ECONOMETRICS. EKONOMETRIA
Advances in Applied Data Analysis
Year 2022, Vol. 26, No. 1
e-ISSN 2449-9994

A BUSINESS-CYCLE MODEL WITH CASH AND CREDIT GOODSAND A MODIFIED CASH-IN-ADVANCE FEATURE: LESSONS FOR BULGARIA (1999-2020)

Aleksandar Vasilev
University of Lincoln, Lincoln, United Kingdom
e-mail: avasilev@lincoln.ac.uk
ORCID: 0000-0002-3956-6314

Quote as: Vasilev, A. (2022). A business-cycle model with cash and credit goodsand a modified cash-in-advance feature: lessons for Bulgaria (1999-2020). *Econometrics. Ekonometria. Advances in Applied Data Analysis, 26*(1).

DOI: 10.15611/eada.2022.1.01

JEL Classification: E32

Abstract: The paper augments the standard business cycle model with cash and credit goods following Lucas and Stokey (1983, 1987), together with a modified cash-in-advance (CIA) considerations. In particular, the cash-in-advance constraint was extended to include private investment and government purchases. This specification was then calibrated to Bulgaria during the 1999-2020 period. The presence of cash and credit goods give a role to money in accentuating economic fluctuations. In particular, the two types of goods and the modified CIA constraint produce a more sophisticated propagation mechanism, with novel trade-offs faced by households. The model generates too volatile consumption, and countercyclical investment, which are at serious odds with the data. Overall, the model with cash and credit goods, and physical capital accumulation, did not provide a good framework to study business cycle fluctuations in Bulgaria.

Keywords: business cycles, cash and credit goods, modified cash-in-advance (CIA) constraint, Bulgaria.

1. Introduction and motivation

It is a well-known fact in the modern quantitative macroeconomic literature, e.g. Cooley and Hansen (1989, 1991), that the perfectly-competitive (Walrasian) approach to modelling labour markets in real business cycles (RBC) – i.e. without money in the setup – does not fit US data well, especially along the labour dimension, and thus creates a 'puzzle' for neoclassical economists. The results are similar for developing economies as well, as shown in Vasilev (2009) for Bulgaria. Thus, the presence of money is taken as an essential ingredient for any macroeconomic model that tries to improve on the previous research results. This paper introduces money seen in the context of certain empirical regularities in Bulgaria, namely that households still use predominantly cash for purchases, which was the norm in the 1999-2020 period[1]. At the same time, the financial system in Bulgaria is constantly evolving, and credit is also on the rise.

The author builds on the work of Lucas and Stokey (1983, 1987) and Woodford (1998), among others, utilising setups with cash and credit goods, and extends the model economy to a stochastic and dynamic general equilibrium framework with both money and physical capital as in Stockman (1981) and Abel (1985), with labor-leisure choice, and the aggregate production function being subjected to technology shocks. Importantly, the model in this paper adds value to Cooley and Hansen (1989, 1991), who simulated a business cycle model with money and a cash-in-advance (CIA) constraint. In this model, however, the author included not only the purchase of cash consumption goods, but also investment and government purchases, which is the approach followed in Cole (2020)[2]. The study incorporated this modified cash-in--advance (CIA) constraint in RBC models in order to investigate the quantitative effect of money on the cyclical fluctuations exhibited by aggregate variables in Bulgaria. As in Hartley (1988), inflation in the model may act like a tax, and would discourage cash transactions, while encouraging credit purchases. This effect drives an interesting wedge between not only cash vs credit consumption goods, but also investment and credit goods. Despite these novel trade-offs, the model with cash and credit goods, and physical capital accumulation, does not provide a good framework to study business cycles in Bulgaria. Importantly, the model generates too volatile consumption, and countercyclical investment, which are at serious odds with the data.

The rest of the paper is structured as follows: Section 2 establishes the artificial economy and lays down the decentralized competitive market equilibrium, Section 3 explains the calibration procedure, and Section 4 contains the steady-state of the artificial economy. Section 5 investigates the general dynamics of model, following a technology shock, and then proceeds to compare the second moments of the model variables vs the moments of the empirical time series. Section 6 concludes the paper and discusses some possible suggestions for extensions to be pursued in future research.

