Structuralist Development Macroeconomics Research Group

SDM

The Term Structure of Interest Rate and Income Distribution in an SFC Post-Keynesian Growth Model with Inflation Targeting and Zero Money Financing of Government Deficit

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Motivation

Two major theoretical postulates of Keynesian economics are that the level of interest rate is a strict monetary phenomenon, being determined by the interaction between liquidity preference of households, firms and commercial banks and the monetary policy conducted by Central Bank (Carvalho, 2015, pp.21-25); and that an increase in government (or other element of the so-called autonomous) expenditures will always increase the level of output and employment and hence aggregate savings, avoiding a crowding out of private investment by government expenditures due to a “lack of savings” (Amadeo, 1989, pp.113-117), at least if the economy is operating in a situation of underemployment equilibrium. The first postulate is the *Liquidity Preference Theory*, the second is the *Principle of Effective Demand*.

Motivation

These postulates **are generally presented in a very simplified model** about the workings of the economic system, where there **is just *one interest rate* and the stock-flow implications of financing of government deficits are ignored**. Many years ago, the dependence of these postulates on simplified assumptions regarding the structure of economic system were questioned by Tom Asimakopoulos, an unsuspected Keynesian economist.

In his 1991 book, Asimakopoulos said that "Keynes´s theory of interest is dependent on the long-term expectations that determine the position and shape of liquidity preference function. He did not recognize that these long-term expectations could be affected by comparison of projected rates on investment and projected savings (based on economy´s propensity to save) in future periods. If it appears that investment would be greater than normal savings, concerns over future interest rates could bring about immediate increases in long-term rates that act as a damper to investment plans. **Thus, the independence of investment from saving – a key element in Keynes´s theory – does not hold in all circumstances**" (Asimakopoulos, 1991, p.116).

Motivation

The aim of the present article is precisely to build an SFC growth model that incorporates some features of the Institutional Arrangement of fiscal and monetary policy that exists in the real world. More precisely in our model monetary policy will be conducted under the framework of Inflation Targeting Regime, money financing of government deficit will be forbidden by law and government issued interest rate-indexed bonds in order to finance its fiscal deficit.

Hence the model is used to analyze the effects of a **once-and-for all change in the level of government expenditures** over the time path of investment to GDP ratio, profit share, capacity utilization, the spread between long-term and short-term interest rates and inflation.

Balance Sheet - SFC

	Workers	Firms	Government	Banks	Central Bank	Rentiers	$\sum$
Loans		$-L$		$+L$			0
Bank Deposits				$-D$		$+D$	0
Bank Reserves				$+R$	$-R$		0
CB Advances				$-A$	$+A$		0
Bonds			$-B$			$+B$	0
Fixed Capital		$+p.K$					$+p.K$
Balance (Net Worth)	0	$-V_f$	$-V_g$	$-V_b$	$-V_{cb}$	$-V_r$	$+p.K$
$\sum$	0	0	0	0	0	0	0

Note: Positive sign (+) preceding a variable represents an asset for that agent and negative sign (-) represents a liability

Transactions-Flow Matrix - SFC

	Workers	Firms: Current	Firms: Capital	Government	Central Bank	Banks	Rentiers	$\sum$
Consumption	$-C_W$	$+C$					$-C_R$	0
Investment		$+I$	$-I$					0
Government Expenditures		$+G$		$-G$				0
Wages	$+W_b$	$-W_b$						0
Tax	$-T_w$	$-T_f$		$+T$		$-T_b$	$-T_r$	0
Retained Profits (Firms)		$-Fu$	$+Fu$					0
Unretained Profits (Firms)		$-Fd$					$+Fd$	0
CB and Bank Profits				$+F_{cb}$	$-F_{cb}$	$-Fb$	$+Fb$	0
Interest in Bonds				$-ib_{-1}.B_{-1}$			$+ib_{-1}.B_{-1}$	0
Interest in Advances					$+ia_{-1}.A_{-1}$	$-ia_{-1}.A_{-1}$		0
Interest in Loans		$-il_{-1}.L_{-1}$				$+il_{-1}.L_{-1}$		0
$\sum$	0	0	$+Fu-I$	$+Sav_g$	0	0	$+Sav_r$	0
Δ Deposits						$+\Delta D$	$-\Delta D$	0
Δ Bonds				$+\Delta B$			$-\Delta B$	0
Δ Advances					$-\Delta A$	$+\Delta A$		0
Δ Loans			$+\Delta L$			$-\Delta L$		0
$\sum$	0	0	0	0	0	0	0	0

Note: Positive sign (+) preceding a variable represents a resource destination and negative sign (-) represents a source

Behavior Equations: Price, Inflation and Income Distribution.

$$p = [1 + m(\cdot)].\frac{W_b}{q} \quad (1)$$

$$m = m_0 + m_1.i_{wacc_{-1}} - m_2.u_{-1} \quad (2)$$

$$h = \frac{\Pi}{Y} = \frac{m(\cdot)}{1+m(\cdot)} = \frac{m_0+m_1.i_{wacc_{-1}}-m_2.u_{-1}}{1+m_0+m_1.i_{wacc_{-1}}-m_2.u_{-1}} \quad (3)$$

$$\omega = 1 - h(\cdot) = \frac{1}{1+m_0+m_1.i_{wacc_{-1}}-m_2.u_{-1}} \quad (4)$$

$$\omega^d = \omega_1 + \omega_2.u \quad (5)$$

$$\widehat{w}_b = (1-\alpha_1).\hat{p}_{-1} + \alpha_1.\left(\omega^d - \omega\right) \quad (6)$$

$$\hat{p} = \frac{m_1.\Delta i_{wacc_{-1}}-m_2.\Delta u_{-1}}{1+m_0+m_1.i_{wacc_{-1}}-m_2.u_{-1}} + (1-\alpha_1).\hat{p}_{-1} + \alpha_1.(\omega_1 + \omega_2.u - \omega) \quad (7)$$

$$r_k = \frac{\Pi}{p.K_{-1}} = h(\cdot).u(\cdot) \quad (8)$$

Behavior Equations: Households

$$C_w = (1-\theta).W_b \qquad (9)$$

$$C_r = a.V_{r_{-1}} \qquad (10)$$

$$C = C_w + C_r = (1-\theta).W_b + a.V_{r_{-1}} \qquad (11)$$

$$V_r = V_{r_{-1}} + S_r \qquad (12)$$

$$B^d = [\lambda_0 + \lambda_1.(i_b - i_a)].V_{r_{-1}} - \lambda_2.(1-\theta).Y \qquad (13)$$

$$D^d = [(1-\lambda_0) - \lambda_1.(i_b - i_a)].V_{r_{-1}} + \lambda_2.(1-\theta).Y \qquad (14)$$

