Firms' Retention Behavior, Debt, and Macroeconomic Dynamics

Yun K. Kim and Alan G. Isaac

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UNIVERSITY OF MASSACHUSETTS BOSTON

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Yun K. Kim*and Alan G. Isaac[†][‡]

Abstract

Building upon Isaac and Kim (2013) and Charles (2008a), we incorporate endogenous retention behavior of firms into a a stock-flow consistent neo-Kaleckian growth model with both consumer and corporate debt. We adopt a logistic endogenous retention ratio, which is a realistic representation of firms retention behavior. We then explore the macrodynamic ramifications. Consumer credit expansion can enhance the stability of the system. Higher interest has a destabilizing effect, and can induce a rather dramatic instability. More prudent firms financial behavior by relying more on their retained earnings reduces the stability of the system although it promotes growth.

Key words: consumer debt, corporate debt, endogenous retention ratio, stability
JEL classifications: E12, E44, O41

1 Introduction

Heterodox macroeconomist has long recognized the role of corporate debt in macroeconomy. Naturally a number of researchers have incorporated the corporate debt into macro models (Taylor and O'Connell, 1985; Skott, 1994; Lavoie, 1995; Foley, 2003; Hein, 2006, 2007; Lima and Meirelles, 2006, 2007; Charles, 2008b; Sasaki and Fujita, 202). Since the Great Recession, there has been also active attempt to incorporate household debt into heterodox macro models to investigate possible consequences (Kapeller and Schütz, 2015; Nishi, 2012;

*Department of Economics, University of Massachusetts Boston, Boston, MA 02125 yun.kim@umb.edu.
[†]Department of Economics, American University, Washington, DC 20016 aisaac@american.edu
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Hein, 2012; Isaac and Kim, 2013; Kim et al., 2014; Setterfield et al., 2016; Setterfield and Kim, 2016, 2017).[1]

Our work provide a contribution on this line of research. More specifically, this paper improve upon Isaac and Kim (2013), which, for the first time, incorporated both consumer and corporate debt in a neo-Kaleckain growth model. This paper incorporates endogenous retention ratio, in the form of a logistic function, into the model, and hence it is also closely related to Charles (2008a), whose work introduced an endogenous retention ratio to a neo-Kaleckain model with corporate debt. In his model, high interest rate is a precondition of financial fragility as it is necessary for multiple equilibria with an unstable equilibrium at a higher level of corporate indebtedness and retention ratio. When there is an increase in interest rate or firms take less prudent behavior in terms of their retention behavior with initially a high value for interest rate, financial fragility worsens in the sense that the stable and unstable equilibriums become closer.

Our model improve upon Charles (2008a) as our proposed retention behavior is more realistic than his formulation as will be discussed below. Once, we build all the components of the model, we will also be able to examine the change in dynamics when there is a change in interest rate or firms retention behaviors. Our model, unlike, Charles (2008a), always exhibits multiple equilibria. Changes in model parameters can increase or reduces the stability of the system in terms of the size of stable region in the relevant phase space.

Our paper is organized as follows. Section 2 lay out the accounting and model components including an endogenous retention ratio of firms. Section 3 discuss temporary equilibrium and its characteristics, while section 4 investigate dynamics. Section 5 offers concluding remarks.

[1]Even before the Great Recession, some of the researchers raised concern on household debt accumulation and its implication on macroeconomy. See, for example, Palley (1994); Dutt (2006); Cynamon and Fazzari (2008); Barba and Pivetti (2009).

2 Theoretical Framework

In this section, closely following Isaac and Kim (2013), we develop a neo-Kaleckian model of growth with both consumer and corporate debt. We first lay out our accounting framework. We then present the behavioral components of our model.

2.1 Social Accounting Matrices

There are four types of agents in this model: workers, rentiers, banks, and non-financial firms.[2] As in Charles (2008a), we consider a closed economy with no government contribution to aggregate demand. Table 1 is the balance sheet matrix of the economy and shows the allocations of asset and liability across agents. We have four types of assets in this economy: capital (K), equity (E), loans to households (D_W), and loans to firms (D_F). The column sums yield the net worth of each class of agent, while the row sums yield the net value of each class of asset.

Table 1: Balance Sheet Matrix

	Workers	Rentiers	Firms	Banks	Sum
Capital			K		K
Deposits		$D_W + D_F$		$-(D_W + D_F)$	
Loans	$-D_W$		$-D_F$	$D_W + D_F$	
Equities		E	$-E$		
Net worth	NW_W	NW_R	NW_F		K

Table 2 is the associated transaction matrix. In the case of firms, we distinguish between capital and current transactions. Following Charles (2008a), for simplicity, we abstract from new equity issue and the equity price is fixed to one. Note that abstraction from the equity price rules out capital gains. Firms pay dividend (Div) and loan interest (iD_F) to rentiers. Firms can finance investment (I) with new borrowing ($\dot{D}_F$) or retained earnings ($s_f \Pi_F$) where s_f is retention ratio and Π_F is net profit after loan interest payment. A common

[2] Our accounting framework closely follows Lavoie and Godley (2002).

interest rate i applies to consumer and corporate debt.[3] Household real wage income ($W_r L$) can be supplemented by new borrowing ($\dot{D}_W$) to finance the sum of consumption (C_W) and interest on past borrowing (iD_W). Rentiers earn income on their net deposits ($iD_W + iD_F$) and dividend, which they use for consumption (C_R) or saving (in the form of new deposits, $\dot{D}_W + \dot{D}_F$). For the transaction matrix, we note that the sums across the rows must equal zero as a consistency condition. The columns also sum to zero reflecting budget constraints.

