POLITICAL ECONOMY RESEARCH INSTITUTE
PERI
University of Massachusetts Amherst

The Simple Analytics of Debt-Driven Business Cycles

Thomas I. Palley

April 2009

WORKINGPAPER SERIES

Number 200

POLITICAL ECONOMY RESEARCH INSTITUTE

Gordon Hall
418 North Pleasant Street
Amherst, MA 01002

Phone: 413.545.6355
Fax: 413.577.0261
peri@econs.umass.edu
www.peri.umass.edu

UMASS

The Simple Analytics of Debt – Driven Business Cycles

Abstract

This paper explores the economics of debt-driven business cycles, distinguishing between Keynesian and new Keynesian approaches. Keynesians emphasize the impact of borrowing and debt on aggregate demand (AD), whereas new Keynesians emphasize the impact on aggregate supply (AS). A unique Keynesian feature is emphasis on debtor – creditor debt-service income transfers. Business cycles result from two mechanisms. One is the multiplier – accelerator AD mechanism. The second is a predator – prey mechanism whereby increased income feeds the level of debt, but the level of debt preys on the level of income. Both the Keynesian and new Keynesian approaches are logically coherent, but the latter is at odds with the stylized facts of business cycles.

Key words: debt, debt service burdens, business cycle, multiplier – accelerator, predator – prey model.

JEL ref.: E3, E5

Thomas I. Palley
Washington, DC 20009
e-mail: mail@thomaspalley.com

This version January 2009

This paper was first presented at the post Keynesian conference held in Kansas City, MO, June 26 – 29, 2004.

I Introduction: debt and the business cycle

The last decade has witnessed a surge of interest in the role of debt in the economic process. One reason is the return of the specter of deflation, which has revived interest in Irving Fisher's (1933) debt – deflation hypothesis of depressions.

A second reason has been the fact that the three U.S. business cycle expansions of the 1980s, 1990s, and 2000s were all accompanied by significant increases in household and corporate sector borrowing that pushed debt levels to record highs, both in absolute terms and in terms of debt-to-income ratios. With the US economy now experiencing a deep recession, there are concerns that the burden of debt service could hamper the recovery and even trigger a double dip recession. A third reason is the collapse of the asset prices in Japan in the 1990s and the US in 2001 and 2008, which has raised questions about the nexus between debt and asset price bubbles.

Whereas mainstream interest in debt is a relatively recent development, Post Keynesian economics has long recognized the significance of debt. Thus, Post Keynesians have emphasized the significance of credit in (i) determining the money supply (Moore, 1988), (ii) rendering downward price and nominal wage adjustment incapable of solving the Keynesian problem of deficient demand (Tobin, 1980; Caskey and Fazarri, 1987; Palley, 1999), and (iii) driving the business cycle and creating financial instability (Minsky, 1982; Gallegati and Gardini, 1991; Semmler and Franke, 1991; Skott, 1994; Palley, 1994).

The current paper excavates the role of debt in the business cycle, and explores the different channels through which debt contributes to fluctuations in real economic activity. Rather than building another model, the paper seeks to deconstruct the

economics of debt driven business cycles and analyze the different theoretical mechanisms at work.[1]

The paper begins by comparing Keynesian and new Keynesian approaches to the economics of debt driven business cycles. These approaches are fundamentally different, but that difference is easily obscured because there are also considerable overlaps. The overlaps concern how financial factors impact agents. The fundamental differences concern how debt affects economic activity. Keynesian models emphasize the aggregate demand (AD) effects of debt, whereas new Keynesian models emphasize aggregate supply (AS) effects.

Thereafter, the paper examines the effects of debt in Keynesian models. Here, it is important to distinguish how debt affects AD versus the financial sector mechanisms that facilitate or restrict the volume of borrowing and debt. Viewed in this light, the financial sector multiplies the AD effects of debt by increasing or restricting the flow of credit, and the determination of debt ceilings and permissible leverage is a critical variable.

Lastly, the paper is deliberately restricted to linear models of the business cycle. Non-linear models easily produce cycles, making it difficult to identify what is causing cycles. In a sense, non-linear models produce too rich a pattern of outcomes to be analytically insightful. For this reason, the paper sticks with linear models that enable identification of the economic mechanisms driving cyclical behavior.

II Keynesian vs. new Keynesian models of debt driven business cycles

[1] One problem with the Keynesian literature is a tendency toward model proliferation. There are numerous channels through which debt can have macroeconomic impacts, and these channels can be combined in different permutations. That tends to lead to model proliferation that obscures the underlying economics. Each model is a partial treatment, while a comprehensive model is analytically intractable. An alternative way of obtaining a comprehensive understanding is to analyze the contribution of the component channels.

Macroeconomics is marked by two dramatically different analytical approaches. On one side, Keynesian and Post Keynesian economics emphasizes the significance of aggregate demand (AD), with the level of AD determining the equilibrium level of output. On the other side, new Classical and new Keynesian economics emphasize aggregate supply (AS), with output being constrained AS conditions.

This analytical difference carries over into the economics of debt driven business cycles. Thus, in the Keynesian and Post Keynesian framework debt influences the level of AD, thereby influencing output. Contrastingly, in the new Keynesian framework (Bernanke et al., 1999; Kiyotaki and Moore, 1997) debt constrains firms' ability to finance production, thereby limiting AS.

There are two core mechanisms whereby debt has real effects. The first can be termed the "balance-sheet congestion" mechanism, which was pioneered by Kalecki (1937) and Minsky (1982), but has since been adopted by new Keynesians (Bernanke et al., 1999). The basic notion is that accumulation of debt over the course of the cycle leads to a deterioration in the quality of firms' balance sheets and build up of debt service obligations, which restricts firms' ability to borrow and finance further investment.[2]

The second mechanism can be termed the "debt service transfer" mechanism, which was pioneered by Fisher (1933) and has been applied in a business cycle context by Palley (1994, 1997). The key feature is that debtors and creditors have different propensities to spend so that transfers from debtors to creditors have AD effects that drive

[2] Kalecki (1937) has balance-sheet congestion working through his principle of "increasing risk." As firms invest more and become more leveraged, this exposes them to greater likelihood of bankruptcy and raises the required rate of return on projects, thereby discouraging investment. For a discussion of Kalecki's principle of increasing risk see Mott (1985).

the cycle.[3] Palley (1994) places this mechanism in a consumption-based model of the business cycle where there are transfers between debtor and creditor households.

A novel theoretical contribution of the current paper is the examination of a new debt service transfer mechanism operating between firms and households. This firm – household debt service transfer mechanism impacts consumption and investment spending, and it is analytically distinct from the balance-sheet congestion mechanism that frames existing thinking about investment and debt. The debt service transfer mechanism rests on differences in propensities to spend between households and firms, whereas the balance sheet congestion mechanism is akin to a credit rationing mechanism.

Figure 1 provides a taxonomy of the different approaches to modeling debt-driven business cycles. The rows distinguish different economic closures. Keynesian models represent output as demand-determined (y = AD), while new Keynesian models represent output as supply-determined (y^* = AD). The columns distinguish different mechanisms (i.e. balance sheet congestion vs. debt service transfer) whereby debt affects economic activity.

| Figure 1 here|

Figure 1 shows that Keynesian and new Keynesian models both use the balance sheet congestion mechanism, which makes it easy to conflate them. However, Keynesian and new Keynesian models are analytically distinct. Within Keynesian models, balance sheet congestion affects the flow of investment spending and AD. In new Keynesian

[3] Tobin (1980) recognizes the significance of Fisher's (1933) distinction between the propensity to spend of debtors and creditors. However, his focus is static macroeconomics and the impact of price level reduction on AD, whereas the current focus is on business cycle dynamics.

models, balance sheet congestion affects firms' capacity to finance investment and impacts the capital stock and AS.[4]

Figure 2 provides a more detailed taxonomy of these competing approaches to modeling debt-driven cycles. The critical difference between the two approaches is that New Keynesian models focus on the effects of borrowing and debt on AS via the capital stock, whereas Keynesian models focus on the effects of borrowing and debt on AD.

|Figure 2 here|

Most Keynesian models emphasize balance sheet congestion effects (see for instance Gallegati and Gardini, 1991; Franke and Semmler, 1991; Skott, 1994) whereby debt imposes a finance constraint on firms, which in turn impacts investment spending and AD. This class of Keynesian models overlaps with new Keynesian models that also use the balance sheet congestion mechanism.

