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Debt-deflation and Counter Cyclical Fiscal Policy: The Principle of the Stock Flow Consistency Model

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Introduction

The ideas of Financial Instability Hypothesis by Hyman Minsky (1981) and the balance sheet recession by Richard Koo (2011) are highly relevant to understanding the post-pandemic situation globally. Since the corporate balance sheet has been deteriorating due to the increases in debt and liabilities, it causes firms to be deleveraging, which will lead to a deficit of demand and deflationary spiral. This paper replicates the Minsky - Koo financialized capitalist macroeconomy in which the financial asset price boom and bust cause deflation in the economy and aims to show the importance of fiscal expansion as a policy tool to mitigate the effect of the macroeconomic contraction.

Being inspired by the works of Godley and Lavoie (2007, cp. 11), Dafermos (2012) Nikolaidi (2014), and Pedrosa and Macedo e Silva (2016), I build the four-sectors (private sector, public sector, financial sector and the rest of the world) stock flow consistency model. This sfc model studies the effect of fiscal policy as a remedy for debt-deflation during the debt-burdened macroeconomic regime by using the stock flow consistent macroeconomic model based on Godley and Lavoie (2007). The model aims to exhibit comparative effects of three different fiscal policies on the post-bubble debt-burden economy. The three different fiscal policies studied in this paper is (i) constant growth of the government expenditures (ii) The countercyclical fiscal policy aims to stabilize the macroeconomy by increasing (decreasing) government expenditures when the private sector exerts contractionary (expansionary) pressures because of its attempts to reduce (increase) its indebtedness. (iii) The third fiscal rule is a simple Maastricht-type rule which states that government expenditures (relative to output) decline when the net government debt-to- output ratio is higher than a specific target. The aim of the present paper is to analyze different fiscal policy regimes and their responses to adverse shocks in a SFC model.

The result shows that the counter cyclical fiscal regime provides stable growth rates before and after the economic shock and rapid macroeconomic recovery even with negative external shocks such as increases in uncertainty due to environmental reasons than other procyclical fiscal policy. The inverse relationship between government debt and private debt, and the paradox of debt can show that if the government sector conducts expansionary fiscal policy during the time of the debt-deflation: the more easily the private sector can fix the liability to asset ratio in the balance sheet, which enables the stabilization of the macroeconomy, and can recover from the recession and keep the positive economic growth rate.

2. Debt Deflation, Financial Instability Hypothesis, Balance Sheet Recession

In the previous study of debt deflation, there are three important pillars. The first one is that Irvin Fisher in the 1930s, argues that due to over indebtedness, borrowers attempt to reduce their burden of debt by engaging in distress selling to raise cash for repaying debt. However, repayment through distress selling in aggregate level causes contraction of deposit money, and decreases in its velocity, and falls in the price level. As a unit pays off more debt, the real value of debt increases due to deflation; the own more debt perversely. The second one is that in the 1980s, during a time of rise of financial innovation, Minsky complemented Fisher's debt-deflation theory by incorporating the asset market in the story. Minsky's theory of financial instability hypothesis tells that asset price bubbles form the financial fragility, and the phenomena is endemic in the capitalist economy because in the hedge period, with increasing expected profit, firms can increase in borrowing in order to invest money. The speculative behavior of firms creates financial asset price bubbles and they later burst. Therefore, capitalism has a cycle that moves from a period of financial stability to instability. Therefore, the government needs to increase the expenditure in order to mitigate when the economic crisis happens. The third one is that Richard Koo, although without crediting to the last two deflation theories, writes a similar analogy in his deflation theory of balance sheet recession. However, Koo emphasis on the cause of economic deflation is that: deflation-spiral comes from the firm's deleveraging behavior when balance sheet recession happens after asset price boom and bust. Firms directly use saving as cash to pay down debt instead using the cash flow for investment. Firms priorities from maximizing profits to minimizing debt. The uniqueness of Koo's theory is that low investment is the cause of the deflation spiral, while Minksy in his financial instability hypothesis explains the changes in the expectation of profit.

3. The SFC model and Fiscal Policies

3.1 Sectoral Balances and Stock-Flow Consistency Model

The stock-flow-consistent (PK-SFC) model has been widely used in post-Keynesian literature. The advantage of using the SFC model is that it takes a holistic approach: these sectoral accounting models capture all flows of funds and all stocks and their circulation within the economy. Godley and Lavoie (2007) recall the advantage of using the stock flow consistency model and say that it can illustrate the mutually interdependent financial relationship between the private sectors and public sectors. Contrary to the mainstream approach which only takes the real sectors into the account of economic analysis, the SFC model allows one to see how nominal sectors can affect the macroeconomy. Keynes and Minsky have argued that decisions made by other sectors of macroeconomics cannot be ignored in macroeconomics since that may affect the balance sheet of the others. The central role of the interactions between public and private sectors was highlighted by both Minsky and Godley.

According to Godley and Lavoie (2007) the accounting rule of the SFC, the sum of financial wealth of all the sectors in an economy must be zero. According to this logic, if the private sector of the economy is in surplus, then the public sector has to be in deficit as a counter cyclical fiscal policy. Usually, the neoclassical economics' loanable fund theory states that if budget deficits happen, then the national savings diminish. On the contrary, the SFC idea holds that if there is any government deficit that comes from the issuing of its bonds, then it creates financial wealth to the private sector. Forsater and Murray (2013) argue that the only way that the private sector creates net financial surplus to save is by letting the government sector have budget deficits. Similarly, Koo (2012) argues, in order to prevent a prolonged balance sheet recession after the boom and bust, the private sector needs to pay off their debt instead of maximizing profit. Therefore, instead of conducting fiscal consolidation, it is necessary that the government creates budget deficits by issuing bonds in order to create surplus in the private sector. The main purpose of the SFC model in my research is to capture Hyman Minsky and Richard Koo's argument on how countercyclical fiscal policy can save the deflationary spiral caused by the private sector's deleveraging behaviour.. In this regard, I build the four-sectors (using the private sector, public sector, financial sector and the rest of the world) stock flow consistency model.

The principal of the SFC models is the interdependency of flows and stocks within and between various sectors of the economy and there are no 'black holes' in the macroeconomy. Flows denote transactions (e.g., public spending and the private sector's investment) while stocks denote sizes of asset positions (e.g., government debt, or the size of positions of different financial assets held by the household sector). In a stock flow consistent model, each flow comes from one sector and goes to another. The corresponding stocks are reduced, respectively increased, by the size of the flow. Just as flows lead to a change in stocks (e.g., net worth), stocks can have an influence on flows (e.g., net worth is a determinant of consumption).

3.2 Balance Sheet and Transaction-flow Matrices

This stock flow consistency model in my paper aims to create an example of balance sheet recession theorized by Richard Koo and Hyman Minky's financial instability hypothesis which were inspired by Irvin FIsher's debt-deflation theory using a semi-open economy. This SFC model to study different types of fiscal regimes is inspired by the works of Godley and Lavoie (2007, cp. 11), Dafermos (2012) Nikolaidi (2014), and Pedrosa and Macedo e Silva (2016). I build the four-sectors (a private sector, a public sector, a financial sector and the rest of the world) in this stock flow consistency model. Table I: *Balance Sheet of The Model* shows that in this model, there are six economic actors : household, and fim, and government, and central bank, and bank and the rest of the world as a foreign sector. The first seven variables in the Balance Sheet (Table 1) are: Advances (A), Money (M), Loans (L), Fixed Capital (K), Cash (H), Government Bill (B), Equity ($e * p_e$), and Bank Capital (OF). They are allocated within the economy for each sector. The last row shows the networth of each sector. Godley and Lavoie (2007) explains that in the sfc model the firm's net worth V_f can be negative or positive since defined the firm's net worth as the difference between the assets and the liability including the market value of equity. At the same time the equity of the banks (the own fund of banks, OF_b) is excluded from the net worth of the bank. For the bank to be solvent, this net worth must be positive. However these own funds of the bank belongs to the owner of the bank, and that is why the bank capital variable has plus sign in the household column and has a negative sign in the bank column in the table I[1]. In this model, the general level of price is denoted as p, and incorporate inflation in this model. Meanwhile the stock price (p_e), is set separately and also it varies over time. Additionally, stocks of financial variables, shown in Tables 1 and 2, are expressed in nominal values. Flow variables presented in capital letters are the real variables. The nominal values can be obtained by multiplying real variables by p, the general level of prices. Superscripts d and s stand for demand and supply, respectively. For simplicity, we suppress time subscripts.

In this model, the money (M) is issued by the domestic central bank, and owned by the household. The government issues bill$B$ as securities, which are held by not only households but also by the central bank, bank and the rest of the world. Advances (A) exist so that the central bank can accommodate the commercial bank's demand to maintain a certain level of liabilities in their balance sheet.

Table I: Balance Sheet

[1] Godley and Lavoie (2007) explains in chapter 11 that in the Haig–Simons frameworks, because if a bank is liquidated, their owners would receive the bank capital as a leftover. The bank's own funds of the bank are part of the wealth of household owners .