Table 2: Transaction Flow Matrix

			Firms		Banks		
	Workers	Rentiers	Current	Capital	Current	Capital	Sum
Consumption	$-C_W$	$-C_R$	$C_W + C_R$				0
Investment			I	$-I$			0
Wages	$W_r L$		$-W_r L$				0
Firms' profits		Div	$-(Div + s_f \Pi_F)$	$s_f \Pi_F$			0
Deposit interest		$iD_W + iD_F$			$-(iD_W + iD_F)$		0
Loan interest	$-iD_W$		$-iD_F$		$iD_W + iD_F$		0
Change in deposits		$-(\dot{D}_W + \dot{D}_F)$				$(\dot{D}_W + \dot{D}_F)$	0
Change in loans	$\dot{D}_W$			$\dot{D}_F$		$-(\dot{D}_W + \dot{D}_F)$	0
Sum	0	0	0	0	0	0	0

2.2 Banks and Firms

All lending is intermediated by the banking sector and banks are pure intermediaries as in Lavoie and Godley (2002) and Ryoo (2010). We also distinguishing the capital and current accounts. We treat the pricing behavior of firms in standard neo-Kaleckian fashion: price is a markup over unit labor costs, reflecting an oligopolistic market structure (Harris, 1974; Asimakopulos, 1975).

$$P = (1 + \tau) W_n L / Y \tag{1}$$

Here $P > 0$ is the price level, $W_n > 0$ is the nominal wage, $\tau > 0$ is the constant markup rate (which represents Kalecki's degree of monopoly), and $L/Y > 0$ is the labor-output ratio (i.e., the inverse of the average product of labor). Such markup pricing behavior implies a

[3] As in Hein (2006) and Charles (2008a), we treat i as an exogenous variable.

standard expression for the gross profit share ($\pi = \Pi/Y$):

$$\pi = \frac{\tau}{1+\tau} \tag{2}$$

Gross profit (Π) is split between retained earnings ($s_f \Pi_F$), dividends (Div), and debt service (iD_F).

$$\Pi = Div + iD_F + s_f \Pi_F \tag{3}$$

where

$$\Pi_F = \Pi - iD_F \tag{4}$$

Dividend payout behavior is modeled as:[4]

$$Div = (1 - s_f)\Pi_F \tag{5}$$

Let $r = \Pi/K$ denote the gross profit rate, $r_F = \Pi_F/K$ denote the retained earnings rate, and $d_F = D_F/K$ denote the leverage ratio (corporate debt/capital). Then we have the following decomposition the gross profit rate:

$$r = s_f r_F + (1 - s_f) r_f + id_F \tag{6}$$

Many empirical studies find retained earnings (or cash flow) to be an important determinant of investment (Fazzari and Mott, 1986-1987; Fazzari et al., 1988; Chirinko and Schaller, 1995; Ndikumana, 1999; Chirinko et al., 1999). As in Jarsulic (1996) and Charles (2008a), our desired investment rate ($g_K = I/K$) therefore responds to the retained earnings rate ($s_f r_F$).

$$g_K = \kappa_0 + \kappa_r s_f r_F \tag{7}$$

[4]This behavior has been used in other studies (Lavoie and Godley, 2002; Charles, 2008a; Skott and Ryoo, 2008).

Here κ_0 captures "animal spirits" (the state of business confidence), and κ_r captures the sensitivity of desired investment to the retained earning.

Note that the gross profit rate can be expressed in terms of the capacity utilization rate ($u = Y/K$). This allows us to reduce the expression for the retained earnings rate and the accumulation rate.

$$r = \pi u \tag{8}$$

$$s_f r_F = s_f(\pi u - i d_F) \tag{9}$$

$$g_K = \kappa_0 + \kappa_r s_f(\pi u - i d_F) \tag{10}$$

2.2.1 Endogenous Retention Ratio

In this paper, the retention ratio is endogenous and assumed to take the following logistic functional form:

$$s_f = \frac{\varepsilon}{1 + e^{-d_F}} \tag{11}$$

where $\varepsilon \leq 1$ and e is the base of the natural logarithm. Figure 1 shows a graphical representation. Note that the advantage of this specification is that the retention ratio has a reasonable upper bound ε. A lower value of ε represents less adverse behavior of the firms regarding their indebtedness. We can compare this proposed behavior to the specification by Charles (2008a):

$$s_f = \varepsilon_0 - \frac{\varepsilon_1}{d_F}. \tag{12}$$

where both ε_0 and ε_1 are constant terms. This is how Charles (2008a) specify the behavior of 'desired' retention ratio. Note that s_f in this form is not well defined around zero of d_F ($d_F = 0$), and hence the dynamics of the retention ratio in his model is not well defined around zero of d_F as well. In other words, this specification effectively rules out the possibility

