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How far away are the CEECs from the EU economic standards?

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Abstract

In October 1999 the European Commission published the second progress report on the state of convergence of the Central- and Eastern European candidate countries (CEECs). The report encompasses an assessment, which is based on the three Copenhagen criteria. From an economic point of view, a country must have a functioning market economy and be able to withstand the competition on the European single market. In this paper we present a synthetic performance measure which helps to assess the economic preparedness of the ten Central and Eastern European Countries (CEECs) to become members of the European Union (EU). With the aid of the Data Envelopment Analysis (DEA) we construct a best practice frontier, which is supported by the best performing EU-countries and which serves as a benchmark for the candidate countries. The preparedness of any CEEC is measured as the relative distance to this frontier. The results confirm that the macroeconomic performance of most of the CEECs lies far behind the EU standards, in foreign trade some of the CEECs already perform better than some EU countries. Interestingly, we find out that some CEECs are already better prepared for the EMU than many EU member states.

Keywords: European Integration, EU Enlargement, Macroeconomic Performance, European Monetary Union, Foreign Trade, Data Envelopment Analysis

JEL-classification: C43, F15, P17

1. Introduction

Over the last ten years the emerging markets of Central and Eastern Europe have undergone enormous changes. The fall of the Berlin Wall in 1989 led to the collapse of Communist governments throughout the region and to the establishment of new systems of government. Besides the establishment of democracies in these societies the Central and Eastern European countries (CEECs) have started to transform their economies from planned to market systems. In addition, they have oriented their interests towards the European Union (EU). Since 1994 ten CEECs have applied for EU membership. Since 1998 the European Commission has been negotiating with the first group of five countries (the „Luxembourg Group"). At the Helsinki Council meeting in December 1999 the EU decided to start negotiations also with the rest of them (the „Helsinki Group").

On its Copenhagen Council meeting in June 1993, the European Union defined three categories of criteria for accession: i) political criteria - i.e. the establishment of democracy and the protection of human rights and minorities; ii) economic criteria – the building up of a functioning market economy able to withstand the competition on the single market; iii) the acquis criterion – i.e. the complete takeover of the legal status of the Union plus the acceptance of its targets (meaning monetary and political union). In the given context we are interested in the evaluation of the „economic criteria". It is not easy to say at what moment in time the CEECs will have reached the point where their market economies can be classified as „functioning". One can approach this goal only by looking at different indicators. This also is the approach applied by the European Commission in its yearly progress reports (see EU, 1999). In a study done by the Austrian Institute of Economic Research (Breuss, 1999) numerous indicators were being looked at to approach a conclusion regarding to what degree the ten CEECs have already reached the necessary preparedness to enter the EU. The final ranking in that study was done just by averaging the position of the numerous indicators.

In this paper we want to take up the idea of evaluating the preparedness for EU membership of the ten accession countries by using several indicators. However, we apply an approach that has hitherto been never used in this context. We use the data envelopment analysis (DEA) to perform this task. In so doing we cover three sets of indicators: one for the macro performance, the other for trade performance and the third representing the preparedness for the entrance into the European Monetary Union (EMU). We not only look at these indicators for the ten CEECs but confront them with the performance of the 15 EU member states as well. In so doing the benchmarks for the different indicators are primarily set by the EU member states. Therefore it makes sense to apply the DEA. The idea of this analysis technique is to measure the performance of variables in relation to the best practice of the same variables. By choosing the EU member states as the potential benchmark economies, we can derive the relative distance of the CEECs from the EU economic standards.

For investigations of the economic performance of economic units (e.g. countries) a number of heterogeneous performance indicators have to be aggregated to one single performance measure. Several approaches to this are known. For example a weighted sum of the indicators

can be computed. In so doing the problem of choosing the weights comes up. In conventional procedures the weights are determined by the researcher.

In our analysis we alternatively apply the Data Envelopment Analysis to compute objective weights. Previously used indexes (e.g. OECD's "Magic Diamond) contain an arbitrary and unrealistic weighting scheme to aggregate their respective indicators: by implicitly assigning a weight of unity to each component, each index treats its respective indicators as being equally important, in all countries and all years. Our performance measures contain several different indicators, they aggregate them into a single performance measure, and the weights they use to aggregate the indicators are allowed to vary across countries and through time. (cf. Lovell and Pastor, 1994, p. 3)

The next section describes the methodology of the DEA in general and the adjustments necessary to be suitable for tackling the problem of benchmarking countries of accession in particular. For this purpose we use the DEA to measure the economic performance. Then we present the results of the application of the DEA. Finally, conclusions related to our problem are drawn.

2. Method

2.1. Data Envelopment Analysis (DEA)

The basic problems with expressing the economic performance in one single indicator are first, to aggregate a number of non-commensurate performance indicators (such as level of national income per capita, unemployment, price stability, etc.) to one single performance measure and secondly, to establish a benchmark that can be used for comparing the performance of the countries in the sample.

In most studies a weighted sum is calculated to aggregate the individual indicators. The weights are chosen by the researcher and reflect his preferences. The results of such a calculation are influenced by these weights. The assessed countries are ranked with respect to their performance scores. An alternative suggested by Lovell and Pastor (1994) and Lovell (1995) is the Data Envelopment Analysis (DEA), which is a non-parametric approach that uses a linear programming technique. The DEA defines the best practice frontier which serves as a benchmark and minimizes the relative distance to this benchmark. This distance is interpreted as the economic performance of the countries in the sample. It is an equivalent to the weighted sum. The weights are calculated by the DEA within the optimization process.

Farrell (1957) introduced the concept of the best practice frontier, which delineates the technological limits of what a country can achieve with a given level of resources. The solid line in Figure 1 shows such a best practice frontier computed by a DEA in a situation in which two indexes are combined to one single performance indicator. Each dot in the diagram (A to D)

stands for the performance of a country of the sample. The DEA constructs an envelope for the observed indicator combinations of all countries in the sample under the constraint that all well performing countries support the envelope. The frontier is called best practice frontier. This frontier allows us to classify countries into well performing units if they are at the frontier and into worse performing units if they lie below. A worse performing country could either augment the index number one or the index number two or even both. The indicator of preparedness is then given by the relative distance between the actual observed performance and the nearest benchmark.

In Figure 1 three countries (A, B and C) support the DEA - best practice frontier and are classified as well performing. The country D lies below the best practice frontier and is identified as worse performing. As a preparedness indicator we use the radial distance measure developed by Farrell (1957). It is defined as the ratio of the distance between the origin and the projected point of the examined country at the frontier divided by the distance between the origin and the actual observed point. For example the preparedness of the country D is $0D^T/0D$. The preparedness scores of the best performing countries is 1 and of the worst performing countries larger than 1.

The case shown in Figure 1 is the aggregation of two indexes with the aid of an index-maximizing DEA. An index-maximizing DEA seeks to compute economic performance as a proportional augmentation in all indexes.[1] It is also possible to measure economic performance as a proportional decrease in all indexes. This approach is an index-minimizing DEA.[2] The index-maximizing approach is applied if scores of all indicators are preferred to be as high as possible (e. g. Gross Domestic Product, employment, etc.) whereas the index-minimizing approach is adopted if scores are preferred to be as low as possible (interest rate, inflation, etc.). To keep the presentation of the method short and simple we just describe the index-maximizing approach in detail. For a description of the index-minimizing DEA see Coelli et al. (1998, pp. 134).

The computation of the envelope and the preparedness indicator can be reduced to a linear program for each individual country in which the following optimization problem is solved[3]:

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[1] In the literature this kind of DEA is referred "output-oriented DEA" (see Coelli et al. (1998, pp. 137)).

[2] This approach is known from the literature as "input-oriented DEA" (see Coelli et al. (1998, pp. 134))

[3] This linear program is derived from the basic model of Banker, Charnes and Cooper (1984) by Lovell, Pastor (1999).

$$\max \boldsymbol{f}_0 + \boldsymbol{e} \sum_i s_i$$

$$\text{s.t.} \qquad \boldsymbol{f}_0 y_{i0} - \sum_j y_{ij} \boldsymbol{l}_j + s_i = 0 \qquad \textit{(for each of the r indicators)}$$

$$\sum_j \boldsymbol{l}_j = 1$$

$$\boldsymbol{f}_O \textit{ free}, \quad s_i \; ^3 \, 0, \quad l_j \; ^3 \, 0,$$

where

ϕ_O ... preparedness score,

ε ... non-archimedean variable ($\varepsilon = 10^{-8}$)[4],

s_i ... slack variable of the i-th indicator, $\quad i = 1,...,r,$ $\qquad$ r ... number of indicators,

y_{ij} ... i-th indicator of the j-th country, $\quad j = 1,...,n,$ $\qquad$ n ... number of countries,

λ_j ... weight of the j-th country.

This procedure computes the preparedness score $\boldsymbol{f}_O$ of a single country and must be repeated for every country in the sample.

Figure 1 also shows the weakness of the DEA. The DEA has the characteristic to diagnose any country supporting the frontier as equally well performing even if it is superior with respect to one indicator but performs poorly with respect to all others (e.g. C). In our opinion the DEA leads to results which do not reproduce the reality very well. In our example A, B, and C are ranked right at the top. Instead of this it would be more realistic to measure the performance relative to a country, which is quite good in all indicators. Such a country would be close to the northeast. In the example of Figure 1 the best practice country would be B.

Figure 1: DEA frontier versus VEA frontier[see appendix]

2.2. Value Efficiency Analysis (VEA)

Halme et al. (1999) developed a procedure and a suitable theory that allows to incorporate preference information into the performance analysis. The procedure begins by determining the well performing countries and the frontier with a normal DEA. Afterwards the procedure aids the Decision Maker (DM) in searching for the most preferred combination of indexes of countries (for short, Most Preferred Solution) among the well performing countries. Then, assuming that the Decision Maker's Most Preferred Solution maximized his/her underlying (unknown) value function, the method approximates the indifference contour of the value function in this point with its possible tangent hyperplanes.

