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MEASURING THE BUSINESS CYCLE IN BULGARIA[2]

The aim of this paper is to estimate the phases of the business cycle in Bulgaria and its degree of synchronisation with the business cycle in the euro area. Applying a structural unobserved components model, consisting of an IS curve, Phillips curve, Okun's law and a monetary policy response function, consistent with the functioning currency board arrangement in Bulgaria, we find that in the period 1999-2004 the Bulgarian economy was operating below its optimal production capacity. The peak of the economic cycle was reached in the middle of 2008, followed by a period of a decline, corresponding to the period of the global financial and economic crisis and a second downturn corresponding to the period of the European debt crisis. Since mid-2016, the Bulgarian economy has operated above potential and this phase continues up to Q3 2019. Another conclusion of our study is that the business cycle in Bulgaria is to a large extent synchronised with the business cycle in the euro area, with the degree of synchronisation increasing after the accession of Bulgaria to the European Union.
JEL: E32; C13

Introduction

The aim of this study is to estimate the phases of the business cycle in Bulgaria, defined as the percentage deviation of real GDP from its potential, and the degree of synchronisation between the business cycles in Bulgaria and in the euro area. The knowledge of the phase of the cycle in which the economy is at any point in time is essential for taking timely macroeconomic policy measures that can help limit the accumulation of risks during the upside phase of the cycle and thus mitigate the effects of the accumulated risks during the recession. As business cycles are virtually an unobservable phenomenon, the assessment of whether an economy is overheating or operating below its potential level is made on the basis of observing and analysing a set of macroeconomic indicators such as GDP, inflation, unemployment, housing prices, stock prices, credit growth etc. The upward phase of the business cycle is usually characterised by a favourable macroeconomic environment and positive expectations of economic agents, rising asset prices, increasing household income and corporate profits, widening trade deficits, accelerating growth of credit and excessive risk-taking by banks through lending to not particularly creditworthy borrowers at relatively

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low-interest rates. An unexpected shock to economic activity or the natural end of an economic expansion leads to the materialisation of the risks accumulated during the upside phase of the cycle and, accordingly, to opposite developments during the downward phase. In this regard, the study of the phases of the economic cycle is of particular interest in the academic and empirical literature. A variety of models are used to measure cyclical fluctuations in the economy, ranging from univariate frequency filters to complex general equilibrium models, based on the extraction of deep structural parameters by optimising the behavioural functions of a set of economic agents.

A structural unobserved components model is used to estimate the phases of the business cycle in Bulgaria, including an aggregate demand curve, a Phillips curve, an Okun's law and a monetary policy response function, consistent with the functioning of a currency board arrangement in Bulgaria. The model is estimated using the maximum likelihood method, while the unobservable cyclical and trend components of the set of observable variables are extracted using the Kalman filter.

The results of the study show that in the period 1999-2004 the Bulgarian economy operated below its optimal production capacity, the peak of the economic cycle was reached at the end of 2008, followed by a period of a decline corresponding to the period of the global financial and economic crisis and a second downturn corresponding to the period of the European debt crisis. Since mid-2016, the Bulgarian economy has operated above potential and this phase continues up to the third quarter of 2019. Another conclusion of our study is that the business cycle in Bulgaria is to a large extent synchronised with the business cycle in the euro area, with the degree of synchronisation between the two cycles increasing after the accession of Bulgaria to the European Union.

1. The Business Cycle and Theoretical Foundations

Economic expansions and recessions are inherent to economic systems. The study of the drivers of the cyclical deviations of the real economic activity from the long-term trend, the turning points, the amplitude and frequency of these cyclical deviations underlies the study of the business cycle. One of the first scientific papers devoted to the empirical study of the business cycle are the works of Mitchell (1927) and Burns and Mitchell (1946), who formalised the idea that the market economy functions in successive periods of growth and decline the following way:

"Business cycles are a type of fluctuation or instability in the aggregate economic activity of nations: the cycle consists of expansions occurring at about the same time in many fields of economic activity, followed by recessions, contractions and revival, which merge with the phase of expansion of the next cycle; this sequence of changes is repetitive but not periodic; the duration of business cycles ranges from more than one year to ten or twelve years."

In general, the business cycle can be defined as a deviation of real GDP from its long-term trend. The basis for the theory of long-term economic growth is the Cobb-Douglas production function, which links the production in an economy to the factors of production – physical capital (K) and human labour (L):

$$Y = K^{\alpha}L^{1-\alpha}, \quad 0 < \alpha < 1$$

Where α is the elasticity of production to invested capital and 1-α is the elasticity of production to human labour. The main features of the Cobb-Douglas production function are decreasing marginal productivity of the factors of production and constant returns to scale. Keeping the labour input in production unchanged, each additional unit of capital leads to an increase in production, but at a declining rate. This property of decreasing marginal productivity of capital can be deduced by the first derivative of Y with respect to K. Similarly, keeping the capital invested in production unchanged, each additional unit of labour leads to an increase in production, but at a declining rate. This property of decreasing marginal productivity of labour can be deduced by the first derivative of Y with respect to L. Constant returns to scale means that if labour and capital invested increase at the same time by a certain percentage t, then production will increase by the same percentage.

The Solow's long-term growth model (1957) adds an additional variable in the production function, namely the technological progress (A):

$$Y = AK^{\alpha}L^{1-\alpha}$$

As A grows, Y also increases, even when production factors remain unchanged, which is why A is called total factor productivity. According to Solow, the total factor productivity is exogenously set and is increasing at a constant rate. It is the part of economic growth, that cannot be explained by changes in the invested human or physical capital. A change in the resources used (factors of production) leads to a movement along the production function itself, and only technological progress can cause its shift, i.e. increase in long-term growth. A widely held view in the earlier academic literature by Solow's followers is that changes in long-term growth are due almost entirely to changes in technology (e.g. Cass, 1965; Koopmans, 1965).

One of the major criticisms of the Solow model is the assumption of exogenous technological change. Romer (1989) eases this assumption by arguing that technological change is at the heart of long-term economic growth, but that it is the result of deliberate actions by economic agents in response to market incentives. In other words, technological change is due to the investment decisions of agents who aim to maximise their profits, and in this sense, they are an endogenous factor that affects long-term growth. In another study, Romer (1986) also alleviates the assumption of constant returns to scale and diminishing returns on factors of production. According to him, the return on production factors is increasing, and long-term growth rates can accelerate over time and be differentiated across countries.