---

[1] This is a period of relative macroeconomic stability, due to the operation of a currency board arrangement in place.

[2] This model is without bonds: allowing for bonds is a trivial extension. However, if bonds are to present in the framework, they have to be in the CIA constraint as well.

2. Model setup

There is a stand-in household in the model economy, which derives utility out of consumption of goods, as well as from enjoying time off-work. There are two types of consumption goods: the first group can only be purchased using money (cash goods), while the second type of goods can be purchased on credit (credit goods)[3]. A household's time endowment can be spent working, or enjoyed in the form of leisure. The government taxes consumption and income in order to finance purchases of commodities, and government transfers. The monetary authority follows an endogenous money supply rule, and redistributes all seigniorage back to the household via lump-sum transfers. In terms of production, there is a stand-in company that hires labour hours and capital services in order to manufacture the aggregate homogeneous final output.

2.1. Representative household's problem

The household maximises its expected discounted utility, which as in Lucas and Stockey (1983, 1987) takes the form

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \{\ln c_{1t} + \phi \ln c_{2t} - \gamma h_t\}, \tag{1}$$

where: E_0 denotes household's expectations as of $t = 0$, the beginning of the optimisation horizon. Next, $0 < \beta < 1$ is the discount factor, as future utility streams are worth less for the household; c_{1t} is household's consumption of cash goods in period t, while c_{2t} is household's consumption of credit goods in period t. The two types of consumption goods are not valued equally: $0 < \phi < 1$ captures the weight attached to credit goods, relative to the cash goods; h_t are hours supplied by the household in period t. Lastly, parameters $\gamma > 0$ are the weights attached to disutility of work[4].

The household starts with a certain endowment of physical capital, $k_0 > 0$, which is then rented to the firm at the going nominal rental rate R_t, hence, pre-tax capital income generated is $R_t k_t$. In addition, the representative household can augment – via investment – the physical capital stock, which evolves as follows:

$$k_{t+1} = i_t + (1 - \delta) k_t, \tag{2}$$

where: $0 < \delta < 1$ denotes capital depreciation rate.

[3] This is implicitly capturing financial frictions associated with the liquidity effect of money, that some agents are facing restrictions on their ability to engage in certain types of (financial) transactions.

[4] Following Hansen (1985) and Rogerson (1988), the author used aggregation and employment lotteries in order to convexify a discrete labour supply decision at individual level – work either zero hours or a full-time – to derive the preferences of an aggregate household. In particular, in equilibrium, a households will be chosen for work every period with a probability h_t, which, from the law of large numbers, will also equal the employment rate.

In addition to the income from owning capital, the household also is the sole owner of the company, and thus receives its nominal profit, Π_t. Lastly, the household supplies a certain number of hours, which are remunerated at the spot nominal wage rate W_t, generating a total nominal labour income of $W_t h_t$ in period t.

The budget constraint of the household, expressed in real terms, is then

$$(1+\tau^c)(c_{1t}+c_{2t})+k_{t+1}-(1-\delta)k_t+\frac{M_{t+1}}{P_t}\frac{P_{t+1}}{P_{t+1}}=$$
$$=(1+\tau^y)[w_t h_t+r_t k_t]+\frac{M_t}{P_t}+g_t^t+\frac{\Pi_t}{P_t}, \qquad (3)$$

where τ^c is the consumption tax, τ^y denotes the capital and labor income tax, g_t^t are real government transfers, and P_t refers to the aggregate price level[5], and M_t denote the nominal quantities of money holdings in period t. Money stock is treated like a consumption good, it stores wealth over time. That is why real money balances in period t are $m_t=\frac{M_t}{P_t}$ in period $t+1$ only buy $\frac{M_t}{P_{t+1}}$ (next period purchasing power). Similarly, $w_t=\frac{W_t}{P_t}$, and $r_t=\frac{R_t}{P_t}r_t = R_t/P_t$ are the real wage, and interest rates, respectively.

