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The macroeconomic implications of zero growth: a post-Keynesian approach

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De-growth, zero growth and/or green growth? Macroeconomic implications of ecological constraints

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1. Motivation & previous literature

- Environmental constraints on growth: is it possible to decouple economic growth from negative environmental impacts? Is it possible to keep growing while respecting planetary boundaries at the same time?
  - Some evidence of relative decoupling, but not enough to meet targets of Paris agreement (Holz et al., 2018; Parrique et al 2019).
  - Hence, there has been an increased interest in analysing a non-growing or de-growing economy as a possibility to tackle the climate crisis and other environmental constraints (Jackson 2009, Kallis 2011, van den Bergh/Kallis 2012, Victor 2011).

1. Motivation & previous literature

- From a post Keynesian approach, several authors have analysed different aspects of low, zero or de-growing economies:
  - Fontana/Sawyer (2013, 2014, 2016): integrate ecological constraints (and the associated lower growth rates) into post-Keynesian macroeconomics.
  - Rosenbaum (2015): stability of zero growth in a Kaleckian model. But has some inconsistencies as pointed out by Monserand (2020).
  - Lange (2018): macroeconomic analysis of the conditions for sustainable economies without growth, no stability analysis
  - Monserand (2019): stability of degrowth transition in a neo-kaleckian model, no financial stability analysis

1. Motivation & previous literature

- Others have concentrated on the issue of growth imperatives:
  - Richters/Siemoneit (2017): review of several models and find that a stationary state with positive profits and interest rates is possible as long as no sector is running financial deficits or surpluses, no retained profits, balanced government budgets and saving out of household income is compensated for by consumption out of wealth. This applies to:
    - Cahen-Fourot/Lavoie (2016): sfc stationary economy and an endogenous determination of debt in the stationary state.
    - Jackson/Victor (2015): sfc model with a differentiated banking sector, including a central bank and commercial banks.
    - Berg et al. (2015): combine a sfc model with an input-output approach.

1. Motivation & previous literature

- Our objective: contribute to the debate of long-run stability of zero growth with positive profits and a positive rate of interest in a capitalist, monetary production economy.
- We aim at clarifying the requirements for the macroeconomic stability of a zero-growth economy in a systematic way. We begin analysing the requirements for zero growth from a national income accounting perspective. Then, we complement the latter with a Monetary Circuit approach, and finally we analyse the short- and long-run stability of zero growth within a Kaleckian autonomous demand-led growth model.

2. Implications of zero growth from an accounting perspective

Goods market:

- Effective demand is sufficient to generate and to reproduce stationary output over time, even with zero net investment.

$$Y = C_R + C_W + G + I + Ex - Im \qquad (1)$$

- For a stationary economy at some target level of output consistent with ecological sustainability (Y^T), we need $I = 0$:

$$Y^T_{I=0} = C_R + C_W + G + Ex - Im \qquad (2)$$

2. Implications of zero growth from an accounting perspective

Financial market:

- The financial structure of a stationary economy should not generate systemic financial instability.
  - ➢ To avoid ever rising debt-income ratios of any sector, the financial balances of each macroeconomic sector:
    - workers' households
    - rentiers' households
    - corporate sub-sector
    - public sector
    - external sector

  should be balanced at the stationary target level of output/income

2. Implications of zero growth from an accounting perspective

Financial market:

$$Y = C_R + C_W + G + I + Ex - Im = \Pi_F^n + T_F + R^n + T_R + W^n + T_W \qquad (3)$$

$$\begin{aligned}&\Pi_F^n - I + R^n - C_\Pi + W^n - C_W + T_W + T_F + T_R - G + Im - Ex \\ &= FB_F + FB_R + FB_W + FB_G + FB_f \\ &= 0\end{aligned} \qquad (4)$$

Or alternatively:

$$S = \Pi_F^n + S_R + S_W$$

$$T = T_W + T_F + T_R$$

$$S - I + T - G + Im - Ex = FB_P + FB_G + FB_f = 0 \qquad (5)$$

Each FB must be equal to zero, not only the sum

2. Implications of zero growth from an accounting perspective

Financial market:

The fact that each sectors' financial balance must be equal to zero implies:

- retained profits must be zero ($I=\Pi_F^n=0$).
- saving out of rentiers' and workers' net incomes have each to be zero ($S_R=S_W=0$)
- governments will have to run a balanced budget ($T-G=0$)
- current account balance has to be equal to zero ($Ex-Im=0$).