	Household	Firm	Goverment	Central Bank	Banks	RoW	Σ
Money	$(+)M$				$(-)M$		0
Loans		$(-)L$			$(+)L$		0
Fixed Capital		$(+)K$					$(+)K$
Cash	$(+)H_h$			$(-)H$	$(+)H_b$		
Gov Bills	$(+)B_h$		$(-)B$	$(+)B_{cb}$	$(+)B_b$	$(+)B_{ROW}$	
Advances				$(+)A$	$(-)A$		
Equities	$(+)e \cdot p_e$	$(-)e \cdot p_e$					
Bank Capital	$(+)OF_b$				$(-)OF_b$		
Net Worth	$(-)V_h$	$(-)V_f$	$(-)V_g$	0	0	$(-)V_{row}$	$(-)K$
Σ	0	0	0	0	0	0	0

Table II: Transaction Flow Matrix of the Model

	Households	Firms		Govt.	Central bank		Banks		RoW	Σ
		Current	Capital		Current	Capital	Current	Capital		
Transaction										0
Consumption	$(-)pC$	$(+)pC$								0
Govt Expenditure		$(+)pG$		$(-)pG$						0
Fixed Investment		$(+)pI$	$(-)pI$							0
Exports		(+)pEX							(-)pEX	0
Imports		(-)pIM							(+)pIM	0
(Output)		**[PY]**								0
Wages	$(+)pWB$	$(-)pWB$								0
Income Tax	$(-)pT$			$(+)pT$						0
Bank's Profit	$(+)pFD_b$						$(-)pF_b$	$(+)pFU_b$		
Firm's Profits/Divident	$(+)pFD_f$	$(-)pF_k$	$(+)pFU_f$							0
Central bank profits				$(+)pF_{cb}$	$(-)pF_{cb}$					0
Interests on advances					$(+)r_{CB(-1)}A_{-1}$		$(-)r_{CB(-1)}A_{-1}$			
Interests on loans			$(-)r_{L(-1)}L_{-1}$				$(+)r_{L(-1)}L_{-1}$			0
Intersts on deposits	$(+)r_{M(-1)}M_{-1}$						$(-)r_{M(-1)}M_{-1}$			0
Intersts on bills	$(+)r_{b(-1)}B_{h-1}$			$(-)r_{b(-1)}B_g$	$(+)r_{b(-1)}B_{cb-1}$		$(+)r_{b(-1)}B_{b-1}$		$(+)r_{b(-1)}B_{row-1}$	
Flow of Fund (Net Lending)	$[NL_h]$	$[NL_f]$		$[NL_g]$	$[NL_{cb}]$		$[NL_b]$		$[NL_{row}]$	0
Advances						(-)ΔA		(+)ΔA		
Δ Loans			(+)ΔL					(-)ΔL		0
Δ Deposits	(-)ΔM							(+)ΔM		0
Δ Cash	$(-)\Delta H_h$					$(+)\Delta H$		$(-)\Delta H_b$		
Δ Bills	$(-)\Delta B_h$			(+)ΔB		$(-)\Delta B_{cb}$		$(-)\Delta B_b$	$(-)\Delta B_{row}$	
Δ Equities	$(-)p_e\Delta E$		$(+)p_e\Delta E$							
Σ	0	0	0	0	0	0	0	0	0	0

3.2.1 The Household decision and portfolio choice

The first equation shows that wage bill which is allocated to the household from firm and πis the firm's profit share. The second equation shows the household's real consumption. Household receives wages, $WB$and dividend from bank, $FD_b$and firm, $FD_f$and interests on government bills and on bank deposits. α_1 is the propensity to consume out of wages and financial income and α_2 is the propensity to consume out of wealth.

$$WB = (1 - \pi) \cdot Y_f$$

Wage bill (1)

$$c = \alpha_1(WB + FB_f + FD_b + r_{m-1}M_d + r_bB_{hd})/p + \alpha_2V_{-1}/p$$

Real Consumption (2)

$$C = C * p$$

Nominal Consumption (3)

Recalling that stock prices fluctuate, the household budget constraint requires the inclusion of capital gains $CG = \Delta p_e \cdot e_{d-1} + \Delta OF_b$, which comes from change in the price of stock $\Delta p_e \cdot e_{d-1}$and changes in the own-funds of bank,ΔOF_b. The capital gain affects the end-of-period wealth given in equation 4.

$$V = V_{-1} + YP - T + \Delta p_e \cdot e_{d-1} + \Delta OF_b - C$$

Household Nominal Wealth (4)

$$v = V/p$$

Household Real Wealth (5)

In each period, households receive personal income , which is subject to taxation. The personal income after tax is called regular disposable incomeYD_rbetween consumption and wealth accumulation. Godley and Lavoie (2007) specifies that real disposable income yd_r that deflated regular disposable income minus the capital losses imposed by price inflation.

$$YP = WB + FD_b + FD_f + r_{m-1} \cdot M_{d-1} + r_{b-1} \cdot B_{hd-1}$$

Personal Income (6)

$$YD_r = YP - T$$

Regular disposable Income (7)

$$yd_r = YD_r/p - (\Delta p)V/p$$

Real disposable income (8)

Godley and Lavie (2007) deines financial market assets, V_{fma}, and that is allocated in line with Tobinesque principles, with the appropriate adding- up constraints described in the equation 9 to 11.

$$\frac{M_d}{V_{fma-1}} = \lambda_{10} + \lambda_{11} * r_m - \lambda_{12} * r_K - \lambda_{13} * r_b - \lambda_{14} * \left(\frac{YP}{V_{fma-1}}\right) \quad (9)$$

$$\frac{\left(p_e * E_d\right)}{V_{fma-1}} = \lambda_{20} - \lambda_{21} * r_m + \lambda_{22} * r_K - \lambda_{23} * r_b - \lambda_{24} * \left(\frac{YP}{V_{fma-1}}\right) \quad (10)$$

$$\frac{B_{hd}}{V_{fma-1}} = \lambda_{30} - \lambda_{31} * r_m - \lambda_{32} * r_K + \lambda_{33} * r_b - \lambda_{34} * \left(\frac{YP}{V_{fma-1}}\right) \quad (11)$$

Households decide how to allocate v_{fma} between various assets, M,B_{hd}, $e_d * p_e$and listed in the accounting matrices. The asset choice of households is a function of assets liquidity premium λ_{i0}, and real expected rate of return λii. The more households have precautionary motivation to possess the asset, the higher the liquidity premium of the asset. Also higher the rate of return of each asset, the more households prefer to possess the asset; λii has positive signs. In other words, the other asset's rate of return and own asset choices have inverse relationship, meaning λ_{ij} has negative signs. Godley and Lavoie set modey, M as a flexible component in the wealth allocation process and Mtakes on a buffering role in equation 12. The equation 14 defines households demand cash which is a share of nominal consumption, λ_c.

$$M_d = V_{fma} - B_{hd} - p_e * E_d$$

Money deposit- a residual (12)

$$V_{fma} = M_d + B_{hd} + p_e * e_d$$

Money deposits as residual (13.A)

$$V_{fma} = V - H_{hd} - OF_b$$

Financial market asset (investible) wealth (13.B)

$$H_{hd} = \lambda_c * C$$

Households' demand for cash (14)

The equilibrium condition in equation 15 reflects that the demand for equities by households expressed in equation 10, has to be equal to the supply of shares which is decided by firms', which decide the number of shares on the stock market. Therefore, the number of shares demanded, e_d, has to adjust to the supply of shares e_s.

$$e_d = e_s$$

(eq. 15)

3.2.2 Firm's Production Equations

Firms' markup on unit costs μ, which is assumed to be exogenously fixed, defines the profit share (equation 16). The real output equation (17) is the sum of consumption and investment, government expenditure, and also net export since it is a semi-open economy.

$$\pi = \frac{\mu}{1+\mu}$$

Firm's profit share (16)

$$y = c + i + g + ex - im$$

Real Output (17)

$$Y_f = p * y$$

Production Function of a firm (Nominal GDP) (eq. 18)

The capacity utilization, u is defined as the ratio of the real output to full capacity output k_{-1}, given by the current state of technology, of previous period capital stock.

$$u = \frac{y}{k_{-1}}$$

The rate of capacity utilization (19)

Minsky explains that three sources for funding investment is 1) retained earnings, FU 2) new shares, e_s, and 3) bank loans, L (Pedrosa and Silva, 2016). The firm profit F_f is divided into two components, retained earnings of firms, FU_f and the dividend of firmsFD_f. FD_f is assumed to be an exogenously-defined $\psi_U$fraction of net profits F_f. In equation 21, retained earning of firms,FUcloses firms' current budget constraint, and firms receive retained earnings from the firm' sprint after distributing dividend to households and also paying the interest of loans.

According to Godley and Lavoie (2008) firms finance proportion ψ_U of nominal investment expenditures through retained earnings. At the same time firms issue new shares to finance investment expenditure; the small portion, $(1 - \psi_U)$ of investment expenditure will be financed through new issues of shares.

$$F_n = Y_f - WB = \pi Y_f$$

Firm's profit (20)

$$FU_f = F_n - FD_f - r_l L_{d-1}$$

Distributed profits of firm (21)

$$FD_f = \psi_U * F_n$$

Dividends of firm(22)

$$e_s = e_{s-1} + (1 - \psi_U) \cdot \frac{I_{-1}}{p_e}$$

Issue of new shares (23)

The equation 24 shows that dividend yield, r_K, is the ratio of the dividends distributed this period over the stock market value of the shares outstanding at the end of the previous period. This ratio will enter the portfolio decisions of households.

$$r_K = \frac{FD_f}{e_{s-1} \cdot p_{e-1}}$$

Dividend yields (24)

$$\Delta L_d = p^* \ i_d \ - \ FU_f \ - p_e \bullet \ \Delta e_s$$

Change in firm's demand for loan (25a)

$$I \ = \Delta L_d + FU_f + p_e \bullet \ \Delta e_s$$

Firm's nominal Investment (25b)

The firm sector's financial requirements, equation 25a, describes the change in firms demand for bank loans, ΔL_d, which can be computed from their capital account column in Table 2. Godley and Lavoie (2007) explains that loans act as a buffer, absorbing unexpected changes in financial requirements. Any positive windfall in entrepreneurial profits will be reflected in a decrease in the demand for loans. Koo (2011) specifies fim's investment behavior using two different cases. In the normal time, firms act as a profit maximizer in the sense that they use the cash flow (retained earning) for investment (Yan-phase). While firm balance sheet problems mean they accumulated a higher amount of loans than they target, and need to fixate ratio of loan to asset in their balance sheet, they start deleveraging (Ying- phase) and become a cost-minimizer. Similarly, Caverzasi and Godin (2015) points out that firms have investment choice: firms can use its internal funds to finance investment such as retained earnings FU_f, and at the same time, using the notion of Minsky, firms can invest through taking out new loans ΔLf. Therefore, in this model when there is no balance sheet recession in the corporate sector, firms use some portion of their internal funds to finance investment and the rest of the cost for investment can be financed through issuing loans. How the firm's change in financing investment is captured in the growth in capital equation.