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[4] The issues of the appropriate specification of the non-archimedean variable are discussed in Ali (1994, p. 78).

Halme et al. (1999) suggest that the preferences are incorporated in performance analysis by explicitly locating the most preferred output vector on the DEA - best practice frontier. They call this vector the Decision Maker's Most Preferred Solution (MPS). It is the vector on the best practice frontier which the DM prefers to any other vector at the moment of choice. They use the interactive Multiple Objective Linear Programming (MOLP) search procedure to lo-cate the MPS.

The MPS is a solution which is preferred by the DM to any other solution. Assuming a ra-tional DM who prefers a score of any index as high as possible, it is obvious that the MPS is at the frontier. Unfortunately defining the MPS in this way provides no practical tool for per-formance analysis. It is not realistic to assume that the DM is generally able to compare all possible solutions to the final solution at the end of the search. In practice, the MPS is a solu-tion at which the search process ends.[5]

Using the knowledge of the MPS, the unknown value function of the MPS is approximated using the so-called tangent cone of the MPS. The performance of each country is then deter-mined with respect to this tangent cone. As a result Halme et al. (1999) obtain scores that they call Value Efficiency scores, because the performance of each country is determined by means of an approximation of the indifference surface of an implicitly known value function at the MPS.

In Figure 1 the MPS is located at country B according to our preferences. Instead of using the Multi Objective Linear Programming procedure we choose an existing country to be the MPS according to our preferences. We prefer a country as best performing which is rather good with respect to all indictors. In the figure the country which fulfils this condition is the coun-try at the northeastern corner of the best practice frontier. In the approach of Halme et al. (1999) the value function is approximated by the two adjoining facets A-B and B-C. These two facets form the so called Value Efficiency Frontier (VEA-frontier). In the figure this frontier is the broken line. The performance of all countries is their relative distance to the VEA-frontier. This is defined as the distance of the origin and the projected point at the VEA-frontier divided by the distance of the origin and the observed index combination. For exam-ple for the country D the performance measure would be $0D^V/0D$.

The VEA approach also has some shortcomings. It can be seen in the example of Figure 1 that the ranking of the best practice countries drown from a normal VEA is not different from the ranking drawn from a common DEA. In both rankings A, B and C are right at the top, al-though in the VEA the country B is selected as best practice. This result is not plausible. In the VEA it might happen like in the classical DEA that a country which has a high score of one indicator is diagnosed as best performing even if it performs poorly with respect to all others.

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[5] For further details of the search process see Halme et al. (1999), p. 107.

2.2. Modified Value Efficiency Analysis (M-VEA)

To overcome the shortcoming of the normal VEA we introduce an artificial best practice frontier different from the tangent hyperplanes. For us the value function is known. We call our approach Modified Value Efficiency Analysis (M - VEA). Our best performance frontier is a tangent of the DEA - best performance frontier at the MPS. On this way we postulate a linear value function and the MPS as a combination of performance indexes of two countries. In the two dimensional case it is a straight line, as shown in Figure 2 and in the more-dimensional case a hyperplane that touches the DEA frontier at MPS (= best performing country). The slope of the tangent depends on the preferences of the researcher. Our prefer-ence is that the importance of all indexes are equal. Therefore the M-VEA frontier is a 45 degree line. Again the preparedness of each country is the relative distance to the M-VEA - frontier.

As can be seen from Figure 2 this is much a better approximation of the indifference contour. The M-VEA frontier is supported by two artificial countries in the close neighborhood of the best performing country (in our example B_1 and B_2). The artificial countries take the place of the best performing country.

The computation of the M-VEA envelope and the new preparedness indicator is again done by solving a linear program:

$$\max \boldsymbol{s}_0 + \boldsymbol{e} \sum_i s_i$$

$$\text{s.t.} \qquad \boldsymbol{s}_0 y_{i0} - \sum_k y_{ik} \boldsymbol{l}_k + s_i = 0 \qquad \textit{(for each of the r indicators)}$$

$$\sum_k \boldsymbol{l}_k = 1$$

$$\boldsymbol{s}_O \textit{ free}, \quad s_i \geq 0, \quad \boldsymbol{l}_1 ... \boldsymbol{l}_n \geq 0, \quad \boldsymbol{l}_{n+1} ... \boldsymbol{l}_{n+r} \textit{ unrestricted}$$

where

σ_O ... preparedness score of the M-VEA,

ε ... non-archimedean variable ($\varepsilon = 10^{-8}$),

s_i ... slack variable of the i-th indicator, $\qquad$ i = 1,..., r, $\qquad$ r ... number of indicators

y_{ik} ... i-th indicator of the k-th country, $\qquad$ k = 1,..., n + r $\quad$ n ... number of countries

λ_k ... weight of the k-th country.

λ_{n+1} to λ_{n+r} ... weights of the artificial countries

This procedure maximizes the preparedness score $\boldsymbol{s}_O$ of a single country and must be repeated for every country in the sample. This linear program is derived from the DEA of Lovell and Pastor (1999) and the VEA of Halme et al. (1999). The differences between this linear pro-gram and the linear program of the DEA are: The sample is enlarged by a number of artificial

countries, and the weights of the artificial countries are unrestricted. For each indicator one artificial country is introduced.

Figure 2: M-VEA and VEA frontiers [see appendix]

The performance measure is defined as the distance between the origin and projected point at the M - VEA frontier divided by the distance between the origin and the observed index combination. For example the performance measure of the country D would be $0D^M/0D$ (Figure 2). The domain of this measure is between 1 and infinity where the score of the MPS is 1 and the scores of all others lager than 1.

This approach does not overestimate the performance of the second best countries anymore. The results reproduce the reality much better than the results of the normal VEA do. The ranking of the countries is unambiguous. In the example of Figure 2, B is ranked right at the top followed by C and A. D is ranked at the bottom.

3. Data

We use different economic indicators divided into the following three categories: the macroeconomic performance, the foreign trade performance and the preparedness for taking part in the European Monetary Union (EMU). The criterion for choosing these indicators is their comparability of the EU countries with the CEECs. We use data over the period from 1993 to 1998 in order to study the time profile of transformation of the CEECs.

Table 1: Indicators for 15 EU-countries and 10 CEECs, 1998 [see appendix]

Four indicators of *macroeconomic performance* are incorporated into the study, namely the unemployment rate, the Gross Domestic Product (GDP) per capita, wages and salaries per employee and month, and finally the productivity of labor. The unemployment rate is, according to the OECD definition, described as the number of unemployed persons as a percentage of civilian labor force. GDP per capita is a well-known indicator for the wealth of a country. The level of wages and salaries of all sectors gives an idea of the level of income. Productivity of labor is the real GDP at prices of 1995 per employee. A high productivity level indicates a potential for more growth. Because unemployment is preferred to be low whereas the other indicators are preferred to be high, we incorporate its reciprocal value into the analysis. For the other variables of this group, no transformation is required.

The analysis of the *trade performance* is based on two indicators: Trade with the EU-15 as a percentage of total trade is defined as exports to, plus imports from the EU-15 divided by exports to, plus imports from the world. This is an indicator for how deeply the countries are integrated into the EU and also indicates the importance of trade with the EU-15 relative to

the trade with the rest of the world. As a measure of intra industry we use the Grubel Lloyd-Index (IIT). The index is given as

$$IIT_i = 100 - \frac{\left| X_i - M_i \right|}{\left(X_i - M_i \right)} 100$$

where X_i (M_i) stands for the export (import) of the good i. The IIT index is calculated on a 3-digit level of SITC. The domain of the index is between 0 and 100. The index has the value of zero on the one hand if either $X_i > 0$ and $M_i = 0$ or $X_i = 0$ and $M_i > 0$ for a particular good i. This means that there is no intra-industry trade. In this case the whole trade is inter-industrial. On the other hand, if exports and imports of a particular good are identical (i. e. $X_i = M_i$), the index is equal to 100. This means that the whole trade is intra-industry trade and there is no inter-industry trade. The IIT index is summed up over all 3-digit SITC products for each country. Intra-industry trade with the EU-15 is a measure of the degree of sophistication of goods exchanged in trade. Developed countries exchange similar goods (e.g. VW Golf for Renault Clio) whereas developing countries, when trading with industrial countries, exchange different goods (they exchange food for cars). In the trade performance analysis Belgium and Luxembourg are considered as one country because no separate data are available for these two countries.

The indicators used in the analysis of the *preparedness to enter EMU* are the four main criteria of the Maastricht treaty, namely the inflation rate, the long term interest rate, the budget balance as a percentage of the GDP and the government debt as a percentage of the GDP.[6] The inflation rate of the EU-15 countries is measured by the percentage change of the consumer price index. The long term interest rate of the EU-15 countries is the interest rate of the 10-year central government bonds. Correct data on the long term interest rate in the CEECs are not available. Instead we use the lending rate for the CEECs published by the EBRD (1999). The budget balance is that of the general government. Because of a lack of data about the budget balance of the general governments of the CEECs we use the balance of the central governments. The measure of the government debt is the sum of the gross debt of the federal government and the debt of all province governments. Because of the lack of data, we use the external debt per GDP of some CEECs. In this group some data transformations are necessary because of negative values in the original data. First we change the sign of the budget balance. Consequently, countries with a deficit (surplus) get a positive (negative) sign. In order to

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[6] The Maastricht treaty defines four convergence criteria: The ratio of the government deficit to gross domestic product (GDP) is intended not to exceed a reference value of 3%, the debt to GDP ratio should not exceed a reference value of 60%. Moreover the member states have to achieve a high degree of price stability. This means that the inflation rate should not be higher than 1.5% of that of the three best performing member states in terms of price stability. Moreover the long-term interest rate should not be higher than 2% of that of the three best performing member states in terms of price stability.

eliminate all negative signs, a small positive number (plus three) has been added to all variables.[7]

For some data we do not have a complete time series about the period from 1993 to 1998. We fill the gaps with the figures of the nearest periods. We do not incorporate any other interesting indicators though, (such as the degree of privatization or of liberalization etc. used by EBRD) because they are not available for EU countries.