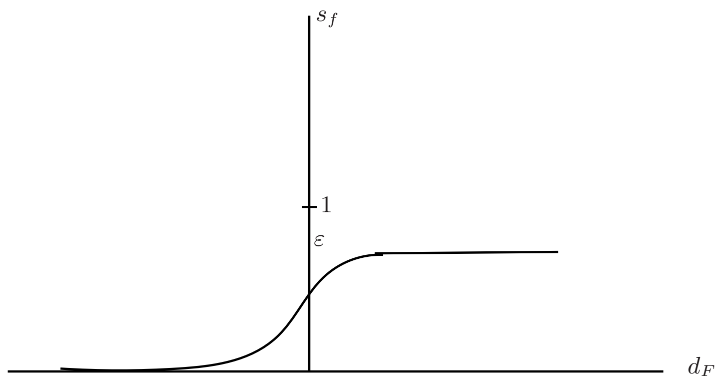

Figure 1: Logistic Retention Ratio

of zero indebtedness of the firms.[5]

On the other hand, the proposed logistic form of the endogenous retention ratio in this paper is not only mathematically convenient, but also economically plausible and preserves the main economic logic behind the specification adopted by Charles (2008a).[6] The implied behavior assumes that firms perceive a higher leverage position as a higher risk position. When there is an increase in the leverage ratio, firms' managers increase the retention ratio to preserve their financial position. Firms' such retention behavior also reflect that borrowers' risk (in Hyman Minsky's terms (Minsky, 1980, 1986)) is an important factor in their financing decision.

2.3 Workers and Rentiers

Workers can borrow to raise their consumption above their current income, and hence workers must pay interest on any outstanding household debt. We therefore explicitly account for

[5]Charles takes the actual retention rate as a state variable that is governed by the following equation of motion:

$$\dot{s_f} = \varphi(s_f^d - s_f)$$

where s_f^d is given by equation 12. Since s_f^d is not well defined around zero of d_F, the dynamics given by the equation are not well defined around zero of d_F as well. In our paper, s_f is an endogenous variable, but not a state variable to keep two dimensional dynamical system as discussed in section 4.

[6]Charles also cites number of empirical works that documents the negative relationship between firms' dividends and indebtedness.

them in workers consumption function. We also include a term that captures the influence of aggregate credit conditions on consumer spending.

$$C_W = W_r L - iD_W + \theta(\overline{D_W} - D_W) \tag{13}$$

The term $W_r L - iD_W$ is after-interest disposable income. Here $\theta > 0$ is an adjustment coefficient, and the 'credit target' $\overline{D_W}$ summarizes current consumer-credit conditions in the macroeconomy.[7]

When accumulated consumer borrowing is below the credit target, the average consumer can borrow, allowing the aggregate consumption of workers to exceed their after-interest disposable income. When there is an increase in $\overline{D_W}$, consumption spending increases. Note that $\overline{D_W}$ regulates contemporary credit flows but not the outstanding stock of credit: the latter is determined historically.

Recalling that the workers' budget constraint from Table 2 requires that $\dot{D}_W = C_W + iD_W - W_r L$, we find that (13) implies a simple adjustment process for consumer indebtedness:[8]

$$\dot{D}_W = \theta(\overline{D_W} - D_W). \tag{14}$$

Rentiers receive interest and dividend incomes. In contrast with workers, rentiers simply consume a fraction of their incomes.

$$C_R = (1 - s_R)(iD_W + iD_F + Div) \tag{15}$$

Here s_R is the saving rate of rentiers.

[7]We use the term credit conditions rather broadly. It is intended to summarize the financial practices of both lenders and borrowers, as influenced by institutional and cultural norms, and in that sense it plays a similar role to the desired level of borrowing in Dutt (2006).

[8]This is a close relative to the discrete time formulation of Palley (1994) and the continuous time formation of Dutt (2005).