Real money balances are needed to purchase cash goods, investment, and government consumption, hence the households face the following cash-in-advance constraint

$$(1+\tau^c)c_{1t}+k_{t+1}-(1-\delta)k_t+g_t^c\leq\frac{M_t}{P_t}=m_t, \qquad (4)$$

where the (tax-inclusive) expenditure on cash goods, government purchases g_t^c, and investment is carried using money. The rest, the spending on credit goods, is purchased using credit. However, beyond the exogenous assumption of credit goods, the study does not model credit markets explicitly in the model framework.

Next, the Lagrangian of the household's problem is set up:

$$\begin{aligned} L = E_0\sum_{t=0}^{\infty}\beta^t\Big\{&\ln c_{1t}+\phi\ln c_{2t}-\gamma h_t \\ &-\lambda_t\Big[(1+\tau^c)(c_{1t}+c_{2t})+k_{t+1}-(1-\delta)k_t \\ &+m_{t+1}(1+\pi_{t+1})-(1-\tau^y)[w_t h_t+r_t k_t]-\frac{M_t}{P_t}-g_t^t \\ &-\frac{\Pi_t}{P_t}\Big]-\mu_t[(1+\tau^c)c_{1t}+k_{t+1}-(1-\delta)k_t+g_t^c-m_t]\Big\}. \end{aligned} \qquad (5)$$

[5] The price level will be indeterminate in the model, and is thus of little importance.

The first-order optimality conditions (FOCs) are:

$$c_{1t}: \frac{1}{c_{1t}} = (1+\tau^c)(\lambda_t + \mu_t), \tag{6}$$

$$c_{2t}: \frac{\phi}{c_{2t}} = (1+\tau^c)\lambda_t, \tag{7}$$

$$h_t: \gamma = \lambda_t(1-\tau^y)w_t, \tag{8}$$

$$k_{t+1}: \lambda_t + \mu_t = \beta E_t[\lambda_{t+1}[1-\delta+(1-\tau^y)r_{t+1}] + \mu_{t+1}(1-\delta)], \tag{9}$$

$$m_{t+1}: \lambda_t = \beta E_t\left[\frac{1}{1+\pi_{t+1}}(\lambda_{t+1}+\mu_{t+1})\right], \tag{10}$$

where π_{t+1} is the inflation rate between periods t and $t+1$. Lastly, the boundary (transversality) conditions for capital, and real money balances are as follows:

$$TVC_k: \lim_{t\to\infty} \beta^t \lambda_t k_{t+1} = 0, \tag{11}$$

$$TVC_m: \lim_{t\to\infty} \beta^t \lambda_t m_{t+1} = 0. \tag{12}$$

The meaning behind the optimality conditions is as follows: in the first two, the household equates the marginal utility of each of the two types of consumption goods to the VAT adjusted shadow price of income, and that of the CIA constraint. When the two FOCs are divided, one obtains:

$$\frac{c_{2t}}{c_{1t}} = \phi\left[1+\frac{\mu_t}{\lambda_t}\right], \tag{13}$$

i.e. there is a time-varying proportion of credit to cash goods. Furthermore, on top of the VAT, there is inflation tax for c_{1t}, i_t, g_t^c while this tax is avoided for the credit goods c_{2t}, as purchasing those does not require money.

Next, the third FOC determines the optimal number of hours worked, by balancing at the margin the cost and benefit from working. Then, the Euler equation for capital stock describes how capital is allocated across any adjacent periods in order to maximize household's utility. Similarly, the next optimality condition describes the rule for optimal real money balances over two congruent periods. Lastly, the transversality conditions (TVC_s) for real cash holdings, and physical capital are put in place to shut down any explosive solutions.

