An Empirical Analysis of Romania's Comovement with the Euro Zone

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Abstract. *In light of adopting the euro in the near future, it is important to asses to which extent the Romanian business cycle evolves in a similar fashion with that of the euro zone. The present study is an empirical investigation of the degree of business cycle synchronization between Romania and the euro area, based on macroeconomic series that capture the cyclical features of the two economies. The results indicate that the most recent period, characterized by major economic and financial turmoil, has lead to an increase of the degree of comovement between of the Romanian economy with that of the euro area.*

Keywords: co-movement; optimum currency area; European integration; cohesion; dynamic correlation.

JEL Codes: E32, F15.
REL Codes: 8H, 20H.

1. Introduction

There is a growing literature that empirically analysis the degree to which the new member states of the European Union have satisfied or currently fulfill the criterion of business cycle synchronization with the euro zone. The problem is important not only for the candidate countries, for which the benefits of euro adoption should outweigh the costs, but also for the well functioning of the union as a whole on the long and medium term.

Sadly, the literature is extremely scarce with respect to empirical studies that focus on Romania. The explanation resides both in the poor quality of available data and in the problematic econometric modeling when tackling transition economies, for which time series are short and institutional changes are frequent. However, there are studies that analyze the Romanian economy from the perspective of business cycle synchronization with the euro area as being part of a group, but they fail to capture the characteristic features of this particular economy.

Savva, Neanidis and Osborn (2007) use a bivariate VAR-GARCH model in order to assess the correlation dynamics between the new member states and the euro zone, taking into consideration a number of countries outside the European Union as well. The obtained results indicate that the degree of comovement with the euro area has exhibited large variations during the period 1980–2006 and for most of the Central and Eastern European countries, the degree of comovement has increased. It is noteworthy the fact that among all the analyzed economies, Romania was the only one at that moment exhibiting a negative correlation with the euro zone for the whole sample. However, the authors find evidence in favor of a structural break in the degree of business cycle synchronization between the candidate countries and the euro area after the completion of the most important negotiation stages for European Union integration. The study reaches the conclusion that after 2002 the correlation coefficient of the Romanian economy with that of the euro area changes from negative to weak positive. Compared to other candidate countries, this coefficient remains low.

A similar approach can be found in Babetskii (2004), who employs time-varying correlation coefficients in order to assess the comovement of supply and demand shocks between a group of candidate countries and other states in the euro zone. The underlying shocks have been isolated based on VAR models with long term restrictions identified as proposed by Blanchard and Quah (1989). As far as supply shocks are concerned, which are crucial for business cycle synchronization, the author points out that the asymmetry between the shocks that affect Romania and the other countries in the European Union hasn't diminished over time.

Other studies that have established a negative correlation between the Romanian business cycle and that of the euro area included: Berger, de Haan and Inklaar (2002) for the period 1990–2001, Furceri and Karras (2006) for the period 1980–2003, Afonso and Furceri (2007) for the period 1995–2005.

The goal of the paper consists in establishing stylized facts referring to business cycle synchronization between Romania and the euro area, more precisely, establishing the way in which macroeconomic correlation has evolved, which is particularly relevant in the perspective of adopting the euro.

We depart from the above mentioned studies by employing dynamic correlation coefficients defined in the frequency domain. We argue that especially in the case of transition economies, dynamic correlation measures are more relevant for assessing business cycle synchronization because the structure of the economy in continually changing, as well as relationships between agents and the degree of financial and economic integration with more developed countries is evolving. Moreover, the current economic context marked by a multi-level crisis triggers profound changes in the macroeconomic variables at a global level. There are empirical studies which bring evidence that periods of financial and economic turbulence lead to a significant increase of correlation coefficients on international markets (for example, Bekaert, Harvey and Ng (2005) or Forbes and Rigobon (2002), Doyle and Faust (2002), Gayer (2007)).

2. Data set and methodology

In order to better grasp the dynamics of the comovement between the Romanian economy and that of the euro area we made use of data that are monthly available, being more suited for a spectral analysis than quarterly data. Moreover, statistical availability is important to characterize the most recent and profound period of economic and financial turmoil.