4. Results

4.1. Introductory remarks

To measure the preparedness of the ten Central- and Eastern European candidate countries we use different economic indicators divided into the following three categories: the macroeconomic performance, the foreign trade performance and the preparedness for participating in the European Monetary Union. At a first stage we compute Modified-Value Efficiency Analyses (M-VEAs) separately to get preparedness scores of these three groups. At a second stage we use the preparedness scores of stage one as data of a M-VEA and estimate the overall preparedness of the CEECs.

All performance indicators are estimated with a Modified Value Efficiency Analysis, but the orientations differ from indicator to indicator. The macroeconomic performance is measured index- maximizing because every country is intended to maximize all indicators, e.g. the goal of the macroeconomic policy of all countries is to maximize the Gross Domestic Product per capita. The trade performance is measured with index-maximizing M-VEA as well, but for a different the reason. Higher scores of both indicators used, trade shares and IIT-index values, are prefered. The higher the trade with the EU-15, the better the CEECs are integrated into the EU. The higher the index of intra industry trade, the higher the degree of sophistication of exchanged goods is. In contrast to the macroeconomic and the trade performance, we measure the preparedness for the European Monetary Union index-minimizing because all of the four indicators in this category are the better, the lower the scores are. We have also measured the EMU preparedness relative to the Maastricht boundaries. For this task we compute an index-maximizing Data Envelopment Analysis with an artificially specified best practice frontier that is exactly given by the so-called Maastricht convergence criteria.

The domains of the different performance indicators are completely different. The scores of an index-maximizing M-VEA and of an index-maximizing DEA are 1 or larger whereas the scores of an index-minimizing M-VEA lie between zero and one. To make the results of the different analyses comparable, a transformation into one common domain is needed. All the

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[7] This transformation causes a small bias (for details see Pastor, 1996). By using an additive model we would avoid this bias, but it is not suitable for us because the domain is not between 1 and infinity and the ranking is not unambiguous.

results are transformed to the domain of the index-minimizing M-VEA by inverting the index-maximizing M-VEA and DEA scores[8].

In the following sections, the results of the study are presented in bar charts and time series diagrams. In the bar charts, the length of each bar corresponds with the preparedness scores of the country. Countries with a score of 1 are the best practice countries whereas countries with scores less than 1 are worse. The bars are ordered according to the scores of the countries. The best is on top and the worst at the bottom. The black bars symbolize the preparedness of the EU-members and the white bars the preparedness of the CEECs.

4.2. Macroeconomic Performance

Figure 3: Macroeconomic performance (1998) [see appendix]

The macroeconomic performance analysis reveals that in 1998 the best performing country in our sample was Luxembourg, which therefore serves as a benchmark for all other countries. Luxembourg is far ahead of all others. All other EU member states, with the exception of Portugal, follow (Figure 3). These countries perform better than the best performing Eastern European country. Among the EU member states, Greece is the worst performing country. The best of the CEECs is Slovenia, followed by the Czech Republic and Hungary. These countries are located in the center of Europe, close to the EU market. At the bottom of the ranking, there are Lithuania, Latvia, Romania, and Bulgaria. These countries are far away from the wealthy European countries also in terms of geography.

All of the CEECs lie far behind the EU standards. Only Slovenia reaches the level of the worst EU member (Greece). Slovenia and Greece perform almost equally. The difference between all other CEECs and the worst performing EU member state Greece is great. On average, the transition countries in the center of Europe perform significantly better than the countries in the periphery. This ranking is highly correlated with the ranking of the GDP per capita. Two other indexes of this category, namely the wages and the labor productivity are correlated with the GDP per capita and in that way strengthen the influence of the GDP per capita.

Figure 4: Macroeconomic performance (time series) [see appendix]

In the first half of the 1990s the Czech Republic, Bulgaria and Romania caught up and dropped back again in the second half, whereas Hungary, Slovenia and Poland came continu-

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[8] The domain of the index-maximizing M-VEA is equal to the domain of the index-maximizing DEA and the domains of the index-minimizing M-VEA and of the index-minimizing DEA are the same. The performance scores of an index-minimizing (= input-oriented) DEA are equal to the reciprocal value of the performance scores of an index-maximizing (= output-oriented) DEA (see Färe and Lovell, 1985 and Lovell and Pastor, 1999).

ously closer to the EU standard (Figure 4). The Slovak Republic caught up in the beginning of the 1990s and stagnated in the second half. Estonia started to catch up in the beginning, dropped back in-between and continued to catch up again in the second half. On average a slight catching up trend can be observed in the 1990s but it comes to standstill in 1998.

4.3. Trade Performance

The sample in the analysis of the trade performance consists of twenty-four countries. In the foreign trade statistics Belgium and Luxembourg are treated as one single country.

Figure 5: Trade performance (1998) [see appendix]

The results of the trade performance analysis (Figure 5) show that Belgium-Luxembourg is the best practice country. It is ranked right at the top, followed by five strong EU member states. The best of the CEECs is the Czech Republic, ranked at the seventh position. Among the CEECs Slovenia is the second and Hungary the third country. These three CEECs are classed in the first half of the ranking. At the bottom of the ranking there are Bulgaria, Latvia and Lithuania.[9]

In foreign trade, the EU member states and the CEECs are not strictly separated from each other like in the analysis of the macroeconomic performance, but mixed. Some of the CEECs (e.g. Czech Republic, Slovenia and Poland) perform better than several EU countries (e.g. Ireland, Finland and Greece). The distance between the CEECs and the EU benchmark is not as large as in the case of the macroeconomic performance and the variation within the CEECs is not as vest either. Poland is classed in the second half of the ranking and the distance to the top three of the CEECs is quite large due to the low intra industry trade with the EU. The reason for the low intra industry trade is the high share of the agricultural sector in the GDP. The low ranking of the Slovak Republic is surprising, but arises mainly because of the low trade relations with the EU and also due to the low intra-industry trade. In general, we observe a remarkably better performance of most of the Central European countries than of the countries further in the east. This can also be considered as center-periphery difference, and it is the same phenomenon we have observed in the analysis of the macroeconomic performance. The reasons for this are the geographic distance to the most developed EU countries, the lack of development (low intra industry trade), the lack of competitiveness, the prevailing direction

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[9] We have also done trade performance analyses that incorporate foreign direct investment flows. The problem with that is the interpretation of the flows. On one hand, high net outflows are primarily seen in highly developed industrial countries. Some of the EU countries have net outflows. On the other hand, high net inflows preserve the basis of a prospective development of a country. (cf. Dunning, 1981). For several CEECs high net inflows are observed. The results of the analysis depend on how the FDIs are being incorporated. If the FDIs are included as net inflows, the ranking of the CEECs with high FDI inflows is much better than in the case of including the FDIs as net outflows.

of trade towards their neighbors and the former USSR, the countries in the Balkan and the Baltic States.

Figure 6: Trade performance (time series) [see appendix]

A look at the time series of the result of the trade performance analysis (Figure 6) tells us that some of the CEECs have continuously improved their relative position to the EU benchmark in the 1990s. At the end of the 1990 several of the CEECs (Czech Republic, Hungary and Slovenia) came quite close the EU benchmark. In general, we can observe a trend towards a catching up of the CEECs in the 1990s. The sole exceptions are Estonia, Latvia and Bulgaria. Estonia is the only country which was further away from the EU foreign trade standards at the end of the observation period than it had been at the beginning. Latvia and Bulgaria had dropped back in the middle of the 1990s and started to catch up again afterwards.

4.4. Preparedness for the European Monetary Union

Figure 7: EMU preparedness (1998) [see appendix]

The results of the evaluation concerning the preparedness to enter the EMU are shown in Figure 7. Luxembourg is ranked right at the top and serves as the benchmark again. Luxembourg is far ahead of all other countries in the sample. Surprisingly, Slovenia is on the position next to the top. It lies ahead of most of the EU member states and the members of the European Monetary Union. Among the CEECs Latvia is on the second position, followed by the Czech Republic and Poland. The two best of the CEECs are ranked within the first quarter, and all of the four best are in the first half. The EU members and CEECs are mixed together. At the bottom there are Bulgaria and Romania, because of their high inflation and interest rates. Close to the bottom there are the EU members Greece, Belgium, and Italy, mainly because of their high government debts.

Since the budget deficits and public debts in the four best CEECs are quite low, compared to the EU-15, the obvious difference between both groups relative to inflation and interest rates might be interpreted as being not too large. The rankings of the EMU preparedness are not correlated with the macroeconomic development or the foreign trade performance. Slovenia, Latvia, the Czech Republic and Poland are better prepared than most of EU members (e.g. Germany, France or Italy). One important conclusion of this exercise is that the CEECs should be allowed to enter the European Monetary Union in spite of their poor macroeconomic strength because they already come close to the Maastricht criteria.

Figure 8: EMU preparedness (time series) [see appendix]

The time series diagram (Figure 8) shows that in the first two years of the examination period, almost all of the CEECs have caught up. Only Hungary dropped back. In the second half of the 1990s the distance from the best performing countries among the CEECs to the EU

benchmark has increased and that of the worst performing CEECs has decreased. Consequently, the variance among the CEECs decreased and they became similar. In 1996 and 1997 Romania dropped back dramatically and Bulgaria in 1997 as well. In these years the inflation rate jumped up to an astronomic level of more than 100 percent in both countries.

We have also measured the EMU preparedness relative to the Maastricht convergence criteria. For this task, we have computed an output-oriented Data Envelopment Analysis with an artificial specified best practice frontier that is exactly given by the so-called Maastricht criteria. All of the Maastricht criteria have to be fulfilled in order to be prepared for the European Monetary Union. There is no trade off in the sense that one criterion could be missed even if the others were exceeded. The frontier does not envelope the Data. All the countries that fulfill all criteria lie exactly at the frontier. The countries that exceed the criteria are below the frontier. This is just a small minority of the European countries. All of them are member states of the EU. All the other countries do not fulfill at least one criterion and lie above the frontier. None of the CEECs fulfill all convergence criteria.

