Paradox of debt and retained profit rate of firm: nonlinear effects of debt, capital and secular stagnation in Japan

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Abstract
In this Stock Flow Consistency model, we analyze Minsky-Koo financial macrodynamic under different firm's saving behavior. Balance Sheet recession by Koo has argued that Japanese nonfinancial firms have been attempting to fix their balancing sheet rather than spending its income on investment to expand its productive capabilities or paying dividends to shareholders. This deleveraging behavior is signified more as the firm's propensity becomes higher through retention rate adjustment.

Firm's debt cycle and instability of macrodynamic by Dafermos (2017) and Nikolaidi (2014) already revealed that under the debt-burden regime, there is a clockwise cycle between the leverage of firm and accumulation rate. My contribution to the past studies is that the relation between the leverage ratio and accumulation rate could produce two different nonlinear outcomes either by Minskyan cycle or paradox of debt cycle. The distinction of these is the former during the euphoric time can have both increasing leverage ratio and higher accumulation rate; this movement can be explained by wealth effects as households get higher disposable income from high dividend payment during the euphoric time. This induces higher consumption, which leads to higher profit and investment.

I argue that the paradox of the debt cycle and the Minsky cycle has the same firm investment behavior when the actual leverage ratio exceeds the benchmark leverage ratio to reduce the level of debt. However, the paradox of debt more likely happens when firms in nature have a high propensity to save which make this to be an explicitly debt-burdened regime. In this case, that more firms attempt to reduce the debt perversely the debt level increases since deleverage causes decreases in the effective demand directly without wealth effects affecting the consumption (debt effect dominates the wealth effects. More importantly, even if both cycles converge to a steady state, the case with higher firm's propensity to save causes permanently lower growth rates while debt to capital ratio is permanently higher. This can explain the secular stagnation of Japan.

1: Stylized fact: Secular Stagnation, and Financialization and Paradox of debt

Post-keynesian economics (PKE) emphasizes the matters of finance on growth. Originated by the 'parsimonious' PKE model by Taylor (2004), in the recent PKE firm's debt theory, Stockhammer (2006), Hein and van Treeck (2010), and Lavoie (2014) and others have studied the effect of debt to capital ratio on growth in their demand regime analysis. As empirical contributions, using the debt to capital demand regime identification (identifying debt-led or debt- burdened), Hein and Shoder (2009) attempted to identify the case of US and Germany and Nishi (2012) for Japan which are found to be both debt burdened. Their motivation is how the leverage ratio of firms affects the trend of decline of accumulation, demand, and long term stagnation despite increases in profitability and debt to capital ratio, which has been a prominent phenomenon in the last few decades.

First, the post-keynesian view on secular stagnation focuses on the demand side issue. Hein (2016) counters the Lawrence Summers's stagnation debate by using Steindl theory of stagnation. Hein argues that mainstream economists' view on the natural or potential rate of growth in the modern discussions about secular stagnation does not incorporate the aggregate demand dynamics on growth.[1] Hein stands the aggregate demand constraints in the long run, and potential growth to become endogenous to actual demand driven growth. And the post-Keynesian approach on stagnations weighs on the role of income distribution , power relationships in institutions, and economic policies for long-run growth.[2]

Second, as a demand side of analysis on stagnation, PKE scholars have pointed out the dominance of the financial market that depresses the actual investment but heterogeneously. Stockhammer (2006) definsthe "finance-dominated accumulation regime" and also provides evidence of the 'investment-profit puzzle.'[3] In a competitive environment corporate managers are motivated by short-term rate of return on equity and would prioritize shareholders by distributing the profit as dividend and neglect the importance of long-term investment projects. However, financialization has affected the macroeconomic outcome heterogeneously pointed out by Stockhammer (2022) who uses the post-Keynesian approach of Comparative political economy (CPE) on study of growth. Each country has unique financial demand patterns and using CPE analysis allows to study the source of growth and stagnation in each demand regime, and the potential financial instability.[4]

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[1] Paul Krugman (2015) and Larry Summer (2015) focuses too much on equilibrium argument regarding real or natural rate of interest in which saving and investment is at equilibrium is currently too low and even zero interest rate policy cannot be attan very low or negative equilibrium real rates of interest. Therefore, Summer (2015) argues that the current state of the economy cannot be adjusted to the potential growth due to the zero lower bound interest rate.

[2] This point is similar to Koo's (2011) argument that Japan's economic stagnation for decades is caused by demand side problems as firms deleverage to fix their balance sheet. Koo also challenges the new-Keynesian equilibrium interest rate and inefficiency of monetary policy on stagnation.

[3] Kaleckian equation shows: Investment = f(Profit) f'(Profit)>0. Investment should be depending on the expected profit; however, the recent trend that Strockhammr shows is that investment to profit ratio has been declining.

[4] In the post-Keynesian perspective, the state of the economy and stagnation varies by the relationship between the income distribution and aggregate demand (wage-led or profit led patterns) and capital accumulation regime based on the debt to capital ratio (debt-led or debt-burdened). Therefore, for analyzing

Represented by the case of the US, financialization has created a consumption led-boom since the mid-1990s (Stockhammer 2009). Finance dominated accumulation regimes as well as credit-driven and consumption-led demand regimes have been more used to study accumulation patterns and stagnation. As the case of finance dominated accumulation, shareholder orientation accelerated the share buy-bucks for higher share price. On the other hand, for Japanese macroeconomic stagnation, it is important to highlight the Steindl debt regime by Lavoie (2014) which cannot be categorized as the US and UK case of "profits without investment" phenominant led by financialization and shareholder orientation. Hattori (2020) argues that the Japanese case is peculiar as it cannot be fully explained by the Minsky type of financial macro model despite the stagnation that has been followed by the asset bubble purset in 1990. Since the 1990s, in the midst of a long period of stagnation, the Japanese government and corporations have made attempts to adopt the US type of financial model endorsed by US neoliberalism. Firms also attempted to suppress wages to help profits to be recovered in the absence of production growth. Big Japanese corporations have a tendency to weigh more on shareholder value and increase dividends, which creates pressure for lower fixed investment. However, compared with US-UK cases, Japan has not experienced a full fledged financialization as the Japanese financial sector has neither the will nor the capability to assume high levels of risk and engage in speculation, and Japanese households have chosen not to increase their borrowing.

There are various explanations of the decline of accumulation of capital. The various cross-country and time-varying econometric research have shown the evidence on the existence and nature of the secular slowdown in investment rates have been existing in the OECD countries. Strauss and Yang (2020) using the bayesian econometrics analysis argues that at the macroeconomic level, the secular investment slowdown over time is strongly related to the non-financial corporate sector's net releasing of funds externally to shareholders, creditors, and bondholders.[5] This explanation is aligned with Hein (2010) and van Treeck (2008), and Stockhammer (2006) as the shareholder oriented financialization in which profit without investment could occur; financialization is claimed to be the source that depresses the growth of investment and animal spirits of entrepreneurs (Hein 2012; 2014, chapter 10; Stockhammer, 2010, 2012, 2015).

There has been a debate whether liquidity preference of firms and cash holding has been affecting the growth of capital and the reason for Japan's long-term stagnation. As a stylized fact, the data from the ministry of finance of Japan, shows an increase in retained earnings of profit and capital adequacy ratio of non-financial firms which has been significant since 1995. While the leverage ratio peaked in 1989 around the bubble burst it has been slowing down. The growth rate of capital has stagnated close to zero % since 1995. In the amids of stagnation since the early 1990s, Japanese business has maintained increasing cash flow and Japanese firms have maintained a high stable retention rate out of

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the pattern of capital accumulation and investment, the theoretical studies of income distribution and dynamics of debt is necessary and has an important role to play at all in the discourse of secular stagnation. Modern capitalistic economy has been more complex since the rise of finance-dominated capitalism over the decades.

[5] Japan investment rates are significantly low among the developed countries. Europe is undergoing a similar secular and long-running decline in investment rates; however, it depends on the country(Yang et al, 2020).

profit. Over the years, the export-led demand allowed the firms to retain a significant part of its profit which signifies as the cost of business such interest payment of loans and wage cost as ratio to retained earning of profit has been decreasing significantly since 1995.[6] However, at the cross country level, Strauss and Yang (2020) concludes that retention of funds internally is a much less relevant predictor, indicating that repairing over-leveraged balance sheets by Koo (2011) has probably not been a dominant motivator. They also emphasize that lower animal spirits firms account for the stagnation while Hein and Shoder (2009) show different empirical evidence in which animal spirits do not account much for the level of accumulation in the US and Germany from the time series analysis from the 1960s to the 2000s.

Therefore, there are lots of analogies for the source of stagnation. This paper reviews the precedent works in regard to the relation between debt to capital of firms and accumulation and growth to find the source of stagnation. This paper gives a theoretical foundation of the debt accumulation regime coupled with the paradox of debt and financial dominated capitalism for the case of Japan while comparing the case of the US. The object of this paper is to open up the discussion and research on the post-Keynesian cooperative political economy for the secular stagnation and financial instability for the case of Japan.

2: Business Debt theories: Debt Deflation, Financial Instability Hypothesis, Paradox of debt and Balance Sheet Recession

Using the notion of Keynes' paradox of thrift which says that an increase in the propensity to save will lead to reduced output, there are following authors attempting to capture the consequences of indebtedness of firms on the effective demand of macrodynamics. After the Wall Street crash of 1929, Irvin Fisher (1933) in his *Debt-Deflation theory* 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. Fisher's argument is aligned with Stendle's paradox of debt. Kalecki's follower, Steindl (1952), also worked on the financial issues and he studies paradox of debt in one of his chapter (1952, ch, 9) called "outside saving and the gearing ratio[7] [of firms]".[8] As a firms' first attempts to reduce their leverage ratio L/K during recession can actually perversely cause increases of the ratio. This is because firms only can attempt to reduce debt size, L through reducing investment, I. Therefore, despite firms initial attempt to decrease the denominator, Debt, L, but it lowers the numerator, K by deleveraging ($I = \Delta K\downarrow$), and the leverage ratio continues to grow. During an economic downturn and profit rates decline, firms manage to reduce their debt to capital through decreases investment I, and with that case, since outside saving (debt) is less elastic than accumulation of real capital, the paradox of debt holds.[9]

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[6] Data source: Policy Research Insitute Ministry of Finance of Japan 法人企業統計調査

[7] Gearing ratio = 1+ L/K

[8] Lavoie (2014) explains the paradox of debt in chapter 1 of Keynesian paradox and chapter 6 of business debt. Steindl (1952, p. 114), the realized gearing ratio is likely to rise, so that 'the entrepreneurs, even apart from their desire to reduce the initial gearing ratio, will soon be inclined to check this relative growth of their indebtedness, and their only possible reaction against it will be to reduce investment (Lavoie, 2014, p. 438).