2.2. Representative company's problem

There is a stand-in firm in the model, which uses rented capital and labour from the household to produce a final good, via the following production function:

$$y_t = A_t k_t^{\alpha} h_t^{1-\alpha}, \tag{14}$$

where A_t denotes the level of total factor productivity in period t, h_t are total hours used, and α and $1-\alpha$ reflect the share of capital and labor, respectively. The firm's problem, in real terms, is to maximize static profit in each period:

$$\max_{(k_t,\,h_t)\geq 0} A_t k_t^{\alpha} h_t^{1-\alpha} - r_t k_t - w_t h_t. \tag{15}$$

The optimality conditions determining capital, and labour use chosen by the company in equilibrium are

$$k_t\colon \alpha\frac{y_t}{k_t} = r_t, \tag{16}$$

$$h_t\colon (1-\alpha)\frac{y_t}{h_t} = w_t. \tag{17}$$

Given the results above, it is evident that profit is zero in all periods.

2.3. Monetary authority

The monetary authority (central bank) was assumed to supply the money aggregate, M_t, endogenously. In other words, the money supply responds to the demand for cash transactions. All money created (seigniorage) in period t is then distributed first to the government, and eventually passed to the households in a lump-sum fashion

$$M_{t+1} - M_t = T_t, \tag{18}$$

where T_t/P_t is the lump-sum real-value transfer incorporated in the government transfer to the household[6].

2.4. Government

In the model economy, the government is taxing labour and capital income, as well as consumption in order to finance its spending on purchases and transfers. The government period budget constraint is:

$$\tau^c(c_{1t} + c_{2t}) + \tau^y(w_t h_t + r_t k_t) = g_t^t + g_t^c. \tag{19}$$

2.5. Stochastic process

Total factor productivity, A_t, follows $AR(1)$ processes in natural logarithms, or

$$\ln A_{t+1} = (1-\rho_\alpha)\ln A_0 + \rho_\alpha \ln A_t + \epsilon_{t+1}^{\alpha},$$

where $A_0 > 0$ denotes the steady-state level of technology, $0 < \rho_\alpha < 1$ is the persistence parameter of the process, and $\epsilon_t^{\alpha} \sim iidN(0, \sigma_\alpha^2)$ are the disturbances to the technology process.

[6] That is, in the government budget constraint below, was assume that the central bank distributes the seigniorage to the Ministry of Finance, which in turn passes it to the household as part of the overall government lump-sum transfer g_t^t.

2.6. Dynamic Competitive Equilibrium (DCE)

Given the stochastic process followed by technology $\{A_t\}_{t=0}^{\infty}$, tax rates $\{\tau^c, \tau^y\}$, capital and money endowments (k_0, m_0), the DCE is a list of sequences for the household $\{c_{1t}, c_{2t}, i_t, k_t, h_t, m_t\}_{t=0}^{\infty}$, a sequence of purchases and transfers for the government $\{g_t^t, g_t^c\}_{t=0}^{\infty}$, and real input prices $\{w_t, r_t\}_{t=0}^{\infty}$ such that (i) the household maximises expected discounted utility subject to its period budget constraint, and the CIA constraint; (ii) the firm maximises profit in each period; (iii) the government budget constraint is always balanced; (iv) goods, labour, and money markets are clear.

3. Data and model calibration

To calibrate the model to Bulgarian data, the author investigated the period 1999-2020. Annual data series on output, consumption and investment were collected from the National Statistical Institute (2021), while the real interest rate was obtained from the Bulgarian National Bank Statistical Database (2021), as the real yield on 10-year government bonds. The calibration in this paper follows the approach taken in the literature, e.g. Cooley (1995): first, the discount factor, $\beta = 0.982$, as in Vasilev (2017d), was set to match the average physical capital-to-output ratio in Bulgaria, $k/y = 3.491$, over the period investigated. Next, the labour share parameter, $\alpha = 0.429$, was obtained from Vasilev (2017a) as the average value of labor income in aggregate output.