However, a second Keynesian approach (Palley, 1994, 1996, 1997; Dutt, 2006) emphasizes debt – service payments from debtors to creditors, which negatively impact AD because debtors have a higher marginal propensity to spend out of income than creditors. This channel is captured in the bottom branch of Figure 2, and it is unique to Keynesian models because new Keynesian models are neutral with respect to systematic anticipated AD effects.[5]

One difficulty distinguishing Keynesian and new Keynesian models is that there is considerable overlap regarding financial sector effects. For instance, both may

[4] Investment has a dual nature, contributing to AD and also adding to the capital stock. Keynesian models emphasize the AD effect of investment; new Keynesian models emphasize the capital stock effects.
[5] In principle such transfers could be introduced in the New Keynesian model, but their effect would be to impact saving and interest rates through the loanable funds market. Increased transfers from debtors to creditors would increase saving and drive down interest rates, thereby raising the capital stock and stimulating economic activity. This is the opposite of the Keynesian story where transfers from debtors to creditors are contractionary.

incorporate asset price collateral effects. In Keynesian models increased asset prices increase the level of collateral, thereby enabling further borrowing to finance investment spending that increases AD and output. New Keynesian models (Bernanke et al., 1999) can also include asset price – collateral value effects, but now collateral underwrites borrowing to finance accumulation of capital that raises the capital stock and AS.

Financial sector mechanisms play a critical role driving debt based business cycle models and significantly affect the amplitude of cycles. However, these mechanisms are shared by both Keynesian and new Keynesian models, which means they are not the decisive factor distinguishing between the two approaches. Instead, the fundamental distinction concerns how borrowing and debt affect output.[6]

III The mechanics of cyclical debt propagation effects

The previous section identified the similarities and differences in the fundamental economic logic of Keynesian and new Keynesian debt-driven business cycle models. This section explores the propagating mechanisms.

In Keynesian models, one mechanism of cyclical propagation is the familiar multiplier – accelerator mechanism developed by Samuelson (1939). Applied to a model with credit, the multiplier works via borrowing which adds to AD, and the accelerator kicks in via the induced change in output that facilitates higher borrowing. This mechanism is captured as follows

(1) $y = \alpha_0 + \alpha_1 b$

(2) $b = \beta_0 + \beta_1 y_{-1} + \beta_2 \Delta y_{-1}$

[6] The fact that Keynesian and new Keynesian models use the same financial sector mechanisms is one reason Keynesians have been unable to puncture the new Keynesian paradigm. This is exemplified by the work of Minsky (1975, 1982, 1986, 1993). Minsky was a Keynesian, yet his description of financial processes and their role in boom – bust cycles can be incorporated in new Keynesian thinking. New Keynesian models therefore include Minsky's financial mechanisms while dropping his Keynesianism.

where y = level of output, b = borrowing, and $\Delta y_{-1} = y_{-1} - y_{-2}$.

The multiplier (α_1) – accelerator (β_2) mechanism is a pure flow based mechanism relating the flow of borrowing to changes in the flow of income. However, there are also impacts from the accumulated debt stock. Borrowing increases economic activity, but it also increases the debt stock which must be serviced, and debt service payments may reduce AD and economic activity.

In effect, debt has a Janus-like character whereby increases in debt initially increase AD, but subsequent debt service payments on the increased stock of debt serve to reduce AD. These negative debt stock effects impact both consumption and investment spending. Their effect is analogous to a predator – prey mechanism that supplements the multiplier – accelerator mechanism. Income serves as prey that feeds the capacity to accumulate debt, and the accumulated debt stock is the predator that feeds on income.

Figure 3 illustrates these twin mechanisms. The right hand loop between borrowing and income constitutes the multiplier – accelerator mechanism. The predator – prey mechanism operates across the two loops. Higher income allows for additional borrowing that in turn raises debt, but higher levels of debt reduce AD and income (the direct channel). Additionally, higher debt reduces ability to borrow, which also reduces AD and income (the indirect channel).

|Figure 3 here|

This cross-looping is a stock – flow process in which the stock variable (debt) preys on borrowing and income flows, while the flow variables (income and borrowing) feed the debt stock. Hence, the analogy between debt driven business cycle models and

predator – prey models.[7] This predator – prey mechanism operates in both Keynesian and new Keynesian models.

IV Debt and AD in Keynesian models of the business cycle

Section II analyzed the architectural differences between Keynesian and new Keynesian approaches to debt and the business cycle, while section III analyzed the propagating mechanisms that create debt driven business cycles. This section excavates the Keynesian approach and presents two models that show the role of debt in business cycles.

The first model is a consumer debt model with debt service transfers between debtor and creditor households. The second model is a new theoretical contribution that shows how the debt-service transfer mechanism also works between households and firms.

In both models the economic logic of cycles is similar. Borrowing to finance consumption and investment increases AD, which expands income. It also increases debt. Accumulating debt burdens start to slow borrowing and eventually outweigh the positive effect of new borrowing, at which stage the cycle goes into reverse. The downturn is marked by debt repayment which lowers AD and income, but also reduces debt burdens. Eventually, the benefit of reduced debt burdens comes to dominate and the cycle reverts to expansion mode.

IV.a) Consumer debt models of the business cycle

[7] The same mechanisms apply in Keynesian growth models with debt (see Dutt, 2006). The main differences from the business cycle model are (i) use of continuous time instead of discrete time, and (ii) variables are scaled by the capital stock (K) so that the model determines the rate of capital accumulation (I/K) instead of the level of investment (I), and the rate of capacity utilization (y/K) instead of the level of output (y).

The starting point for the analysis is the model of a consumer-debt-driven business cycle presented by Palley (1994). That model involves two types of households – debtors and creditors. Debtor households borrow from creditor households and have a higher marginal propensity to consume. Consequently, their borrowing increases AD and output, and the increase in output raises their debt ceiling, thereby allowing additional borrowing. This is the multiplier – accelerator mechanism.

The predator – prey mechanism works through debt service burdens. Thus, additional borrowing raises debtor household indebtedness, which increases debt service transfers to creditor households. Since debtors have a higher propensity to consume, these transfers reduce AD, and in this way accumulated debt preys on output.

This process is captured in the following eight equation model:

(3) $y_t = c_{1,t} + c_{2,t} + a_0$ [Aggregate Demand]

(4) $c_{1,t} = a_1[zy_{t-1} - S_t] + \Delta D_t$ $0 < a_1 < 1, 0 < z < 1$ [Debtor consumption]

(5) $c_{2,t} = a_2[[1-z]y_{t-1} + S_t - \Delta D_t]$ $0 < a_2 < 1, a_1 > a_2$ [Creditor consumption]

$[1-z]y_t + S_t - \Delta D_t > 0$

(6) $\Delta D_t = D_t - D_{t-1}$ [Borrowing]

(7) $D_t = a_3 z y_{t-1}$ $a_3 > 0$ [Debt ceiling]

(8) $S_t = rD_{t-1}$ [Debt service payments]

where y = level of real output, c_1 = real consumption of debtor households, c_2 = real consumption of creditor households, a_0 = autonomous expenditures, a_1 = MPC of debtor households, a_2 = MPC of creditor households, z = share of income received by debtor households, r = real interest rate, ΔD = change in the level of real debt, S = level of real

interest service payments on debt, and D = level of real debt of debtor households. Subscripts represent dates, with the subscript t referring to current period outcomes.

Equation (3) has current period output being determined by AD, which depends on consumption of debtor and creditor households and autonomous expenditures. Equation (4) determines consumption of debtor households, which depends on income adjusted for debt service payments plus borrowing. All borrowing is spent. Equation (5) determines consumption of creditor households, which depends on income adjusted for debt service receipts less lending. This adjusted income is restricted to be positive. Debtor households are assumed to have a higher marginal propensity to consume than creditor households. Equation (6) defines the change in the level of debt.