The series employed to capture the cyclical evolution of the Romanian economy and of the euro zone were taken from the Eurostat database and graphically depicted in the appendix. In order to estimate the degree of business cycle synchronization between the two economies, among all macroeconomic series, we have selected the most representative from this perspective, as follows: the industrial production index (for the time span 2000m1 – 2009m6); the index of production in construction (2000m1 – 2009m6); unemployment rate (2000m1 – 2009m3); harmonized index of consumer prices – *HICP* (2000m1 – 2009m7); the economic sentiment indicator[1] – *ESI* (2000m1 – 2009m4), a forward looking indicator that directly assess agents' expectations regarding the state of the economy for the next twelve months.

The time series that exhibited seasonal patterns were seasonally adjusted using TRAMO/SEATS methodology. In order to capture the cyclical evolution of each economy, the available series were considered as deviation from trend, computed using a Hodrick-Prescott filter. A logarithm was applied on the initial series, in order to obtain the percentage deviation from trend.

Empirical analyses on the degree of business cycle synchronization within a group of countries can be carried out in the time domain or in the frequency domain. The first category has been so far dominant in the comovement literature. Both types of

investigations can be subject to criticism. Spectral analysis can capture facts otherwise not revealed by time domain investigations, such as whether business cycles more are correlated on the short (at higher frequencies) or on the long term (at lower frequencies). Unlike temporal analysis, the spectral one allows a frequency by frequency approach. The static correlation is defined for the whole spectral band, consequently, it eliminates the possibility of focusing on the most dominant frequencies, leaving aside the ones that account for minor economic fluctuations. On the other hand, spectral analysis has its own drawbacks as well, the most important being that it doesn't capture time variations of the time series behavior.

In order to eliminate these shortcomings, the present study combines spectral analysis with the temporal one. To this respect, we'll make use of two dynamic correlation measure defined in the frequency domain, namely coherence and the dynamic correlation coefficient proposed by Croux, Forni and Reichlin (2001). These measures are being attached a time dimension by computing them period by period, based on a predefined rolling window. Similar investigations have been made by Eickmeier and Breitung (2006), Aarle, Kappler et al. (2008), without attaching the time dimension to the dynamic correlation measures; this is done, for example, by Essaadi and Boutahar (2008).

In the frequency domain, time series are considered as aggregating an infinite number of components with different periods and amplitudes. The properties of a stationary stochastic process are captured by applying a Fourier transform to the autocovariances. The spectrum of the series is obtained, as follows:

$$S_x(\omega) = \frac{1}{2\pi} \sum_{j=-\infty}^{\infty} e^{-i\omega j} \times \gamma_x(j) \qquad (1)$$

where $S_x(\omega)$ is the power spectral density of process x for the frequnecy expressed in radians; $i = \sqrt{-1}$ and is the autocovariance function of process x for the j lag. The spectrum contains the same information as the autocavariance function, but presented in a different manner. The power spectral density has been estimated through Welch's averaged, modified periodogram method.

The first correlation measure employed to analyze the interdependencies between the Romanian economy and that of the euro area is coherence, which is estimated according to the following relation:

$$C_{xy}(\omega) = \frac{\left|S_{x,y}(\omega)\right|^2}{S_x(\omega) \times S_y(\omega)} \qquad (2)$$

where $C_{xy}(\omega)$ is the coherence between signals x and y for frequency ω, $S_{x,y}(\omega)$ is the co-spectrum between series x and y, $S_x(\omega)$ is the series x spectrum and $S_y(\omega)$ is the series y spectrum.

The coherence measure establishes how well signal x corresponds to signal y for each frequency. It belongs to the interval $(0,1)$ and it has the drawback that it doesn't take into consideration any faze differencies among the two business cycles.

Frequency domain analysis enables taking into consideration only dominant frequency, leaving aside the ones that

explain only a minor fraction in the business cycle evolution. To this respect, we compute the mean coherence ($\overline{C}_{xy}$), according to the following relation:

$$\overline{C}_{xy} = \frac{\sum_{\min(\omega_{mx},\omega_{my})}^{\max(\omega_{mx},\omega_{my})} C_{xy}(\omega)}{\max(\omega_{mx},\omega_{my}) - \min(\omega_{mx},\omega_{my}) + 1} \quad (3)$$

where stand for the frequency for which the spectrum of series *x* and *y*, respectively, have a peak.

