Minsky models in post-Keynesian macroeconomics

Engelbert Stockhammer
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Based on Nikolaidi and Stockhammer (2017)
Starting point

• Since 2008 re-newed interest in Minsky, even from mainstream
• Minsky long an outsider, has worked on financial instability in relatively stable postwar era
• Since 1990s various attempts to formalise his argument, but
  • no canonical Minsky model
  • Substantial differences in how to model Minsky
Basics... what do firms do

• Neoclassical firm: optimising input combination based on given prices
• Marxist firm: how to squeeze (exploit) workers
• Keynesian firm: make bold investment decisions in the face of fundamental uncertainty
• New Keynesian firm: similar to neoclassical firm, but with transaction costs, all sorts of rigidities etc
• Minskyan firm: has to service debt out of current income, always in danger of bankruptcy; stability is destabilising
Outline

• A few words on Minsky
• Families of Minsky models
• A few words about analysing stability and cycles in 2D
• Debt and interest cycles
  – Kalecki-Minsky models
  – Kaldor-Minsky models
  – Goodwin-Minsky models
  – Credit rationing models
  – Endogenous debt target models (‘Godley-Minsky models’)
  – Household debt models (‘Veblen-Minsky models’)
• Asset price cycles
  – Equity prices
  – Real estate prices
• Comparison and comments
Minsky himself

• Minsky
  – Endogenous instability and cycles (‘stability breeds instability’)
  – Stock prices overshoot in boom
  – Increasing debt by firms
  – (business) debt has negative effect on investment
  – Interest rates rise in boom
• But typically in institutionally rich fashion, but no model
• focus on business debt and equity prices (not on household debt)
• Stability is destabilising -> endogenous cycles
Families of Minsky models

- Minsky models
  - Debt or interest dynamics
    - Kalecki-Minsky
    - Kaldor-Minsky
    - Credit rationing
    - Endogenous target debt ratio
  - Asset price dynamics
    - Goodwin-Minsky
    - Minsky-Veblen
    - Equity prices
    - Real estate prices
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<tr>
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<th>firms</th>
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<td><strong>Debt cycles</strong></td>
<td>• Debt payments + interest rates</td>
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<td>• Debt ratio and debt targets</td>
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Stability analysis of 2D system

\[
\begin{bmatrix}
\dot{g} \\
\dot{d}
\end{bmatrix} = 
\begin{bmatrix}
J_{11} & J_{12} \\
J_{21} & J_{22}
\end{bmatrix}
\begin{bmatrix}
g \\
d
\end{bmatrix}
\]

- Trace = J_{11} + J_{22}
- Det = J_{11}J_{22} - J_{12}J_{21}
- Eigenvalues: \( \lambda_{1,2} = \frac{1}{2} [\text{tr} - \sqrt{\text{tr}^2 - 4\text{det}}] \)
Green background means the origin is stable; areas with a red or yellow background are unstable. The orange axes and plots are a representative picture of what solutions near the origin will look like for such a trace and determinant; the actual appearance will depend on the eigenvectors. The blue axes represent the complex plane and we draw dots where the eigenvalues
Stability analysis of 2D system

\[
\begin{bmatrix}
\dot{g} \\
\dot{d}
\end{bmatrix} = \begin{bmatrix}
J_{11} & J_{12} \\
J_{21} & J_{22}
\end{bmatrix}\begin{bmatrix}
g \\
d
\end{bmatrix}
\]

- Stable if trace = (J_{11} + J_{22}) < 0 and det = (J_{11}J_{22} - J_{12}J_{21}) > 0
- Eigenvalues: \(\lambda_{1,2} = \frac{1}{2}[\text{tr} - \sqrt{\text{tr}^2 - 4\text{det}}]\)
- Oscillations if \(\text{tr}^2 < 4\cdot\text{det}\)
- Local stability: Jacobian evaluate at equilibrium
- Global stability relevant in non-linear system
Closed orbits and limit cycles

• For closed orbits: \( \text{tr} = 0 \)
• Local limit cycles will arise where the system undergoes a Hopf bifurcation (e.g. when equilibrium switches from stable to unstable)
• Limit cycles can arise when there is a locally unstable equilibrium that is globally stable (e.g. Kaldor cycles)
• Intuitively: to give cycles the model need an overshooting and a stabilising variable
Debt cycle models

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<th>Model</th>
<th>Description</th>
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<td>Kalecki-Minsky</td>
<td>Stable goods mkt, explosive debt</td>
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<td>Kaldor-Minsky</td>
<td>Overshooting investment, debt is stabilising</td>
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<td>Goodwin-Minsky</td>
<td>Interest payment as another squeeze on business profits</td>
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We expect the following Jacobian structure for a Minsky model

\[
\begin{bmatrix}
\dot{g} \\
\dot{d}
\end{bmatrix} = \begin{bmatrix}
? & - \\
+ & ?
\end{bmatrix} \begin{bmatrix}
g \\
d
\end{bmatrix}
\]
Kalecki-Minsky models

• Simple economy with households, firms and banks.

