Minsky models in post-Keynesian macroeconomics

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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 rigdities etc
- Minskyan firm: has to service debt out of current income, always in danger of bankrupcy; stability is destabilising

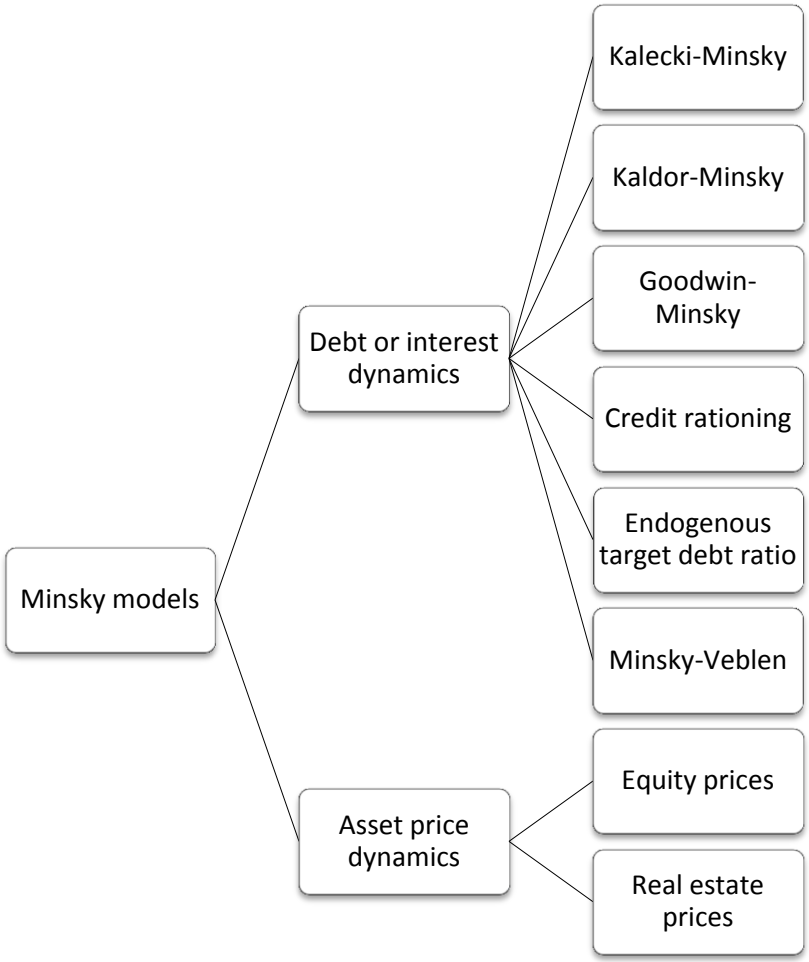
Outline

- 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

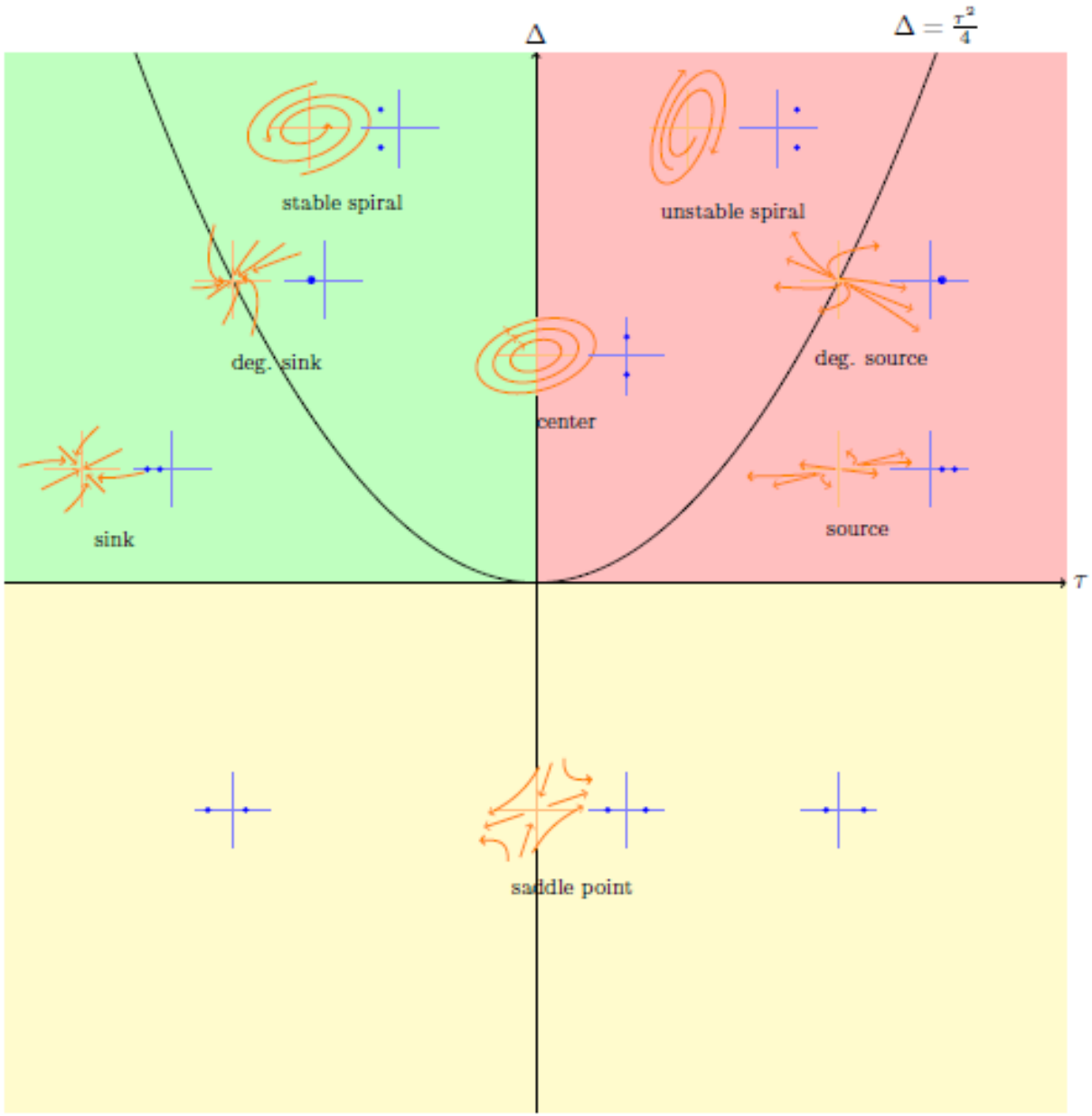


		firms	*households*
Debt cycles	• Debt payments + interest rates • Debt ratio and debt targets		
Asset price cycles	• Equity prices • Real estate prices		

Stability analysis of 2D system

$$\begin{bmatrix} \dot{g} \\ \dot{d} \end{bmatrix} = \begin{bmatrix} J11 & J12 \\ J21 & J22 \end{bmatrix} \begin{bmatrix} g \\ d \end{bmatrix}$$

- Trace = J11+J22
- Det = J11.J22-J12.J21
- Eigenvalues: $\lambda_{1,2} = ½[tr- \sqrt{(tr^2-4det)}]$



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

$$\begin{bmatrix} \dot{g} \\ \dot{d} \end{bmatrix} = \begin{bmatrix} J11 & J12 \\ J21 & J22 \end{bmatrix} \begin{bmatrix} g \\ d \end{bmatrix}$$

- Stable if trace= (J11+J22) <0 and det= (J11.J22-J12.J21)>0
- Eigenvalues: $\lambda_{1,2} = ½[tr- √(tr^2-4det)]$
- Oscillations if $tr^2 < 4.det$
- Local stability: Jacobian evaluate at equilibrium
- Global stability relevant in non-linear system

Closed orbits and limit cycles

- For closed orbits: 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

Kalecki-Minsky	Stable goods mkt, explosive debt
Kaldor-Minsky	Overshooting investment, debt is stabilising
Goodwin-Minsky	Interest payment as another squeeze on business profits

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:

$$\frac{\dot{D}}{K} = g - s_f\left(r - id\right)$$

- **Law of motion of the debt-to-capital ratio**:

$$\dot{d} = \left(\frac{\dot{D}}{K}\right) = \frac{\dot{D}}{K} - \frac{D}{K}\frac{\dot{K}}{K} = \frac{\dot{D}}{K} - dg$$

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.
- The family of Kalecki-Minsky models includes, under certain assumptions, Lima and Meirelles (2007), Charles (2008), Fazzari et al. (2008) and Nishi (2012).

Kaldor-Minsky models

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

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

- 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 bankrupcy

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

- Ryoo (2010, 2013a) full SFC, households, firms and banks. Two versions: Kaleckian and Kaldorian.
- 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.

