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Testing the cyclical asymmetries in the Romanian macroeconomic data

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Abstract

According to economic theory, economic variables evolve differently on business cycles stages, i.e. they are asymmetric. The results of business cycles asymmetry testing are rather divergent: some support business cycles asymmetry while others contradict it. The existence of a possible business cycles asymmetry has major implications in economic stabilization policies modeling, forecasting and application. There are rather few studies on business cycles stylized facts in Romania and they fail to tackle business cycles asymmetry. Therefore, the purpose of our research is to test the possible business cycles asymmetry in several Romanian macroeconomic variables. We estimated the business cycles of the variables under survey using the Hodrick–Prescott filter, whereas for the tests conducted on the business cycles asymmetry recorded we preferred Sichel’s (1993) methodology. We checked the robustness of the results recorded by business cycles estimation using the Beveridge Nelson decomposition. The results of the business cycles analysis carried out on Romanian macroeconomic variables do not support the existence of any business cycles asymmetry.

Keywords: Business cycles, Hodrick-Prescott filter, Baxter King decomposition, cyclical asymmetry;

1. Introduction

In economic theory, Mitchell (1927), Keynes (1936), Burns and Mitchell (1946) and Hicks (1950) are acknowledged to be the first to indicate the idea of business cycles asymmetry. In a broad sense, business cycles asymmetry means that in periods of economic growth business cycles are not the identical mirror-image of the business cycles in periods of economic recession. Sichel (1993) proposes and tests two notions related to business cycles asymmetry, which may exist either independently or simultaneously: cycle steepness and cycle deepness asymmetry. Cycle steepness asymmetry means that the economic decreasing slopes are steeper than the economic increasing slopes. Cycle deepness appears when troughs in absolute value are higher than the values identified as peaks.

The two types of asymmetry are also known in the literature on the topic as longitudinal and transversal asymmetry (Ramsey and Rothman, 1996), and unconditional and conditional asymmetry (Peiró, 2004).

The existence of asymmetry implies the necessity of embedding in the theoretical patterns of business cycles the asymmetric behavior, the identification of the policies of economic stabilization which should be established
according to the stages of the business cycles and the fact that in order to forecast the future of economy one cannot use the linear economic models which ignore the stages of business cycles.

Likewise, the existence of the two types of asymmetry has a major importance: steepness asymmetry can be determined by the patterns of asymmetric costs (production of industry firms may decrease very quickly, but it may extend less quickly), and deepness asymmetry may be determined by a model with asymmetric adjustment of prices (the negative shocks upon demand will have a bigger effect than the positive shocks upon demand).

Business cycles asymmetry testing is relatively recent and it is due to the search of new empirical characteristics of business cycles because the most used linear modeling is not able to reflect the asymmetric behaviour of business cycle. The results obtained in testing asymmetry are contradictory: Sichel (1993), Ramsey and Rothman (1996), Narayan S. and Narayan P.K. (2007) find evidence of asymmetry in the macro-economic series, while Mills (2001), Peiró (2004), Olekands (2001) do not identify asymmetries in the analyzed variables.


In this paper we want to test the possible asymmetries of business cycles in the macroeconomic data at the level of Romania country. We shall continue to present the methodology, on the one hand in order to test asymmetry, and on the other hand for detrending time series, then we shall present the results obtained and the conclusions.

2. Methods

2.1. Asymmetry tests

In order to test asymmetry we have to go through several stages. The first stage targets the detrending of non-seasonal logarithmized statistic series. We mention that an non-seasonal time series has the following components according to the relation:

$$y_t = \tau_t + c_t + \varepsilon_t$$

where: $y_t$ - values of recorded variable, $\tau_t$ - non-stationary trend component, $c_t$ - stationary cyclical component, $\varepsilon_t$ - random component.

The cyclical $c_t$ component obtained after the detrending time series is tested for the identification of deepness and/or steepness asymmetry. Deepness asymmetry is present when the cyclical component $c_t$ presents a negative asymmetry, i.e. it will have a smaller number of values below the trend than those which are above the trend, and the average of deviations from the trend of the values below the trend exceeds that of the values above the trend.

