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An Assessment on the Monetary Business Cycle Theory

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Abstract
In recent years, considerable attention has given to analyzing the business cycle in terms of money. Many researchers have developed dynamic stochastic general equilibrium models that generate business cycle facts and guide for making monetary policy decisions. The aim of this study is to investigate how the persistence of total factor productivity (TFP) and money growth shocks drive the business cycles within the USA. To achieve this aim, we employ a monetary business cycle model with a cash-in-advance constraint, as in Cooley and Hansen (1995) and simulate this model in Dynare with conventional parameter values that are widely accepted and utilized in DSGE models for the USA. Our results indicate that the volatility of macroeconomic variables is higher when the persistence of TFP shocks is greater compared to that of money growth shocks. Furthermore, TFP shocks seem to have a more significant role in driving variability within the models compared to money growth shocks. This is demonstrated by the higher percentage of variance decomposition attributed to TFP shocks, except in the case of consumption variability.

Para Tabanlı İş Döngüsü Teorisi Üzerine Bir Değerlendirme

Öz
Son yıllarda iş çevrimlerinin parasal açıdan analiz edilmesine büyük önem verilmiştir. Birçok araştırmacı iş döngüsü gerçeklerini üreten ve para politikası kararlarının alınmasında rehberlik sağlayan dinamik stokastik genel denge modelleri geliştirmiştir. Bu çalışmanın amacı, toplam faktör verimliliği (TFV) ve para büyüme şoklarının kalıcılığının Amerika'daki iş çevrimlerini nasıl etkilediğini araştırmaktır. Bu amaca ulaşmak için Cooley ve Hansen (1995)'te olduğu gibi peşin nakit kısıtlaması olan bir parasal iş döngüsü modeli kullanılmakta ve model Dynare programı kullanılarak Amerika için yaygın olarak kabul edilen ve DSGE modellerinde sıkça kullanılan geleneksel parameter değerleri ile simüle edilmektedir. Sonuçlar, TFV şoklarının kalıcılığının para büyüme şoklarına kıyasla daha büyük olması durumunda makroekonomik değişkenlerdeki oynaklığın daha yüksek olduğunu göstermektedir. Ayrıca, TFV şoklarının para büyüme şoklarına kıyasla modellerdeki değişkenliği artırmada daha önemli bir rol oynadığı görülmektedir. Bu durum, tüketim değişkenliği durumu haricinde, TFV şoklarına atfedilen varyans ayrıştırmasının yüzdesinin daha yüksek olmasıyla gösterilmektedir.

Anahtar Kelimeler: *TFP şokları, para büyüme şokları, para politikası iş döngüsü modeli, iş döngüsü.*

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1. Introduction

Advancements in dynamic economic theory and improvements in computational techniques over the past three decades have furnished economists with a new set of instruments to explore significant economic issues. These instruments have amplified our ability to build and investigate artificial economies, which serve as laboratories for economic investigations (Cooley and Prescott, 1995). In the real business cycle (RBC) models, such as Kydland and Prescott (1982), the cycles emerge from exogenous shocks affecting the production function. The primary mechanism of these models works through the dynamic optimizing behavior exhibited by agents in the economy that emphasizes that both consumption and investment show positive responses to these shocks. In turn, this influences the marginal productivity of labor, which induces a cyclical pattern in employment (Greenwood et al., 1988). Although various types of macroeconomic disruptions can theoretically lead to economic fluctuations in RBC models, the primary focus has predominantly been on technology shocks. This emphasis is due to the fact that other types of disruptions are improbable to produce variations in RBC models that closely mirror real-world economic fluctuations (Mankiw, 1989).