Similar to the mean coherence, we define the mean dynamic correlation ($\overline{\rho}_{xy}$) based on the indicator proposed by Croux, Forni and Reichlin (2001), according to the following relation:

$$\overline{\rho}_{xy} = \frac{\sum_{\min(\omega_{mx},\omega_{my})}^{\max(\omega_{mx},\omega_{my})} \rho_{xy}(\omega)}{\max(\omega_{mx},\omega_{my}) - \min(\omega_{mx},\omega_{my}) + 1} \quad (4)$$

where:

$$\rho_{xy}(\omega) = \frac{real(S_{xy}(\omega))}{\sqrt{S_x(\omega) \times S_y(\omega)}} \quad (5)$$

Unlike the mean coherence, the dynamic correlation measure given by relation 5 takes into account the faze differences between the two business cycles. This indicator belongs to the interval $(-1,1)$. Croux, Forni and Reichlin (2001) argue that this correlation measure is an appropriate method to study the comovement between two economies, it allows disentangling the long-term correlation from the short-term one. Based on this indicator, the authors propose a cohesion measure among a group of countries as the simple arithmetic mean of the dynamic bivariate correlation coefficient computed for all pairs of two countries for a certain frequency band or for the whole band.

The two mean correlation measures have been attached a time dimension by computing them on a 8 year rolling window, a period that characterizes the business cycle length.

3. Results and their interpretation

The series employed for measuring the interdependencies between the Romanian economy and that of the euro area indicate the fact that there is a powerful correlation between the chosen economic variables for the dominant frequencies of the business cycle. Figure 1 illustrates the evolution of the two correlation measure, where the mean coherence is displayed against the left axis, and the mean dynamic correlation is drawn against the right axis.

