

Testing Business Cycles Asymmetry in Central and Eastern European Countries

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ABSTRACT

The idea of business cycles asymmetry is not new in economic theory. According to business cycles asymmetry, a country's economy behaves differently during economic growth periods as compared to economic recession periods. The results achieved by business cycles asymmetry testing are far from unanimous: some are positive, others are negative. Business cycles asymmetry has major econometric implications: business cycles cannot be modeled using linear models. This paper aims to test business cycles asymmetry in Central and Eastern European Countries, where few business cycles analyses, and especially business cycles asymmetry researches, have been conducted. The industrial production index was considered when testing business cycles asymmetry. We estimated business cycles using the Hodrick-Prescott filter and Mills' test of asymmetry. Mira's test was also employed to test results reliability. According to our results, business cycles in Central and Eastern European countries are not asymmetric.

Keywords: Business Cycles; Asymmetry; Hodrick-Prescott Filter

1. Introduction

Business cycles research enjoys a cyclical evolution itself. Papers on this topic are published mostly at times of economic recession. The explanation seems simple and it relies on the researchers' intent to forecast future economic recessions likely to have a major negative impact on economy, which in its turn influences the population's standard of living. The empirical characteristics of business cycles are vital in business cycles modeling and forecast. Therefore, special attention is paid to empirical characteristics. The concept of asymmetry as a business cycle characteristic is not new, yet converging results have not been achieved so far. Authors such as Mitchell [1], Keynes [2] Burns and Mitchell [3], and Hicks [4] have mentioned business cycles asymmetry in their economic theory papers.

Business cycles asymmetry roughly means that economy behaves differently during economic growth periods than during economic recession periods. Boldwin [5] argues that asymmetric business cycles only occur in the case where recessions and expansions are not mirror images of each other. Business cycles asymmetry refers, on the one hand, to the fact that decrease due to economic recession is more abrupt than increase during economic growth periods and, on the other hand, to the fact that the minimum value reached at times of economic recession is greater in absolute value than the peak reached during

economic growth. Siechel [6] defines the first type as steepness asymmetry and the second as deepness asymmetry and reckons that they may occur either simultaneously or separately. These types of asymmetry are also called transversal and longitudinal asymmetry [7] or unconditional and conditional asymmetry [8].

Business cycles asymmetry has serious implications on their econometric modeling: Business cycles cannot be described by linear models. Deepness asymmetry enables specialists to capture business cycles using a model involving asymmetric price adjustments (as positive demand shocks have greater relative negative impact on output than positive shocks, which have less impact on output). Steepness asymmetry allows capturing business cycles by an asymmetric costs model, which relies on the assumption that production may decrease very rapidly, yet its increase is much slower.

The outcome of business cycles asymmetry testing is different. Nefci [9], Falk [10] and Mills [11] did not get positive results when testing business cycles asymmetry in industrial production. On the other hand, there are studies supporting the existence of asymmetry in a number of economic series by Ramsey and Rothman [7], Andreano and Savio [12] and Stanca [13].

Speight tests business cycles asymmetry [14] on a sample of 16 OECD countries considering their volume of industrial production, as he thinks that this variable "displays as much cyclical variation as possible", based

on available data. The analyzed period is 1961:1-1994:4 for most countries, except for Spain, Greece and OECD aggregates. It uses Sichel's methodology (1993), as well as Newey's and West's corrections [15] with two parzen windows: T/4 and T/3. Although negative asymmetry is present in very many countries, deepness asymmetry is significant, considering an up to 10% risk, only for Germany, Japan, Sweden and UK. He also achieves significant steepness asymmetry for Japan, Sweden and UK, taking an up to 10% risk.

Business cycles asymmetry has not been tested for Central and Eastern European countries. Therefore, our study is designed to fill this gap. The following countries were included in our business cycles asymmetry analysis: Bulgaria, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia and Slovakia. The analyzed period was 1998.1-2011.3. We used the Hodrick-Prescott filter [16] to estimate business cycles, and the Mills test [17] and Mira test [18] to test asymmetry. The two estimation and testing variants allowed us to check the reliability of the reported results.

The rest of the paper is structured as follows: the second section includes a synthetic presentation of, on the one hand, the methods employed to estimate business cycles and, on the other hand, the methods devoted to business cycles asymmetry testing; the third section describes the data used, whereas the fourth section reveals the reported results. This paper ends with a set of conclusions.