3 Temporary Equilibrium

Commodity market equilibrium in this model has a standard representation:

$$Y = C_W + C_R + I \tag{16}$$

Substituting from the consumption equations (13) and (15) and normalizing all variables by the capital stock produces a representation of commodity market equilibrium.

$$u = (1-\pi)u - id_W + \theta(\overline{d_W} - d_W) + (1-s_R)(id_W + id_F + Div) + g_K \tag{17}$$

$d_W = D_W/K$ denotes the normalized indebtedness of workers and $\overline{d_W} = \overline{D_W}/K$ denotes the exogenous consumer credit target. (Exogeneity of $\overline{d_W}$ implies that $\overline{D_W}$ is scaled to the size of the economy.) After substituting from the investment demand equation (10) and solving for u, we find a reduced form expression for capacity utilization.

$$\begin{aligned} u \quad = \quad & \frac{1}{\pi[s_R + (1-s_R-\kappa_r)\frac{\varepsilon}{1+e^{-d_F}}]}[\kappa_0 + \theta\overline{d_W} - (\theta + s_R i)d_W \\ & +(1-s_R-\kappa_r)\frac{\varepsilon}{1+e^{-d_F}} id_F] \end{aligned} \tag{18}$$

Substituting (18) into (8), (9), and (10), we produce reduced forms for the profit rate, the net profit rate, the retained earnings rate, and the accumulation rate.

$$\begin{aligned} r \quad = \quad & \frac{1}{[s_R + (1-s_R-\kappa_r)\frac{\varepsilon}{1+e^{-d_F}}]}[\kappa_0 + \theta\overline{d_W} - (\theta + s_R i)d_W \\ & +(1-s_R-\kappa_r)\frac{\varepsilon}{1+e^{-d_F}} id_F] \end{aligned} \tag{19}$$

$$r_F = \frac{1}{[s_R + (1-s_R-\kappa_r)\frac{\varepsilon}{1+e^{-d_F}}]}[\kappa_0 + \theta\overline{d_W} - (\theta + s_R i)d_W - s_R i d_F] \tag{20}$$

$$s_f r_F = \frac{\varepsilon}{[(1+e^{-d_F})s_R + (1-s_R-\kappa_r)\varepsilon]}[\kappa_0 + \theta\overline{d_W} - (\theta + s_R i)d_W - s_R i d_F] \tag{21}$$

$$g_K = \kappa_0 + \kappa_r(\frac{\varepsilon}{1+e^{-d_F}})\frac{1}{[s_R + (1-s_R-\kappa_r)\frac{\varepsilon}{1+e^{-d_F}}]}[\kappa_0 + \theta\overline{d_W} - (\theta + s_R i)d_W - s_R i d_F] \tag{22}$$

3.1 Comparative Statics

In this section, we briefly discuss the comparative statics of temporary equilibrium. Table 3 summarizes the results. When there is an increase in the credit target $\overline{d_W}$, workers increase their borrowing and consumption spending. This results in an increases of the capacity utilization, profit, retained earning, and accumulation rates. On the other hand, an increase in the level of consumer indebtedness (d_W) has the opposite effect as it implies higher interest payments for workers and more income for rentiers, and workers have a higher marginal propensity to consume than rentiers.

An increase in i affects the economy through both a consumer debt channel and a corporate debt channel. A higher interest rate increases rentiers' income and correspondingly reduces workers' after-interest disposable income. This result in lower overall consumption and demand. On the other hand, an increase in the interest rate causes a reduction in retained earnings for a given level of corporate debt, and hence a fall in investment demand. At the same time, there is a corresponding increase in rentiers' consumption. The net effect on effective demand and profit rate is ambiguous therefore, while there is a clear decrease of retained earnings and hence accumulation rates.

Higher corporate debt, on the other hand, results in higher interest payments for firms, cutting net profits. On the other hand it increases rentiers' consumption via higher interest income. Furthermore firms will increase their retention ratio s_f as it can be seen in figure 1. Therefore, the net effects on the capacity utilization, profit, retained earning, and accumulation rates are ambiguous.

An increase in the retention ratio due to an increase in the exogenous parameter ε has also an ambiguous impact on the endogenous variables. Although an increase in ε increases the retention ratio and the retained earning rate, and hence has a positive effect on the accumulation rate, it also reduces the dividend income of the rentiers, thereby reducing rentiers' consumption. The net impact is therefore ambiguous.

Table 3: Short-Run Comparative Statics

	u	r	$s_f r_F$	g_K
κ_0	+	+	+	+
i	?	?	−	−
d_F	?	?	?	?
d_W	−	−	−	−
$\overline{d_W}$	+	+	+	+
s_R	−	−	−	−
ε	?	?	?	?

4 Dynamics

We treat d_F and d_W as state variables for dynamic analysis. $\dot{d}_F$ is determined by the transactions flows in Table 2. We see that when investment spending exceeds retained earnings, firms must engage in debt finance. We therefore have[9]

$$\dot{d}_F = g_K - s_F r_F - g_K d_F \tag{23}$$

[9]From Table 2 we have $\dot{D}_F = I - \Pi_F$. Recall that by definition $d_F = D_F/K$. Then $\dot{d}_F = (\dot{D}_F K - \dot{K} D_F)/K^2 = (I - s_f \Pi_F)/K - (I/K)(D_F/K) = g_K - s_f r_F - g_K d_F$.