2. Implications of zero growth from an accounting perspective

Financial market:

For the stationary state target level of output the latter implies:

$$Y^{T}_{I=0} = C_R + C_W + G = R^n + W^n + T_R + T_W = R^n + W^n + T \qquad (6)$$

From a national accounting perspective, we thus have that total net profits are equal to rentiers' net income and rentiers' consumption:

$$\Pi^n = R^n = C_R \qquad (7)$$

3. A monetary circuit for a closed zero growth equilibrium economy

We now complement the accounting perspective with a monetary circuit approach. From the previous analysis, we know the following must hold for a for a zero-growth equilibrium economy with initial government debt and thus interest payments of the government to the rentiers (iB_{GR}):

$$Y^T_{I=0} + iB_{GR} = C_R + C_W + G + iB_{GR} = R^n + W^n + T_R + T_W = R^n + W^n + T. \qquad (9)$$

$$I = S = \Pi_F + S_R + S_W = 0$$

$$\Pi_F = 0,\ S_R = 0,\ S_W = 0 \qquad (10)$$

$$C_R = R - T_R = R^n. \qquad (11)$$

Rentiers spend net income/net profits (they own the firms)

$$C_W = W - T_W = W^n. \qquad (12)$$

Workers spend net wages

$$T_R + T_W = T = G + iB_{GR} \qquad (13)$$

Governments have a balanced budget

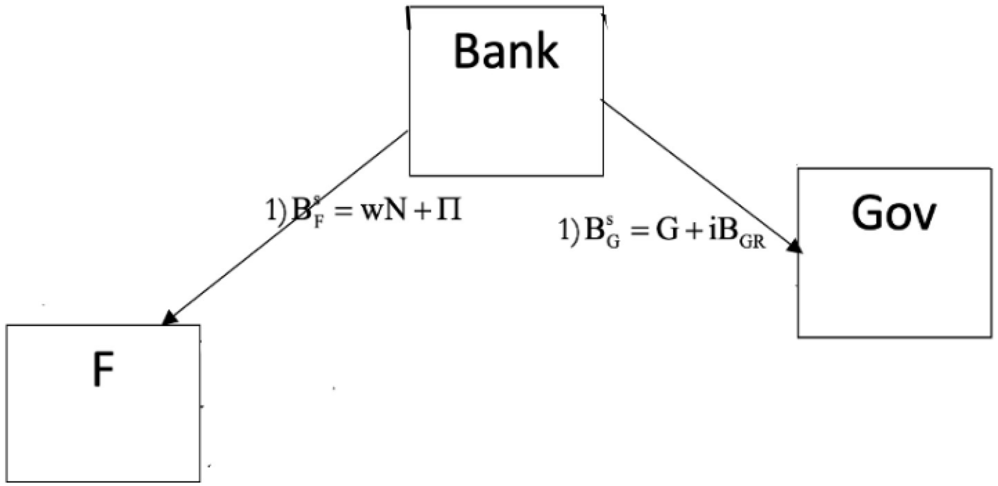
3. A monetary circuit for a closed zero growth equilibrium economy

Table 1: Balance sheet matrix for a zero growth closed economy with a government and a commercial bank

	Workers' households	Rentiers' households	Firms	Government	Banks	Σ
Deposits		$+D_R$			$-D_R$	0
Loans		$+B_{GR}$		$-(B_{GR}+B_{GB})$	$+B_{GB}$	0
Equity		$+E_R$	$-E_R$			
Capital			pK			pK
Σ	0	$+E_R+B_{GR}+D_R$	$+E_F$	$-(B_{GR}+B_{GB})$	0	$pK = E_F+E_R$