Cooley and Hansen (1989) emphasize that the initial equilibrium of business cycle models is significantly affected by the monetarist doctrine. These models center on the effect of unanticipated variations in the supply of money and have a significant role in driving changes in real indicators and elaborating the relation among real and nominal variables. However, more recently, the research on the business cycle has shifted to exogenous technology shocks. These models have success in generating the business cycle fluctuations while abstracting the significance of money; it does not assert that money is unimportant. In addition, recent studies indicate that monetary shocks do not lead to persistent real impacts in dynamic general equilibrium models including with reasonable price rigidity (Chari et al., 1996). This outcome holds significance for our understanding of the business cycle theory. If money cannot replicate the observed level of persistence in real world economic variations within a model, it becomes less credible as a primary driver of the business cycle (Jeanne, 1998). Also, certain macroeconomists perceive money as merely passive, causing a positive correlation by responding to changes in economic activity. In contrast, some other researchers regard variations within the money supply as substantial, possibly dominant contributors to economic fluctuations (King and Watson, 1996). Hence, the precise role of money within these models remains an open and somewhat controversial issue.

Incorporating money into the neoclassical growth framework can be achieved through three general approaches (Cooley and Hansen, 1995): 1) incorporating real money balances as a direct component of the utility function, 2) assuming that money helps save on the transaction expenses relate purchasing goods, and 3) stipulating that money is required for purchasing certain or all consumption goods. Cooley and Hansen

(1995) demonstrate that monetary shocks do not emerge to play a quantitatively significant role in driving the business cycle but they do have a significant effect when they are propagated due to certain rigidity in wages or prices.

This work aims to examine the fluctuations in aggregate activity in the USA with a real business cycle model that is subject to both technology and money growth shocks and the role-played by the persistence of the TFP and money growth shocks in business cycle fluctuations in the US economy. In our model, we depict an economy where individuals possess money due to the necessity of using cash to buy specific consumption goods. More specifically, we implement money and a cash-in-advance constraint into a RBC model as in Cooley and Hansen (1995). With this model, we investigate the characteristics of the US economy where money holds value in equilibrium. We then run simulations of our model under different scenarios using Dynare program, employing parameter values that have gained wide acceptance within the field of economics and are commonly utilized in DSGE models designed to represent the dynamics of the US economy. Later on, we present the businesss cycle facts obtained from the simulated data from the model for output, consumption, investment, hours, capital, and total factor productivity as well as the percentage of the variance for each variable that can be attributed to technology and money growth shocks.

In this work, Section 2 reviews the existing literature. Section 3 exhibits the model, Section 4 evaluates the primary findings and Section 5 concludes the work.

2. Literature Review

A well-established characterics of economic fluctuations is the robust positive correlation observed between fluctuations in the money supply and variations in production, income and employment within business cycle frequences. This outcome has sparked a vast body of research dedicated to analyzing the influence of monetary policy shocks on the real economy, with a focus on the role of money within the business cycle (Ohanian et al., 1995). Several monetary business cycle models have been formulated that feature distinct channels through which monetary policy can have real impacts. Cooley and Hansen (1989) incorporate money into a RBC model utilizing a cash-in-advance constraint. Then, they employ the model to investigate potential distinctions in the business cycle between high and low inflation economies. After that, these authors explore how fluctuations in the money growth rate can affect the economy. Cooley and Hansen (1998) also search three different equilibrium business cycle models that vary based on how monetary growth shocks influence the economy. Their model includes inflation tax, staggered nominal wage contracts and unexpected inflation impacts. Then, they analyze certain monetary aspects of postwar US business cycles and compare them with the same facts in the artifical economy. Note that in these models, money influences real economic activity but the aggregate fluctuations are primarily triggered by technology shocks.

Jeanne (1998) examines whether the presence of money within dynamic general equilibrium models of business cycles can generate fluctuations in an economy. They explore that including nominal constraints in the goods market and real wage rigidity in the labor market can cause a substantial and lasting impact of monetary shocks on output. Also, King and Watson (1996) investigate the consequences of three macroeconomic frameworks concerning the relation between money, price, interest rate and business cycle: a RBC model with endogenous money, a RBC model incorporating real influences of money resulting from sticky prices and a RBC model that capture real effects of money driven by financial market frictions. Although their models show success in generating the relationship between nominal variables with real output, all of the models display inadequate performance to explain the relation between real and nominal interest rates about real economic activity. Canova and Menz (2011) analyze the impact of money on economic variations in the United States, the United Kingdom, Japan, and the euro area employing a monetary business cycle model. They find that real balances play a statistically substantial role in output and inflation variations but their contribution varies over time. They figure out that money-excluded models offer a distorted depiction of the origins of cyclical variations and the propagation of shocks.