Substituting the appropriate equations for the endogenous variables,

$$\begin{aligned}\dot{d_F} &= g_K - (\frac{\varepsilon}{1+e^{-d_F}})r_F - g_K d_F \\ &= \kappa_0(1-d_F) \\ &\quad +(\frac{\varepsilon}{1+e^{-d_F}})\frac{(\kappa_r - 1 - \kappa_r d_F)}{[s_R + (1 - s_R - \kappa_r)\frac{\varepsilon}{1+e^{-d_F}}]}[\kappa_0 + \theta\overline{d_W} - (\theta + s_R i)d_W - s_R i d_F]\end{aligned} \tag{24}$$

Next consider consumer debt. From the definition of d_W, we see that[10]

$$\dot{d_W} = \theta(\overline{d_W} - d_W) - g_K d_W \tag{25}$$

So we can use equation (22), our reduced form for g_K, to determine the reduced form for $\dot{d_W}$.

$$\begin{aligned}\dot{d_W} &= \theta(\overline{d_W} - d_W) - g_K d_W \\ &= \theta(\overline{d_W} - d_W) - d_W \kappa_0 \\ &\quad -\kappa_r(\frac{\varepsilon}{1+e^{-d_F}})\frac{d_W}{[s_R + (1 - s_R - \kappa_r)\frac{\varepsilon}{1+e^{-d_F}}]}[\kappa_0 + \theta\overline{d_W} - (\theta + s_R i)d_W - s_R i d_F]\end{aligned} \tag{26}$$

Equations 24 and 26 provide a system of equations for our dynamic analysis.

Figure 2 presents the phase diagram of the model.[11] Our analysis focus on the positive space of (d_F, d_W) based on the stylized fact. The phase diagram describing the dynamics of the model looks similar to the one in Isaac and Kim (2013), but there is an important difference between them. This extended model with an endogenous retention ratio allows for the existence of a stable steady state with positive levels of both household and corporate debt, so there is no kind of 'euthanasia of the rentier' as in Isaac and Kim (2013). In Charles

[10] $\dot{d}_W = \dot{D}_W/K - \dot{K}D_W/K^2 = \theta(\overline{D_W} - D_W)/K - (I/K)(D_W/K) = \theta(\overline{d_W} - d_W) - g_K d_W$.

[11] Due to the complexity of the equations of motion, we have to rely on simulation methods for the analysis. This phase diagram is obtained assuming the following parameter values: $\kappa_0 = 0.1, \theta = 0.5, \kappa_r = 0.2, i = 0.03, \overline{d_W} = 0.2, s_R = 0.6, \varepsilon_0 = 0.8$. These parameter values are also our benchmark values for the later study on macroeconomic stability in section 4.1. With these parameter values, the system exhibits a nodal sink point at (0.3547, 0.1626) and a saddle point at (27.7665, 0.1939).

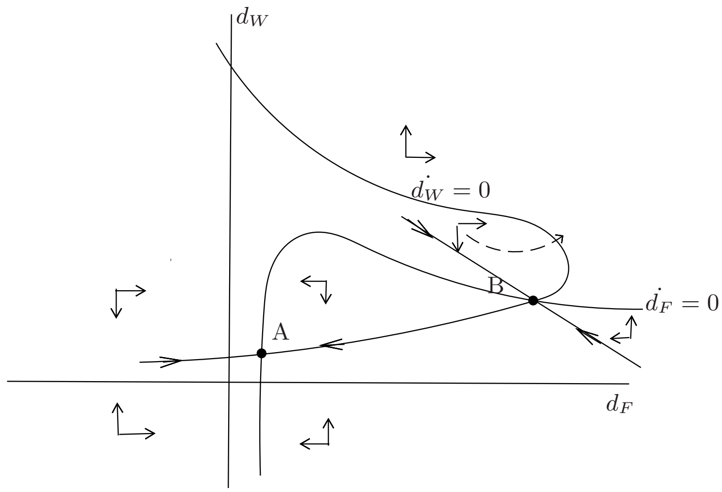

Figure 2: Debt Dynamics

(2008a), a high value of the interest rate is a necessary pre-condition for multiple equilibria and the discussion of instability (financial fragility in his term), as, at a low initial value of i, his model will only exhibit one stable equilibrium. But such condition is not necessary for multiple equilibria in our model.

The key element for the unstable dynamics around the saddle point B in the phase diagram lies in the investment financing behavior of the firms. Combining the financial constraint in the transaction matrix (table 2) with the investment behavior,

$$\begin{aligned} dD_F/dt &= I - s_f(\Pi - iD_F) = \kappa_0 K + \kappa_r(\Pi - iD_F) - s_f(\Pi - iD_F) \\ &= \kappa_0 K + (\kappa_r - 1)s_f \Pi_F \end{aligned} \tag{27}$$

and normalizing by capital stock:

$$(dD_F/dt)/K = \kappa_0 + (\kappa_r - 1)s_f r_F \tag{28}$$

When the level of corporate debt is too high, debt service payments could eventually become higher than net profits, and therefore $r_F(= r - id_F)$ as well as $s_f r_F$ are negative. When the net profit rate is negative, firms have to borrow just to make debt service payments, and debt grows faster. This sets off a vicious cycle. The unstable process is related to Hyman Minsky's Ponzi state of firms, which refers to the case where the firms' cash flow is not sufficient to cover the interest payments on the firms' outstanding debt. They have to borrow just to make debt service payments. Our framework shows that, although endogenous retention ratio incorporates borrower's risk in firms financing behavior, it only partially do so as it does not provide enough of a damping mechanism since it is bounded by 1 even when the level of debt is too high.