Table 1. Model parameters

Parameter	Value	Description	Method
β	0.982	Discount factor	Calibrated
α	0.429	Capital Share	Data average
δ	0.050	Depreciation rate, physical capital	Data average
φ	0.327	Utility weight, credit goods	Calibrated
γ	2.801	Parameter, disutility of work	Calibrated
τ^c	0.200	VAT/consumption tax rate	Data average
τ^y	0.100	Average income tax rate	Data average
ρ_α	0.701	$AR(1)$ parameter, total factor productivity	Estimated
σ_α	0.044	st.dev., total factor productivity	Estimated

Source: own calculations.

The relative weight attached to leisure in the household's utility function, γ, was calibrated to match the that on average, consumers work eight hours daily. Similarly, for credit goods, parameter $\varphi = 0.327$ was calibrated to match the average share of purchases made using cash in Bulgaria, which was 85% over the period. In other words, the money in the model corresponds to $M2$ money aggregate, and $M\ 2/Y\ =\ 0.848$ on average over the period 1999-2020. Next, the capital depreciation rate in Bulgaria, $\delta\ =\ 0.05$, was taken from Vasilev (2015), where it was estimated as the average depreciation rate. Similarly, the income tax rate was set to τ^{y} = 0.1, and the tax rate on consumption, τ^{c}= 0.2, were set to their respective values over the period. Finally, the total factor productivity process was estimated from the detrended Solow residual series by running an $AR(1)$ regression, and saving the residuals from that regression. Table 1 presents the values of all model parameters used in the paper.

4. Steady-state

Substituting the values of model parameters into the steady-state equilibrium system allows the model to be solved, and the 'big ratios' can be compared to their averages in Bulgarian data. The results are reported in Table 2 (the author approximated the economy around the zero inflation.) The big ratios – consumption-to-output, investment and government purchases – are closely approximated by the model. The shares of income are identical to those in the data, which is a direct result of the Cobb--Douglas production function used. Lastly, the after-tax return on capital, after depreciation, $\tilde{r} = (1 - \tau^{y})r - \delta$, was also very closely captured by the model.

Table 2. Data averages and long-term solution

Variable	Description	Data	Model
y	Steady-state output	N/A	1.000
$(c_1\ +\ c_2)/y$	Total consumption-to-output ratio	0.674	0.674
c_1/y	Cash consumption-to-output ratio	0.493	0.493
c_2/y	Credit consumption-to-output ratio	0.181	0.181
i/y	Investment-to-output ratio	0.201	0.175
g^c/y	Government cons-to-output ratio	0.159	0.151
wh/y	Labour income-to-output ratio	0.571	0.571
rk/y	Capital income-to-output ratio	0.429	0.429
h	Share of time spent working	0.333	0.333
$\tilde{r}$	After-tax net return on capital	0.056	0.057

Source: own calculations.

5. Out of steady-state model dynamics

The model in this paper does not have an closed-form (symbolic) solution for the equilibrium behaviour of variables in the general case, so it was necessary to proceed by solving the model numerically, by log-linearizing the original equations around the steady-state. This results are given in a first-order system of stochastic difference equations, which is easy to work with. Next, the author studied the dynamic behaviour of model variables to an isolated shock to the total factor productivity process, before proceeding to fully simulate the model.

5.1. Impulse Response Analysis

The impulse response function (IRFs) of the model variables to a 1% surprise innovation to technology are presented in Figure 1 below.

As a result of the one-time unexpected positive innovation in total factor productivity, output increases immediately. This expands resource availability, thus the use of output-consumption of both cash and credit goods, and government consumption also increase upon the impact of the shock. Investment decreases, as inflation acts like a tax, and in addition the household moves away from investment and towards credit goods.

