

Fields Institute Seminars

Tuesday June 5th 2012
A Primer on Endogenous Money

Money: Endogenous or Irrelevant?

- The conventional Neoclassical view
 - Banks merely intermediaries between savers & borrowers
 - Level of private debt irrelevant to macroeconomics
 - Banks, debt (& money!) can be ignored in macroeconomics
- Versus the endogenous money view
 - Banks crucial actors in own right in macroeconomics
 - Level of private debt vitally important
 - Banks, debt & money must be centre stage in economics

Banks: the Neoclassical view

- Macroeconomics can ignore banks:
 - “I’m all for including the banking sector in stories where it’s relevant; but why is it so crucial to a story about debt and leverage?” ([Krugman 2012](#))
- Banks mere intermediaries:
 - “If I decide to cut back on my spending and stash the funds in a bank, which lends them out to someone else, this doesn’t have to represent a net increase in demand.
 - Yes, in some (many) cases lending is associated with higher demand, because resources are being transferred to people with a higher propensity to spend;
 - but Keen seems to be saying something else, and I’m not sure what. I think it has something to do with the notion that creating money = creating demand, but again that isn’t right in any model I understand.”

Debt: the Neoclassical view

- Level of debt irrelevant—only distribution can matter
 - “The idea of debt-deflation goes back to Irving Fisher (1933). Fisher envisioned a dynamic process in which falling asset and commodity prices created pressure on nominal debtors, forcing them into distress sales of assets, which in turn led to further price declines and financial difficulties. ..
 - Fisher's idea was less influential in academic circles, though, because of the counterargument that debt-deflation represented no more than a redistribution from one group (debtors) to another (creditors).
 - Absent implausibly large differences in marginal spending propensities among the groups, it was suggested, pure redistributions should have no significant macro-economic effects...” (Bernanke 2000, p. 24)

Money: the Neoclassical view

- Money should only have nominal effects:
 - “It is natural (to an economist) to view the cyclical correlation between real output and prices as arising from a volatile aggregate demand schedule
 - that traces out a relatively stable, upward-sloping supply curve.
 - This point of departure leads to something of a paradox, since
 - *the absence of money illusion on the part of firms and consumers appears to imply a vertical aggregate supply schedule,*
 - which in turn implies that aggregate demand fluctuations of a purely nominal nature should lead to price fluctuations only.” (Lucas 1972, p. 51; emphasis added)

Crisis: A Neoclassical View

- Crisis forced Neoclassicals to consider debt:
 - “Given both the prominence of debt in popular discussion of our current economic difficulties
 - and the long tradition of invoking debt as a key factor in major economic contractions,
 - one might have expected debt to be at the heart of most mainstream macroeconomic models—especially the analysis of monetary and fiscal policy.
 - Perhaps somewhat surprisingly, however, it is quite common to abstract altogether from this feature of the economy.”

Crisis: A Neoclassical View

- “Even economists trying to analyze the problems of monetary and fiscal policy at the zero lower bound
- —and yes, that includes the authors—
- have often adopted representative-agent models in which everyone is alike, and in which the shock that pushes the economy into a situation in which even a zero interest rate isn’t low enough takes the form of a shift in everyone’s preferences.” (Krugman & Eggertsson 2010, p. 2)
- Krugman’s model with debt:
 - “Ignoring the foreign component, or looking at the world as a whole, the overall level of debt makes no difference to aggregate net worth — one person’s liability is another person’s asset.” (p. 3)

Crisis: A Neoclassical View

- “In what follows, we begin by setting out a flexible-price endowment model in which “impatient” agents borrow from “patient” agents
 - [where what is borrowed is not money, but “risk-free bonds denominated in the consumption good” (p. 5)]
- but are subject to a debt limit.
- If this debt limit is, for some reason, suddenly reduced, the impatient agents are forced to cut spending;
- if the required deleveraging is large enough, the result can easily be to push the economy up against the zero lower bound.
- If debt takes the form of nominal obligations, Fisherian debt deflation magnifies the effect of the initial shock.” (p. 3)

Lending: the Neoclassical view

- Banks mere intermediaries between agents
- Money as “loanable funds”
- Patient lends to Impatient



- Patient’s spending power goes down
- Impatient’s spending power goes up
- No change in aggregate demand
- Banks mere intermediaries (ignored in analysis)

The Endogenous Money View

- A neglected idea with a long pedigree
 - “Money means are created, and the command of capital is supplied, **without cost or sacrifice on the part of any saver.**” (Taussig 1911, p. 357)
 - “[I]n so far as credit cannot be given out of the results of past enterprise ... it can only consist of credit means of payment created ad hoc, which can be backed neither by money in the strict sense nor by products already in existence...
 - It provides us with the connection between lending and credit means of payment, and leads us to what I regard as the nature of the credit phenomenon... *credit is essentially the creation of purchasing power for the purpose of transferring it to the entrepreneur, but not simply the transfer of existing purchasing power.*” (Schumpeter 1934, pp. 106-107)

The Endogenous Money View

- Two consequences:
 - Banks (& money) are essential to understanding capitalism
 - “this again leads us to ... the heresy that money ... perform[s] an essential function, hence that processes in terms of means of payment are not merely reflexes of processes in terms of goods.
 - In every possible strain, with rare unanimity, even with impatience and moral and intellectual indignation, a very long line of theorists have assured us of the opposite...”
 - **Aggregate demand exceeds income**
 - “From this it follows, therefore, that in real life total credit must be greater than it could be if there were only fully covered credit. The credit structure projects not only beyond the existing gold basis, but also beyond the existing commodity basis.” (Schumpeter 1934 , pp. 95, 101)

The Endogenous Money View

- Schumpeter: growth in credit money funds entrepreneurs
 - “Even though the conventional answer to our question is *not obviously absurd*, yet there is another method of obtaining money for this purpose,
 - which ... does not presuppose the existence of accumulated results of previous development, and hence may be considered as the only one which is available in strict logic.
 - This method of obtaining money is the creation of purchasing power by banks...
 - It is always a question, not of transforming purchasing power which already exists in someone's possession, but of **the creation of new purchasing power out of nothing...**” (Schumpeter 1934, p. 73)