We also observe that the stable saddle path which divides the stable and unstable regions is downward sloping. The reason is found in the negative relationship between the consumer debt-capital ratio and capacity utilization. A higher consumer debt-capital ratio means a lower capacity utilization and gross profit rates, all else being equal. The unstable dynamics become effective at a lower level of the corporate debt-capital ratio when the consumer debt-capital ratio is higher. This is captured by the downward sloping stable saddle path.

4.1 Debt and Macroeconomic Stability

In this section, we investigate the change in dynamics due to changes in model parameters. Debt dynamics dictate macro dynamics of the economy as well since d_W and d_F are the state variables of the system. Dynamics are depicted in figures 3, 4, and 6. Table 4 summarizes the corresponding comparative statics results of endogenous variables at the stable steady state.[12]

Figure 3 illustrates the effect of looser consumer credit conditions. An increase in the consumer credit target increase demand as it will increase the consumption demand, and hence increase capacity utilization, profit, retained earning, and growth rates. This also shifts the saddle point from point B to D, and produces a larger stable region. In this sense,

[12] With the benchmark parameter values and π=0.3, we observe $u = 0.56, r = 0.17, r_F = 0.15, s_f r_F = 0.47, g_K = 0.11$ at the stable steady state. Table 4 summarizes the change of stable steady state values of these endogenous variables induced by an increase in model parameters.

