Discussion of

“A Macroeconomic Model with a Financial Sector”
by Brunnermeier and Sannikov

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Huberto M. Ennis*
Research Department
Federal Reserve Bank of Richmond

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*The views here do not necessarily represent those of the Richmond Fed or the Federal Reserve System
The goal of the paper

- Study how limits to the amount of leverage by productive agents can have important implications for the dynamics of aggregate variables (like output) in the economy.

- The authors develop a dynamic stochastic general equilibrium economy (in continuous time) and study global dynamics.

- They also use the model (under reasonable extensions) to study externalities and securitization.

- This is an impressive and ambitious piece of technical work.

- But beware: this is no paper for beginners (in the continuous-time literature).
What they show

- In the benchmark economy, aggregate net worth and the price of capital can display, occasionally, significant departures from their modal values (i.e., where they spend most of the time) → situations that look like “downward spirals” in prices and “feedback loops”

- Price volatility increases when the economy enters these downward spirals

- Externalities may result on excessive exposure to this type of event

- ... and many other (potentially) very interesting things

- Being a beginner, though, I could not get pass the benchmark economy and trying to understand the economics of what was going on there → this is what I will talk about (...what else could I do?)
My version of the benchmark economy

- There is a large number agents (called experts) which own capital $k_t$ and have a technology of production $y_t = a k_t$

- Capital (is irreversible, I think, and) depreciates at a (common to all experts) random rate with mean $\delta$ (→ the exogenous aggregate shock in the economy)

- Experts

  - consume output
  
  - are risk-neutral $\rightarrow u(c_t) = c_t$
  
  - discount the future at rate $\rho$
• Experts can also:

  – invest to increase their capital stock (but there are “adjustment costs”)

  – trade capital (among each other) in a competitive market at the endogenous equilibrium price $p_t$, which they (of course) take as given (also, there is a natural lower bound on $p_t$)

  – borrow at a fix rate $r < \rho$ (from, say, an ATM machine) and have to always repay their debt $d_t$

• Expert net worth, $n_t = p_t k_t - d_t$ is restricted to be always greater than (or equal) to zero

• There are well-crafted justifications for these restrictions in the paper (but these reduced-forms are what is ultimately used for solving the model)
What happens in this economy?

Suppose we want to study a discrete-time version (recursively)

- The agent’s problem:

\[
V(k_t, d_t, K_t, D_t) = \max \left\{ c_t + \frac{1}{1 + \rho} E \left[ V(k_{t+1}, d_{t+1}, K_{t+1}, D_{t+1}) \right] \right\}
\]

subject to

\[
\begin{align*}
 ak_t + (d_{t+1} - d_t) &= c_t + \iota(i_t) + rd_t + p_t s_t \\
 k_{t+1} &= i_t + s_t + (1 - (\delta + \varepsilon_t)) k_t \\
 n_t &= p_t k_t - d_t \geq 0
\end{align*}
\]

where \( s_t \) is purchases/sales of new capital and \( \varepsilon_t \) is a random variable with mean zero

- Market clearing for capital: \( s_t = 0 \); and \( K_t = k_t \) and \( D_t = d_t \)

(representative agent)
• Solving for an equilibrium is not easy (for many reasons, as far as I can tell → not just the non-negativity constraint on $n_t$ → also risk-neutrality, $ak$ technology, $r < \rho$)

• Some conjectures: Given a sequence of equilibrium prices so that $s_t = 0$, what does the agent want to do?

  – the agent is risk-neutral and can borrow at a rate lower than the discount rate → borrowing seems attractive

  – but the constraint on $n_t$ implies that, eventually, the agent has to sacrifice consumption to repay (cannot roll over ballooning debt)

  – in order to repay debt the agent has to produce output (and not consume all) or sell capital → hence, it is not always optimal to borrow to consume

  – in fact, if $a$ or $p_t$ is expected to be high tomorrow then the agent may want to delay consumption
• The authors solve for an equilibrium in a continuous-time version (makes solving actually possible)

• They can actually characterize the global dynamics in the economy

• They find that:
  
  – agents consume only when aggregate net worth $\eta_t$ reaches a threshold $\eta^*$
  
  – the price of capital $p_t$ is increasing in $\eta_t$
  
  – the aggregate level of net worth stays most of the time near $\eta^*$ but, occasionally, may “spiral” down and stay for some time in a low level (away from $\eta^*$)
  
  – prices $p_t$ follow $\eta_t$ down the spiral!
Some closing remarks

- The solution method is (very far) from trivial, and understanding what is going on in the equilibrium is very hard (i.e., it was for me)

- What is driving things? Which features of the model are responsible for the main findings?

- In my opinion, the occasional downward spirals in net worth and prices are really interesting, and potentially very important → note that the downward spirals happen in the unique equilibrium, without externalities of any sort

- We need to know more about them: why and how they happen (in the model)? how robust are they? how important quantitatively? would downward spirals happen away from steady state in most Kiyotaki-Moore type of economies?
• Kocherlakota’s (2000) dictum → not too hard to write an economy in which credit constraints amplify and propagate exogenous shocks

  – but, is such an economy *relevant* qualitatively and quantitatively?

  – Kocherlakota writes down one (that appears to be) not quantitatively relevant (and there are many other examples)

  – results are based on analysis “around” the steady state

• Brunnermeier and Sannikov study global dynamics but in what appears to be a very stylized economy

• They show that large aggregate (partly endogenous) fluctuations can happen in equilibrium (sometimes?) → how robust is this finding, qualitatively and quantitatively?

  In my (small) mind this remains an open question

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