A Stock-Flow Consistent Model of Minskyan Long Waves

Soon Ryoo

Assistant Professor of Economics
Adelphi University
Garden City, NY, USA

The Hyman P. Minsky Summer Conference
The Levy Economics Institute of Bard College, June 27-29, 2010

- based on “Long waves and short cycles in a model of endogenous financial fragility”, *Journal of Economic Behavior and Organization*, 2010, June, 74(3)

- Motivations and Ideas

1. Hyman Minsky's Theory of Long Waves

   "The more severe depressions of history occur after a period of good economic performance, with only minor cycles disturbing a generally expanding economy" (Minsky, 1995, p.85)

2. Main systemic forces behind long waves: Endogenous changes in financial practices

   The "mechanism which has generated the long swings centers around the cumulative changes in financial variables that take place over the long-swing expansions and contractions" (Minsky, 1964).

3. Key behavioral assumption: A prolonged period of good years induces firms, bankers and households to take riskier financial practices.

   "Success breeds disregard of the possibility of failures...As previous financial crisis recedes in time, it is quite natural for central bankers, government officials, bankers, businessmen and even economists to believe that a new era has arrived" (Minsky, 1982, p.213).

- Objectives

  1. build a model in which financial practices of firm and household sectors evolve endogenously.
  2. examine the mechanisms behind long waves
  3. provide a unified framework of both long waves and short cycles

- Literature

  1. Early Contributions
     - Taylor and O'Connell (1985), Semmler (1987), Foley (1987), Jasulic (1989, 1996), Delli Gatti and Gallegati (1990), Skott (1994), Dutt (1995), Keen (1995) and Flaschel, Franke and Semmler (1998)
  2. Recent Works
     - Setterfield (2004), Nasica and Raybaut (2005), Lima and Meirelles (2007), Fazzari, Ferri and Greenberg (2008)

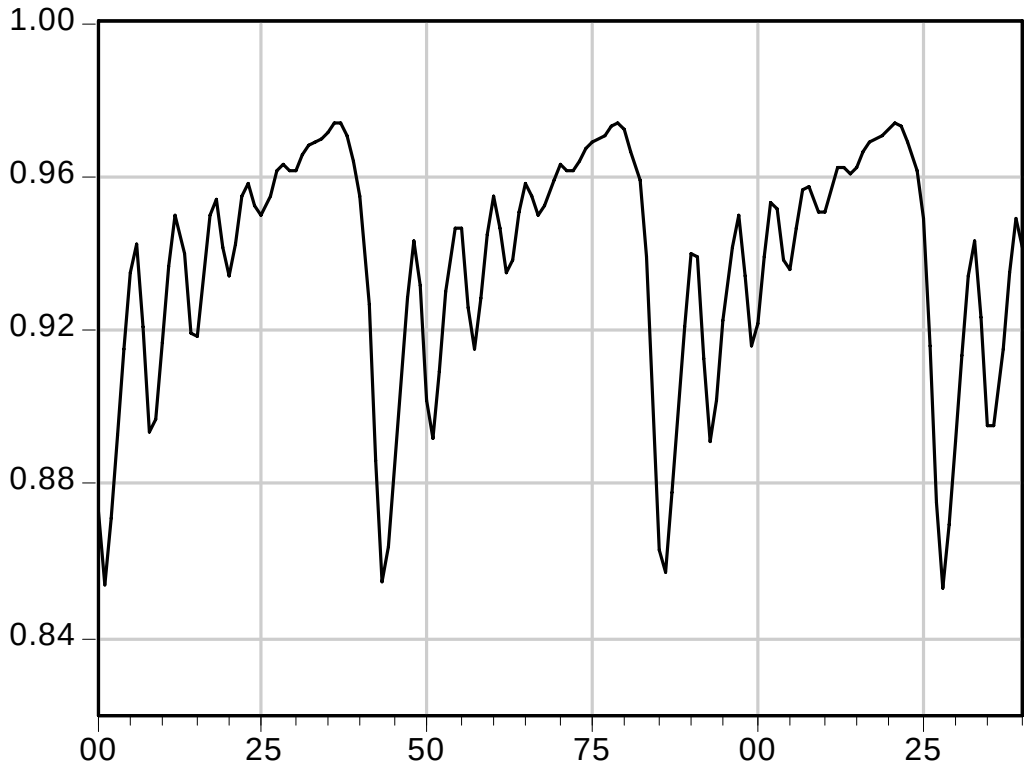
- Contributions

1. stock-flow consistent
   - carefully introduce financial stocks and examine their implications for income and financial flows
   - capital gains from stock holdings are not assumed away
2. emphasize *both* firms' and households' financial decisions. Long waves emerge from *the interaction* between them
   - Existing Minskian literature tends to privilege the firm sector as a source of fragility
3. explain long waves and short cycles in a *single* framework
   - Minsky's Financial Instability Hypothesis interpreted as a theory of long waves rather than a theory of short business cycles

- Results

1. Analytic Results: The Hopf bifurcation theorem shows the conditions under which long waves emerge
2. Simulation Results: The model generates long waves around which short cycles fluctuate.

