CO-MOVEMENT AND SYNCHRONICITY OF BUSINESS AND FINANCIAL CYCLES IN ROMANIA AND OTHER EEMS

Andreea MURARU

Bucharest Academy of Economic Studies, Romania

andreea.muraru@ie.ase.ro

Abstract. *This paper investigates the existence of a common movement between the financial cycle (proxied by the cyclical components of financial variables) and the real cycle in Romania and 3 other European emerging markets (Czech Republic, Hungary and Poland), and also the existence of common cycles across countries. The results, obtained through band-pass filtering, turning-point analysis, factor analysis and wavelet coherence, show that there is synchronicity between the economic and the financial cycle (especially if measured in terms of house prices and credit to households) in each country as well as a high level of uniqueness in explaining the variance of credit to non-financial corporations. Moreover, the analysis also reveals the existence of common cycles across countries for 10Y bond yield, stock and house prices, and also, with somewhat weaker communality, in economic activity. The study also illustrates that loan developments among the selected countries are to a larger extent driven by specific factors.*

Keywords: co-movement, coherence, factor analysis, financial cycle, real cycle.

JEL classification: C38, E32

DOI: 10.12948/ie2019.07.04

1. Introduction

A lot of attention has been given recently to financial cycles and their interactions with the business cycles. Numerous papers investigate the coherence between cycles especially for developed economies, as data availability and its length allow for a larger range of analyses.

This paper tries to investigate to what extent the synchronicity between the economic and the financial cycle can be identified for Romania and extends the analysis to some other European emerging markets: Czech Republic, Hungary and Poland, analysing at the same time the existence of common cycles in the evolution of the selected variables.

The article is structured in three parts, plus introduction and conclusions. The first part is a short review of the literature dedicated to the subject, the second one describes the data, its sources and the methodology, and the third one presents the results of the analyses.

2. Literature review

The vast literature on business and financial cycles addresses three main categories of problems: (i) selecting the variables suitable for measuring financial cycles and estimating or building indicators of financial cycles; (ii) analysing the synchronicity of cycles among countries or, at country level, the coherence between real and financial cycles; (iii) studying financial cycles from a policy perspective with a focus on macroprudential measures.

The methods used for measuring and building cycle indicators are mostly turning point (TP), and filtering techniques. TP analysis is applied in [1] and subsequently extended in [2] for studying the interaction between business and financial cycles. Haavio [3] applies the Bry-Boschan algorithm to identify financial and economic cycles in euro- and non-euro-area

countries and conclude that financial prices lead real activity, while loans seem to be lagging developments in GDP. Aikamn [4], using the same method, also identify regular financial cycles, different from the real cycles both in duration and amplitude in a cross-country study. In [5] both TP analysis and band-pass filters are used to construct financial cycles as the medium-term component of the common movement in credit and property prices.

The synchronicity among variables specific for the real sector and the financial one, or between cycles in a cross-country perspective is the subject of research in papers like [6] [7], [8], [9], [10], [11]. [6] use a multivariate structural model to identify the financial cycles and investigate their relation to the real cycle in 5 European economies and the US. They identify a medium-term component in GDP that is strongly related to the financial cycles and also conclude that there is a direct relation between the rate of home ownership and the length and amplitude of financial cycles, conclusion also reached by Huber [12] in a study identifying house price cycles by using TP analysis and studying them in connection with housing bubbles. Breitung [8] use a multi-level factor model to study the co-movement of international business cycle and international financial linkages and find that there is high commonality in stock prices and interest rates and lower for credit and house prices on account of national regulations. In [9], the author builds a synchronicity index in a cross-country study finding that mortgage market developments have important contribution to real and financial cycle co-movement. The methods used in [10] and [11] are somewhat similar and include principal component analysis, synchronicity and similarity as well as wavelet coherence. The authors of [10] develop an extensive analysis on business and financial cycles. They apply band pass filter to isolate the cyclical component in the selected time series, and analyze the co-movement both across series and among countries. In [11] there is a similar approach to [10] the paper being in fact an extension of the analysis of co-movement among countries. Wavelet analysis is also used in [13] to study the coherence between financial variables in 9 euro-area countries.

Various papers treat the subject of financial cycles from a macroprudential perspective. The Basel III regulations regarding the countercyclical capital buffer make specific reference to credit gap, measured as the difference between the credit to GDP ratio and its long-run trend, extracted with an HP filter. [14] review the work on macroprudential policy and indicators. There is a large number of studies discussing financial cycles from a policy point of view, among which [15], [16], [17], [18].