[9] The speed of K declines is faster than the speed of L does when firms attempt to deleverage.

One of the most important pillars of contemporary financial macroeconomic theory in Post-Keynesian economics is by Hyman Misky who in the 1980s, during a time of rise of financial innovation, complemented Fisher's *debt-deflation theory* by incorporating the asset market in the story. Minsky's theory of *financial instability hypothesis* (FIH) 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.

Observing Japan's long economic stagnation and deflation after the financial bubble burst in the early 1990s, Richard Koo writes a similar analogy in his deflation theory of *balance sheet recession*.[10] Koo's emphasis on the cause of economic deflation is that: deflation-spiral comes from the firm's excessive saving and 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 due to firms attempting to control their leverage ratio to get back to normal level is the cause of the deflation spiral, while Minksy in his financial instability hypothesis explains the changes in the expectation of profit. There is also a distinction between Minsky and Steindl's debt theory. In the paradox of debt, an increase in a firm's level of debt is always a negative influence on investment and growth, and creates downward pressure on demand. However, Minsky's euphoric phases entails the debt expansion actually stimulates demand and investment because asset price and expected profit is increasing. The most important point of Koo's balance sheet recession is that neither increase nor decrease the debt affects the demand or growth, but the the firms attempt to control the leverage ratio to certain level, which comes with higher the saving behavior of the private sector (and by the deleverage) was the principal driver of contractions of economies. Then the question is how firms' reaction to rising leverage ratio and its attempt to reduce debt size would mean to overall macroeconomic outcomes? This paper replicates the Minsky-Koo financialized capitalist macroeconomy in which the firm's initial attempt to adjust actual indebtedness within a normal level and corresponding deleveraging behavior will be an impetus to over indebtedness as argued by the paradox of debt.

3. The SFC model of a corporate debt cycle

3.1 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 inspired by Steindl's paradox of debt and Hyman Minky's financial instability hypothesis which were originally based on Irvin FIsher's debt-deflation theory.[11] This SFC model to study Minsky-Koo's financialised capitalist

[10] Koo doescreadit to the other economic deflation theories done by Fisher, Steindl, Misnky, and Keynes.

[11] Lavoie (2014) echoes the importance of the Post-Keynesian model to work on the topic of monetary growth, especially firm's debt and business cycle.

"Nothing has been said about firms needing bank credit or about business debt, and nothing has been said about the liquidity preference of households…since post-Keynesians attach so much importance to the monetary and financial aspects of the economy, but this, to some extent, is a symptom of the difficulties that

economy affected by firms leverage ratio explained in the previous section is inspired by the works of Godley and Lavoie (2007, cp. 11), Dafermos (2012 and 2017) Nikolaidi (2014). I built a SFC model of three-sectors (a private sector, a public sector, a financial sector). Table I: *Balance Sheet of The Model* shows that in this model, there are six economic actors : household, fim, government, central bank, and bank. The first seven variables in the Balance Sheet (Table 1) are: Advances (A), Money (M), Loans (L), Fixed Capital (K), Government Bill (B), Equity ($e * p_e$), and high power money (H). They are allocated within the economy for each sector. The last row shows the networth of each sector. As Godley and Lavoie (2007) explains, 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. In this model, the general level of price is denoted as p. 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 nominal 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 banks, 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. 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

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

Table II: Transaction Flow Matrix of the Model

post-Keynesians have had in the past in conflating the real and the financial sides of the economy" (2014, pp. 437).

There are models of business debt that have been worked such as by Taylor (2004) and also Lavoie (1995), Lavoie and Seccareccia (2001), Hein (2006, 2007), Toporowski (2008) and Bellofiore et al (2010) and by Stockhammer and Michell (2017), and also firms debt cycle also studied by and Ryoo (2008) and Skotto Ryoo (2012). However, since the late 2010s, the major updates in this field have not been done, while the study of the private sector's debt dynamics has shifted on the US based consumer side of the story, or consumer credit dynamics.

	Households	Firms		Govt.	Central bank		Banks		Σ
		Current	Capital		Current	Capital	Current	Capital	
Transaction									0
Consumption	$(-)C$	$(+)C$							0
Govt Expenditure		$(+)G$		$(-)G$					0
Fixed Investment		$(+)I$	$(-)I$						0
(Output)		**[PY]**							0
Wages	$(+)WB$	$(-)WB$							0
Income Tax	$(-)T$			$(+)T$					0
Bank's Profit	$(+)FD_b$						$(-)F_b$	$(+)FU_b$	
Firm's Profits Divident	$(+)FD_f$	$(-)F_h$	$(+)FU_f$						0
Central bank profits				$(+)F_{cb}$	$(-)F_{cb}$				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	$(+)r_{b(-1)}B_{h-1}$			$(-)r_{b(-1)}B$	$(+)r_{b(-1)}B_{cb-1}$		$(+)r_{b(-1)}B_{b-1}$		
Flow of Fund (Net Lending)	$[NL_h]$	$[NL_f]$		$[NL_g]$	$[NL_{cb}]$		$[NL_b]$		0
Advances						(-)ΔA		(+)ΔA	
Δ Loans			(+)ΔL					(-)ΔL	0
Δ Deposits	(-)ΔM							(+)ΔM	0
Δ Highpower money						$(+)\Delta H$		$(-)\Delta H_b$	
Δ Bills	$(-)\Delta B_h$			(+)ΔB		$(-)\Delta B_{cb}$		$(-)\Delta B_b$	
Δ Equities	$(-)p_e\Delta E$		$(+)p_e\Delta E$						
Σ	0	0	0	0	0	0	0	0	0

3.2.1 Household Decision and Portfolio Choice

Eq. 1 shows that wage bill is allocated to the household from firm and π is the firm's profit share. Eq. 2 shows the household's real consumption. Household receives wage bills, WB, dividend from bank, FD_b and firm, FD_f, and interest payments 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 (eq. 1)

$$c = \alpha_1 (YD_r)/p + \alpha_2 V_{-1}/p$$

Real Consumption (eq. 2)

$$C = C * p$$

Nominal Consumption (eq. 3)

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

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

Household Nominal Wealth (eq. 4)

$$v = V/p$$

Household Real Wealth (eq. 5)

In each period, households receive personal income , which is subject to taxation. The personal income, YP after tax ($T = \theta * YP$) is called regular disposable income, YD_r between 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 (eq. 6)

$$YD_r = YP - T = (1 - \theta)YP$$

Regular disposable Income (eq. 7)

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

Real disposable income (eq. 8)

Godley and Lavie (2007) describes portfolio choice of household, in which household allocate V, in line using Tobinesque principles, with the appropriate adding- up constraints described in the eq. 9 to 11. Household allocate V , wealth between various assets, M, B_{hd}, $e_d * p_e$ and listed in the accounting matrices.

$$\frac{M_d}{V_{-1}} = \lambda_{10} + \lambda_{11} * r_{m-1} - \lambda_{12} * r_{e-1} - \lambda_{13} * r_{b-1} - \lambda_{14} * \left(\frac{YP}{V_{-1}}\right) \quad \text{(eq. 9)}$$

$$\frac{\left(p_e * e_d\right)}{V_{-1}} = \lambda_{20} - \lambda_{21} * r_{m-1} + \lambda_{22} * r_{e-1} - \lambda_{23} * r_{b-1} - \lambda_{24} * \left(\frac{YP}{V_{-1}}\right) \quad \text{(eq. 10)}$$

$$p_e = [\lambda_{20} - \lambda_{21} * r_{m-1} + \lambda_{22} * r_{e-1} - \lambda_{23} * r_{b-1} - \lambda_{24} * \left(\frac{YP}{V_{-1}}\right)]e_d^{-1} \quad \text{(eq. 10.R)}$$

$$\frac{B_{hd}}{V_{-1}} = \lambda_{30} - \lambda_{31} * r_{m-1} - \lambda_{32} * r_{e-1} + \lambda_{33} * r_{b-1} - \lambda_{34} * \left(\frac{YP}{V_{-1}}\right) \quad \text{(eq. 11)}$$

The asset choice of households is a function of assets liquidity premium λ_{i0}, and real expected rate of own asset return λii, and expected rate of other asset return, λ_{ij}. 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 (2007) set money, M as a flexible component in the wealth allocation process and M takes on a buffering role in eq. 12.

$$M_d = V - B_{hd} - p_e * e_d$$

Money deposit as residual (eq. 12)

The equilibrium condition in eq. 13 reflects that while the price of equity is decided by the portfolio choice by households expressed in eq. 10, the demand of equities has to be decided by the supply of shares (the number of shares on the stock) by firms. Therefore, the number of shares demanded, e_d, has to adjust to the supply of shares e_s. This means the market value of firm's total share in the stock market, $p_e * e_d$ is decided by both demand side (stock price, p_e by households) and supply side (the number of shares, e_d to be issued by firms as a means to finance its investment, eq. 21).

$$e_d = e_s$$

(eq. 13)

3.2.2 Firm Equations

We use Kaleckian mark up pricing in which firms' markup on unit costs μ, is assumed to be exogenously fixed, defines the profit share (eq. 14); therefore, we have exogenous profit share. The real output (eq. 15) 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 (eq. 14)

$$y = c + i + g$$

Real Output (eq. 15)

$$Y_f = p * y$$

Nominal GDP (eq. 16)

The proxy of 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 (eq. 17)

Minsky explains that three sources for funding investment is 1) retained earnings, FU 2) new shares, e_s, and 3) bank loans, L. The firm profit F_f is divided into two components, retained earnings of firms, FU_f and the dividend of firms FD_f. FU_f is assumed to be an exogenously-defined s_f fraction of net profits F_f. Kaldor (1966) assumes firms issue new shares to finance investment expenditure; the small fixed portion, x of investment expenditure will be financed through new issues of shares (eq. 21).

$$F_n = Y_f - WB - r_{l-1}L_{d-1} = \pi Y_f - r_{l-1}L_{d-1}$$

Firm's profit (eq. 18)

$$FU_f = s_f * F_n$$

Retained earning of firm (eq. 19)

$$FD_f = F_n - FU_f = (1 - s_f)F_n$$

Dividends of firm(eq. 20)

$$e_s = e_{s-1} + x_e \cdot \frac{I_{-1}}{p_e}$$

Issue of new shares (eq. 21)

Eq. 22 shows that dividend yield, r_e, 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 value enters in the portfolio decision of households in eq. 9, 10, 11.