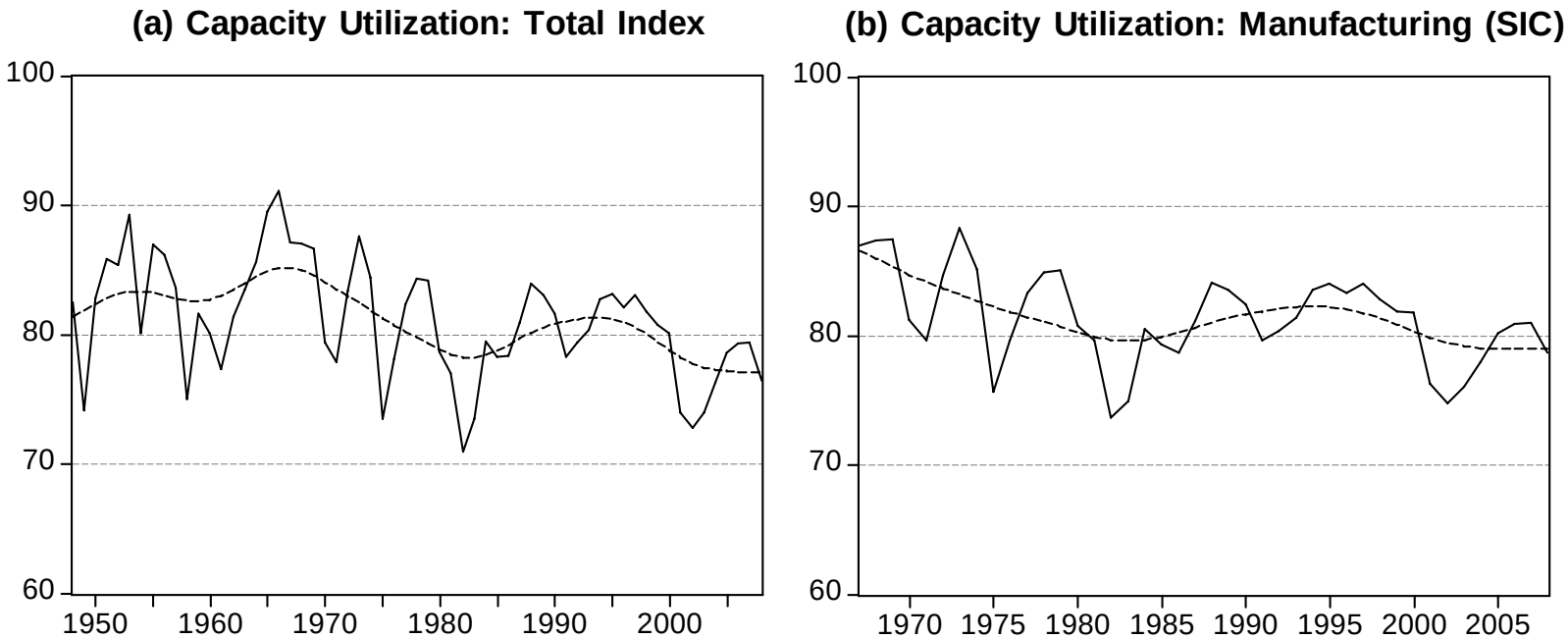
Figure: Employment Rate



- Modeling strategy to obtain two distinct cycles

1. The model assumes that
   - firms/banks' and households' financial decisions are long-term decisions in nature.
   - financial practices are not greated affected by short-run business cycles
2. The anlaysis of long waves abstracts from short business cycles by assuming:
   - capacity utilization is constant at the desired rate.
3. The analysis of short cycles shows this assumption is a good approximation.
   - The system of short cycles produces the fluctuations of capacity utilization around the desired rate and capital accumulation around the natural rate of growth.

- Mild long run variations in capacity utilization (U.S)



- Balance Sheets

	Households	Firms	Banks	Total
Capital		$+K$		$+K$
Loans		$-M$	$+M$	0
Equities	$+vN^H$	$-vN$		0
Deposits	$+M^H$		$-M^H$	0
Total	$vN^H + M^H$	$K - (vN + M)$	0	$+K$

- the same as Skott (1981, 1989) and Lavoie and Godley (2001-2).

- Financial Markets

1. Assumptions
   - Two financial assets: bank deposits and stocks (equity holdings)
   - Banks set the interest rate (r). The loan rate equals the deposit rate.
   - No cash holding. No cost involved in banking.
   - an example of Wicksellian pure credit banking system
2. Implications:
   - Money (=deposits) is generated endogneously so that

     Firm Debt (Bank Loans) = Household Deposits
   - Firms/banks' decisions on corporate debt structure affect household wealth.
3. Key Financial Variables
   - **Debt-Capital Ratio (m)**: determined by firms' behavior.
   - **Equity-Deposit Ratio (α)**: determined by household portfolio decisions.
   - **Household Wealth** $=$ Equity $+$ Deposits

- Goods market

1. Assumptions
   - Consumption is a function of household income and wealth
   - Capital accumulation (I/K) is a function of capacity utilization. → In the analysis of long waves, I/K is kept constant at its long run average due to the assumption of constant utilization rate
   - Income distribution adjusts to clear the goods market (Kaldorian mechanism, 1955/56). → Increases in aggregate demand is absorbed by higher profit share and profit rate.
2. Features
   - Firms' and households' financial decisions (m and α) influence aggregate demand.
   - Changes in aggregate demand affect the profit rate.
   - increase in m or α → increase in household wealth → increase in consumption → increase in AD → increase in profit rate