The real capital sock is given by the growth in capital gr_k(eq. 26) and the low of motion of capital tells that real gross investment is a function of change in capital and capital depreciation d_k (eq. 27).

$$k = k_{-1} + (1 + gr_k)$$

The real capital stock (26)

$$i = \Delta k - d_k * k_{-1}$$

The low of motion of capital (27)

Firms first choose how much they grow their assets (in this case, capital is the only asset of a firm) by specifying an investment function gr_k. In the model investment has a positive correlation ($\beta_1 > 0$ *and* $\beta_u > 0$) with the ratio of firm's retained profits to nominal capital, $\frac{FU_{f-1}}{K_{-1}}$and the capacity utilization rate,u. The third component of right hand side of investment function (eq. 28) shows that real interest rate on loan, rr_l can affect the firm's investment decision negatively.

$$rr_l = \left\{ \frac{(1+r_l)}{1+pi} \right\} - 1$$

Real interest rate on loan (28)

$$pi = \Delta p / p_{-1}$$

Price inflation rate (29)

The post-Keynesian investment function (eq. 30) emphasizes that investment depends on the previous value of assets and liabilities which is a proxy for a margin of safety in Minsky's theory, which Koo (2011) also talks about in his investment theory. As Nikiforos and Zezza (2017) specify that Investment has the negative correlation with the degree of indebtedness $\frac{L_{d-1}}{pK_{-1}}$.[2]

$$g_k^{\ e} = \frac{I}{K_{-1}} = \beta_0 + \beta_1 \frac{FU_{f-1}}{K_{-1}} - \beta_2 \frac{L_{d-1}}{pK_{-1}} - \beta_r rr_l + \beta_u \frac{Y_{f-1}}{pK-1}$$

Post Keynesian Investment Function (30)

The coefficient value degree of indebtedness $\beta_2$is positive, meaning when there is a balance sheet of recession the $gr_k$and the ratio of loan to capital L_{d-1}/K_{-1} has negative correlation. In order to replicate the firm's behavior captured by Minsky and Koo, I introduce the cycle

[2] Nikiforos and Zezza (2017) explains the dynamic of the model, saying that "the stocks, as determined at the end of each period, feed back into the flows of the next period, which in turn determine the stocks of that period and so on. This makes the model dynamic, and the position of the system at every time period is determined by its historical path" (9).

of investment behavior of the private sector (frim) by Nikolaidi (2017). When the actual level of debt of the firm with respect to the firm's income is greater than the target level of the firm's debt to income ratio, firms attempt to reduce the level of loans in the balance sheet. d_p is the net private debt-to-income ratio, and d_p^T expresses the target net private debt-to-income ratio.

$$d_p = \frac{L_{d-1}}{Y_{f-1}}$$
$$Actual\ level\ of\ indebtedness \ (31)$$

$$\beta_2 > 0\ iff\ d_p \geq d_p^T \text{ (eq. 32A)}$$
$$\beta_2 < 0\ iff\ d_p^T > d_p \text{ (eq. 32B)}$$

Equations 30.A is the macroeconomics condition that Koo (2013) calls a 'balance sheet recession'. In this analysis Koo makes a distinction between periods in which the private sector maximises profits ('Yang phases') and periods in which the private sector minimises its debt ('Yin phases'). The equation 32A shows that gr_k and L_{d-1}/K_{-1} has an inverse relationship and it captures the behaviour that firms attempt to use the retained earnings instead issuing more loans to finance the investment. In our model, equation 32B shows that the increase in the private sector's loans leads to higher investment ($\beta_2 < 0$) when the target private sector's indebtedness is greater than the actual indebtedness of corporates ($d_p \geq d_p^T$) that resembles a debt-led regime of Minsky's theory (Dafermos, 2015, Nikolaidi 2017). This regime is also resemble what Koo says 'Ying phase" in which When $d_p^T \geq d_p$ firms finance new investment by asking for a loan from banks. Minsky (2008, pp.

193, 209) argued that during periods of expansion, when the outstanding debts are serviced without significant problems, the desired margins of safety of borrowers is low. Nikolaidi (2017) uses d_p as the proxy of margin of safety in her model. This happens because the recent good performance of the economy and the favourable credit history induce economic units to accept financial structures that were previously assessed as risky. The opposite holds in periods in which the economic performance and credit history are not favourable. This endogenous responsiveness of the perceptions of risk to the economic fluctuations is in line with the empirical features of financial cycles (Dafermos, 2015; Borio, 2013). Dafermos (2015) specifies that the growth of the net private debt-to-income ratio d_p^T is endogenous (eq. 34).

$$g_y = \frac{Y_f - Y_{f-1}}{Y_{f-1}} - pi$$

The real GDP growth as Nominal GDP growth after the price inflation (eq. 33)

$$\Delta d_p^T = \theta_1(g_y - g_{y0}) + \theta_2(d_p^B - d_p^T) \quad \theta_1 > 0 \; and \; \theta_2 > 0$$

The target level of firm's (private sector) level of indebtedness (eq. 34)

Endogenizing the target net private debt-to-income ratio allows the model to extend Godley's exogenous stock-flow norm to Minsky's financial instability hypothesis for the private sector (Nikolaidi: 2017 and Dareformos: 2015). Equation 32 states that when the actual growth rate, g_Y is higher than the benchmark growth rate, g_{Y0}, the target net debt-to-income ratio of the private sector increases. Minsky (1980) and Koo(2011) argue that higher economic growth can induce private sectors to take more risky positions by increasing the proportion of their assets that is held in the form of equities or by increasing their investment. Dafermos (2015) argues that although the stock flow consistency model does not incorporate asset price inflation in the model, the impact of economic growth on the target net debt-to-income ratio of the private sector is compatible with the role that asset prices play in Minskyan dynamics.

The second component of the right hand side of equation 34 states that the growth of private sector's debt to income (leverage) ratio target is also partially attracted by a benchmark net debt ratio, d_p^B. Firms do not let target private sector's degree of indebtedness d_p^T deviate from the benchmark value, d_p^B which is exogenously set in this model. When the target degree of indebtedness increases (decreases), relative to the benchmark value, firms attempt to reduce (increase) their target degree of leverage.

$$\omega = \nu\omega_{-1} + (1 - \nu)\omega_0 + \lambda(g_k - g_{k-1})$$

The phillips curve (35)

Price inflation rate, ω is determined by a standard Phillips curve. Equation 35 shows that current inflation is a weighted average of lagged inflation rate (ω_{-1}) and a 'normal' level of inflation ω_0, plus the impact of a proxy to the output gap, λ. The change in price level is represented in equation 36.

$$p = p_{-1}(1 + \omega)$$

The general level of price (36)

3.2.3 The Government Sector

The government expenditure, $G$is financed through taxes (T) and bills (B) and . Equation 35 shows the government receives tax $T$from household, which is the proportion of personal income (tax rate is given as θ).

$$PSBR = G + r_{b-1} \bullet \left(B_{hs-1} + B_{bs-1} + B_{rows-1}\right) - T$$

Nominal government deficit (eq. 35)

$$T = \theta * YP$$

$$t = T/p$$

Government Tax (eq. 36)

$$B_s = B_{s-1} + PSBR$$

$$\Delta B_s = PSBR$$

New issues of bills (37)

$$GD = B_{hs} + B_{rows} + B_{bs} + H_s$$

Nominal government debt (38)

In my model, there are three fiscal rules to define the growth of government expenditure. In the ‘constant growth of the government expenditures’ case (32A), the government expenditure is a constant fraction γ of level of output as used in the model in Dos Santos and Zezza (2008).

$$G = p * g$$

$$g = g_{-1}(1 + gr_g)$$

Fixed proportion of spending relative to GDP (39.A)

The second case is countercyclical fiscal policy, in which there are no limits on any specific fiscal aggregate. This counter cyclical fiscal policy attempts to stabilise the macroeconomy by increasing (decreasing) government expenditures when the private sector exerts contractionary (expansionary) pressures as a result of its attempts to reduce (increase) its indebtedness. Using the countercyclical fiscal policy used in the model of Dafermos (2016), the government expenditure gr_g increases when the target private sector's (firm) debt to income ratio is higher than the actual private (fimr) sector's debt to income ratio, and the government increases its spending.

$$g = g_{-1}(1 + gr_g)$$

The government expenditure for counter cyclical fiscal policy (39.B)

$$gr_g = -\kappa(d_p^T - d_p); \kappa > 0$$

The growth of the government expenditure for counter cyclical fiscal policy(39.B.2)

The third fiscal rule is a simple Maastricht-type rule which states that government expenditures (relative to output) decline when the net government debt-to- output ratio is higher than a specific target (Dafermos, 2016), where $\chi > 0$.

$$g = g(1 + gr_g)$$

The government expenditure for Maastricht-type fiscal policy (39.C)

$$gr_g = \chi(d_G^T - d_G)$$

The growth of the government expenditure for Maastricht-type fiscal policy (39.C.2)

$$d_G = PSBR/Y_f$$
The net government debt-to-output ratio (eq. 39.C.3)

3.2.4 Central Bank's Equations

The central bank receives interest payments from its holding of the government bills and also interest payments given to the commercial bank. The profit of the central bank is directly distributed to the government.

$$F_{cb} = r_{b-1} * B_{cbd-1} + r_{cb} * A_{-1}$$
Central Bank's profit (40)

The equation 41-44 and 46 shows supply equals to demand condition, which is set in the model by Godley and Lavoie (2007) where all supplies of assets passively match all demands. The various equations that describe how government securities or central bank liabilities are supplied on demand

$$B_{hs} = B_{hd}$$
Household bills supplied on demand (41)

$$H_{hs} = H_{hd}$$
Cash supplied on demand (42)

$$H_{bs} = H_{bd}$$
Reserve supplied on demand (43)

$$H_s = H_{bs} + H_{hs}$$
Supply of high-powered money (44)

$$B_{cbd} = B_d - B_{hd} - B_{bd}$$
Central bank bills (Balance Sheet) (45)

Equation 45 shows that the central bank is the residual purchaser of government bonds, and equation 47 shows that the central bank set the interest rate on the government bill exogenously. The redundant equation, 47R is implied by all the others, and it guarantees the closure of the central bank's balance.

$$B_{cbs} = B_{cbd}$$

Central Bank buys bills that it demands (46)

$$r_b = \overline{r_b}$$

The rate of interest on bills is set exogenously (47)

$$H_s = A_s + B_{cbs}$$

Redundant equation (47-R)

3.2.5 The Commercial Bank's Equation

The equation 48 says in the post keynesian endogenous money theory, money deposits are endogenous, being created on demand. Banks always credit (debit) the account of a householder who receives (pays) a cheque from (to) another party, including the government, or exchange credit money for cash and vice versa.

$$M_s = M_d$$

Bank deposits supplied on demand (48)

In this model, banks do not always provide the loan demanded by firms. Dafermos (2012) introduces Perceived Degree of Uncertainty (PDU) as an exogenous variable that captures the economic agent's perceived uncertainty caused by the exogenous shock such as natural disaster or political instability etc). Increases in PDU means decreases in confidence of economic agents and expectation of the economy. PDU in equation 41 acts as credit rationing of banks, and therefore, when there is an exogenous shock such as COVID-19, political uncertainty, or natural disasters happen and loans demanded by the firms will not be 100% guaranteed from the banks.

$$L_s = L_d * (1 - PDU)$$

$$0 \leq PDU \leq 1$$

The loans supplied on demand of who qualified it (49)

$$H_{bd} = (\rho + w) * M_s$$

Reserve requirements of banks (50)

$$w = w_0 + w_1 PDU - w_2 r_{CB} \quad (51)$$

Equation 45 states that banks must also keep reserves proportional to their deposits in their balance sheet as requirement, ρ, and proportional to their deposits as excessive reserves, w.equation 51 shows that the amount of excess reserve is positively related with PDU and negatively related with the interest rate on advances, which is regarded as opportunity cost of holding excess reserves.