Therefore, the second stage in testing asymmetry consists in calculating the asymmetry indicator and testing if it is negative and statistically significant. The asymmetry indicator is calculated using the formula:

$$D(c) = \frac{m(c)}{\sigma(c)^3} = \frac{\sum(c_i - \bar{c})^3}{T}$$

where: $\bar{c}$ - cyclical component average, $T$ - the number of recorded values, $m(c) = \sum(c_i - \bar{c})^3 / T$ third degree moment, $\sigma(c)$ - standard deviation for cyclical component.

Since the $c_t$ cyclical component is autocorrelated, Sichel (1993) in order to obtain an asymptotic standard error for $D(c)$, builds a variable $z_t = (c_t - \bar{c})^3 / \sigma(c)^3$ and with her run a regression with a constant, using Newey-West’s (1987) heteroscedasticity and autocorrelation consistent standard error estimates (the intercept obtained through the regression will have a value identical with that of $D(c)$). Thus $D(c)$ obtained is asymptotically normal and allows the use of conventional critical values.
Asymmetry steepness is present when in the cyclical component there are sudden decreases which are deeper and fewer than the increases, which are larger in number but more moderate. This situation implies negative asymmetry in the first difference of the cyclical component. Testing asymmetry steepness is achieved in a similar way to testing deepness asymmetry, but it is applied to the first difference of the cyclical component \( \Delta c \).

\[
S(\Delta c) = m(\Delta c) / \sigma(\Delta c)^3 ,
\]

where: \( \Delta c \) - the average of the first difference of the cyclical component, \( T \) – the number of the first differences of the cyclical component, \( m(\Delta c) = \sum (\Delta c_i - \Delta c) / T \) the third degree moment of the first difference of the cyclical component, \( \sigma(\Delta c) \) - standard deviation for first differences of cyclical component.

2.2. Detrending methods

In order to estimate the cyclical component, the trend of the macro-economic variable must be excluded. Econometric literature has proposed various detrending methods, but none of these methods proved to be the best. All the detrending possibilities of a time series have both upsides and downsides; therefore, choosing one method or another is done according to the research topic. Canova (1998) offers a comparative approach to these methods. Taking into account that we purport to study business cycles asymmetry, the methods chosen for detrending must not induce asymmetry into the cyclical component obtained as a difference between the initial series and the trend. Therefore, as Sichel (1993) also chose, we shall use the Hodrick-Prescott filter in this study because it does not induce asymmetry in the estimated cyclical component. In order to test the robustness of the results we have also used the Beveridge-Nelson decomposition for the detrending time series.

Even if the Hodrick-Prescott filter was very much criticized (Cogley T., Nason J. M., 1995, Harvey A. C., 1997, King R.G., Rebelo S.T., 1993), it is still the most used one in the analysis of business cycles. By means of the Hodrick-Prescott filter the trend is determined by minimizing the expression:

\[
\sum c_i \sum\left(\left(g_{i,1} - g_{i,2}\right) - \left(g_{i,1} - g_{i,2}\right)\right) \]

where: \( c_i \) is \( \ln y(t) \) and \( \ln y(t+1) \), \( g_{i,1} = \ln y(t) \), \( g_{i,2} = \ln y(t+1) \), \( \lambda \) - the long-term trend of the variable \( y \).

The most frequent value used for the parameter \( \lambda \) in the case of the frequency of quarterly data is 1600, and in the case of monthly data the most used value is 14400.

Beveridge and Nelson (1981) identified a possibility of decomposing a non-stationary time series into a trend permanent component and a cyclical component through the use of ARIMA modeling. The Beveridge-Nelson decomposition applies to non-stationary first order integrated series, which can be stationary by first difference. The decomposition leads to a trend component which is not stationary and a cyclical stationary component, the two components being correlated. The trend is considered as a prediction of future values of the series.

The main criticism of this decomposition is determined by the fact that Christiano and Eichenbaum (1990) demonstrated that there might be several ARIMA models which fit the sample autocorrelations of data set fairly well.

Wald’s theorem stipulates that any covariance stationary process has a representation MA (\( \infty \)) which is also consistent with an ARMA (p,q) representation. In order to truncate the infinite sum and thus obtain the trend and the cycle, various methods were proposed by Newbold (1990), Cuddington and Winters (1987), Miller (1988) and Morley (2002). The cyclical component obtained through the Beveridge-Nelson decomposition cannot be obtained with the relation:

\[
c_i = \sum \left[ \hat{z}_i \left( j \right) - \mu \right] + \left( 1 - \phi_1 - \ldots - \phi_p \right) \sum \sum \phi_1 \left( \hat{z}_i \left( q - j + 1 \right) - \mu \right)
\]

in which: \( \hat{z}_i \left( k \right) \) represents \( k \) forthcoming periods for forecasting \( z = \Delta y \) achieved in the \( t \) period, \( \phi_i \) - is the AR coefficient for lag \( j \), \( \mu \) - is the average of the process of \( z_i \).

