# A strategy switching approach to Minskyan business cycles

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# What We Do

- We present a simple, stylised Minsky model in which firms' target debt-output ratio varies over time according to a strategy switching mechanism
- This relies on an approximate aggregation technique borrowed from the heterogeneous agent real business cycle literature
- We demonstrate the existence of limit cycles over a wide range of the parameter space, some nice bifurcations, and (apparently) chaotic dynamics

# Minsky

*"The required margins of safety affect the acceptable financing plans of investing units. The ratio of external financing that is acceptable changes over time to reflect the experience of economic units and the economy with debt-financing. If recent experience is that outstanding debts are easily serviced, then were will be a tendency to stretch debt ratios; if recent experience includes episodes in which debt-servicing has been a burden and representative units have not fulfilled debt contracts, then acceptable debt ratios will decrease."*

*(Minsky 2008 [1986]: 209)*

# Existing Literature

- Most of the literature surveyed in Nikolaidi and Stockhammer (2017) focuses on aggregate dynamics
- However, as Taylor and O'Connell (1985) observe, "shifts of firms among classes as the economy evolves in historical time underlie much of its cyclical behaviour"
- This is reflected in Minsky's writing, where firms clearly learn from their recent experience and from each other
- Minsky appears to be talking about **strategy switching** - evolving heterogeneity in firm behaviour

# Existing Literature

- Two clusters of the literature consider firm-level heterogeneity in formal Minskyan models:
  1. A group of papers by Delli Gatti et al in the early 1990s, which argue that composition effects lead to procyclical investment propensities and leverage ratios
  2. A group of papers following Chiarella and Di Guilmi (2011) which allow for firm investment rates to depend on strategy switching in the stock market (between chartists and fundamentalists)
- There are also a small number of papers that propose that the aggregate target debt-output ratio or the state of confidence vary over the business cycle

# Our contribution

- None of the previously mentioned papers explicitly model strategy switching at the level of the firm
- Moreover, the recent papers following Chiarella and Di Guilmi (2011) rely on intensively numerical techniques, including agent based modelling and stochastic differential equations
- Our contribution is to introduce **explicit strategy switching** into the Minskyan literature, and do so in a highly transparent manner
- We appeal to the usual benefits of "small models"

# A linear model

- Our model is essentially a multiplier accelerator model (structurally similar to the Phillips (1954) model)
- The **corporate debt market** is the only functioning financial market - equity has e.g. strong signalling problems or firms have a strong pecking order preference
- In addition, there are (some form of) bankruptcy costs increasing in the debt to output ratio
- So a zero debt to output ratio is unprofitable, but a very large debt to output ratio is also unprofitable - this implies the existence of an **optimum debt to output ratio**

# A linear model

- Some form of **adjustment costs** in the debt stock mean that firms partially adjust their debt stock towards the optimum debt to output ratio
- At the same time, costs to output adjustment mean that firms partially adjust their production towards observed consumption and investment demand
- Meanwhile, the absence of functioning financial markets is consistent with a two class household structure - workers consume their wages and capitalists save (in the usual manner)

# The linear reduced form

- Using the assumptions above and various accounting identities, a **linearised** 2D reduced form model is found:

$$\dot{Y} = \alpha\gamma v Y - \alpha(\gamma + r)D$$

$$\dot{D} = \gamma(vY - D)$$

- Note the variables are in deviations from steady state!

- All we need to do to complete the model is to specify how $v$ varies over the business cycle

# Strategy choice

- Consider a production sector comprising a large number of firms
- We suppose that firms can play a "hedge" strategy defined by $v^h$, or a "speculative" strategy defined by $v^s$, where $v^h < v^s$
- The proportion of firms playing strategy $v^h$ is given by $n$, and the probability of firms playing strategy $v^s$ is given by $1 - n$
- Following Brock and Hommes (1997) and Hommes et al (2005), $n$ is increasing in $Z = \theta(rD - \varsigma Y) + (1 - \theta)Y^2$

