A MIXED FREQUENCY ANALYSIS OF CONNECTIONS BETWEEN MACROECONOMIC VARIABLES AND STOCK MARKETS IN CENTRAL AND EASTERN EUROPE

Radu LUPU, PhD[1]
Adrian Cantemir CALIN, PhD[2]

Abstract

The importance of connections between macroeconomic growth and financial markets is studied for a long time in the academic research. The special case of the developing countries, which is the case of the Central and Eastern European economies highlights this phenomenon even more, as many of them are still at the verge of reforming their economies. Our paper proposes the use of MIDAS regression in an analysis of the connections between macroeconomic growth and equity markets in this region in order to exhibit the importance of the latter for the reform strategies.

Keywords: MIDAS regression, mixed frequency series, CEE markets

JEL Classification: C51, C53, G17

Introduction

Modeling the relations between macroeconomic variables and parameters that characterize the financial environment has recently become an important research topic. One of the biggest challenges faced when dealing with this type of approach is the fact that economic time series exhibit important differences in terms of the frequency of the data. In general, financial variables have high frequencies that can be studied at a daily or intraday level. On the opposite side of the spectrum, core macroeconomic variables like for example the gross domestic product (GDP) have in general quarterly or annual

[1] *Scientific researcher II, Institute for Economic Forecasting, Romanian Academy.*
[2] *Scientific researcher III, Institute for Economic Forecasting, Romanian Academy.*

frequencies. This difference in frequency constitutes an important obstacle that needs to be dealt with in applications that focus on the linkages between financial and macroeconomic variables.

An interesting solution derived from the studies of Ghysels, Santa-Clara and Valkanov (2006), Ghysels, Sinko, and Valkanov (2007) or Andreou et al (2013), is the procedure called Mixed Data Sampling (MIDAS) regression.

The main advantage of the nonlinear *autoregressive distributed lag* (ADL) formulation included in the MIDAS procedure is the fact that it permits the use of regressors that have a much higher frequency than that of the regressand.

Since its genesis, the MIDAS methodology has been used in a wide range of macroeconomic forecasting applications like, Hogrefe (2008), Montefort and Moretti (2010), Kuzin et al (2011).

In addition to this, the mixed data sampling regressions were also used in empirical financial studies, key contributions being issued by: Tay (2007), Chen and Ghysels (2010) or Ghysels and Volkanov (2010).

We contribute to this literature by addressing the interconnections between macroeconomic variables and the dynamics of the financial markets in the case of the Eastern European Markets. Therefore, the purpose of this paper is to provide an analysis of the dependences between the economic growth on one hand and the dynamics of the stock market on the other hand. We search for this type of evidence by using the MIDAS regression methodology, which allows for such types of studies.

The remainder of the paper is organized in the following manner. Section II provides a review of the literature, then we present the data and the methodology, the results found and we conclude with some remarks regarding the observed evidences.

Literature review

As stated above, the study of the correspondence between macroeconomic variables and financial markets has received an important amount of academic attention during the last decades.

The scientific literature has shown that stock prices are influenced in some manner by core macroeconomic variables such as inflation or exchange rate. Chen, Roll and Ross (1986) report a correlation between aspects like output and inflation and the evolution

of financial returns. Other key studies in this direction were carried out by Geske and Roll (1983), Chen (1991), Fama (1900), Poon and Taylor (1991) or Lee (1992).

Mukherjee and Naka (1995) build on the Johansen cointergration methodology and report a close relation between the Japanese financial market and a series of macroeconomic variables such as industrial production inflation, money supply or bond rates. In a similar approach Mayasmai and Koh (2000) add a VECM model and observe that the Singapore stock market exhibits cointegration with macroeconomic phenomena. In another cointegration approach, Maghyereh (2002) finds that the evolution of macroeconomic fundamentals has an impact on the stock prices in the Jordanian capital market.

In an investigation on the connections between stock prices and exchange rates on a data series specific to the G-7 countries, Nieh and Lee (2001) report a lack of long-run relationships between the above mentioned values. However, the author observes the presence of certain short run effects for some countries.