$$\rho_T = \rho_T(\underset{+}{m}, \underset{+}{\alpha})$$

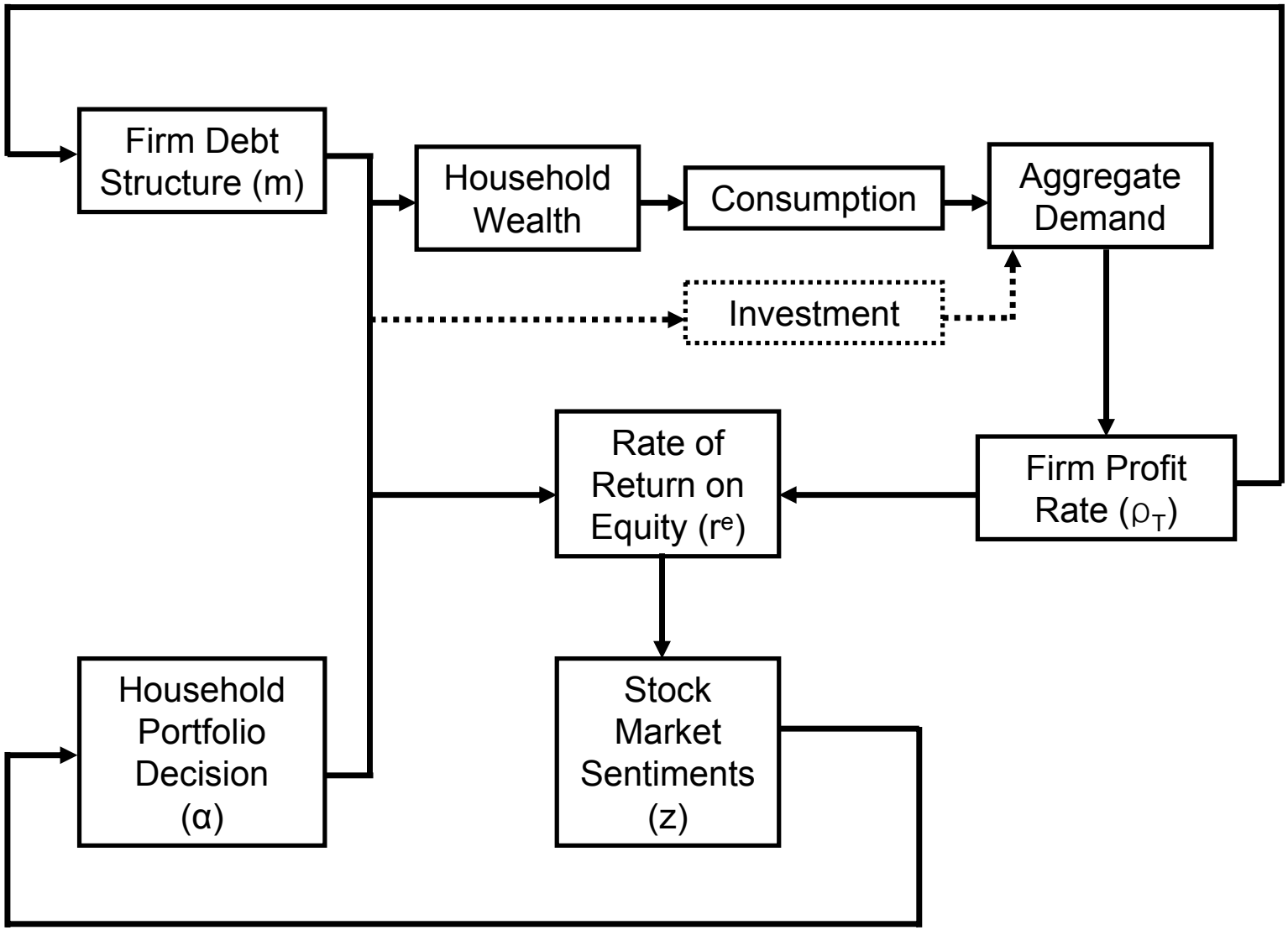
ρ_T: (trend) rate of profit

- Key Behavioral Assumption

  Firms/banks and households tend to take riskier financial practices during a prolonged period of good years.

  1. Firms' debt structure: firms' leverage (m) increases during good years.
     - During good years, banks' lending stardard get relaxed and firms are willing to take higher debt finance.
     - an indicator of good years for banks/firms: profit-payment commitment ratio ("the fundamental margin of safety")
  2. Household portfolio: Households tend to hold an increasing share of stocks (α) in their portfolio during good years.
     - an indicator of good years for households(or stock market investors): history of the rate of return on equity

Figure: Dynamic Interactions



- The System of Long Waves

1. Firm Debt Dynamics

$$\dot{m} = \tau\left(\frac{\rho_T}{rm}\right); \quad \tau'(\cdot) > 0 \tag{1}$$

m: debt-capital ratio, ρ_T: trend rate of profit

r: interest rate (exogenous)

2. Households Portfolio Dynamics

$$\dot{\alpha} = \zeta(z); \quad \zeta'(z) > 0 \tag{2}$$

α: equity-deposit ratio, z: a measure of household optimism about stock markets.