Equation (7) describes the relation between debt and income. The coefficient a_3 represents the debt - income leverage ratio. There are two possible interpretations of this relation. The first is that last period's income represents borrower's expectations of current income, in which case the coefficient a_3 represents a desired debt - income ratio. Alternatively, last period income is what lenders observe, and this determines the loan ceiling. In this case the coefficient a_3 represents a debt - income ceiling, and borrowers are implicitly always constrained by this ceiling. Finally, equation (8) is the debt service equation. Interest is paid in arrears, so that debt service is based on last period's debt. The real service burden is the real interest rate multiplied by the real level of debt. The above specification implies that the real interest rate is fixed.

Substituting equations (4) and (5) into (3) yields

(9) $y_t = b_0 + b_1 y_{t-1} + b_2 \Delta D_t + b_3 S_t$

where $b_0 = a_0$; $0 < b_1 = a_1z + a_2[1-z] < 1$; $0 < b_2 = [1-a_2] < 1$; and $0 > b_3 = [a_2 - a_1] > -1$. Equation (9) provides insight into the dynamics of the model. Aggregate demand depends positively on last period's income, which affects current consumption. b_1 is the aggregate MPC, which is a weighted average of the MPCs of debtors and creditors, where the weights are income shares. AD also depends positively on changes in the level of debt, reflecting the working of the accelerator mechanism. Increases in debt are expansionary since they finance additional expenditures, while decreases in debt are contractionary. Borrowers are assumed to spend all their borrowings (i.e. have an MPC of one for borrowed funds). Borrowing therefore increases aggregate demand because it transfers income from low MPC creditor/lender households to higher MPC debtor/borrower households. Debt repayments operate in reverse. Lastly, debt service payments are contractionary since they transfer income from debtors to creditors. The coefficient b_3 represents the difference between the MPCs of debtors and creditors.[8]

Substituting equations (6) - (8) into equation (9) yields a standard second order difference equation in y given by

(10) $y_t = b_0 + [b_1 + b_2a_3z]y_{t-1} - [b_2a_3 - b_3a_3r]zy_{t-2} = A_0 + A_1y_{t-1} + A_2y_{t-2}$

where $A_0 = b_0$, $A_1 = [b_1 + b_2a_3z]$, and $A_2 = -[b_2a_3 - b_3a_3r]z$

The solution to the particular integral for this equation is

(11) $y_p = b_0/[1 - b_1 - b_3a_3zr]$

Differentiating y_p with respect to a_3, z, and r yields

[8] Specification of the debt service burden in real terms implies abstraction from any effects of inflation. Such an abstraction is theoretically accurate if all debt is floating rate and the real interest rate is constant. In this case, changes in inflation produce one-for-one increases in the nominal interest rate and there is no re-distribution between debtors and creditors. If either of these assumptions are violated, inflation would have real effects operating through either or both the existing stock of debt and the flow of new borrowing. If debt is non-floating rate, then increases in inflation benefit debtors, while decreases benefit creditors. If the nominal interest rate adjusts by less than the inflation rate, then increases in inflation benefit borrowers while decreases benefit creditors.

$\delta y_p/\delta a_3 < 0$, $\delta y_p/\delta r < 0$,

$\delta y_p/\delta z \gtrless 0$ if $1 - a_3 \gtrless 0$

Increases in the borrowing ceiling and the real interest rate reduce equilibrium income. This is because both variables raise the equilibrium debt burden of debtor households, and that burden lowers equilibrium AD and output. Thus, borrowing is initially expansionary, but it gives rise to debt effects that come back to lower AD and income.

Increases in debtor households' share of income is expansionary if $a_3 < 1$. The logic is debtor households have a higher marginal propensity to spend. However, raising their income also increases their borrowing, which is ultimately contractionary. For equilibrium income to rise as a result of increasing the debtor income share, borrowing must not increase too much ($a_3 < 1$).

The Routh – Hurwicz conditions (see footnote 8) show that instability is more likely: (i) the greater the marginal propensity to spend out of debt, b_2; (ii) the greater the allowable debt - income ratio, a_3; (iii) the greater the share of income going to debtors, z; (iv) the greater the marginal effect of debt service on spending, $|b_3|$; and (v) the higher the real interest rate.[9]

Increases in b_2, a_3, and z, increase the multiplier effect of changes in income by generating larger induced expansions of AD through borrowing. This can generate instability by causing explosive expansions of income, debt, and AD. The same holds for increases in $|b_3|$.

IV.b) Firms and debt – driven business cycles: a new model

[9] The Routh – Hurwicz necessary and sufficient conditions for stability are $1 + A_1 + A_2 > 0$, $1 - A_2 > 0$, and $1 - A_1 + A_2 > 0$.

Consumer debt represents one source of transfers between debtors and creditors. However, firms also borrow, which creates another source of transfers that can also generate business cycles.

Gallegati and Gardini (1991) present a non-linear model of the business cycle that includes a finance constraint on firms that restricts investment spending. Gallegati and Gardini's analysis pivots off the empirical findings of Fazzari et al. (1988) that firms' investment spending is positively influenced by the level of internal cash flows. This indicates that firms are subject to finance constraints, and increased cash flows relieve these constraints.

However, though including debt, the Gallegati – Gardini model is not a debt driven model of the business cycle. Instead, the cycle is driven by a non-linear profit function. In the early stages of the cycle when output is low, profits rise with output. This increases cash flows and investment, which in turn increases AD and output. As output increases, profits decline, which decreases investment, AD, and output. Thus, non-linearity of the profit function generates a non-linear investment function, which drives the cycle.[10]

Despite this, Gallegati and Gardini's (1991) core insight regarding the significance of firm level finance constraints can still be incorporated to create a debt driven business cycle by re-specifying cash flows to include the effect of borrowing and debt re-payment.

[10] Skott (1994) presents another non-linear investment model of a debt-driven business cycle. Whereas Galegatti and Gardini (1994) emphasize cash-flow effects, Skott emphasizes financial fragility defined as a debt-service ratio. Financial fragility then constrains additional borrowing for Stiglitz-Weiss (1981) credit-rationing reasons. A business cycle emerges because financial fragility makes for a non-linear investment function. In this the Skott and Galegatti – Gardini models are similar.

Additionally, a debt service transfer mechanism can be incorporated to recognize that indebted firms make payments to households. This effect requires amending the consumption function to take account of interest income and lending to firms.

These channels are included in the following six equation model:

(12) $y_t = c_t + I_t + G$

(13) $c_t = \eta_0 + \eta_1\{[1-\varphi]y_{t-1} + rD_{t-1}\} - \Delta D_t \quad \eta_0 > 0,\ 0 < \eta_1 < 1, 0 < \varphi < 1,\ 0 < \gamma < 1$

(14) $I_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 CF_t \qquad \alpha_0, \alpha_1, \alpha_2 > 0$

(15) $CF_t = \gamma\varphi y_{t-1} - rD_{t-1} + \Delta D_t$

(16) $\Delta D_t = D_t - D_{t-1}$

(17) $D_t = \Omega\ \varphi y_{t-1}$

where I = real investment spending, G = government spending, CF = real cash flows available in period t, γ = firms' profit retention ratio, φ = profit share, and ΔD_t = firm borrowing or repayment.

Equation (12) is the goods market clearing condition. Equation (13) is an aggregate consumption function (without consumer borrowing). Aggregate consumption depends on the wage share, $[1 - \varphi]y_{t-1}$; the share of profits paid out as dividends, $[1-\gamma]\varphi y_{t-1}$; debt service income received from firms (rD_{t-1}); and lending to firms (ΔD_t).[11]

Equation (14) is an investment function in which investment depends on lagged output and available cash flow; equation (15) determines cash flow which depends on retained profits less interest plus (minus) new borrowing (debt repayment); equation (16) determines borrowing; and equation (17) determines firms' debt level. Firms are always at their debt ceiling, which is a multiple of the profit share.

[11] Debt service is assumed to be paid one period in arrears, and hence the terms rD_{t-1}.