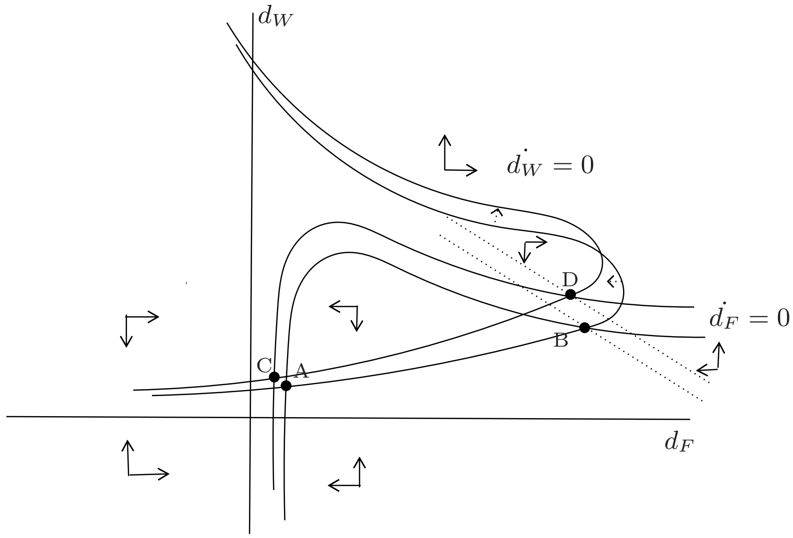

Figure 3: The Effect of a Higher Credit Target

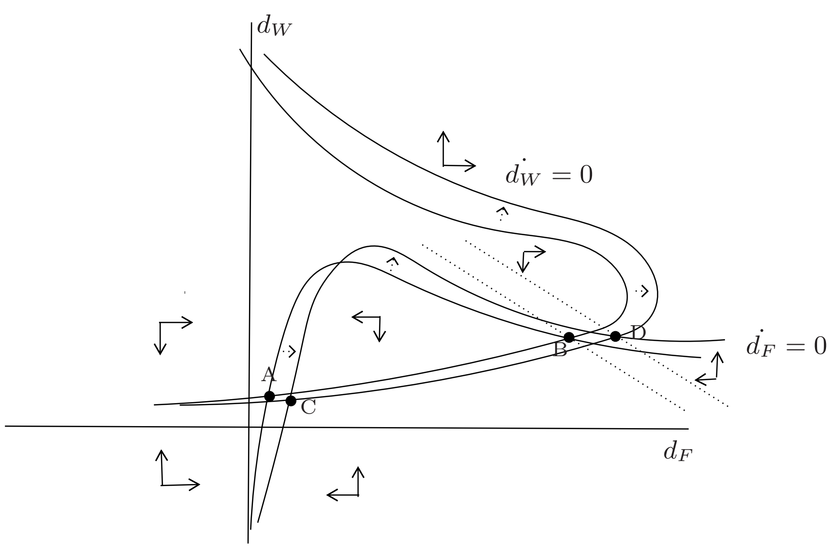

Figure 4: The Effect of a Higher State of Confidence

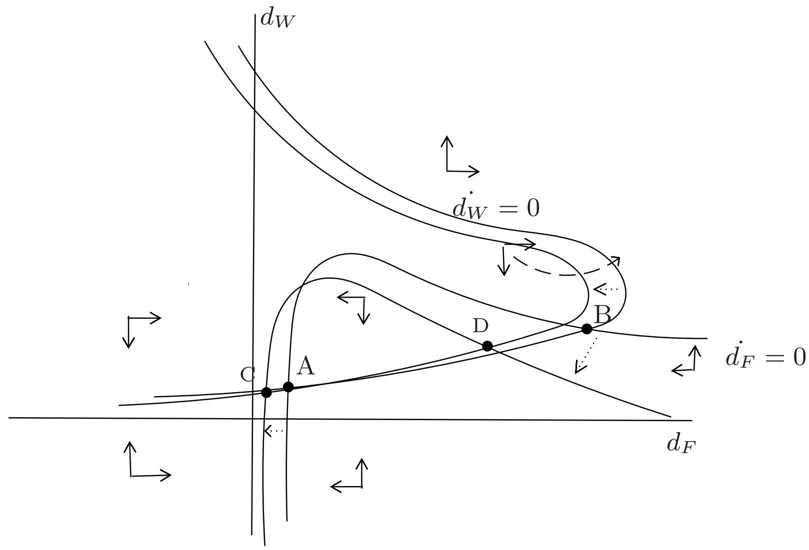

Figure 5: The Effect of a Higher Retention Ratio (Increase in ε)

Table 4: Steady-State Responses

	κ_0	ε	i	$\overline{d_W}$	s_R
u	$+$	$-$	$-$	$+$	$-$
r	$+$	$-$	$-$	$+$	$-$
r_F	$+$	$-$	$-$	$+$	$-$
$s_f r_F$	$+$	$+$	$-$	$+$	$-$
g_K	$+$	$+$	$-$	$+$	$-$

looser consumer credit conditions promote macroeconomic stability. Note that retained earnings increases due to increase in consumption, capacity utilization rate and profit rate. So capital accumulation rely more on retained earnings. d_F drops therefore. However, with a looser consumer credit conditions, workers borrower more and their indebtedness increase. Therefore we see an increase in d_W for the both steady states.

An increase in what Keynes (1936) also called 'spontaneous optimism' via an increase in animal spirits is another possible source of increased demand and figure 4 illustrates the dynamics. As with looser consumer credit conditions, we see that an increase in animal spirit enlarges the stable region of the economy as there is a shift of the saddle point from point B to D. Conversely a decrease in the state of confidence can shrink the stable region, and in that sense it decreases the stability of the system.

Figure 5 depicts the comparative dynamics when firms become more frugal in their dividend policy and increase in their retained earnings (modeled here as an increase in ε). An increase in ε means an increase in firms' retention ratio, for any given level of d_F. This reduces dividend income and hence the supply of funds available to consumers and firms. There is also increase in capital accumulation rate due to an increase in retained earning rate. Therefore both d_F and d_W shifts down at both stable and unstable points, resulting in a smaller stable region. This is different from Charles (2008a) that *less* prudent behavior worsens stability (financial fragility in his term) as it makes stable equilibrium and unstable equilibrium closer. It is also noteworthy that g_K increases despite of a reduction of capacity utilization, profit, and net profit rates as indicated in table 4. It is because an increase in retention ratio raises retained earnings despite of a decrease in net profit. Endogenous retention ratio provides a mechanism for a disjoint behavior between demand and growth rates.

An increase in the interest rate has a negative effect on macroeconomic stability. As illustrated in Figure 6, an increase in the interest rate shifts B to D and A to C. This reduces the size of the stable region.[13] In this sense, interest-rate shocks can destabilize the macroeconomy. and this is similar to Charles (2008a)' emphasis that an interest shock (with a high initial value of i) will leads to a financial instability in the sense that the stable and unstable steady states become closer.

In our model, furthermore, a large swing in interest rate can destabilize the economy in a more significant way. Figure 7 depicts the emergence of an instability due to a large increase in interest rate.[14] In this case, no steady state exists in a reasonable range of positive debt values. According to this result, when this sudden change in a behavioral parameter occurs, the stable macroeconomic trajectory becomes an unstable one and explodes. Consequently,

[13] Essentially the same result are obtained when there is an increase in s_R.

[14] One could for example obtain such a phase diagram with the following parameter values: $\kappa_0 = 0.1, \theta = 0.5, \kappa_r = 0.2, i = 0.2, \overline{d_W} = 0.2, s_R = 0.6, \varepsilon_0 = 0.8$.