The Exogenous Money Rejoinder

- “out of nothing” proposition derided by Neoclassicals:
 - “banks are a clever but somewhat dangerous form of financial intermediary, one that exploits the law of large numbers to offer a better tradeoff between liquidity and returns, but does so at the cost of taking on very high leverage, with all the risks that entails...
 - But that’s a quantitative thing, not a qualitative thing...
 - banks don’t change the basic notion of interest rates as determined by liquidity preference and loanable funds — yes, both, because the [message of IS-LM](#) is that both views, properly understood, are correct.
 - *Banks don’t create demand out of thin air any more than anyone does by choosing to spend more; and banks are just one channel linking lenders to borrowers.”* ([Krugman 2012](#))

The Exogenous Money Rejoinder

- **Update:** It’s obvious that many commenters don’t get the distinction between the proposition that banks create money — which every economics textbook, mine included, says they do (*that’s what the money multiplier is all about*) — and the proposition that their ability to create money is not constrained by the monetary base. Sigh.
- I often see the view that banks can create credit out of thin air. There are vehement denials of the proposition that banks’ lending is limited by their deposits, or that the monetary base plays any important role; banks, we’re told, hold hardly any reserves (which is true), so the Fed’s creation or destruction of reserves has no effect.
- This is all wrong, and if you think about how the people in your story are assumed to behave—as opposed to getting bogged down in abstract algebra—it should be obvious that it’s all wrong.

The Exogenous Money Rejoinder

- First of all, any individual bank does, in fact, have to lend out the money it receives in deposits.
- Bank loan officers can't just issue checks out of thin air; like employees of any financial intermediary, they must buy assets with funds they have on hand...
- But the usual claim runs like this: sure, this is true of any individual bank, but the money banks lend just ends up being deposited in other banks, so there is no actual balance-sheet constraint on bank lending, and no reserve constraint worth mentioning either.
- That sounds more like it — but it's also all wrong.

The Endogenous Money View

- Yes, a loan normally gets deposited in another bank—
- but the recipient of the loan can and sometimes does quickly withdraw the funds, not as a check, but in currency.
- And currency is in limited supply — with the limit set by Fed decisions.
- So there is in fact no automatic process by which an increase in bank loans produces a sufficient rise in deposits to back those loans,
- and a key limiting factor in the size of bank balance sheets is the amount of monetary base the Fed creates — *even if banks hold no reserves.*
- So how much currency does the public choose to hold, as opposed to stashing funds in bank deposits?

The Exogenous Money Rejoinder

- Well, that's an economic decision, which responds to things like income, prices, interest rates, etc....
- In other words, we're firmly back in the domain of ordinary economics, in which decisions get made at the margin and all that.
- Banks are important, but they don't take us into an alternative economic universe.
- Now, under current conditions — that is, in a liquidity trap — the monetary base is indeed irrelevant at the margin, because people are indifferent between zero interest public liabilities of all kinds.
- That's why there are no immediate policy differences between some of the monetary heterodoxies and what IS-LMists like me are saying. But that's not the way things normally are.
- Feel free to start yelling.” ([Krugman 2012](#))

Something new

- Plenty of existing theoretical *and empirical* evidence against this
- But firstly something new: explaining money creation with double-entry bookkeeping
- Starting point:
 - “Bank loan officers can't just issue checks out of thin air; like employees of any financial intermediary, they must buy assets with funds they have on hand...”
- True; but banks start with an intangible but valuable asset: a banking licence
 - Model of this coming...
- But first some personal History of Economic Thought
 - My first forays into strictly monetary macroeconomics began with strict ODEs:

Some personal History of Economic Thought (HET)

- 1st key slide at 2006 Post Keynesian conference, UMKC

Modelling endogenous money dynamically

- First complete (but still simple!) system is:

$$\frac{d}{dt}K_D = r_d K_D - (r_d K_D + R_p K_D)$$

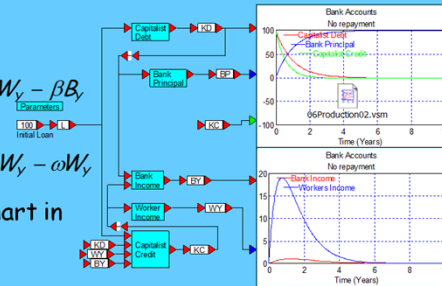
$$\frac{d}{dt}K_C = r_c K_C - (r_d K_D + R_p K_D) - PK_C + \pi PK_C + \omega W_Y + \beta B_Y$$

$$\frac{d}{dt}B_p = R_p K_D$$

$$\frac{d}{dt}B_Y = r_d K_D - r_c K_C - r_c W_Y - \beta B_Y$$

$$\frac{d}{dt}W_Y = (1 - \pi)PK_C + r_c W_Y - \omega W_Y$$

- Simulated as flowchart in systems engineering software:



Some personal HET

- Second key slide: endogenous money creation

Reconciling Accommodationists & Structuralists...

- Final model

$$\frac{d}{dt}K_D = r_d K_D - (r_d K_D + R_p K_D) + \text{Sraa} \text{ RESB}_p$$

$$\frac{d}{dt}K_C = r_c K_C - (r_d K_D + R_p K_D) - PK_C + \pi PK_C + \omega W_Y + \beta B_Y \text{ Sraa} \text{ RESB}_p$$

$$\frac{d}{dt}B_p = R_p K_D \text{ Sraa} + (n \text{ RESB}_m) B_p$$

- Includes Moore's "Lines of credit Horizontalism"...

$$\frac{d}{dt}B_Y = r_d K_D - r_c K_C - r_c W_Y - \beta B_Y$$

- And Dow's (et al.) "structuralist" active role for banks...

$$\frac{d}{dt}W_Y = (1 - \pi)PK_C + r_c W_Y - \omega W_Y$$

- Foundation for proper transactions modeling of Minsky
 - Behavioral relations replace constant parameters
 - Investment expectations generate new money
 - Bank rationing controls money reflux
- Presentation caused furore in overflowing room...

Some personal HET

- Partly due to lack of knowledge of dynamic methods
 - The MEGO Effect: “My Eyes Glaze Over” (Trond Andresen)
- Partly due to different methodology
 - After-presentation discussion with Scott Fullwiler
 - “You must have made a mistake in double-entry bookkeeping” (DEB)
- Didn’t know much about DEB then
 - But I know my ODEs! No mistakes there, so I thought...
 - “wonder if I could explain models using a table”?
 - Worked out that I could...
 - Next key presentation, ICAPE in Salt Lake City, 2007...

Some personal HET

- Introductory slide:

Genesis, Book One...

