of intra-industry trade. Note that these correlations can be alternatively interpreted as indices of endogenous optimum currency area (EOCA indices) similar to those constructed by Bayoumi and Eichengreen (1997).

A comparison of Table 4 and Table 5 shows that the correlations of business cycles in Germany and in other EU countries were on average slightly higher in the 1990s than those predicted by the EOCA indices. Again, this is hardly surprising. First, the European Union has made significant progress in coordination of economic policy among the member states. As a result of the introduction of the single market in 1992 and the preparations for EMU in the last decade, the similarity of business cycles within the EU countries was likely higher in the 1990s than in previous decades. Second, Germany was selected as a proxy for the EU because it is known to dominate the European business cycle (see Bayoumi and Eichengreen, 1993).

Using various specifications of equation (1), the correlation of industrial production and GDP in Germany and other EU countries is predicted at about 0.37 for both indicators on average. In fact, the corresponding correlations predicted for the CEECs (EOCA indices) are only slightly lower. The Czech Republic, Poland and Hungary could potentially reach correlations as high as 0.35 on average in the medium run, while Slovak and Slovene trade is less oriented towards Germany, resulting in a lower predicted correlation of about 0.24 on average.

Table 5: Indices of Endogenous Optimum Currency Area of Selected Countries with Germany

| | Industrial Production | | | | Real Gross Domestic Product | | | |
|---|---|---|---|---|---|---|---|---|
| | (1.a) | (1.b) | (1.c) | (3.a) | (1.d) | (1.e) | (1.f) | (3.b) |
| **Austria** | 0.42 | 0.44 | 0.41 | 0.43 | 0.42 | 0.44 | 0.40 | 0.41 |
| **Belgium** | 0.43 | 0.43 | 0.44 | 0.43 | 0.43 | 0.43 | 0.43 | 0.41 |
| **Greece** | 0.24 | 0.22 | 0.26 | 0.24 | 0.24 | 0.22 | 0.26 | 0.24 |
| **Spain** | 0.38 | 0.38 | 0.40 | 0.41 | 0.38 | 0.38 | 0.39 | 0.39 |
| **Finland** | 0.29 | 0.29 | 0.28 | 0.34 | 0.28 | 0.29 | 0.28 | 0.32 |
| **France** | 0.46 | 0.46 | 0.47 | 0.45 | 0.46 | 0.46 | 0.46 | 0.43 |
| **Ireland** | 0.27 | 0.30 | 0.22 | 0.28 | 0.26 | 0.30 | 0.21 | 0.27 |
| **Italy** | 0.43 | 0.44 | 0.44 | 0.39 | 0.43 | 0.44 | 0.44 | 0.37 |
| **Netherlands** | 0.44 | 0.46 | 0.45 | 0.41 | 0.44 | 0.45 | 0.44 | 0.39 |
| **Portugal** | 0.30 | 0.30 | 0.30 | 0.36 | 0.30 | 0.30 | 0.29 | 0.35 |
| **Denmark** | 0.34 | 0.35 | 0.34 | 0.38 | 0.34 | 0.35 | 0.34 | 0.37 |
| **UK** | 0.43 | 0.42 | 0.45 | 0.43 | 0.43 | 0.42 | 0.44 | 0.41 |
| **Sweden** | 0.35 | 0.34 | 0.36 | 0.36 | 0.35 | 0.34 | 0.35 | 0.35 |
| **Czech Rep.** | 0.36 | 0.36 | 0.36 | 0.43 | 0.36 | 0.36 | 0.35 | 0.41 |
| **Hungary** | 0.33 | 0.33 | 0.33 | 0.38 | 0.32 | 0.33 | 0.33 | 0.37 |
| **Poland** | 0.36 | 0.37 | 0.35 | 0.33 | 0.35 | 0.37 | 0.34 | 0.31 |
| **Slovakia** | 0.26 | 0.27 | 0.24 | 0.34 | 0.25 | 0.27 | 0.24 | 0.33 |
| **Slovenia** | 0.23 | 0.23 | 0.23 | 0.36 | 0.22 | 0.23 | 0.22 | 0.35 |

Notes: Indices of Endogenous Optimum Currency Area are computed according to particular specification of (1) and (3) as indicated by column headings.

Similarly, using (3) to compute the EOCA indices in Germany and select countries, we get results even higher than the previous figures (see Table 5). Indeed, the Czech Republic is predicted to have a higher correlation of industrial production with Germany than all EU countries except for France, although this prediction still remains below the realized levels in several EU countries.

The comparison of predicted, or potential, business cycle correlations for selected Western and Eastern European countries shows small differences between both regions. Further coordination of economic policy in CEECs with the EU is likely to result in a fast convergence of business cycles. Thus, the CEECs face extraordinarily favorable preconditions for a fast convergence to the business cycle in the EU (or EMU). This expectation is based on the high openness of the CEECs vis-à-vis the EU and the high shares of intra-industry trade in bilateral relations. Given the high potential gains from an OCA between the current EMU countries and the CEECs (as illustrated by the high importance of EU trade in the CEECs) and the currently observed convergence of business cycles in both regions (partly caused by the first observation), we can expect a strong tendency among CEECs to join EMU.