2. Methodology

When testing business cycles asymmetry, the cyclical component should be estimated first and the asymmetry tests should be conducted afterwards. Business cycles estimation relies on the general assumption that an unseasonable variable may be decomposed in three components, namely the trend, cycle and random components. There are several methods applied to exclude the trend component. Nevertheless, none of them has been declared as the best variable trend exclusion method so far. Canova [19] provides a well-structured detailed presentation of these methods. It is important to say that the previous studies proved that the trend determination method may influence the results.

Some of these trend exclusion methods consider the assumption according to which the variable only includes the trend and cycle components:

$$y_t = x_t + c_t$$

where: x_t is the non-stationary trend component and c_t is the cyclical stationary component, which is trend-dependent.

In our paper, we decided to determine the cyclical

component using the Hodrick-Prescott filter.

Even if the Hodrick-Prescott filter was very much criticized by Rand and Tarp [20], it is also the most used in business cycles analysis. Therefore, we will also use it in our study. By means of the Hodrick-Prescott filter, the trend is determined by minimizing the expression:

$$\sum_{t=1}^T c_t^2 + \lambda \sum_{t=2}^T [(g_t - g_{t-1}) - (g_{t-1} - g_{t-2})]^2 \quad (1)$$

where:

$$c_t = \ln y(t) - \ln y^*(t), \quad g_t = \ln y^*(t+1), \quad g_{t-1} = \ln y^*(t), \\ g_{t-2} = \ln y^*(t-1) \quad \text{and} \quad y^* \text{—the long-term trend of the variable } y.$$

The most frequent value used for the parameter λ in the case of quarterly data is 1600.

To test the existence of the cyclical component for a time series we use the Ljung-Box test. The tested hypotheses are the following: the null hypothesis H_0 presupposes that the variable is a white noise and the alternative hypothesis H_1 presupposes that the variable is autocorrelated. The test statistics is calculated according to the relation:

$$Q_k = T(T+2) \sum_{i=1}^k \frac{\hat{\rho}_i^2}{T-i} \quad (2)$$

For asymmetry testing purposes, we will consider the test proposed by Mills [17], which modifies the test proposed by Sichel [6] by a Newey-West adjustment of variance for lack of normality.

The test relies on the following asymmetry coefficient

$$S = \frac{\mu_3}{\mu_2^{3/2}} \quad (3)$$

where μ_j is the moment j of the cyclical component of the series. If the sample is large and the component is normal and independently distributed, the variance of the estimated asymmetry coefficient would be equal to $6/T$. Yet, since these assumptions are not observed, we calculate variance S as follows:

$$\sigma_s = \frac{1}{T} \left(\frac{\mu_6}{\mu_3^3} - 6K + 9 + \frac{S^2}{4} (9K + 35) - \frac{3\mu_5\mu_3}{\mu_2^4} \right) \quad (4)$$

where:

$$K = \frac{\mu_4}{\mu_2^2} \text{ is the kurtosis coefficient (Jaba, 2001),}$$

T is the sample volume.

Mills [17] adjusts the variance as follows

$$\sigma_s^2(l) = \sigma_s^2 \left(1 + \frac{2}{T} \sum_{j=1}^l f_j \rho_j \right) \quad (5)$$

where:

ρ_j is the autocorrelation coefficient j of the variable

$\frac{c_t^3}{\mu_2^{3/2}}$, $f_j = 1 - \frac{j}{l+1}$ calculates the weights and

$$l = 4 \left(\frac{T}{100} \right)^{2/9}$$

The statistical test employed is asymptotically standard normal

$$z_s = \frac{S}{\sigma_s(l)} \tag{6}$$

and it determines whether asymmetry is significantly negative. According to the null hypothesis, business cycles have no deepness asymmetry, whereas according to the alternative hypothesis, business cycles do have deepness asymmetry.

In order to test results reliability, we applied Mira's alternative test [18], which is calculated as follows:

$$z_g = \frac{g}{\sigma_g} \tag{7}$$

where:

$g = \bar{c}_t - c_{med}$, c_{med} is the c_t median

$$\sigma_g = 4\sigma^2 + D^2 - 4D \cdot E$$

$$\sigma^2 = \frac{\sum_{t=1}^T (c_t - \bar{c})^2}{T-1}$$

$$D = T^{1/5} \left(c_{\lceil 1/2(T+T^{4/5}) \rceil} - c_{\lfloor 1/2(T-T^{4/5}+2) \rfloor} \right)$$

$$E = \bar{c} - \frac{2}{T} \sum_{t=1}^T c_t I(c_t \leq c_{med})$$

Just like Mills' test [17], Mira's test [18] tests whether asymmetry is significantly negative. According to the null hypothesis, business cycles have no deepness asymmetry, whereas according to the alternative hypothesis, business cycles do have deepness asymmetry. In order to test steepness asymmetry existence, the first variable difference Δc_t is considered instead of the variable c_t . The first difference enables us to test whether the deep series decreases are more considerable and less common than series increases.