The primary cause of fluctuations in economic performance, according to the RBC theory, is seen as the random changes in factor productivity. Other triggering mechanisms, like shifts in preferences or alterations in monetary policy, are usually thought to have minimal impact on the business cycle, as suggested by Stadler (1994). Fluctuations in the economy exhibit significant differences in both their amplitude and duration, and it seems that no two cycles are completely identical. However, these cycles also encompass consistent qualitative aspects or patterns that consistently emerge (Stadler, 1994). RBC theory represents the most recent form of the classical view on economic fluctuations. It posits the existence of significant, unpredictable variations in the pace of technological change. In reaction to these changes, individuals make rational adjustments to their labor supply and consumption levels. According to this theory, the business cycle is the inherent and effective reaction of the economy to alterations in the accessible production technology (Mankiw, 1989). In addition, there has been an abundance of research conducted to explore the reaction of the economy to technology shocks in the literature. Some studies create a new indicator to measure technology shocks. For instance, Alexopoulos (2011) creates a new indicator of technological change based on published books in the field of technology to define technology shocks and she finds that positive technology shock increases employment, TFP and capital. Shea (1999) also creates a new indicator using R&D expenditures and patent applications. He explores that technology shocks increase input use in the short run but reduce it in the long-run and lead to a decrease in TFP.

Some other research papers delve into the realm of DSGE models that incorporate elements such as price and wage rigidities along with considerations for imperfect competition. These papers explore and contribute to the existing body of literature on this topic by providing insights and analyses within this framework. Poghosyan and

Beidas-Strom (2011) build a DSGE model for the Jordanian economy including nominal and real rigidities, imperfect competition and habit formation in the consumer's utility function and estimate it by using Bayesian estimation techniques. Their results show that while the fixed exchange rate regime can lead to increased volatility in output, consumption and both price and wage inflation, it also carries a relatively low risk premium. Ball and Romer (1990) explain that rigidities in real wages and prices are not sufficient to account for real effects of nominal disturbances. They also mention that when nominal frictions are absent, prices adjust fully to nominal shocks, irrespective of the degree of real rigidity. However, in their paper, they demonstrate that when the substantial real rigidity coexist with small costs of nominal flexibility, it can result in substantial real consequences arising from monetary changes. In addition, Christiano, Eichenbaum and Evans (2011) present a model that incorporates a moderate level of nominal rigidities. They find that the model produces an inertial response in inflation and a persistent, hump-shaped response in output following a monetary policy shock. They also explore that the interest rate and the money growth rate exhibit persistent movement in opposite directions following a monetary policy shock. Moreover, Bergin (2003) employs the maximum likelihood method to estimate a DSGE model featuring price and wage rigidities, which are incorporated as adjustment costs for Australia, Canada and the UK. His findings suggest that nominal rigidities play a pivotal role across all three countries. Furthermore, he finds that price rigidity is more important than wage rigidity. Lastly, Blanchard and Gali (2007) mention that the conventional New Keynesian framework frequently faces criticism due to its absence of a trade-off mechanism between stabilizing inflation and the output gap. To solve this issue, they introduce real wage rigidities.

3. Model

In this paper, we use a monetary business cycle model with a cash-in-advance constraint as in Cooley and Hansen (1995). With this model, we aim to investigate how macroeconomic indicators interact and react to shocks in the USA

3.1. Household Problem

In the following model, the detrended representative household aims to maximize its utility over an infinite time horizon. The household chooses consumption, labor, nominal money balances, and investment in each period to maximize its utility over time. So, the detrended representative household's problem is:

$$\max_{\{c_t, h_t, m_t, k_{t+1}\}} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t [\Psi \, log \, \hat{c}_t + (1-\Psi)\log(1-h_t)]$$

$\mathbb{E}_0$ represents the expectation operator at time t=0. It means that the household is considering the expected value of future utility. $\hat{c}_t$ is consumption, $1-h_t$ is leisure in period t. β is a discount factor which shows the household's preferences for consumption today versus consumption in the future. Ψ is the weight parameter for consumption in the representative household's objective function.