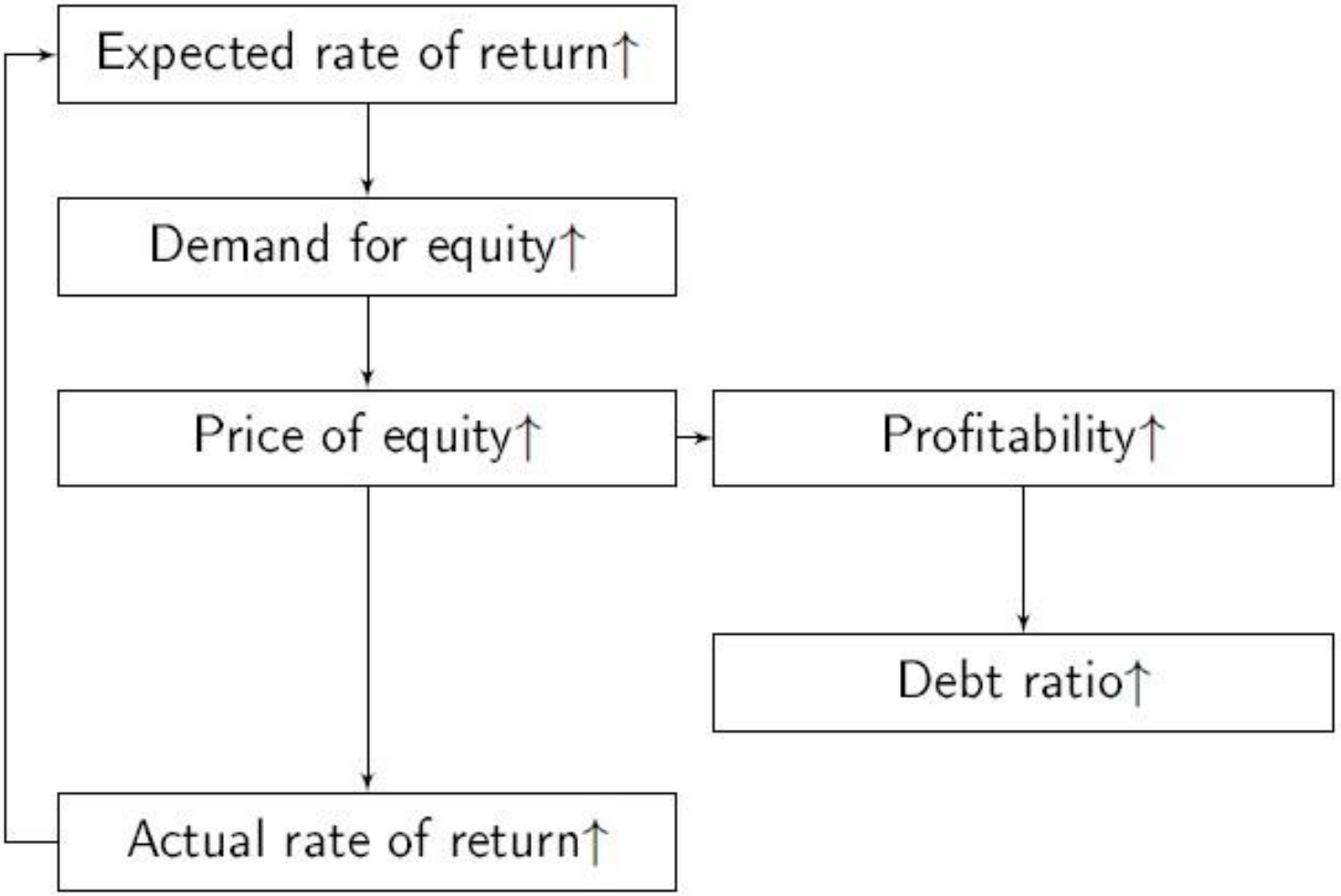
Moment trader model

- 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)



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

		Stable goods market	Unstable goods market	Non-Keynesian goods market	Corporate debt	Household debt	Equity prices	Real estate prices	Credit rationing	Bankruptcy	Financial regulation	Labour market	Endogenous interest rate	Fiscal policy	Hedge, speculative and Ponzi finance regimes	Endogenous stock-flow norms
Kalecki-Minsky	Charles (2008)	ü			ü								ü			
	Fazzari et al. (2008)	ü			ü							ü	ü			
	Lima and Meirelles (2007)	ü			ü								ü		ü	
	Nishi (2012)	ü			ü										ü	
Kaldor-Minsky	Asada (2001)		ü		ü								ü			
	Foley (1987)		ü		ü								ü			
	Jarsulic (1989)		ü		ü								ü			
	Semmler (1987)		ü		ü								ü			
	Skott (1994)		ü		ü											
Goodwin-Minsky	Keen (1995)			ü	ü							ü	ü	ü		
Credit rationing	Delli Gatti et al. (2005, 2010)			ü	ü				ü	ü			ü			
	Nikolaidi (2014)				ü				ü					ü		ü
	Ryoo (2013b)				ü				ü		ü	ü				
Endogenous target debt ratio	Dafermos (2017)													ü		ü
	Jump et al. (2017)				ü										ü	ü
Minsky-Veblen	Kapeller and Schütz (2014)					ü			ü	ü			ü		ü	
	Kapeller et al. (2016)					ü			ü	ü	ü		ü	ü	ü	
	Ryoo and Kim (2014)					ü			ü							
Equity prices	Chiarella and Di Guilmi (2011)				ü		ü			ü			ü		ü	
	Delli Gatti and Gallegati (1990)				ü		ü						ü			
	Delli Gatti et al. (1994)				ü		ü						ü			
	Franke and Semmler (1989)				ü		ü						ü			
	Ryoo (2010, 2013a)				ü		ü		ü			ü				
	Taylor and O'Connell (1985)						ü						ü			

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