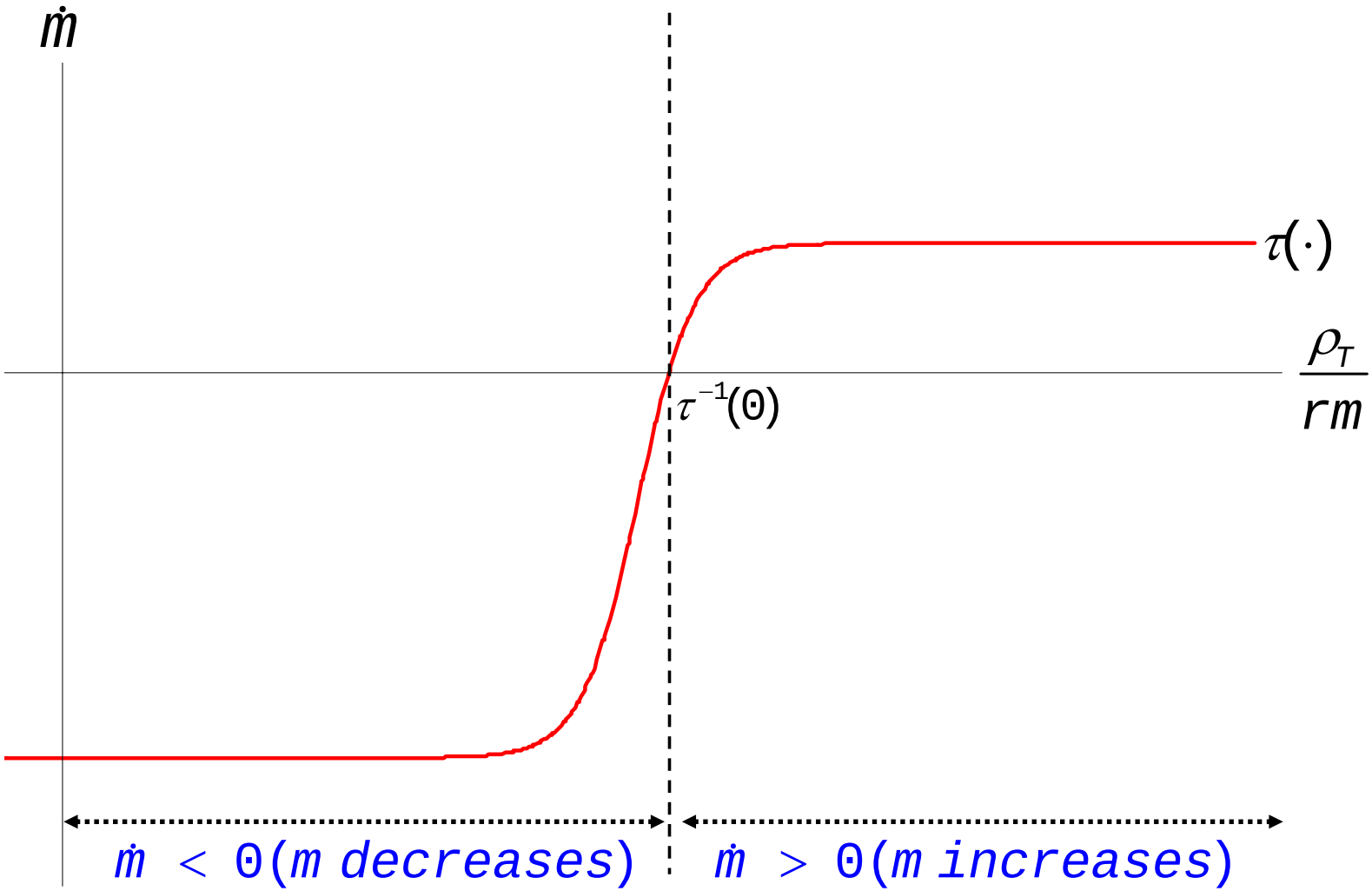
3. Determination of z

$$z = \int_{-\infty}^{t} \exp[-\lambda(t-\nu)]\kappa(r_\nu^e, \alpha_\nu)d\nu$$

r_ν^e: rate of return on equity in time ν, λ: rate of memory loss

$$\dot{z} = \kappa(\underset{+}{r^e}, \underset{-}{\alpha}) - \lambda z \tag{3}$$

Figure: Debt-capital ratio and profit-interest ratio



- Analytic Results

1. The Hopf bifurcation theorem is applied to clarify the conditions for the existence of a limit cycle.
2. In general, the existence of a limit cycle (long waves) requires that household portfolio dynamics should be neither too stabilizing nor too destabilizing.