Behavior Equations: Government

$$T = \theta . d . \Pi + \theta . (1 - d) . \Pi + \theta . W_b = \theta . Y \tag{15}$$

$$G = g_0 . K_{-1} \tag{16}$$

$$PBR = \Delta B = G - (T + F_{cb}) \tag{17}$$

$$B^s = \left(1 + i_{b_{-1}}\right) B^S_{-1} + PBR \tag{18}$$

$$F_{cb} = i_{a_{-1}} . A_{-1} \tag{19}$$

Behavior Equations : Interest Rates

$$i_a = i_{a_{-1}} + \phi_2 . (\hat{p}_{-1} - \hat{p}^T) \tag{20}$$

$$i_b = -\frac{\lambda_0}{\lambda_1} + i_a + \frac{(1-\tau)}{\lambda_1} . i_{a_{-1}} + \frac{\left(1 + i_{b_{-1}}\right) B^S_{-1} + g_0 . K_{-1} - i_{a_{-1}} . (L_{-1} + (1-\tau) . B_{-1}) + [\lambda_2 . (1-\theta) - \theta] . Y}{\lambda_1 . V_{r_{-1}}} \tag{21}$$

Behavior Equations : Comercial Banks

$$i_l = (1 + \phi_1).\, i_a \qquad (22)$$

$$R \equiv \tau.\, D \qquad (23)$$

$$Fb = i_{l_{-1}}.\, L_{-1} - i_a.\, A_{-1} \qquad (24)$$

$$L = L_{-1} + I - Fu \qquad (25)$$

$$A \equiv L - (1 - \tau).\, D \qquad (26)$$

Behavior Equations : Firms

$$i_{wacc} = x_1.\, i_a + (1 - x_1).\, i_l, \quad 0 \leq x_1 \leq 1 \qquad (27)$$

$$in = \frac{\Delta K}{K_{-1}} = \gamma_0 + \gamma_1.\, (r_k - i_{wacc}) \qquad (28)$$

$$F = h.\, Y - i_{l_{-1}}.\, L_{-1} \qquad (29)$$

$$Fd = d.\, F, \quad 0 < d < 1 \qquad (30)$$

$$Fu = (1 - \theta).\, (1 - d).\, F \qquad (31)$$

$$K = K_{-1} + I \qquad (32)$$

The same model in a reduced version

$$\hat{p} = \frac{m_1.z_1\Delta.i_{a_{-1}} - m_2.\Delta u_{-1}}{1 + m_0 + m_1.z_1\Delta.i_{a_{-1}} - m_2.u_{-1}} + (1-\alpha_1).\hat{p}_{-1} + \alpha_1.[\omega_1 + \omega_2.u - (1-h)] \quad \text{(R.1)}$$

$$u = \frac{1}{\theta + \gamma_2 + a_3.h}(A_1 + a.v_{r_{-1}} - \gamma_1.z_1.i_a) \quad \text{(R.2)}$$

$$i_a = i_{a_{-1}} + \phi_2.(\hat{p}_{-1} - \hat{p}^T) \quad \text{(R.3)}$$

$$i_b = -\frac{\lambda_0}{\lambda_1} + i_a + \frac{(1-\tau)}{\lambda_1}.i_{a_{-1}} + \frac{g_0 + [1 + i_{b_{-1}} - (1-\tau).i_{a_{-1}}].b_{-1} - i_{a_{-1}}.l_{-1} + [\lambda_2.(1-\theta) - \theta].u}{\lambda_1.v_{r_{-1}}} \quad \text{(R.4)}$$

$$h = \frac{m_0 + m_1.z_1.i_{a_{-1}} - m_2.u_{-1}}{1 + m_0 + m_1.z_1.i_{a_{-1}} - m_2.u_{-1}} \quad \text{(R.5)}$$

$$in = \gamma_0 + \gamma_1.h.u - \gamma_1.z_1.i_a \quad \text{(R.6)}$$

$$b = \frac{[1 + i_{b_{-1}} - (1-\tau).i_{a_{-1}}].b_{-1} + \gamma_0 - \theta.u - i_{a_{-1}}.[l_{-1} - (1-\tau)]}{1 + in} \quad \text{(R.7)}$$

$$l = \frac{[1 + (1+\phi_1).i_{a_{-1}}].l_{-1} + in - (1-\theta).(1-d).h.u}{1 + in} \quad \text{(R.8)}$$

$$v_r = \frac{[1 - a + (1-\tau).i_{a_{-1}}].v_{r_{-1}} + (1-\theta)\{[i_{b_{-1}} - (1-\tau).i_{a_{-1}}].b_{-1} + [(1-d)(1+\phi_1) - 1].i_{a_{-1}}.l_{-1} + d.h.u\}}{1 + in} \quad \text{(R.9)}$$

Model - Reduced Version

Short-run links among the variables:

	Short-run link among variables															
	Actual Variables									*Lagged Variables*						
	$\hat{p}$	u	i_a	i_b	h	in	b	l	v_r	$\hat{p}_{-1}$	u_{-1}	$i_{a\,-1}$	$i_{b\,-1}$	b_{-1}	l_{-1}	$v_{r\,-1}$
$\hat{p}$	-	>0	<0	-	>0	-	-	-	-	>0	?	?	-	-	-	-
u	-	-	<0	-	<0	-	-	-	-	<0	-	<0	-	-	-	>0
i_a	-	-	-	-	-	-	-	-	-	>0	-	>0	-	-	-	-
i_b	-	>0	>0	-	-	-	-	-	-	>0	-	>0	>0	>0	<0	<0
h	-	-	-	-	-	-	-	-	-	-	<0	>0	-	-	-	-
in	-	>0	<0	-	>0	-	-	-	-	<0	?	?	-	-	-	>0
b	-	?	?	-	-	<0	-	<0	-	-	-	?	>0	>0	<0	-
l	-	?	-	-	?	?	-	-	-	?	-	?	-	-	>0	-
v_r	-	?	?	-	?	<0	-	-	-	?	?	?	>0	?	>0	>0