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

Dividend yields/ Return on equities (eq. 22)

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

Change in firm's demand for loan (eq. 23a)

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

Firm's nominal Investment (23b)

The firm sector's financial requirements, equation 23a, 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) uses Skott (1989) assumption in sfc model and explains that loans act as a buffer, absorbing unexpected changes in financial requirements.[12] Eq. 23b shows that firm uses 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 ΔL_f, and also can issue new shares, Δe_s.[13]

Above is the basic structure of the firm often used in post-Keynesian SFC literature. According to *Balance Sheet Recession* of Koo (2011) the mechanism of a firm's financing decision and investment behavior split into two phases. In the normal time, firms act as a profit maximizer in the sense that they use the cash flow (retained earning) for investment (*Yang-phase*). While, firms with balance sheet problems mean realized liability to asset ratio is higher than they target, and need to fixate the ratio of loan to asset to be normal. It

[12] There are multiple endogenous mechanisms of fall in entrepreneur profit: the growth of GDP, increases in interest payment on firm's loan, and decrease retained earning ratio out of firm's profit. Any positive windfall in entrepreneurial profits will be reflected in a decrease in the demand for loans.

[13] The Lavoie and Godley (2001) approach is based on Kaldor's 1966 neo-Pasinetti model by assuming that firms obtain finance by borrowing from banks as well as by issuing equities.

leads them to deleverage (*Yin- phase*) and become a debt-minimizer. The study regarding firm's balance sheets, leverage and investment choice in post-Keynesian economics is done by Daferemos (2017), Nikolaidi (2014), Lavoie (2014), Ryoo (2013), Asada (2012), Ryoo and Skott (2008), van Treeck (2008), Taylor (2004), and Godley and Lavoie (2001). Aligned with Koo (2011)'s balance sheet recession, Daferemos (2017) attempts to capture the private sector's financial regime switch (Yin phase and Yang phase) that endogenously arises based on the target debt to income ratio; when indebtedness (debt to income ratio) exceeds the target value, decline in propensity to invest occurs. Nikolaidi (2012) Taylor (2004) , and Godley and Lavoie (2001) use debt to capital ratio as a proxy of Minskian notion of margin of safety or level of financial fragility. SImilar to Dafermos, Nikolaidi (2014) also uses its endogenous target value to specify when firms start deleveraging. Nikolaidi's debt cycle successfully replicates the endogenous Minsky debt cycle; however, as the model is based on credit rationing, it does not incorporate the portfolio choice of household, equities of firms, price of share (asset), which are the fundamental of Minsky's debt theory. My contribution to the past studies regarding Minsky-Koo's financialized capitalist macroeconomy is to integrate the role of household's portfolio choice and price of share in the firm's balance sheet regime switch model. Based on Godley's stock flow norm, the benchmark target leverage ratio is set as exogenous to see how firms control their balance sheet at a certain level (deleverage) effects on overall effective demand and macroeconomic growth. In addition, to illuminate the Lavoie's (2014) study on the business debt dynamics that capture various debt cycle based on the different level of firms propensity to save, s_f, I identify there are mainly two debt dynamic either Minsky or Steindl type, in the story of Koo's balance sheet recession.

Specifying the regime switching 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 investment finance changes when they have a balance sheet recession (eq. 28). The real capital sock is given by the growth in capital gr_k(eq. 24) and the law of motion of capital tells that real gross investment is a function of change in capital and capital depreciation d_k (eq. 25).

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

The real capital stock (eq. 24)

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

The law of motion of capital (eq. 25)

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

Real interest rate on loan (eq. 26)

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

Price inflation rate (eq. 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(eq. 28) using the extended investment function of the Bhaduri and Marglin model used in Nikiforos and Zezza (2017). The level of investment depends on the autonomous level of β_0 which represents the animal spirit of firms. In this 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. The post-Keynesian investment function (eq. 28) 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 (Nikolaidi, 2014). Koo (2011) argues that firms decreases its indebtedness represented by the negative correlation with the degree of indebtedness, $\frac{L_{d-1}}{K_{-1}} = d_p$ in eq 28.[14] There is a question regarding procyclicality or countercyclicality of debt to capital ratio during the euphoric era of boom (see Stockhammer and Michell, 2018).[15] Whether during the *euphoric time* in Minsky or *Yang phase* in Koo, β_2 (the coefficient value of d_p in eq. 28) could be positive: as leverage ratio increases the accumulation rate increases (procyclicality of leverage ratio in accumulation function). This often depends on the treatment of target debt to capital ratio, $d_p{}^B$, or what is called the *stock-flow norm* of Godley.[16] Procyclical assumption is more plausible when we set endogenize the target

[14] Nikiforos and Zezza (2017) model the dynamics of the system in the growth of capital capital eq. 28; at the time period, growth of capital is determined by its historical path. Specifically, the stock (of capital) which is determined at the end of each period feeds back into the flows of the next period, which in turn determine the stocks of that period next period.

[15] Instead of using the normal post-Keynesian investment function, a more neutral assumption using the Lotka–Volterra equation of financial fragility and output is made by Stockhammer and Michell discussing whether the leverage ratio of firms should increase during the boom or euphoric time. Lavoie and Seccareccia (2001) argue that although Minsky's argument that the economic upswing would be accompanied by increasing leverage of firms, this is a microeconomic based argument. The countercyclical or procyclical debate is dealt in the model of Stockhamer et al (2017) using pseudo-Goodwin cycle, financial fragility is a positive function of the level of demand due to optimistic expectation of frim. At the same time financial fragility is an inverse function of demand and financial fragility of firms since firms are vulnerable to bankruptcy if they have higher financial fragility (see Stockhammer and Michell, 2017, pg 11).

[16] Nikolaidi (2014) and Dafermos (2018) uses endogenous benchmark value of leverage ratio: if firm's indebtedness exceeds the target level of indebtedness (over indebtedness), the firm's leverage ratio has negative effect on the accumulation rate of capital (Niolaidi, 2014) or firm's propensity to invest (Dafermos 2018). Otherwise the firm's indebtedness and growth of capital or propensity to invest has positive correlation based on Minskyan assumption of euphoric time of speculation (Minsky Taxonomy). Nikolaidi (2014) specifies the same assumption in the bank's leverage ratio to have a procyclical credit rationing: when the bank's leverage ratio is within the benchmark level, using the same assumption of Minsk's margin of safety, lending to capital ratio can increases while bank's leverage is increasing. These firm and bank leverage ratios are endogenous dependent on the phase of economic or firm's level of optimism on growth. When the economy is good, firms tend to take more risk borrowing more to invest (debt-led growth). However, when the growth of investment is too high to a point that diminishes the endogenous target level ratio (margin of safety) then, firm realizes their business to be in a ponzi scheme, start to deleverage by reducing the growth of investment (debt-burdened growth).

leverage ratio, d_p^B in eq. 30 depending on the growth of GDP or previous level of leverage ratio.[17] However, without the assumption, in euphoric time, the u is also increasing and that allows an increase in gr_k (in eq. 28, β_u>0) , enabling firms to take more leverage, that can lead to higher loans indirectly. Therefore, the sign of β_2 is always negative in our case.

$$g_k^e = \frac{I}{K_{-1}} = \beta_0 + \beta_1 \frac{FU_{f-1}}{K_{-1}} - \beta_2 d_p + \beta_u u$$

Post Keynesian Investment Function (eq. 28)

In order to replicate the firm's behavior captured by Minsky and Koo, I introduce the regime switch of investment behavior of firms: When the level of indebtedness of a firm is greater than the target values, firms attempt to reduce the level of loans in the balance sheet by having higher level of β_2 during the balance sheet recession than usual.

$$d_p = \frac{L_{d-1}}{K_{f-1}}$$

Actual level of indebtedness (eq. 29)

$$\beta_2 = (1 + x_a * (d_p \geq d_p^B)) * \beta_{20} \quad \text{(eq. 30)}$$
$$0 < x_a < 1$$

In Eq. 31, $d_p \geq d_p^B$ is the macroeconomics condition that Koo (2013) calls as *balance sheet recession*. The regime switching condition is as follows. One phase in which the private sector *maximizes profits* ('Yang phases') ;$d_p < d_p^B$ and the coefficient value of d_p on eq. 28 as β_{20}. However, in another high financial stress regime the private sector *minimizes its debt* ('Yin phases'); $d_p \geq d_p^B$ and accumulation rate is more elastic (d_p is x_a% more responsive) . Eq. 30 shows that gr_k and L_{d-1}/K_{-1} has an inverse relationship and when in *balancesheet recession* β_2 (>0) takes x_a% higher value than its benchmark value (β_{20}>0).[18] It captures the behaviour that firms attempt to use more retained earnings and use less loans to fix its balance sheet. Firm attempts to fix its balancesheet (debt to capital ratio) when the actual private sector's debt to capital ratio is greater than the target one ($d_p \geq d_p^B$), which resembles a debt-burdened regime in Dafermos, 2018, Nikolaidi 2014, and Taylor, 2004. In debt burdened regime firms use their retained earnings more to pay off loans than usual and reduce investment level. Minsky (2008, pp. 193) argued that during periods of

[17] We set the firm's leverage ratio and growth of capital is always negatively correlated and the target leverage ratio, dpB as exogenous.