The household's problem is subject to a cash-in-advance constraint that limits consumption based on nominal money balances $\widehat{m}_{t-1}$ that the household had in the previous period t-1 and a tax term $\widehat{T}_t$, which shows the tax payments made by the household in time t. P_t is the relative price of goods to money.

$$\hat{c}_t \leq \frac{\widehat{m}_{t-1}}{P_t} + \frac{\widehat{T}_t}{P_t}$$

So, this equation above shows that the consumption of the household should not exceed the sum of two terms. The following equation below represents an important relation in monetary business cycle model, including, consumption, investment, money balances, government bonds, output, wages, interest rates, taxes.

$$\hat{c}_t + \hat{\mathrm{I}}_t + \Lambda \frac{\widehat{m}_t}{P_t} + \Lambda \frac{b_t}{P_t} = \hat{\pi}_t + \widehat{w}_t h_t + r_t \hat{k}_t + \frac{\widehat{m}_{t-1}}{P_t} + (1 + q_{t-1}) \frac{b_{t-1}}{P_t} + \frac{\widehat{T}_t}{P_t}$$

$\hat{\mathrm{I}}_t$ shows investment. b_t is the value of government bonds. $\hat{\pi}_t$ represents profit in time period t. $\widehat{w}_t$ is the labor income. h_t is employment. r_t is the real interest rate. $\hat{k}_t$ is the capital stock. q_t is the nominal interest rate. Λ is Lagrange multiplier that is related to the cash in advance constraint. Based on the information provided, this equation shows how the decisions of household (consumption and investment), the behavior of firms (output, wages and profit), and the government (taxes and bonds) interact within the economy. The evolution of the capital stock over time is as follows:

$$\Lambda \hat{k}_{t+1} = (1 - \delta)\hat{k}_t + \hat{\mathrm{I}}_t$$

k_0, m_0 are given. δ is the depreciation rate of capital.

3.2. Firm Problem

Firms produce output employing capital and labor according to a Cobb-Douglas production function. They aim to maximize profits, subject to production and labor constraint. So, the firm problem is:

$$\max \hat{\pi}_t = \hat{y}_t - \widehat{w}_t h_t - r_t \hat{k}_t$$

subject to

$$\hat{y}_t = z_t \hat{k}_t^{\theta} \hat{h}_t^{1-\theta}$$

$\hat{y}_t$ is the production level of the firm. θ is the share of capital in production. z_t is total factor productivity. It captures the overall efficiency and technology level of the economy.

3.3. Government Budget Constraint

The government budget constraint equates tax revenue to the change in money supply $(M_t - M_{t-1})$. The government collect taxes and redistributes a fraction of the money supply as transfer income.

$$T_t = M_t - M_{t-1} = \chi_t M_{t-1}$$

T_t shows the government's total transfer income. M_t is money supply. χ_t is money growth rate.

3.4. Stochastic Processes

The model incorporates stochastic processes for total factor productivity (z_t) and money growth rate (χ_t). These stochastic processes capture random fluctuations in these variables over time.

$$z_t = \rho_z \, z_{t-1} + \varepsilon_{z,t} \quad , \varepsilon_{z,t} \sim N\,(0, \sigma_z^2)$$

$$\chi_t = \rho_m \, \chi_{t-1} + \varepsilon_{m,t} \quad , \varepsilon_{m,t} \sim N\,(0, \sigma_m^2)$$

ρ_z and ρ_m are the persistence of shocks. They define how shocks propagate through the economy, influencing productivity and money growth. $\varepsilon_{z,t}$ and $\varepsilon_{m,t}$ are stochastic shock terms, assumed to follow a normal distribution with mean 0 and variance.