Figure 9: EMU preparedness relative to Maastricht boundaries (1998) [see appendix]

The frontier divides the sample into two groups, namely one group of countries which either fulfill or exceed all criteria and another group of countries which do not fulfill at least one criterion. The preparedness scores of the first group are larger than or equal to one and the scores of the second group smaller than one. The first group is much smaller than the second. None of the CEECs belong to the first group because none of them fulfills all criteria, as their interest rates and inflation rates are higher than the Maastricht boundary. Most of the EU members belong to the second group as well, mainly because their budget deficits and/or government debts are higher than the Maastricht boundary.

The results of the analysis of the EMU - preparedness relative to the Maastricht criteria are rather different from the results of the first (Figure 9). Luxembourg is right at the top again. Its preparedness score is considerably higher than one. There are two more countries with preparedness scores larger than one, namely Denmark and Finland, and one with a preparedness score equal to 1 (France). These countries exceed or fulfill the criteria too and are ranked right next to Luxembourg. All the other EU member states do not fulfill all criteria, but they are ranked better than almost all the CEECs. Lithuania outperforms all the CEECs and lies even ahead of the three worst EU countries Greece, Belgium and Italy. All the other CEECs perform worse than all the EU members. They are far away from the Maastricht standard and the EU average. At the bottom of the ranking there are Hungary - mainly because of its rather bad performance in all four indicators -, Bulgaria and Romania - mainly because of their very high inflation and interest rates.

Figure 10: EMU preparedness relative to Maastricht boundaries (time series) [see appendix]

The mean distance between the CEECs and the Maastricht boundary has decreased in the 1990s (Figure 10) but on average these countries still are far behind. The variability of the

distance increased very much. Lithuania caught up considerably. It started from the last position in 1993 and was right at the top in 1998. Slovenia, Estonia and Hungary caught up continuously, whereas the Czech Republic and Slovakia have improved their situation in the beginning and dropped back at the end. Figure 10 also shows the influence of the crises in Bulgaria and Romania in the middle of the 1990s. At this time they dropped back very much.

4.5. Overall preparedness

Figure 11: Overall preparedness (1998) [see appendix]

At a second stage we use the preparedness scores of stage one as data of a M-VEA which estimates the overall preparedness of the CEECs. As the representation for the preparedness for the European Monetary Union we use the scores of the preparedness analysis without the Maastricht boundaries, instead of the results of the analysis according to the Maastricht criteria.

The results of this aggregation are shown in Figure 11 and Figure 12. They show that in 1998 Luxembourg was the overall best performing country. Then came France, Denmark, Belgium, and Austria. Among the CEECs the best country was Slovenia followed by the Czech Republic, Hungary, and Poland. Slovenia was ranked at the thirteenth position. The four best performing CEECs performed better than the worst performing EU member states Greece. These countries should become members of the European Union. The worst performing countries were Romania and Bulgaria. Most of the CEECs were worse than the average of the EU members.

Figure 12: Overall preparedness (time series) [see appendix]

The time series of the overall preparedness shows a slight tendency towards a convergence of the CEECs to the EU benchmark. On average the preparedness of the CEECs is better and the variation smaller at the end of the 1990s than it had been in the beginning

Slovenia, Poland and Latvia have continuously improved. Slovenia has been the best performing country of the CEECs with the exception of 1995. In that year it was outperformed by the Czech Republic. The Czech Republic, Estonia, the Slovak Republic and Romania caught up in the first half of the 1990s and dropped back afterwards. The Czech Republic lost the position as best performing country of the CEECs and dropped back to its performance level of 1993 because of the deep recession at the end of the 1990s. The preparedness of Hungary has been almost constant. The results also show a deep depression in Romania and Bulgaria in 1997. At that time the performance of both countries has dramatically decreased. This is mainly due to the high performance loss with respect to the EMU preparedness, which is caused by the high increase in inflation and interest rates. The performance loss with respect to the other two groups (macroeconomic and foreign trade) of indicators is by far less. The amount of catching up is rather diverse among the CEECs.

Table 2: A Comparison of the final rankings of this study to the ranking of the WIFO study [see appendix]

Table 2 shows a comparison of our M - VEA ranking with to ranking of Breuss (1999). In Breuss (1999) the final ranking was simply done by averaging the position of the numerous indicators. The results of both studies are rather similar. The Spearman's rank correlation index between both rankings is 0.77 (the two tailed significance is 0,009). The assessments of Slovenia and Estonia are the conspicuously diverging. Slovenia is right at the top in our study whereas in Breuss (1999) it can be found on fifth position. The assessment of Estonia in our study is much worse than in Breuss (1999). The difference in the assessment of Poland also is considerable. The reasons for the divergences are that we have used less and different variables (e.g. we did not use qualitative indicators like the degree of privatization, liberalization, etc.), another method and newer data.

5. Summary and conclusions

In this paper we present a synthetic performance measure which helps to assess the economic preparedness of the ten Central and Eastern European Countries (CEECs) to become members of the European Union (EU). The preparedness of the CEECs is measured with respect to the EU economic standards, so that the EU member states are included in the study. With the aid of a modified Value Efficiency Analysis (M-VEA) a best practice frontier is constructed, that is supported by the best performing country of the European Union and which serves as a benchmark for the candidate countries.

We use different economic indicators divided into the following three categories: the macro-economic performance, the foreign trade performance and the readiness for the European Monetary Union (EMU). At a first stage we compute separate M-VEAs to get preparedness scores of these three groups. At a second stage we use the preparedness scores of stage one as data of a M-VEA and estimate the overall preparedness of the CEECs.

Concerning the *macroeconomic performance*, all of the CEECs lag substantially behind the EU member states. Only the best performing country of them (Slovenia) reaches the level of the least performing EU member (Greece). The difference between all other CEECs and Greece is considerable. On average the transition countries in the center of Europe perform considerably better than the countries in the periphery. This ranking is highly correlated with the ranking of the GDP per capita. Two other indexes of this category, namely the wages and the labor productivity also are positively correlated with the GDP per capita and in that way strengthen the influence of the GDP per capita.

As far as *foreign trade* integration into the EU is concerned, the EU member states and the CEECs seem more similar than in the case of the macroeconomic performance. Some of the CEECs (e.g. Czech Republic, Slovenia, Hungary and Poland) perform better than several EU

countries (e.g. Ireland, Finland and Greece). The distance from the CEECs to the EU benchmark is not as large as in the macroeconomic performance and the variation within the CEECs is not as large either. Poland comes in the second half of the ranking and the distance to the top three of the CEECs is rather great due to the low intra industry trade with the EU. The reason for its low intra industry trade is the high share of the agricultural sector. Surprisingly, the Slovak Republic ranks in the last quarter mainly because of its weak trade links but also due to the low level of intra-industry trade with the EU. In general we observe a remarkably better performance of most of the countries of Central Europe than of the countries further in the east. This can also be considered as center-periphery difference. This is the same phenomenon we have observed in the analysis of the macroeconomic performance. The reasons are the geographic distance to the most developed Western European countries, a lack of development (low intra industry trade), a lack of competitiveness, the prevailing direction of trade towards their neighbors and the former USSR, the countries in the Balkan and the Baltic States.

In the *preparedness to enter the European Monetary Union (EMU)*, the four best of the CEECs are ranked better than several EU members mainly because of their low government debt and low budget deficit. The variation of these countries with respect to inflation and interest rates is not too large. The rankings of the EMU preparedness are not correlated with the macroeconomic development or the foreign trade performance. Slovenia, Latvia, the Czech Republic and Poland are better prepared than most of EU members (e.g. Germany, France or Italy). If the CEECs were admitted to the European Union in spite of their low macroeconomic strength, they should immediately enter the European Monetary Union (EMU).

Finally the results of the *overall performance* measure say that the four best CEECs (Slovenia, the Czech Republic, Hungary, and Poland) are better prepared than the least performing EU-country (Greece). These countries should become members of the European Union.

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Appendix: Tables and Figures

Table 1: Indicators for 15 EU-countries and 10 CEECs, 1998

	EU - 15			CEEC - 10		
	Mean	Min	Max	Mean	Min	max
Macroeconomic performance						
Unemployment rate (in %)	8.78	3.10	19.60	9.91	6.40	13.80
GDP per capita (in PPP)	20,575.00	13,572.00	34,674.00	8,140.00	4,600.00	13,700.00
Wages and salaries per employee and month (in USD)	1,991.00	876.00	2720.00	292.00	95.00	849.00
Labor productivity [1] (in USD)	46,710.00	19,821.00	64,577.00	7,899.00	2,824.00	21,899.00
Foreign trade performance						
Trade with the EU-15 as a Percentage of total	63.56	45.85	86.54	58.58	43.62	68.27
Intra industry trade relations with EU-15 (in %)	62.28	23.50	82.40	42.89	20.30	69.80
European Monetary Union						
Inflation rate (CPI, in %)	1.78	-0.10	4.80	15.31	4.70	59.10
Long term interest rate (in %)	5.09	4.60	8.50	19.64	10.50	56.80
Budget balance (in % of GDP)	-0.73	-2.80	2.20	-2.42	-5.80	0.90
Government debt (in % of GDP)	66.19	6.50	116.80	46.74	25.20	92.60

[1] Real GDP per employed person at prices of 1995

Note: The sampel size is 25.