Substitution of equations (13), (14), (15), (16) and (17) into equation (12) yields a second order difference equation given by

(18) $y_t = \{\eta_0 + \alpha_0 + G\} + \{\eta_1\{[1-\varphi] + [1-\gamma]\varphi\} + \alpha_1 + \alpha_2\varphi[\gamma + \Omega] - \Omega\varphi\}y_{t-1}$

$+ \{[1 - \alpha_2] + [\eta_1 - \alpha_2]r\}\Omega\varphi y_{t-2}$

$= A_0 + A_1 y_{t-1} + A_2 y_{t-2}$

where $A_0 = \eta_0 + \alpha_0 + G > 0$, $A_1 = \{\eta_1\{[1-\varphi] + [1-\gamma]\varphi\} + \alpha_1 + \alpha_2\varphi[\gamma + \Omega] - \Omega\varphi\} > 0$, and $A_2 = \{[1 - \alpha_2] + [\eta_1 - \alpha_2]r\}\Omega\varphi > 0$.

With regard to generation of cycles, there are now two mechanisms at work. One is the familiar multiplier – accelerator mechanism (Samuelson, 1939), which works through the effect of income on investment via firms' cash flows. The second is the predator – prey mechanism that works via transfer of debt service from firms to households in a fashion analogous to the consumer debt model with its transfers between creditor and debtor households.

The permanent solution is given by

(19) $y_p = A_0/\{1 - \{\eta_1\{[1-\varphi] + [1-\gamma]\varphi\} + \alpha_1 + \alpha_2\varphi\gamma]\} - [\eta_1 - \alpha_2]r\Omega\varphi\}$

Differentiating with respect to firms' debt ceiling and the interest rate yields

$\delta y_p/\delta\Omega \gtrless 0$ if $\eta_1 > \alpha_2$ $\quad \delta y_p/\delta r \gtrless 0$ if $\eta_1 > \alpha_2$

Increased debt capacity and higher interest rates increase equilibrium income if households' propensity to spend exceeds firms' propensity to invest out of cash flow. The logic is firms are making larger transfers to households who spend more than do firms.

In the consumer debt model the critical parameters were the difference in propensity to consume of creditor and debtor households, and increases in debt were contractionary because creditors had a lower consumption propensity. In the firm model,

the critical parameter is the difference in households' propensity to consume relative to firms' propensity to invest from cash flows, and the sign can go either way.

The effect of income distribution on equilibrium output ($\delta y_p/\delta\varphi$) is also ambiguous. Increases in the wage share will tend to be expansionary if households have a high propensity to consume (large η_1) and firms have a low propensity to invest out of cash flow (small α_2). In this case shifting income to wages adds to consumption but has little impact on investment spending.

Lastly, the parameters $\eta_1$and α_2, representing the propensities to spend of households and firms, are also critical for stability. The Routh – Hurwicz stability conditions are the same as before (see footnote 8). The critical condition is $1 - A_2 > 0$. This can be violated if η_1 and r are large and α_2 is small. Under these conditions, borrowing by firms raises investment and AD, while firms also make debt service transfers to creditor households that also increase AD. That can produce an explosive outcome as debt-financed investment spending fuels AD, which in turn fuels more debt-financed investment.

IV.c) A combined model with consumer and firm debt

The above firm – household model of the business cycle can be combined with the earlier consumer debt model. One complication is that rather than an aggregate consumption function, there is need for separate consumption functions for creditor and debtor households. Creditor households receive all dividend and debt service payments from both firms and debtor households.

A second complication is that the wage bill, $[1 - \varphi]y_{t-1}$, must be allocated across debtor and creditor households. The appendix provides a model with these features. Since

the two simple models can produce cycles, so too can the combined model as the two debt transfer mechanisms effects can work in the same direction at the same time. The combination of debt service transfer mechanisms can therefore produce cycles of greater amplitude.

The simple conclusion is that debt service transfers, between households and between firms and households, provide a robust mechanism for generating Keynesian debt driven business cycles. This mechanism has great economic common sense and seems especially relevant in light of current real world conditions.

V Financial sector effects in the Keynesian model

Sections III and IV focused on how debt affects AD to create cycles in the goods market. This section explores a range of financial sector mechanisms that can amplify the business cycle. Such financial sector mechanisms are particularly associated with the work of Hyman Minsky (1975, 1982, 1986, 1993).

V.a) Adding asset prices and collateral to the Keynesian model

Minsky emphasizes the significance of asset price movements as a force driving the business cycle. This line of thinking has also been adopted by new Keynesians. Such a feature can be readily incorporated in the Keynesian business cycle model by making corporate and household debt ceilings a function of collateral values, with collateral values in turn depending on asset prices. This provides a channel whereby debt ceilings can fluctuate pro-cyclically, making for cycles of greater amplitude.

For the consumer debt model, equation (7) determining debtor households' debt ceilings can be modified as follows:

(20) $D_t = \lambda V_t + a_3 z y_{t-1}$ $\quad \lambda > 0$

(21) $V_t = p_tE$

(22) $p_t = my_{t-1}$ $\quad m > 0$

where V = value of debtor household assets, p = price of assets. and E = asset units (perhaps equities). Equation (20) determines debt ceilings as a function of collateral values; equation (21) determines collateral values; and equation (22) determines asset prices.

Combining (20), (21) and (22) then yields

(23) $D_t = \lambda V_t + a_3zy_{t-1} = \lambda my_{t-1}E + a_3zy_{t-1}$

Now, debt ceilings fluctuate because of pro-cyclical fluctuation in both asset values and debtor household incomes. The asset value effect enables additional borrowing that amplifies the cycle. When the cycle peaks, output declines and the process also goes into reverse with greater force. This reveals the amplification role of financial practices.

Just as asset price effects can be incorporated in the consumer debt business cycle model, so too they can be incorporated in the firm debt model. The process is entirely analogous. Thus, firm debt ceilings can be modified to depend on the value of firms' collateral (such as real estate), which also fluctuates pro-cyclically along with general asset prices. This requires modifying equation (17) to include an asset value variable similar to equations (21) and (22).

V.b) Financial speculation and irrational exuberance

Another original feature of Minsky's work is that financial markets become increasingly speculative over the course of the cycle. In his terminology, financing moves

from hedge, to speculative, to Ponzi.[12] This framework resonates closely with the notion of "financial exuberance," made famous former Federal Reserve Chairman, Alan Greenspan. The Minskyian schema can be interpreted as one whereby borrowers become increasingly willing to borrow during cyclical expansions, and lenders become increasingly reckless in their willingness to lend. This psychosocial aspect to borrowing and lending constitutes a supplementary feature that adds psychological richness to the basic debt mechanism.

Such Minskyian financial speculation can be incorporated in the Keynesian debt service transfer model by re-specifying the process by which debt ceilings evolve (Palley, 1994). For the household debt model this involves re-specifying equation (7) so that it becomes

(7') $D_t = a_3 z y_{t-1} + a_4 z \Delta y_{t-1}$ $\qquad a_4 > 0$

where $\Delta y_{t-1} = y_{t-1} - y_{t-1}$. Now, changes in the level of income positively affect the debt - income ceiling through the coefficient a_4. Equation (7') embodies a process whereby periods of income expansion make borrowers and lenders more optimistic, enabling increased leverage.

In the original mechanism given by equation (7) the debt ceiling fluctuates pro-cyclically but the leverage ratio is constant. In equation (7') both the debt ceiling and the leverage ratio fluctuate pro-cyclically, potentially making for cycles of greater amplitude.

Solving the model given by equations (3), (4), (5), (6), (7'), (8), and (13) yields a third-order difference equation governing the motion of output, given by

(24) $y_t = b_0 + [b_1 + b_2 z[a_3 + a_4]]y_{t-1} - [b_2 z[a_3 + 2a_4] - b_3 a_3 zr - b_3 a_4 zr]y_{t-2}$

[12] "Hedge" financing has cash flows covering interest and principal payments. "Speculative" financing has cash flows covering interest costs. "Ponzi" financing has cash flows inadequate to cover even interest costs, and investors anticipate making profits via capital gains.

$$+ [b_2a_4z - b_3a_4zr]y_{t-3}$$

Regarding stability properties, the main conclusions are that larger values of b_1, b_2, $|b_3|$, a_3, z, and r, all increase the likelihood of instability for the reasons discussed earlier. Larger values of a_4 also increase the likelihood of instability. The optimism induced by financial exuberance can therefore make for instability, the mechanism being similar to that of "self-fulfilling" prophecy. In the presence of financial exuberance, increases in income translate into accelerated debt expansion, which generates further income expansion. The reverse holds for income contractions. The addition of an "exuberance" effect operating through a_4 can therefore render a model unstable, vindicating Minsky's (1982) descriptive analysis of the makings of financial crises.[13]

Once again, the same mechanism can be incorporated in the firm debt driven model of the cycle by re-specifying equation (17) as follows

(17') $D_t = \Omega_1\varphi y_{t-1} + \Omega_2\varphi\Delta y_{t-1}$ $\Omega_1, \Omega_2 > 0$

Now it is lending to firms that is subject to an exuberance effect, with lenders increasing their willingness to lend as profits rise.