3.5. Equilibrium Conditions

We derive the equilibrium conditions assuming that the cash in advance constraint always binds.

$$(1-\theta)\frac{\hat{y}_t}{h_t} = \frac{1-\Psi}{1-h_t}\frac{1}{\phi_{2,t}}$$

$$\Lambda\, \phi_t = \beta\, \mathbb{E}_t[\phi_{t+1}\left(\theta\frac{\hat{y}_{t+1}}{\hat{k}_{t+1}} + 1 - \delta\right)]$$

$$\Lambda\, \phi_t = \beta\, \mathbb{E}_t[\phi_{t+1}]\left(\frac{1+q_t}{1+\iota_t}\right)$$

$$\Lambda\, \phi_t = \beta\, \mathbb{E}_t\left(\frac{\Psi}{\hat{c}_{t+1}}\frac{1}{1+\iota_{t+1}}\right)$$

$$\hat{\mu}_t = \hat{c}_t$$

$$\Lambda\, \hat{\mu}_t = \frac{1+\chi_t}{1+\iota_t}\,\hat{\mu}_{t-1}$$

$$\hat{y}_t = \hat{c}_t + \hat{\mathrm{I}}_t$$

$$\hat{y}_t = z_t \hat{k}_t^{\theta} \hat{h}_t^{1-\theta}$$

$$\Lambda\, \hat{k}_{t+1} = (1-\delta)\hat{k}_t + \hat{\mathrm{I}}_t$$

Where $\emptyset_t$ is the Lagrange multiplier for the budget contraint. ι_t is inflation. We define $\hat{\mu}_t = \frac{\hat{M}_t}{P_t}$ for convenience. Therefore, there are 9 equations for 9 variables $(y_t, c_{t,} i_t, h_t, k_{t+1}, \mu_t, q_t, \iota_t, \phi_t)$

The equilibrium conditions of model are linearized to explore the economy's behavior around a steady state. This involves approximating equations using log-linearization and Taylor expansion techniques. The linearized equations express relationships between log-deviations of variables from their steady-state values. When we linearize the equilibrium conditions using log linearization and Taylor expansion:

$$\tilde{y}_t = \left(\frac{1}{1-\bar{h}}\right) \tilde{h}_t - \tilde{\phi}_t$$

$$\tilde{\phi}_t = \mathbb{E}_t[\tilde{\phi}_{t+1} + \frac{\beta}{\Lambda} \theta \frac{\bar{y}}{\bar{k}} (\tilde{y}_{t+1} - \tilde{k}_{t+1})]$$

$$\tilde{\phi}_t = \mathbb{E}_t[\tilde{\phi}_{t+1} + \tilde{q}_t - \tilde{\iota}_{t+1}]$$

$$\tilde{\phi}_t = \mathbb{E}_t[-\tilde{c}_{t+1} - \tilde{\iota}_{t+1}]$$

$$\tilde{\mu}_t = \tilde{c}_t$$

$$\tilde{\mu}_t = \tilde{x}_t - \tilde{\iota}_t + \tilde{\mu}_{t-1}$$

$$\tilde{y}_t = \left(\frac{\bar{c}}{\bar{y}} \tilde{c}_t\right) + \left(\frac{\bar{\mathrm{I}}}{\bar{y}} \tilde{\mathrm{I}}_t\right)$$

$$\tilde{y}_t = \tilde{z}_t + \theta \tilde{k}_t + (1-\theta)\tilde{h}_t$$

$$\Lambda \tilde{k}_{t+1} = \left(\frac{\bar{\mathrm{I}}}{\bar{k}} \tilde{\mathrm{I}}_t\right) + (1-\delta)\tilde{k}_t$$

After we simplify and rearrange the model equations to isolate the variables of interest in terms of their steady state values which involves setting time derivatives to zero, we solve the simplified equations fo the steady state values of the variables. To calibrate the model, we use the steady state level of the model as shown in Table 1. In this study, we have relied on highly conventional parameters widely used in the literature for the US economy (Kydland and Prescott (1982), Hansen and Wright (1992), Cooley and Dwyer (1998)). The discount factor, β is set to 0.99 so as to imply a reasonable steady state real interest rate. The capital share, θ is set to 0.36 to match the average fraction of total income going to capital in the US economy. The depreciation rate, β is set to 0.03, which implies a reasonable steady state ratio of capital to output and a ratio of investment to output. The weight parameter for consumption, Ψ is set to 0.24 and Λ is Lagrange multiplier that is related to the cash in advance constraint which is set to 1.0052.