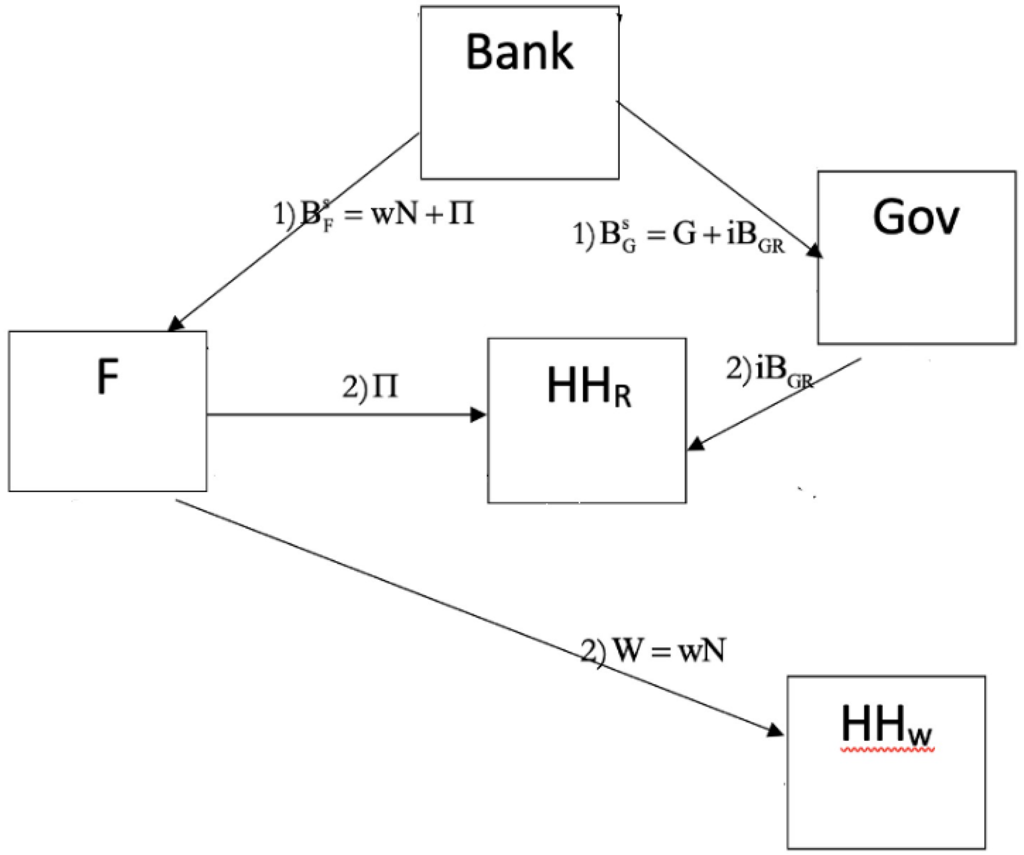
3. A monetary circuit for a closed zero growth equilibrium economy

Phase 1: initial finance



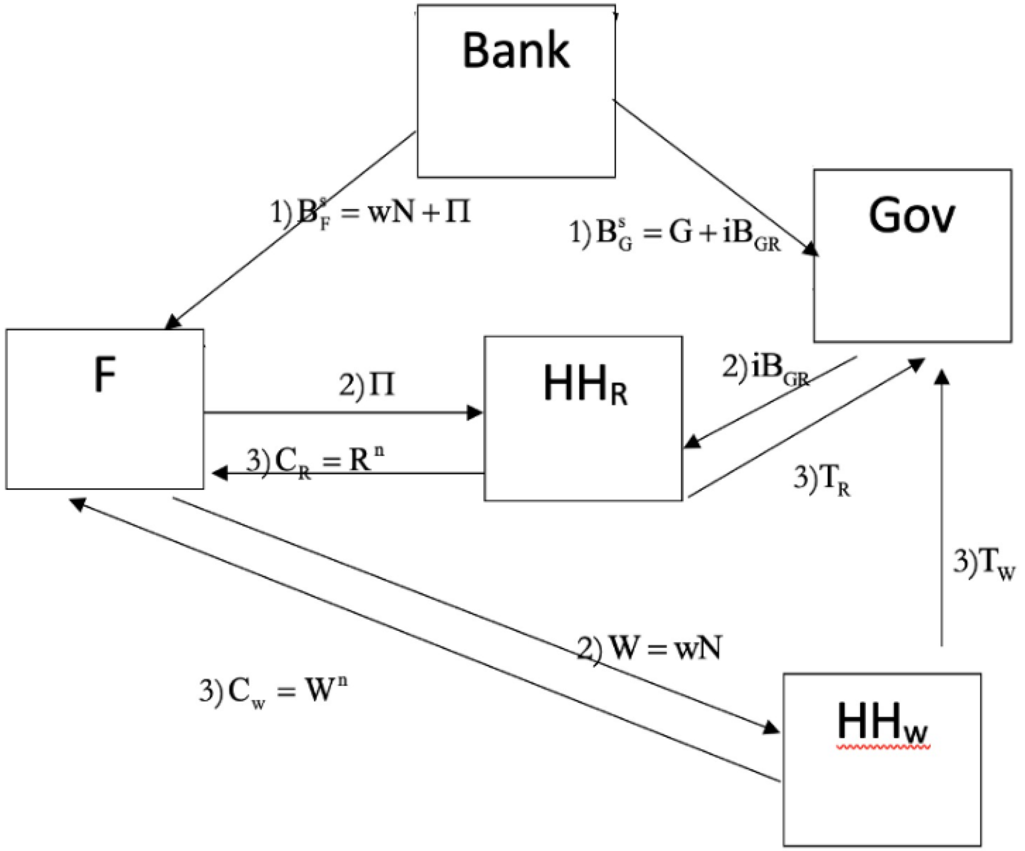
3. A monetary circuit for a closed zero growth equilibrium economy