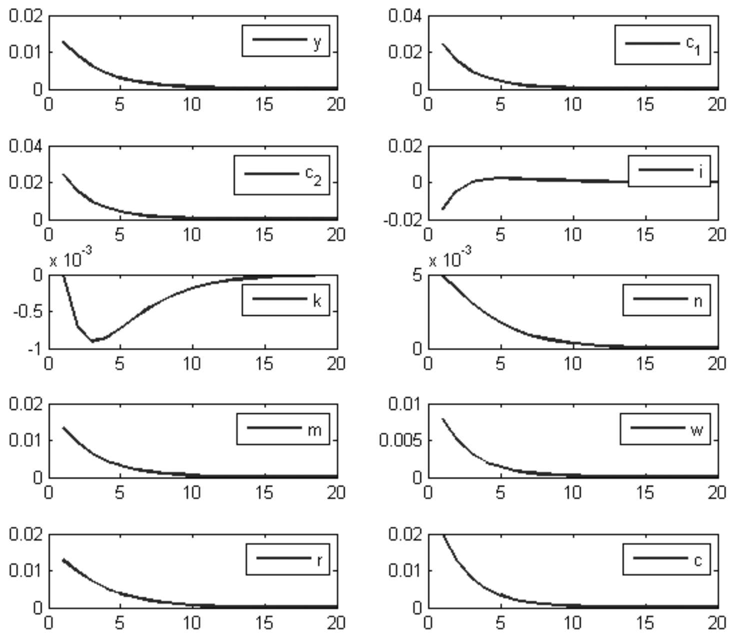

Fig. 1. Impulse responses to a 1% surprise innovation in technology

Source: own calculations.

At the same time, the jump in productivity increases the after-tax return on the two factors of production, labour and capital; the representative household starts supplying more hours worked. In turn, the increase in total hours further increases output, again indirectly. Over time, physical capital stock returns to its steady-state, and follows a hump-shaped dynamics over its response path. The rest of the model variables return to their old steady-states in a monotone fashion as the effect of the one-time technology shock dies out.

5.2. Simulation and moment-matching

Now we simulate the model, detrending both the empirical and model simulated data using the Hodrick-Prescott (1980) filter. Table 3 summarises the moments of data (relative volatilities to output, and contemporaneous correlations with output) versus the same moments computed from the model-simulated data at annual frequency. The model matches quite well the absolute volatility of output, however it substantially overestimates the variability in both consumption of cash and credit goods. At the same time, investment in the model varies too little. As explained earlier, this is due to the inflation tax causing the household to shift towards the purchase of credit goods[7]. With respect to the labour market variables, the variability of employment and wages predicted by the model is much lower than that in the data.

Table 3. Business cycle moments

	Data	Model
σ_y	0.05	0.05
σ_c/σ_y	0.55	1.33
σ_{c_1}/σ_y	–	1.63
σ_{c_2}/σ_y	–	0.53
σ_i/σ_y	1.77	0.56
σ_g/σ_y	1.21	1.00
σ_h/σ_y	0.63	0.46
σ_w/σ_y	0.83	0.54
$\sigma_{y/h}/\sigma_y$	0.86	0.54
$corr(c,y)$	0.85	0.99
$corr(c_1,y)$	0.85	0.99
$corr(c_2,y)$	0.85	0.99
$corr(i,y)$	0.61	–0.40
$corr(g,y)$	0.31	1.00
$corr(h,y)$	0.49	0.99
$corr(w,y)$	–0.01	0.99

Source: own calculations.

[7] Still, the model is qualitatively consistent with the stylised fact that credit goods consumption is less volatile than output. By construction, government spending in the model varies as much as in the data.

Next, in terms of contemporaneous correlations, the model overpredicts the procyclicality of the main aggregate variables – consumption and government consumption. Yet, in the labour market dimension, the contemporaneous correlation of employment with output is relatively well-approximated. With respect to wages, the model predicts strong cyclicality, while wages in data are acyclical. Finally, the model with cash and credit goods generates a counter-cyclical investment series, at odds with the data. Overall, the model with cash and credit goods, and physical capital accumulation, does not provide a good framework to study business cycles in Bulgaria. Some of the limitations included the ad hoc division into cash and credit goods. More specifically, cash goods cannot be purchased on credit, and vice versa[8]. Furthermore, in the setup, credit for c_{2t} is not modeled explicitly, and is implicitly assumed to be perfectly elastic. Credit is also free, as the household borrows at zero cost; purchasing a credit good has no direct, monetary cost, as the inflation tax is avoided. However, there is a utility cost due to the fact that $0 < \varphi < 1$[9], i.e. that the household prefers cash goods, which could be reflecting some credit market frictions[10]. One possible avenue for future research is to modify the current monetary framework, and more specifically, to link it to banking and finance theory by introducing deposits and loans explicitly in the setup.