In practice, the Solow model fails to explain why there are differences in living standards across countries. According to the model's assumptions, in the short term, each country is moving towards its sustainable level of growth, with the speed of reaching that sustainable level dependent on the initially accumulated human and physical capital. Thus, due to the assumption of diminishing returns on production factors, in the absence of shocks, less developed countries will grow at a faster rate due to the low initial level of accumulated capital and the correspondingly higher return on capital. This is valid until these countries reach a sustainable level of growth. In turn, long-term growth is only affected by changes in technology. Since, according to the model's assumptions, technological progress is exogenously set, in the long run, all countries should have a similar level of technological progress and, accordingly, converge to the same level of sustainable growth. However, the convergence hypothesis is not empirically confirmed.

Many countries are trapped in poverty and economic recession. The reason for the lack of convergence lies in the different production functions in different countries, as a result of which they reach different steady states. The idea that convergence occurs but depends on the specific characteristics of each country is known in the literature as the conditional convergence hypothesis.

The unexplained part of economic growth, also referred to as the Solow residual, is applied in the classical theory of real business cycles as a measure of productivity growth. Kydland and Prescott (1982), who are one of the founders of the theory of real business cycles, find that fluctuations in the Solow residual explain more than half of the fluctuations in real GDP, leading them to conclude that a business cycle theory can be built in which technology takes a central place. According to this theory, economic agents (households and companies) have rational expectations and maximise the expected utility of using labour and capital, subject to budgetary and technological constraints. The classical theory of real business cycles is based on the assumption that in the background of perfect competition, the real wages and the rental price of capital, which represent the cost of using the two factors of production – labour and capital, immediately respond to technology shocks. Thus, unexpected changes in technology are seen as supply shocks that cause a shift in the production function, which ultimately determines the supply function in the economy. Supporters of this theory claim that most changes in actual production are permanent, not a temporary deviation from the long-run equilibrium due to shocks.

The classical real business cycle models cannot fully explain the cyclical fluctuations in the real economy, since they proceed from the assumption that changes in growth are driven by exogenously set technological changes and monetary policy and interest rate movements do not affect real economic activity.

The new Keynesian theory, unlike the classical theory of real business cycles, proceeds from the assumption that prices do not immediately respond to unexpected shocks, but are determined by firms operating under monopolistic competition. Like the classical school, the new Keynesian approach assumes that economic agents have rational expectations, but it differs in assuming perfect competition. According to the supporters of the new Keynesian school, there is imperfect competition in pricing and wages, which explains why they do not immediately adjust to changes in economic conditions. The lack of flexible prices suggests that the economy may not be able to reach full employment. In this regard, new Keynesians argue that macroeconomic stabilisation by the government (using fiscal policy) and by the central bank (using monetary policy) can produce a more effective macroeconomic outcome than the policy of non-intervention.

The new Keynesian dynamic stochastic general equilibrium models (DSGE) are an extended version of the classical general equilibrium models based on the theory of real business cycles (RBC) (Plosser, 2012). The approach taken in the new Keynesian DSGE models is to include both real and nominal frictions within the RBC models. In this way, real economic activity can respond to changes in monetary policy, at least in short to medium term. A common friction in DSGE models is that in the presence of shocks, firms and households have to wait a fixed period of time before they can recover their prices and wages in a way that is optimal for the future. The interaction between nominal and real frictions enables the transmission of monetary policy to the real economy. Under the new Keynesian DSGE models, monetary policy is represented by an interest rate or Taylor-type rule that monetary policymakers are committed to follow. This element of the new Keynesian DSGE models obliges the central bank to increase the interest rate when inflation rises above the target set by the central bank.

Achieving macroeconomic stabilisation by pursuing a countercyclical monetary or fiscal policy depends to a large extent on the exchange rate regime in a country, a fixed or floating exchange rate regime.

In a fixed exchange rate environment, the central bank cannot pursue an independent monetary policy and target inflation and the price level in the economy is determined by international prices. Therefore, under a fixed exchange rate regime, monetary policy is ineffective in achieving macroeconomic stabilisation. At the same time, in the event of shocks, an expansionary fiscal policy can shift the aggregate demand curve and help stabilise the economy more quickly in the short term.

In a floating exchange rate environment, expansionary fiscal policy does not change aggregate demand, as the exchange rate offsets the shift in the IS curve (which describes the equilibrium in the market for goods and services) and affects the competitiveness of the economy. As a result, aggregate demand remains unchanged. At the same time, with a floating exchange rate, an expansionary monetary policy can lead to an increase in production and employment in the short term.

Despite the differences in the views of different theories of economic growth, there are several basic understandings that are shared by all. Two are that the existence of shocks in the economy causes deviations from the long-run equilibrium in the short term due to price and wage stickiness, but in the long run, the economy returns to its equilibrium level.

2. Approaches for Measuring Cyclical Fluctuations in the Real Economy

Different approaches are used in the academic literature to study and evaluate the cyclical fluctuations in economic activity. In general, they can be classified as follows:

1) *Methods, based on the use of a production function approach.* Within these methods, potential GDP is estimated using a Cobb-Douglas-type production function and is determined by three factors of production: labour, capital and total factor productivity (Solow, 1956; Solow, 1957; Cass, 1965; Koopmans, 1965; Romer, 1986; Barro, 1989; Romer, 1989; Lucas, 1990; King, Rebello, 1990; Mankiw, Romer, Weil, 1992; McCallum, 1996; Lee, Pesaran, Smith, 1997; Hansen, Prescott, 2002). Accordingly, the estimate of the business cycle represents the deviation of real GDP from its potential.

   The methods based on the use of a production function approach are mainly used to evaluate potential growth and to analyse the economy in the long run and rarely to estimate cyclical fluctuations, i.e. the deviations from the long-run equilibrium.