Table 1. Steady State Levels

Steady States Levels	Values	Parameters	Values
$\bar{h}$	0.2354	Λ	1.0052
$\frac{\bar{c}}{\bar{y}}$	0.6802	θ	0.3688
$\frac{\bar{I}}{\bar{y}}$	0.3197	δ	0.0363
$\frac{\bar{y}}{\bar{k}}$	0.0672	β	0.9967
$\frac{\bar{I}}{\bar{k}}$	0.0215	Ψ	0.2492

4. Results

In this section, we present the business cycle facts for the USA obtained from the simulated data from the model for output (Y), consumption (C), investment (I), hours (H), capital (K) and total factor productivity (TFP). Tables 2, 3 and 4 present the stylized facts of these variables based on the volatility, the correlation between the variable and output and autocorrelation. These tables also illustrate the percentage of the variance for each variable that can be attributed to the exogenous shocks for the USA. In addition, the standard deviation of both shocks is set to 1 in this model. Note that our aim is not to show whether our model does a good job replicating the second moments of macroeconomic dynamics in the USA. Rather, our aim is to show how the persistence of productivity and money growth shocks drive the business cycles in this country.

If we first assume that the persistency of total factor productivity shock (ρ_z) and money supply shock (ρ_m) are set to 0.95 and 0.5, respectively, the volatility of output is 5.91 and it is perfectly correlated with itself (1.00). The variable output has a high autocorrelation of 0.96, which indicates that current output is significantly correlated with recent past output. Also, its variance is fully explained by the total factor productivity shocks (ε_z) and there is no contribution from money growth shocks (ε_m). In addition, the volatility of consumption is found as 3.90 and the correlation between output and consumption is 0.85 as it exhibits substantial autocorrelation, with a value of 0.95. When we look at the results for variance decomposition, most of its variance (98.07%) is explained by the ε_z shock, while a small portion (1.93%) is explained by the ε_m shock. Moreover, the investment variable has the highest volatility of 12.27. It exhibits a significant correlation with the output (0.94) and a moderate autocorrelation of 0.93. Most of its variance (99.23%) is explained by the ε_z shock, with a smaller portion (0.77%) attributed to the ε_m shock. Looking at hours worked, it has a volatility of 2.51 and a relatively significant correlation with output (0.80) as well as a high autocorrelation (0.91). Nearly all of its variance (99.94%) is due to the ε_z shock, with a minimal contribution (0.06%) from the ε_m shock. The capital variable has a volatility of 5.56. It is moderately correlated with output (0.76) and has a high autocorrelation (0.99). Also, most of its variance (99.93%) comes from the ε_z shock, with a small contribution (0.07%) from the ε_m shock. The TFP variable has a volatility of 3.20. It correlates almost perfectly with output (0.99) and has a high autocorrelation (0.95). Its entire variance (100.00%) is explained by the ε_z shock, with no contribution from the ε_m shock.

Table 2. Simulation of the US Economy ($\rho_z = 0.95$, ρ_m = 0.5)

				Variance Decomposition	
	Volatility	**Correlation with Output**	**Autocorrelation**	$\boldsymbol{\varepsilon_z}$	$\boldsymbol{\varepsilon_m}$
Output	5.91	1.00	0.96	100.00	0.00
Consumption	3.90	0.85	0.98	98.07	1.93
Investment	12.27	0.94	0.93	99.23	0.77
Hours	2.51	0.80	0.91	99.94	0.06
Capital	5.56	0.76	0.99	99.93	0.07
TFP	3.20	0.99	0.95	100.00	0.00

We then simulate the model by assuming that the ρ_z and ρ_m are 0.5 and 0.95, respectively. The findings are displayed in Table 3. The findings indicate that the volatility of the variables has decreased significantly. In addition, the correlation between consumption and output and between capital and output declines in this second scenario. Also, about 89.49% of output variance is explained by the ε_z shock, while 10.51% is explained by the ε_m shock. For consumption, a small portion (7.15%) of its variance is attributed to the ε_z shock, while the majority (92.85%) is attributed to the ε_m shock. For investment, most of its variance (92.98%) is due to the ε_z shock, while a smaller portion (7.02%) is due to the ε_m shock. For hours worked, about 52.38% of its variance is explained by the ε_z shock, while 47.62% is explained by the ε_m shock. For capital, a higher percentage of its variance (55.89%) is attributed to the ε_z shock compared to the ε_m shock (44.11%). Lastly, for TFP, its entire variance (100.00%) is attributed to the ε_z shock, with no contribution from the ε_m shock.