[18] Even what is called speculative or ponzi schemes, or Taylor (2004) calls it as debt-led growth, higher the indebtedness does not have a positive effect on demand while all other things equal. Debt-led growth is although the higher indebtedness will give pressure for the firms to decrease the level of investment, however, the wealth growth produced by the higher debt will create more profit that leads to higher investment.

expansion, when the outstanding debts are serviced without significant problems, the desired margins of safety of borrowers is low. Nikolaidi (2017) uses loans to capital ratio or liability to asset ratio, L/K as the proxy of margin of safety in her model. The recent good performance of the economy and the favourable credit history or corporate balance sheet induce economic units to accept financial structures that were previously assessed as risky and hedge financing turns into speculative and ponzi phases. 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).

$$gr_y = \frac{y_f - y_{f(-1)}}{y_{f-1}}$$

The real GDP growth as Nominal GDP growth after the price inflation (eq. 31)

$$\omega = \upsilon\omega_{-1} + (1 - \upsilon)\omega_0 + \lambda(gr_k - gr_{k-1})$$

The phillips curve (eq. 32)

Pedro and Silva (2016) specifies the Phillips curve for price inflation rate, ω for the case of constant mark-up. Eq. 32 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 eq. 34.

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

The general level of price (eq. 33)

3.2.3 Government

The government expenditure, G is financed through taxes (T) and bills (B). Eq. 34 shows the government receives tax T from household, which is the proportion of personal income (tax rate is given as θ).

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

Nominal government deficit (eq. 34)

$$T = \theta * YP$$

Government Tax (eq. 35)

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

New issues of bills (eq. 36)

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

Nominal government debt (eq. 37)

In this model, the growth of government expenditure is constant (eq. 38); the government expenditure annually grows at a constant rate as in Godley and Lavoie (2007).

$$G = p * g$$
$$g = g_{-1}(1 + gr_{g0})$$

Constant growth of government expenditure (eq. 38)

3.2.4 Central Bank Behavior

The central bank receives interest payments from its holding of the government bills and also interest payments received 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 (39)

The equation 40-42 and 44 shows supply equals to demand conditions set in Godley and Lavoie (2007) where all the supplies of assets passively match all the 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 (eq. 40)

$$H_{bs} = H_{bd}$$

Reserve supplied on demand (eq. 41)

$$H_s = H_{bs}$$

Supply of high-powered money (eq. 42)

$$B_{cbd} = H_s - A_s$$

Central bank bills (eq. 43)

Eq. 43 is the balance sheet of the central bank, and eq. 45 shows that the central bank set the interest rate on the government bill exogenously. The redundant equation, 46R 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 (eq. 44)

$$r_b = \overline{r_b}$$

The rate of interest on bills is set exogenously (eq. 45)

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

Redundant equation (eq. 46-R)

3.2.5 Commercial Bank Equations

Eq. 47 indicates 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 (eq. 47)

$$L_s = L_d$$

The loans supplied on who demand (eq. 48)

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

Reserve requirements of banks (eq. 49)

$$w = w_0 - w_2 r_b$$

Proportion of excessive reserves to their deposits (eq. 50)

Eq. 49 states that banks must keep reserves proportional to their deposits in their balance sheet as requirement, ρ, and proportional to their deposits as excessive reserves, *w*. Eq. 50 shows that the amount of excess reserves is negatively related with the interest rate on advances, which is regarded as the opportunity cost of holding excess reserves. Eq. 51 is the balance sheet constraints of banks. Eq. 51 and 52 state 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. Eq. 60 shows banks retain a proportion λ_b of their profits (bank's saving rate). The equation 61 shows the distributed profits of banks.

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

Balance-sheet constraints of banks (eq. 51)

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

Bills demanded by banks (eq. 52)

$$A_d = \{w * M_s;\ B_{nd} \geq 0$$

$$= \{H_{bd} + L_s - M_s;\ B_{nd} < 0$$

Advances demanded by Banks (eq. 53)

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

The redundant equation (eq. 54):

$$r_m = r_b - add_l$$

Change in deposit ratio (eq. 55)

$$r_l = r_m + add_l$$

Loan interest rate (eq. 56)

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

The profit of commercial banks (eq. 57)

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

Interest rate on advances as set by the central bank (eq. 58)

$$r_b = \overline{r_b}$$

Interest rate on the government bills (eq. 59)

$$FU_b = \lambda_b \cdot F_b$$

Retained portion of bank's profits (eq. 60)

$$FD_b = F_b - FU_b$$

Distributed profits of bank (eq. 61)

Sovereign debt is financed domestically, meaning that the domestic household, and bank are the ones holding most of the bills issued by the government. 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.

4. Analytical Solution and steady state implications

This SFC model with several differential equations is subjected to difficulties to solve analytical solutions for steady states. In order to analyze whether the system is debt-led or debt-burdened, we need the steady state capacity utilization rate and partial derivative with respect to leverage ratio. In order to obtain the equilibrium level of (u*), we use the eq (2), (14) into eq (28) and divide by K_{-1}. Then, we solve for u we get equilibrium level of u*,

$$u^{*}=\frac{\alpha_1(1-\theta)\{(1-\lambda_b)(r_{l-1}d_p+\Gamma_1)+\Gamma_2-(1-s_f)r_{l-1}d_p\}+\alpha_2 v_{-1}+\beta_0-\beta_1 r_{l-1}d_p-\beta_2 d_p+gov_{-1}(1+gr_g)}{\Delta} \quad \text{(eq. 62)}$$

Where $\Gamma_1 = r_{b-1}b_{bd-1} + r_{m-1}m_{s-1} - r_{cb}a_{-1}$ and $\Gamma_2 = r_{m-1}m_{d-1} + r_{b-1}b_{hd-1}$

Where $\Delta = 1 - \alpha_1(1 - \theta)\{(1 - \pi) + \pi(1 - s_f)\} - \beta_1\pi s_f - \beta_u > 0$. For the Keynesian stability to be hold, we requires $\Delta > 0$ and assumes u* >0 ($m = M/K$, and $b_{bd} = B_{bd}/K$, $b_{hd} = B_{hd}/K$, $v' = V/K$ and $gov = G/K$). Δ can be interpreted as the Keynesian multiplier of the model. If we use eq. 68 for eq. 28 we have an equilibrium rate of capital growth.

$$gr_k^{*} = \frac{I}{K_{-1}} = \beta_0 + \beta_1\{\pi s_f u^{*} - r_{l-1}d_p\} - \beta_2 d_p + \beta_u u^{*} \text{ (eq. 63)}$$

from the eq. 62 and 63 we can see how change in d_p and u^{*} and g^{*} .

$$\frac{\partial u^*}{\partial d_p} = \frac{\partial u^*}{\partial d_p}\Big|_{v=\bar{v}} + \frac{\partial u}{\partial v}\frac{\partial v}{d_p} \text{ (eq. 64)}$$

$$= \Delta^{-1}[\alpha_1(1 - \theta)\{(1 - \lambda_b)r_{l-1} - (1 - s_f)r_{l-1}\} - \beta_1 r_{l-1} - \beta_2 + (\partial u/\partial v) * (\partial v/\partial d_p)] \leq\geq 0$$

(eq. 64)

$$\frac{\partial u^*}{\partial d_p}\Big|_{v=\bar{v}} = \Delta^{-1}[\alpha_1(1 - \theta)\{(1 - \lambda_b)r_{l-1} - (1 - s_f)r_{l-1}\} - \beta_1 r_l - \beta_2 \text{ (eq. 65)}$$

$$\frac{\partial gr_K^{*}}{\partial d_p} = \beta_1(\pi s_f \frac{\partial gr_K}{\partial u}\frac{\partial u}{\partial d_p} - r_l) - \beta_2 + \beta_u \frac{\partial gr_K}{\partial u}\frac{\partial u}{\partial d_p} = \frac{\partial gr_K}{\partial u}\frac{\partial u}{\partial d_p} - \beta_1 r_l - \beta_2 \text{ (eq. 66)}$$

$$= (\beta_1\pi s_f + \beta_u)[\frac{\partial u^*}{\partial d_p}\Big|_{v=\bar{v}} + \frac{\partial u}{\partial v}\frac{\partial v}{d_p}] - \beta_1 r_l - \beta_2 \leq\geq 0$$

To have more understanding of the model, we also have solved the model numerically using E-view. First we assigned initial values to the variables and parameters using reasonable stylized facts. Then we solved the model, and found two steady-state solutions; one is high value of $s_f = 0.85$ and the other one with s_f=0.2 In the next section, we analyze the two different steady state solutions using the precedent works done by Lavoie (2014), van Treeck (2009), and Taylor (2004).

4.2 Debt-led or debt-burden?

Taylor (2004) uses debt led regime and debt burdened regime as an analogy to wage-led or profit-led analysis of post-keynesian economics. This debt-led or debt-burdened regime can be recognized through equilibrium capacity utilization rate, u^{*}. Taylor calls debt-led regime as $\partial u^{*}/\partial d_p > 0$; positive relationship between capacity utilization and leverage ratio. While debt-burdened regime entails $\partial u^{*}/\partial d_p < 0$. In eq. 64 the effects on the capacity utilization rate by change in the firm's leverage ratio tells whether the system is debt-led or debt burdened. For the first term of right hand side of eq. 64, with sufficiently

high β_1 and β_2, $\frac{\partial u^*}{\partial d_p}|_{v=\bar{v}} < 0$. Most importantly, the second term of eq. 64, $\Delta^{-1}(\partial u/\partial v) * (\partial v/\partial d_p)$ gives the crucial condition to see the system to be debt-led or debt-burdened.