Lastly, not only can Minsky's financial exuberance concept be applied to debt ceilings (i.e. the willingness of banks to lend), it can also be applied to asset prices and collateral values. Thus, asset prices can be a positive function of changes in output so that equation (19) becomes

(19') $p_t = m_1y_{t-1} + m_2\Delta y_{t-1}$ $m_1, m_2 > 0$

An alternative formulation that yields a similar impact is to make the coefficient m_1 a positive function of output. However, that also renders the model non-linear.

[13] Minsky's thinking has a temporal dimension to it not captured in equation (7'). This temporal dimension has the coefficient a_4 change over time. This can be captured by making a_4 a function of income so that $a_4 = f(y_t)$ where $f' > 0$. However, that renders the model non-linear.

V.c) Gradual adjustment of debt positions

So far it has been assumed that borrowers are always at their debt ceilings. In practice borrowers may adjust slowly to their ceilings, reflecting the fact that it takes time to plan expenditures. In this case debt levels will be governed by a gradual adjustment mechanism such as

(25) $D_t - D_{t-1} = h[D_t^* - D_{t-1}]$ $\quad 0 < h < 1$

where D_t^* = desired debt, and h is the coefficient of adjustment. For households, the level of desired debt is the household debt ceiling (equation (7) or (7')). For firms, it is the firm debt ceiling (equation (17) or (17')).

Equation (25) can then be combined with the two core models. For the basic consumer debt model described above this yields a second-order difference equation determining output given by

(26) $y_t = b_0 + [b_1 + b_2a_3zh]y_{t-1} + [b_3r - b_2h]D_{t-1}$

(27) $D_t = ha_3zy_{t-1} + [1 - h]D_{t-1}$

In the event that h = 1, the model is the same as the basic household debt model As in that model, increases in b_1 and increases in the absolute value of b_3, both increase the likelihood of instability. Increases in h also increase the likelihood of instability.

Unlike collateral value effects and irrational exuberance effects, gradual adjustment of borrowing is a stabilizing feature of the economy. The logic is that gradual adjustment means that increases in income generate smaller subsequent changes in borrowing and AD, therefore reducing the likelihood of a cumulative unstable expansion. The same holds for contractions in income, with gradual adjustment reducing the likelihood of a cumulative contraction.

V.d) Financial institutions and endogenous money

The models described above are akin to loanable funds models of the credit market. Thus, creditors are assumed to lend directly to borrowers, and borrowers make debt service payments directly to creditors. Post Keynesian economics emphasizes that money is endogenously created by banks. These features (financial institutions and endogenous money) can be added to the Keynesian model and they have two significant effects.[14]

First, adding financial intermediaries (FI) creates a filter between lenders and borrowers. That is because interest payments are made to FIs, and the extent to which they are received by creditor households depends on the distribution policies of FIs. To the extent that FIs pay out less than one hundred percent, this is tantamount to an additional leakage of AD out of the circular flow. However, this leakage can be offset if FIs lend out this interest income.

Second, whereas a loanable funds construction of the credit process views it in terms of transferring existing money balances between lenders and creditors, an endogenous money perspective views the credit process as involving the creation of new money balances. As a result, endogenous money lending has a larger effect on AD because there is no need for lenders to forgo spending.

Both of these effects are amplifying effects. Endogenous money amplifies the impact of credit creation on AD, while retention of interest payments by banks amplifies the negative AD effect of debt service transfers from debtors to creditors.

[14] Jarsulic (1989) presents an investment driven business cycle model with endogenous money. His model focuses on the implications of endogenous money for interest rates. It has no distinction between bank-financed and bond-financed lending, and nor does it have a distinction between the propensities to spend of debtors and creditors.

Palley (1997a) presents a consumer debt business cycle model with both endogenous money and a loanable funds credit market. The equations of the model are given by:

(28) $y_t = a_0 + c_{1,t} + c_{2,t}$

(29) $c_{1,t} = a_1[zy_{d,t-1} - S_t] + \Delta D_{1,t} + \Delta D_{2,t}$ $\quad 0 < a_1 < 1, 0 < z < 1$

(30) $c_{2,t} = a_2\{[1-z]y_{d,t-1} + S_t - \Delta D_{2,t}\}$ $\quad 0 < a_2 < 1, a_1 > a_2 \quad [1-z]y_{d,t} + S_t - \Delta D_{2,t} > 0$

(31) $y_{d,t} = [1 - t]y_t$

(32) $\Delta D_{1,t} = D_{1,t} - D_{1,t-1}$

(33) $\Delta D_{2,t} = D_{2,t} - D_{2,t-1}$

(34) $D_{1,t} = a_3 zy_{d,t-1} + a_4 z\Delta y_{d,t-1}$ $\quad a_3 > 0, a_4 > 0$

(35) $D_{2,t} = a_5 D_{1,t}$ $\quad a_5 > 0$

(36) $\Delta y_{d,t-1} = y_{d,t-1} - y_{d,t-2}$

(37) $St = r[D_{1,t-1} + D_{2,t-1}]$

where y = level of real output, y_d = after tax income, c_1 = real consumption of debtor households, c_2 = real consumption of creditor households, a_0 = autonomous expenditures, a_1 = propensity to consume of debtor households, a_2 = propensity to consume of creditor households, z = share of income received by debtor households, t = tax rate, r = real interest rate, ΔD_1 = change in real bank debt (indirect finance), ΔD_2 = change in real credit market debt (direct finance), S = level of real interest service payments on total debt, D_1 = level of real bank debt, D_2 = level of real credit market debt, and Δy_d = change in the level of after-tax real income.

The economic logic is entirely analogous to the earlier model of consumer borrowing. The innovation is the introduction of a distinction between bank borrowing

(ΔD_1) and credit market borrowing (ΔD_2). Bank borrowing and credit market borrowing have differential impacts on consumption of creditors, reflecting the nature of endogenous money. Endogenous credit money allows banks to lend without affecting the consumption of their owners since bank lending creates new money. This contrasts with finance provided directly through credit markets, which involves the transfer of existing money balances to borrowers.

Inspection of equations (29) and (30) reveals the more expansionary effect of bank (indirect) finance. Such finance adds a full dollar to aggregate spending, whereas credit market (direct) finance only increases AD by $a_1 - a_2$ which represents the difference in the propensities to consume of debtors and creditors. Indirect finance creates a dollar of spending, whereas direct finance redistributes a dollar of spending.

Substituting equations (29) and (30) into (28) yields

(38) $y_t = a_0 + b_1 y_{d,t-1} + \Delta D_{1,t} + [1 - a_2]\Delta D_{2,t} + b_2 S_t$

where $b_1 = \{a_1 z + a_2[1 - z]\}$ and $b_2 = [a_2 - a_1] < 0$. Increases in bank borrowing ($\Delta D_{1,t} > 0$) increase AD dollar for dollar since banks create money that is then spent. These expenditures enter the circular flow of money income and support further economic activity and consumption. The reverse holds for repayments of bank loans which destroy money. Increases in direct finance are also expansionary, but less so than increases in bank lending. Direct finance transfers money income claims from creditors to debtors, and the net increase in AD is equal to the difference in the propensities to consume of debtors and creditors ($[1-a_2]\Delta D_{2,t}$).

The particular solution for the model is given by

(39) $y^* = a_0/\{1 - b_1[1 - t] + b_2 r[1 + a_5]a_3 z[1 - t]\}$

Partial differentiation of (39) generates the following comparative static effects: (i) A higher interest rate (r) reduces equilibrium income since it increases the income transfer from debtor to creditor households. (ii) Increases in the allowable debt-income ratios (a_3 and a_5) also reduce equilibrium income. Though borrowing gives an initial boost to AD, this positive effect is dominated in the long run by the increased negative debt stock effect. (iii) Shifts in the distribution of income (z) toward debtor households have an ambiguous effect on income. On one hand shifts in distribution toward debtor households have a positive effect owing to debtors' higher MPC: on the other hand they have a negative debt stock effect by allowing debtors to take on larger equilibrium debt burdens.