2) *Vector Autoregressive Models (VAR Models).* Within these models, potential GDP growth and the deviation from it are represented by a linear combination of a set of observable variables. VAR models represent an extended version of univariate autoregressive models, allowing dependent variables to be represented as a linear combination of their own lagged values, lags of a set of explanatory variables, and an error term. The results of this type of models are presented in the form of impulse responses of the dependent variables to shocks in the economy, as well as in the form of variance decomposition. The variance decomposition makes it possible to evaluate the impact of different shocks on the fluctuations in the dependent variables. These types of models are less commonly used in the empirical literature to estimate business cycles (Rotemberg, Woodford, 1996; Claus, 1999; Chari, Kehoe, McGrattan, 2008; Cavallo, Ribba, 2015).
3) *Methods, based on the use of univariate frequency filters (HP filter, band-pass filter).* The most commonly used statistical filter to derive an estimate of the trend and cycle of real GDP is the Hodrick and Prescott filter (HP filter) (Hodrick, Prescott, 1997). Although it suffers from some drawbacks, most notably the likelihood that the estimate does not reflect real economic developments at the beginning and end of the observed period, it serves as a good starting point for gaining an initial idea of cycle and trend information contained in the data (Baxter, King, 1995; Stock, Watson, 1998).

   When using univariate filters, trend and cycle information is only extracted from the real GDP series. In this framework, the only consideration to be made is how smooth the trend should be, in other words, whether the trend is to follow the data actually observed or to allow for larger cyclical deviations. When using the HP filter, this estimate is made by setting a specific value to the smoothing parameter λ. The assessment of the degree of smoothing of the trend is directly related to the question of the nature of economic shocks. For example, if the shocks in the economy are predominantly demand-side while supply conditions are unaffected, then it can be expected that potential GDP does not follow the data actually observed and in this case, it is appropriate to use a high value of the smoothing parameter. Conversely, if the economy is primarily affected by supply shocks, the value of the smoothing parameter should be relatively low because it can be expected that the potential product moves close to the real trends observed in real economic activity. This example illustrates the importance of the smoothing parameter whose mechanical imposition can distort estimates of both the potential product and the business cycle.

   The HP filter extracts from the time series the trend information in the series. Using this filter, the cyclical component is obtained as a residual by subtracting the trend from the observed series. As a result, the cyclical component not only contains information about the actual cycle, but also includes noise (the error), and for this reason, in many cases, the cyclical components extracted with the HP filter are characterised by considerable volatility. Unlike the HP filter, the band-pass filter directly extracts from the time series information about the cyclical component by setting a predetermined range for the cycle length, and therefore the extracted cyclical component is noise-free.

4) *Structural unobserved components models and general equilibrium models.* Within the structural unobserved components models, a system of equations is defined that

characterise the cyclical and trend components of a set of observable variables (most often GDP, inflation and unemployment). The estimation of these models is based on the use of the maximum likelihood method or Bayesian methods, and the dynamics of the unobservable variables are extracted using the Kalman filter (Kalman, 1960; Laxton, Tetlow, 1992; Kuttner, 1994; Coe, McDermott, 1996; Conway, Hunt, 1997; Laubach, Williams, 2003; Benes, N'Diaye, 2004; Benes et al., 2010; Blagrave et al., 2015; Melolinna, Tóth, 2016). The equations within the structural models with unobservable components often resemble a logarithmically linearised version of micro-based model equations. Micro-based models, in turn, are based on extracting deep structural parameters obtained by optimising the behavioural functions of a set of economic agents (households, companies, banks, central bank, government, etc.)[3] (Dixit, Stiglitz, 1977; Singleton, 1988; King, Plosser, Rebelo, 1988; Christiano, Eichenbaum, 1992; Evans, 1992; Cogley, Nason, 1995; Greenwood, Hercowitz, Krusell, 2000; King, Rebelo, 2000; Gali, Lopez-Salido, Valles, 2003; Christiano, Eichenbaum, Evans, 2005; Andrle et al., 2009; Araújo, 2015; Guo, Sirbu, Weder, 2015).

The simplest dynamic stochastic general equilibrium (DSGE) models consist of three blocks: aggregate demand, aggregate supply and a Taylor-type rule. Formally, the equations that define these blocks are micro-oriented and based on a set of assumptions about the behaviour of economic agents. Within these models, households typically maximise the expected utility of consuming goods and services, seeking to maximise utility with as little labour input as possible. Accordingly, companies maximise the expected profit from the production of goods and the provision of services. Dynamic stochastic models of general equilibrium rely largely on theoretical assumptions and are based on the idea that the economy is populated by identical economic agents, with the result that one household or one firm is representative of everyone else.

The use of structural unobserved components models is a validated and tested approach to assess and measure cyclical fluctuations in the real economy. They combine the benefits of using filters to extract information about the trend and cycle of the observed variables, while allowing the existing theoretical dependencies and structural relationships in the economy to be taken into account.

3. Assessment of the Business Cycle in Bulgaria Using a Structural Unobserved Components Model

In order to estimate the business cycle in Bulgaria, a structural unobserved components model is applied, based on the use of the maximum likelihood and a Kalman filter to decompose a set of observable variables into the trend and cyclical component. Unlike univariate frequency filters, the multivariate approach allows to derive a business cycle measure whose assessment includes information on the relationship between the trend and cycle components of all series within the model. Thus, the assessment of the business cycle is based on solving

[3] For a more detailed review of the most commonly used methods for estimating the business cycle see Andrle (2013), Ganev (2015).

a system of equations characterising the individual trend and cyclical components of a set of variables and taking into account the relationship between them. The equations within the structural unobserved components models often resemble a logarithmically linearised version of micro-based equations (DSGE), except that the coefficients in the equations are not based on "deep parameters" obtained through optimisation, but are calibrated or estimated using the maximum likelihood method or Bayesian methods. The long-run equilibrium in this type of models converges to an exogenously set steady-state, and the cyclical components represent deviations of the observed variables from the long-run equilibrium.

The model used for the estimation of the business cycle in Bulgaria is similar to the structural unobserved components models (also known as gap models) used in other papers[4] and consists of four main blocks: aggregate demand (IS curve), aggregate supply and price-setting (New Keynesian Phillips curve), monetary policy response function and Okun's law. The main difference is that due to the functioning currency board in Bulgaria, the monetary policy response function is reduced to reflect only changes in euro area interest rates and a certain risk premium.