Figure: Long Waves: Limit Cycles

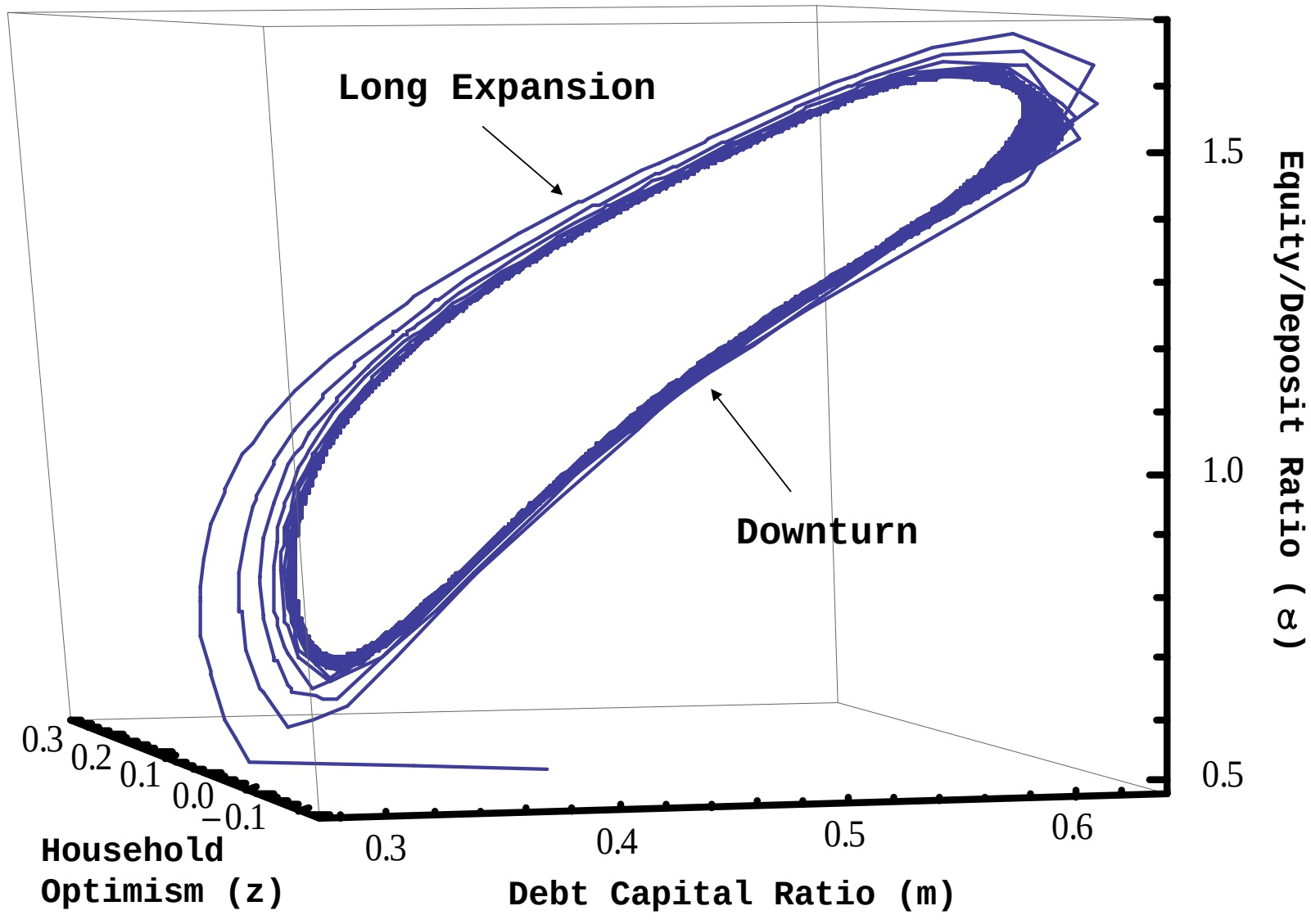


Figure: Long Waves

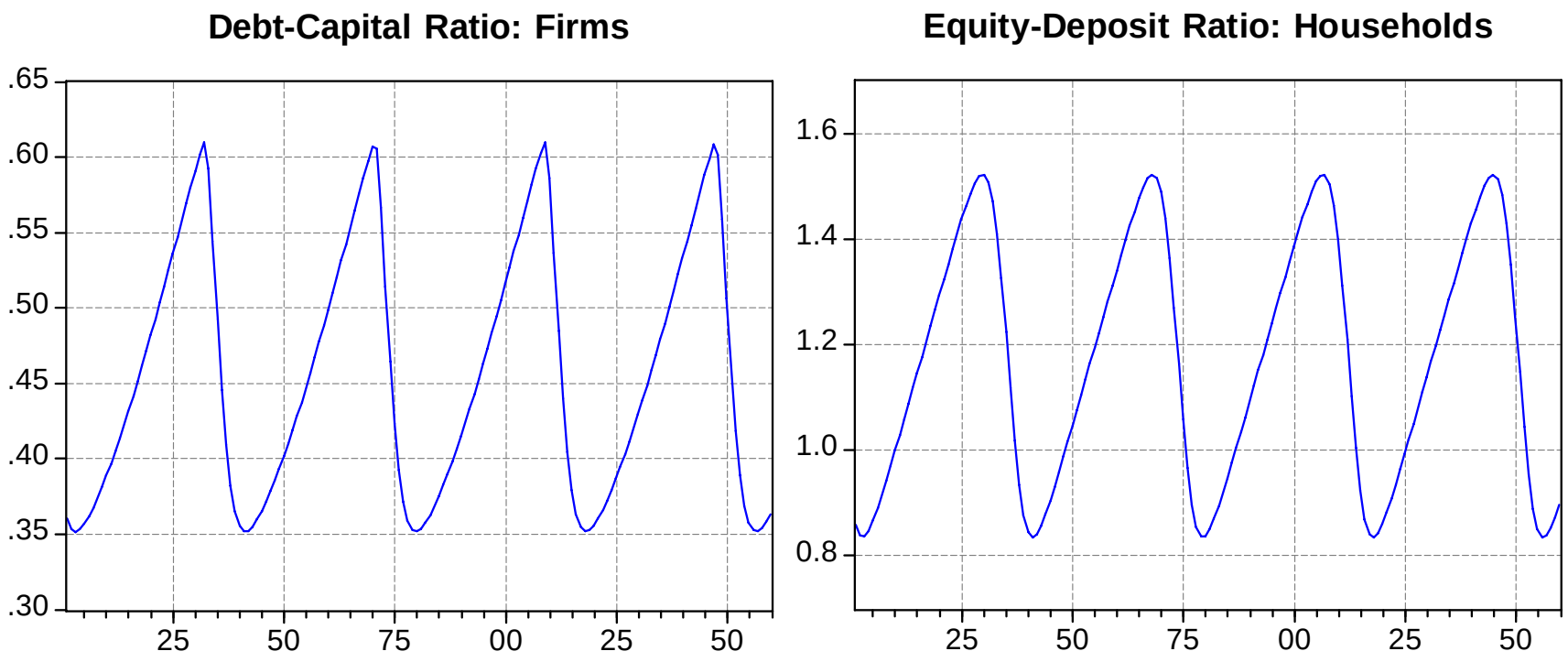
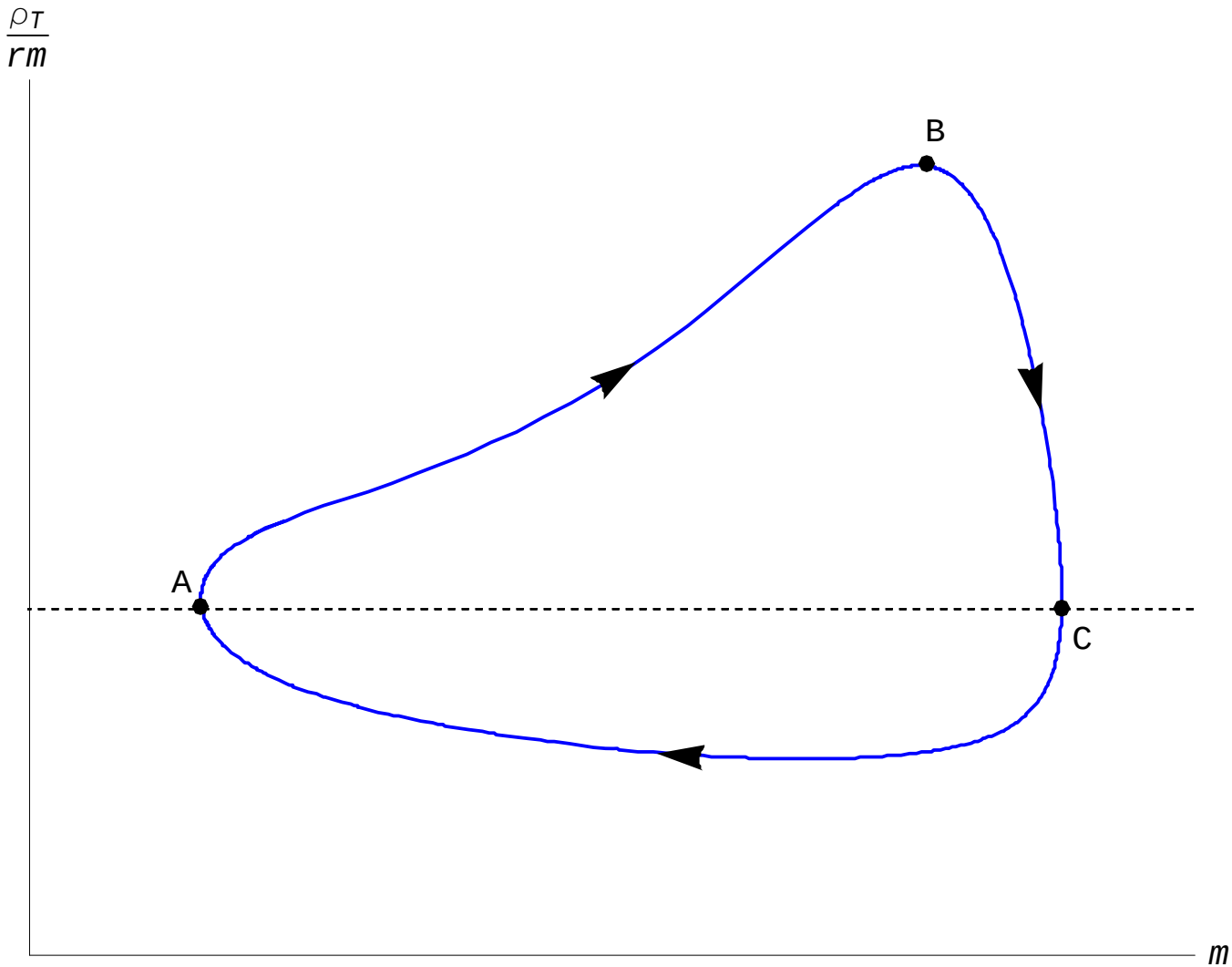


