

AN ALGORITHM BASED APPROACH FOR ROMANIA'S ROAD TOWARDS THE EURO-AREA MEMBERSHIP STATUS. IN SEARCH OF A SUITABLE EXAMPLE*

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Abstract: Recent developments of the economic and financial crises all-over Europe have created a new, rather frightful perspective of the economic integration process and further-more of monetary integration and the Euro-area. There is an exit case-scenario, but is it considered a disastrous option. Neither Greece, nor Ireland considered this option and it is even less of a case for the founding members of the Euro-zone. As a consequence, actual candidates have been urged to consider even more seriously their convergence process as long as they are under the no-opt-out clause. These are the essential hypothesis of this paper. From this new perspective, the paper envisages pointing out the role of preparation and of the convergence process has had for some of the most recent members of the Euro-Area. Analysis also involves a fuzzy clustering algorithm previously applied by the authors. We try to find similarities, useful examples or *lessons to be learnt* by Romania in this single currency accession process.

JEL classification: E50, E52, E58

Key words: monetary integration, real convergence, economic crises, fuzzy clustering algorithm

1. INTRODUCTION

Monetary integration means foregoing the use of monetary and exchange rate policies for national purposes alone (Angeloni et al. 2005). These authors further state that in signing the Maastricht Treaty – that contains the institutional arrangements for the conduct of monetary policy in the European Economic and Monetary Union (EMU) – these countries agreed to immediately start taking into account the implications of such policies for other EU members; in the longer run, monetary integration means adopting the euro. The new member states, and even still candidate countries, have undergone a very rapid and deep transformation in all economic and institutional areas. Most of them have been able to achieve a high pace of nominal convergence, but that was valid before the debut of the financial and economic crisis. Both then and now, as far as real convergence is concerned, results are mixed and differentiated. There are

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best and less performing areas or criteria. While trade integration with the other 15 EU Member States (EU15) has progressed quickly in recent years, real terms convergence in output specialization or GDP per capita has registered less progress or a slower rate in convergent (and ascending evolution). The monetary policy in respect of choice, implementation and results is also an issue. Looking at central bank statutes, objectives, strategies and instruments, authors have described certain progress and even sound central banking structures. Still, conditions for full monetary integration have not been reached. Even though a case-by-case approach to adopting the euro – based on country-specific conditions – seems natural, we are still looking for the closest example in recent states adopting the single currency.

2. OBJECTIVES

This paper aims to point out monetary evolutions and convergence processes in recent member states of the Euro-area, trying to focus on their role in preventing further economic and financial imbalances. The essential hypothesis is that while convergence and monetary control are undertaken in a serious and sustainable manner, eventual asymmetric shocks, disequilibrium and instability can be at least prevented if not kept away. Early age imprudent behavior, lack of unsustainable real convergence and unsuitable monetary policy measures may represent serious and predictable causes of disruption and crisis. We also aim to look for any models employed by previous candidates which would present as suitable solutions for the Romanian monetary economy aiming the Euro adoption.

3. METHODOLOGY AND THEORETICAL BACKGROUND

In analyzing monetary convergence, we must consider the debate developed in the mid-1990s during the birth period of the EMU. According to the ECB, the real convergence set of indicators used for the quantification of the progress of the candidates is based on growth, productivity and price level convergence. (Arratibel, Furceri si Martin 2008). Also, later on, attention has been directed towards the mix between nominal convergence, real convergence, and the optimal monetary area criterias. (Lipinska, 2008). Also, the composition of the output is taken into account from this perspective – if the output composition differs internationally, sectorial disturbances tend to generate asymmetric country disturbances and asynchronous national cycles, since sectors have different cyclical properties and may even respond differently to monetary policy (Dedola and Lippi (2000)). The composition of output and employment tends to be closely related to the stage of economic development. International comparisons have shown that a higher level of development tends to be associated with a smaller share of agriculture in aggregate output and a larger share of services, whereas the share of industry typically has an inverted U-shaped relationship to per capita output, increasing first and declining later (Chenery and Taylor, 1968). The output shares can then be used to “benchmark” the degree of economic development, as recently done for central European countries by Raiser et al. (2003). Several other studies raised new questions on the convergence matter: Haan et al. (2004), an analysis of business cycle correlation analyses has been conducted by Fidrmuc and Korhonen (2005), Frenkel and Nickel (2002) set up a structural vector auto-regression model to identify and compare demand and supply shocks – as well as the speed with which economies adjust to shocks – between euro area countries and central and eastern European countries etc. Monetary integration process also involves