6. Conclusions

The study augmented the standard business cycle model with cash and credit goods following Lucas and Stokey (1983, 1987), and adding a cash-in-advance (CIA) feature. In particular, the cash-in-advance constraint was extended to include private investment and government purchases. This specification was then calibrated to Bulgarian data for the 1999-2020 period. The presence of cash and credit goods gives a role to money in accentuating economic fluctuations. In particular, the two types of goods and the modified CIA constraint produce a more sophisticated propagation mechanism, with novel trade-offs faced by the household. The model generates a too volatile consumption, and countercyclical investment, which are both at serious odds with the data. Overall, the model with cash and credit goods, and physical capital accumulation, does not provide a good framework to study business cycles in Bulgaria.

One of the limitations of the model is the assumed ex ante division into cash and credit goods. Furthermore, credit markets are not modelled explicitly as the supply and demand forces driving credit are not present. One possible extension is to modify

---

[8] The counterargument is that the two types of good are motivated by empirics, that for the majority of the goods money is used, while for other big purchases households use credit, such as buying a car, and certain consumer durables.

[9] The author also fed a persistent shock followed by φ in order to understand what would happen in the artificial economy if the preference for credit goods increases exogenously, and this could reflect financial innovations and/or ease of use of credit instruments.

[10] The author sees this in the marginal rate of substitution (MRS), in the presence of μ. There is also no risk, and no inflation in steady-state.

the current monetary framework, and more specifically, to link it to banking and finance theory, as there are no deposits and loans in the framework in this paper. This avenue, however, is left for future research.

Conflict of Interest: The author declares no conflict of interest.

References

Abel, A. B. (1985). Dynamic behavior of capital accumulation in a cash-in-advance model. *Journal of Monetary Economics, 16*(1), 55-71.

Bulgarian National Bank [BNB]. (2021). *BNB statistical database*. Retrieved November 18, 2021 from www.bnb.bg

Canova, F. (2007). *Methods for applied macroeconomic research*. Princeton, NJ: Princeton University Press.

Cogley, T., and Nason, J. M. (1995). Output dynamics in real-business-cycles models. *American Economic Review, 85*(3), 492-511.

Cole, H. (2020). *Monetary and fiscal policy through a DSGE lens*. Oxford, UK: Oxford University Press.

Cooley, T. F. (1995). *Frontiers of business cycle research*. Princeton, NJ: Princeton University Press.

Cooley, T. F., and Hansen, G. D. (1989). The inflation tax in a real business cycle. *American Economic Review*, *79*(4), 733-748.

Cooley, T. F., and. Hansen, G. D. (1991). The welfare cost of moderate inflations. *Journal of Money, Credit, and Banking*, *23*(3 pt 2), 482-502.

Hansen, G. (1985). Indivisible labor and the business cycle. *Journal of Monetary Eco- nomics, 16*, 309-327.

Hartley, P. (1988). The liquidity services of money. *International Economic Review, 29*(1), 1-24.

Hodrick, R. J., and Prescott, E. C. (1980). *Post-war US business cycles: An empirical in-vestigation*(unpublished manuscript). Pittsburgh, PA: Carnegie-Mellon University.

Lucas, R. E. (1982). Interest rates and currency prices in a two-country world. *Journal of Monetary Economics*, *10*(3), 335-359.

Lucas, R. E., and Stokey, N. L. (1983). Optimal fiscal and monetary policy in an economy without capital. *Journal of Monetary Economics*, *12*(1), 55-93.

Lucas, R. E., and Stokey, N. L. (1987). Money and interest in a cash-in-advance economy. *Econometrica*, *68*(2), 247-274.