Aggregate demand – IS curve

$$\hat{y}_t = b_1\hat{y}_{t-1} - b_2 mci_t + b_3\hat{y}_t^* + \varepsilon_t^y \quad (1)$$

$\hat{y}$ – output gap

mci – monetary conditions index

$\hat{y}^*$ – output gap in the euro area

Within the model, the business cycle (the deviation from potential GDP) is represented as a function of the output gap in the previous period, of a monetary conditions index and of the output gap in the euro area. The reason for choosing the euro-area output gap instead of the output gap in the EU as a whole is related to the striving of Bulgaria towards nominal and real convergence towards the euro area. Being already a part of the EU, it is more appropriate to compare the business cycle in Bulgaria with that in the euro area, to which Bulgaria is seeking to join. Moreover, as of the end of 2019, nearly 70% of Bulgaria's trade with the EU is trade with euro area member states, which is why it should be sufficiently representative for the trade with the EU.

The monetary conditions index is a combination of the cyclical component of the real interest rate (the deviation of the real interest rate from its long-term trend) and the cyclical component of the real exchange rate (the deviation of the real exchange rate from its long-term trend)

$$mci_t = b_4\left(\hat{r}_t + cr\_prem_t\right) + (1-b_4)(-\hat{z}_t) \quad (2)$$

mci – monetary conditions index

[4] See for example Melolinna and Tóth (2016), CNB (2003), Gavura and Reľovský (2005), Bokan and Ravnik (2018).

$\hat{r}$ – real interest rate gap

cr_prem – risk premium

$\hat{z}$ – real exchange rate gap

where the real interest rate is defined as the difference between the nominal interest rate and the expected inflation,

$$r_t = i_t - E_t\{\pi_{t+1}\} \tag{2.1}$$

r – real interest rate

i – nominal interest rate

E{π} – inflation expectations

while the real exchange rate takes into account the relationship between the nominal exchange rate, the country's price level and the euro area price level.

$$z_t = s_t + p_t^* - p_t \tag{2.2}$$

z – real exchange rate

s – nominal exchange rate

p – domestic price level

p^*– euro area price level

A positive deviation of the real interest rate from its long-term trend is equivalent to tightening monetary conditions, which has a negative impact on aggregate demand. At the same time, a positive deviation of the real exchange rate (interpreted as a depreciation of the local currency) from its long-term trend is equivalent to a relaxation of monetary conditions, since the real depreciation of the currency makes local goods and services more competitive, thus stimulating exports and thus having a positive impact on economic growth.

The aggregate demand equation in the structural unobserved components model represents a logarithmically linearised version of the Euler equation obtained from the optimisation of household consumption in micro-based models with added elements (external demand). The monetary conditions index, in turn, accounts for two of the most important transmission channels - through interest rates and through the real exchange rate. The real interest rate influences the attitudes of economic agents to replace consumption today with consumption in the future, as well as their investment decisions. At the same time, the real exchange rate influences the attitudes of economic agents for the consumption of domestic or foreign goods. Demand in the euro area, in turn, affects exports of goods and services, and thus economic activity in the country.

Aggregate supply and price-setting – New Keynesian Phillips curve

The use of a new Keynesian type of the Phillips curve is a standard approach in the academic literature to represent the price setting and, thus, the supply side of the economy. In this set up the Phillips curve is augmented with one quarter ahead inflation expectations. Expected inflation is defined in the model as a weighted combination of a backward-looking component (the one-quarter lag of the four-quarter rate of change of the overall CPI) and a forward-looking component (the predicted value of overall CPI inflation over the next quarter). Due to the importance of price stickiness an additional element of lagged inflation is included in the Phillips curve. Real activity i.e. output gap enters the Phillips curve via overall real marginal cost.

$$\pi_t = a_1 \pi_{t-1} + (1-a_1) E\{\pi_{t+1}\} + a_2 rmc_t + \varepsilon_t^{\pi} \quad (3)$$

π - domestic inflation

E{π} – inflation expectations

rmc – real marginal cost

The real marginal cost is presented as a function of the output gap and the real exchange rate gap.

$$rmc_t = a_3 \hat{y}_t + (1-a_3) \hat{z}_t \quad (4)$$

rmc – real marginal cost

ŷ – output gap

ẑ – real exchange rate gap

The inflation equation is a logarithmically linearised version of the Phillips curve with incorporated expectations resulting from the maximisation of firms' profits under the assumption of monopoly competition and price stickiness.

The domestic output gap is used as an approximation of the marginal cost of production of local producers, since increasing demand is a prerequisite for local firms to increase the use of spare production capacity, which leads to an increase in production costs (due to additional hours worked subject to additional payment, depreciation of equipment, etc.) and higher costs are partly carried over into final prices. At the same time, the real exchange rate gap approximates the marginal costs of importers of goods and services. An appreciation of the exchange rate, resulting in a positive deviation from the equilibrium level, leads to an increase in marginal costs for importers, which, in order to recover their profit margins, carry some of the higher costs into final consumer prices.

The general consumer price index is decomposed into three subcomponents: core inflation (π^{core}), food prices (π^{food}), and energy product prices (π^{energy}), with equations for the three subcomponents being similar to that for total inflation. After the decomposition, the overall CPI inflation is estimated as a weighted average of the three subcomponents. The reason for having a more detailed price block is to be able to distinguish between different price pressures and when estimating the output gap to give more weight on the price component that is of greater importance.

$$\pi_t^{core} = a_1 \pi_{t-1}^{core} + (1-a_1) E_t \pi_{t+1}^{core} + a_2 rmc_t + \varepsilon_t^{core} \quad (3.1)$$

$$\pi_t^{food} = a_{21}\pi_{t-1}^{food} + (1-a_{21})E_t\pi_{t+1}^{food} + a_{22}rmc_t^{food} + \varepsilon_t^{food} \tag{3.2}$$

$$\pi_t^{energy} = a_{31}\pi_{t-1}^{energy} + (1-a_{31})E_t\pi_{t+1} + a_{32}rmc_t^{energy} + \varepsilon_t^{energy} \tag{3.3}$$