the issue of the exchange rate regime. The assessment connected to its functioning and efficiency is a fundamental discussion amongst economists. This has also taken the shape of estimating the real equilibrium exchange rate and its deviation from the real effective exchange rate. Lately, transition countries, after the fall of their communist regimes, have had several approaches according to their macroeconomic strategies. According to economic developments, they adapted these approaches so that they would fulfill their targets.

The evaluation of real and nominal convergence according to a certain set of criteria can also be accomplished by means involving a fuzzy clustering analysis. Even if originating in a rather rigorous set of mathematical relations, the fuzzy clustering technique allows an in depth research of relative phenomena and a delimitation involving homogenous groups, beyond some mathematical results. This type of analysis provides the opportunity to process several variables sets providing an overall image of the envisaged evolutions. The advantages apart from classical mathematics reside in a higher degree of finess in the evaluation and a relative positioning (Tanasie et al. 2008). The fuzzy algorithm used in this paper was originally used by Kaufman and Rousseuw (1990).

4. ANALYSIS

For analysis, we have selected two very recent members of the Euro-Area – Estonia and Slovakia, aiming a brief comparison and the extraction of *lessons to be learnt* by Romania. They are rather small economies subject to high degree of connection with the international environment both by means of external trade or important foreign sector. That seems to also be the case of Romania if we envisage the trade openness degree and the share of trade in GDP.

Just like all the other EU countries, the global financial and economic crisis, triggered a deep recession that started end-2008 in Estonia. Even before, weakening economic activity determined inflation developments. The subsequent rapid adjustment in product and labor markets led to a general decline of prices in 2009. Recent developments indicate that the recession bottomed out in late 2009, but the recovery is likely to remain subdued in the context of the current uncertain global economic outlook. The Commission services' estimates suggest that the output gap of the Estonian economy turned sharply negative in 2009 and that growth will remain significantly below potential in 2010 (EU Commission Convergence Report). The Commission services' Spring 2010 Forecast projects Estonia's economic growth to be close to 1% in 2010, and close to 4% in 2011. The initial positive impact to growth is likely to emerge from strengthening external demand and from a turn in the inventory cycle. Estonia has been operating a currency board arrangement since the reintroduction of the kroon in 1992, with the kroon initially pegged to the Deutsche mark. The peg was switched to the euro as of 1 January 1999. The currency board arrangement has been backed up by generally prudent fiscal policies, open markets and a broadly flexible economy. Since its inception, the currency board arrangement has served as a key policy anchor and enjoyed wide popular support (EU Commission Convergence Report).

Most recent economic and monetary developments in Estonia can be briefly described as following:

- a tightening in monetary conditions since 2009 with an increase in short-term real interest rates and falling inflation.

- substantial fiscal consolidation thus limiting the general government deficit to 1.7% of GDP for 2009,
- minor effects of exchange rate volatility as the kroon remained broadly stable
- historical peaks of unemployment – 15%
- rather limited financial sector mostly owned by Swedish banks, with a precautionary agreement with the central bank of Sweden (Riksbank) aiming to broaden the Bank of Estonia's capabilities to provide liquidity to the financial sector
- The long-term interest rates convergence criterion applicable to Estonia, as no government bonds or other comparable securities are available - reflecting a very low level of gross public debt and prudent fiscal policies
- Public debt remains by far the lowest in the EU while strongest correction took place in the balance of trade in goods, where the deficit declined to less than 5% of GDP in 2009 and the degree of trade openness (almost 80%) was the highest among the small new Member States
- A strict policy discipline determined credibility of its commitment to sustainability in the context of the global financial crisis.

Slovak economy can be described as following:

- very small, less than 1% in terms of both GDP and population
- very important the foreign sector, exports representing 80% of GDP - foreign direct investment (FDI) accounted for much of the growth until 2008.
- budget deficit to rise slightly, to 8.2% of GDP in 2010
- GDP fell nearly 5% in 2009 before gaining back 4% in 2010
- unemployment rose above 12% in 2010, as the global recession impacted many segments of the economy.