The equation 52 is a balance sheet constraints of banks. Equation 53 and 54 states that there are two scenarios in the demand of banks for the government bills and the bank's demand for advances from the central bank. The first scenario: if deposits net of required reserves are higher than loans $B_{nd} \geq 0$, banks will use the government bonds to make up the differences and advances will be equal to excess reserves. The second case: if loans are higher than deposits net of required reserves, banks will not ask for additional government bonds but they demand central bank advances are demanded to fill the gap.

$$B_{nd} = M_s - \rho M - L_s - H_{bd}$$

Balance-sheet constraints of banks (52)

$$B_{bd} = \{B_{nd},\ B_{nd} \geq 0$$
$$= \{0,\ B_{nd} < 0$$

Bills demanded by banks (53)

$$A_d = \{w * M_s,\ B_{nd} \geq 0$$
$$= \{H_{bd} + L_s - M_s - OF_b,\ B_{nd} < 0$$

Advances demanded by Banks (54)

$$B_{bs} = B_{bd}$$
$$A_s = A_d$$

The redundant equation:

$$BLR = \frac{B_{bd}}{M_s}$$

Bank liquidity ratio (55)

$$r_m = r_{m-1} + \zeta_m \bullet \left(z_1 - z_2\right)$$

Change in deposit ratio (56)

$$z_1 = 1\ iff\ BLR < bot$$

(57)

$$z_2 = 1\ iff\ BLR > top$$

(58):

Equation 55-58 is from the Godley and Lavoie (2006) note regarding the change in the deposit rate: if the bank's liquidity ratio drops below the acceptable range, the banks' response must be to raise the rate of interest on money deposits relative to the given bill rate. The equation 59 shows that banks set the rate of loan using the mark up, add_*l* over the deposit rate, which is set by Banks to generate the targeted level of profits had there been no mistake in their estimates. Equation 60 is the formula to get the spread between the deposit rate and loans rate. Equations 62 and 63 shows that interest rate on advances and the government bill is set exogenously by the monterey authority.

$$r_l = r_m + add\_l$$

Loan rate interest rate (59)

$$add\_l = \frac{F_b - r_b B_{bd-1} - r_{cb-1} A_{d_{-1}} + r_{m-1}(M_{s-1} - L_{s-1})}{L_{s-1}}$$

Lending mark-up over deposit rate (60)

$$F_b^T = (r_{l-1} + add\_l) \bullet L_{-1} + r_{b-1} \bullet B_{bd-1} - r_{m-1} \bullet M_{s-1} - r_{cb} A_d$$

$$F_b^T = F_b$$

Formulas to get the spread between the deposit rate and loan rate (60.A)

$$F_b = r_{l-1} \bullet L_{-1} + r_{b-1} \bullet B_{bd-1} - r_{m-1} \bullet M_{s-1} - r_{cb} A_d$$

The profit of commercial banks (61)

$$r_{cb} = \overline{r_{cb}}$$

The exogenous interest rate on advances as set by the central bank (62)

$$r_b = \overline{r_b}$$

The exogenous rate of interest rate on the government bills (63)

$$FD_b = \lambda_b \cdot Y_{f-1}$$

Dividends of banks (64)

$$FU_b = F_b - FD_b$$

Actual retained earnings (65)

$$OF_b = OF_{b-1} + FU_b$$

Own funds of banks (66)

The equation 64 shows that the dividends of commercial banks is the fraction of previous period's GDP. The actual retained earnings of commercial banks is the one that the commercial banks keep from the profit after giving the houlds the dividends. The equation 66 shows that the banks' capital will be equal to their own funds of the previous period, plus the retained earnings of the current period.

3.2.6 The Rest of the World Equations

In this model, in order to replicate the Japanese economy we have another sector, the rest of the world, which makes this model a semi-open economy . The assumption is that debt of the Japanese government is financed domestically, meaning that the domestic household, bank and are the ones holding most of the bills issued by the government. Although the investor from outside of the country will hold the Japanese t-bill, the amount is small. That makes it possible that the debt of the government is not denominated by the foreign currency. Also, in this paper, the main focus is to see how deleveraging in the domestic private sector can affect the macroeconomic growth; therefore, in this paper, the effect of balance of payment is omitted. Although Japan has been an export-led economy since the mid-1990s, to make this model simple, there is no inequality of export and import.

$$IM = \phi Y_f$$

Imports are proportional to GDP (57)

$$EX = IM$$

Balanced balance of payment (58)

$$B_{rows} = B_{rowd}$$

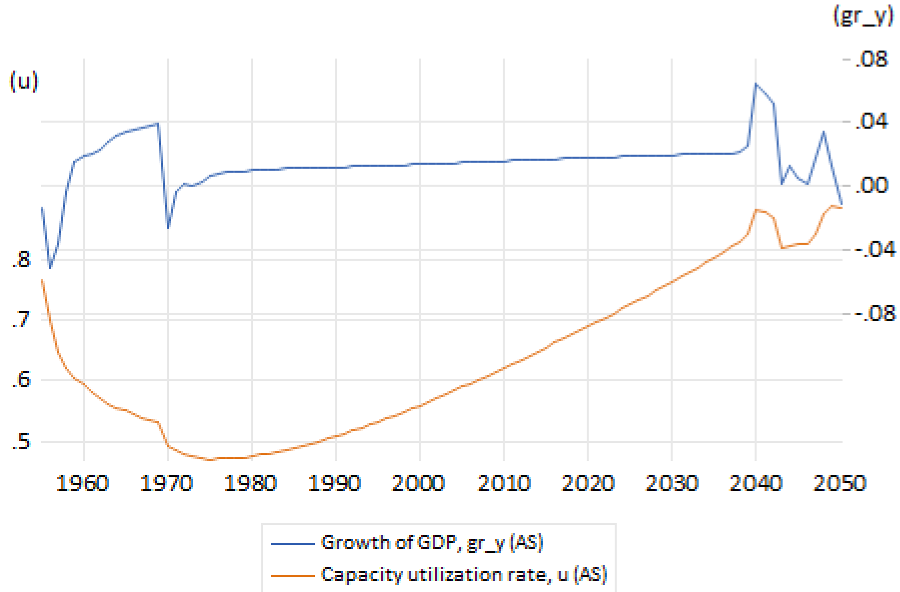
The rest of the world bills supplied on demand (59)

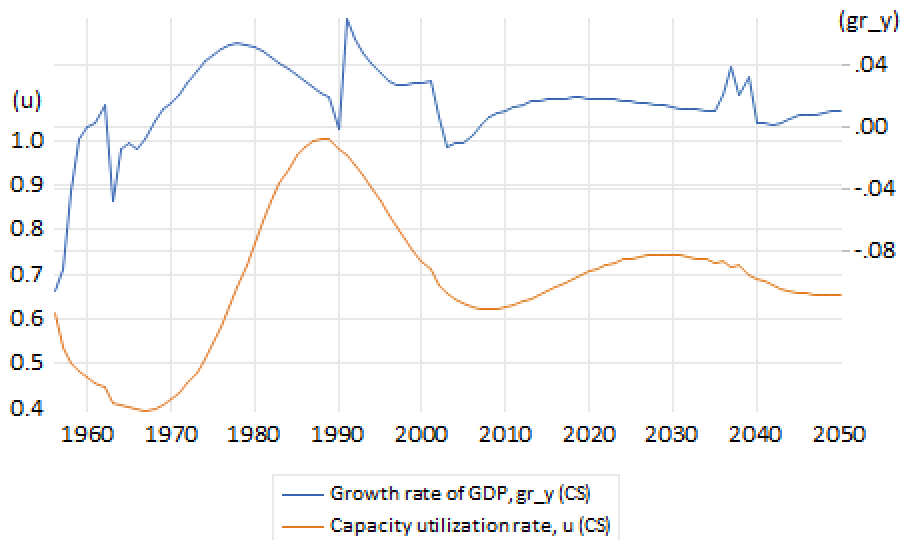
4. The behavior of the model under the different fiscal regimes

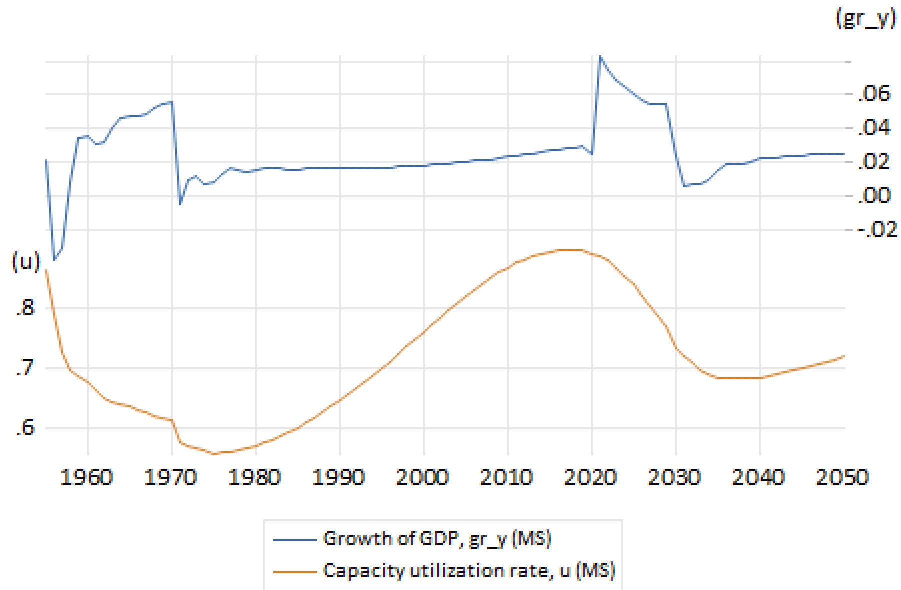
In this section, we run the baseline model with the three fiscal regimes discussed above. The three fiscal regime models have the same initial values for the endogenous variables, the same parameters, and the same equations. The only differences are the fiscal regimes equations.