$$rmc_t = a_3\hat{y}_t + (1-a_3)\hat{z}_t^{core} \tag{4.1}$$

$$rmc_t^{food} = a_{23}\hat{z}_t^{food} + (1-a_{23})\hat{y}_t \tag{4.2}$$

$$rmc_t^{energy} = \widehat{rwoil}_t + \hat{z}_t^{energy} \tag{4.3}$$

Monetary policy response function

Due to the operating in Bulgaria regime of a fixed exchange rate of the Bulgarian lev to the euro, the Bulgarian National Bank is not able to conduct an independent monetary policy and to set the level of the short-term interest rate. In a currency board arrangement, the monetary policy transmission mechanism reflects the effects of ECB monetary policy on the local market. Thus, interest rates on the interbank money market in Bulgaria reflect the dynamics of euro area money market interest rates. Due to the low volume of transactions on the interbank money market in Bulgaria, the transmission from interest rates on the interbank market to interest rates on deposits and loans is relatively weak. One of the characteristics of the Bulgarian banking system is related to the fact that most of the banks are financed mainly through deposits from residents. For this reason, interest rates on deposits depend to a large extent on the availability of sufficient liquidity in the banking system and the need of credit institutions to attract funds from residents. On their part, interest rates on loans in Bulgaria reflect in addition to the dynamics of interest rates in the euro area (as a large part of the interest rates on loans, especially those in euro, are tied to EURIBOR), the cost of financing and a specific risk premium. The size of the risk premium is determined by various factors such as the amount of attracted funds in the banking system and the availability of sufficient liquidity, the general state of the macroeconomic environment, fiscal sustainability indicators and other macro indicators that influence investors' perceptions of the degree of risk in the economy.

In order to take into account the specific characteristics of the Bulgarian economy, the interest rate policy of the central bank is reduced to the following relationship:

$$i_t = E_t\Delta s_{t+1} + i_t^* + prem_t + \varepsilon_t^i \tag{5}$$

i – domestic nominal interest rate

i^*– euro area nominal interest rate

prem – risk premium

This relationship reflects the fact that the central bank does not pursue an independent monetary policy and does not determine the level of the short-term interest rate. Interest rates in Bulgaria are influenced by the level and dynamics of euro area interest rates and the risk premium. Due to the currency board arrangement, the change in the nominal exchange rate in period t + 1 relative to period t equals zero $(E_t \Delta s_{t+1}=0)$.

Theoretically, the interest rate equation follows from the uncovered interest rate parity (UIP) condition, which is a non-arbitrage condition. According to this condition, the spread between the nominal interest rates in the two countries should be equal to the expected change in the nominal exchange rate between the two countries. The condition for uncovered interest parity implies the existence of perfect capital mobility and is based on the assumption that the rate of return on a foreign currency interest rate investment must be equal to the return on the same amount of the national currency investment despite the difference in nominal interest rates.

$$s_t - E_t\{s_{t+1}\} = i_t^* - i_t \tag{5.1}$$

s – nominal exchange rate

E{s} – exchange rate expectations

i – domestic nominal interest rate

i^*– euro area nominal interest rate

If domestic and foreign assets are perfect substitutes, investors would respond to the differentiated interest rate by moving funds from local to foreign currency and vice versa, which would result in a reconciliation of the return on both investments. In practice, the condition for uncovered interest rate parity is not valid due to the presence of different degrees of risk across economies, as a result of which investors require a certain risk premium.

$$s_t - E_t\{s_{t+1}\} = i_t^* - i_t + prem_t. \tag{5.2}$$

Okun's Law

The Okun's law takes into account the relationship between the output gap and the unemployment gap. The inclusion of this relationship in the model can be justified by the fact that the period after the financial crisis of 1996-1997 and the introduction of the currency board in Bulgaria was characterised by both high inflation and very high unemployment, which had a negative impact on potential output.

$$\hat{u}_t = c_1 \hat{u}_{t-1} - c_2 \hat{y}_{t-1} + \varepsilon^{\hat{u}}_t \tag{6}$$

û - unemployment gap

ŷ – output gap

The structural unobserved components model is based on the assumption that in the long run, all deviations from the long-run equilibrium are closed, inflation is close to target inflation (in the case of Bulgaria, close to long-term inflation), interest rates are at neutral levels, and the level of the unemployment rate is close to its natural level.

$$\hat{y} = 0, \hat{r} = 0, \hat{z} = 0, \hat{y}^* = 0, \hat{u} = 0 \quad (7)$$

$$\pi = \pi^T \quad (8)$$

$$\pi^* = \overline{\pi}^* \quad (9)$$

$$\bar{i} = \bar{r} + \pi^T \quad (10)$$

$$\bar{i}^* = \bar{r}^* + \overline{\pi}^* \quad (11)$$

$$\bar{u} = \text{NAIRU} \quad (12)$$

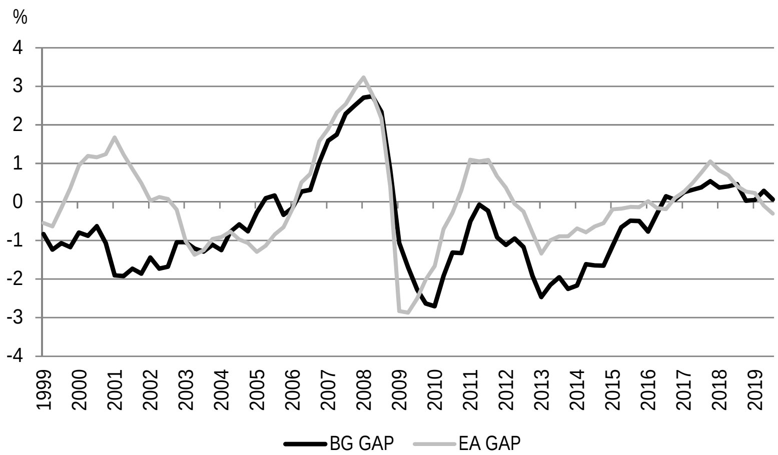
π^T – long-term inflation

NAIRU – natural rate of unemployment

The presented structural unobserved components model is estimated with data from the first quarter of 1999 to the third quarter of 2019. The data used for Bulgaria include seasonally adjusted real GDP (at 2015 prices), nominal exchange rate and nominal interest rates on loans, the harmonised index of consumer prices, data on core inflation, food and energy inflation, as well as data on the unemployment rate (NSI). Data for the euro area include real seasonally adjusted GDP, the harmonised index of consumer prices, the 3-month Euribor and the price of oil in USD (ECB, Eurostat). The estimated business cycles in Bulgaria and in the euro area are presented on Figure 1.