As far as Romania is concerned, the following highlights may be depicted:

- Economic situation has degraded ever since 2008 and at the same time, the perspectives of monetary convergence have gone further away.
- Coherence of economic policies has not been adequate from a preventive or anti-cyclical point of view.
- It needs a coherent macro-economic mix
- The real economy must be supported by an impulse of the fiscal policy, opposite of the GDP deviation.
- The economic and monetary reality have continuously been under the inflationary pressure
- Competitiveness has lacked the necessary boost. There has not been an under-unit share between earning increase and productivity dynamics.
- Public debt has risen.

Some clarifying and resuming figures can be depicted below.

Table 1. Key economic indicators (2010)

	GDP per capita (% in EU27)	Inflation	Budget deficit (%)	Debt (%of GDP)	Exchange rate fluctuation	Interest rate
Romania	43*	5,5	7,2	30,4	+1,71 /-14,3	7,34
Slovakia	70*	1	8,2	51	-	3,87
Estonia	62*	1,77	3	7,7	0	-

Source: authors synthesis based on Eurostat and national banks data and estimates

In order to assess the results in convergence towards the Euro-zone, we use the algorithm of Kaufman and Rousseuw (1990) may be described as following. We have a data set consisting of n objects (the number of states) with p variables (the convergence criteria considered). It is noted $X_{np} = \{x_1, x_2, x_3 \dots x_n\}$ where each $x_i = \{x_{i1}, x_{i2}, \dots x_{ip}\}$. Each variable is standardized with zero median and the standard deviation is 1 in order to treat the criteria as having similar share of importance in determining the structure. The dissimilarity coefficient (the difference) between two objects can be defined as the Euclidian distance between two points. (Tanasie et al. 2008)

$$d(i, j) = \sqrt{\sum_{k=1}^p (x_{ki} - x_{kj})^2} \quad (1)$$

The algorithm is employed in order to minimize function C as following.

$$C = \sum_{v=1}^k \frac{\sum_{i,j=1}^n u_{iv}^2 u_{jv}^2 d(i, j)}{2 \sum_{j=1}^n u_{jv}^2} \quad (2)$$

where $u_{iv} \geq 0$ for $i=1, \dots, n$; $v=1, \dots, k$ $\sum_v u_{iv} = 1$ for $i=1, \dots, n$, where u_{iv} represents the unknown membership coefficient of the object (country) i to the cluster v , and k represents the number of clusters countries are divided into.

This algorithm results in a coefficient array Un_{xk} , where the sum of elements on the rows is 1, thus showing the degree of membership of the object to a certain cluster. If one of the coefficients is rather high, then, there is a high degree of certitude that the object belongs to a certain cluster. In order to perform an analysis of the degree of accuracy of the data partitioning we use some statistical elements:

- The Dunn normalized partitioning coefficient according to Boreiko (2002):

$$F_k = \frac{\frac{k}{n} * \sum_{i=1}^n \sum_{v=1}^k u_{iv}^2 - 1}{k - 1} \quad (3)$$

That varies from 1 (indicating a perfect data partitioning into clusters) to 0 (indicating the contrary - a data partitioning). The coefficient is 1 only if for each object there is one coefficient that equals one and the rest are 0. The coefficient is 0 when all membership coefficients $1/k$.

- the *silhouette* defined as following:

$$s(i) = \frac{b(i) - a(i)}{\max(a(i), b(i))} \quad (4)$$

where $a(i)$ is the average of dissimilarities of the objects compared to the objects in the same cluster, and $b(i)$ is the minimum of the dissimilarities' average of the object i compared to all the other object in its cluster, for all clusters. When $s(i)$ is close to 1 it means that the object (country) is correctly classified in the cluster where it can be found. A value closer to 0 indicates the fact that the object is incorrectly classified. The averages corresponding to each cluster and to all the data considered indicate the correctness of data partitioning. (Tanasie 2007).