# Final reduced form

- The final reduced form model is,

$$\dot{Y} = \alpha\gamma \left[ v^s + n(v^h - v^s) \right] Y - \alpha(\gamma + r)D \tag{1}$$

$$\dot{D} = \gamma \left[ v^s + n(v^h - v^s) \right] Y - \gamma D \tag{2}$$

$$\dot{n} = \mu \left[ \frac{e^Z}{e^Z + e^{-Z}} - n \right] \tag{3}$$

with

$$Z = \theta(rD - \varsigma Y) + (1 - \theta)Y^2 \tag{4}$$

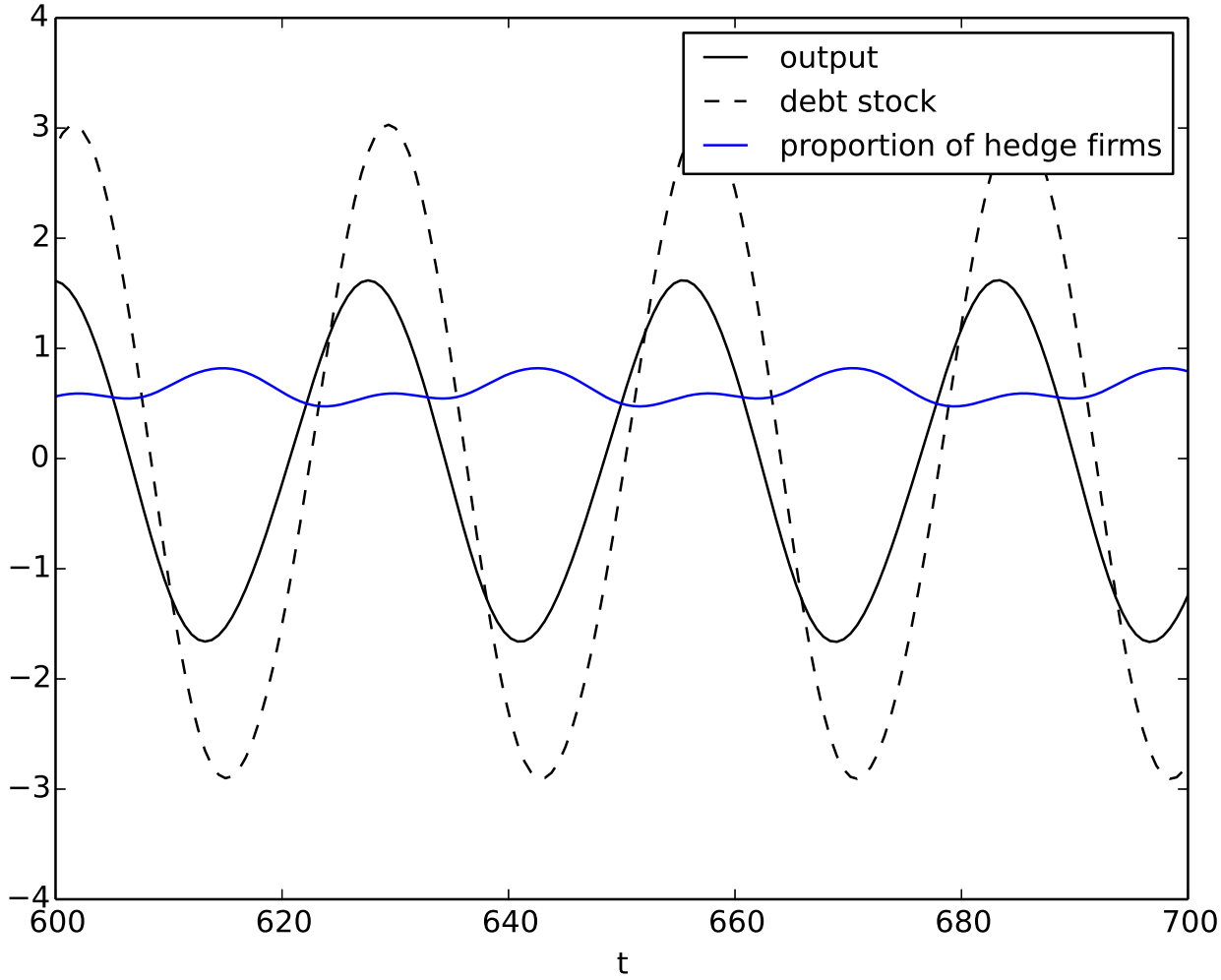
# Results - intuition

- The model produces **endogenous business cycles** driven by an accelerator mechanism - investment increases when debt stocks are low, and decreases when debt stocks are high. Debt stocks follow investment, and if the propensity to invest is strong, overshooting leads to oscillations
- On top of this, when the economy is perceived to be volatile the target debt ratio (thus propensity to invest) decreases - stabilising the model - and when the economy is perceived to be tranquil the target debt ratio (thus propensity to invest) increases - destabilising the model
- So **stability is destabilising** (and vice versa!)