As the share of bank debt in total debt increases, the amplitude of the cycle increases and the critical debt - income ratio at which the model becomes unstable falls. Bank debt has a greater impact on the economy, reflecting the fact that it is created without diminishing the disposable income of creditors. Similarly, it is extinguished without increasing the disposable income of creditors. This feature is destabilizing. From a policy standpoint, it suggests that monetary authorities may find it useful to use counter-cyclical regulatory controls that discourage bank lending in booms, and encourage bank lending in slumps.

V.e) Endogenous pro-cyclical interest rates

Another possible extension of the Keynesian model is inclusion of endogenous pro-cyclical movements of interest rates – perhaps via a leaning against the wind interest rate policy reaction function.

Such interest rate policy can serve to smooth the cycle by offsetting the AD impact of borrowing during the upturn and loan repayments during the downswing.

Thus, higher rates during the upturn reduce debtor disposable income at a time when they are borrowing and adding to AD. Similarly, lower rates in a downturn increase their disposable income at a time when they are repaying debt and lowering AD.

VI Aggregate supply and new Keynesian debt driven business cycles

The Keynesian approach to debt and the business cycle emphasizes the impact of borrowing and debt on the flow of AD, including investment spending. The new Keynesian approach (Bernanke et al., 1999; Kiyotaki and Moore, 1997) emphasizes the impact of debt and borrowing on capital accumulation and the capital stock, which then affects aggregate supply (AS).

The starting point for new Keynesian models is that firms need finance to fund capital accumulation. However, financial markets are beset by asymmetric information problems, with lenders having less information than borrowers. Because of these information imperfections, lenders impose collateral requirements to screen lenders and appropriately align borrower incentives. This means credit limits are affected by the price of collateralized assets. Asset price fluctuations therefore tighten and loosen credit limits, which in turn tightens and loosens financial constraints on firms' ability to produce.

The important feature about the new Keynesian approach is that credit constraints operate to restrict firms' ability to produce. The effects of credit shocks therefore operate on AS rather than AD.

Bernanke and Gertler (1996) construct a model in which a temporary negative productivity shocks lower firms' cash flows, thereby reducing firms' ability to finance investments through retained earnings. The shock also reduces net worth, raising the

average external cost of finance, which reduces investment. Lower investment then lowers productive capacity and cash flows in subsequent periods, amplifying and propagating the initial shock.

Kiyotaki and Moore (1997) tell a story in which the initial productivity shock lowers the value of collateral, which raises borrowing costs. This leads to less production, which further lowers the value of capital, thereby propagating the shock through time. In this model, asset prices are the critical transmission channel. Diminishing marginal product of capital also plays an important role. As investment falls, the capital stock shrinks and the marginal product of capital rises, thereby raising asset prices which provides a mechanism for reversing the downturn.

This process can be captured by the following simple non-linear structure

$$(40)\quad y_t = f(K_t)$$
$$\qquad\qquad +$$
$$(41)\quad K_t = K(K_{t-1}, D_{t-1})$$
$$\qquad\qquad +\quad -$$
$$(42)\quad D_t = D(K_{t-1}, D_{t-1})$$

Where y = output, K = capital stock, and D = level of firms' debt. Signs above functional arguments represent first partial derivatives. Equation (49) is the key new Keynesian equation as it makes the economy supply-side driven. According to this equation the level of output is determined by the level of the capital stock, and debt effects impact output via their effect on the capital stock. Equation (41) determines the evolution of the capital stock. It is positively influenced by last period's capital stock which impacts income and saving, and negatively influenced by last period's level of debt which constrains investment spending. Equation (42) then determines the evolution of debt. A higher

capital stock means more income and collateral to support additional borrowing, but higher debt acts as a constraint on new borrowing.

Equations (41) and (42) embody a predator – prey mechanism in which the capital stock feeds debt, and debt preys on the capital stock by reducing investment. Thus, a higher capital stock facilitates borrowing to finance investment, which raises debt. But a higher level of debt tightens the finance constraint and restricts investment, thereby lowering the capital stock. This shows the predator – prey mechanism also applies in new Keynesian models.[15]

VII Conclusion: which model is empirically more plausible?

Both the Keynesian and new Keynesian approaches to debt-driven business cycles have logically coherent theoretical foundations and they share common financial sector amplification mechanisms. However, they have fundamentally different cycle forcing mechanisms.

The Keynesian model identifies debt driven AD fluctuations as the cause of the business cycle. Contrastingly, the new Keynesian model identifies debt driven AS fluctuations as the cause of the cycle. Firms become debt constrained and are unable to invest. This reduces available productive capacity in subsequent periods, resulting in reduced output.

These alternative forcing mechanisms generate sharply different empirical implications, and the new Keynesian interpretation is glaringly at odds with the stylized facts of the cycle. First, real world cycles are characterized by significant fluctuations in

[15] It may also be possible to introduce an AS channel into the Keynesian model. Consider an economy in which production take time and firms produce on the basis of expected future AD (Palley, 1997b). Firms' abilities to produce for future sale may be constrained if they lack finance and are burdened by debts. Additionally, high levels of consumer indebtedness will reduce expected AD so that firms cut back on production. In such a Keynesian economy debt burdens will operate on both AS and AD.

capacity utilization, with downturns being marked by excess capacity rather than capacity shortages. This is directly contrary to the predictions of the new Keynesian model, which has output downturns being due to capital stock shortages.

Second, the new Keynesian model identifies capital stock fluctuations as the cause of the cycle, yet investment fluctuations do not affect the capital stock enough to explain observed output fluctuations. For instance consider an economy in which the capital/output ratio is 4 and the investment output ratio is 0.2. This implies a capital/investment ratio of 20. A 20 percent decrease in investment decreases the capital stock by 1 percent, which decreases output by 0.25 percent. The implication is that explaining output fluctuations as the result of capital stock effects requires huge implausible fluctuations in investment.

In reality, output fluctuates but the capital stock barely moves. That suggests it is not capital stock effects operating on AS that drive the business cycle. The new Keynesian approach is trapped by a logic that requires second-order capital stock fluctuations to drive first-order output fluctuations. This contrasts with the Keynesian approach, which identifies first order fluctuations in investment and consumption spending to explain first order changes in output. The stylized facts of the business cycle therefore strongly support a Keynesian interpretation rather than a new Keynesian one.

Appendix

This appendix provides a comprehensive Keynesian model of a debt-driven business cycle. The model assembles the different components analyzed in the main body of the paper. It includes household and firm debt, collateral effects, and financial market effects associated with distinguishing between direct and indirect lending, lender exuberance, and gradual adjustment of borrowing. Households are assumed to borrow from banks, while firms borrow directly in credit markets. Additionally, there is a government sector, which taxes households and firms at different rates, and runs a balanced budget. The equations of the model are as follows:

(A.1) $y_t = g_t + c_{1,t} + c_{2,t} + I_t$ [Aggregate Demand]

Household sector:

(A.2) $c_{1,t} = a_1\{[1-t_H]z[1-\phi]y_{t-1} + [1-\beta][1-\gamma][1-t_F]\varphi y_{t-1} - S_{H,t}\} + \Delta D_{1,t}$ [Debtor cons.]
$0 < a_1 < 1,\ 0 < z < 1$

(A.3) $c_{2,t} = a_2\{[1-t_H]\{[1-z][1-\phi]y_{t-1} + \beta[1-\gamma][1-t_F]\varphi y_{t-1} + S_{H,t} + S_{F,t}\} - \Delta D_{2,t}\}$ [Creditor cons.]
$0 < a_2 < 1,\ a_1 > a_2,\ [1-t_H]\{[1-z]\,[1-\phi]y_{t-1} + S_{H,t} + S_{F,t}\} - \Delta D_{2,t} > 0$

(A.4) $S_{H,t} = rD_{1,t-1}$ [Debtor household interest payments]