3. Data and methodology

3.1 Data and sources

The dataset comprises 5 quarterly data series: credit to households and credit to non-financial corporations, house prices, stock prices, 10 year government bond yields and GDP, collected for 4 countries – Romania, Czech Republic, Hungary and Poland. Data sources and data length varied among both indicators and countries. The sample ranges from 1996q1-2018q3 to 2005q1-2018q2 for Poland house prices. The data on loans was collected from the BIS with the exception of Romania, for which the data source is the NBR; stock prices were taken from Fred database with the exception of Romania for which the source was the Bucharest Stock Exchange; house prices were obtained from various sources: Magyar Nemzeti Bank for Hungary, Czech Central Bank and Eurostat both for the Czech Republic and Poland, National Statistical Institute and the NBR for Romania; the yields on 10 year government bonds were downloaded from the Fred database for Hungary, Poland and Czech Republic and in the case of Romania from the NBR and extended backwards through regression on long term interest rates for convergence purposes (source ECB, SDW) and ROBOR 12M (source NBR). Data

entered the analyses in real terms, deflated with the GDP deflator and in logarithms, with the exception of indexes and interest rates.

3.2 Methodology

The cycles were identified by the use of the band-pass filter. As the sample is relatively small, a length of 30 years for the financial cycle could not be considered in the analysis, therefore the median length of financials cycle [19] (15 years) was chosen. Thus, the filtering bounds were 8 and 60. Even though, traditionally, the economic cycle has a length between 2 and 8 years, I used the same frequency band of 8-60 so as to avoid obtaining uncorrelated series by construction [10]. Similarity between the financial variables and GDP was analyzed on the extracted cycles and was investigated at country level by means of factor analysis and similarity index calculated after identifying peaks and troughs with the *Bry-Boschan* algorithm for quarterly series. The common evolution of the series was also studied through wavelet analysis. Between countries the co-movement was analyzed by factor analysis.

Factor analysis is a multivariate data analysis technique that allows for the identification of latent variables that induce a common movement in the investigated dataset. This technique explains the original data series through some common factors and unique elements. In matrix form, the model can be written as: $X - \mu = AF + U$ (1) where:

$X = (x_1 \ x_2 \ \dots \ x_n)'$ the vector of n initial variables, $\mu = (\mu_1 \ \mu_2 \ \dots \ \mu_n)'$ the mean of the variables, A = matrix of factor coefficients known as intensities, $F = (f_1 \ f_2 \ \dots \ f_p)'$ the p common factors ($p < n$) and $U = (u_1 \ u_2 \ \dots \ u_n)'$ the unique factors for each initial variable.

The assumptions of the factor model are: (i) common factors are uncorrelated, have zero mean and unit variance ($var(f_i) = 1$); (ii) unique factors are also uncorrelated and of zero mean, but with a different variance ($var(u_i) = \psi_i$); (iii) Common factors are not correlated with unique factors ($cov(f_i, u_i) = 0, \forall i, j$). Therefore, the variance of a variable x_i can be expressed as: $var(x_i) = \sigma_i^2 = \alpha_{i1}^2 var(f_1) + \alpha_{i2}^2 var(f_2) + \dots + \alpha_{ip}^2 var(f_p) + var(u_i)$ (2)

which can be written as: $\sigma_i^2 = h_i^2 + \psi_i$ (3)

where $h_i^2 = \alpha_{i1}^2 + \alpha_{i2}^2 + \dots + \alpha_{ip}^2$ is the communality – the share of variance attributed to common factors – and ψ_i is the uniqueness – the variance attributed to specific elements for the series' evolution. For standardised variables the sum of communality and uniqueness is 1.

Wavelet analysis decomposes the data series in its periodic elements, cycles, illustrating how they change over time, or as mentioned in [20], wavelets estimate the power spectrum as a function of time. It represents an extension to spectral analysis by allowing for time variation [10]. The co-movement of series can also be studied with wavelet analysis, by computing the wavelet coherence (which is based on dynamic correlation). The continuous wavelet transformation that we use implies the projection of the time series on a wavelet function. As in most economic applications, we use the Morlet wavelet. Details about wavelet analysis can be found in [21], [10], [13], [22], [20].

4. Results

4.1 Common movement at country level

In analysing the common movement of indicators at country level the first step was to apply the band-pass filter with a frequency band of 8-60 quarters. The co-movement was then analysed on the filtered series so that the common elements of cycles would be identified. I investigated the synchronicity of cycles by using the concordance indicator, factor analysis and wavelet coherence.