# 4 Conclusions

This paper examines the endogeneity hypothesis of OCA criteria originally introduced by Frankel and Rose (1997 and 1998). On the one hand, this issue has significantly influenced the shape of European monetary integration. On the other hand, there is considerable doubt as to whether there is a causal relationship between trade and business cycles. Krugman (1993) argues that integration is likely to support the specialization of participating countries according to the comparative advantage, and indeed finds empirical support for his arguments in the specialization pattern and business cycles of the US regions. Kenen (2000) and Hughes Hallett and Piscitelli (2001) demonstrate that the trade links alone do not ensure the convergence of business cycles if countries are not sufficiently similar.

This paper addresses the importance of structural variables in the harmonization of business cycles. In particular, intra-industry trade is shown to induce convergence of business cycles in OECD countries. Furthermore, econometric analyses reveal that there is no direct relation between business cycle and trade intensity if regressions are augmented by additional structural variables. Following Krugman's (1993) argument, the OCA endogeneity hypothesis is confirmed to the extent intra-industry trade is positively correlated with trade intensities.

This result is robust with respect to the definition of trade intensity and the selection of the indicators of economic activity for comparison of business cycles. The sensitivity analysis reveals that preparations for EMU have already exerted positive effects on the synchronization of business cycles in the participating countries in the 1990s. This confirms the importance of the structural variables in the convergence of business cycles.

Finally, this paper addresses the current enlargement agenda. Enlargement of the euro area to Central and Eastern European countries has initiated an intense academic and political discussion, although the membership negotiations between the EU and the associated countries have just started. This discussion is characterized by a multitude of different policy proposals, ranging from the immediate adoption of the euro in some countries (mostly in Poland and in Estonia) to suggestions that the CEECs should not sacrifice exchange rate flexibility to support their growth and convergence with the EU.

The contribution of this paper to the discussion focuses on five associated countries (the Czech Republic, Hungary, Poland, Slovenia, and Slovakia). It partly confirms earlier findings that the CEECs have rapidly converged to the EU countries in terms of business cycles and trade integration. In particular, business cycles in several CEECs (Hungary, Slovenia and, to a lesser extent, Poland) have strongly correlated with the business cycle in Germany since 1993. Apparently Hungary, Slovenia and possibly Poland, but not the Czech Republic and Slovakia, have made headway toward constituting an optimum currency area with the EU.

This paper also reveals that the observation period was still too short (and characterized by too few supply and demand shocks) to conclude that the business cycles are already similar. Furthermore, the business cycle in the Czech Republic did not correlate with Germany's. As the Czech Republic is quite similar to other CEECs, this indicates that country-specific shocks may still have significant effects on these economies.

To shed more light on this ambiguous result, I computed the potential correlation of the business cycle in Germany and in the CEECs using Frankel and Rose's (1998) relation between the degree of trade integration and the convergence of the business cycles of trading partners. These figures may be alternatively interpreted as 'EOCA indices' following Bayoumi and Eichengreen (1997).

As a result, the high degree of trade between the EU and the CEECs represents a sound base for business cycle convergence, and thus for fulfillment of OCA criteria in the medium and long run. These results do not fully confirm the hypothesis that the CEECs constitute an optimum currency area with the EU already, but nevertheless indicates that they will eventually fulfill OCA criteria to the same degree as current EU members.

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# Notes

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[1] The country sample includes Switzerland, Norway, the US, Canada, Australia, New Zealand, Turkey, and Israel in addition to 14 EU countries (Belgium and Luxembourg are reported as a single region). I use industrial production and GDP indices according to the International Financial Statistics of the IMF, lines 66 and 99. Quarterly GDP is not available for Greece. Trade intensities were computed for 1997, the most recent year available.

[2] Some explanatory variables which will be used later (intra-industry trade) are not available for the earlier periods due to changes in trade statistics. Therefore, the analysis has to be restricted to the 1990s throughout the paper.

[3] Rose (2000), for example, documents positive effects of currency unions and negative effects of exchange rate volatility on bilateral trade.

[4] Intra-industry trade as measured by Grubel-Lloyd indices, see equation (5), was computed for three-digit SITC commodity groups in 1998. When available, data according to Eurostat were used. Intra-industry trade at the same level of disaggregation between non-EU countries was computed using UN World Trade Data.

[5] Bratkowski and Rostowski (1999) discuss the possibility of adopting the euro as legal tender in some CEECs before EU membership. Portes (2001) and Buiter and Grafe (2001) also address this issue.

[6] As estimated by gravity models, Fidrmuc and Fidrmuc (2000) show that the trade between the CEECs and the EU, as well as trade between individual CEECs, has already reached its ‘natural’ level, corresponding to economic size, distance between countries, and stage of integration.

[7] In contrast to our results, Cincibuch and Vavra (2000) show that an alternative measure of similarity in business cycles – standard deviation of percentage changes in relative output in the Czech Republic and Germany – has declined during the reform period, meaning that the symmetry of business cycles has increased.

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