Model - Reduced Version

Fixed Points for the Steady-State

$$\hat{p}^* = p^T$$ [Inflation]

$$u^* = \frac{1}{\omega_2}(\hat{p}^T + \omega^* - \omega_1)$$ [Capacity Utilization]

$$i_a^* = \frac{1}{A_2}.\left[(A_1 + a.v_r^*) - \frac{1}{\psi_1.\omega_2}.(\hat{p}^T + \omega^* - \omega_1)\right]$$ [Short Interest Rate]

$$i_b^* = -\frac{\lambda_0.v_r^*}{\lambda_1.v_r^* - b^*} + \frac{[\lambda_1 + (1-\tau)].i_a^*.v_r^*}{\lambda_1.v_r^* - b^*} + \frac{b^* + g_0 - i_a^*.[l^* + (1-\tau).b^*] + [\lambda_2.(1-\theta) - \theta].u^*}{\lambda_1.v_r^* - b^*}$$ [Long Interest Rate]

$$h^* = \frac{m_0 + m_1.z_1.i_a^* - m_2.u^*}{1 + m_0 + m_1.z_1.i_a^* - m_2.u^*}$$ [Profit Share]

$$in^* = \gamma_0 + \gamma_1.h.u^* - \gamma_1.z_1.i_a^*$$ [Investment Rate]

$$b^* = \frac{\gamma_0 - \theta.u^* - i_a^*.(l^* - v_r^*)}{(1 - i_a^*).in^* - i_b^* - i_a^*}$$ [Bonds/Capital]

$$l^* = \frac{\gamma_0 - \gamma_1.z_1.i_a^* + [\gamma_1 - (1-\theta).(1-d)].h^*.u^*}{\gamma_0 + \gamma_1.h^*.u^* - (1 + \phi_1 + \gamma_1.z_1).i_a^*}$$ [Loans/Capital]

$$v_r^* = \frac{(1-\theta)\{[i_b^* - (1-\tau).i_a^*].b^* - [1 - (1-d)(1+\phi_1)].i_a^*.l^* + d.h^*.u^*\}}{\gamma_0 + a + \gamma_1.h.u^* - (1 - \tau + \gamma_1.z_1).i_a^*}$$ [Wealth/Capital]

Model - Reduced Version

Parameters’ Maping for the Steady State Equilibrium

Algorithm Steps:

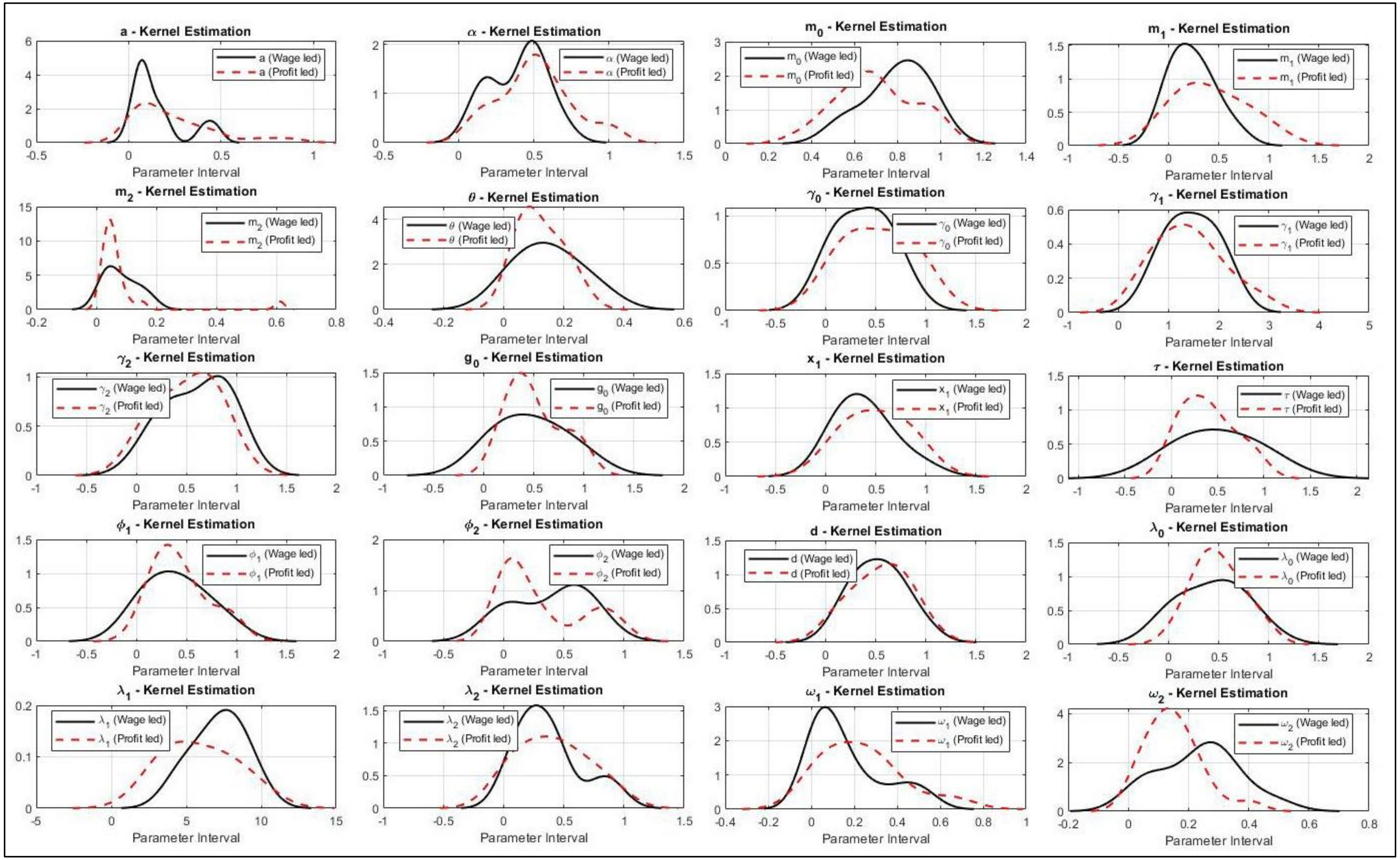
1. Generation of random parameters through a plausible economic interval.
2. Model resolution via Gauss-Seidel using these random parameters as input.
3. Storage of reduced model variables when $t = 1000$.
4. Separate $\Delta\hat{p}, \Delta u, \Delta h, \Delta in, \Delta i_a, \Delta i_b, \Delta b, \Delta l, \Delta v_r < 10^{-6}$ (tolerance).

Parameters’ Division for Wage Led e Profit Led Regimes:

1. From the filtered data, it is calculated for $t = 1000$ the values of $\Delta u/\Delta h$ and $\Delta in/\Delta h$.
2. If $\Delta u/\Delta h > 0$ and $\Delta in/\Delta h > 0$, Profit-led demand and accumulation regimes. Wage-led, otherwise.