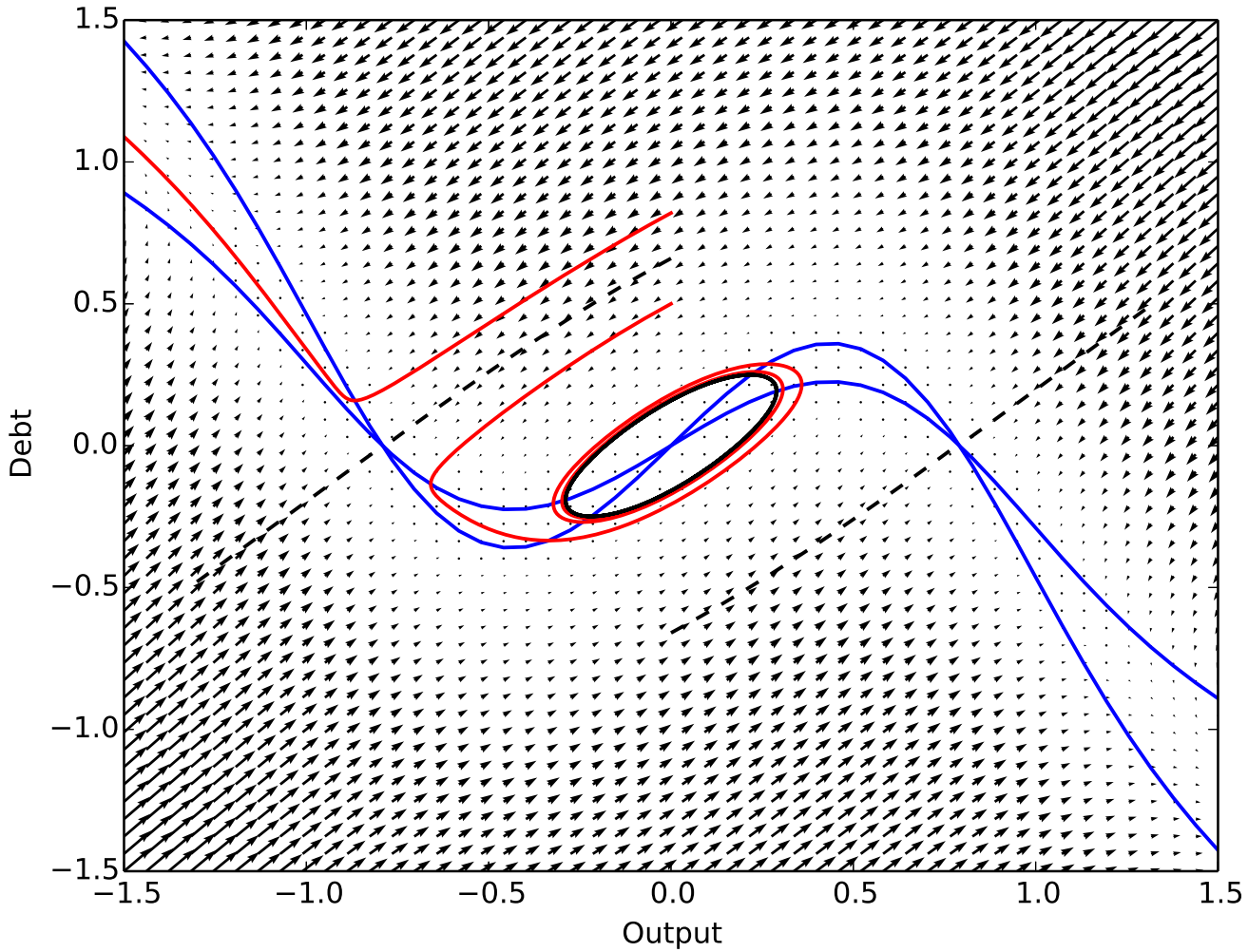
# Results - formal

- We demonstrate a number of results:

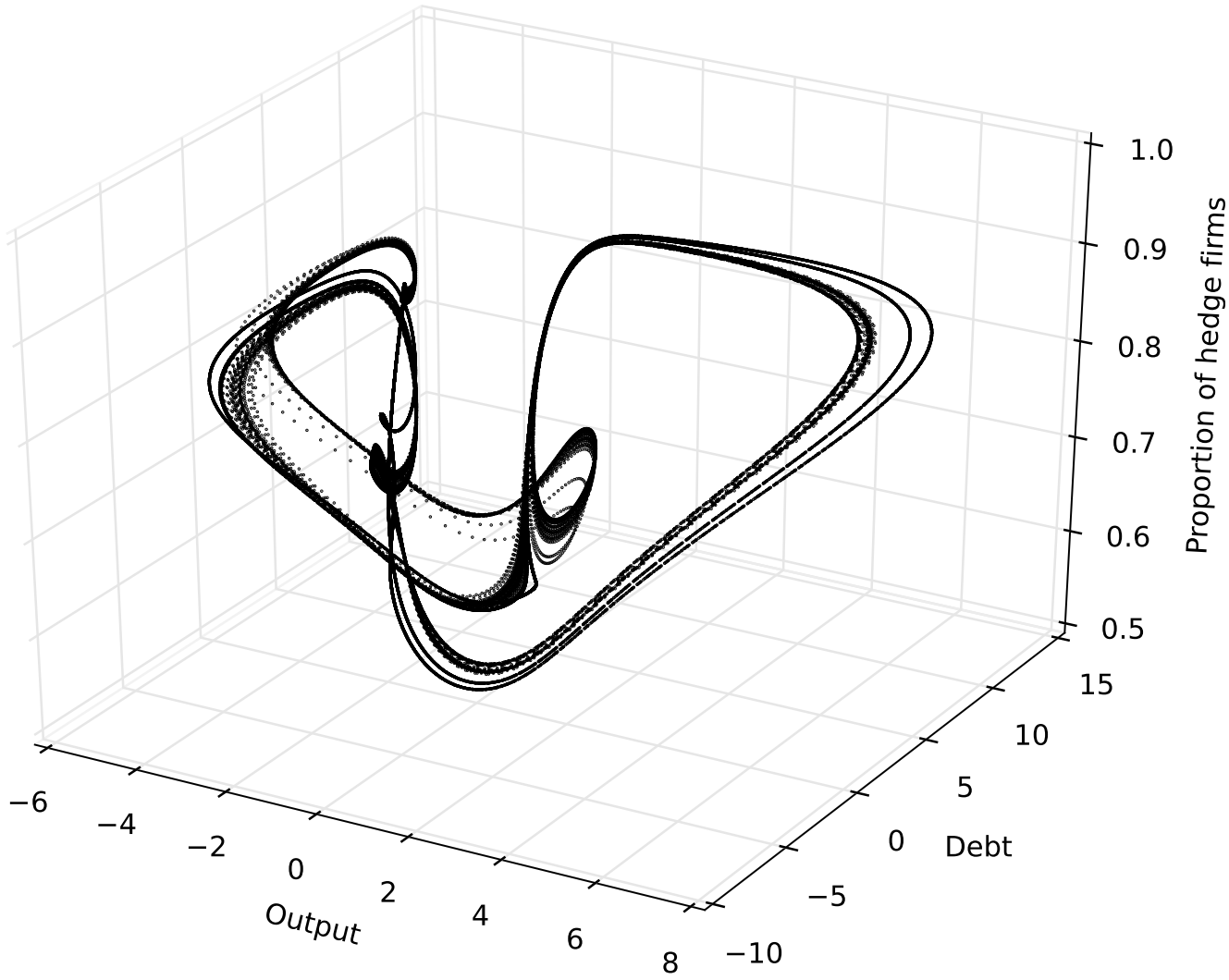
1. When $v^h > 0$, the model has a unique equilibrium at $Y = D = 0$, $n = 0.5$
2. When $v^h < 0$, the model retains the equilibrium at $Y = D = 0$, $n = 0.5$, which is now surrounded by two further saddle point equilibria
3. The model undergoes a Hopf bifurcation around the central equilibrium at $v^{eq} = \frac{v^h + v^s}{2} = \frac{1}{\alpha}$
4. A corridor of stability can exist, leading to homoclinic and heteroclinic bifurcations
5. Chaotic dynamics (apparently) exist




Simulation of the aggregate model, $\alpha = \gamma = 0.5$, $v^h = 1.8$, $v^s = 2.4$, $r = 0.1$, $\varsigma = 0.4$, $\theta = 0.8$, $\mu = 0.5$




Phase portrait of A simplified 2D model, $\alpha = 0.9$, $\gamma = 0.5$, $v^h = -1$, $v^s = 3.5$, $r = 0.3$, $\varsigma = 0.4$




Strange attractor (apparently), $\alpha = \gamma = 0.5$, $v^h = -1.5$, $v^s = 19$, $r = 0.1$, $\varsigma = 0.4$, $\theta = 0.5$, $\mu = 0.5$