In our case, debt-led regime ($\frac{\partial u^*}{\partial d_p}$>0) occurs under following condition:

1) In eq. 64, as $\frac{\partial u}{\partial v} > 0$, $\frac{\partial u}{\partial v}\frac{\partial v}{d_p} > 0$ holds is if only if $\frac{\partial v}{d_p}$>0.
2) As we already know, in eq. 64, $\frac{\partial u^*}{\partial d_p}|_{v=\bar{v}} < 0$, and in order to make $\frac{\partial u^*}{\partial d_p} = \frac{\partial u^*}{\partial d_p}|_{v=\bar{v}} + \frac{\partial u}{\partial v}\frac{\partial v}{d_p}$ $(eq.\ 64)$ >0 so that system to be debt-led, the $\frac{\partial u}{\partial v}\frac{\partial v}{d_p}$ has to dominates $\frac{\partial u^*}{\partial d_p}|_{v=\bar{v}}$

What makes the increases of firm indebtedness increases the wealth to capital ratio of households, $\frac{\partial v}{\partial d_p}$>0?[19] Analytical solution of $\frac{\partial v}{\partial d_p}$ is quite difficult to achieve since the households' wealth, V (in eq. 4) is in the form of a difference equation and incapable to solve for the steady state equilibrium because of the loop effects. However, with logical reasoning, it is quite possible to capture the reason of why increases of firms' leverage ratio can affect positively on utilization rate through higher household wealth: What makes the positive effect of increase in leverage ratio dominate the negative effect of it? The basic assumption is during the time firms increase their accumulation rate by using external funding, (as debt is an external source of finance), higher profit income is higher and households consume more; and if the positive effects of increases in debt outweigh the negative effects of increase in debt (leverage ratio increase, firms deleverage). The dominance of positive effects of higher leverage ratio over the negative effects does depend on the firm's saving rate, the retained earnings ratio of firm, s_f given the high enough propensity to consume out of income and wealth (van Treeck, 2009).[20] For crucial part that makes $\frac{\partial v}{\partial d_p}$>0 to have $\frac{\partial u^*}{\partial d_p}$>0 (debt-led regime), we need a sufficiently low saving rate of firms so that a significant part of firms profit to be distributed to consumers.[21] In order words, as a self explanatory assumption $\partial d_p/\partial s_f < 0$ (from eq. 19 and 23), we can intuitively analyze what makes the system to be debt-led using the stability analysis done by van Treeck (2009). Recall, $\frac{\partial v}{\partial d_p} > 0$ as the condition to make the system to be debt led for this case: firms take more (less) leverage ratio wealth to capital ratio, v' increase (decreases). If we have a low firm's retention rate (the households have higher dividend share out of firms profit), there are higher wealth to be distributed to the households.

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[19] The debt-led d(v)/d(dp) or debt-burdened d(v)/d(dp) >0<0

[20] The level of s_f is often perceived as the degree of shareholder orientation or firms propensity to save out of profit. Higher (lower) profit retention rates sf, means the profit of firms is distributed less (more) to the households as dividends income and that entails that firms have high (lower) saving rates and which creates fewer (more) wealth effects.

[21] van Treeck (2009) calls it as shareholder orientation and households share of firms profit to dividend is high.

Godley and Lavoie (2001-2) discuss wealth effects saying higher dividend ratio out of firms profit (shareholder orientation) causes wealth effects which boost profit, utilization rate and accumulation rate and enhance overall economy. However, according to the analysis of van Treeck (2009) on wealth effects with increase in $(1 - s_f)$, it depends the level of propensity of households consumption out of wealth, $c_V = \partial C/\partial V (0 < c_v < 1)$ to be sufficiently high.[22] As we have have sufficiently high propensity of consume out of wealth (α_2), thus with sufficiently low s_f, debt-led regime ($\frac{\partial u^*}{\partial d_p}$>0) could be possible due to higher spending of households who receive the dividend money from firms. Therefore, if the opposite case, if we have low s_f we have a debt-burdened regime ($\frac{\partial u^*}{\partial d_p}$>0).

4.3 Minsky or Steindl debt dynamics?

The dynamic of leverage ratio and its effect on overall macroeconomic performance is highly correlated with the firm's retained earnings rate.[23] Lavoie (2014) has already noticed this point in and differentiated firms debt dynamics into two Minsky or Steindl Debt dynamics .

The evolution of the debt ratio towards its long-run value when both debt and capital grow at the same time? Lavoie (2014, ch. 6) uses the concept of Minsky or Stendle Debt Dynamics based on the business debt and growth model by Taylor's (2004, ch. 8).

Form equation of firm's nominal investment which is financed by new issue of loan, retained earning of firm's profit and new issue of shares (eq. 67 based on eq. 23b) and divide it by K_{-1}

$$I = \Delta L_d + FU_f + p_e \Delta e_s \text{ (eq. 67)}$$

$$I/K_{-1} = [x_e I + s_f(\pi Y_f - r_l L_{-1}) + (\Delta L/L_{-1})L]/K_{-1} \text{(eq. 68a)}$$

$$gr_k = x_e gr_k + s_f(\pi u - r_l d_p) + (\Delta L/L_{-1}) \cdot d_p \text{(eq. 68b)}$$

Using growth rate of leverage ratio and ignoring the lag:

$$gr_{d_p = L/K} = \Delta d_p/d_p = \Delta L/L - \Delta K/K_{-1} = gr_L - gr_k \text{ then, } \Delta d_p = \Delta L/L \cdot d_p - gr_k * d_p$$

$$gr_k = x_e gr_k + s_f(\pi u - r_l d_p) + \Delta d_p + gr_k * d_p \text{ (eq. 69)}$$

$$\Delta d_p = gr_k(1 - x_e - d_p) + s_f r_l d_p - s_f \pi u = (s_f r_l - gr_k)d_p + (1 - x_e)gr_k - s_f \pi u \text{ (eq. 70)}$$

Use eq. 28 in eq. 70:

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[22] In Treeck (2008)'s analysis to make debt-burden regime the propensity to consume out of wealth has to be :, c_v <0.0131 while in his case, the household is split into worker and rentier in which only rentier has wealth from dividend and interest income while workers consume all the wage. In our cases, we don't have the distinction; threore, propensity to consume out of wealth holds to the entire household as we set alpha_2 = 0.06. Thus, we have a sufficiently high propensity to consume out of wealth to make low s_f value can create a debt-led regime.

[23] Lavoie (2014) identifies in firms debt dynamics, there are two types, Minsky or Steindl Debt dynamics. To make the MInsky cycle, he gives the condition: "The effect of When the share of retained earnings in national income is low, when the proportion of investment financed by share is low, and when the current debt is low.

$$\Delta d_p = [\beta_0 + \beta_1\{s_f \pi u - s_f r_l d_p\} - \beta_2 d_p + \beta_u u](1 - x_e - d_p) + s_f r_l d_p - s_f \pi u \quad \text{(eq. 71)}$$

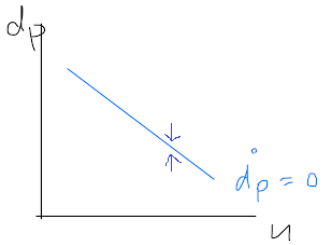
(I use $d_p^{\bullet} = 0$ in stead Δd_p while the model contains difference equations.)

The demarcation line in our cases is shown below in eq. 72. Lavoie (2014) using the approach by Taylor (2004) to shows the stability analysis of d_p in the (u, d_p) plane: to analyze the slope of the demarcation line – the steady-state locus where $d_p^{\bullet} = 0$, Lavoie (2014) suggests to see $d_p^{\bullet}$ with respect to u. It is because our model is not simple as u itself depends on d_p and since demarcation line (eq. 71) contains a multiplicative term in d_p, and with these problems, we cannot simplify the stability approach of eq, 71.

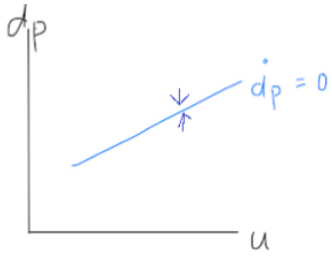
$$\partial d_p^{\bullet} / \partial u = s_f \pi[(1 - x_e - d_p)\beta_1 - 1] + \beta_u(1 - x_e - d_p) \quad \text{(eq. 72)}$$

The slope of the demarcation line, $d_p^{\bullet} = 0$ (or in our difference equation, $\Delta d_p = 0$) with respect to u as being used to show the condition of the Minsky or Steindl regime. In our case, lower s_f leads to $\partial d_p^{\bullet} / \partial d_p > 0$; $(\partial d_p^{\bullet} / \partial u > 0)$; the demarcation line has a positive sign. This is the Minskyan regime in which faster growth and higher economic activity generate higher debt ratios. On the contrary, if we set high s_f we can have negative demarcation line, $\partial d_p^{\bullet} / \partial d_p < 0$; $(\partial d_p^{\bullet} / \partial u < 0)$; Steindl regime in which the debt ratios get lower as we have higher economic activity.
As combined with the debt-led or debt burdened regime, if we have sufficiently low s_f, the system is a Minskyan debt-led regime. By contrast, if we have sufficiently high s_f, then have a Steindl debt-burdened regime.

Graph 2a: Steindl debt-burdened regime



Graph 2b: Minsky debt led regime



The graphs 2a and 2b show the Steindl debt-burdened and Minsky debt led regime in the phase diagrams. The interpretation of retained earning ratio of firms in the post-keynesian framework has been summarized by Lavoie (2014): the case of a financialized capitalistic economy, (as Stockhommer (2008) calls 'financialization' and 'shareholder orientation') characterized by low s_f , there are higher wealth effects due to their influence of dividend and portfolio choice of households. In these models, shareholder value orientation exerts on rising stock prices, which in turn potentially stimulates consumption while it also causes

increases in leverage ratio and lower investment. In other words, firms can create asset or share price bubbles to achieve higher profit through financialization. The study on wealth and asset prices effects on macroeconomic outcome by the European Central Bank (Altissimo, et al., 2005) finds regional or institutional characteristics: financialization is prominent in the anglo-saxon countries such as the US and the UK while Japan has significantly lower progress of financialization compared with other major European economies. With more financialization of firms, Minsky-type of macroeconomic fluctuation of asset price (in our case the return of equities or household portfolio choice) can destabilize macroeconomics cycles with higher leverage ratio. In the debt led regime of Minsky, higher leverage ratio can entail a positively higher capacity utilization rate through wealth effect; however, the over indebtedness of firms can also affect negatively afterwards the bubble burst which can cause down part of the economy. At the same time, in a less financialized economy, wealth effects are low and tend to be subjected to debt burdened regimes. In the Steindl debt burdened regime, Firms are prompt to have high propensity save due to its high risk-averse nature or more to be immersed in the past trauma of previous recession. In the debt-burdened economy, it will have a *Balance sheet recession* aligned with what is called the 'paradox of debt'. Similar to what Koo (2011) describes the case of Japan, higher saving rates of firms with low investment due to debt-minimization entails this Steindl (paradox of debt) debt burdened regime. In this type of system, wealth effects are small and the negative effect of leverage ratio on profit dominates and as firms attempt to reduce the leaves of leverage ratio perversely increases its leverage ratio.