(A.5) $S_{F,t} = rD_{2,t-1}$ [Firms' interest payments]

(A.6) $\Delta D_{1,t} = D_{1,t} - D_{1,t-1} = h[D_{1,t}^{*} - D_{1,t-1}]$ [Household bank borrowing\repayment]
$0 < h < 1$

(A.7) $D_{1,t}^{*} = [1-t_H]\{z[1-\phi]\{a_3 y_{t-1} + a_4 \Delta y_{t-1}\} + [1-\beta][1-\gamma][1-t_F]\varphi y_{t-1}\} + \lambda\beta V_t$
$a_3 > 0,\ a_4 > 0,\ \lambda > 0$ [Household credit ceiling]

(A.8) $V_t = p_t E$ [Value of household collateral]

(A.9) $p_t = m_1 y_{t-1} + m_2 \Delta y_{t-1}$ $m_1, m_2 > 0$ [Equity prices]

Business sector:

(A.10) $I_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 CF_t$ [Investment Equation]

(A.11) $CF_t = \gamma[1-t_F]\varphi y_{t-1} - rD_{2,t-1} + \Delta D_{2,t}$ [Firms' cash flows]

(A.12) $\Delta D_{2,t} = D_{2,t} - D_{2,t-1} = k[D_{2,t}^{*} - D_{2,t-1}]$ [Firm credit market borrowing\repayment]
$0 < k < 1$

(A.13) $D_{2,t}^{*} = [1-t_F]\{\Omega_1 \varphi y_{t-1} + \Omega_2 \varphi \Delta y_{t-1}\}$ $\Omega_1, \Omega_2 > 0$ [Firm credit market loan ceiling]

Government sector:

(A.14) $g_t = t_H\{[1-\phi]y_t + [1-\gamma]\varphi y_{t-1} + S_{F,t}\} + t_F[\varphi y_{t-1} - S_{F,t}]$ [government budget constraint]

where y = level of real output
c_1 = real consumption of debtor households
c_2 = real consumption of creditor households
I = real investment spending
g = real government spending
a_1 = MPC of debtor households
a_2 = MPC of creditor households
t_H = tax rate on household incomes
z = share of wage income received by debtor households
$1 - \varphi$ = wage share
$1 - \gamma$ = firms' dividend payout ratio
β = share of equity owned by debtor households
r = real interest rate
ΔD_1 = change in the level of real household bank debt
S_H = level of household real interest service payments on bank debt
D_1 = level of real bank debt of debtor households
D_1^* = households' desired level of bank debt
S_F = level of firms' real interest service payments on credit market borrowing
V = value of debtor household assets
p = price of assets
E = asset units (perhaps equities)
CF = real cash flows
φ = profit share
γ = firms' profit retention ratio
$\Delta D_{2,t}$ = firms' borrowing or repayment
D_2 = level of firms' real credit market debts
D_2^* = firms' desired level of debt
Ω = debt-to-profit ratio.
t_H = tax rate on households
t_F = tax rate on firms

Equation (A.1) defines aggregate demand. Equation (A.2) determines the consumption of debtor households. They receive a portion of the wage bill and a share of dividend payouts, and make interest payments on bank borrowings. They also borrow from banks or repay existing loans. Equation (A.3) determines the consumption of creditor households. In addition to receiving a share of the wage bill and dividend payouts, they receive bank interest and interest payments from firms. Banks are assumed to pay out all of their interest income. Loans to firms are made through the credit market and reduce the consumption of creditor households. Equations (A.4) and (A.5) determine the interest payments of debtor households and firms. Equation (A.6) determines household new borrowing or loan repayments. The adjustment of household debt is governed by a gradual adjustment mechanism. Equation (A.7) determines household's bank borrowing ceiling borrowing. This is a multiple of after tax total income, an income exuberance effect, and equity collateral. Equation (A.8) determines the value of equity wealth.

Equation (A.9) determines the price of equities, and includes an equity price exuberance effect.

Equations (A.10) – (a.13) describe the business sector. Equation (A.10) determines investment spending, which is a positive function of cash-flow. Equation (A.11) determines cash-flow, which is a negative function of debt service payments and a positive function of new borrowing. Equation (A.12) determines new borrowing, which is governed by a gradual adjustment mechanism. Equation (A.13) determines firms' debt ceilings, which are a multiple of the after-tax profit share and include a lender exuberance effect.

Finally, equation (A.14) is the government budget constraint. Spending is constrained to be equal to tax revenues. Taxes are levied on households' total income and firms' profits, and households and firms are taxed at different rates.

The reduced form of equations (A.1) – (A.14) is a complicated second order difference equation that incorporates all the mechanisms discussed in the text. These include debt service transfers between debtor and creditor households, debt service transfers between debtor firms and creditor firms, and a household stock price collateral effect that raises households' borrowing ceiling. These mechanisms can support a business cycle as discussed in the text.

References

Bernanke, B., Gertler, M., and Gilchrist, S., "The Financial Accelerator in a Quantitative Business Cycle Framework," in Taylor & Woodford (eds.), Handbook of Macroeconomics, Volume 1, Elsevier Science, p. 1341 – 93, 1999.

----------, "The Financial Accelerator and the Flight to Quality," Review of Economics and Statistics, 78 (1996), 1 – 15.

Caskey, J., and S. Fazzari, "Aggregate Demand Contractions with Nominal Debt Commitments: Is Wage Flexibility Stabilizing?" Economic Inquiry, 25 (October, 1987), 583-97.

Dutt, A.K., "Maturity, Stagnation and Consumer Debt: A Steindlian Approach," Metroeconomica, 57 (July 2006), 339- 364.

----------, "Consumer Debt, Growth and Income Distribution," unpublished manuscript, Department of Economics, University of Notre Dame, South Bend, IN, March 2003.

Fazzari, S., R.G.Hubbard, and B.C.Petersen, "Financing Constraints and Corporate Investment activity," Brookings Papers on Economic Activity, 1 (1988), 141 - 95.

Fisher, I., "The Debt-Deflation Theory of Great Depressions," Econometrica, 1 (October 1933), 337-57.

Friedman, M., A Theory of the Consumption Function, Princeton, New Jersey: Princeton University Press, 1956.

Gallegati, M., and Gardini, L., "A Non-linear Model of the Business Cycle with Money and Finance," Metroeconomica, 42 (1991), 1 – 32.

Jarsulic, M., "Endogenous Credit and Endogenous Business Cycles," Journal of Post Keynesian Economics, (1989) 35 – 48.

Kalecki, M., "The Principle of Increasing Risk," Economica, 4 (1937), 440-47.

Kiyoyaki, N., and Moore, J., Credit Cycles, Journal of Political Economy, 105 (1997), 211 – 48.

Minsky, H.P., John Maynard Keynes, New York: Columbia University Press, 1975.

----------, Can it Happen Again? Armonk, N.Y.: M.E.Sharpe, 1982.

----------, Stabilizing an Unstable Economy, New Haven: Yale University Press, 1986.

----------, “The Financial Instability Hypothesis,” in Arestis P. and Sawyer M. (eds), Handbook of Radical Political Economy, Aldershot: Edward Elgar, 1993.

Mott, T., “Kalecki’s Principle of Increasing Risk and the Relation Among Mark-up Pricing, Investment Fluctuations, and Liquidity Preference,” Economic Forum, XV (Winter 1985-86), 65 – 76.

Palley, T.I , "General Disequilibrium Analysis with Inside Debt," Journal of Macroeconomics, 21 (Fall 1999), 785 - 804.

----------, "Endogenous Money and the Business Cycle," Journal of Economics, 65 (1997a), 133 – 149.

----------, "Expectations, the Production Period, and Keynes' Aggregate Supply Schedule," The Manchester School of Economic and Social Studies, LXV (June 1997b), 295-309.

----------, “Inside Debt, Aggregate Demand, and the Cambridge Theory of Distribution,” Cambridge Journal of Economics, 20 (July 1996), 465 – 74.

----------, “Debt, AD and the Business Cycle: A Model in the Spirit of Kaldor and Minsky,” Journal of Post Keynesian Economics, 1994.

Samuelson, P.A., “Interactions Between the Multiplier Analysis and the Principle of Acceleration,” The Review of Economic and Statistics, 21 (May 1939), 75 – 78.