• **Investment function** \((g^d)\):

\[ g^d = \Phi(r, id) = \alpha + \beta(r - id) \]

• **Saving rate** \((g^s)\):

\[ g^s = s_f(r - id) + s_c((1 - s_f)(r - id) + id) \]

• **Slow adjustment on the goods market:**

\[ \dot{g} = \lambda(g^d - g) \]

where \(r\) is the gross rate of profit, \(i\) is the interest rate, \(d\) is the leverage ratio of firms, \(g\) is the effective investment rate, \(s_f\) is the retention ratio and \(s_c\) capitalists’ propensity to save.
Kalecki-Minsky models

- **Budget constraint** of the firm sector:
  \[
  \dot{D} + R = I + iD
  \]

- Dividing through by capital stock:
  \[
  \frac{\dot{D}}{K} = g - s_f (r - id)
  \]

- **Law of motion of the debt-to-capital ratio**:
  \[
  \dot{d} = \left( \frac{\dot{D}}{K} \right) = \frac{\dot{D}}{K} - \frac{D \dot{K}}{K^2} = \frac{\dot{D}}{K} - dg
  \]

  where \( K \) is capital stock, \( I \) is investment, \( R \) denotes gross profits and \( D \) is debt.
Kalecki-Minsky models

- Nishi (2012): interest rate is exogenous
- Charles (2008): commercial banks increase the interest rate when leverage ratio increases
- Lima and Meirelles (2007): interest rate is a function of the banking mark-up
- Fazzari et al. (2008): rise in the interest rate is caused by central banks
- An endogenous interest rate reinforces the destabilising forces.
Kalecki-Minsky models

- The Jacobian matrix in the Kalecki-Minsky models is:

\[
\begin{bmatrix}
\dot{g} \\
\dot{d}
\end{bmatrix} = \begin{bmatrix}
- & - \\
+ & +
\end{bmatrix} \begin{bmatrix}
g \\
d
\end{bmatrix}
\]

- Goods market is stable, debt relation is explosive.
Kaldor-Minsky models

• The Jacobian matrix in the Kaldor-Minsky models is:

\[
\begin{bmatrix}
\dot{g} \\
\dot{d}
\end{bmatrix} = \begin{bmatrix}
+ & - \\
+ & -
\end{bmatrix} \begin{bmatrix}
g \\
\end{bmatrix}
\]

• Investment is overshooting (inv more elastic at equilibrium that savings); debt is stabilising.

• The family of Kaldor-Minsky models includes, under certain assumptions, Asada (2001) and Skott (1994).

• Foley (1987) is similar.
Kaldor-Minsky models

- Asada (2001):
  - similar to the structure of Kalecki-Minsky models
  - commercial banks increase the interest rate when leverage ratio increases
  - Hopf bifurcation
- Skott (1994):
  - Kaldorian model with abstract financial variables
  - Poincaré-Bendixson theorem
- Foley (1987):
  - Marxist inspired model with some Minskyan features
  - Interest rate rises in the boom
  - Hopf bifurcation
Kaldor-Minsky models: Skott

• Skott (1994) uses some abstract financial variables

• Change in the financial fragility variable ($F$):
  \[ \dot{F} = T \]

• Tranquillity variable ($T$):
  \[ T = Au - BF \]

• Investment function ($g^d$):
  \[ g^d = \phi(u) + cAu + (b - cB)\frac{id}{\bar{r}} \]

• Saving function ($g^s$):
  \[ g^s = su \]

where $\phi(u)$ is an s-shaped bounded function, $\bar{r}$ is the normal profit rate and $u$ is the capacity utilisation.
Goodwin-Minsky models

• Builds on Goodwin (1967): endog cycles between wage share and employment
• Output determined by capital stock (Say’s law)
• Investment convex in profits -> firms run into debt during boom
• Interest rate positive function of debt; debt payments squeeze retained profits and investment
Credit rationing Minsky models

• Ryoo (2013b): Kaldorian investment with short cycles; firms take on debt and issue equity (residual finance); equity-deposit ratio constant; banks ration credit; as banks profitability declines in boom, they reduce credit -> slowdown (long cycles)
• Nikolaidi (2014): loans as residual finance, banks and firms have target debt ratio for firms
• Delli Gatti et al (2005, 2010): ABM, heterogenous firms, model NK financial accelerator; no explicit demand function; random shocks to net worth of firms, which determines their credit worthiness
Endogenous debt targets