Previous studies of the Minsky debt dynamic of SFC models have been created by Nikolaidi (2014) and Dafermos (2017). In the credit rationing Minsky mode of Nikolaidi (2014), the the story of asset price and wealth effects does not play a central role despite the Minsky's FIH has grounded heavily in the financial macro story of role of equity, asset price fluctuation, the rate of return of shares and also its influence of portfolio choice. Nikolaidi's Minsky model is based on the fluctuation of firm's debt and banks financial position that both increases during the optimistic tranquil time and goes down due to credit rationing when both bank and fims leverage ratio exceeds the margin of safety which accounts for the dynamics of macroeconomics outcomes. Dafermos (2017) has a Godley-Minsky model like Nikolaidi but the endogenous target debt to output ratio (stock-flow-norm) plays the central role. The private sector's debt to output and propensity to spend creates cycle and dynamics and the system is destabilized when debt to output ratio significantly deviates from the Godley's stockflow norm. The role of asset price fluctuation is not incorporated; however, in his model asset price is a positive linear function of growth rate and Dafermos uses the growth rate of GDP as a proxy of asset to decide the endogenous level of stock-flow norm. My Minsky-Koo's financialized macroeconomy of sfc modeling is to provide debt to capital ratio as indication of financial fragility by using the idea of Taylor (2004) and also set the the target leverage ratio as exogenous to follow Godley's stock flow norm to see how firm deleveraging behavior effects on overall the effective demand and macroeconomic growth. Also, incorporating the equities and household portfolio choice, the rate of return of equities and price of shares thus the household's portfolio choice also plays the role in the fluctuation of the firm's profit and debt-cycle. Also, recognizing the different types of debt dynamics discussed by Lavoie (2014) and Ryoo (2008), we create two different debt cycles, Steindl or Minsky

version by differentiating the level of s_f as a proxy to measure it. Therefore in the next section we analyze what would happen in an economy with debt-led Minsky regime (sufficiently low s_f) and debt-burdened Steindl regime (sufficiently high s_f).

5. Debt cycle of Minsky debt-led and and Steindl debt-burdened

Case 1: Debt-led and financial Minsky regime

The important factor to differentiate Minskyan or Paradox of debt dynamics is s_f. In the Minskyan debt-led regime higher economic activity will lead to rising debt ratios when the share of retained earnings is low. This phenomenon is possible even in the accumulation equation (eq. 28) if the coefficient value of $\frac{L}{K}$, β_2 has a negative sign.[24] This will thus be called the Minsky regime although firms still have nature to attempt to decrease leverage ratio if it increases.

To show the dynamic of the system of ow debt led Minsky regime, as a shock in the baseline model s_f is set 0.6 and lower at 0.2. Graph 3a shows the relationship between the firm's leverage ratio and capacity utilization rate in a cycle of counter-clockwise movement in which propensity to save of firm household is relatively rewarded with high dividend out of firms profit (high $(1 - s_f)$). As retained earning rate declines (as firms distributes more profit to households through dividend, lower s_f)[25] it leads firms with higher debt to capital ratio as firms get less retained earnings to be used for financing its investment. The accumulation also declines as the firm has higher debt to capital ratio. Although profit through investment will be decine, the higher dividend will cause rate of return of equities ($r_e = \frac{FD_f}{e_{s-1} \cdot p_{e-1}}$, see in graph 4) surge and households will invest more in equities more out of their wealth.[26] Despite the decline in fixed investment and sudden increases in debt to capital ratio, rate profit increases significantly as higher consumption though wealth effects due to higher dividend income stimulated the demand. Higher profit rate created higher capacity utilization. Therefore, in graph 3a the debt to capital ratio and capacity utilization rate both increases at the same time. Lavoie (2006), Treeck (2009) explains that the 'investment–profit puzzle' is a phenomenon under shareholder value orientation that causes exercises a 'dampening effect' on investment, and interesting the profits increase since while consumption out of distributed profits (dividend income) and wealth effects stimulates profits .

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[24] In Nikolaidi (2014) and Dafermos (2017), in order to create Minskyan debt cycle, they set the coefficient value of relative debt ratio on investment is either positive or negative based on the downturn or uptown phases of the cycle. My invention is that we can also create a Minskyan debt led regime with always negative coefficient value of relative debt ratio on the capital accumulation equation.

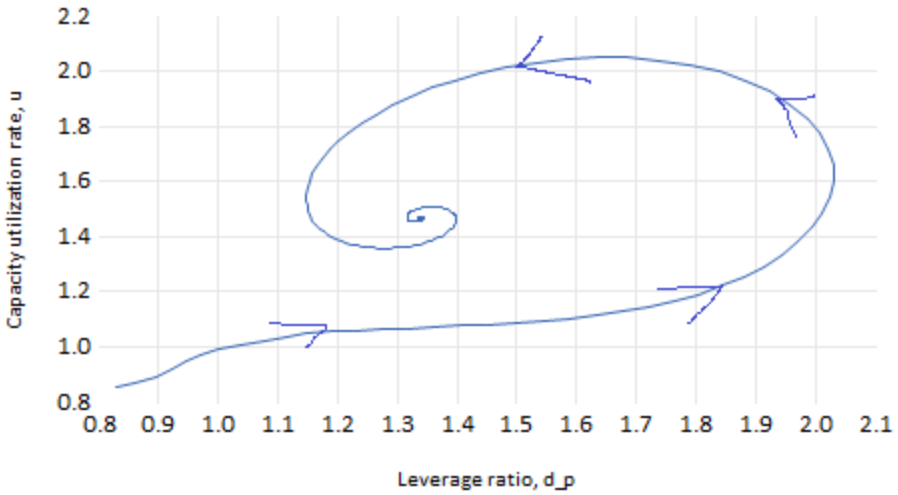
[25] high capacity utilization comes with a higher rate of profit. Firms income increase more attributes to increase in Households dividend proportionally more than firms retained earnings (since we are in low retained earning ratio s_f).

[26] Households have portfolio choice and divide their wealth into three assets, T-bills, equities, and deposit money depending on the interest rate/ yield of the assets (eq. 10).

As similar to the Misnky's euphoric time, the endogenous monetary expansion stimulates the economic activity (Ryoo, 2012). During the expansionary phases of the overall economy firms are optimistic despites debt to capital ratio is serging. Then firms deleveraging behavior is offset by their increasing rate of profit and capacity utilization rate (the expectation channel though higher rate of profit). However, in the next phase downward part comes as the rate of return on equities ($r_e = \frac{FD_f}{e_{s-1} \cdot p_{e-1}}$) goes down as sudden rises in denominator, p_e serges (graph 3b). This firm's financial asset (equities) return burst brings a sudden decline of wealth and consumption (graph 3b). This leads firms' expectation to be less optimistic and at this moment the leverage ratio is at the highest and firms attempt to deleverage, which first temporarily decreases leverage ratio. At the same time, households still are being benefited from higher dividend income and that stabilization (less volarity in) the rate of equalities. As firms attempts to fixes its balancesheet to restore its confidence and started to increases in fixed investment , which increase capital accumulation and leverage ratio (L/K) declines. In this debt-led system, as we set the system to be shareholders (household) oriented and wealth effects (which stimulates consumption and profit) counter the debt effect (higher leverage ratio makes firms more deleverage and cause slow down in investment). The driving force of the dynamic and cyclical fluctuation in capacity utilization rate and leverage ratio is the rate of return of equities and portfolio decisions.

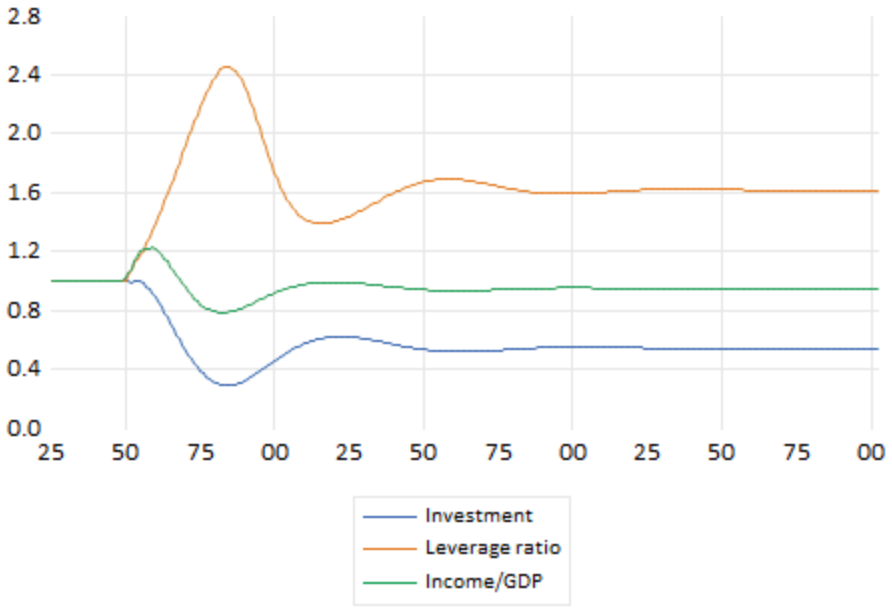
The cycle shown in the graph 3a shows a stable convergence into a steady state.[27] Although compared with the initial point to the convergence point, the capacity utilization rate is slightly higher (expansionary effects) but it comes with the leverage ratio which is significantly higher than the initial, and the question is can this debt-led economy be sustainable? In terms of the sustainability of a wealth-led economy, the capital accumulation significantly declines as the economy becomes more towards shareholder oriented wealth growth rather than long-term profit of investment and capital-led growth. In the long run, the GDP is recovered but it comes with higher leverage ratio and permanently low level of investment.

[27] In the simple Minskyan model with a Lotka-Voterra system Asada (2001) based on the model by Taylor and O'Connell shows a clockwise Hopf Bifurcation limit cycle of leverage ratio (predator) and output capital ratio (prey) which is different from our outcome. In our case we include capital gain from household financial investment on equities and wealth dynamics. Our model is similar to the Minskyan longwave by Ryoo (2006 and 2013), and the system of three equations, change in debt to capitatio, ratio of stocks (equities) to households' deposits (wealth), and expected rate of return of equities.