Sources: EBRD, European Commission, EUROSTAT, OECD, WIFO, WIIW

Table 2: A Comparison of the final rankings of this study with the ranking of the WIFO study

	M - VEA	Breuss (1999)
Bulgaria	10	10
Czech Republic	2	1
Estonia	6	2
Hungary	3	3
Latvia	7	7
Lithuania	8	8
Poland	4	6
Romania	9	9
Slovak Republic	5	4
Slovenia	1	5
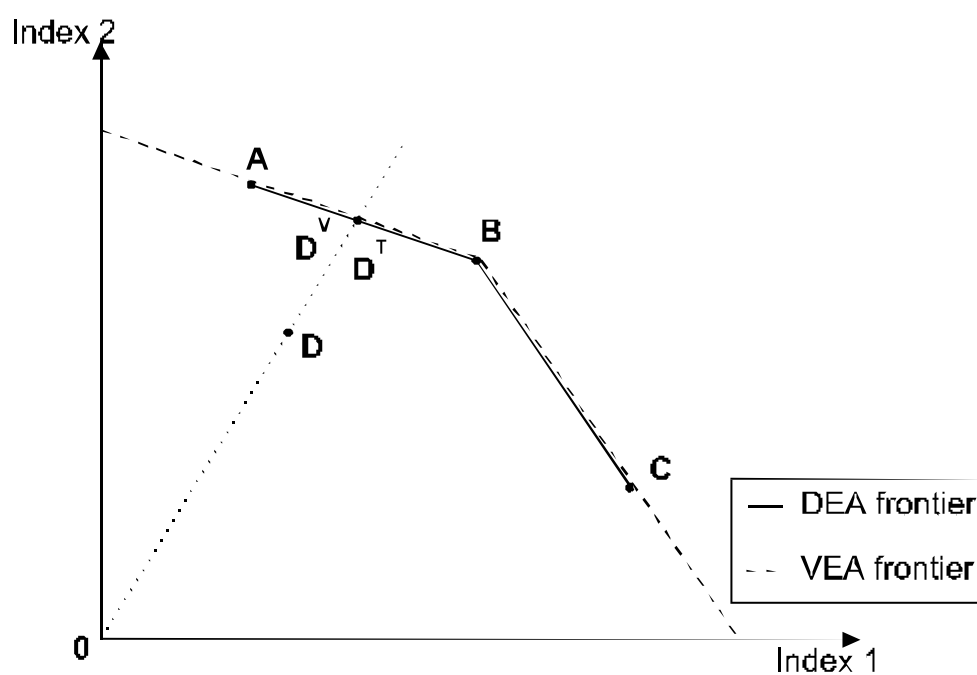
Figure 1: DEA frontier versus VEA frontier
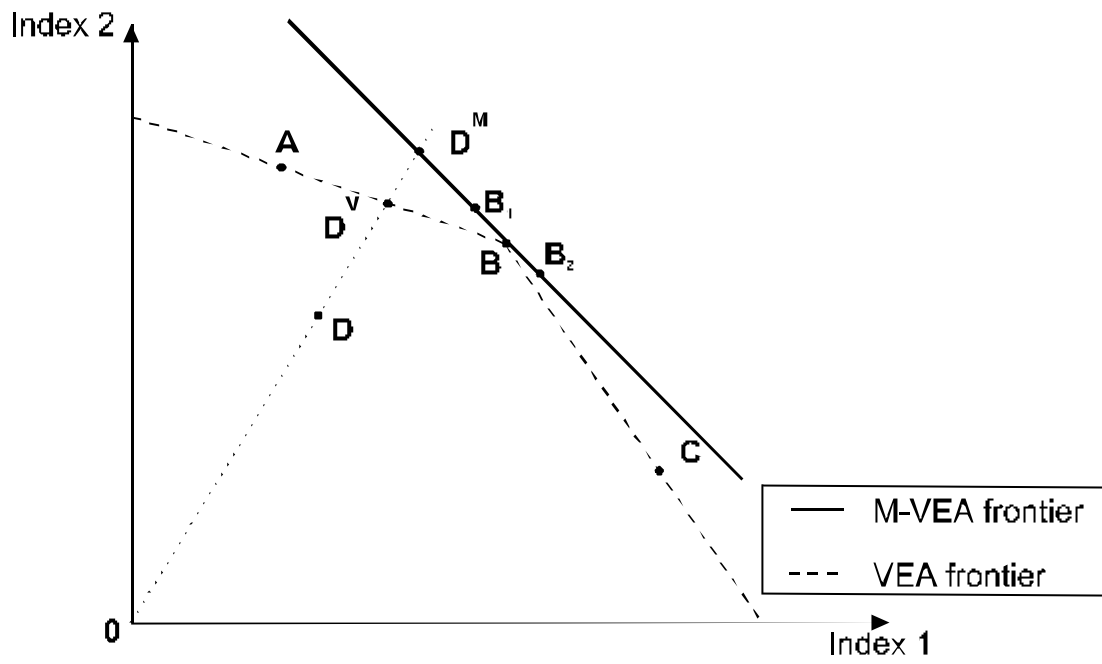
Figure 2: M-VEA and VEA frontiers

Figure 3: Macroeconomic performance (1998)

List of country abbreviations:

CEECs: EU-15:

BG..Bulgaria   B....Belgium
CZ..Czech Republic   DK...Denmark
EE..Estonia   D....Germany
HU..Hungary   EL...Greece
LV..Latvia   E....Spain
LT..Lithuania   F....France
PL..Poland   IRL..Ireland
RO..Romania   I....Italy
SK..Slovak Republic   L....Luxembourg
Sl..Slovenia   NL...Netherlands
                        A....Austria
                        P....Portugal
                        FIN..Finland
                        S....Sweden
                        UK...United Kingdom
                        B-L..Belgium-
Luxembourg
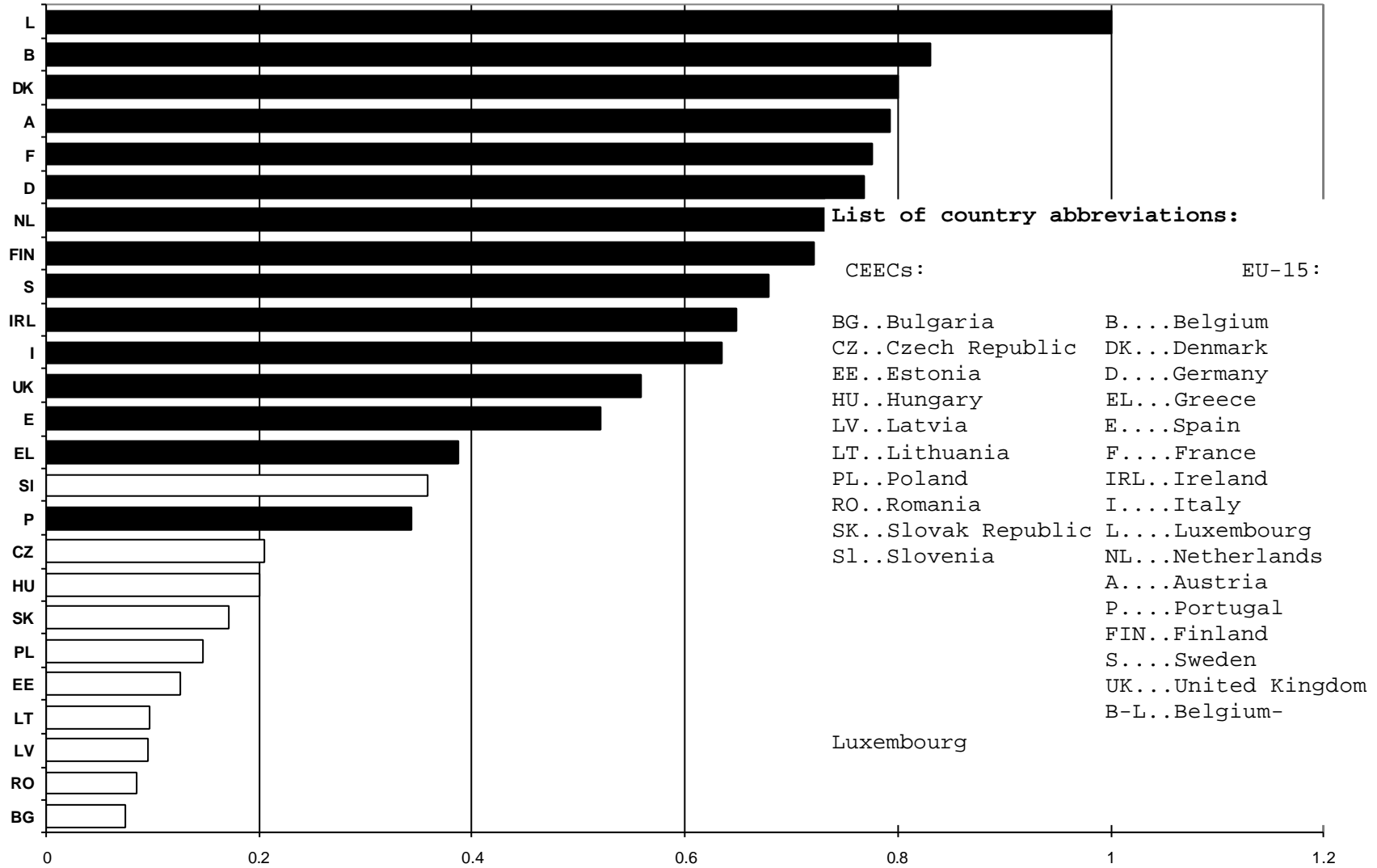
Figure 4: Macroeconomic performance (time series)
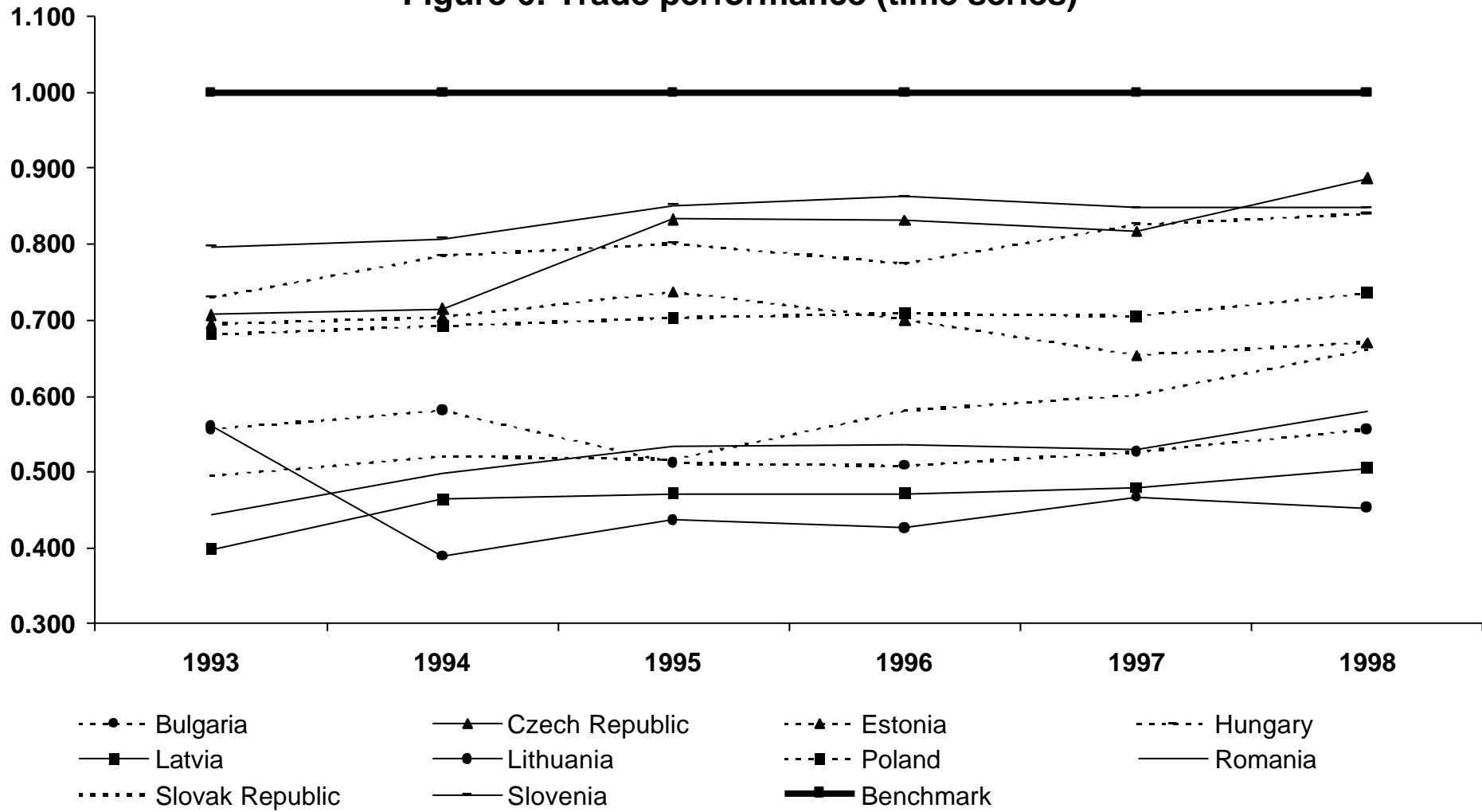
Figure 5: Trade performance (1998)
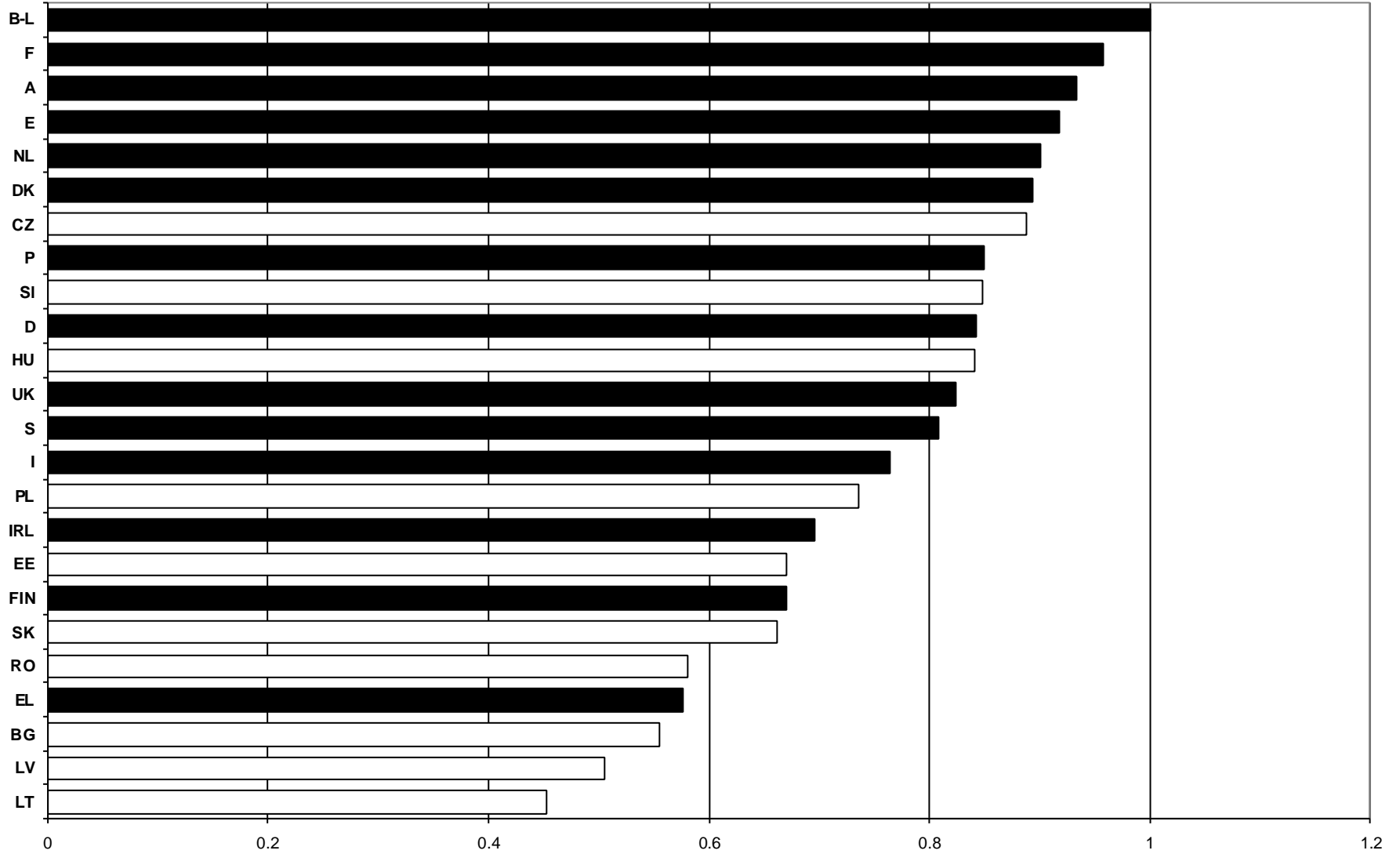
Figure 6: Trade performance (time series)
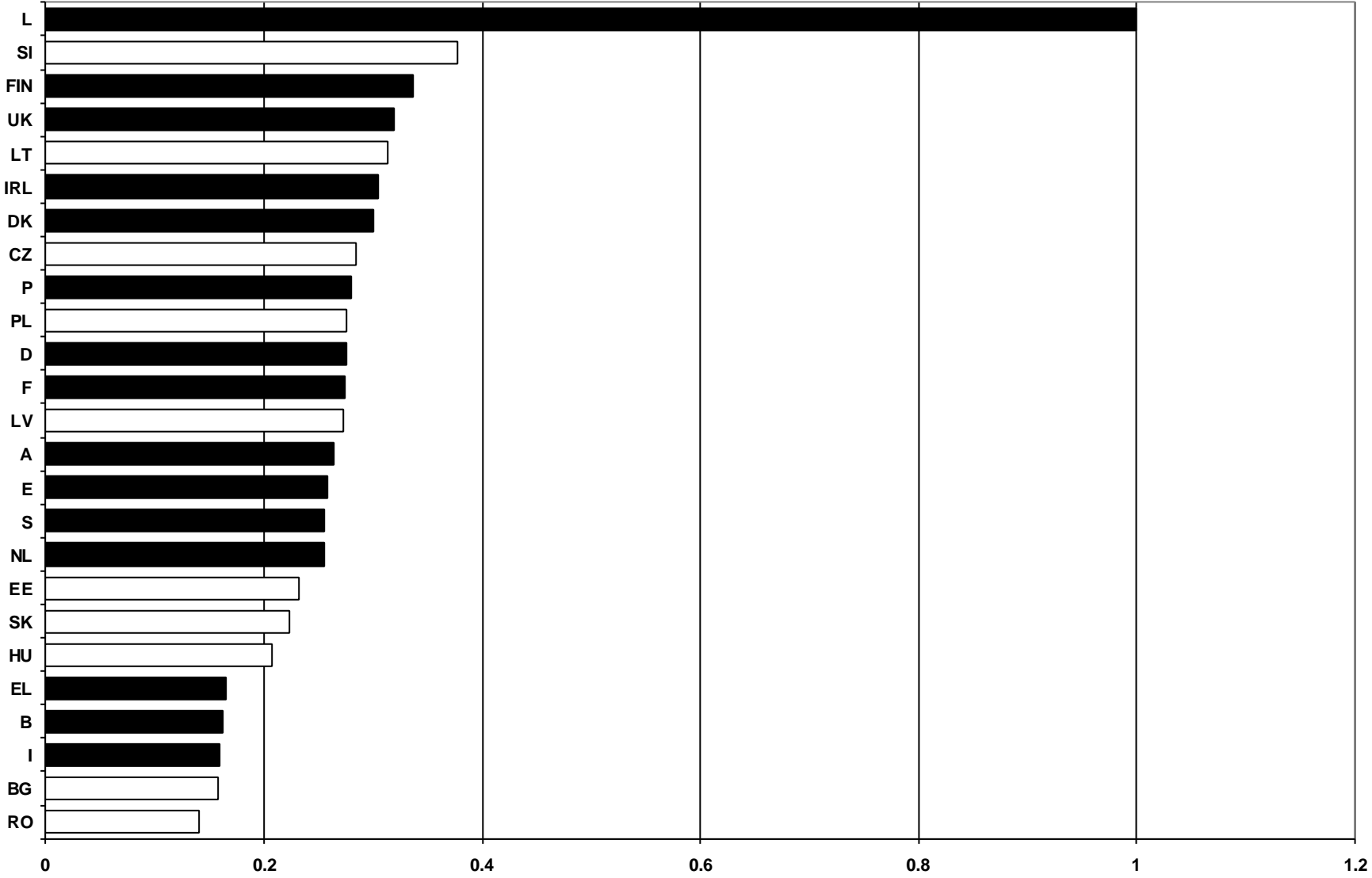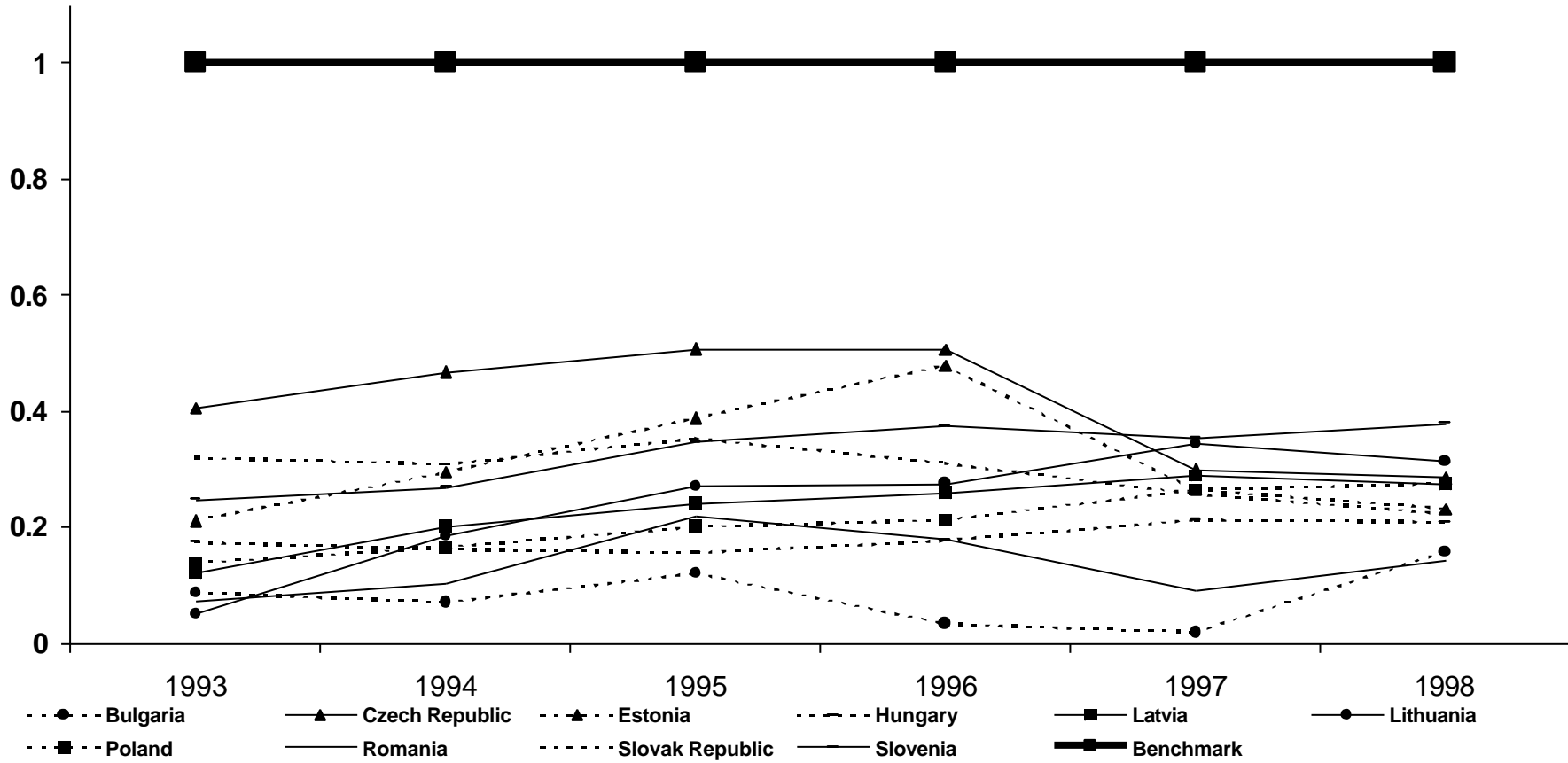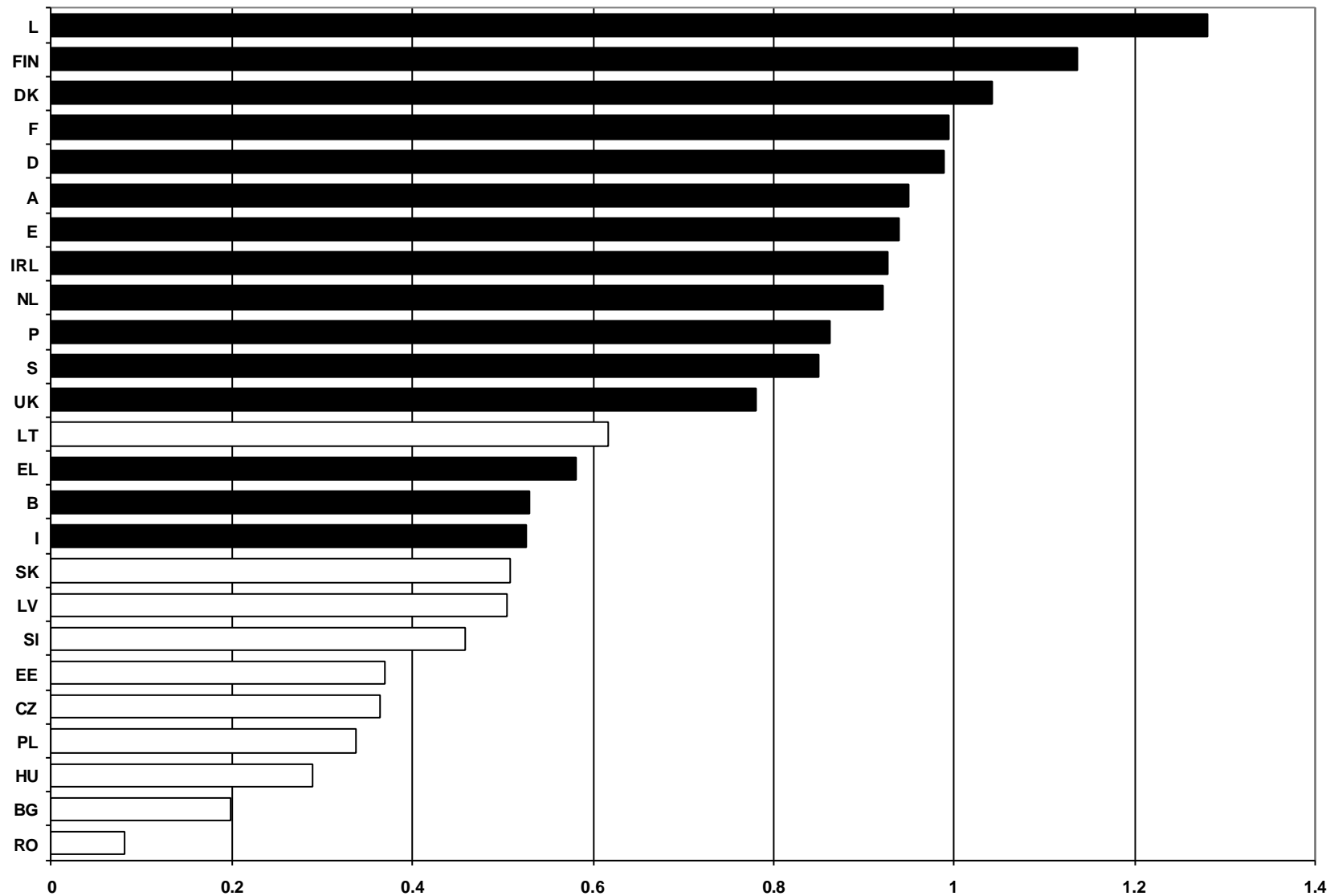
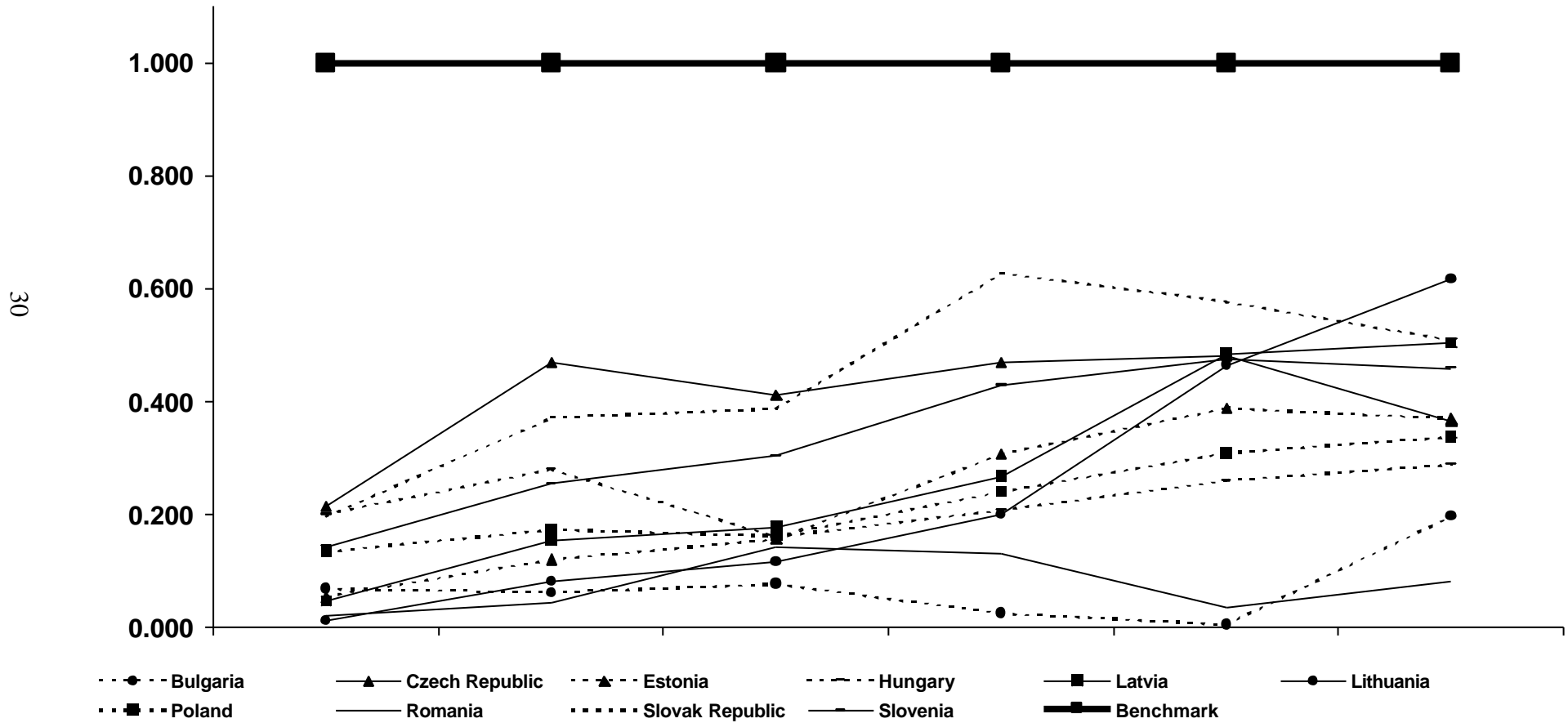**Figure 7: EMU preparedness (1998)**