Figure 1

Business cycles in Bulgaria (BG GAP) and in the euro area (EA GAP)



According to the results of the assessment of the business cycle, several periods in the economic development of Bulgaria can be distinguished.

After the hyperinflation and the financial and economic crisis of 1996-1997 and the introduction of the currency board in Bulgaria, in the period 1999-2004, the economy was still operating below its optimal production capacity. This period was characterised by high unemployment ranging between 12% and 20% and relatively high inflation, which was partly a legacy of the hyperinflationary period in the late 1990s. During this period, the Bulgarian economy was still characterised by a high share of state-owned enterprises and banks, with no or limited access to foreign financing and know-how from parent companies and a low share of foreign direct investment in the country. At the same time, the share of non-performing loans in banks' balance sheets was relatively high, which made them cautious when lending to the private sector. The limited access to bank lending and financing from foreign companies and the low share of foreign direct investment suppressed consumption and investment activity in the country and thus negatively affected the overall macroeconomic environment during this period.

The signing of the Treaty of Accession of Bulgaria to the European Union in 2005 had a positive impact on investors' perceptions of the country's future prospects. In the meantime, the process of structural reforms and privatisation of many local banks by foreign financial institutions contributed to the deepening of financial intermediation in the country. Parent banks were beginning to provide their subsidiary banks and branches in Bulgaria with capital, liquidity and know-how, intending to increase their market share in a region where the return on capital was very high. These processes stimulated strong competition between banks and contributed to the gradual acceleration of credit growth. The high expected return on investment and positive expectations for income convergence related to the process of a gradual transition to a market economy, as well as the favourable internal macroeconomic environment and the global upswing in the business cycle, stimulated consumption, investment and FDI inflows. Increasing revenues and profits, on the other hand, contributed to the increase in attracted funds in the banking system. By financing its lending activities mainly with deposits from residents and funds from its parent banks, credit institutions in Bulgaria were expanding their operations and activities in the country, which contributed to further acceleration of credit growth. The period from 2005 to 2008 was characterised by declining spreads between interest rates on loans in Bulgaria and the euro area, reflecting a lower risk perception. At the same time, high credit growth contributed to increasing bank profits and, among other factors, also contributed to higher house prices. The current account deficit widened as a percentage of GDP during the period under review, as a result of high levels of investment in the economy and strong domestic demand (in particular investment demand stimulated by FDI inflows), which translated into higher growth in imports compared to that of exports.

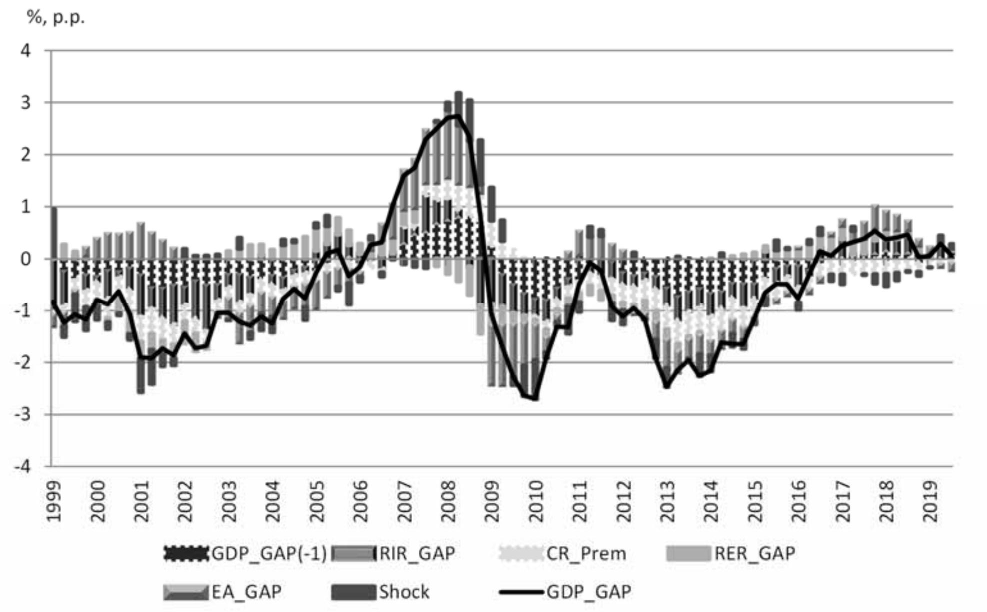
The positive deviation from potential output peaked in the second quarter of 2008. With the spreading of the aftermaths of the global financial and economic crisis in late 2008 and early 2009, the business cycle in Bulgaria entered its downward phase, turning into a negative territory (the output gap became negative) in the first quarter of 2009 and reached its bottom at the beginning of 2010. A gradual recovery had been observed since mid-2010, with the negative output gap gradually closing, but with the deepening of the European debt crisis, the Bulgarian economy plummeted again and reached another trough in mid-2013. With the gradual recovery of the European economy, Bulgaria's economy has started to operate above its potential level since mid-2016. In 2019 the output gap is still positive, but it is gradually closing, and by the third quarter of the year, the deviation from potential is close to 0, i.e. it can be stated that the economy is working close to its potential level.

Figure 2 shows the historical decomposition of the business cycle in Bulgaria, which makes it possible to highlight the contribution of the individual variables included in the model to deviations from potential output. As can be seen from Figure 2, in the period 1999-2004 the main factors contributing to the negative deviation of real GDP from the potential level were the monetary conditions in the country and the high-risk premium. At the same time, during the period 2000-2002, the business cycle in the euro area was positive, but due to the still insufficient integration of Bulgaria into the European Union, the business cycles in Bulgaria and the euro area were poorly synchronised in that period.

After 2005, the business cycle in Bulgaria followed closely that in the euro area, moving at a slight lag. Between 2006 and 2009, both the upswing in the European and global business cycles contributed to the high growth of Bulgaria's real GDP. During this period, monetary conditions in the country also supported the business cycle, with spreads between interest rates on new loans to households and non-financial corporations with the 3-month EURIBOR significantly declining, which was indicative of a decrease in the risk premium.