3. Empirical Results

We considered the actual industrial production index to estimate business cycles in Central and Eastern European countries. Industrial production is a poly-cyclical variable and it is one of the most commonly used variables, although there is no evidence supporting its asymmetric character. Asymmetry testing is more recommended in industrial production rather than in GDP, since the latter is a more comprehensive variable, which may have

counter-cyclical components.

The quarterly data were taken from the Eurostat database and the time period considered was dependent on the availability of the data in this database. We found data for the analyzed countries (Bulgaria, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia, Slovakia), whose common registration period was 1998.1-2011.3. We employed X 12 ARIMA for data deseasoning.

To estimate economic cycles, we used the Hodrick-Prescott filter described in the paragraph above.

Tables 1 and 2 show the results of the statistical tests for deepness and steepness asymmetry. The asymmetry indicator is negative for Bulgaria, Czech Republic, Estonia, Latvia, Lithuania, Hungary, Slovenia and Slovakia and positive for Croatia, Poland and Romania. The business cycles of these countries would be characterized by deepness asymmetry if the resulting asymmetry indicators were significantly negative. The results of Mills' [17] and Mira's [18] asymmetry tests do not support this. Therefore, the business cycles of Central and Eastern European countries are not characterized by deepness asymmetry.

In order to test steepness asymmetry, we first calculated the asymmetry indicator, yet, this time, for the first business cycles values difference for each analyzed country. In this case, almost all the countries in the sample have negative asymmetry indicator, with the exception of Croatia and Romania. Mills' [17] and Mira's [18] tests show no evidence of any significant asymmetry, hence they do not support the presence of steepness asymmetry.

Table 1. Tests results for deepness asymmetry.

	$S(c)$	z_s	z_g
Bulgaria	-0.310	-1.373	-0.182
Czech Republic	-0.063	-0.198	0.040
Croatia	0.294	1.579	0.089
Estonia	-0.747	-3.611	-0.039
Latvia	-0.356	-1.492	0.062
Lithuania	-0.447	-1.517	-0.084
Hungary	-0.271	-1.291	-0.034
Poland	0.014	0.069	-0.024
Romania	1.182	1.331	0.060
Slovenia	-0.056	-0.183	0.035
Slovakia	-0.068	-0.176	0.121

Remark: The business cycles were estimated using the Hodrick-Prescott filter of the Eviews 7 software.

Table 2. Tests results for steepness asymmetry.

	$S(\Delta c)$	z_s	z_g
Bulgaria	-0.115	-0.429	-0.111
Czech Republic	-0.514	-1.236	0.011
Croatia	0.450	1.443	0.046
Estonia	-0.724	-1.116	-0.035
Latvia	-0.726	-1.735	-0.114
Lithuania	-0.413	-2.143	-0.106
Hungary	-0.251	-0.658	-0.115
Poland	-0.592	-2.414	-0.019
Romania	0.385	0.264	-0.097
Slovenia	-0.611	-1.633	-0.074
Slovakia	-0.806	-2.434	-0.034

Remark: The business cycles were estimated using the Hodrick-Prescott filter of the Eviews 7 software.

4. Conclusion

The concept of business cycles asymmetry is not new in economic theory. The results of business cycles asymmetry testing are both positive and negative. The asymmetric nature of business cycles has been tested especially in developed countries, where large series of data on macroeconomic indicators are available. The Central and Eastern European countries started to embrace market economy in 1989. Consequently, the macroeconomic indicators series recorded in accordance with the requirements of the European Union are much smaller. This accounts for the relatively small number of papers devoted to business cycles in Central and Eastern European countries. We preferred the industrial production index to test steepness asymmetry and deepness asymmetry. According to the results of Mills' test [17], applied to determine the two types of asymmetry, they are absent in the Central and Eastern European countries. This lack of asymmetry is also supported by the results of Mira's test [18]. Business cycles asymmetry in the Central and Eastern European countries should be reanalyzed in the future, when a larger data sample and further macroeconomic indicators are available.

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