Figure: “Fundamental margin of safety” and debt structure



- Combine the proposed long wave model with a short cycle model (e.g. Skott 1989).

A Model of Long Waves and Short Cycles

- *Long Waves*

$$\dot{m} = \tau\left(\frac{\rho_T}{rm}\right) \tag{1}$$

$$\dot{\alpha} = \zeta(z) \tag{2}$$

$$\dot{z} = \kappa(r^e, \alpha) - \lambda z \tag{3}$$

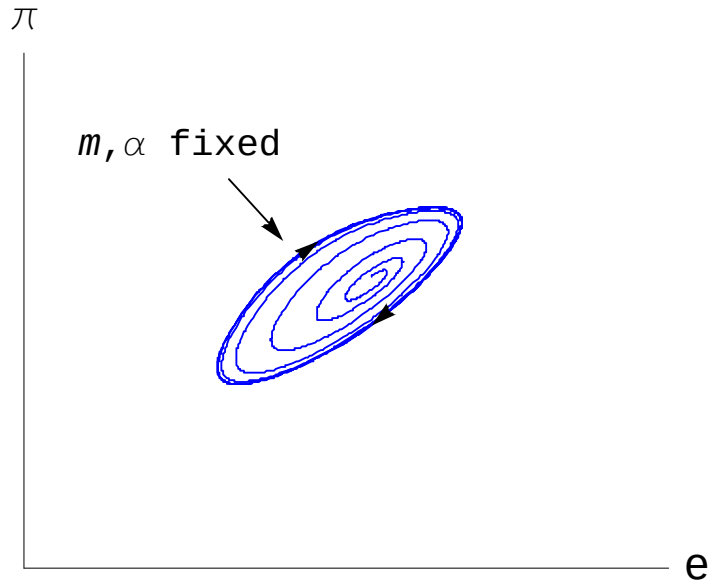
- *Short Cycles*

$$\hat{u} = \hat{Y} - \hat{K} = h(\pi(u, m, \alpha), e) - \phi(u) \tag{4}$$

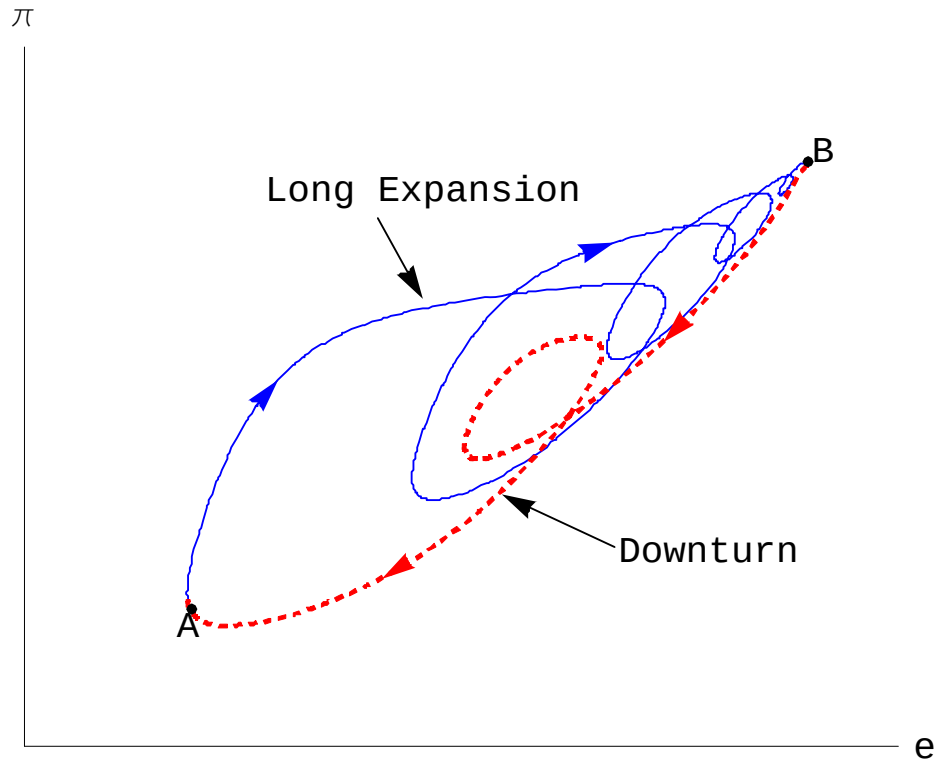
$$\hat{e} = \hat{Y} - \hat{L} = h(\pi(u, m, \alpha), e) - n \tag{5}$$

$\rho_T = \rho_T(m, \alpha)$; $r^e = \frac{\rho_T(m,\alpha) - \delta - rm + (1+\alpha)[\dot{m}+mn] + \dot{\alpha}m - n}{\alpha m}$; $\pi(u, m, \alpha) = \frac{\rho(u,m,\alpha)}{u}$

Figure: Comparision



Short Cycles only (m,α given)