It is important to note that the time frame of the graphs is fictitious. Here, we follow the time frame of Godley and Lavoie (2007), running the model for 100 periods, from 1950 to 2050. The label in itself is just a convenience. It could range from 1 to 100 without any change in the results. Other authors, like Dafermos (2012), use periods that run from 1500 to 2010. The Eview has solved the models numerically and found a set of the steady state parameter values.

Graph 1: Growth rates and capacity utilization rates for the constant growth of the government expenditures fiscal regime


(gr_y)
(u)
.08
.04
.00
-.04
-.08
.8
.7
.6
.5
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
Growth of GDP, gr_y (AS)
Capacity utilization rate, u (AS)


(gr_y)
(u)
.04
.00
-.04
-.08
1.0
0.9
0.8
0.7
0.6
0.5
0.4
1960
1970
1980
1990
2000
2010
2020
2030
2040
2050
Growth rate of GDP, gr_y (CS)
Capacity utilization rate, u (CS)

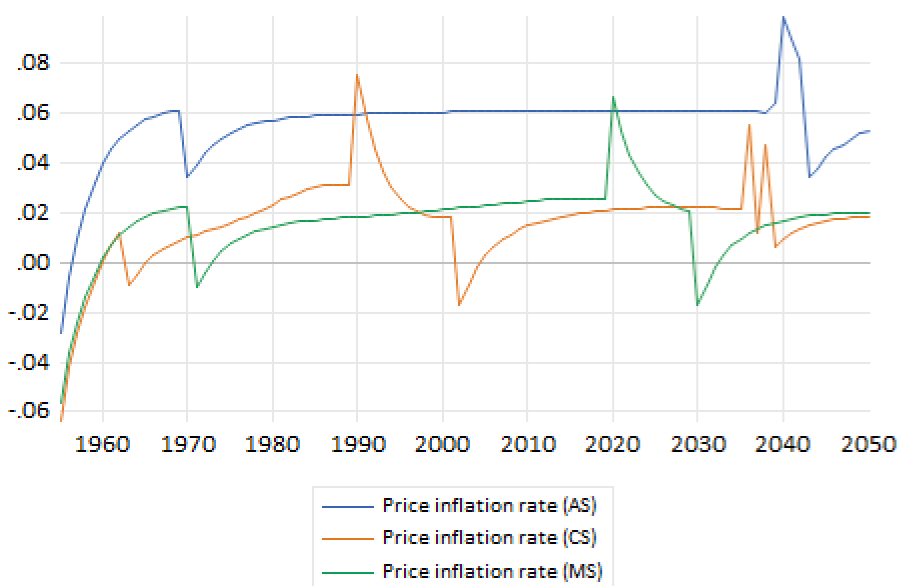


The GDP growth rates of constant growth of the government expenditures regime (AS), the counter cyclical fiscal regime (CS) and Maatriastrich-type fiscal regime (MS) are on the graph 1. For the AS fiscal regime, the growth rates do not show a cycle but have constant growth from 1970-2020 except at the end of the period (2035-2040). The Maastricht type fiscal regime shows a similar pattern in growth of GDP like the AS regime where it shows long-term steady growth of GDP. However, For CS fiscal regime, there is a cycle of boom and bust in the growth rates over the years.

The growth rate affects the capacity utilization rates, which is shown significantly in the CS regime; capacity utilization rates and GDP growth rates are correlating. The capacity utilization rates for the AS and MS regime show steady growth over the years from 1970 until 2030, and the growth rate of GDP of AS and MS regimes also increasing constantly. The capacity utilization rate, u affects positively in the three regime in theri growth rates of GDP because in this models, growth of capita, g_k equation in the post-keynesian investment function (eq. 30) shows that when u increases, g_k increases, which also increases firms' investment level in the equation of the law of motion of capital (eq. 27).

Graph 2: Price inflation rate for the three different fiscal regimes

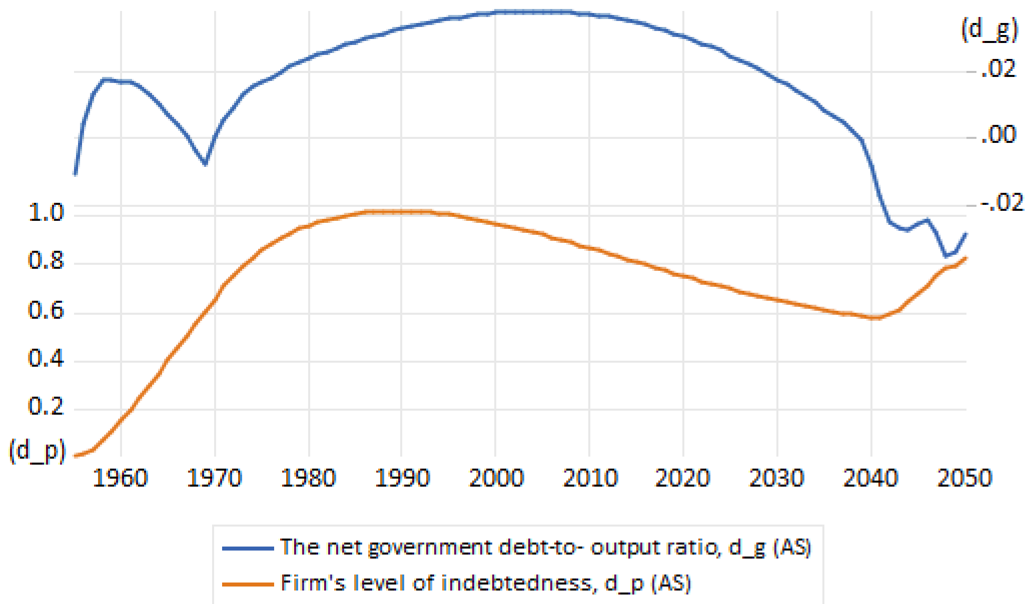
The graph 2 shows the price inflation rate for each fiscal regime. The inflation rate of the constant growth of the government expenditures regime (AS) stays relatively high around 6 % overall. The price inflation rates for counter cyclical fiscal regime (CS) and Maastricht-type fiscal regime (MS) shows cycles of inflation and deflation pashes most frequently among the other fiscal regim models. The frequency of the cycles in CS regime is hgh than MS regime, while in both cases the cycle resonates what Minsky theorizes as cycle of financial asset price boom and bust and burst in capitalistic market economy.

