A Stock-Flow Consistent Model of Minskyan Long Waves

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

2. Recent Works
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 greatly affected by short-run business cycles.

2. The analysis 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

<table>
<thead>
<tr>
<th></th>
<th>Households</th>
<th>Firms</th>
<th>Banks</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td></td>
<td>$+K$</td>
<td></td>
<td>$+K$</td>
</tr>
<tr>
<td>Loans</td>
<td></td>
<td>$-M$</td>
<td>$+M$</td>
<td>0</td>
</tr>
<tr>
<td>Equities</td>
<td>$+vN^H$</td>
<td>$-vN$</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Deposits</td>
<td>$+M^H$</td>
<td></td>
<td>$-M^H$</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>$vN^H + M^H$</td>
<td>$K - (vN + M)$</td>
<td>0</td>
<td>$+K$</td>
</tr>
</tbody>
</table>

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

Implications:
- Money (=deposits) is generated endogeneously so that
  Firm Debt (Bank Loans) = Household Deposits
- Firms/banks’ decisions on corporate debt structure affect household wealth.

Key Financial Variables
- **Debt-Capital Ratio** \( m \): determined by firms’ behavior.
- **Equity-Deposit Ratio** \( \alpha \): 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 \((m \text{ and } \alpha)\) influence aggregate demand.
- Changes in aggregate demand affect the profit rate.
- increase in \(m\) or \(\alpha\) → increase in household wealth → increase in consumption → increase in AD → increase in profit rate

\[
\rho_T = \rho_T(m, \alpha)
\]

\(\rho_T\): (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 standard 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 ($\alpha$) 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

- Firm Debt Structure (m)
- Household Wealth
- Household Portfolio Decision (α)
- Consumption
- Aggregate Demand
- Investment
- Rate of Return on Equity (r_e)
- Stock Market Sentiments (z)
- Firm Profit Rate (ρ_T)
The System of Long Waves

1 Firm Debt Dynamics

\[ \dot{m} = \tau \left( \frac{\rho_T}{r m} \right); \quad \tau'(\cdot) > 0 \]  

\( m \): debt-capital ratio, \( \rho_T \): trend rate of profit
\( r \): interest rate (exogenous)

2 Households Portfolio Dynamics

\[ \dot{\alpha} = \zeta(z); \quad \zeta'(z) > 0 \]  

\( \alpha \): equity-deposit ratio, \( z \): a measure of household optimism about stock markets.

3 Determination of \( z \)

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

\( r^e_\nu \): rate of return on equity in time \( \nu \), \( \lambda \): rate of memory loss

\[ \dot{z} = \kappa(\dot{r}^e, \dot{\alpha}) - \lambda z \]  

(3)
Figure: Debt-capital ratio and profit-interest ratio

\[ \dot{m} \]

\[ \rho_T \]

\[ \tau(\cdot) \]

\[ \tau^{-1}(0) \]

\( \dot{m} < 0 \) (\( m \) decreases)

\( \dot{m} > 0 \) (\( m \) increases)
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

Long Expansion

Downturn

Equity/Deposit Ratio (α)

Debt Capital Ratio (m)
Figure: Long Waves

Debt-Capital Ratio: Firms

Equity-Deposit Ratio: Households
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**

\[
\dot{m} = \tau \left( \frac{\rho_T}{rm} \right) \\
\dot{\alpha} = \zeta(z) \\
\dot{z} = \kappa(r^e, \alpha) - \lambda z
\]  

**Short Cycles**

\[
\hat{u} = \hat{Y} - \hat{K} = h(\pi(u, m, \alpha), e) - \phi(u) \\
\hat{e} = \hat{Y} - \hat{L} = h(\pi(u, m, \alpha), e) - n
\]  

\[\rho_T = \rho_T(m, \alpha); \ r^e = \frac{\rho_T(m, \alpha) - \delta - \alpha m_n + (1 + \alpha)\dot{m} + m\dot{n}}{\alpha m} + \dot{\alpha}m - n; \ \pi(u, m, \alpha) = \frac{\rho(u, m, \alpha)}{u} \]
Figure: Comparison

Long Waves and Short Cycles

Short Cycles only ($m, \alpha$ given)

$m, \alpha$ fixed

Long Expansion

Downturn
Figure: Simulation Results: Long Waves and Short Cycles

(a) Profit Share

(b) Profit Rate

(c) Employment Rate

(d) Rate of Return on Equity
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?

\[ \dot{z} = \kappa(r^e, \alpha) - \lambda z \]

- 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 \(\alpha\)) tempers the further increase in optimism: if \(\alpha\) 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 (\(r^e\))

\[ r^e(m, \alpha, z) = \frac{\rho_T(m, \alpha) - \delta - rm + (1 + \alpha)[\dot{m} + mn] + \dot{\alpha}m - n}{\alpha m} \]
Figure: The ratio of net issues of equities to fixed investment (1952-2007, U.S.)
Figure: Actual and desired debt ratios

Expansion $m < m^*$

Contraction $m > m^*$

$t$