Graph 3a: Nonlinear relationship between the firm's leverage ratio (counter-clock movement), and capacity utilization rate under low retained earring rate of firm

Graph 3b: Trajectory of important variables



Graph 3c: Trajectory of important, investment, Leverage ratio, and GDP

Overall, for the Minsky debt-dynamic and cycle, there are more studies done such as by Nikolaidi (2014) and Taylor (2004) and Lavoie (2014). In this paper I will not approach the way to find the Minsky debt-led regime into the Minsky cycle. However, in the next section I show a simple approach for attaining the Paradox of debt into debt-burden Steindl debt cycle using the ideas by Taylor (2004) and Godley and Lavoie (2002).

Case 2: Steindl Debt-burdened regime:

The necessary condition that makes the cycle to be a Steindl debt dynamics (Lavoie, 2014, ch 6) as mentioned in the previous section is to set sufficiently high s_f.

$$\partial u^*/\partial d_p < 0 \text{ and } \partial d_p^{\bullet}/\partial d_p < 0\ ;\ (\partial d_p^{\bullet}/\partial u < 0)\ ,$$

The level of firm's propensity to save or retain earnings of the firm out of their profit should be sufficiently high so that wealth effect (the third component in the right hand side of eq. 64 is low.

Taylor's debt-burden regime (in eq. 64 to be $\partial u^*/\partial d_p < 0$), can arise if we have as we set sufficiently high s_f; then the third part of the right hand side of eq. 64 $(\partial u/\partial v) * (\partial v/\partial d_p)$ diminishes. Then we have debt-burdened regime:

$$\frac{\partial u^*}{\partial d_p}|_{v=\bar{v}} = \Delta^{-1}[\alpha_1(1-\theta)\{(1-\lambda_b)r_{l-1} - (1-s_f)r_{l-1}] - \beta_1 r_l - \beta_2 < 0$$

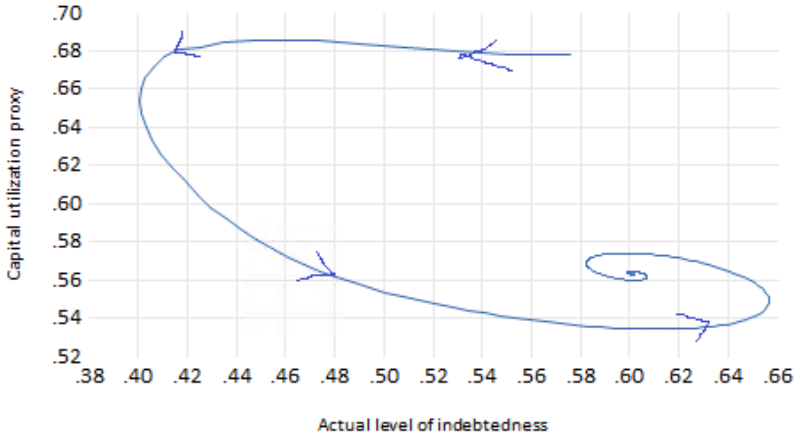
The negative effect of increases (decreases) in firm's leverage on capacity utilization rate occurs when

$$\beta_1 r_{l-1} + \beta_2 \geq \Delta^{-1}[\alpha_1(1-\theta)(1-\lambda_b)r_{l-1} - (1-s_f)r_{l-1}] \text{ (eq. 68)}$$

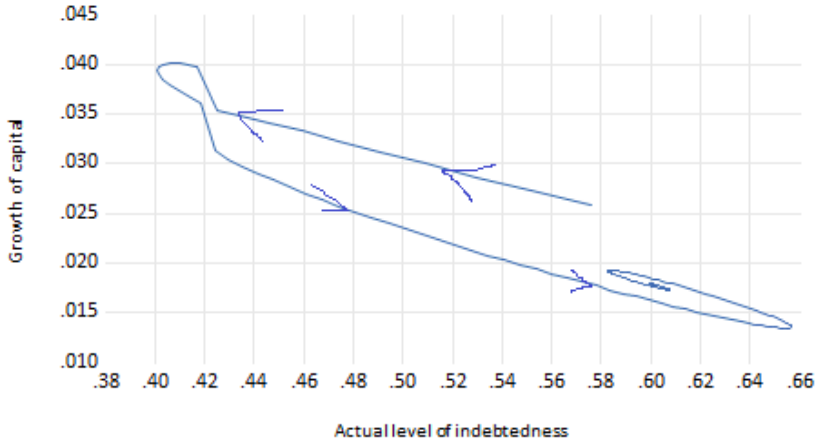
For this debt burdened economy to hold, we need sufficiently large β_1 and β_2 values. The direct negative effect of firm's debt to capital ratio on capacity utilization can be captured by β_2 in eq. 68. Firms deleverage if the level of firm's indebtedness (or debt to capital ratio) d_p increases (eq. 30) and d_p depress more investment if d_p exceeds d^B_p . Also, from $\beta_1 r_{l-1}$ captures that indirect negative effect of higher indebtedness of firms. Higher the interest payments of loans less consumption since firms will have less profits to be distributed (eq. 18 and 20) which is part of disposable income of households. The partial derivative value changes depending on the level of parameter values used in each model, but in this case, the negative effect of increases in firm's leverage on capacity utilization rate (debt-burdened regime) always holds with given the parameter values in this model.

From eq. 66, we can tell if a change in d_p give positive or negative effects on the capital growth rate. As direct negative effect of higher leverage ratio, increases in d_p decreases in gr_k*, meaning as firms become more indebted, accumulation of capital decreases can be captured by $\beta_1 r_{l-1}$ in eq. 66. Having higher interest payment on loans depresses profit of firms and retained earning to to capital ratio FU_{-1}/K_{-1}. Firms have less source to finance their investment. We need to examine what it entails in a world where firms have excessive deleveraging behavior and high propensity to save. Usually firms use their savings to invest, however, firms now use its savings to pay off the debt as Richard Koo calls it as *Balancesheet recession*. The partial derivative value changes depending on the level of parameter values used in each model, but in this case, as we set sufficiently high s_f, β_1 $\beta_2$and the negative effect of increases in firm's leverage on capacity utilization rate and the capita growth rate always holds.

Graph 4a shows the relationship between d_p and u. We set growth of government expenditure is set exogenous and constant, and the firm's target leverage ratio, d_p^B is also exogenous. In this scenario of higher saving rates of firms s_f, the system is converging to a steady state damped oscillations towards lower u and gr_K and higher d_p position (spiral sink) towards the long-run equilibrium. We start at a point where u and gr_K is higher than the steady state level and and $d_p > d_p^B$ (over indebtedness) . As a shock, firms increase its saving rate (higher s_f) entails higher retained earnings of profit to pay off the debt that causes decline in leverage ratios. While firms decrease their level of debt, the u does not increase. This firm's initial attempts to decrease d_p by decreasing its investment and paying off its debt from its higher level of cash flow (savings) causes both growth of investment and capacity utilization rates decline while firms' leverage keeps increasing. Here, we observe the paradox of debt: initial firms' attempt to fix its balance sheet, paradoxically increase its debt to capital ratio. The economy contracts more (continuous declines in the growth of capital and capacity utilization rates) as this is a debt burdened economy, The increase of debt to capital ratio is because the denominator of leverage ratio L/K decreases faster than the numerator.



Graph 4a: the relationship between the firm's leverage ratio, and capacity utilization rate under Steindl debt-led cycle (paradox of debt)

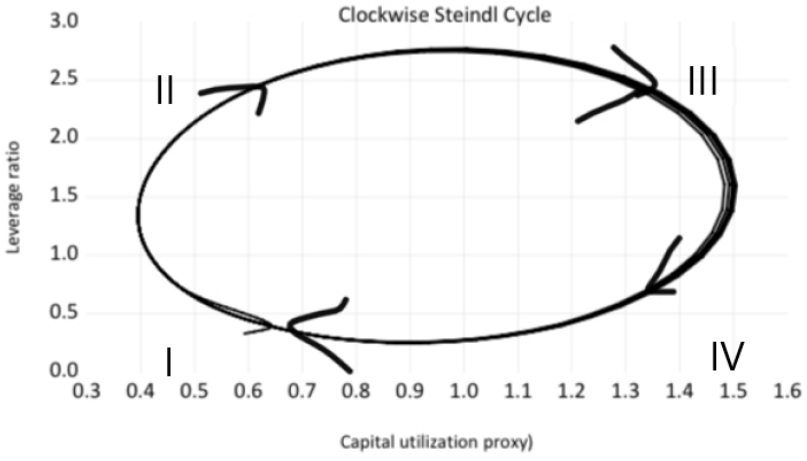


Graph 4b: the relationship between the firm's leverage ratio, and capacity utilization rate under Steindl debt-led cycle (paradox of debt)