National Statistical Institute [NSI]. (2021). *NSI statistical database*. Retrieved November 18, 2021 from www.nsi.bg

Nelson, C. R., and Plosser, C. I. (1982). Trends and random walks in macroeconomic time series. *Journal of Monetary Economics*, *10*(2), 139-162.

Rogerson, R. (1988). Indivisible labor, lotteries and equilibrium. *Journal of Monetary Eco- nomics, 21*.

Rotemberg, J., and Woodford, M. (1996). Real-business-cycle models and the forecastable movements in output, hours, and consumption. *American Economic Review*, *86*, 71-89.

Stockman, A. (1981). Anticipated inflation and the capital stock in a cash-in-advance economy. *Journal of Monetary Economics*, *8*(3), 387-393.

Svensson, L. E. O. (1985). Money and asset prices in a cash-in-advance economy. *Journal of Political Economy*, *93*(5), 919-944.

Vasilev, A. (2009). Business cycles in Bulgaria and the Baltic countries: an RBC approach. *International Journal of Computational Economics and Econometrics, 1*(2), 148-170.

Vasilev, A. (2015). Welfare effects of income tax reform: the case of Bulgaria. *Eastern European Economics*, *53*(2), 205-220.

Vasilev, A. (2016). Search and matching frictions and business cycle fluctuations in Bulgaria. *Bulgarian Economic Papers* [BEP], (03).

Vasilev, A. Z. (2017a). A real-business-cycle model with efficiency wages and a government sector: the case of Bulgaria. *Central European Journal of Economic Modelling and Econometrics*, *9*(4), 359-377.

Vasilev, A. (2017b). A real-business-cycle model with reciprocity in labor relations and fiscal policy: the case of Bulgaria. *Journal of Economics and Econometrics, 61*(2), 47-76.

Vasilev, A. Z. (2017c). Business cycle accounting: Bulgaria after the introduction of the currency board arrangement (1999-2014). *European Journal of Comparative Economics*, *14*(2), 197-219.

Vasilev, A. Z. (2017d). VAT evasion in Bulgaria: A general-equilibrium approach. *Review of Economics and Institutions*, *8*(2), 2-17.

Woodford, M. (1998). Doing without money: Controlling inflation in a post-monetary world. *Review of Economic Dynamics*, (1), 173-219.

MODEL CYKLU BIZNESOWEGO Z GOTÓWKĄ I TOWARAMI KREDYTOWYMI ORAZ ZMODYFIKOWANĄ FUNKCJĄ PŁATNOŚCI ZALICZKOWEJ: PRZYPADEK BUŁGARII (1999-2020)

Streszczenie: Artykuł opisuje rozszerzenie standardowego modelu cyklu biznesowego uwzględniającego gotówkę i dobra kredytowe – analogicznie do podejścia Lucasa i Stokeya (1983, 1987) – oraz wprowadzającego zmodyfikowaną płatność zaliczkową (CIA). Ograniczenie zaliczki obejmuje przede wszystkim inwestycje prywatne i zakupy rządowe. Wymagania modelu sprawdzano dla danych zaobserwowanych dla Bułgarii w latach 1999-2020. Wprowadzone do modelu gotówka i dobra kredytowe pełnią funkcję pieniądza w uwydatnianiu wahań ekonomicznych. W szczególności te dwa rodzaje towarów i zmodyfikowane ograniczenie CIA tworzą zaawansowany mechanizm propagacji, z nowatorskimi transakcjami wymiany gospodarstw domowych. Model generuje konsumpcję o zbyt wysokiej zmienności i niecykliczne inwestycje, które są w poważnej sprzeczności z danymi. Ogólnie model uwzględniający gotówkę i dobra kredytowe oraz akumulację kapitału materialnego nie zapewnia dobrych ram do badania wahań cykli koniunkturalnych w Bułgarii.

Słowa kluczowe: cykle koniunkturalne, gotówka i dobra kredytowe, zmodyfikowane ograniczenie płatności zaliczkowej (CIA), Bułgaria.