- In the beginning was the ODE:

$$\frac{d}{dt}F_L = +L_R \cdot B_R - R_L \cdot F_L + F_I \cdot F_D$$

$$\frac{d}{dt}F_D = (r_D F_D - r_L F_L) - (1-s) \cdot P \cdot F_D + (\omega \cdot W_D + \beta \cdot B_D) + (L_R \cdot B_R - R_L \cdot F_L) + F_I \cdot F_D$$

$$\frac{d}{dt}B_D = (r_L F_L - r_D F_D) - r_D \cdot W_D - \beta \cdot B_D$$

$$\frac{d}{dt}W_D = (1-s) \cdot P \cdot F_D + r_D \cdot W_D - \omega \cdot W_D$$

$$\frac{d}{dt}B_R = +R_L \cdot F_L - L_R \cdot B_R$$

- And the audience looked upon it and said:
 - *“Verily, we don’t get it”*
- And there was much wailing and nashing of teeth
 - *By the presenter...*
- And lo, the audience said:
 - *“Your double-entry bookkeeping must be stuffed!”*
- And the presenter had an idea...
 - *A “double entry bookkeeping” approach to systems...*

Some personal HET

- Restated **original system of ODEs** in tabular form:

A simple approach to dynamic systems

- Each column represents a particular stock (system state)
- Each row entry represents a flow between stocks
- Specify relations between system states across rows...

Dynamic System					
"System States"					
	Stock A	Stock B	...	Stock Z	Accounting
	+ Flow 1	- Flow 1	→ Relations →		Sum(=0)
Flows	...	...	+ Flow 2	- Flow 2	Sum

$\frac{d}{dt} A(t)$ $\frac{d}{dt} B(t)$ $\frac{d}{dt} Z(t)$

- To generate the model, add up each column
 - Sum of column is "differential equation" for stock

Some personal HET

- Initial **constant money stock** model:

Complete model:

- Whole model is:

Bank Assets & Liabilities					
Flows	Assets		Liabilities		SAM
	Firm Loan (FL)	Firm Deposit (FD)	Banker Deposit (BD)	Worker Deposit (WD)	Sum
Interest flows initiated by loan	0	+ $r_D \cdot F_D$ - $r_L \cdot F_L$	+ $r_L \cdot F_L$ - $r_D \cdot F_D$	0	0
Wage flow to initiate production		- $w \cdot F_D$		+ $w \cdot F_D$	0
Interest income flows from wages			- $r_D \cdot W_D$	+ $r_D \cdot W_D$	0
Flows from sale		+ $\omega \cdot W_D$ + $\beta \cdot B_D$	- $\beta \cdot B_D$	- $\omega \cdot W_D$	0

- Equations of motion read down the columns: e.g., F_D :...

$$\frac{d}{dt} F_D = (r_D F_D - r_L F_L) - w \cdot F_D + (\omega \cdot W_D + \beta \cdot B_D)$$

Some personal HET

- Extension to endogenous money growth...

Model with Growth

- System is now "dissipative" ²
 - Sum of SAM exceeds ² zero
- Endogenous creation of money

1 Bank Assets & Liabilities					
Flows	Assets		Liabilities		SAM
	Firm Loan (FL)	Firm Deposit (FD)	Banker Deposit (BD)	Worker Deposit (WD)	Income

This bit riled some people... Sum of row > 0

1 Bank Reserves		
Time	Reserves	Capital
Investment by firms	$+F_L, F_D - F_L, F_D$	0
SAM	Sum	$+F_L, F_D$

- "Walras Law" violated in growing economy
 - Sum of excess demands > 0
 - Sum of MAM > 0: not all entries are transactions

Some personal HET

- Next step—using computer algebra program (Mathcad) to generate ODEs from table automatically:
- Input flow terms in matrix:

Sample :=	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 2px 10px;">"Type"</td> <td style="padding: 2px 10px;">1</td> <td style="padding: 2px 10px;">-1</td> <td style="padding: 2px 10px;">-1</td> <td style="padding: 2px 10px;">-1</td> </tr> <tr> <td style="padding: 2px 10px;">"Account"</td> <td style="padding: 2px 10px;">"Firm Loan (FL)"</td> <td style="padding: 2px 10px;">"Firm Deposit (FD)"</td> <td style="padding: 2px 10px;">"Bank Deposit (BD)"</td> <td style="padding: 2px 10px;">"Worker Deposit (WD)"</td> </tr> <tr> <td style="padding: 2px 10px;">"Account"</td> <td style="padding: 2px 10px;">$F_L(t)$</td> <td style="padding: 2px 10px;">$F_D(t)$</td> <td style="padding: 2px 10px;">$B_D(t)$</td> <td style="padding: 2px 10px;">$W_D(t)$</td> </tr> <tr> <td style="padding: 2px 10px;">"Interest on Loan"</td> <td style="padding: 2px 10px;">0</td> <td style="padding: 2px 10px;">$-\rho_L F_L(t)$</td> <td style="padding: 2px 10px;">$\rho_L F_L(t)$</td> <td style="padding: 2px 10px;">0</td> </tr> <tr> <td style="padding: 2px 10px;">"Interest on Deposit"</td> <td style="padding: 2px 10px;">0</td> <td style="padding: 2px 10px;">$\rho_D F_D(t)$</td> <td style="padding: 2px 10px;">$-(\rho_D F_D(t))$</td> <td style="padding: 2px 10px;">0</td> </tr> <tr> <td style="padding: 2px 10px;">"Wages"</td> <td style="padding: 2px 10px;">0</td> <td style="padding: 2px 10px;">$-w F_D(t)$</td> <td style="padding: 2px 10px;">0</td> <td style="padding: 2px 10px;">$w F_D(t)$</td> </tr> <tr> <td style="padding: 2px 10px;">"Consumption"</td> <td style="padding: 2px 10px;">0</td> <td style="padding: 2px 10px;">$\beta B_D(t) + \omega W_D(t)$</td> <td style="padding: 2px 10px;">$-\beta B_D(t)$</td> <td style="padding: 2px 10px;">$-\omega W_D(t)$</td> </tr> </table>	"Type"	1	-1	-1	-1	"Account"	"Firm Loan (FL)"	"Firm Deposit (FD)"	"Bank Deposit (BD)"	"Worker Deposit (WD)"	"Account"	$F_L(t)$	$F_D(t)$	$B_D(t)$	$W_D(t)$	"Interest on Loan"	0	$-\rho_L F_L(t)$	$\rho_L F_L(t)$	0	"Interest on Deposit"	0	$\rho_D F_D(t)$	$-(\rho_D F_D(t))$	0	"Wages"	0	$-w F_D(t)$	0	$w F_D(t)$	"Consumption"	0	$\beta B_D(t) + \omega W_D(t)$	$-\beta B_D(t)$	$-\omega W_D(t)$
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"Wages"	0	$-w F_D(t)$	0	$w F_D(t)$																																
"Consumption"	0	$\beta B_D(t) + \omega W_D(t)$	$-\beta B_D(t)$	$-\omega W_D(t)$																																