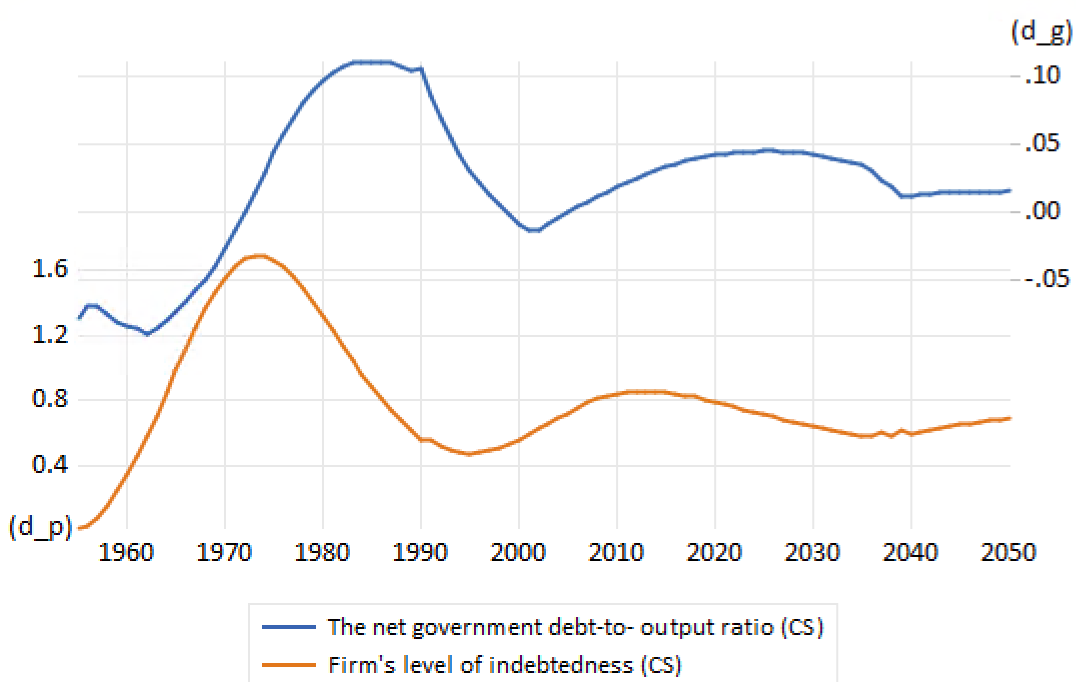


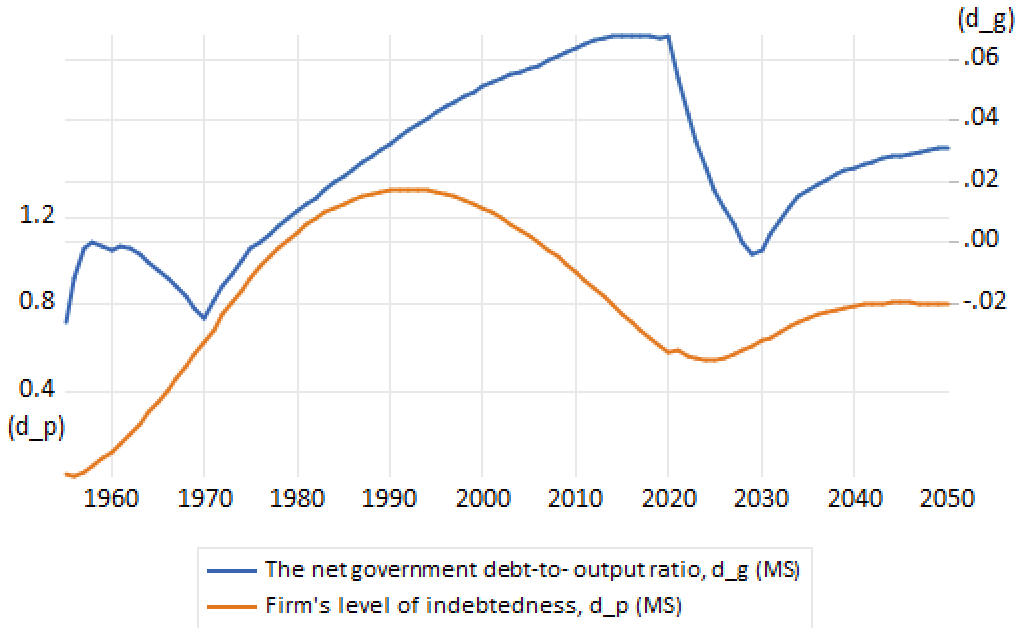
The graph 3 shows the relationship between net government debt to output ratio and firm's level of indebtedness. Recall that firm's leverage rate (degree of indebtedness) is defined as, $d_p = \frac{L_{d-1}}{Y_{f-1}}$. The interesting fact is that each fiscal regime has the same parameters and endogenous variables (only differences are the fiscal regime equations); however, the result shows that each regime has a different cycle of firm's degree of indebtedness. The counter cyclical fiscal regime has most biggest volatility in d_p while the Maatricht type fiscal regime shows least volatile in d_p . Overall, as modeled in the firm's investment function (eq. 30), when firm exceeds a target level of indebtedness d_p^T firms start deleveraging. This is reflected in the cyclical movement of all firm's level of indebtedness. The difference of cyclical movement in each fiscal regime's d_p comes from the endogenous variable of d_p^T which is affected by the growth rates of GDP, gr_y.

The CS fiscal regime shows that firm's level of indebtedness peaked around 1975 which is considered a boom and bust moment and then firms start deleveraging. In CS regime, d_p and d_g has the opposite movement while in the AS regime d_p and d_g movements show similar direction. The Maastricht-type regime also shows shows mixed movement in d_p and d_g; until 1990s d_p and d_g shows positive correlations but after that theses shows inverse relations.

Graph 3: The net government debt to output ratio and firm's level of indebtedness

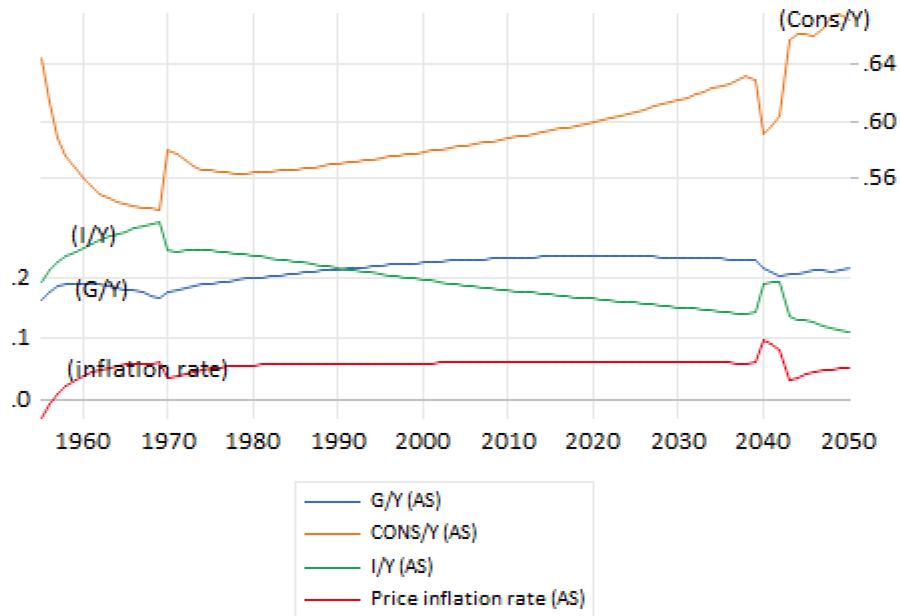


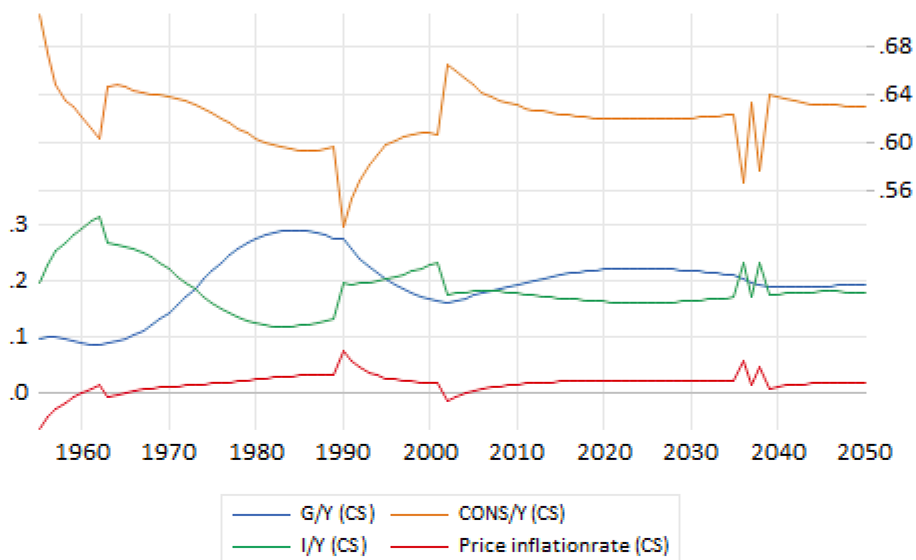


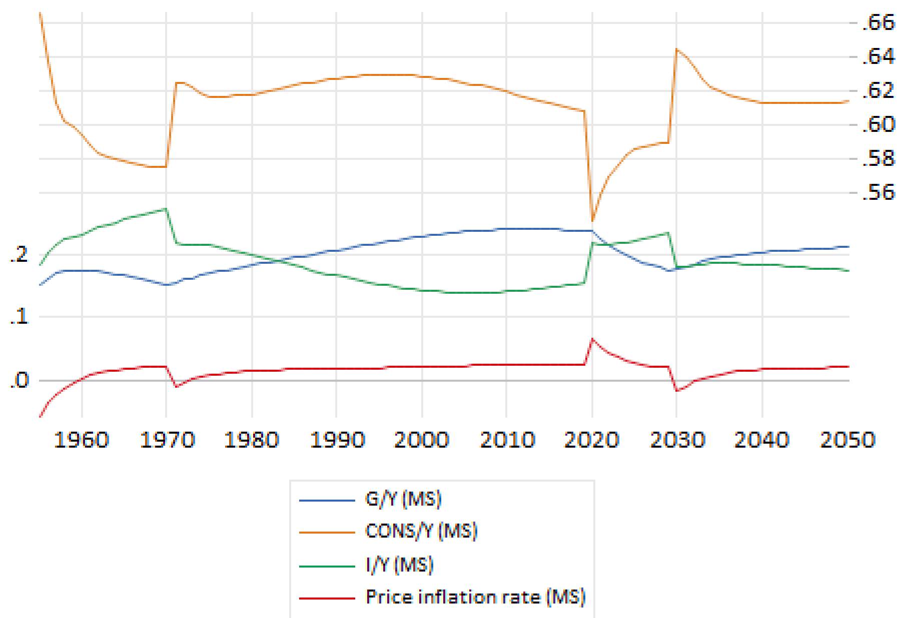


The graph 4 shows the government expenditure, consumption, investment share of output, and price inflation rate for each fiscal regime. The constant growth of the government expenditures fiscal regime (AS) shows the declining value of investment share of output over years while other variables keep increasing slightly. The Counter Cyclical fiscal regime (CS) has the government expenditure and investment out of output has symmetric movement and converges to stable and equivalent values. The Maastricht-type fiscal regime (MS) also symmetric movements in the government expenditure and investment out of output shows the lowest rate of inflation (0.5%). However, the inflation rate has cyclical movement and it reaches to the negative ranges when the government expenditure and investment converse together (late 1980s and 1945).

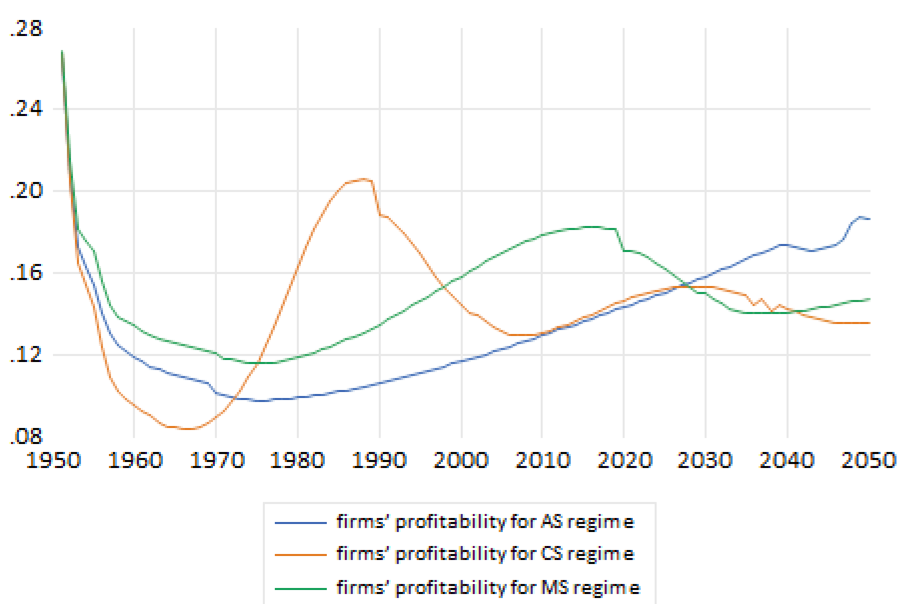
Graph 4: The government expenditure, consumption, investment share of GDP and price inflation rate for 3 fiscal regimes.