Phase 2: income payments in advance



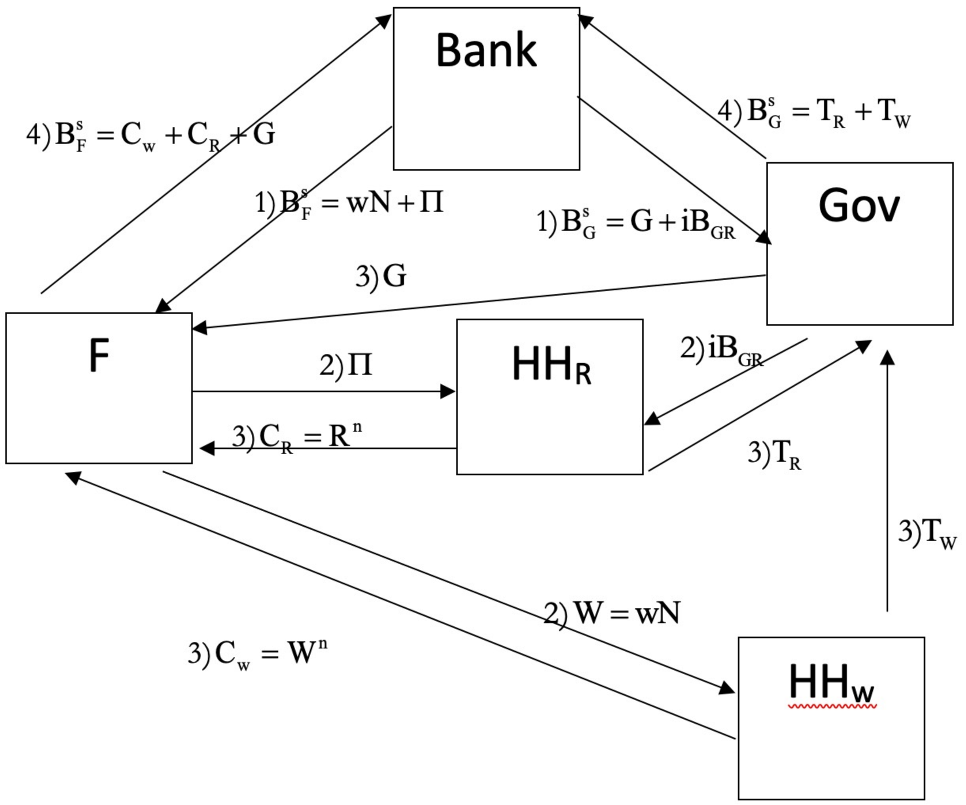
3. A monetary circuit for a closed zero growth equilibrium economy

Phase 3: income expenditures



3. A monetary circuit for a closed zero growth equilibrium economy

Phase 4: Repayment



3. A monetary circuit for a closed zero growth equilibrium economy

Table 2: Transaction flow matrix for a zero growth closed economy with a government and a central bank							
	Workers' house-holds	Rentiers' households	Firms' current	Firms' capital	Government	Banks	Σ
Taxes	$-T_W$	$-T_R$			$+T_W+T_R$		0
Government consumption			+G		-G		0
Consumption	$-C_W$	$-C_R$	$+C_W+C_R$				0
Investment							0
Wages	+W		-W				0
Retained profits							0
Distributed profits/dividends		+Π	-Π				
Interest payments		$+R_G$			$-R_G$		0
Σ	0	0	0	0	0	0	0
Change in deposits		$-/+dD_R$				$+/-dD_R$	0
Change in loans		$-/+dB_{GR}$			$+/-B_{GR}$ $+/-B_{GB}$	$-/+dB_{GB}$	0
Change in equity		$-/+dE_R$		$+/-dE_F$			0
Σ	0	0	0	0	0	0	0

4. An autonomous demand-led model for a zero-growth economy

- Having clarified the properties of a stationary economy from an accounting and a monetary circuit perspective we integrate these properties into a dynamic model.
- We consider an autonomous autonomous demand-led growth model inspired by Hein (2018) and Hein/Woodgate (2021), which are among the first autonomous demand-led growth models explicitly addressing financial dynamics and stability.
- The dynamic model will build on the closed economy model structure developed in the previous sections.
- We introduce taxes as in Dutt (2020), and following our requirements derived above, a balanced government budget, as in Allain (2015).

4. An autonomous demand-led model for a zero-growth economy

- The autonomous demand-led growth model allows to endogenize investment and to examine the long-run dynamics of our zero-growth model economy.
- In the short run, with given government expenditures- and government debt-capital ratios, the model may generate a goods market equilibrium with positive accumulation and saving rates
- In the long run, the model converges towards the autonomous growth rate of government expenditures. We examine the conditions under which this long run convergence will lead to stable equilibria for government expenditures- and government debt-capital ratios – and thus to a stable stationary economy.