1. Concordance indicator – This indicator counts the moments when both series are in the same phase of the cycle relative to the total number of observations (1= perfect concordance, 0=no concordance).

Table 1. Concordance with economic cycle

	Loans to households	Loans to non-fi. corporations	Stock prices	House price	10y bond yield
Romania	0.77	0.52	0.64	0.89	0.54
Czech Republic	0.69	0.53	0.71	0.59	0.60
Poland	0.48	0.44	0.65	0.69	0.67
Hungary	0.57	0.47	0.54	0.59	0.40

As it can be seen from Table 1, there is a relatively high concordance between the cycles of the selected variables and economic activity, very few values being below 0.5. The concordance of GDP is the highest with house prices and loans to households, variables traditionally associated with the financial cycle. For Romania the maximum concordance level is between the economic activity and house prices, closely followed by loans to households. The lower synchronicity with loans to non-financial corporations could be due to some lead-lag pattern of the two series; in the construction of the indicator all series were considered coincident.

2. Factor analysis – The necessary number of factors was 2, with the exception of Poland where 3 were needed. The conclusions from factor analysis are somewhat similar to what the concordance indicator reveals, mainly that the common factor that has high loadings on GDP also has high loadings on house prices and credit to households (see Table 2). Moreover, there is a high uniqueness associated with credit to non-financial corporations (0.88 for Romania, 0.55 for the Czech Republic and 0.68 for Hungary), meaning that its evolution is triggered to a greater extent by specific factors and not by the common elements of the real and financial cycle.

Table 2. Results from factor analysis

	Romania		Czech Republic		Poland			Hungary	
	f1	f2	f1	f2	f1	f2	f3	f1	f2
Loans to households	0.87	0.47	0.66	0.65	0.7	0.65	-0.1	0.07	0.99
Loans to non-fi. corporations	-0.33	0.1	-0.08	0.67	0.99	0.08	-0.12	0.17	-0.54
Stock prices	0.36	-0.69	0.82	-0.16	-0.92	-0.1	0.28	0.78	-0.09
House price	0.99	-0.08	0.62	0.74	-0.29	0.28	0.91	0.65	0.59
10y bond yield	0.19	0.98	0.05	0.79	0.26	0.93	0.24	-0.32	0.09
GDP	0.97	-0.05	0.98	0.18	-0.11	0.74	0.56	0.76	0.1

3. Wavelet coherence – confirms the existence of important correlation between GDP, house prices and loans to households. As can be seen from Figure 1, in the case of Romania there is a constant correlation between GDP and house prices and between GDP and loans to households at a frequency of 12-24 quarters and 20 to 24 quarters, respectively and also periodic significant correlations at lower frequencies. The same pattern of persistent correlation at longer frequencies and occasional coherence at lower periodicities is true for all countries under review.

x-scale: period in quarters, colour-scale: bright yellow: correlation=1, dark blue: correlation=0

Figure 1. Wavelet coherence

4.2 Common movement across countries

The investigation of the common movement across countries was done through factor analysis applied on each of the filtered series for all selected countries. As can be seen from Table 3, strong co-movement across countries can be identified for stock prices, yields and house prices, the loadings of the common factor on all countries being very high and therefore the largest part of the series evolution is determined by the common factor (the communality can be calculated as the square of the coefficient). For credit variables there is a higher degree of uniqueness, most probably due to national specificities (conclusion similar to [8]). Regarding GDP, there is also some evidence of a common real cycle among countries, but the loadings are high only for 3 out of 4 countries; for Poland the uniqueness element accounts for 82 percent of the economic cycle.

Table 3. Factor loadings

	GDP	10y bond yield	Stock prices	House price	Loans to households	Loans to non-fi. corporations	Total credit
Czech Republic	0.99	0.96	0.98	0.86	0.84	0.99	0.99
Hungary	0.84	0.83	0.78	0.75	0.10	0.69	0.79
Poland	0.42	0.94	0.92	0.81	0.44	0.69	0.65
Romania	0.88	0.97	0.96	0.87	0.99	0.57	0.80

5. Conclusions

By using factor analysis, measures of cyclical phase concordance and wavelet analysis, this paper showed that there is a common movement between the economic and the financial cycle (especially if measured in terms of house prices and credit to households) in Romania and other European emerging markets, namely Czech Republic, Poland and Hungary, and a high level of uniqueness in explaining the variance of credit to non-financial corporations. The paper also illustrates that there is a common cycle among countries in bond yields, stock and house prices and also, to some extent, in economic activity, but that a higher degree of uniqueness characterises loan developments.