Graph 5: Equities' prices in the four fiscal regimes



The CS regime shows the most fluctuations in the firm's profitability (F_f/K), while the MS regime also has fluctuation in the firm's profitability but with a less frequent cycle. In both CS and MS regime there is a cycle of profitability which has the asymmetrical movement of a firm's level of indebtedness. Also, CS and MS regimes have the capacity utilisation rates that have symmetrical movement with the firm's profitability of CS and MS regimes. The CS and MS fiscal regimes show cycles of the price boom and bust while the AS fiscal regime has shown constant increases in the asset price.

5. Experiments

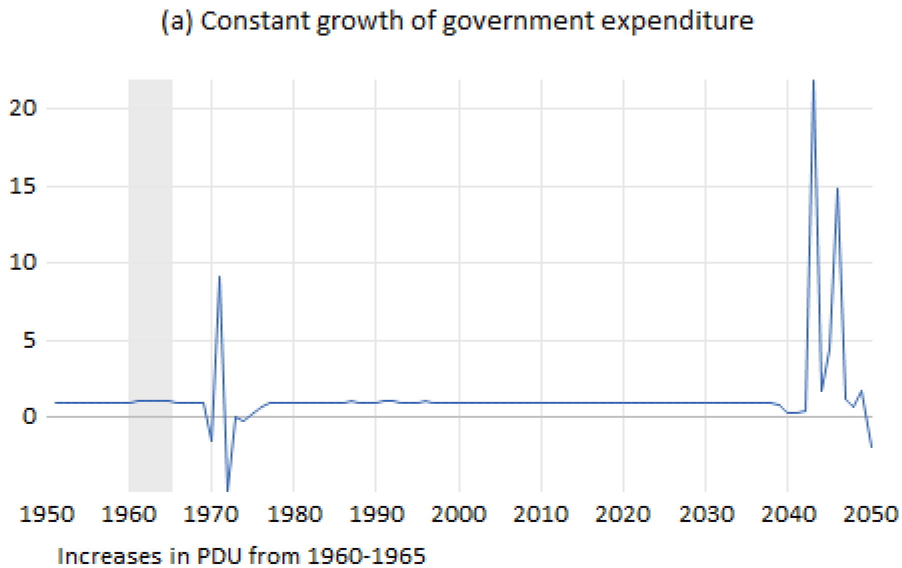
We have 3 different fiscal regimes that are listed previously. The goal of this section is to analyze how those different regimes show different effects caused by stimulus. The three fiscal regime models have the same initial values for the endogenous variables, the same parameters, and the same equations. The only differences are the fiscal regimes equations (equation 39A, B, and C). Using the baseline scenario that was created in the previous section without giving any stimulus, as an experiment, we give a stimulus in each attempt by changing the values of certain parameters that we use for the stimulus in the experiment.[3] AS a stimulus, I increased one of the values of exogenous parameters from 1960-1965. Therefore, the shock is temporary and each figure shows the evolution of the values of important economics variables relative to the *baseline solution* (initial values without the stimulus schock). The experiment to conduct is to increase PDU by 400% from the original value. Recall from the previous section, PDU is an exogenous variable that

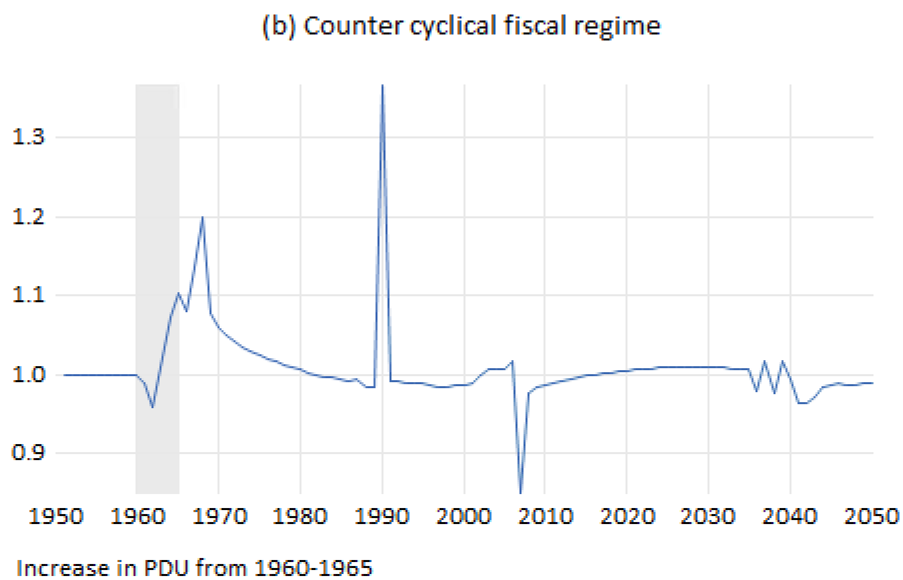
[3] Time frame of the graphs in the experiment follows the time frame of Godley and Lavoie (2007), running the model for 100 periods, from 1950 to 2050.

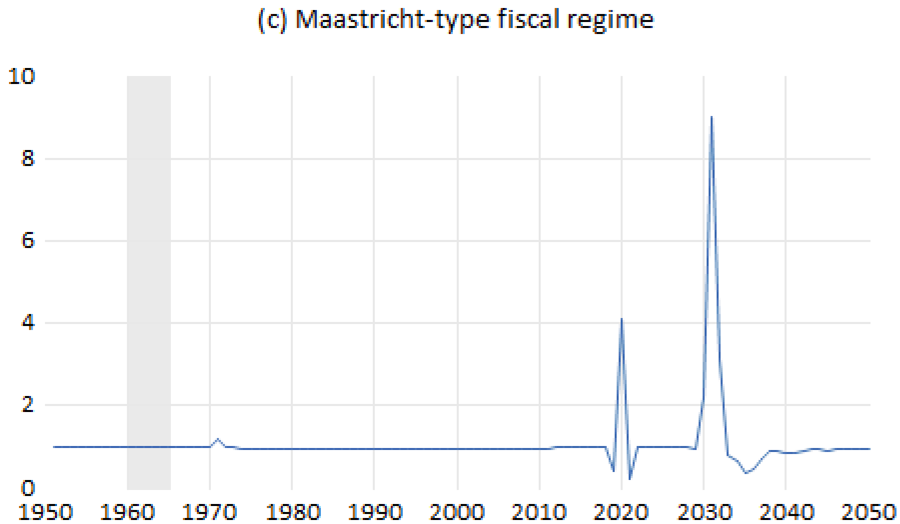
captures the economic agent's perceived uncertainty caused by the exogenous shock such as natural disaster or political instability etc). Increase in PDU means decreases in confidence of economic agents and expectation of the economy. The purpose of this first experiment is to replicate the condition for the recent economic recession caused by the Covid-19. The figures that shows the result of the experiment are all shows in terms of relative to the original steady state values

Graph 6 shows the evolution of GDP growth rates relative to their initial steady state values following increases in PDU. In the case of constant growth of government expenditures (AS) fiscal regime , the growth rate of GDP increases significantly after 80 years of shock (in the year of early 2040s) and has the biggest volatility. Counter-cyclical (CS) fiscal regime shows the least volatility in these values among the three different fiscal regimes. The Maastricht-type (MS) fiscal regime shows the constant values (the values stays at 1); however, after 60 years from the shock, the relative value shows dramatic cyclical movements (2020-2030).

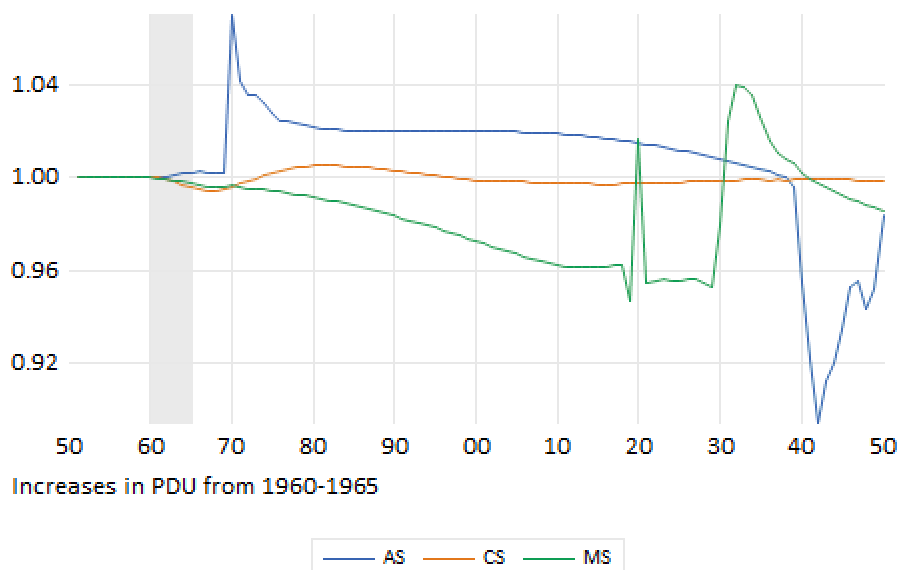
Graph 6: Evolution of growth rates relative to their initial steady state values following increases in PDU


(a) Constant growth of government expenditure
20
15
10
5
0
1950 1960 1970 1980 1990 2000 2010 2020 2030 2040 2050
Increases in PDU from 1960-1965


(b) Counter cyclical fiscal regime
1.3
1.2
1.1
1.0
0.9
1950 1960 1970 1980 1990 2000 2010 2020 2030 2040 2050
Increase in PDU from 1960-1965