Table 3. Simulation of the US Economy ($\rho_z = 0.5$, ρ_m = 0.95)

				Variance Decomposition	
	Volatility	**Correlation with Output**	**Autocorrelation**	$\boldsymbol{\varepsilon_z}$	$\boldsymbol{\varepsilon_m}$
Output	2.28	1.00	0.56	89.49	10.51
Consumption	1.98	0.41	0.93	7.15	92.85
Investment	6.61	0.81	0.51	92.98	7.02
Hours	2.11	0.87	0.70	52.38	47.62
Capital	1.20	0.14	0.99	55.89	44.11
TFP	1.15	0.94	0.50	100.00	0.00

We lastly simulate the model by assuming the ρ_z and ρ_m are 0.5 and 0.5, respectively. Our observation is that the volatility of consumption and capital are lower as well as the correlation between output and consumption is lower when we compare the results with the second scenario. Also, the outcomes show that a significant portion of consumption variance (51.19%) is attributed to ε_m shock, while the remaining portion (48.81%) is attributed to the ε_z shock. For other variables, note that most of their variance is explained by ε_z shock.

Overall, the results imply that the ε_z shock seems to be a more important driver of variability for the US economy compared to ε_m, indicated by the higher percentages of variance decomposition attributed to ε_z. However, the ε_m shock seems to affect consumption variability in the USA more significantly in cases of $\rho_z = 0.5$, ρ_m = 0.5 and $\rho_z = 0.5$, ρ_m = 0.95. Also, we observe that the volatility of the variable is higher if the persistency of total factor productivity shocks is high compared to the volatility resulting from money growth shocks. We can conclude that the specific effects and relatios between variables and shocks depend on the parameter values of the model.

Table 4. Simulation of the US Economy ($\rho_z = 0.5$, ρ_m = 0.5)

				Variance Decomposition	
	Volatility	**Correlation with Output**	**Autocorrelation**	ε_z	ε_m
Output	2.16	1.00	0.52	99.97	0.03
Consumption	0.75	0.29	0.72	48.81	51.19
Investment	6.46	0.97	0.48	97.22	2.78
Hours	1.53	0.96	0.47	99.83	0.17
Capital	0.91	0.36	0.98	97.22	2.78
TFP	1.15	0.99	0.50	100.00	0.00

5. Conclusion

The primary aim of this paper is to investigate the nature of variations in overall economic activity in the USA using a real business cycle model. This model takes into account both technology shocks and money growth shocks. In this model, we consider an economy where individuals hold money to purchase specific consumer goods. More specifically, we introduce the concept of money and a constraint that requires cash in advance into a RBC model, similar to the approach outlined by Cooley and Hansen (1995). Furthermore, this article delves into the influence exerted by the persistence of total factor productivity and money growth shocks on fluctuations in the business cycle. Our findings suggest that the fluctuations in macroeconomic indicators show an increased level of instability when the persistence of TFP shocks in the USA is more pronounced in comparison to the persistence of money growth shocks. Additionally, it seems that TFP shocks have a more notable impact on driving changes in variability within the models as opposed to money growth shocks. This is illustrated by a higher proportion of variance decomposition associated with TFP shocks, except for consumption variability.

Overall, our results imply that TFP shocks have a substantial impact on the features of the real business cycle for the US economy. Nevertheless, monetary growth shocks, while still important, might have a relatively smaller effect on shaping the business cycle fluctuations in the USA. The significance of this study lies in its exploration of the dynamics of economic activity fluctuations within an economy through the lens of a RBC model as well as it provides insights into the relative importance of guiding policy decisions.

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