• Nikolaidi (2014), Dafermos (2017)
• Jump et al (2017): heterogeneous firms have debt target, which depends on past experience. In good time firms switch to higher debt target -> destabilises system
Minsky-Veblen

• Households emulate richer peers
• HH expenditures overshoot, HH run into debt
• Debt = consumer credit
• Ryoo and Kim (2014): Kaldorian SFC; workers vs rentiers
• Kapeller and Schutz (2014): SFC, 3 types of HH (skilled and unskilled workers); model bankruptcy
Asset price models

• Taylor and O'Connell (1985) emphasise the destabilising role of the equity market; build on ISLM, minimalist model
• Key variable: Expected rate of return relative to interest rate; can be pos or neg function
• Increase in animal spirits will have pos effect on interest rate (higher transaction demand) and neg effect (substitution to equity); if latter effect is stronger -> instability
• Similar Delli Gatti and Gallegatti (1990): explicit investment function
• Chiarella and Di Guilmi (2011) heterogenous agents; 2 types of firms (speculative and hedge); 2 types of investors (‘fundamentalists’ who like hedge firms, and ‘chartists’, who like speculative firms)
Asset price models 2


• Households’ consumption depends on asset prices and disposable income

• HH portfolio (deposits, equity) depends on interest and expect returns on equity.

• Exp return: depends on past return (similar to momentum traders)

• Can give rise to cycles.
Moment trader model

• At core of Ryoo (2010, 2013a) is a momentum trader model
• Interaction of (overshooting) momentum traders and (stabilising) fundamentalists (Beja and Goldman 1980).
• Note: this is a purely financial cycle (no real-financial interaction)
• Change in $P$ depends on weights of fundis $(a)$ and momentum traders $(b)$

\[ \dot{P} = a(P^F - P) + bE \]
\[ \dot{E} = c(\dot{P} - E) \]
Speculative cycle model (Ryoo)

- Expected rate of return $\uparrow$
  - Demand for equity $\uparrow$
  - Price of equity $\uparrow$
    - Profitability $\uparrow$
      - Debt ratio $\uparrow$
  - Actual rate of return $\uparrow$
Mainstream Minsky models

• Eggertson and Krugman (2012), Farmer (2013) and Bhattacharya et al. (2015): incorporate Minskyan ideas into a mainstream framework
Comparison and comments

• Debt cycles have pro-cyclical leverage (pos effect of growth (investment) on debt) and negative effect of debt on investment (‘debt-burdened’ growth)

• Kalecki-Minsky model: stable goods market + explosive debt relation. Usually emphasise interest rate that rises in boom.

• Kaldor-Minsky: explosive goods market (strong accelerator effects) + dampening debt relation. Some assume non-linear investment function => limit cycles

• Goodwin Minsky: build Minsky mechanism into classical model (with Say’s Law holding); not a Keynesian model, but works via wage share (no cycles if fixed WS)
• Credit rationing models: similar to debt+interest cycles, but volume rather than price adjustment of credit
• Endogenous debt norms: explicitly introduce debt norms, which change over the business cycle
Asset price models

- Asset price models: instability if expected rates of return have strong effects (=> perverse interest movements because of asset substitution)
- Asset price models: Speculative cycles: result from interaction of chartists and fundamentalists with equity prices playing an important role (Tobin’s Q in Inv or wealth effects in Cons), often equity issue as residual form of finance. Can be combined with Kalecki or Kaldorian good markets (with short and long cycles)
Household debt

• Consumer debt: overshooting consumption because of consumption emulation (‘Veblen effects’)

• Asset prices: consumption reacts because of wealth effects
<table>
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<tr>
<th>Author/Model</th>
<th>Stable goods market</th>
<th>Unstable goods market</th>
<th>Non-Keynesian goods market</th>
<th>Corpora...</th>
<th>Real estate prices</th>
<th>Credit rationing</th>
<th>Bankruptcy</th>
<th>Financial regulation</th>
<th>Labour market</th>
<th>Endogenous interest rate</th>
<th>Fiscal policy</th>
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concluding

- Surprising diversity, even regarding key mechanism
- Different modelling approaches: small macro, SFC, ABM...
- Key differences in investment function and the main financial variable (Debt vs asset prices); a few models without explicit demand (Keen, Delli Gatti et al)
- Many aspects could be combined (but then difficult to track analytically) but Kaldorian vs Kaleckian models disagree
- How sensitive are $I$ and $C$ to asset prices?
- How important are debt and equity issue for financing investment at the margin (‘residual source of finance’)
- Overall Minsky literature more advanced theoretically than empirically