Wongbangpo and Sharma (2002) follow the financial markets of five ASEAN countries (Thailand, Philippines, Indonesia, Singapore and Malaysia) searching for the role of significant macroeconomic variables such as GNP, CPI, exchange rate or money supply. They report long and short term relationships between the macroeconomic elements and stock prices. Panetta (2003) focuses on the macroeconomic constituents that have an impact on the Italian financial markets and finds an unstable relation between the two sets of variables.

Another cointegration based research is found in Humpe and Macmillan (2007) which also consider macroeconomic factors such as industrial output, CPI, long term interest rates and the money supply. Using monthly data for a period of over 40 years for the financial markets of Japan and US they observe a single cointegration vector between the financial variables, the industrial output and the long interest rate.

Abugri (2008) conducts an analysis for four Latin American Countries focusing on indicators like: industrial output, money supply, interest rates and exchange rates. Using a VAR approach, the author finds that both global factors and the global values have a significant effect on the dynamics of all the markets considered.

The linkages between financial and macroeconomic variables are also investigated in more modern studies. In a dynamic factor analysis approach, Ludvigson & Ng (2009) examine the connections between the variation in excess bond yields and macroeconomic fundamentals. They observe that inflation is a key parameter in relation to forecasting excess returns.

Alper and Forni (2011) consider the implications of fiscal and macroeconomic variables on long term yields and a possible spillover effects of advanced economies' debt levels on the yields of other markets. They conclude that domestic debt clearly influences long-term yields. In a similar study, Gruber and Kamin (2012) focus on the influence of fiscal positions, level of debt and fiscal balance on the evolution of long-term bond returns in OECD. Using a panel data methodology, they find a strong and significant effect of fiscal performance on long-term bond returns.

Albu et al (2014 a) and Albu et al (2014 b) investigate the influence of quantitative easing initiatives on a series of nine sovereign CDSs belonging to CEE countries, through an ARMA-GARCH based event studies. The studies report a significant and powerful effect of these monetary policies on the returns of the sovereign CDSs. In another analysis on the Eastern European Countries Albu, Lupu and Calin (2014) use a nonlinear model in order to estimate the correlation between stock market capitalization and GDP per capita.

Data and methodology

Our data consists of two types of series for the following Central and Eastern European countries: Poland, Hungary, Bulgaria, Estonia, Latvia, Slovenia and Romania. On one hand, we are using GDP series with quarterly frequency for the period between the first quarter of 1998 and the second quarter of 2014 and on the other hand we use stock market indices with daily frequency from the 1st of January 1998 until the 1st of May 2014.

The mixed frequencies of the data at hand require the use of a methodology that needs to be relevant for such type of connections. We therefore use the so-called ADL-MIDAS (p_Y^Q, q_X^D), as in the work of **Error! Reference source not found.** (2010). Their specification is the following:

$$Y_{T+1}^{Q} = \mu + \sum_{j=0}^{p_Y^Q - 1} \alpha_{j+1} Y_{t-j}^{Q} + \beta \sum_{j=0}^{q_X^D - 1} \sum_{i=0}^{N_D - 1} w_{i+j*N_D}(\theta^D) X_{N_D - i, t-j} + u_{t+1} \quad (1)$$

where the weighting structure, $w(\theta^D)$, is developed according to the Almon lag polynomial, which has the following formulation:

$$w_j(\theta^D) = w_j(\theta_1, \theta_2) = \frac{exp\theta_1 j + \theta_2 j^2)}{\sum_{j=1}^{m} exp(\theta_1 j + \theta_2 j^2)} \quad (2)$$

We will be able to develop an analysis of the relations existing between the changes in GDP series with quarterly frequency, for the above mentioned countries and the corresponding log-returns of the stock market indices with daily frequency. In our notation the dependent variable (changes in GDP) will be denoted by Y_t^Q (equation 1), while the explanatory variable is denoted by X_t^D (the log-returns for each index).

Results

After an analysis for the whole period, the MIDAS regression results are presented in Table 1 and Table 2.