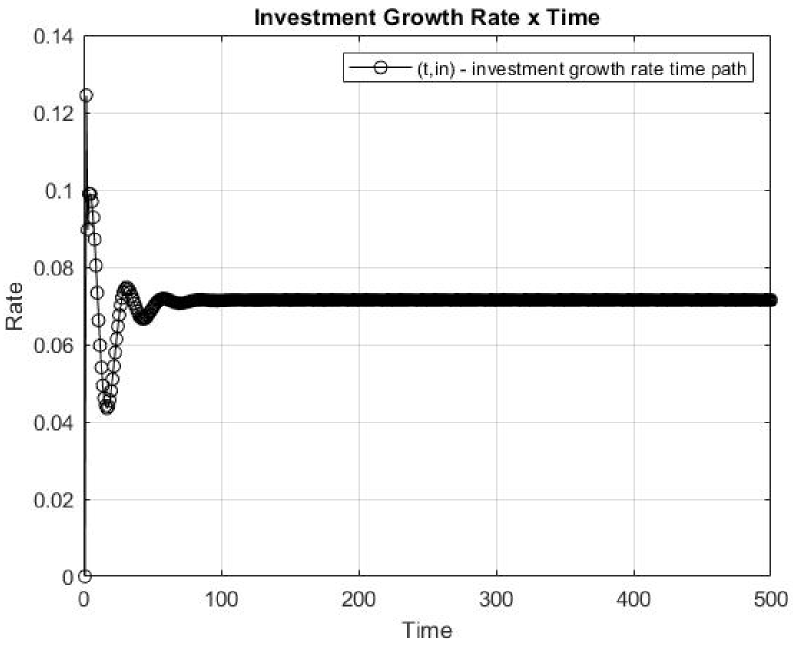
Model –Reduced Version

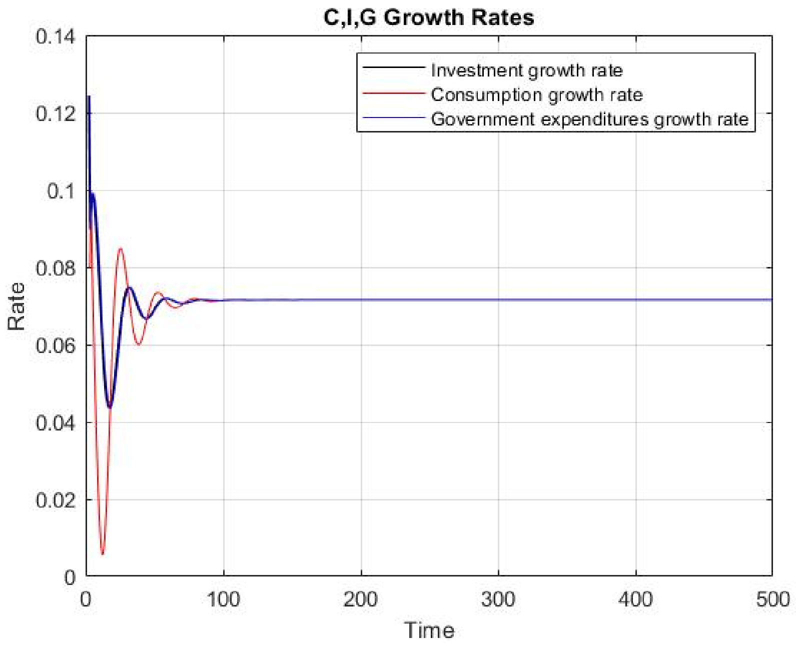
Parameters' Maping for the Steady State Equilibrium

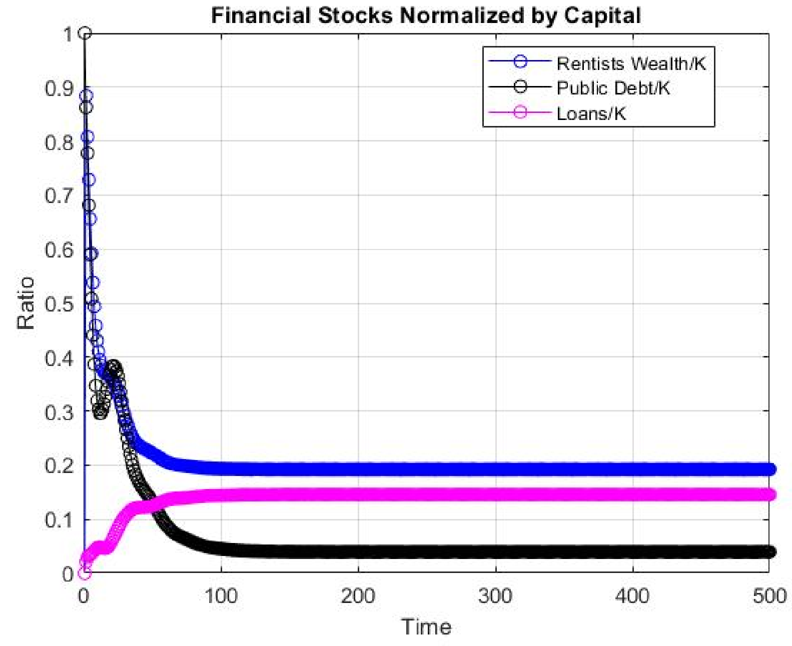


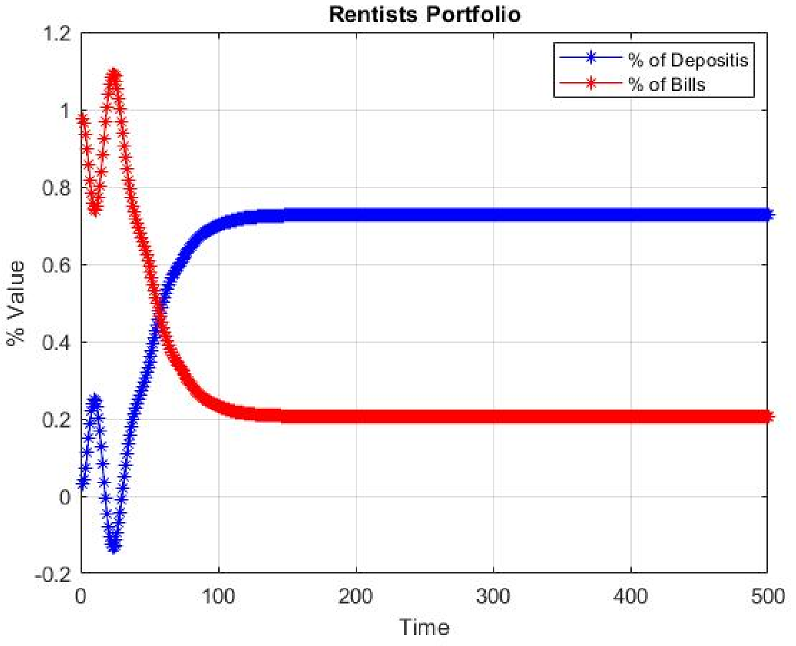
Calibration and Simulation:

Parameter	Value	Parameter	Value
a	0,04	m_0	0,5
α	1	m_1	0,2
α_1	0,15	m_2	0,2
d	0,25	ω_1	0,4
g_0	0,07	ω_2	1
γ_0	0	ϕ_1	0,5
γ_1	0,5	ϕ_2	0,25
γ_2	-0,05	τ	0,1
λ_0	0,3	θ	0,2
λ_1	100	x_1	0,6
λ_2	0,5	$\hat{p}^T$	0,04









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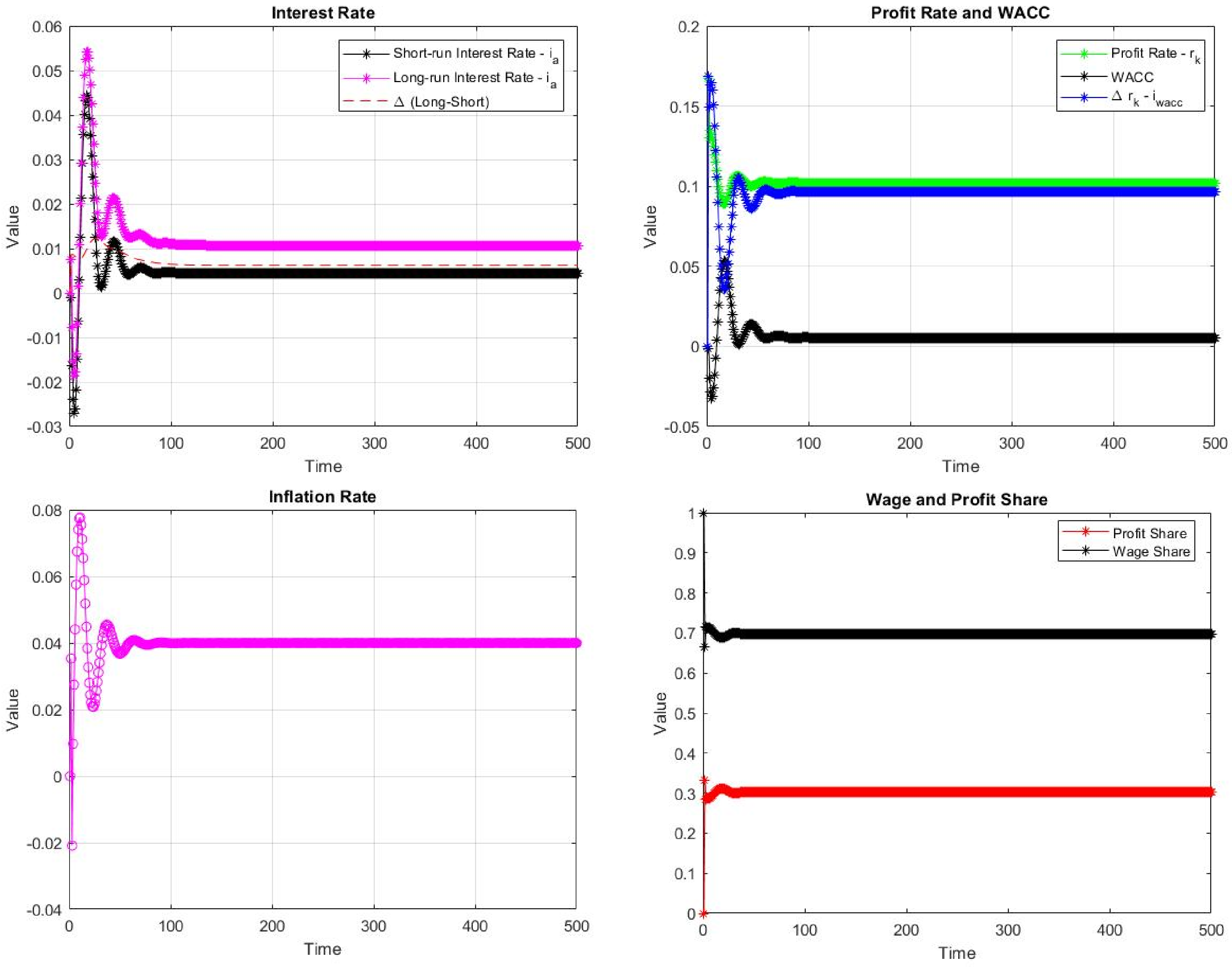