Figure 2

Historical decomposition of the business cycle in Bulgaria

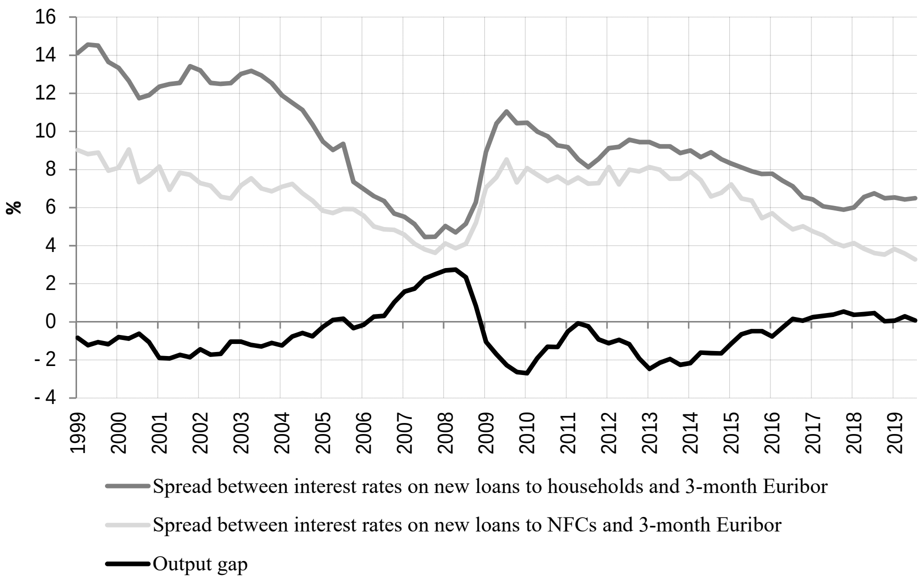


Legend:
GDP_GAP – output gap
GDP_GAP (-1) – output gap in t-1
RIR_GAP – real interest rate gap
CR_Prem – risk premium
RER_GAP – real exchange rate gap
EA_GAP – output gap in the euro area
Shock – external shocks

The main driving force behind the significant negative deviation from the potential output in 2009-2011 was the cycle in the euro area and globally, as a consequence of the spread of the effects of the global financial and economic crisis. This period was also characterised by a significant increase in interest spreads and risk premiums in a number of countries, with similar developments observed in Bulgaria (see Figure 3).

Figure 3

Interest rate spreads between new loans to households and non-financial corporations (NFCs) with the 3-month EURIBOR and the business cycle



Although the negative output gap almost closed in mid-2011, with the intensification of the European debt crisis, the Bulgarian economy started operating again below its potential level and this period continued until mid-2016. Both the euro area business cycle and the relatively high-interest rate spreads and the higher risk premium of the country contributed to these developments. From mid-2016, with the gradual recovery of the European economy, the output gap in Bulgaria turned to positive and remained positive till the third quarter of 2019.

A notion for the degree of synchronisation between the business cycles in Bulgaria and the euro area can be obtained through the calculation of the so-called concordance index, proposed by Harding and Pagan (2002). Essentially, the concordance index measures the periods in which two or more variables are in the same phase – of expansion or contraction with respect to all periods for which observations are available. If the variables are in the same phase in all observed periods, the synchronisation index will be 100%. At the same time, if the variables are characterised by divergent dynamics, i.e. in the periods in which one of the variables is in the expansion phase, the other is in the contraction phase and this is valid for all observed periods, the synchronisation index will be 0%. Harding and Pagan (2002) define the concordance index as follows:

"We suggest that co-movement be measured by the degree of synchronisation between the specific cycle of y_{jt} and the reference cycle (based on (say the) variable y_{rt}), and that it be quantified by the fraction of time in which the two series are simultaneously in the phase of increase ($S_t = 1$) or decrease ($S_t = 0$)" (Harding, Pagan, 2002, p. 370).

$$I_{jr} = n^{-1} [\sum S_{jt} S_{rt} + (1- S_{jt}) (1- S_{rt})]$$

The calculated concordance index between the business cycles in Bulgaria and the euro area over the whole observed period – 1999-2019 shows that the two cycles are synchronised in 56% of the time. At the same time, if we calculate the synchronisation indices between the two cycles separately for the years 1999-2006 and 2007-2019, it can be seen that the synchronisation rate has increased significantly since 2007, reaching 61% in the period 2007-2019 compared to 48% for the period 1999-2006 (see Table 1). This is indicative that the degree of synchronisation between the business cycles in Bulgaria and in the euro area has increased after the accession of Bulgaria to the European Union.

Table 1

Synchronisation between the business cycles in Bulgaria and in the euro area

Period	Concordance index
1999 - 2019	56%
1999 - 2006	48%
2007 - 2019	61%

Subject of study in the empirical literature are not only the phases of the business cycle and the degree of synchronisation between business cycles in different countries, but also the length of these cycles. There is a widely accepted view in the literature that the business cycle is a relatively short-term phenomenon with a duration between 3 and 8 years. An approach that can be applied to measure the length of cycles in the economy is the so-called turning point analysis. In general, turning points occur when the deviation of a variable from its long-term trend reaches a local maximum (peak) or a local minimum (trough). The cycle length is measured from peak to peak or from trough to trough, respectively. Tables 2 and 3 present the results of the turning point analysis. Table 2 shows the timings of the troughs in the business cycles in Bulgaria and in the euro area and the average length of the cycle, when measured from trough to trough. According to the results, the average length of the business cycle in Bulgaria from trough to trough is approximately 6 years, while the average length of the business cycle in the euro area is estimated at around 5 years.

Table 3 shows the timings of the peaks in the business cycles in Bulgaria and in the euro area and the average length of the cycle, when measured from peak to peak. The results show that the average length of the business cycle in Bulgaria from peak to peak is approximately 9 years, while that of the euro area is around 6 years. When measured from peak to peak, the estimated length of the business cycle in Bulgaria exceeds the generally assumed in the literature maximal length for business cycles of 8 years. However, this result is consistent with another estimate of the length of the Bulgarian business cycle (Karamisheva et al., 2019).