- Process with simple program: • Generate system:

```

SystemODEs(x) :=
  Functions ← submatrix(x, 2, 2, 1, cols(x) - 1)
  Equations ← submatrix(x, 3, rows(x) - 1, 1, cols(x) - 1)
  for i ∈ 0..cols(Functions) - 1
    E_i ← d/dt Functions_i = ∑ Equations_i
  return E

SystemODEs(Sample) →
  (
    d/dt F_L(t) = 0
    d/dt F_D(t) = β · B_D(t) + ω · W_D(t) - w · F_D(t) + ρ_D · F_D(t) - ρ_L · F_L(t)
    d/dt B_D(t) = ρ_L · F_L(t) - ρ_D · F_D(t) - β · B_D(t)
    d/dt W_D(t) = w · F_D(t) - ω · W_D(t)
  )
    
```

Some personal HET

- Still using “single entry” from accountant’s point of view...
- Some rows summed to zero... some didn’t:
- Some didn’t:

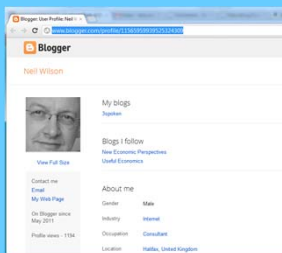
$$CC_3 := \begin{pmatrix} \text{"Type"} & 0 & 0 & 1 & -1 & -1 \\ \text{"Account"} & \text{"Bank Equity"} & \text{"Bank Transactions"} & \text{"Firm Loan"} & \text{"Firm Deposit"} & \text{"Worker Deposit"} \\ \text{"Symbol"} & B_E(t) & B_T(t) & F_L(t) & F_D(t) & W_D(t) \\ \hline \text{"Record Loan"} & 0 & 0 & A & 0 & 0 \\ \text{"Compound debt"} & 0 & 0 & B & 0 & 0 \\ \text{"Pay interest"} & 0 & C & 0 & -C & 0 \\ \text{"Record payment"} & 0 & 0 & -C & 0 & 0 \\ \text{"Deposit interest"} & 0 & -D & 0 & D & 0 \\ \text{"Wages"} & 0 & 0 & 0 & -E & E \\ \text{"Deposit interest"} & 0 & -F & 0 & 0 & F \\ \text{"Consumption"} & 0 & -G & 0 & G + H & -H \\ \text{"Repay Loan"} & I & 0 & 0 & -I & 0 \\ \text{"Record Repayment"} & 0 & 0 & -I & 0 & 0 \\ \hline \text{"Gov Policy Banks"} & K & 0 & 0 & 0 & 0 \\ \text{"Gov Policy Households"} & 0 & 0 & 0 & 0 & L \end{pmatrix}$$

Some personal HET

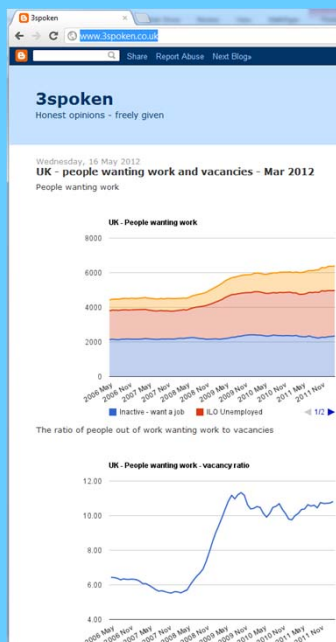
- I saw no problem
 - Underlying ODEs still correct
 - Various necessary equalities maintained (“loans=deposits”)
- But violated accounting’s double-entry bookkeeping rule:
 - “All rows must sum to zero”
- Still didn’t worry me
 - Focused instead on difference between conservative & dissipative systems
 - Thought “DEB” inherently conservative
 - Economy inherently dissipative...
- But then along came Neil Wilson...

Reconciling with Double Entry Bookkeeping

- Member of my blog
- Blogger in own right...
 - <http://www.3spoken.co.uk/>



- Knows a thing or two about accounting
- Decided to see if could make my “single entry” approach double-entry consistent



Reconciling with Double Entry Bookkeeping

- Did so earlier this year:

Steve Keen's Debtwatch
Analysing the Global Debt Bubble

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Guest Post: A Double Entry View on the Keen Circuit Model
By Steve Keen on January 11th, 2012 at 8:14 am
Posted in: Debtwatch

Neil Wilson is a UK-based finance and information systems professional who blogs at 3Spoken.co.uk, and who is an active participant in monetary debates. He has just published a post where he takes my "Godley table" modeling approach and rejigs it to make it consistent with double-entry bookkeeping standards.

I am no accountant—I never studied accounting at university (I did an Arts/Law degree as an undergraduate, majoring in Economics with minors in Maths & Psychology), and have never had to develop the skills subsequently—so I am happy to take advice from someone like Neil about how to conform to proper double-entry standards.

Neil notes below that a number of monetary theory types rejected my model out of hand because it didn't conform to those standards—and they therefore assumed it had to be intrinsically wrong.

I, on the other hand, developed these models in the first instance as systems of differential equations—an area where I do have some training—and was confident they were correct.

Neil decided to see whether the basic Circuit model (as outlined in *Debunking Economics II* and this downloadable academic paper) could be expressed in proper double-entry-bookkeeping form. His end conclusion was yes: the model could be rejigged into double-entry form, and the resulting simulations were numerically identical.

In a future post, Neil and I will jointly extend this research—including publishing the system of equations that result. But in the meantime, I'm very happy to cross-post Neil's blog entry here.