Table 1. Results of MIDAS regression for the whole period – part 1

	Coefficients	Standard Errors	Tstats	R-squared
Poland	0.956	NaN	NaN	0.361
Hungary	-1.290	0.735	-1.755	0.251
Bulgaria	-1.405	1.447	-0.971	0.045
Estonia	-1.167	0.933	-1.252	0.405
Latvia	2.552	1.579	1.616	0.417
Slovenia	1.288	0.275	4.687	0.676
Romania	-1.028	1.986	-0.517	0.080

Source: Reuters-Datastream and authors' calculations

Table 2. Results of MIDAS regression for the whole period – part 2

	LogLikelihood	Akaike Criterium	Bayesian Criterium
Poland	88.115	-353.531	-342.582
Hungary	75.965	-329.231	-318.283
Bulgaria	30.097	-206.278	-196.241
Estonia	85.831	-320.583	-310.457
Latvia	54.810	-264.217	-253.915
Slovenia	111.040	-305.729	-298.246
Romania	-0.065	-171.495	-160.701

Source: Reuters-Datastream and authors' calculations

We notice the fact that, with the exception of the Slovenian economy, there is very little dependence of the economic growth on the stock market dynamics. Latvia shows also a larger significance of the MIDAS regression coefficients, but there is not a particular significant contribution found for the whole sample in the rest of the cases.

We also ran the MIDAS regression for the sample until the end of 2008 and separately for the period after 2008. Table 3 and 4 show the results for the first period, while Table 5 and 6 show the results for the second sample period.

Table 3 – Results of MIDAS regression for the period 1998-2008 - part 1

	Coefficients	Standard Errors	Tstats	R-squared
Poland	-1.881	1.239	-1.517	0.413
Hungary	-2.809	1.267	-2.217	0.328
Bulgaria	0.675	1.260	0.536	0.013
Estonia	-1.657	0.942	-1.759	0.524
Latvia	2.354	1.799	1.309	0.510
Slovenia	1.737	0.625	2.779	0.713
Romania	-2.959	2.415	-1.225	0.099

Source: Reuters-Datastream and authors' calculations

Table 4 – Results of MIDAS regression for the period 1998-2008 - part 2

	LogLikelihood	Akaike Criterium	Bayesian Criterium
Poland	64.776	-244.419	-235.498
Hungary	54.324	-223.515	-214.594
Bulgaria	22.990	-129.630	-122.148
Estonia	57.080	-200.647	-193.015
Latvia	35.870	-163.904	-155.987
Slovenia	36.290	-93.797	-91.808
Romania	2.145	-113.481	-104.792

Source: Reuters-Datastream and authors' calculations

For the first period of our analysis, we observe similar situation as for the whole sample, with the extrapolation of the negative dependence of stock markets on the macroeconomic growth, which suggests that the stock market had a low weight of the economy for most of the countries in our sample. Slovenian is still the only case with significant coefficients.

Table 5 – Results of MIDAS regression for the period 2009-2014 - part 1

	Coefficients	Standard Errors	Tstats	R-squared
Poland	1.688	1.678	1.006	0.360
Hungary	-2.698	4.375	-0.617	0.217
Bulgaria	-2.741	6.868	-0.399	0.086
Estonia	0.790	0.963	0.820	0.607
Latvia	2.673	4.320	0.619	0.360
Slovenia	0.948	0.256	3.701	0.601
Romania	2.512	4.596	0.547	0.153

Source: Reuters-Datastream and authors' calculations

Table 6 – Results of MIDAS regression for the period 2009-2014 - part 2

	LogLikelihood	Akaike Criterium	Bayesian Criterium
Poland	25.448	-100.492	-95.269
Hungary	24.447	-98.490	-93.267
Bulgaria	8.848	-67.291	-62.068
Estonia	37.951	-125.497	-120.275
Latvia	21.767	-93.129	-87.906
Slovenia	83.311	-216.217	-210.995
Romania	2.495	-54.585	-49.363

Source: Reuters-Datastream and authors' calculations

The period after the crisis shows that the negative coefficients become insignificant, which could be interpreted by the fact that the economic growth has shrunk and the stock markets showed similar dynamics in the crisis period.

Conclusions

In this paper we aimed to determine the possible linkages between the evolution of the GDP and the dynamics of stock market indices for a series of CEE countries.

The results indicate a very weak dependence between economic growth and the movements of the stock market. The only conclusive case observed is that of Slovenia, with Latvia displaying also a greater significance but without a notable effect on the entire sample.

We then divided the data in two separate samples in order to investigate the effects of the economic crisis on the analysis. The results were symmetrical to those previously found, with Slovenia being the only significant case.

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