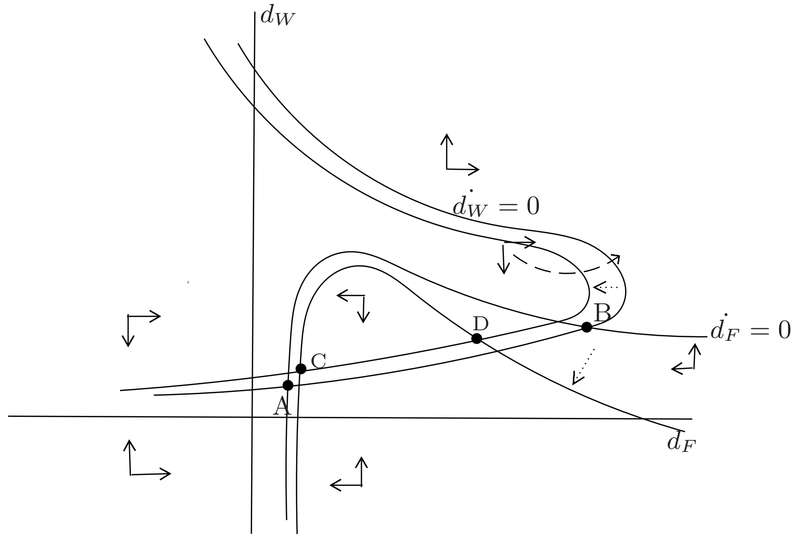

Figure 6: The Effect of a Higher Interest Rate

u, r, r_F, and g_K will collapse as well. For example, consider the macroeconomic trajectory at point A in figure 7. Suppose it was initially a stable one. After the changes in parameters, we observe that it suddenly becomes an unstable macroeconomic trajectory and explodes. This instability result is unique compared to Charles (2008a)'s result that, when there is an interest shock with a high initial value of it, both stable and unstable steady states still exist and they become closer in the positive domain of debt (corporate debt as he deals only with one kind of debt).[15]

To understand the intuition, recall equation (28):

$$(dD_F/dt)/K = \kappa_0 + (\kappa_r - 1)s_f r_F$$

An increase in the interest rate increases demand leakages. In this demand driven growth model, this will result in a reduction of net profits (r_f). This will induce firms to borrow

[15]This result is also unique to the model with the logistic endogenous retention ratio, compared to Isaac and Kim (2013) which this study build upon. The model exhibits this kind of a drastic change in dynamics when only either i increases or κ_0 decreases to a negative level. When κ_0 decrease to a negative level, instability dominates in the sense that there is only a saddle steady state at the positive domain of (d_F, d_W).

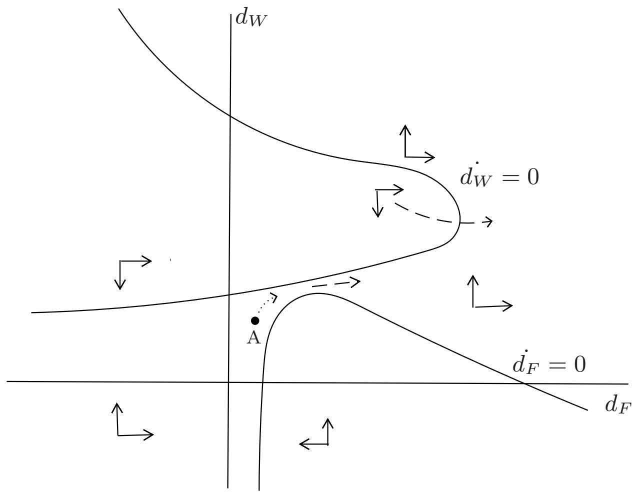

Figure 7: Instability due to Increases in Interest Rate

more[16]. This is not sustainable. Debt service payments eventually become higher than net profits, and hence $r_F (= r - id_F)$ becomes negative. Firms then have to borrow just to make debt service payments, and debt grows faster. Firms experience Ponzi-state of financing. Increasing s_f (as d_F increases) does not provide enough stabilizing mechanism as it is bounded by 1.

5 Concluding Remarks

The present paper incorporates a realistic retention behavior of firms into a neo-Kaleckian growth model with both corporate and consumer debt. We adopt a logistic functional form to represent endogenous retention ratio. According to proposed behavior, firms perceive a higher leverage position as a higher risk position. Therefore, when they experience a higher leverage, firms increase the retention ratio to preserve their financial position.

Our model exhibit multiple equilibria of stable and unstable ones in the positive space of corporate and consumer debt. Credit expansion in the way of increase in consumer credit target generates more debt financed consumption and it enhances stability of the system

[16]Note that Keynesian stability condition insures $\kappa_r - 1 < 0$

in the sense that it increases stable region. Similarly, a higher state of firms confidence via an increase in animal spirits will be stability enhancing. If firms behave more frugally in their dividend policy and increase self-financing by increasing their retention ratio, this will reduces demand and negatively affect stability by reducing the size of stable region. However, due to an increase retention ratio, it will generate a higher accumulation rate. Endogenous retention ratio provides a mechanism of disjoint behavior between demand and growth. A higher interest reduces stability as stable and unstable steady states gets closer and reduces stable region. A large swing in interest rate can generate more drastic instability in the economy.

The endogenous retention ratio in our model is reasonable and addresses the idea of borrowers risk in firms financing behavior, but only do so partially as discussed above. This point out that incorporating additional dimension to reflect such borrowers' risk in firms financing behavior would be a meaningful extension of the model as a future research.

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