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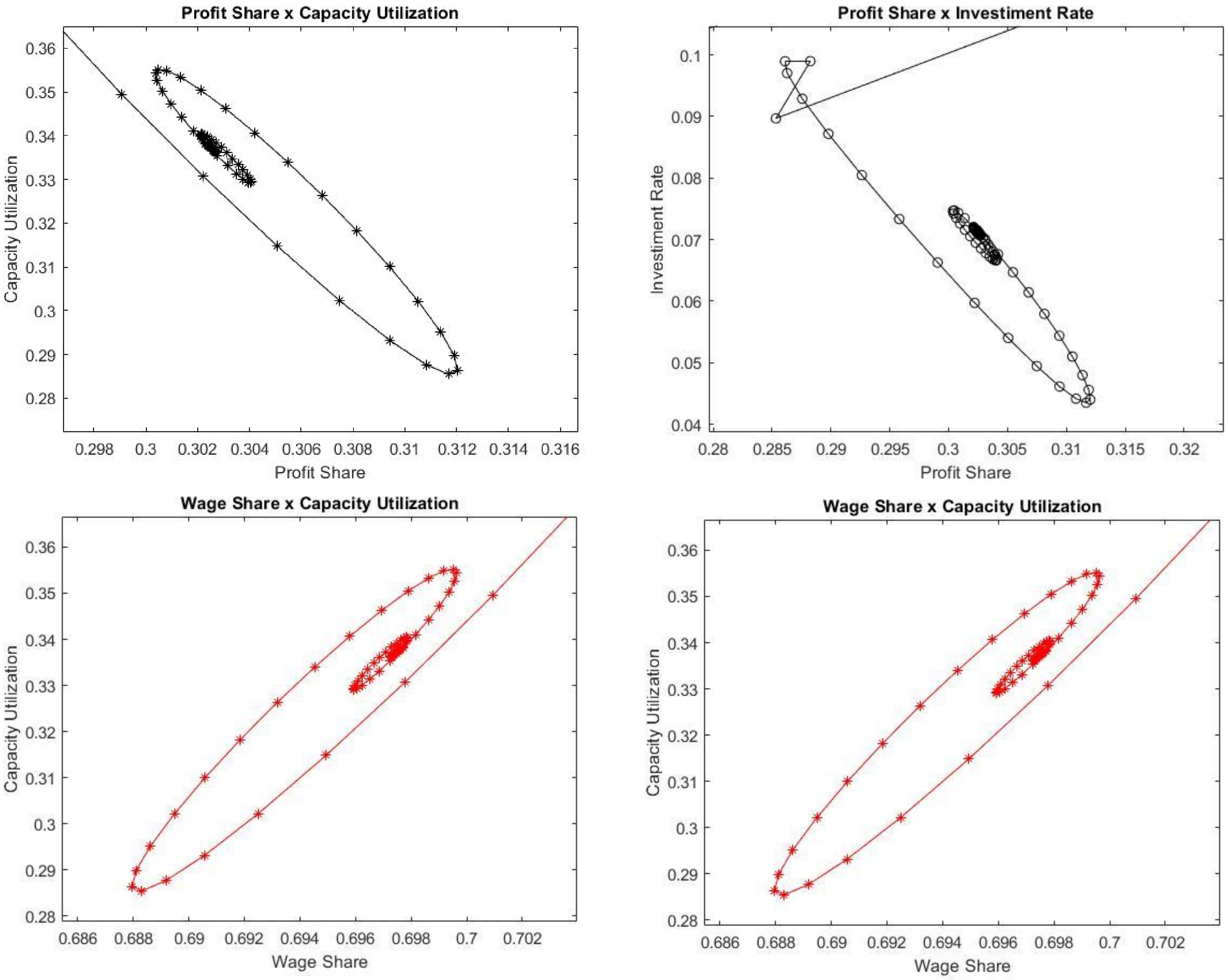

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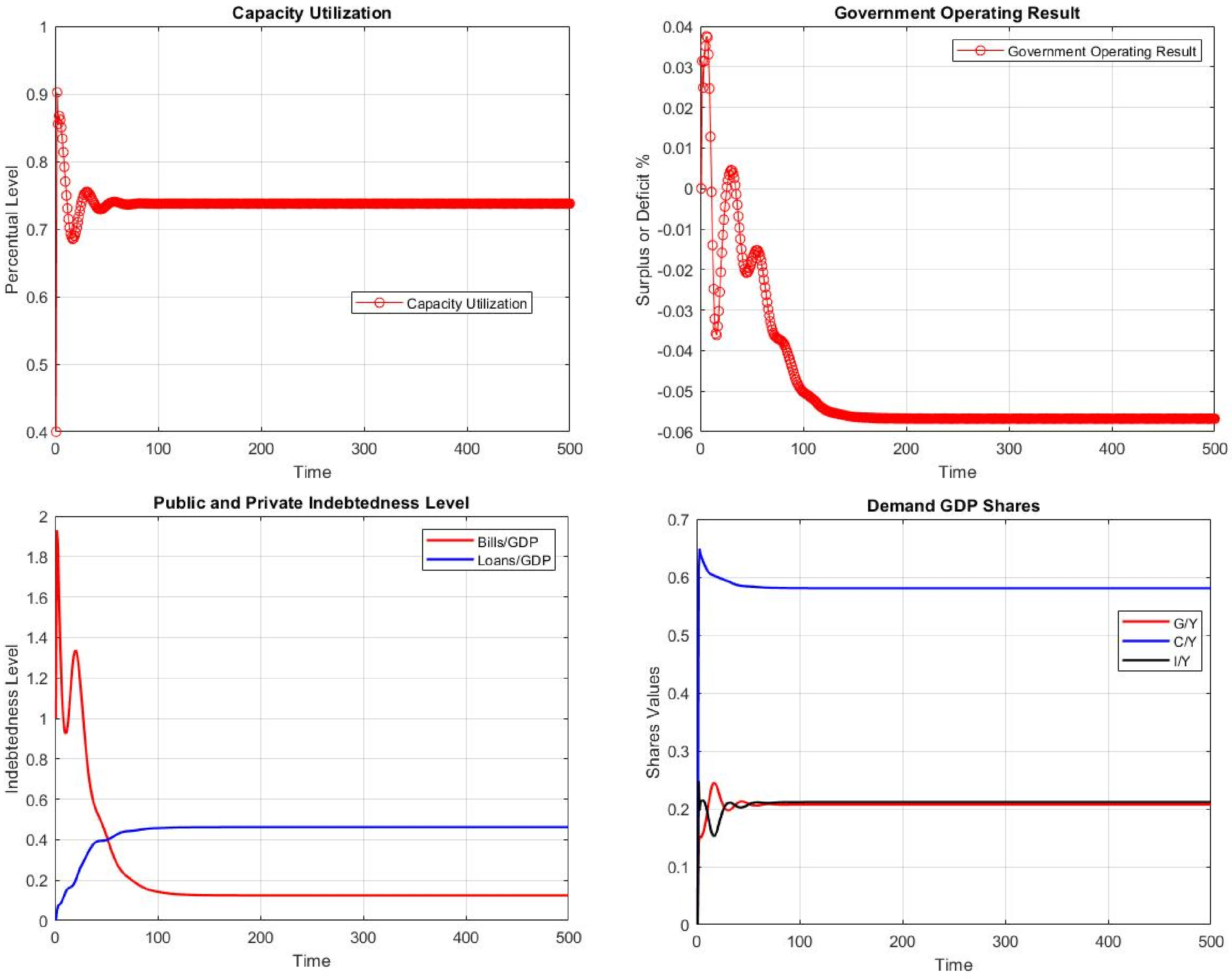
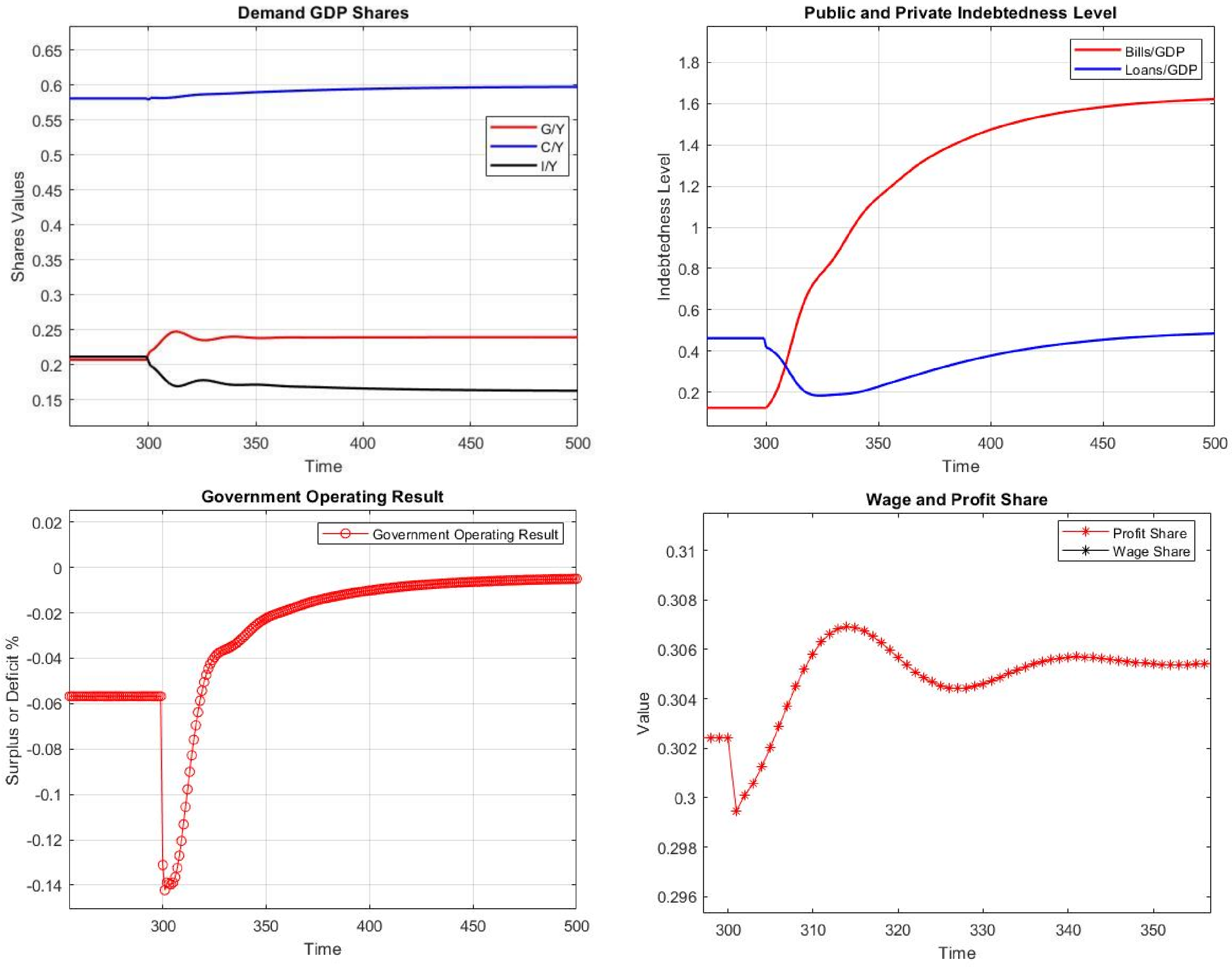