Long Waves and Short Cycles

Figure: Simulation Results: Long Waves and Short Cycles

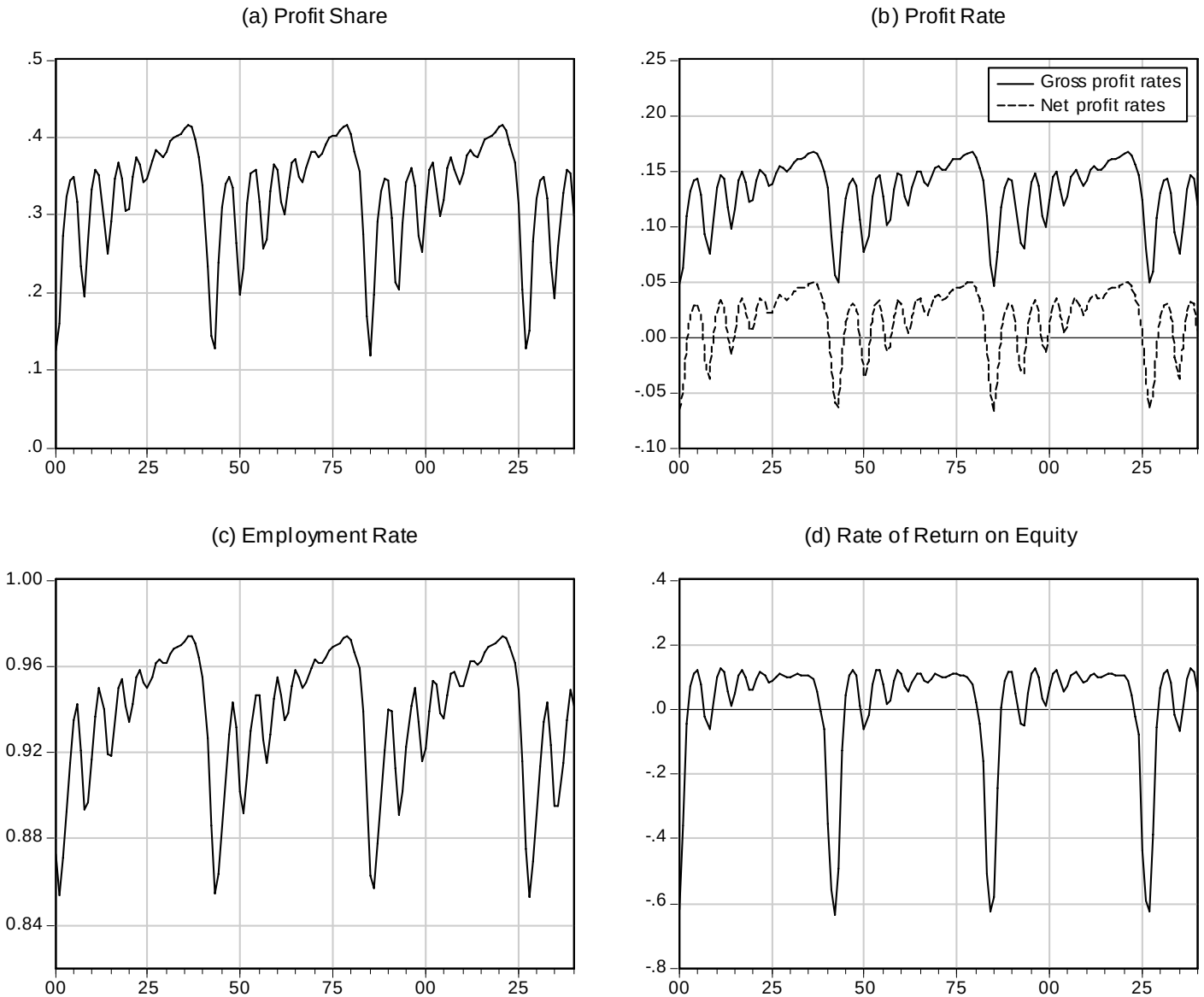
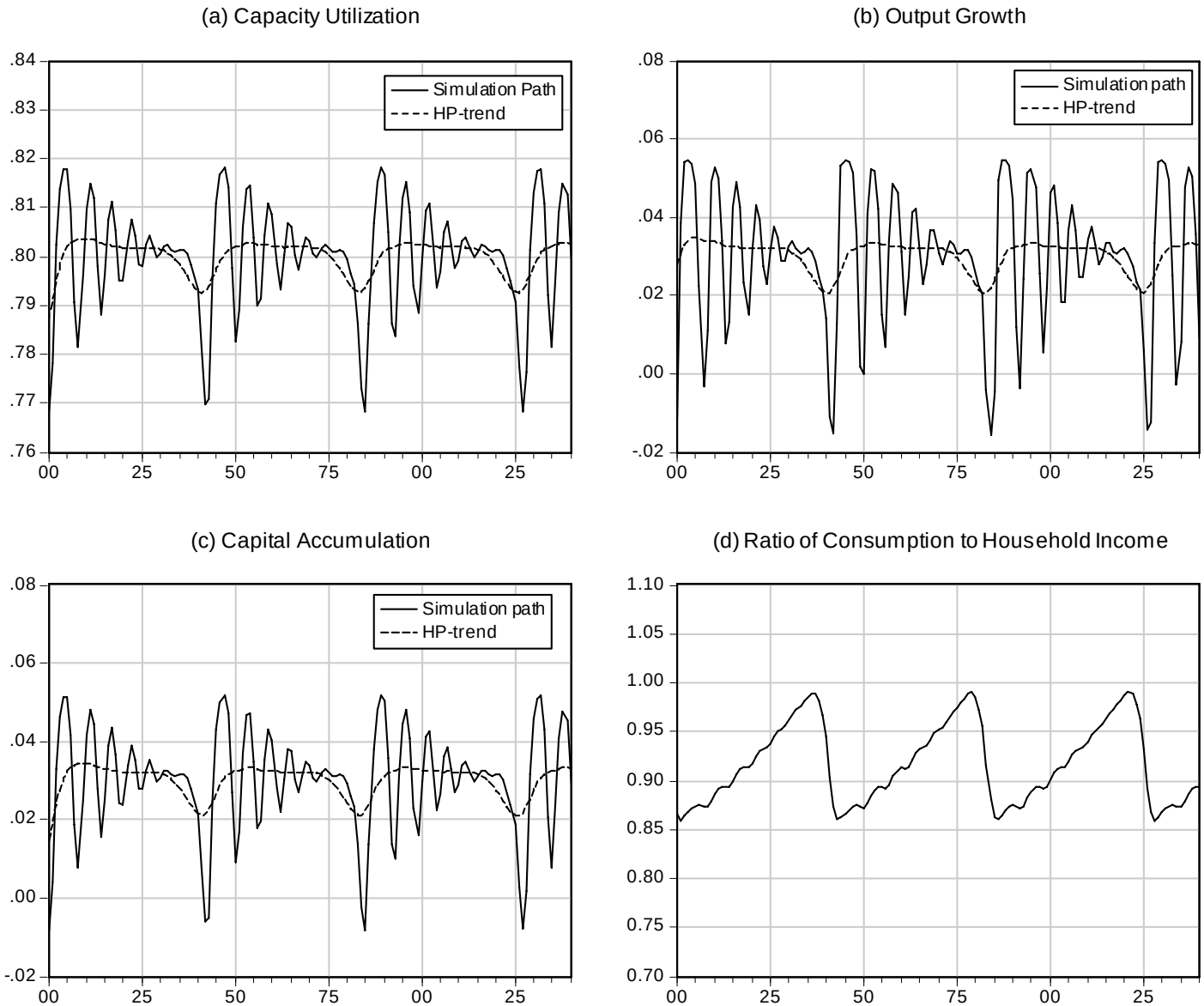