6. Steindl debt-burdened Cycle: Experiment of increase in animal spirit

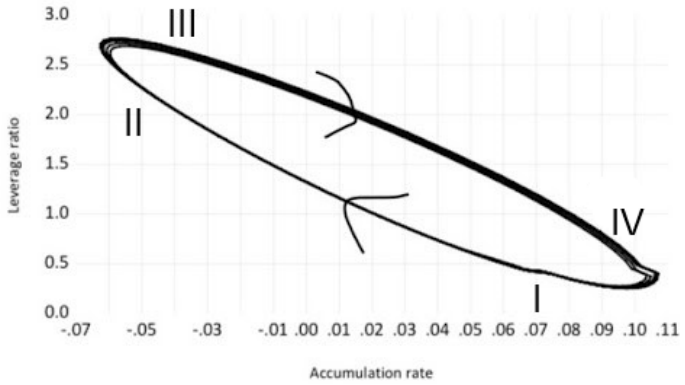
In the previous section, we find that with differentiating s_f value we get damped oscillations towards the lower u and gr_k and higher d_p (spiral sink) than initial position. We start from the steady state position in the previous **Steindl debt-burdened** regime to see how it can transform to a business cycle called **Steindl debt-burdened Cycle**. The motivation of this is in Steindl paradox of debt, we permanently converge to lower u and gr_k, as this situation can be described as secular stagnation like Koo (2011) talks that Japan's macroeconomic contraction is the result of firms deleverage behavior: firms being debt minimizer (having high saving and low investment). while to a As we find that in the

debt burdened Steindl mode, the paradox of debt holds. In order to create a cycle in the Steindl regime, we can bring the animal spirits in. Taylor (2004, ch 9) introduce the idea of the autonomous growth accumulation, $\beta_0$as a dynamic variable as a function of itself and leverage ratio. However, without adding another difference equation using the endogenous level of β_0 and complicating the system, I introduce increases in $\beta_0$as a shock so that the transform the spiral sink into limit cycle. This attained through changing the $\beta_0$level from 0.02 to 0.057 as a shock in the steady state model of Steindl debt-burdened regime (high s_f). Initially, at the steady state (I), we have relatively low u and $d_p > d^B{}_p$and while the $gr_K$is high. As this paradox of debt Steindl regime $\partial d_p^{\bullet}/\partial gr_K < 0;\ (\partial u/\partial gr_k > 0)$ works out in a way that despite firms attempts to reduce debt that affects decreases in investmentment but actually the leverage ratio increases (Yin phase of debt-minimizing behavior). Then, a a shock of higher high animal spirits o ($\beta_0$level from 0.02 to 0.057), gives impetus for accumulation rate to increase which leads to decline in the leverage ratio; firms finally started to leverage to invest more to have higher profit (Yang phase of profit maximizer). As moving from phase II to III, the economy continues to exhibit a high growth as accumulation rate increases however, accompanied by higher fragility. When phase entering at III u is high to compensate for the high leverage ratio to go down till the system gets to IV where recession begins. We have now Steindl debt-led regime at IV $\partial d_p^{\bullet}/\partial gr_K < 0;\ (\partial u/\partial d_p > 0)$ while capital accumulation keeps rising[28], the d_p and u diminishes. In this phase (from IV to I) of low growth with declining indebtedness, as firms deleverage demand decreases. However, continuous decline in indebtedness sets the stage for the recovery that occurs when d_p falls less than d_p^B and once this happens, a new cycle begins.

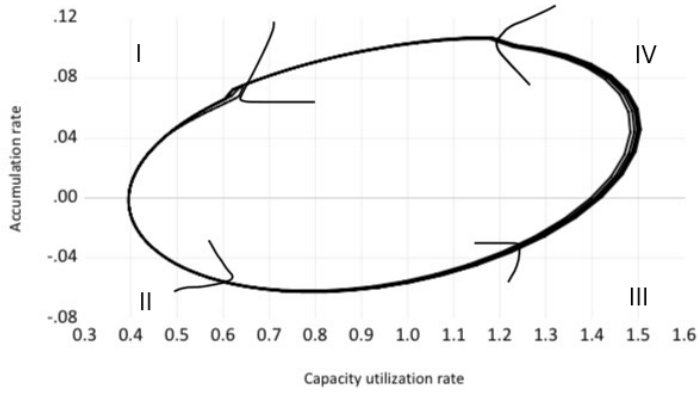


[28] It decreases not due to higher investment but as the economy gets into the recession the denominator of I/K decreases faster than the investment decreases.

Graph 4c: Steindl debt cycle of leverage ratio and capacity utilization rate[29]



Graph 4c: Steindl debt cycle of leverage ratio and accumulation rate



Graph 4d: Steindl debt cycle of capacity utilization ratio and accumulation rate

Conclusion

In this Stock Flow Consistency model, we analyze Minsky-Koo financial macrodynamic under different firm's saving behavior. *Balance sheet recession* by Koo has argued that Japanese nonfinancial firms have been attempting to fix their balancing sheet rather than spending its income on investment to expand its productive capabilities or paying dividends to shareholders. This deleveraging behavior is signified more as the firm's propensity to save becomes higher through retention rate adjustment. Firm's debt cycle and instability of macrodynamic by Dafermos (2017) and Nikolaidi (2014) already revealed that under the debt-burden regime, there is a counter-clockwise cycle between the leverage of firm and accumulation rate. My contribution to the past studies is that the relation

[29] The growth rate of capital is net after subtracting constant capital depreciation rate which is set as 0.1%.

between the leverage ratio and accumulation rate could produce two different nonlinear outcomes either by Minskyan cycle or paradox of debt cycle. The distinction of these is the former during the euphoric time can have both increasing leverage ratio and higher accumulation rate; this movement can be explained by wealth effects as households get higher disposable income from high dividend payment during the euphoric time. This induces higher consumption, which leads to higher profit and investment. I argue that the paradox of the debt cycle and the Minsky cycle has the same firm investment behavior when the actual leverage ratio exceeds the benchmark leverage ratio to reduce the level of debt. However, the paradox of debt is more likely to be a problem when firms in nature have a high propensity to save which make this to be an explicitly debt-burdened regime. In this case, that more firms attempt to reduce the debt perversely the debt level increases since deleverage causes decreases in the effective demand directly without wealth effects affecting the consumption (debt effect dominates the wealth effects). More importantly, even if both cycles converge to a steady state, the paradox of debt causes permanently lower growth rates while debt to capital ratio is permanently higher. This can explain the secular stagnation of Japan. Self-explanatory assumption is to avoid the long-term secular stagnation firms need to have high animal spirits.

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Appendix I: Key Difference Equation for Steady States in the Baseline Model

For dynamic analysis of this model, there are three difference equations, which in the steady-state, will be equal to zero.

$$\frac{\Delta V}{K_{-1}} = (1-\alpha_1)(1-\theta)[(1-\pi)u^* + (1-\lambda_b)(d_p r_{l-1} + \Gamma_2) + (1-s_f)(\pi u - r_{l-1} d_p) + \Gamma_1] + cg - \alpha_2 v'_{-1} \quad \text{(eq. 75)}$$

$$\frac{\Delta L}{K_{-1}} = [\beta_0 + \beta_1\{s_f \pi u - s_f r_l d_p\} - \beta_2 d_p + \beta_u u](1 - x_e - d_p)d_p) + s_f r_l d_p - s_f \pi u \quad \text{(eq. 77)}$$

$$\frac{\Delta K}{K} = \beta_0 + \beta_1\{\pi s_f u^* - r_{l-1} d_p\} - \beta_2 d_p + \beta_u u^*$$

$$\frac{\Delta B}{K_{-1}} = gov_{-1}(1 + gr_g) + r_{b-1}(b_{hs-1} + b_{bs-1}) - \theta[(1-\pi)u^* + (1-\lambda_b)(d_p r_{l-1} + \Gamma_2) + (1-s_f)(\pi u - r_{l-1} d_p) + \Gamma_1] \quad \text{(eq. 79)}$$

Appendix II: Parameter values for the baseline simulation

α_1	0.75	λ_{30}	0.375	β_0	0.02* 0.057	x_a	0.2	w_0	0.05
α_2	0.064	λ_{31}	2.2	β_1	0.04	ν	0.75	λ_b	0.25
μ	0.264	λ_{32}	2.2	β_2	0.05	λ	0.75	gr_g	0.0178
λ_{20}	0.375	λ_{33}	6.6	β_u	0.05	θ	0.23	gr_{g0}	0.016
λ_{21}	2.2	λ_{34}	0.1	x_e	0.085	κ	0.065	d_p^B	0.42
λ_{22}	6.6	r_b	0.035	gr_{y0}	0.03	ω_0	0.02	r_b	0.0035
λ_{23}	2.2	s_f	0.85; 0.2	d_P^B	0.35	r_{cb}	0	r_m	0.00175
λ_{24}	0.1	d_K	0.11	θ	0.224	ρ	0.05	r_l	0.014

Variables:
A: Advances
B_{hd}: Government bills demanded by households
B_{hs}: Government Bills supplied to households
B_{bd}: Government bills demand by banks

B_{sd}: Government bills supplied to banks
B_{nd}: Government bills demand by banks when $B_{bd} > 0$
B_{bd}: Government bills that the central bank demand
B_{cbd}: Government bills that supplied to the central bank
C: Nominal consumption
c: Real consumption
e_d: Numbers of shares (equities) demanded by households
e_s: Number of shares supplied by firms
F_f: Profit of firms
F_{cb}: Profit of central bank
F_b: Profit of banks
FD_b: Dividend of banks distributed to households
FD_f: Dividend of firms distributed to households
FU_f: Retained profit of firms
G: Nominal government expenditure
g: Real government expenditure
GD: Government debt
H: Supply of securities
H_{bd}: Demand of securities
H_{bd}: Securities supplied to the banks
I: Nominal investment
i: Real investment
K: Fixed nominal capital
k: Fixed real capital
L_d: Commercial bank loan issued to firms
L_s: Loans supplied by banks to firms
M_d: Deposit money demanded by households
M_s: Money supply
p_e: Price of equities
p: price level
T: Nominal Tax
V: Households' nominal wealth
v: Real households wealth
v': Household wealth to capital ratio
WB: Nominal wage bills
Y: Nominal output
y: Real output
YD_r: Nominal disposable income
yd_r: Real disposable income
YP: Nominal personal income

Parameters:
α_1: propensity to consume out of wage
α_2: propensity to consume out of wealth
β_0: autonomous accumulation rate
β_1: coefficient value of retained earning to capital in investment function
β_u: coefficient value of capacity utilization rate in investment function
β_u: coefficient value of leverage ratio in investment function
d_p: leverage ratio of firm
d_p^B: benchmark leverage ratio
d_K: depreciation rate of capital
x_e: portion of investment to be financed by new issue of shares
x_a: increment of β_2 when balance sheet recession
r_b: interest rate on government bills
r_m: interest rate on deposit
θ: tax rate
λ: reaction parameters in the portfolio choice of households
λ_b: portion to be retained from bank's profit
μ: firm's mark-up in unit cost
π: firm's profit share
r_e: return of equities/ dividend yields
r_b: interest on bills
r_{cb}: interest rate on advances
r_l: interest rate on commercial bank loan
r_m: interest rate on deposit
s_f: retention rate of firm
g_K: growth rate of capital
gr_Y: growth rate of GDP
gr_{Y0}: benchmark growth rate of GDP
κ: parameter in phillips curve equation
ω: price inflation rate
pi: price inflation rate
w: parameters in bank's excess reserve to deposit rate equation
ρ: required reserve ratio of bank