4. An autonomous demand-led model for a zero-growth economy

Assumptions again:

- no corporate debt, but initial government debt.
- single good for investment and consumption purposes produced using a fixed coefficient technology.
- non-depreciating capital stock (K).
- profit share (h) determined by mark-up pricing of firms in an oligopolistic goods market.
- constant prices (p=1).
- long-term finance of the real capital stock consists of equity issued by the firms and held by the rentiers.
- profits are distributed to the rentiers (hY) as well as the interest paid out by the government (iL).
- rentiers save according to their propensity to save (s_R) and consume part of their wealth according to their propensity to consume out of wealth (c_{WR}).
- workers do not save.

4. An autonomous demand-led model for a zero-growth economy

- Normalising all variables by the firms' capital stock, such that we have a rate of capacity utilisation ($u=Y_P/K$), a government debt-capital ratio ($\lambda=B_G/K$), and a profit rate in production ($r=\Pi/K=hu$), the saving rate ($\sigma=S/K$) is given as:

$$
\begin{aligned}
\sigma &= s_R(1-t_R)(hu+i\lambda)-c_{RW}(1+\lambda) \\
&= s_R(1-t_R)hu+\lambda\left[is_R(1-t_r)-c_{RW}\right]-c_{WR}, \qquad (14) \\
& 0<s_R\leq 1, 0<c_{RW}
\end{aligned}
$$

4. An autonomous demand-led model for a zero-growth economy

- Firms adjust the capital stock via net investment (I) according to the expected trend rate of growth of output and sales (α), and they will slow down (accelerate) the rate of capital accumulation (g=I/K) whenever the actual rate of capacity utilisation falls short of (exceeds) the normal or the target rate of utilisation (u_n):

$$g = \alpha + \beta(u - u_n), \quad \beta > 0 \qquad (15)$$

4. An autonomous demand-led model for a zero-growth economy

- Government expenditures (G) for goods and services grow at a rate γ and drive our model. The government expenditures-capital ratio (b=G/K) is given as:

$$b = \frac{G_0 e^{\gamma t}}{K} \qquad (16)$$

- Since we assume that only rentiers' income is being taxed, the tax-capital ratio (τ=T/K) is given by:

$$\tau = t_R\left(hu + i\lambda\right), \quad 0 \le t_R < 1 \qquad (17)$$

- Hence, we obtain the following balanced budget condition required for stable zero growth

$$\tau = t_R\left(hu + i\lambda\right) = b + i\lambda \qquad (18)$$

4. An autonomous demand-led model for a zero-growth economy

Short-run equilibrium

- Goods market equilibrium with balanced government budget and government expenditures- and debt-capital ratios given in the short run:

$$\begin{aligned} \sigma + \tau &= g + b + i\lambda \\ \sigma &= g \end{aligned} \qquad (19)$$

- Stability of short-run goods market equilibrium

$$\frac{\partial \sigma}{\partial u} - \frac{\partial g}{\partial u} > 0 \Rightarrow s_R\left(1 - t_R\right) - \beta > 0 \qquad (20)$$

4. An autonomous demand-led model for a zero-growth economy

Short-run equilibrium

- Goods market equilibrium with balanced government budget:

$$u^* = \frac{\alpha - \beta u_n + c_{RW} + \left[c_{RW} - s_R\left(1 - t_R\right)i\right]\lambda}{s_R\left(1 - t_R\right)h - \beta} \qquad (21)$$

- Short-run equilibrium profit rate and the rate of accumulation are:

$$r^* = hu^* = \frac{h\left\{\alpha - \beta u_n + c_{RW} + \left[c_{RW} - s_R\left(1 - t_R\right)i\right]\lambda\right\}}{s_R\left(1 - t_R\right)h - \beta} \qquad (22)$$

$$g^* = \frac{\left(\alpha - \beta u_n\right)s_R\left(1 - t_R\right)h + \beta\left\{c_{RW} + \left[c_{RW} - s_R\left(1 - t_R\right)i\right]\lambda\right\}}{s_R\left(1 - t_R\right)h - \beta} \qquad (23)$$

4. An autonomous demand-led model for a zero-growth economy

Short-run equilibrium

- From the balanced budget condition, we know:

$$\tau = t_R\left(hu + i\lambda\right) = b + i\lambda \qquad (18)$$

- Rate of utilisation associated with a balanced budget:

$$u = \frac{b + \left(1 - t_R\right)i\lambda}{t_R h} \qquad (24)$$

- Hence, we obtain the following equilibrium tax rate:

$$t_R^* = \frac{\left(s_R h - \beta\right)\left(b + i\lambda\right)}{h\left(\alpha - \beta u_n + c_{RW} + s_R b\right) + \left[c_{RW} h + \left(s_R h - \beta\right)i\right]\lambda} \qquad (25)$$