We shall identify the ARIMA model of each analysed series, taking into account the tiniest values of the Akaike information (AIC) and Schwarz (SIC) obtained from estimating the ARIMA models.
3. Data and empirical analysis

The time series for the economic variables considered in this analysis have been taken from the Eurostat database, with the exception of monetary amount M3, which has been taken from the National Bank of Romania website www.bnr.ro. According to their availability, the variables are recorded monthly, while others are recorded quarterly. The latest value of the monthly variables was recorded in November 2012, and the starting periods differ according to the data availability: January 1996 for the harmonised index of consumer prices (HICP), industry production index (IPI), nominal effective exchange rate index (NR) unemployment (UNM) and real effective exchange rate index (RR), January 1998 for industry employment index (IL) and gross wages and salaries index (WS), January 2000 for volume of work done (hours worked) index (HW), industry new orders index (NO), and January 2007 for the monetary amount M3 (M3).

The quarterly variables recorded over the period 1998.1 – 2011.3 are exports of goods and services (EX), imports of goods and services (IM), gross fixed capital formation at current prices (GFCF), final consumption aggregates, current prices (FCONS).

The series have been deseasonalized with the aid of the ARIMA X12 method. The deseasonalized and logarithmic series have been used for testing. With the aid of the Hodrick-Prescott filter and the Beveridge-Nelson decomposition, we have obtained business cycles. The results of testing the asymmetry of business cycles with the aid of the Eviews statistic program for the analyzed variables are shown in Table 1 and Table 2.

### Table 1. Steepness and deepness (Hodrick Prescott filter)

<table>
<thead>
<tr>
<th>Variable</th>
<th>( D(c) )</th>
<th>Test NW</th>
<th>( p ) value</th>
<th>( S(\Delta c) )</th>
<th>Test NW</th>
<th>( p ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HICP</td>
<td>-0.312238</td>
<td>-0.714237</td>
<td>0.4760</td>
<td>2.168619</td>
<td>1.222753</td>
<td>0.2229</td>
</tr>
<tr>
<td>IPI</td>
<td>-0.076667</td>
<td>-0.195207</td>
<td>0.8454</td>
<td>0.0266693</td>
<td>1.108570</td>
<td>0.2792</td>
</tr>
<tr>
<td>IL</td>
<td>-0.689718</td>
<td>-0.935540</td>
<td>0.3509</td>
<td>-5.118169</td>
<td>0.745046</td>
<td>0.2792</td>
</tr>
<tr>
<td>HW</td>
<td>0.335270</td>
<td>0.851659</td>
<td>0.3958</td>
<td>-0.054104</td>
<td>0.182987</td>
<td>0.8871</td>
</tr>
<tr>
<td>M3</td>
<td>-0.312020</td>
<td>-0.486688</td>
<td>0.6283</td>
<td>0.376562</td>
<td>0.736523</td>
<td>0.4644</td>
</tr>
<tr>
<td>NO</td>
<td>-0.244685</td>
<td>-0.377611</td>
<td>0.7063</td>
<td>-0.706860</td>
<td>-1.108792</td>
<td>0.2436</td>
</tr>
<tr>
<td>WS</td>
<td>0.942688</td>
<td>0.960148</td>
<td>0.3384</td>
<td>-0.229900</td>
<td>-0.199307</td>
<td>0.8423</td>
</tr>
<tr>
<td>NR</td>
<td>-1.428999</td>
<td>-0.860047</td>
<td>0.3909</td>
<td>0.6205209</td>
<td>-1.044642</td>
<td>0.2975</td>
</tr>
<tr>
<td>RR</td>
<td>0.136324</td>
<td>0.207933</td>
<td>0.8355</td>
<td>0.187047</td>
<td>0.182987</td>
<td>0.8871</td>
</tr>
<tr>
<td>UNEM</td>
<td>-0.244685</td>
<td>-0.377611</td>
<td>0.7063</td>
<td>-0.706860</td>
<td>1.108792</td>
<td>0.2436</td>
</tr>
<tr>
<td>FCONS</td>
<td>0.826355</td>
<td>0.971772</td>
<td>0.3355</td>
<td>0.036786</td>
<td>-0.967224</td>
<td>0.3378</td>
</tr>
<tr>
<td>EX</td>
<td>-0.331794</td>
<td>-0.585617</td>
<td>0.5606</td>
<td>-0.266505</td>
<td>-0.420911</td>
<td>0.6755</td>
</tr>
<tr>
<td>GFCF</td>
<td>1.208923</td>
<td>0.913657</td>
<td>0.3650</td>
<td>-0.321952</td>
<td>-0.910261</td>
<td>0.3668</td>
</tr>
<tr>
<td>IM</td>
<td>0.672155</td>
<td>0.643853</td>
<td>0.5224</td>
<td>-0.548426</td>
<td>-0.720802</td>
<td>0.4742</td>
</tr>
</tbody>
</table>