We have applied this method in order to point out the EU member states' clusters according to real convergence performance. Data used has been provided by the Eurostat database. The aim is to find Romania's place and to find out whether previous examples – Estonia and Slovakia could represent suitable examples. We have stated before their course of action consisting in macroeconomic policies and measures, their monetary and exchange rate regimes and their economic performance in figures, and now, by means of positioning we shall find out *who has done better*. Results have been determined using dedicated software and are being presented in the chart below.

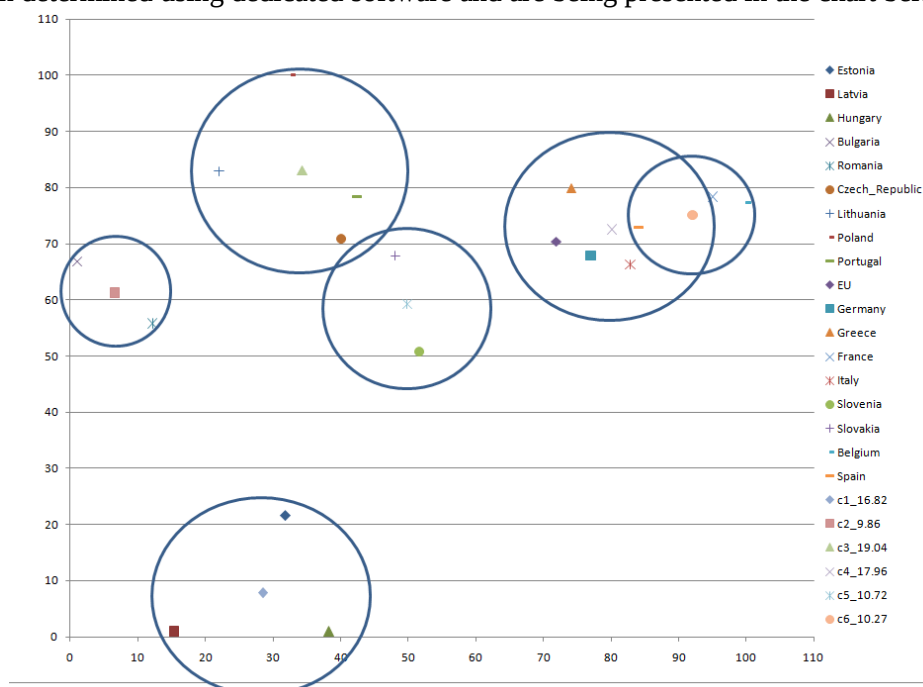


Figure 1. Countries' cluster partitioning

Source: authors' computing

Romania is, unfortunately part of the last (less performing) cluster. Estonia and Slovakia have definitely performed better. They are part of two different, but superior clusters. The evaluation is based on the GDP per capita indicator, but also assumes other real convergence indicators. Thus, this type of analysis provides the opportunity to combine maximum relevance indicators in determining the clusters. States are being classified according to the distance between a certain object (country) and the center of the cluster. One must not forget in this situation that the share of foreign direct investments is clearly in favor of new member states, and of the candidates to the Euro-zone. For this very reason, for example, Greece seems to perform better than if we would consider nominal convergence indicators seriously affected by the budget deficit or the public debt. c1 to c6 represent the centers of the determined clusters, and the adjacent values represent the radius of the cluster.

5. CONCLUSIONS

Analysis pointed out several essential issues in Romania's convergence process influencing the macroeconomic policy mix and the overall economic and monetary

evolution, such as: (1) the need for continuous convergence of income under the pressure of inflation or nominal exchange rates; (2) avoiding further macroeconomic disequilibrium beyond the economic and financial crises; (3) the need to transfer resources towards the tradable sector aiming convergence supported by a sector which already is the main source for that – the exporting sector; (4) the pressures of migration together with labor and wage pressures. The other two former candidates, actual members of the Euro-zone have been confronted with similar issues during the accession period. Patterns are not really compatible due to aspects such as differentiated developments of the associated environment during the specific periods, differently applied economic instruments or difference in structure. Still, the essential lesson to be learnt is that convergence is not in itself, but real convergence envisaging no further disequilibrium, absorption of asymmetric shocks and common development inside the monetary union.