4. An autonomous demand-led model for a zero-growth economy

Short-run equilibrium

- Plugging t_R into u leads to an alternative representation of the equilibrium rate of capacity utilisation:

$$u^* = \frac{\alpha - \beta u_n + c_{RW}(1+\lambda) + s_R b}{s_R h - \beta} \qquad (26)$$

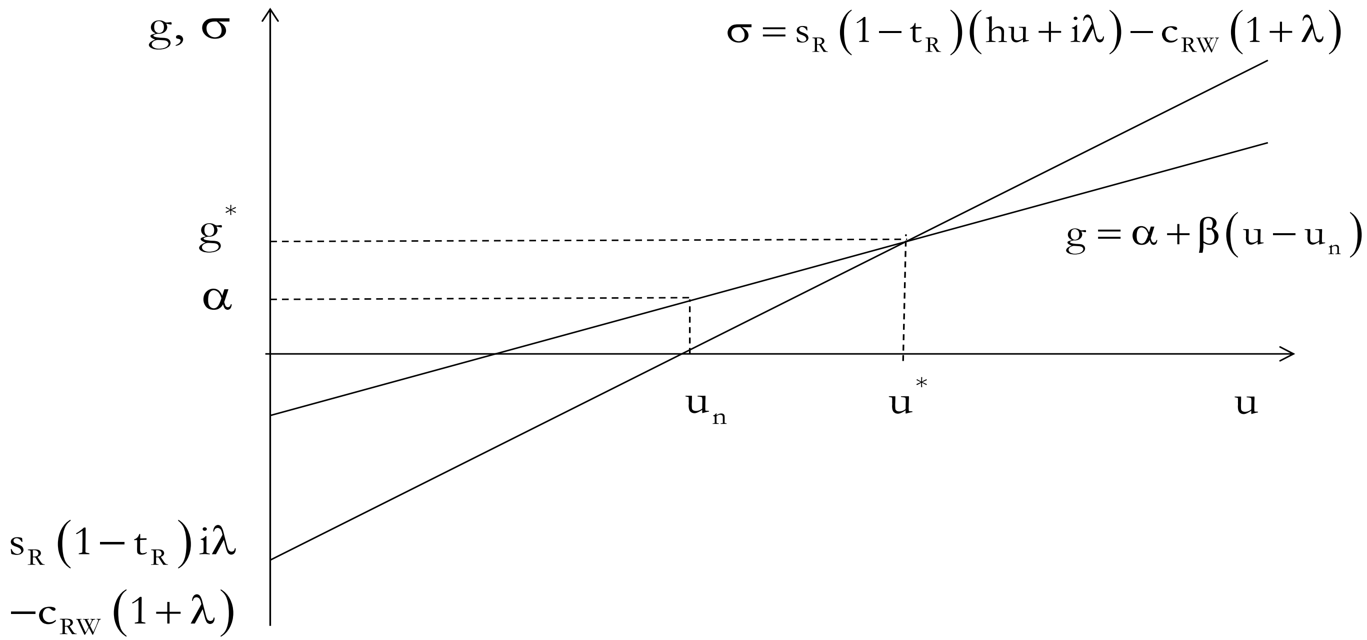
- Alternative representation of the equilibrium profit:

$$r^* = \frac{h\left[\alpha - \beta u_n + c_{RW}(1+\lambda) + s_R b\right]}{s_R h - \beta} \qquad (27)$$

$$g^* = \frac{(\alpha - \beta u_n) s_R h + \beta\left[c_{RW}(1+\lambda) + s_R b\right]}{s_R h - \beta} \qquad (28)$$

4. An autonomous demand-led model for a zero-growth economy

Figure 2: Short-run equilibrium



4. An autonomous demand-led model for a zero-growth economy

Long-run equilibrium

- Following Dutt (2019, 2020), expectations about the trend rate of growth of the economy adjust to the autonomous growth rate of government expenditures, equal to zero in our model economy:

$$\alpha = \gamma = 0 \qquad (29)$$

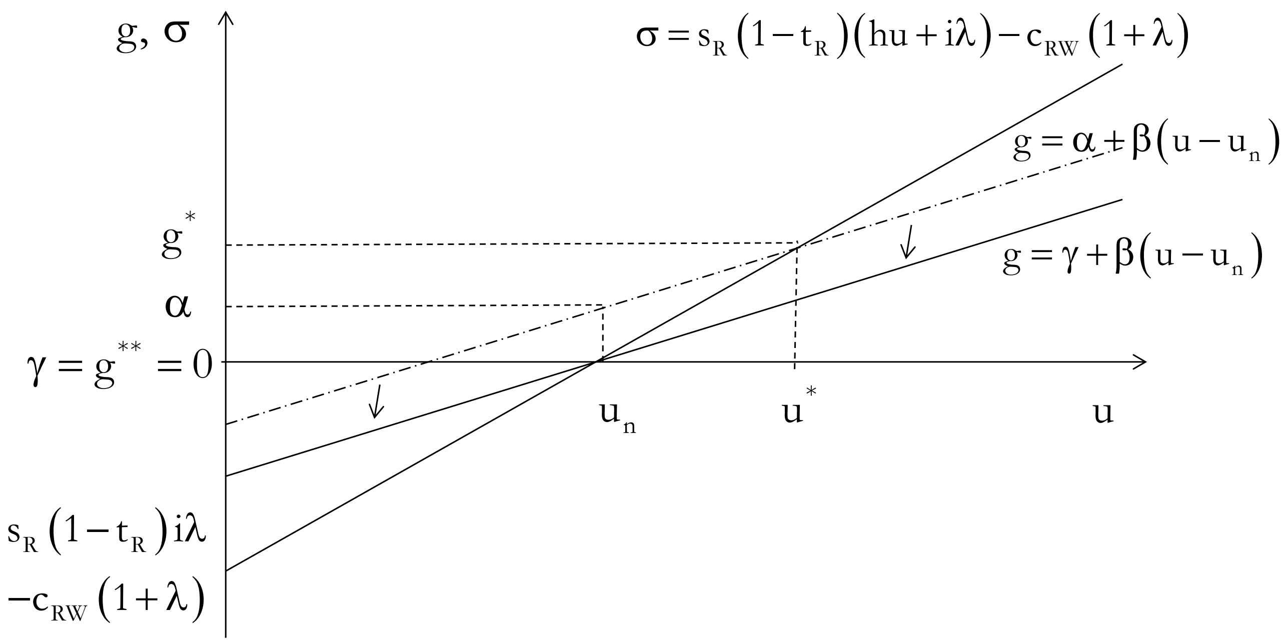
- Government expenditure- and government debt-capital ratios are now endogenous. Their time rates of change are given by:

$$\dot{b} = b(\gamma - g) = b\left[\gamma - \alpha - \beta\left(u^{*} - u_{n}\right)\right] \qquad (30)$$

$$\dot{\lambda} = -\lambda g = -\lambda\left[\alpha + \beta\left(u^{*} - u_{n}\right)\right] \qquad (32)$$

4. An autonomous demand-led model for a zero-growth economy

Figure 3: Long-run equilibrium



4. An autonomous demand-led model for a zero-growth economy

Long-run equilibrium

- For the long-run equilibrium, we need $\dot{b} = 0$ and $\dot{\lambda} = 0$. This provides the long-run equilibria of:

$$u^{**} = u_n \qquad (33)$$

$$g^{**} = \gamma = 0 \qquad (34)$$

$$r^{**} = hu_n = r_n \qquad (35)$$

$$b^{**} = 0 \qquad (36)$$

$$\lambda^{**} = 0 \qquad (37)$$

4. An autonomous demand-led model for a zero-growth economy

Long-run equilibrium

- However, we can also derive economically meaningful long-run equilibria with positive government expenditures- and debt-capital ratios, $u^{**} = u_n$ implies:

$$u_n = \frac{\alpha + c_{RW} + \left[c_{RW} - s_R\left(1 - t_R\right)i\right]\lambda}{s_R\left(1 - t_R\right)h} \qquad (38)$$

- Rearranging, and including α=γ=0, provides the long-run equilibrium government debt-capital ratio:

$$\lambda^{**} = \frac{s_R\left(1 - t_R\right)hu_n - c_{RW}}{c_{RW} - s_R\left(1 - t_R\right)i} \qquad (39)$$

4. An autonomous demand-led model for a zero-growth economy

Long-run equilibrium

- Furthermore, from the latter and the balanced budget condition:

$$b^{**} = t_R h u_n - (1-t_R) i \lambda^{**} = t_R h u_n - \frac{(1-t_R) i \left[s_R (1-t_R) h u_n - c_{RW} \right]}{c_{RW} - s_R (1-t_R) i} \qquad (40)$$

4. An autonomous demand-led model for a zero-growth economy

Long-run equilibrium

To examine the dynamic stability of the non-zero equilibria in b^{**} and λ^{**}, we need to evaluate the following Jacobian at the long run equilibrium values:

$$J = \begin{pmatrix} \dfrac{\partial \dot{b}}{\partial b} & \dfrac{\partial \dot{b}}{\partial \lambda} \\ \dfrac{\partial \dot{\lambda}}{\partial b} & \dfrac{\partial \dot{\lambda}}{\partial \lambda} \end{pmatrix} \qquad (41)$$