Shock: $\uparrow g_0$



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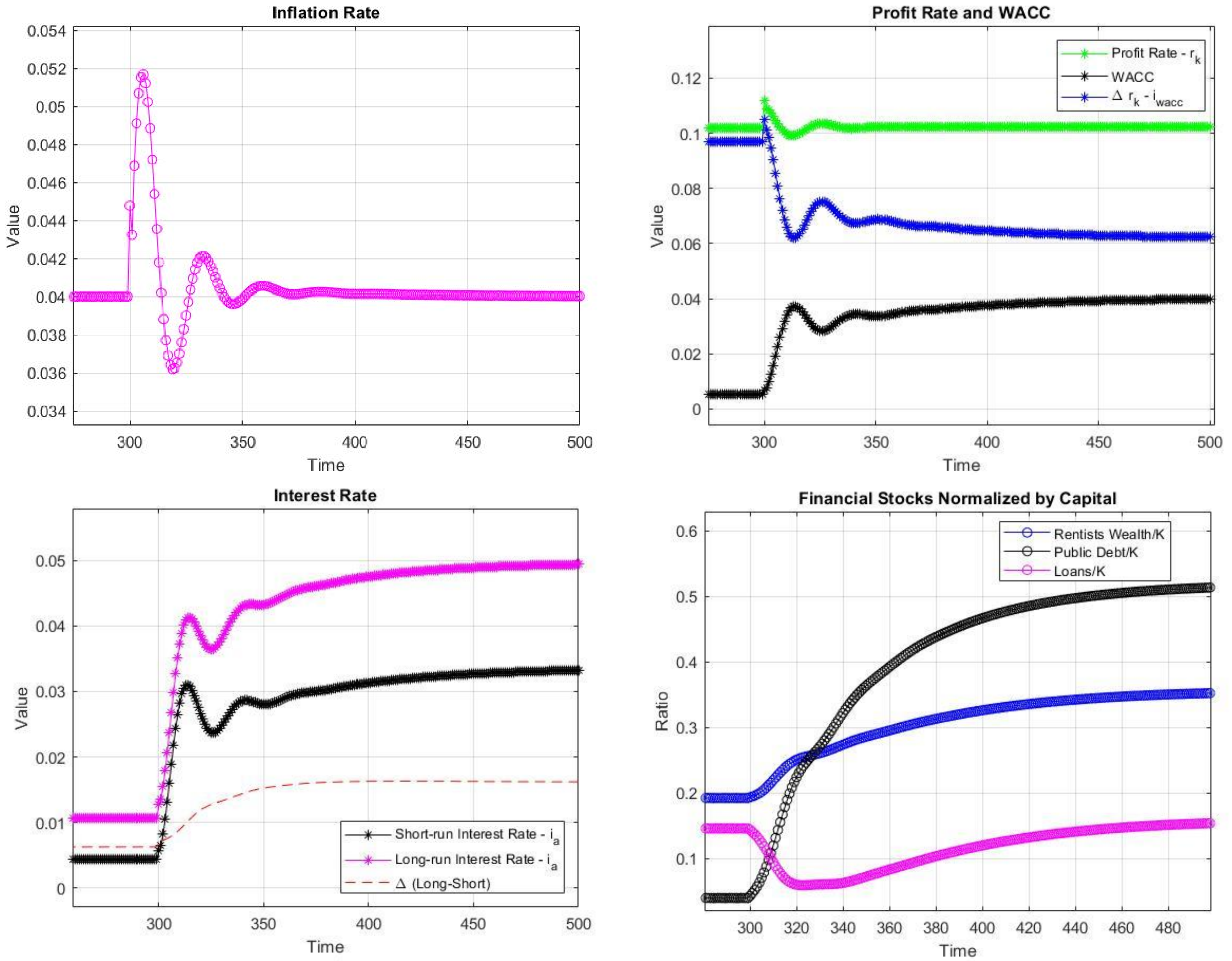