A Double Entry View on the Keen Circuit Model

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Reconciling with Double Entry Bookkeeping

- Neil's arguments:
 - “Now Steve is a great speaker, a good writer and formidable mathematician. *[Not from a Fields Institute perspective!]*
 - But I'm afraid he would get a fail in a bookkeeping exam.
 - For something to be consistent with double entry
 - there has to be at least two entries in the journal
 - and the journal must sum to zero.”
- Took my simple model in *Debunking Economics II* (p. 364):



TABLE 14.1 A pure credit economy with paper money

	Bank assets		Bank liabilities plus equity		
			Liabilities (deposits)		Equity
Operation	Vault	Loan ledger	Firms	Workers	Safe
Lend money	– Lend money		+ Lend money		
Record loans		– Lend money			
Charge interest		+ Charge interest			
Pay interest			– Charge interest		+ Charge interest
Record payment		– Charge interest			
Deposit interest			+ Deposit interest		– Deposit interest
Hire workers			– Wages	+ Wages	
Bankers consume			+ Bankers' consumption		– Bankers' consumption
Workers consume			+ Workers' consumption	– Workers' consumption	
Loan repayment	+ Loan repayment		– Loan repayment		
Record repayment		– Loan repayment			

Reconciling with Double Entry Bookkeeping

- Many criticisms:
 - “the liabilities side is strictly the wrong sign. Liabilities are generally shown negative so that when you add them to assets you get zero...
 - **Also ‘-’ is generally a credit and ‘+’ a debit.**
 - So in the table ... firms appear to pay wages by ‘crediting’ and workers receive wages by ‘debiting’
 - which is inconsistent with the way bank accounts are usually described.
 - The bank only gets paid when the firm pays the interest.
 - Yet in accounting the bank will ‘recognise’ the income (ie credit its profit and loss account) as soon as it charges interest and this will allow it to spend before it gets paid.
 - This isn't seigniorage as the bank has indeed earned that money. ...”

Reconciling with Double Entry Bookkeeping

- “The initial conditions on a balance sheet must be created by a series of journals and must balance to zero. Money shouldn’t magically appear in a Vault.
- But most importantly there are a lot of single entries in the rows. That makes this table inconsistent with the fundamentals of double entry that requires every transaction to sum to zero.
- To be double entry there must be at least two entries and the journal rows must sum to zero – or it is not a double entry table.”
- Neil’s task:
 - “to reconcile this table so that it works from a double entry viewpoint, still have loans creating the equivalent deposits and have them both destroyed and not destroyed at the same time all while satisfying as many viewpoints as possible.”

Reconciling with Double Entry Bookkeeping

- First step: change signs
 - Addition is a “-” on Liabilities & “+” on Assets
- Change first line:

	Assets	Liabilities			Equity
Operation	Vault	Loan Ledger	Firms	Workers	Safe
Lend Money	+Lend Money		-Lend Money		
- Now sums to zero (correct)
- But Neil notices a problem:
 - “But the balancing entry now appears wrong – why would crediting a Firm account increase a vault asset?
 - Answer: it wouldn’t.
 - Vault is on the wrong side of the balance sheet.
 - Paper notes in a Vault are a stock of non-circulating bank liabilities – as are the electronic equivalent.
 - So let’s move Vault.”

Reconciling with Double Entry Bookkeeping

- (I was unsure about this one at first, but see later)

	Assets	Liabilities			Equity
Operation	Loan Ledger	Vault	Firms	Workers	Safe
Lend Money		+Lend Money	-Lend Money		

- “Now it makes sense, the flow is moving the liabilities from the non-circulating stock in the Vault to the circulating stock at the Firm.
- Which then leads onto the next question.
 - **How are there any liabilities in the Vault in the first place?**
- Well, thinking in paper for a moment, notes have to be made and there will be a limit to how many can be made.
- And only banks can make these notes, not firms.
- So what’s the difference?”
- Neil’s key insight...

Reconciling with Double Entry Bookkeeping

- **The banks have a ‘licence to print money’ that the firms don’t have** (even if its one they gave themselves – as a truly independent central or private bank would do for example)...
- A licence is an ‘intangible asset’.
- The value of the licence to create money will vary over time depending upon the terms of the licence, the amount of outstanding loans and various other factors.
- And, like the intrinsic goodwill of the firm or its ‘human resources’, you don’t usually see the value on a bank balance sheet.
- But in this model we want to know how much ‘potential money’ is in the system at any point in time
- so let’s add in a journal to give the bank the ability to create a fixed amount of money (remember this model is operating under fixed parameter heuristic assumptions).”

Reconciling with Double Entry Bookkeeping

- “This neatly solves the problem of where the ‘initial value’ comes from
- and makes new money and old money the same thing—the value of the licence can vary dynamically like any other variable.”
- *Small slipup here—initial conditions shown in table flow region – But fixed later...*

	Assets		Liabilities			Equity
Operation	Licence Value	Loan Ledger	Vault	Firms	Workers	Safe
Grant Licence	+Grant Value		-Grant Value			
Lend Money			+Lend Money	-Lend Money		

Reconciling with Double Entry Bookkeeping

- Final DEB-consistent table is:

	Assets		Liabilities			Equity
Operation	Licence Value	Loan Ledger	Vault	Firms	Workers	Safe
Grant Licence	+Licence Value		-Licence Value			
Lend Money			+Lend Money	-Lend Money		
Record Loan	-Lend Money	+Lend Money				
Charge Interest			+Interest Charge			- Interest Charge
Record Interest	-Interest Charge	+Interest Charge				
Repay Loan and Interest			-Loan Repayment ? Interest Charge	+Loan Repayment +Interest Charge		
Record Loan and Interest Repayment	+Loan Repayment +Interest Charge	-Loan Repayment ? Interest Charge				

- Neil then models it using QED

Reconciling with Double Entry Bookkeeping

- Simulation program developed by UK programmer
 - Input financial relations in “Godley Table”

Flows V / Stock Variables ->	Vault	Loans	Firms	Workers	Safe
Initial Conditions	100	0	0	0	0
Lend	-A		A		
Record Loan		A			
Compound Debt		B			
Pay Interest			-B		B
Record Payment		-B			
Wages			-C	C	
Consume			D	-D	
Consume			E		-E
Repay Debt	F		-F		
Record Repayment		-F			

- Define terms & parameters

Coupled Ordinary Differential Equations

$A = v \cdot \text{Vault}(t)$

$B = rL \cdot \text{Loans}(t)$

$C = w \cdot \text{Firms}(t)$

$D = wc \cdot \text{Workers}(t)$

$E = bc \cdot \text{Safe}(t)$

$F = \text{repay} \cdot \text{Loans}(t)$

Variables and Equations

$v = 0.5$

$rL = 0.05$

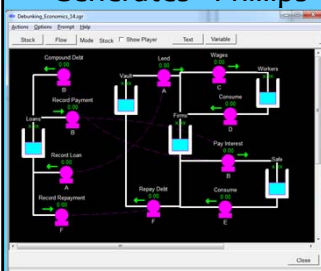
$w = 4$

$wc = 26$

$bc = 1$

$\text{repay} = \frac{1}{7}$

- Generates “Phillips” flow diagram



- Neil compares my single entry model to his double entry transformation...