4. An autonomous demand-led model for a zero-growth economy

Long-run equilibrium

For the local stability in this 2x2 dynamic system, the trace of the Jacobian has to be negative and the determinant needs to be non-negative. For our system we get:

$$\mathrm{TrJ}^{**} = \frac{\partial \dot{b}}{\partial b} + \frac{\partial \dot{\lambda}}{\partial \lambda} = \frac{-\beta s_R b^{**}}{s_R h - \beta} - \frac{-\beta c_{RW} \lambda^{**}}{s_R h - \beta} = \frac{-\beta\left(s_R b^{**} + c_{RW} \lambda^{**}\right)}{s_R h - \beta} \qquad (42)$$

positive long-run equilibrium values b^{**} and λ^{**} will make sure that $\mathrm{TrJ}^{**}<0$

$$\mathrm{DetJ}^{**} = \frac{\partial \dot{b}}{\partial b}\frac{\partial \dot{\lambda}}{\partial \lambda} - \frac{\partial \dot{b}}{\partial \lambda}\frac{\partial \dot{\lambda}}{\partial b} = 0 \qquad (43)$$

we have a zero-root model, with a continuum of locally stable equilibria

4. An autonomous demand-led model for a zero-growth economy

Long-run equilibrium

- For λ**>0 we need:

$$s_R(1-t_R)hu_n > c_{RW} > s_R(1-t_R)i \quad \Rightarrow \quad r_n > \frac{c_{RW}}{s_R(1-t_R)} > i \tag{44a}$$

- And for for b**>0, too:

$$\frac{c_{RW}t_R hu_n}{(1-t_R)(s_R hu_n - c_{RW})} > i \quad \Rightarrow \quad \frac{c_{RW}}{s_R(1-t_R)} > \frac{ir_n}{t_R r_n + (1-t_R)i} = \frac{i}{t_R + (1-t_R)i/r_n} \tag{45}$$

4. An autonomous demand-led model for a zero-growth economy

Long-run equilibrium

- Since $r_n > i$ implies that $\frac{i}{t_R+(1-t_R)i/r_n} > i$, for positive and stable long-run equilibria for both b^{**} and λ^{**} in a stationary economy, we need:

$$s_R(1-t_R)hu_n > c_{RW} > \frac{s_R(1-t_R)ihu_n}{t_R r_n + (1-t_R)i} \tag{46}$$

- Alternatively:

$$hu_n > \frac{c_{RW}}{s_R(1-t_R)} > \frac{ihu_n}{t_R hu_n + (1-t_R)i} \quad \Rightarrow \quad r_n > \frac{c_{RW}}{s_R(1-t_R)} > \frac{i}{t_R + (1-t_R)i/r_n} \tag{47}$$

4. An autonomous demand-led model for a zero-growth economy

Long-run equilibrium

Table 3: Response of long-run stable zero growth equilibrium towards changes in exogenous variables in the short run and in the long run

	short run			*long run*				
	u^*	r^*	g^*	u^{**}	r^{**}	g^{**}	$b^{**} > 0$	$\lambda^{**} > 0$
s_R	–	–	–	0	0	0	–	+
c_{RW}	+	+	+	0	0	0	+	–
h	–	–	–	0	+	0	+/–	+
u_n	–	–	–	+	+	0	+/–	+
i	–	–	–	0	0	0	–	+
t_R	+	+	+	0	0	0	+	–
b	+	+	+					
λ	+	+	+					

Note: In the short-run, there are two cases regarding t_R and b: In case 1, t_R is exogenous while b is endogenous, while in case 2, b is exogenous and t_R endogenous. Rows 5 and 6 represent the first case and row 7 the second case.

5. Conclusions

1. A stationary economy, with positive profits and positive interest rates is possible
   - evident starting from national income and financial accounting or applying the model of a monetary circuit.

2. A stationary economy does not generate systemic financial instability, i.e. rising/falling financial assets- or financial liabilities-income ratios
   - Condition: financial balances of each macroeconomic sector are zero, such that sectoral financial assets- or financial liabilities-income ratios with constant income, remain constant.
     - corporate sector does not have retained earnings
     - saving of private households has to be equal to zero
     - government has to run a balanced budget.

5. Conclusions

3. In a long-run dynamic model, driven by autonomous non-capacity creating demand, i.e. government demand in our case:
   - it is possible to have a stable stationary state with zero growth, positive profits and a positive interest rate.
   - net investment responds to deviations of capacity utilisation from target utilisation in the short-run, but adjusts to sales growth expectations determined by autonomous demand growth in the long-run.
   - governments balance their budget continuously
   - stable adjustment of government expenditure-capital and government debt-capital ratios to their positive long-run equilibrium values require specific maxima for the propensity to consume out wealth and the rate of interest.

4. Limits
   - closed economy
   - no structural change and/or productivity growth
   - stability of full employment/labour market