Figure: Simulation Results: Long Waves and Short Cycles



- Conclusion

1. has presented an integrated approach that:
   - is stock-flow consistent;
   - emphasizes both firms' and households' financial behavior;
   - explains both long waves and short cycles.
2. extensions
   - institutional and historical dimensions
   - more detailed modelling of financial institutions
   - household indebtedness and housing
   - implications of inflation
   - open economy aspect (international capital mobility and exchange rate dynamics)

Thank you so much!

- Household perceptions on stock markets

1. How do households revise their perspectives on stock markets?

$$\dot{z} = \kappa(\underset{+}{r^e}, \underset{-}{\alpha}) - \lambda z$$

   - The higher the rate of return on equity (r^e), the more optimistic households' views on stock markets: if r^e high, $\dot{z} > 0$.
   - A high level of equity holdings (high α) tempers the further increase in optimism: if α high, $\dot{z} < 0$.
   - Today's perspective loses its relevance as tomorrow is coming: if z high, $\dot{z} < 0$.

2. Rate of Return on Equity (r^e)

$$= \frac{\text{Dividends} + \text{Capital Gains}}{\text{Market Value of Equity}}$$

$$r^e(m, \alpha, z) = \frac{\rho_T(m, \alpha) - \delta - rm + (1 + \alpha)[\dot{m} + mn] + \dot{\alpha}m - n}{\alpha m}$$

Figure: The ratio of net issues of equities to fixed investment (1952-2007, U.S)

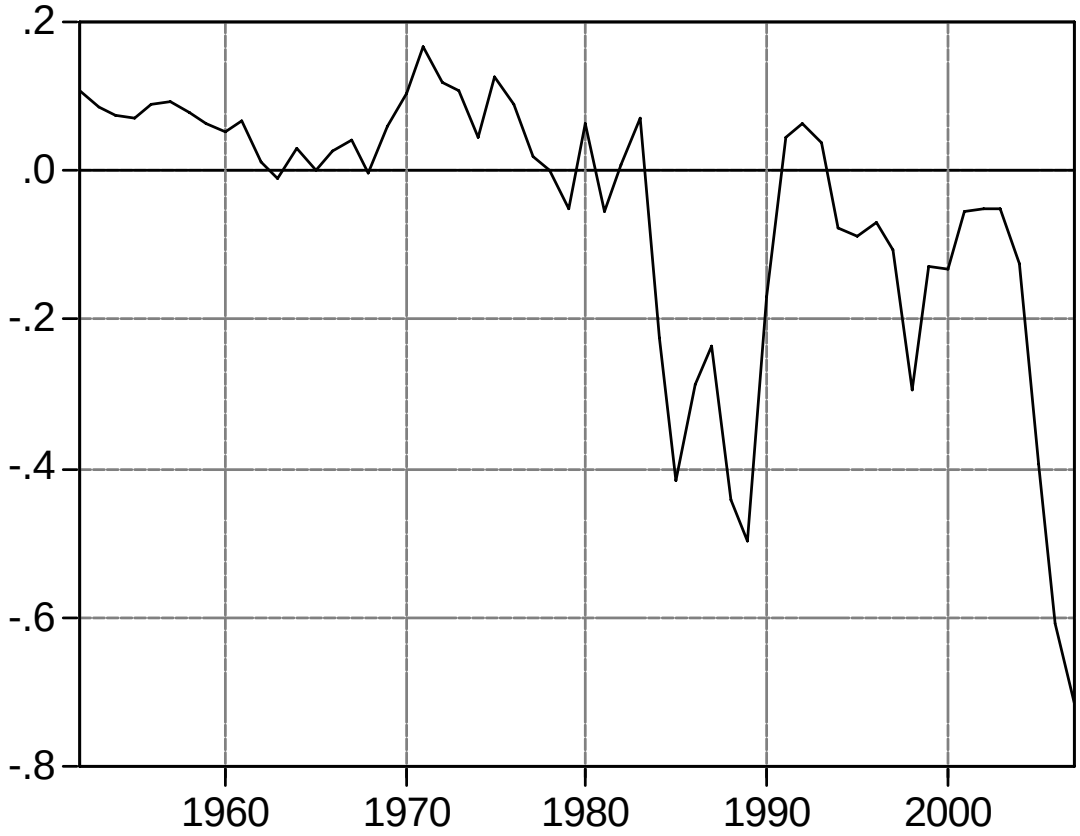


Figure: Actual and desired debt ratios