REFERENCES

1. Altar et al. *"Impactul liberalizarii contului de capital asupra cursului de schimb si a competitivitatii economiei romanesti"*, Institutul European din România – Studii de impact III(2006)
2. Angeloni I., Michael Flad M., Mongelli F.P., *"Economic and Monetary Integration of the New Member States. Helping to chart the Route"*, ECB Working Papers, No. 36 / September 2005
3. Arratibel O., Furceri D., Martin R. *"Real Convergence in Central and Eastern European EU Member States"*, ECB Working Papers, NO 929 /- 2008
4. Bini-Smaghi, L., *"Asymmetric Adjustment in Monetary Unions: Evidence from the Euro Area"*, Speech at conference at the German Institute for International and Security Affairs: "The Eurozone under stretch? Analysing regional divergences in EMU: Facts, Dangers and Cures (2007)
5. Capiello, et al. *"The Impact of the euro on financial markets,"* ECB Working Paper series nr. 556. (2006),
6. Cerna ,S., - *"Teoria zonelor monetare optime"*, Editura Universitatii de Vest, Timisoara, ISBN 1, Nr.pag. 194, 2006
7. Clausen V., Hayo, B. *"Monetary policy in the Euro area-lessons from the first years"*, in "International Economics and Economic Policy", n°1, 2005, pp.349-364
8. Coeurdacier N., Martin, P. *"The Geography of Asset Trade and the Euro: Insiders and Outsiders"*, CEPR Discussion Paper nr. 6032(2007).
9. De Grauwe, *"Enlargement of the Euro Area?"*, in "Ces Ifo Forum", vol. VII, n°4,
10. Dogan N., *"Income Convergence of European Union and Candidate Countries: Are they all the Same?"* International Research Journal of Finance and Economics, ISSN 1450-2887 Issue 12 (2007)
11. Duval R. Elmeskov, J. *"The Effects of EMU on Structural Reforms in Labour and Product Markets,"* ECB Working Paper series nr. 557. (2006),
12. Ferreira, A.L. Leon-Ledesma, M.A. *"Does the real interest rate parity hold? Evidence for developed and emerging markets"*, Journal of

13. Fidrmuc, J. International Money and Finance, vol. 26(2007)
"The Endogeneity of the Optimum Currency Area Criteria and intraindustry trade: implications for EMU enlargement", in Paul De Grauwe and Jaques Melitz, (Eds) Monetary Unions after EMU, MIT Press. (2005),
14. Mongelli, F. P. *"European Economic and Monetary Integration, and the Optimum Currency Area Theory"* (2008)
15. Gerdesmeier, D., Mongelli, F.P., Roffia B. *"The Eurosystem, the U.S. Federal Reserve, and the Bank of Japan: similarities and Differences"*, Journal of Money, Credit, and Banking Vol 39, nr. 7 pp. 1785-1820. (2007),
16. Giannone, D. Reichlin, L. *"Trends and cycles in the euro area: how much heterogeneity and should we worry about it?"*, ECB Working Paper No 595(2006),
17. Berg, J., Grande, M., Mongelli, F.P. *"Elements of the Euro Area: integrating financial markets"*, Global Finance Series, Ashgate Publishing Company, 2005;
18. Bini Smaghi, L. Ferri, G. *"Revisiting the European Monetary System experience: where some members more equal than others?"*, in "Economic Notes", n°35, febbraio 2006, pp.151-172
19. Lipinska, A., *"The Maastricht Convergence Criteria And Optimal Monetary Policy For The Emu Accession Countries"*, ECB Working Papers, NO 896 / 2008
20. Molle, W. *"The Economics of European Integration: Theory, Practice, Policy"*, Ashgate, Aldershot, England(2006),
21. Petroulas, P. *"The effect of the euro on foreign direct investment"*, European Economic Review Vol 51 (2007) pp. 1468–1491(2007)
22. Tanasie A. et al. *"A fuzzy clustering algorithm application for monetary unions"* – International Journal of Economic Perspectives, ISSN: 1307-1637, Volume 2, Issue 4, 2008
23. Wyplosz C. *"European Monetary Union: The Dark Sides of a Major Success"*, Economic Policy, April (46), pp 207-278, (2006)