Although most of the asymmetry indicators calculated are negative both for the business cycles and for the first difference, they are not statistically significant. The results obtained confirm that the macroeconomic variable business cycles in Romania are not characterized by steepness and deepness asymmetry. In order to check the robustness of the results obtained, we used the Beveridge-Nelson decomposition for the variable detrending. The results obtained, which are shown in Table 2 confirm the results obtained previously by using the HP filter.

### Table 2. Steepness and deepness (Beveridge-Nelson decomposition)

<table>
<thead>
<tr>
<th>Variable</th>
<th>( D(c) )</th>
<th>Test NW</th>
<th>( p ) value</th>
<th>( S(\Delta c) )</th>
<th>Test NW</th>
<th>( p ) value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HICP</td>
<td>2.507300</td>
<td>1.365523</td>
<td>0.1737</td>
<td>-0.394895</td>
<td>-0.596726</td>
<td>0.5514</td>
</tr>
<tr>
<td>IPI</td>
<td>-0.065738</td>
<td>-0.384379</td>
<td>0.7011</td>
<td>-0.057796</td>
<td>-0.592978</td>
<td>0.5539</td>
</tr>
<tr>
<td>IL</td>
<td>2.840705</td>
<td>1.457221</td>
<td>0.1471</td>
<td>-0.172809</td>
<td>-0.248418</td>
<td>0.8041</td>
</tr>
<tr>
<td>HW</td>
<td>0.002021</td>
<td>0.006946</td>
<td>0.9945</td>
<td>-0.081921</td>
<td>-0.530406</td>
<td>0.5967</td>
</tr>
<tr>
<td>M3</td>
<td>0.285858</td>
<td>0.556764</td>
<td>0.5799</td>
<td>0.026488</td>
<td>0.214297</td>
<td>0.8311</td>
</tr>
<tr>
<td>NO</td>
<td>-1.357605</td>
<td>-0.999934</td>
<td>0.3190</td>
<td>0.018622</td>
<td>0.032049</td>
<td>0.9745</td>
</tr>
<tr>
<td>WS</td>
<td>-0.187910</td>
<td>-0.328029</td>
<td>0.7433</td>
<td>-0.770725</td>
<td>-1.099189</td>
<td>0.2733</td>
</tr>
<tr>
<td>NR</td>
<td>-0.379228</td>
<td>-1.001804</td>
<td>0.3178</td>
<td>1.074419</td>
<td>0.460899</td>
<td>0.6454</td>
</tr>
<tr>
<td>RR</td>
<td>-0.534183</td>
<td>-0.564454</td>
<td>0.5731</td>
<td>0.038438</td>
<td>0.085354</td>
<td>0.9321</td>
</tr>
<tr>
<td>UNEM</td>
<td>0.382198</td>
<td>0.667424</td>
<td>0.5075</td>
<td>-0.479396</td>
<td>-0.802483</td>
<td>0.4260</td>
</tr>
<tr>
<td>FCONS</td>
<td>-0.104415</td>
<td>-0.213042</td>
<td>0.8322</td>
<td>0.068340</td>
<td>0.193694</td>
<td>0.8473</td>
</tr>
</tbody>
</table>
4. Conclusions

The existence of business cycles asymmetry of macroeconomic variables has implications in business cycles modeling, in identifying the policies of stabilizing the economy, and in economic forecast. The results of testing the cyclical asymmetry of the macroeconomic data in Romania show that they do not support the existence of any business cycles asymmetry.

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References