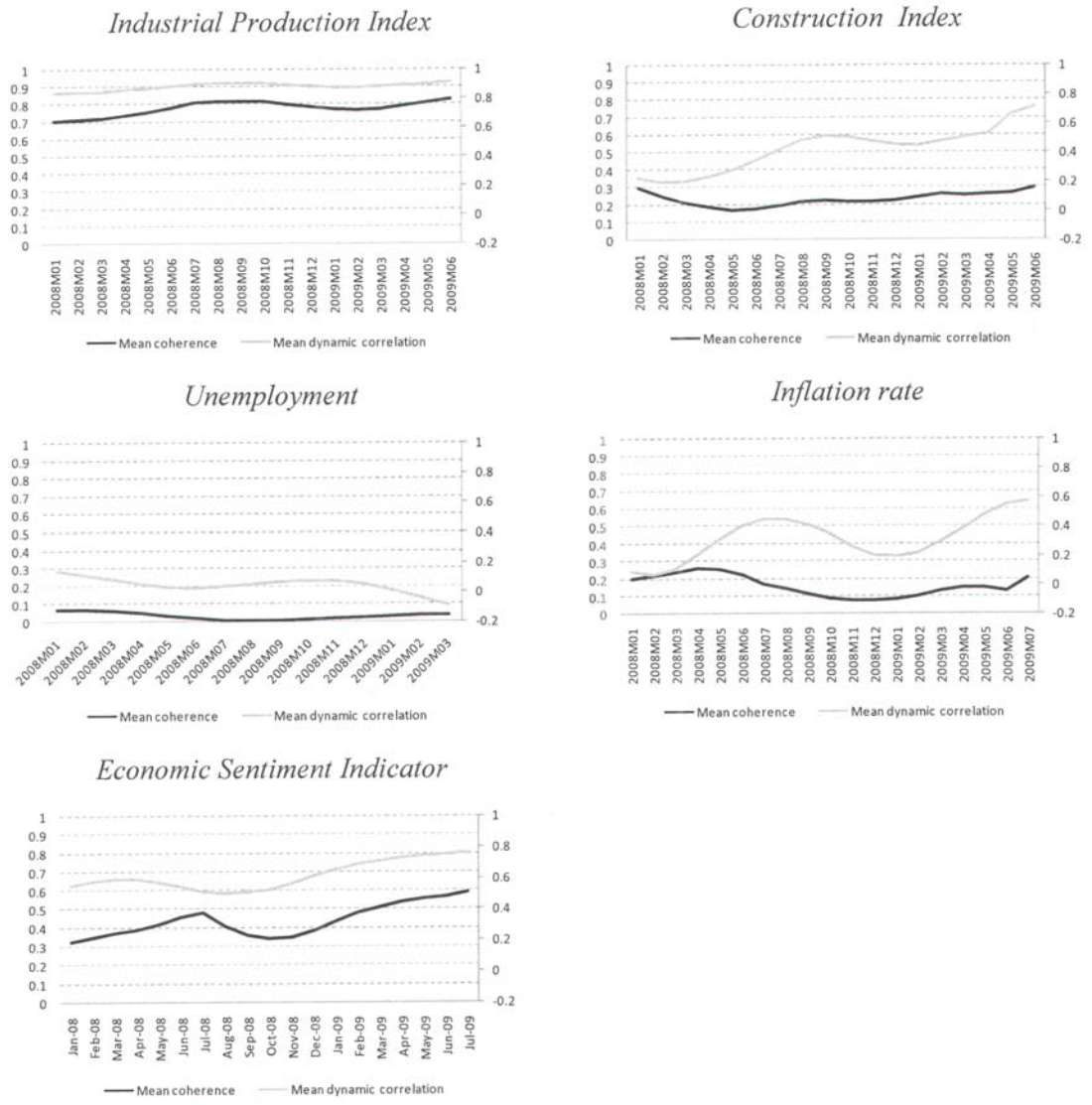

Figure 1. *Evolution of dynamic correlation measures between the Romanian economy and that of the euro zone computed with a 8 year rolling window*

A first conclusion that can be drawn based on the visual inspection of the correlation measures is that the most powerful correlation is attained for the industrial production index. The mean coherence belongs to the interval (0.70; 0.83), whereas the mean dynamic correlation measure varies in the interval (0.84; 0.91). This can be explained through a high dependency of the Romanian industry of the import goods, but also of export orders for the domestic industrial goods.

The lowest correlation is achieved with respect to the unemployment rate, for which the mean coherence belongs to the interval (0.03; 0.06) and the mean dynamic correlation ranges within the interval (-0.09; 0.13). Basically, for this particular indicator, an analysis of the correlation trend is irrelevant, as the correlation is not statistically significant. The explanation

resides in the labor market conditions, which are different in Romania as compared to the euro zone; the labor unit cost constantly rose in Romania over the studied period (even in 2008Q4. Compared to the previous quarter, the total labor unit cost rose 4.7%), which limited the number of unemployed. Moreover, the characteristics of the Romanian economy as a developing country lead to different needs on the labor market as opposed to the mature economies in the euro zone.

These differences also explain the evolution of correlation in the construction sector. The correlation became more powerful starting with may 2008, when the pace of production slowed in Romania, as well.

As far as the economic sentiment indicator gap, it can be regarded as a composite measure that characterizes the evolution of the economy as a whole and can be considered a proxy for the business cycle extracted from the GDP. The computed correlation measures indicate a strong interdependence for this indicator and exhibits an ascending trend, especially starting with the fourth quarter of the year 2008, when Romania recorded a negative rate of economic growth, similar to the conditions in the euro area.

The results obtained in the present study are according to those suggested by De Haan, Inklaar and Jong-a-Pin (2005). The authors review the most relevant empirical studies related to business cycle synchronization and draw attention on the fact that high correlation periods and small correlation periods tend to alternate, with respect to the business cycle faze. Correlations are higher during recessions.

A simple statistical test for assessing the trend of correlation measures and indirectly, for the convergence of the two economies, is based on estimating the following regression:

$$\text{Correlation measure}_t = \text{const} + c_1 \times @trend + \varepsilon_t \quad (6)$$

If $c_1 > 0$ and the trend coefficient is statistically significant, this indicates that the underlying correlation measure has increased in the analyzed period and if $c_1 < 0$, the trend has been descending. The table below presents the results of the convergence test for all variables considered for characterizing the business cycle for the two correlation measures: 1 – mean coherence and 2 – mean dynamic correlation. The equations have been estimated using OLS.