Reconciling with Double Entry Bookkeeping

- Different structure...

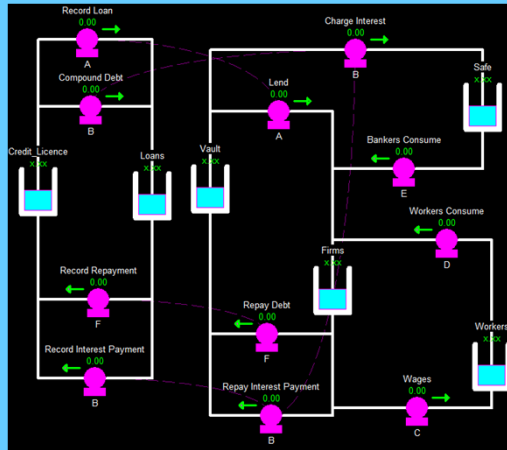
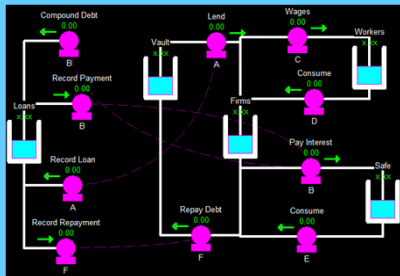
Flows V / Stock Variables ->	Vault	Loans	Firms	Workers	Safe
Initial Conditions	100	0	0	0	0
Lend	-A		A		
Record Loan		A			
Compound Debt		B			
Pay Interest			-B		B
Record Payment		-B			
Wages			-C	C	
Consume			D	-D	
Consume			E		-E
Repay Debt	F		-F		
Record Repayment		-F			

Initial conditions in correct place...

Flows V / Stock Variables ->	Credit	Loans	Vault	Firms	Workers	Safe
Record Loan	-A	A				
Compound Debt	-B	B				
Charge Interest			-B			B
Repay Interest Payment		B	-B			
Record Interest Payment	B	-B				
Wages				-C	C	
Workers Consume				D	-D	
Bankers Consume				E		-E
Repay Debt			F	-F		
Record Repayment	F	-F				

Reconciling with Double Entry Bookkeeping

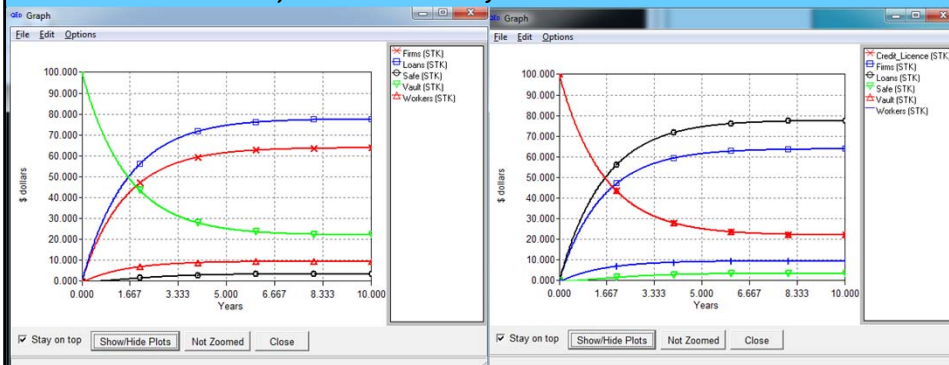
- Different structure...



- DEB inherently more appealing
 - Two complete circuits
 - Assets
 - Liabilities

Reconciling with Double Entry Bookkeeping

- Same results—just one extra system state



- Reason: same underlying equations
 - Additional DEB flow terms cancel out in ODEs
 - *Much ado about nothing?*
- No...

Reconciling with Double Entry Bookkeeping

- DEB shows way to reconcile Neoclassical/Krugman
 - “the overall level of debt makes no difference to aggregate net worth — one person’s liability is another person’s asset”
- With Endogenous Money
 - “**the creation of new purchasing power out of nothing...**”
- Taking Neil’s key insight
 - Intangible asset of Banking Licence actual source of capacity to create money
 - Not “out of nothing” but “out of intangible asset”
- **Maintaining intangible asset at constant value is consistent with rising liabilities and assets over time**

Endogenous Money and Double Entry Bookkeeping

- Bank initial assets = Licence value (Goodwill) only
 - Balanced by initial liabilities (that it owns) in Vault
- Loan transfer liabilities from itself to “impatient” customer
- Bank records change in assets: Loans up, Goodwill down
- Bank restores value of Goodwill
- Assets up, liabilities down, net zero
- Goodwill remains constant
- **Loans and Deposits grow over time...**

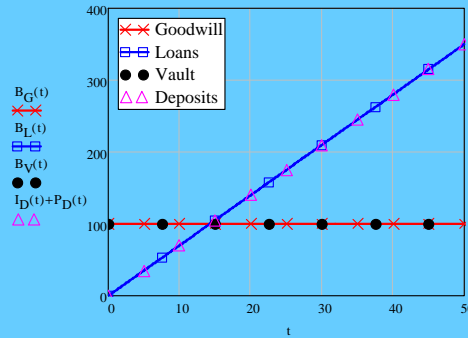
"Private Banks"	"Columns"	6	6
"Rows"	"Type"	0	-1
2	"Account"	"Bank Vault"	"Patient"
4	"Symbol"	$B_V(t)$	$P_D(t)$
5	"Lend"		0
6	"Record Loan"	0	0
7	"Restore Goodwill"		0