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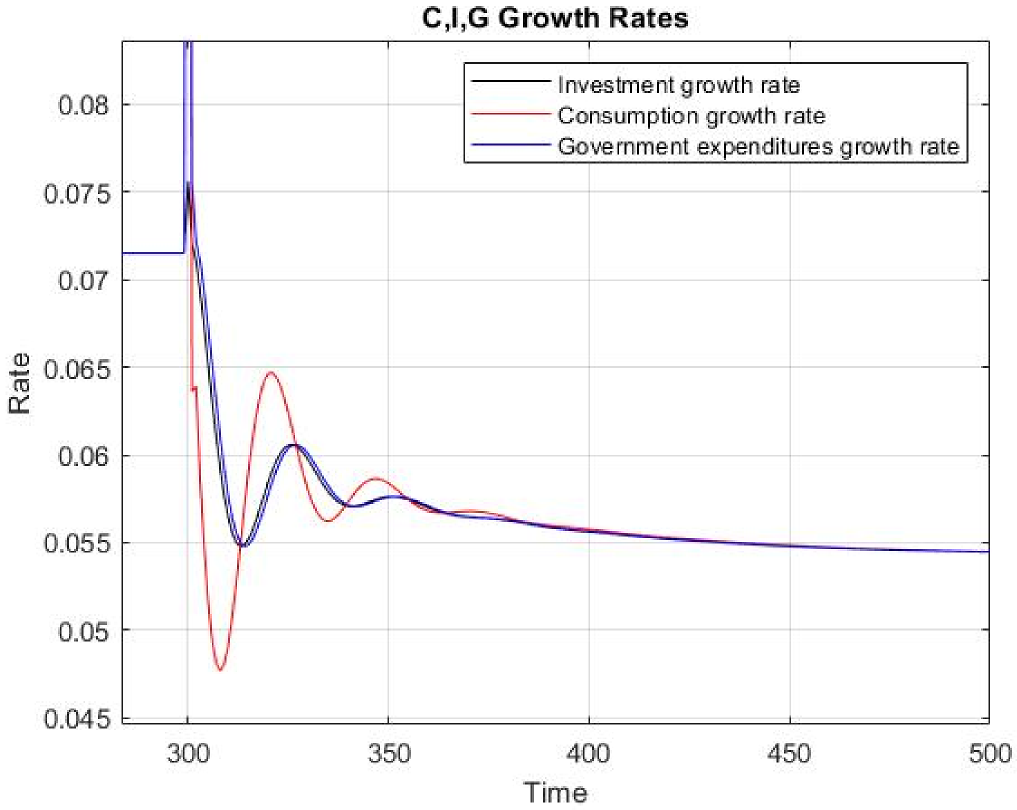

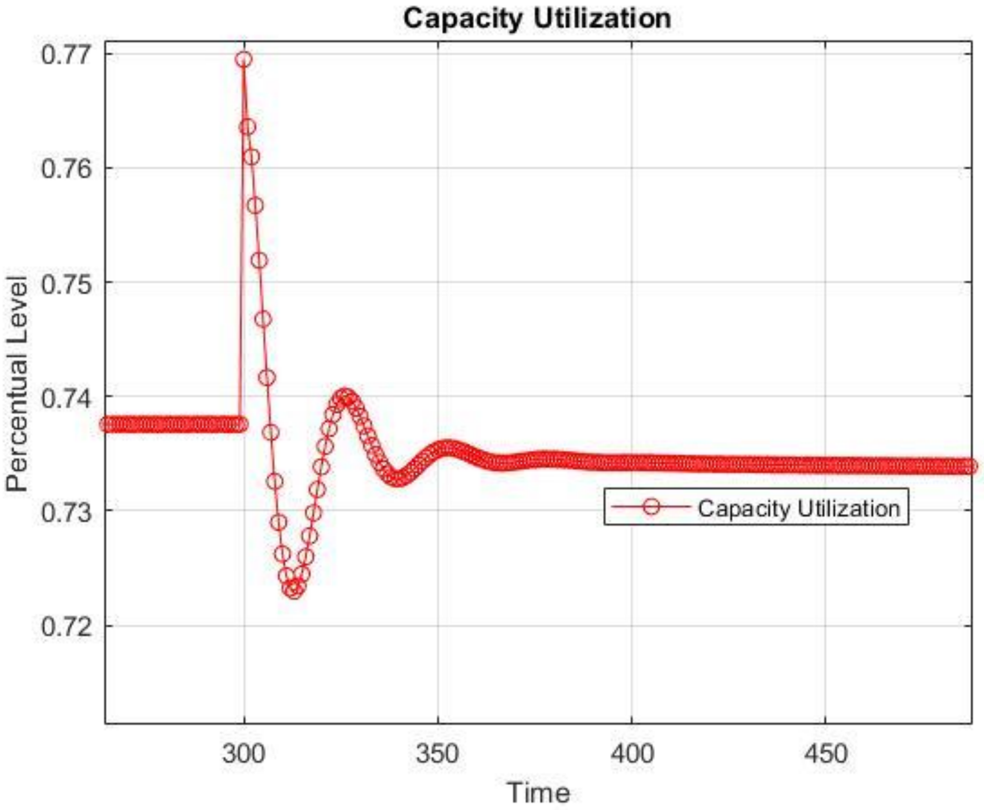

Conclusion

- The developed model aims to understand the dynamics of public financing and its interrelationships with other macroeconomic variables in a closed economy with government, having as characteristics: monetary policy driven by the inflation targeting regime, prohibition of treasury financing via Central Bank and post fixed government bonds.
- The results obtained allow us to conclude that, in the model's parameterized conditions, it is possible to obtain results such as:

a) Fall in the growth rate of the economy when public expenditures rises.
b) Crowding-Out effect through the endogenous channels of the Financial System.

Thank you !

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