Semmler, W., and Franke, R., “Debt Financing of Firms, Stability, and Cycles in a Dynamical Macroeconomic Growth Model,” in E. Nell and W. Semmler (eds.) Nicholas Kaldor and Mainstream Macroeconomics, Macmillan, London, 1991.

Skott, P., “Theoretical and Empirical shortcomings of the Kaleckian Investment Function,” Department of Economics Working Paper 2008 – 11,University of Massachusetts, Amherst, MA, 2008.

----------, “On the Modeling of Systemic Financial Fragility,” in A.K. Dutt (ed.), New Directions in Analytical Political Economy, Edward Elgar: Cheltenham, 1994.

Stiglitz, J.E., and Weiss, A., “Credit Rationing in Markets with Imperfect Information,” American Economic Review, 71 (1981), 393 – 410.

Tobin, J., Asset Accumulation and Economic Activity, Chicago: Chicago University Press, 1980.

	Balance-sheet congestion mechanism	**Debt-service transfer mechanism**
Keynesian closure, y = AD	Minsky, 1982 Gallegati & Gardini, 1991 Semmler & Franke, 1991 Skott, 1994	Palley, 1994, 1996, 1997
New Keynesian closure, y* = AD	Bernanke et al., 1999 Kiyotaki and Moore, 1997	

Figure 1. Taxonomy of debt-driven business cycle models (y = output, y^* = potential output, AD = aggregate demand).

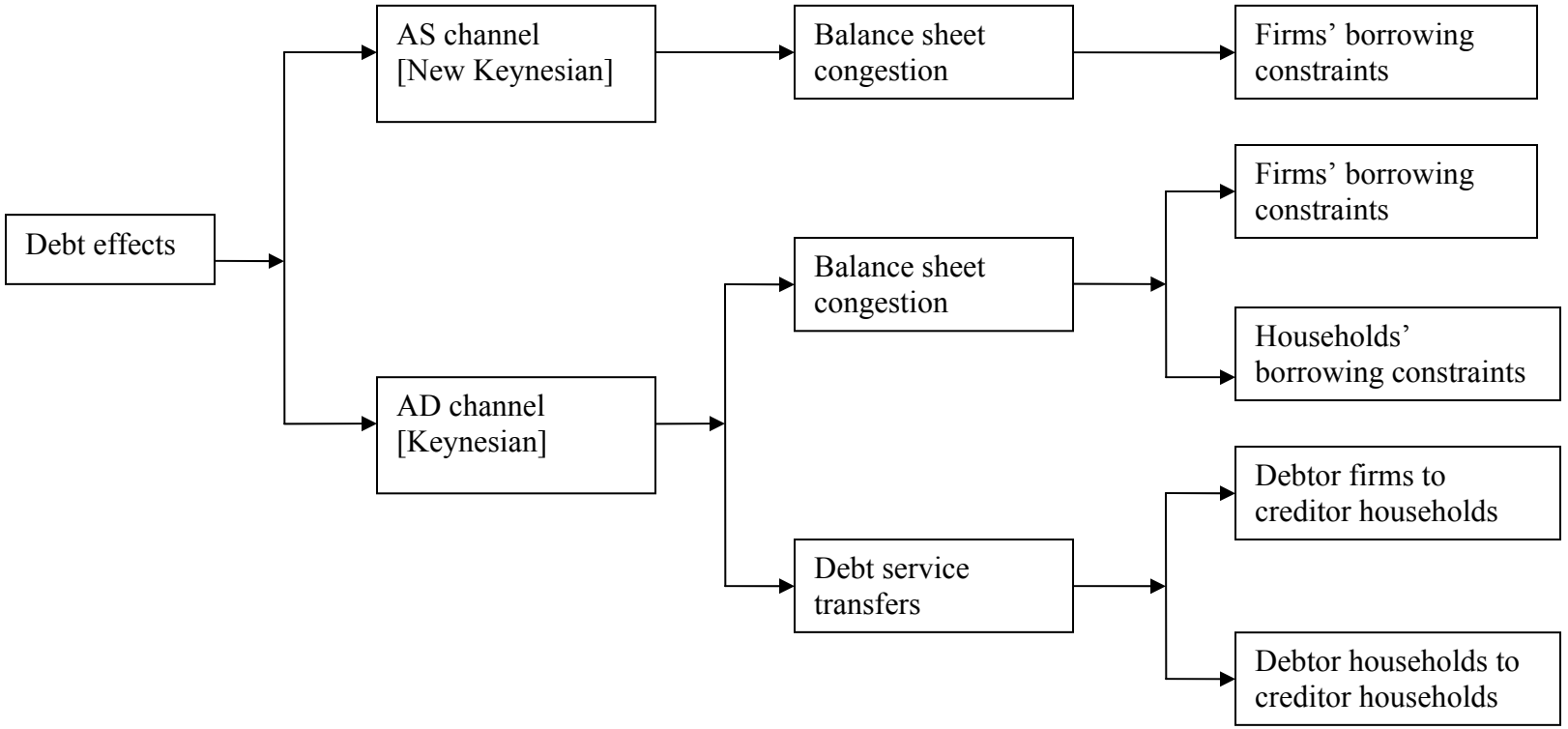

Figure 2. Comparison of the ways in which debt impacts economic activity in Keynesian and New Keynesian models of the business cycle.

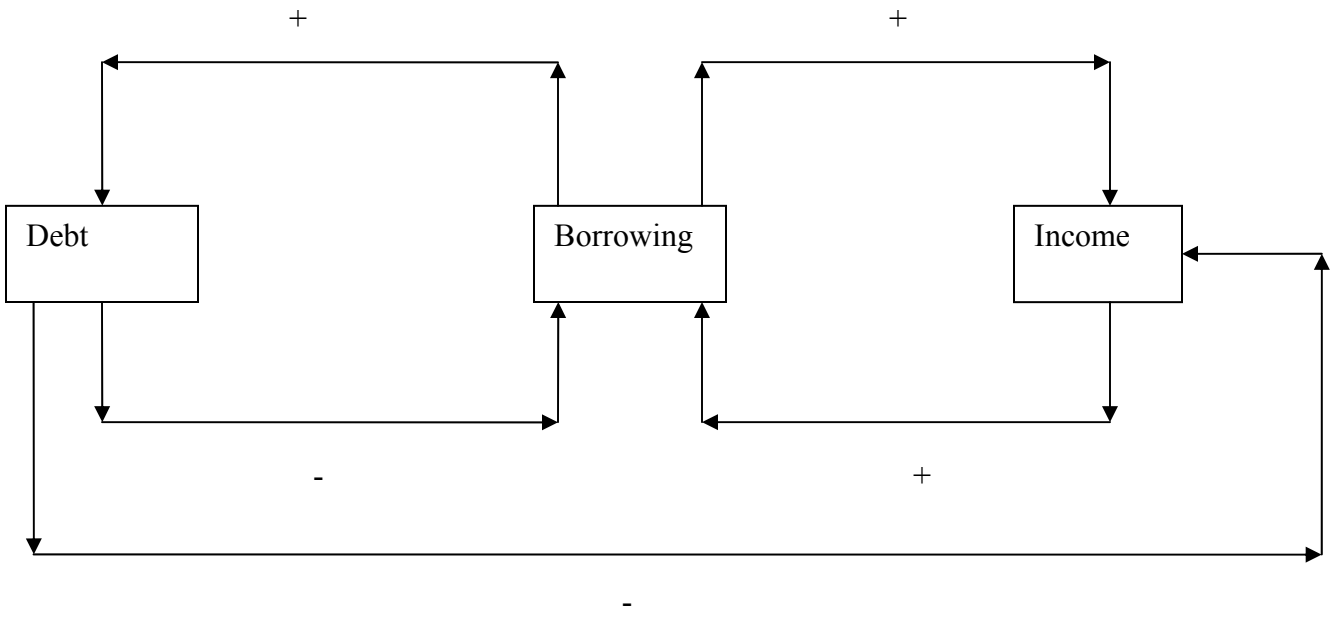

Figure 3. Shows the predator – prey structure of the interaction between debt and income. Higher income feeds borrowing and debt, but higher debt reduces borrowing and income.