Figure 8: EMU preparedness (time series)

Figure 9: EMU preparedness relative to the Maastricht boundaries (1998)

Figure 10: EMU - Preparedness relative to the Maastricht bounderies (time series)

Legend:
- ● Bulgaria
- ▲ Czech Republic
- ▲ Estonia
- Hungary
- ■ Latvia
- ● Lithuania
- ■ Poland
- Romania
- Slovak Republic
- Slovenia
- ■ Benchmark
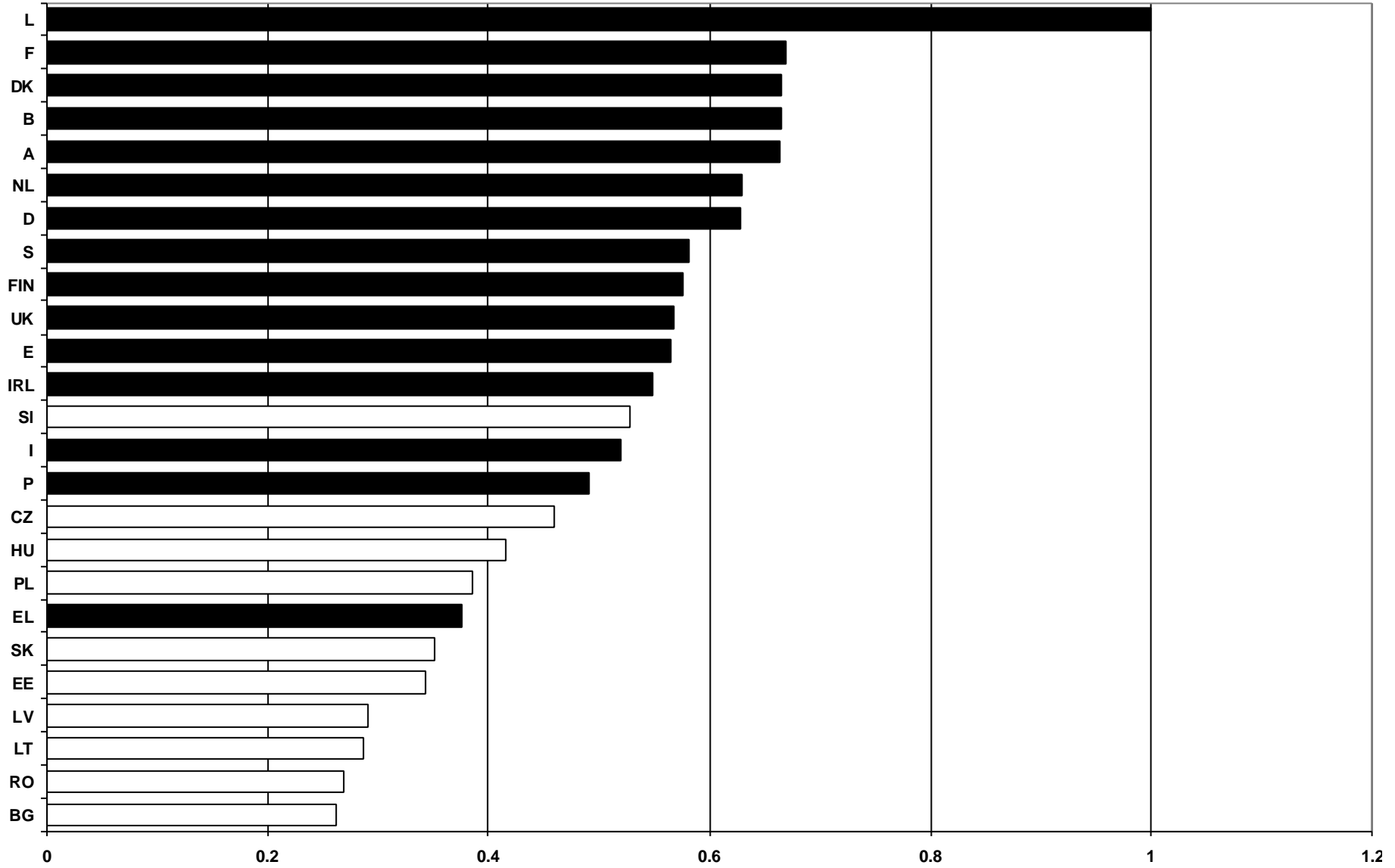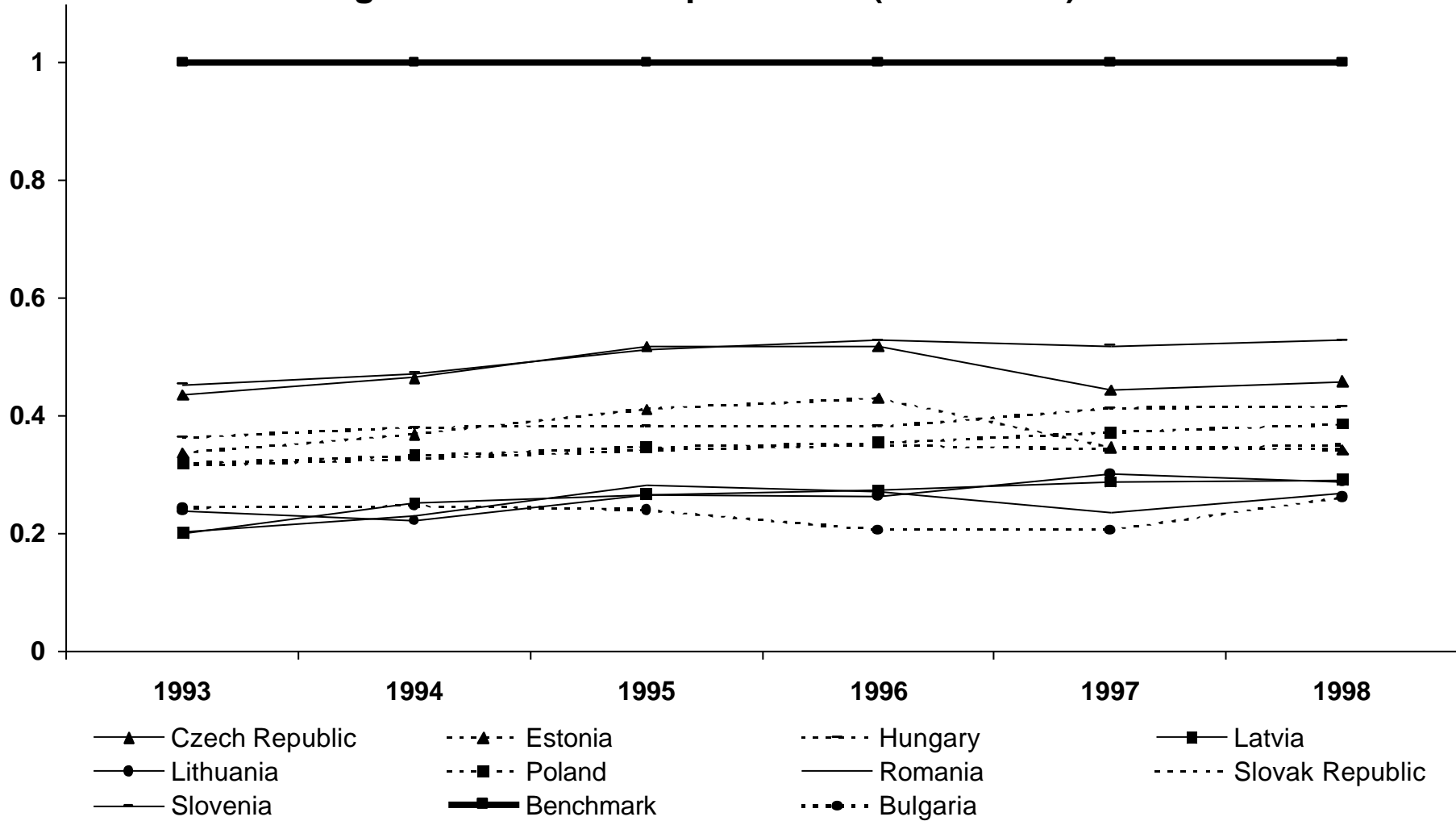
Figure 11: Overall Preparedness (1998)

Figure 12: Overall Preparedness (time series)

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