Correlation measures against a deterministic trend

Table 1

	Correlation measure	Coefficient	Standard error	t-Statistic	Prob.
Industrial Production Index	1	0.0050	0.0013	3.8103	0.0015
	2	0.0029	0.0007	3.8820	0.0013
Construction Index	1	0.0032	0.0016	1.9926	0.0637
	2	0.0260	0.0028	9.2826	0.0000
Inflation rate	1	-0.0060	0.0022	-2.7063	0.0150
	2	0.0168	0.0050	3.3549	0.0038
Economic Sentiment Indicator	1	0.0117	0.0023	5.1489	0.0001
	2	0.0126	0.0024	5.2356	0.0001

For all the considered variables, the correlation measures exhibit an ascending trend in the period January 2008 – July 2009, a trend which is statistically significant for a p-value of 10%. An exception is given by the mean coherence for the inflation rate, but this is rising starting with the last quarter of 2008, when Romania experienced a negative economic growth, similar to what was happening in the euro zone. From the business cycle synchronization perspective, we consider that the industrial production index and the economic sentiment indicator are particularly important, both being strongly correlated at the end of the sample.

4. Conclusions

During the period January 2008 – July 2009 the Romanian business cycle became strongly synchronized with that of the euro area, which can be mainly attributed to the global economic and financial crisis. The upward trend of the correlation is particularly significant starting with the fourth quarter of the year 2008, when the effects of the international crisis triggered a negative rate of economic growth in Romania as well. The results confirm the findings of empirical studies that analyze crisis periods and find that these episodes lead to an increase of correlations on all markets.

The theory of optimum currency areas draws attention to the analysis of asymmetric shocks, that affect certain countries or regions within the union and trigger significant cost generated by the adoption of a common currency. According to this theory, the optimum dimension of a monetary union – the optimum border of a common monetary area – corresponds to a situation in which the costs and benefits of using the same currency compensate each other.

In light of adopting the euro, the increase of the degree of business cycle synchronization is in line with the theory of optimum currency areas, according to which the higher the degree of business cycle synchronization with the rest of the union, the smaller the cost associated with giving up the national currency.

The euro adoption will generate permanent benefits for Romania, but this decision will not be cost free. The immediate effects will be eliminating the transaction costs and the exchange rate risk, the increase of investment, of macroeconomic credibility that will diminish country risk. Moreover, the euro adoption will foster financial integration with the European market, which can improve financing conditions of Romanian companies.

Entering the common currency area will also generate costs due to the loss of monetary policy autonomy, more precisely, the interest rate and flexible exchange rate policy, will no longer be used to smooth out economic fluctuations that appear as a result of shock that hit the Romanian economy. The magnitude of these costs depends on the vulnerabilities of the Romanian economy to asymmetric shocks. The most important indicator that assesses these vulnerabilities is the degree of business cycle synchronization with the euro area. According to the present study, this degree is sufficiently high for the Romanian economy.

Note

(1) The indicator is computed by the European Commission. More precisely, ESI is a composite index whose value is determined based on four confidence indices that are attached different weights: an indicator for the confidence in the industrial sector (which bears a weight of 40%), a consumer sentiment indicator (with a weight of 20%), a construction confidence index (20%) and a retail sector confidence indicator (20%). ESI aggregates the attitudes and judgments of a large number of economic agents (68,000 firms and 27,000 consumers) and according to European Commission statements, is being used in short term analyses. Also, ESI is extremely useful in predicting the turning points of the business cycle.

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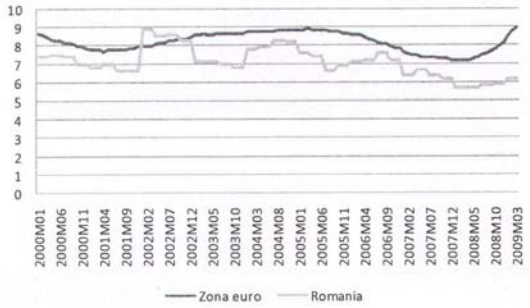
Appendix. Data series

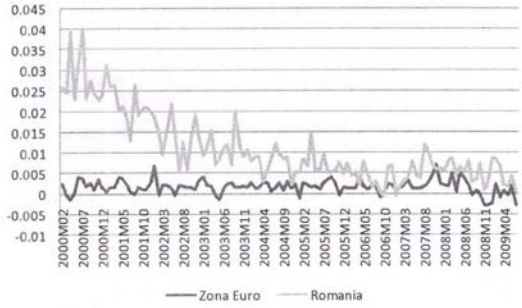
Industrial Production Index (2005=100)

Construction Index (2005=100)

Unemployment Rate



Inflation Rate (based on HICP)



Economic Sentiment Indicator