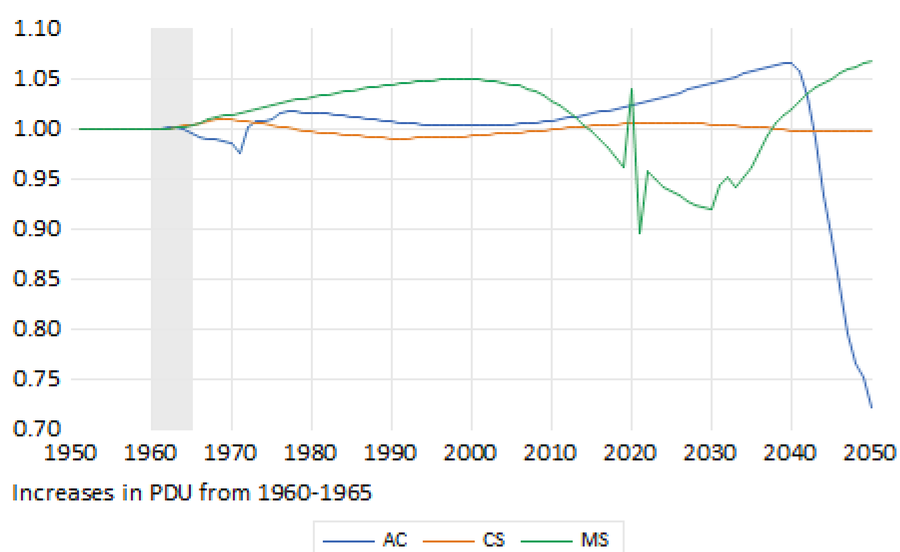


Graph 7: Evolution of real output relative to their initial steady state values following increases in PDU



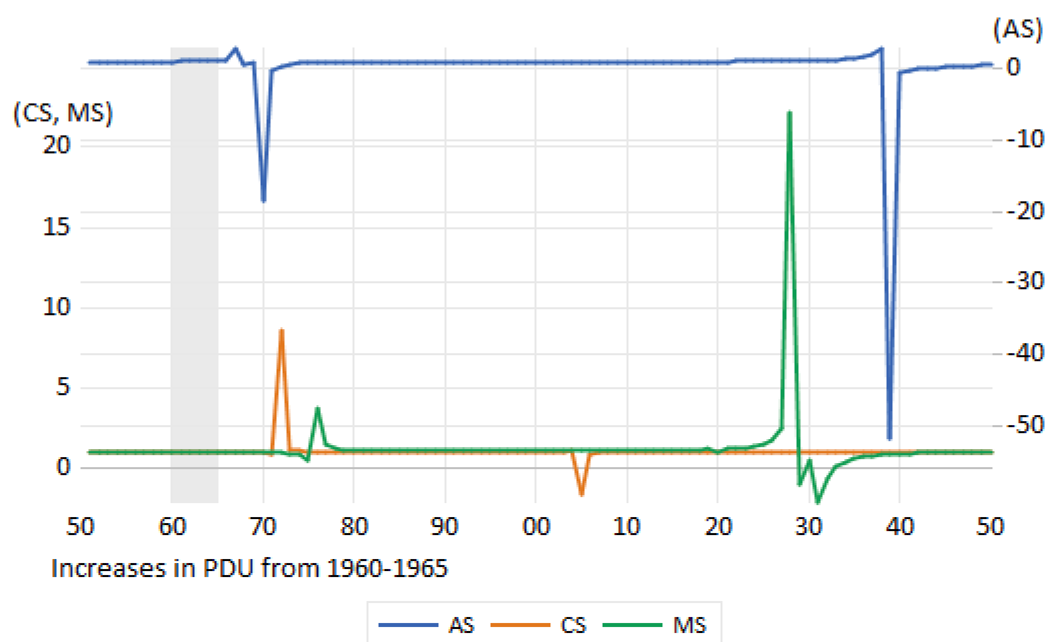
Graph 7 shows evolution of real output relative to their initial steady state values following increases in PDU for three fiscal regimes. With the shock of decrease in PDU, the level of output compared with the baseline model stays the same for the CS fiscal regime while other two regimes have dramatic decreases and increases from the baseline values. This means a counter cyclical fiscal regime has the most resilience to the shock. Recall that in this experiment, the shock of increasing PDU affects directly having the lower loans supplied from banks to firms. Having counter cyclical fiscal policy works in keeping the level of output level after shocks because it aims to increase the government expenditure when the private sector deleverage (meaning when actual firm's level of firm's indebtednessd_p, is lower the target level of indebtedness, d_p^T (eq. 39.B2).

Graph 8: Evolution of Firm degree of indebtedness (d_p) relative to their initial steady state values following increases in PDU



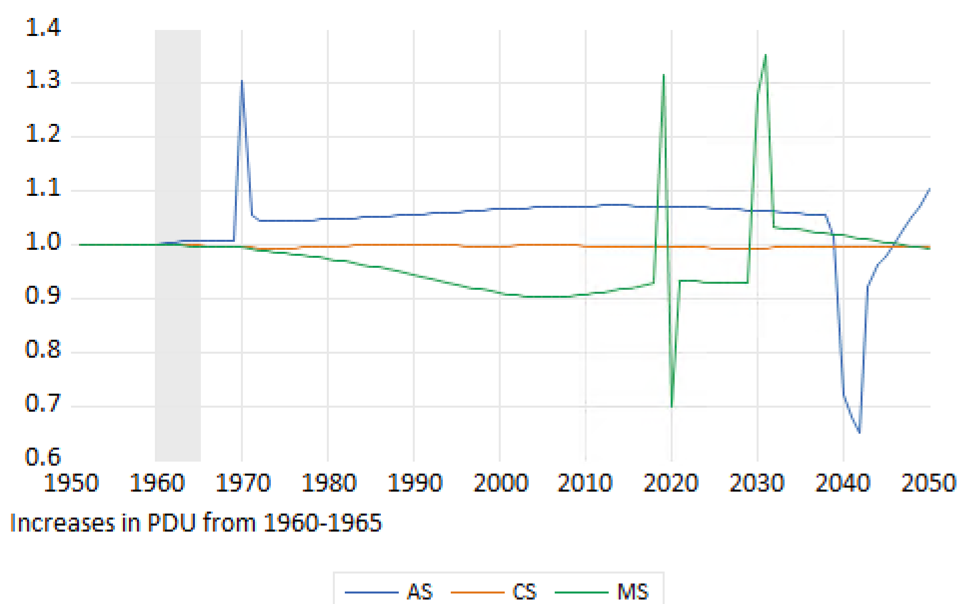
The graph 8 shows evolution of Firm degree of indebtedness (d_p) relative to their initial steady state values following increases in PDU for the three fiscal regimes. While AS and MS fiscal regimes show the disruptions in the values, CS fiscal regime shows relatively constant values compared with other regimes. It means that when shock happens, increases in PDU (decreases in the firm's level of confidence and expectation) causes the decreases in loan supplies from banks to the firms. However, the level of firm's loans to income level stays constant in CS fiscal regimes. AS regimes show dramatic decreases in irm degree of indebtedness (d_p) relative to their initial steady state values while in the graph 7, real output relative to their initial steady state values in AS regime also dramatically decreases.

Graph 9: Evolution of net government debt to output ratio (d_g) relative to their initial steady state values following increases in PDU



The graph 9 shows evolution of net government debt to output ratio (d_g) relative to their initial steady state values following increases in PDU for the three fiscal regimes. The CS fiscal regime shows the least disruption among the three regimes in that value. Interestingly MS regime in which government expenditures (relative to output) is designed to decline when the net government debt-to- output ratio is higher than a specific target, shows the most increases in evolution of net government debt to output ratio (d_g) relative to their initial steady state values following the shock. The AS fiscal regime attempts to contain the growth of government expenditure in a constant rate even after economic shock, the evolution of net government debt to output ratio (d_g) relative to their initial steady state values shows the most decreases among the three regimes.

Graph 10: Evolution of level of real investment of firm relative to their initial steady state following increases in PDU



The graph 10 shows the evolution of the level of real investment of firms relative to their initial steady following increases in PDU for the three fiscal regimes. The CS fiscal regime shows stability while AS and MS fiscal regimes show disruptions in those values. Interesting fact is that these results show that the fiscal regime type can affect the firm's investment behaviour. As explained in graph 6 and graph 7, the counter cyclical fiscal regime has shown that growth rates of GDP and level of real output before and after the shock has remained relatively constant compared with other regimes meaning that counter cyclical fiscal policy has the most resilience to the shock to keep the level of real GDP. The target level of firm's (private sector) level of indebtedness, d_p^T is endogenous variable and affected by the growth rates of GDP positively as long as it exceeds the the benchmark growth rate, g_{Y0}. Therefore, having the higher growth rates, g_Y make it allow to sustain the level of firm's indebtedness, $d_p = \frac{L_{d-1}}{Y_{f-1}}$, which allows firms to keep the level of investment level.

6. Conclusion and Remarks

The baseline model in this paper has a behaviour that when firm's debt to income ratio (level of indebtedness, d_p) is higher than the target value, firms deleverge while it is still lower than the target value, firms increase the growth rates of capital and increase the level of investment. Then, I introduced three fiscal regimes, (i) the constant growth of government expenditure, (ii) counter cyclical fiscal regime, and (iii) the Maastricht-type fiscal regime in the model. The baseline model shows that the counter cyclical and the Maastricht type fiscal regimes shows cycles of price asset boom and bust (graph 5 equity price level) and also cycles in investment out of output, price inflation rates, and growth rates of GDP like as theorized in the Minsky and Richard Koo. The Debt-deflation economy is in this model captured in a cycle that when the firms accumulated the debt and when the firm's level of indebtedness peaked, firms start to attempt to reduce the values by deleveraging for decades, at the same time that causes decreases in growth rates in GDP; then after long decades of deleveraging firms behaviour causes decrease in price level and asset price level.

In this paper, I conducted an experiment that was given as a shock by increases in the level of PDU, which means decreases in confidence of economic agents and expectation of the economy. PDU in equation 41 acts as credit rationing of banks, and therefore, when there is an exogenous shock such as COVID-19, political uncertainty, or natural disasters happen and loans demanded by the firms will not be 100% guaranteed from the banks.

The outcomes show that the Counter cyclical fiscal regime shows the stability and least volatility in the relative value of after the shock and value in baseline modes (before the shock) in growth rates, level of real output, firm’s real investment rates, and net government debt to output ratio. It can shows that counter cyclical fiscal policy show that if the government sector conducts expansionary fiscal policy during the time of the debt-deflation: the more easily the private sector can fix the liability to asset ratio in the balance sheet, which enables the stabilization of the macroeconomy, and can recover from the recession and keep the positive economic growth rate.

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