LoanEgDEB :=

Endogenous Money and Double Entry Bookkeeping

- Simple simulation here: Flow of Loans constant times Goodwill
 $Loan = \beta \cdot B_G(t)$ • (Just for illustration)
- Resulting system: • Constant goodwill, growing money & debt

$$\begin{aligned} \frac{d}{dt} B_G(t) &= 0 & B_G(0) &= \text{Goodwill} \\ \frac{d}{dt} B_L(t) &= \beta \cdot B_G(t) & B_L(0) &= 0 \\ \frac{d}{dt} B_V(t) &= 0 & B_V(0) &= \text{Goodwill} \\ \frac{d}{dt} I_D(t) &= \beta \cdot B_G(t) & I_D(0) &= 0 \\ \frac{d}{dt} P_D(t) &= 0 & P_D(0) &= 0 \end{aligned}$$



Endogenous Money and Double Entry Bookkeeping

- Need to convert from DEB to ODE at present
- DEB: Assets positive, Liabilities negative
 - “- means +” on Liabilities, “+ means +” on Assets
- ODE: Both positive, “+ means +” on both sides of ledger

LoanEg _{DEB} :=	"Private Banks"	"Columns"	2	3	6	5	6
	"Rows"	"Type"	∞	1	0	-1	-1
	2	"Account"	"Goodwill"	"Loan"	"Bank Vault"	"Impatient"	"Patient"
	3	"Initial Value"	Goodwill	0	-Goodwill	0	0
	4	"Symbol"	$B_G(t)$	$B_L(t)$	$B_V(t)$	$I_D(t)$	$P_D(t)$
	5	"Lend"	0	0	Loan	-Loan	0
	6	"Record Loan"	-Loan	Loan	0	0	0
7	"Restore Goodwill"	Loan	0	-Loan	0	0	
LoanEg _{ODE} :=	"Private Banks"	"Columns"	2	3	6	5	6
	"Rows"	"Type"	∞	1	0	-1	-1
	2	"Account"	"Goodwill"	"Loan"	"Bank Vault"	"Impatient"	"Patient"
	3	"Initial Value"	Goodwill	0	Goodwill	0	0
	4	"Symbol"	$B_G(t)$	$B_L(t)$	$B_V(t)$	$I_D(t)$	$P_D(t)$
	5	"Lend"	0	0	-Loan	Loan	0
	6	"Record Loan"	-Loan	Loan	0	0	0
7	"Restore Goodwill"	Loan	0	Loan	0	0	

Endogenous Money and Double Entry Bookkeeping

- Much more complex models possible of course:
 - Schumpeter: New credit finances investment

DEB ₂ :=	(	Private Banks	"Columns"	2	3	4	5	6	7	8)
	"Rows"	"Type"	∞	1	0	-1	-1	-1	-1		
	2	"Account"	"Licence"	"Firm Loan"	"Bank Vault"	"Firm Dep"	"Worker"	"Sholder"	"Bank Safe"		
	3	"Initial Value"	Licence	0	-Licence	0	0	0	0		
	4	"Symbol"	B _C (t)	F _L (t)	B _V (t)	F _D (t)	W _D (t)	S _D (t)	B _S (t)		
	5	"Working Capital"	0	0	WC	-WC	0	0	0		
	6	"Record Loan"	-WC	WC	0	0	0	0	0		
	7	"Charge Interest"	0	0	Int	0	0	0	-Int		
	8	"Record Interest"	-Int	Int	0	0	0	0	0		
	9	"Pay Interest"	0	0	-Int	Int	0	0	0		
	10	"Record Payment"	Int	-Int	0	0	0	0	0		
	11	"Wages"	0	0	0	Wages	-Wages	0	0		
	12	"Divs"	0	0	0	Div	0	-Div	0		
	13	"Consume"	0	0	0	-Con _W	Con _W	0	0		
	14	"Consume"	0	0	0	-Con _B	0	0	Con _B		
	15	"Consume"	0	0	0	-Con _S	0	Con _S	0		
	16	"Repay Firm"	0	0	-Repay	Repay	0	0	0		
	17	"Record Repav"	Renav	-Repav	0	0	0	0	0		

Endogenous Money and Double Entry Bookkeeping

- As more familiar (at Fields!) system of ODEs:

$$\frac{d}{dt} B_C(t) = \frac{F_L(t)}{\tau_R} - \frac{B_V(t)}{\tau_V} \quad B_C(0) = \text{Licence}$$

$$\frac{d}{dt} F_L(t) = \frac{B_V(t)}{\tau_V} + \frac{F_D(t)}{\tau_I} - \frac{F_L(t)}{\tau_R} \quad F_L(0) = 0$$

$$\frac{d}{dt} B_V(t) = \frac{F_L(t)}{\tau_R} - \frac{B_V(t)}{\tau_V} \quad B_V(0) = \text{Licence}$$

$$\frac{d}{dt} F_D(t) = \frac{B_S(t)}{\tau_B} - r_L \cdot F_L(t) + \frac{B_V(t)}{\tau_V} + \frac{F_D(t)}{\tau_I} - \frac{F_L(t)}{\tau_R} + \frac{S_D(t)}{\tau_{SH}} + \frac{W_D(t)}{\tau_W} + \frac{F_D(t) \cdot (s-1)}{\tau_S} - \frac{f_D \cdot s \cdot F_D(t)}{\tau_S} \quad F_D(0) = 0$$

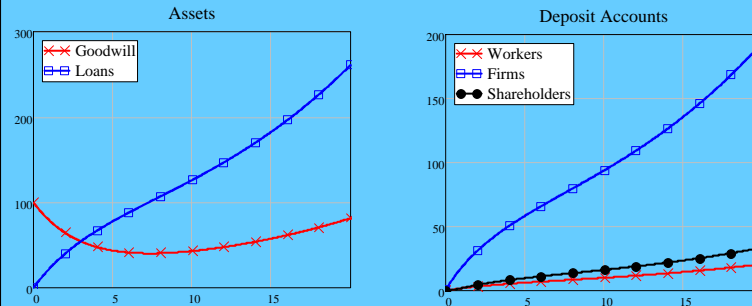
$$\frac{d}{dt} W_D(t) = -\frac{W_D(t)}{\tau_W} - \frac{F_D(t) \cdot (s-1)}{\tau_S} \quad W_D(0) = 0$$

$$\frac{d}{dt} S_D(t) = \frac{f_D \cdot s \cdot F_D(t)}{\tau_S} - \frac{S_D(t)}{\tau_{SH}} \quad S_D(0) = 0$$

$$\frac{d}{dt} B_S(t) = r_L \cdot F_L(t) - \frac{B_S(t)}{\tau_B} \quad B_S(0) = 0$$