Table 2

Length of the business cycle in Bulgaria and in the euro area measured from trough to trough

	BG GAP	EA GAP
1. Trough	-1.92	-1.37
Timing	2001 Q2	2003 Q2
2. Trough	-2.70	-2.87
Timing	2010 Q1	2009 Q2
3. Trough	-2.47	-1.34
Timing	2013 Q1	2013 Q1
Average length in years	6	5

Table 3

Length of the business cycle in Bulgaria and in the euro area measured from peak to peak

	BG GAP	EA GAP
1. Peak	2.74	1.67
Timing	2008 Q2	2001 Q1
2. Peak	0.54	3.24
Timing	2017 Q4	2008 Q1
3. Peak		1.10
Timing		2011 Q1
4. Peak		1.05
Timing		2017 Q4
Average length in years	9	6

In the period under consideration (1999-2019) the business cycle in the euro area reached local minima three times and local maxima four times, respectively. At the same time, the business cycle in Bulgaria reached only two peaks and three troughs.

To see how the estimated business cycle compares with other estimates for Bulgaria, we undertake a comparison with a business cycle, derived using a production function approach, as well as with an estimated financial cycle for the Bulgarian economy.[5] The comparison reveals a very similar dynamics of both the business cycle, estimated using the structural unobserved components model and that, derived using a production function (Figure 4). The degree of synchronisation between both estimates of the business cycle and the financial cycle can be calculated with the help of the respective concordance index. The results are presented in Table 4.

[5] For more details concerning the estimate of the business cycle, using a production function approach and the estimate of the financial cycle see Karamisheva et. al. (2019).

Figure 4
Comparison between the estimated business cycle, an alternative estimation using a production function approach and the financial cycle

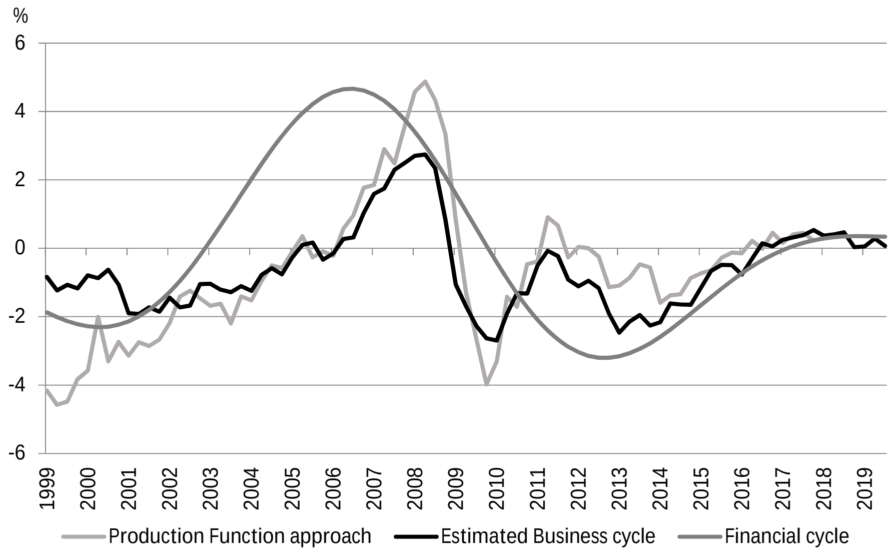


Table 4
Synchronisation between the estimated business cycle, an alternative estimation using a production function approach and the financial cycle

	Concordance index
Estimated business cycle vs. production function approach	61%
Estimated business cycle vs. financial cycle	57%

The calculated concordance index between the estimated business cycles in Bulgaria, using the unobserved components model, presented in this section and an alternative business cycle, derived using a production function approach is comparatively high – 61%. At the same time, the estimated business cycle is synchronised with the estimated financial cycle for the Bulgarian economy in 57% of the time.

Conclusion

The aim of this study was to measure the business cycle in Bulgaria, to estimate its phases and to investigate the extent to which the Bulgarian business cycle is synchronised with the business cycle in the euro area. A wide range of models for measuring the business cycle are used in the academic literature. Some of them are based to a large extent on theoretical assumptions about the behaviour of economic agents. Others rely almost entirely on obtaining information from the data available. An example of models, which rely predominantly on theoretical assumptions, are real business cycle models (RBC) and dynamic stochastic general equilibrium models (DSGE). At the same time, univariate frequency filters like the HP filter or band-pass filter are used to derive trend and cycle information from observable time series, namely from the series for real GDP in the case of estimating the business cycle. A compromise between theoretical and empirical techniques for measuring the output gap are structural unobserved components models, which combine the benefits of using filters to extract information about the trend and cycle of the observed variables, while allowing the existing theoretical dependencies and structural relationships in the economy to be taken into account.

Using data for Bulgaria and the euro area for the 1999-2019 period and applying a structural unobserved components model, consisting of an aggregate demand curve, Phillips curve, Okun's law and monetary policy response function, consistent with the operating currency board arrangement in Bulgaria, we extract a measure of the business cycle in Bulgaria and in the euro area. Our results show that in the period 1999-2004 the Bulgarian economy was operating below its potential level, which was to a large extent related to high unemployment, unfavourable monetary conditions and a high-risk premium in the country. This period also reflected the gradual transition of Bulgaria towards a market economy with all the structural changes accompanying this process. In that period, the business cycles in Bulgaria and the euro-area were poorly synchronised. The signing of the Treaty of Accession of Bulgaria to the European Union in 2005 had a positive impact on investors' perceptions of the country's future prospects. The favourable macroeconomic environment, declining interest rate spreads and the global upswing in the business cycle supported economic growth, resulting in a peak of the business cycle in Bulgaria in the second quarter of 2008. With the intensification of the global financial and economic crisis and later on with the spreading of the effects of the European debt crisis, Bulgaria suffered a double-dip recession. The entire period from 2009 to 2015 was characterised by a negative output gap. From mid-2016, with the gradual recovery of the European economy, the output gap in Bulgaria turned to positive and remained positive till the third quarter of 2019. However, the positive gap is gradually closing and moving towards zero, so it can be stated that in 2019 the Bulgarian economy is working close to its potential level.

Concerning the degree of synchronisation between the business cycles in Bulgaria and the euro-area, we find that both cycles are to a large extent synchronised, especially in the period after the accession of Bulgaria to the European Union, when the estimated concordance index between both cycles reaches 61%. Our results point that the length of the business cycle in Bulgaria, when measured from trough to trough, fits well into the largely accepted in the literature range for the business cycle length from 2 to 8 years. However, when measured from peak to peak, the estimated length of the Bulgarian business cycle is 9 years and basically exceeds both the length of the cycle in the euro area and the generally assumed in the literature maximal length for business cycles of 8 years.

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