References

- [1] S. Claessens, A. Kose and M. Terrones, "Financial cycles: What? How? When?", *Centre for Economic Policy Research Working Papers*, No 8379, 2011.

- [2] S. Claessens, A. Kose and M. Terrones, “How Do Business and Financial Cycles Interact?”, *Journal of International Economics*, Vol. 87, Issue, 1, 2012, pp. 178-190.
- [3] M. Haavio, *Financial Cycles and Business Cycles: Some Stylised Facts*, Bank of Finland, BoF Online, 2012.
- [4] D. Aikamn, A. Haldane and B.D. Nelson “Curbing the credit cycle”, *The Economic Journal*, Vol. 125, 2015, pp. 1072-1109.
- [5] M. Drehmann, C. Borio, and K. Tsatsaronis , “Characterising the financial cycle: don’t lose sight of the medium term!”, *BIS Working Papers*, No 380, 2012.
- [6] G. Rünstler and M. Vlekke, “Business, housing and credit cycles”, *ECB Working Paper*, No. 1915, 2016.
- [7] K. Hubrich, A. D’Agostino, M. Cervená, M. Ciccarelli, P. Guarda, M. Haavio, P. Jeanfils, C. Mendicino, E. Ortega, M. Valderrama, and M. Endrész, “Financial shocks and the macroeconomy”, *ECB Occasional Papers*, No 143, 2013.
- [8] J. Breitung and S. Eickmeier “Analysing international business and financial cycles using multi-level factor models”, in J. Hillebrand and S.J. Koopman (eds.) *Advances in Econometrics*, Vol. 35. Emerald Insight, 2016.
- [9] M. Comunale, “Synchronicity of real and financial cycles and structural characteristics in EU countries”, *Occasional Paper Series*, Bank of Lithuania, No 15, 2017.
- [10] WGEM Team on Real and Financial Cycles, “Real and financial cycles in EU Countries: stylised facts and modelling implications”, *ECB Occasional Paper* No. 205, 2018.
- [11] D. Kunovac , M. Mandler, M. Scharnagl, “Financial Cycles in Euro Area Economies: A Cross-Country Perspective”, Working Papers, Croatian National Bank, 2018
- [12] S. Hube, “Housing Booms and Busts: Convergence and Divergence in OECD Countries”, 2016, available: <https://bit.ly/2TFXd3z> [7.03.2019]
- [13] M. Scharnagl and M. Mandler, “Financial cycles in the euro area: a wavelet analysis”, 2016, available: <https://bit.ly/2T6qHCI> [7.03.2019]
- [14] B. Gadanez and K. Jayaram, “Macroprudential policy frameworks, instruments and indicators: a review”, in *Irving Fisher Committee Bulletin No 41: Combining micro and macro statistical data for financial stability analysis*, BIS, 2016.
- [15] M. Drehmann, C. Borio and K. Tsatsaronis, “Anchoring countercyclical capital buffers: the role of credit aggregates”, *BIS Working Papers*, No 355, 2011.
- [16] C. Borio, “Monetary policy and financial stability: what role in prevention and recovery?” *BIS Working Papers*, No 440, 2014.
- [17] J. Benes, D. Laxton and J. Mongardini, “Mitigating the deadly embrace in financial cycles; countercyclical buffers and loan-to-value limits”, *IMF Working Papers*, No 16/87, 2016.
- [18] V. Bruno and H. S. Shin, “Capital flows and the risk-taking channel of monetary policy”, *Journal of Monetary Economics*, Vol. 71, pp. 119-132, 2015.
- [19] M. Drehmann, C. Borio, L. Gambacorta, G. Jiménez and C. Trucharte, “Countercyclical capital buffers: exploring options”, *BIS Working Papers*, No 317, 2010.
- [21] L. Aguiar-Conraria, and M. Soares “The continuous wavelet transform: Moving beyond uni- and bivariate analysis”, *Journal of Economic Surveys*, Vol. 28, 2014, pp. 344-375.
- [22] B. Cazelles, M. Chavez, D. Berteaux, F. Menard, J. Vik, S. Jenouvrier and N. Stenseth, “Wavelet analysis of ecological time series”, *Oecologia*, Vol. 32, Issue 7, 2008, pp. 287-304.
- [23] L. Aguiar-Conraria, N. Azevedo, M. Soares, “Using wavelets to decompose the time–frequency effects of monetary policy”, *Physica A*, No. 387, 2008, pp. 2863–2878.