Endogenous Money and Double Entry Bookkeeping

- Simulation outcome: growing money over time



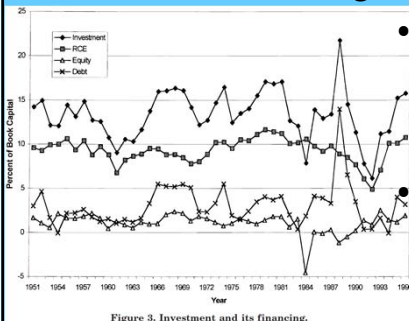
- Simulation outcome: growing money over time
- So “the overall level of debt makes no difference to aggregate net worth — one person’s liability is another person’s asset”
- Is completely consistent with “**the creation of new purchasing power out of nothing...**” • “**out of an intangible asset...**”

Pre-Copernican Economics

- Neoclassical failure to understand this pre-scientific behaviour
 - Start with *a priori* reasoning
 - Find contradictory evidence
 - Ignore it! Continue on as if nothing happened
- Numerous studies contradict Neoclassical barter fantasy
 - Kydland & Prescott 1990 (p. 15; emphasis added)
 - “The fact that the transaction component of real cash balances (M_1) moves contemporaneously with the cycle while the much larger nontransaction component (M_2) leads the cycle suggests that *credit arrangements could play a significant role in future business cycle theory.*
 - *Introducing money and credit into growth theory in a way that accounts for the cyclical behavior of monetary as well as real aggregates is an important open problem in economics.*”

Pre-Copernican Economics

- Fama & French: change in debt finances investment



- “The source of financing most correlated with investment is long-term debt. The correlation between It and $dLTDt$ is 0.79...

- These correlations confirm the impression from Figure 3 that debt plays a key role in accommodating year-by-year variation in investment. (Fama and French 1999, p. 1954)

- Krugman: “many commenters don’t get the distinction between the proposition that banks create money—which every economics textbook, mine included, says they do (*that’s what the money multiplier is all about*)—and the proposition that their ability to create money is not constrained by the monetary base.

Pre-Copernican Economics

- Carpenter & Demilrap (US Fed 2010) on “the multiplier”
- “Since 2008, the Federal Reserve has supplied an enormous quantity of reserve balances relative to historical levels as a result of a set of nontraditional policy actions...
- The question arises whether or not this unprecedented rise in reserve balances ought to lead to a sharp rise in money and lending.
- *The results in this paper suggest that the quantity of reserve balances itself is not likely to trigger a rapid increase in lending...*
- *the narrow, textbook money multiplier does not appear to be a useful means of assessing the implications of monetary policy for future money growth or bank lending.”* (p. 29; emphasis added)

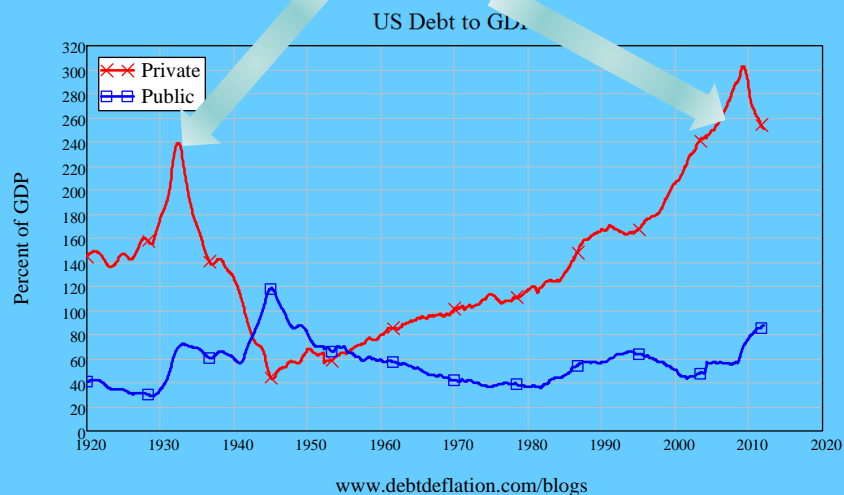
Pre-Copernican Economics

- Krugman dismisses importance of level of debt:
 - “People think of debt’s role in the economy as if it were the same as what debt means for an individual: there’s a lot of money you have to pay to someone else.
 - But that’s all wrong; the debt we create is basically money we owe to ourselves, and the burden it imposes does not involve a real transfer of resources.
 - That’s not to say that high debt can’t cause problems — it certainly can.
 - But these are problems of distribution and incentives, not the burden of debt as is commonly understood.” (Krugman 2011)

Pre-Copernican Economics

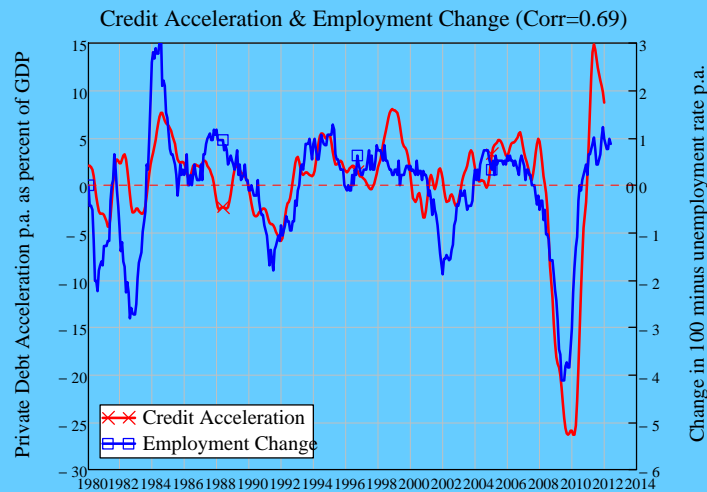
- So we can ignore this data then?

Mere Coincidence?



Pre-Copernican Economics

- Or this?



Post-Copernican Economics

- If your theory has empirical anomalies, change the theory
- Neoclassicals utterly resistant here—even after GFC
 - “the recent financial crisis was more a failure of economic engineering and economic management than of what I have called economic science” (Bernanke 2010).
- Time for a revolt from within, a revolution from outside

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