Intermediation, Money Creation, and Keynesian Macrodynamics in Multi-agent Systems

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Abstract

Keynesian economists refer to capitalism as a monetary production economy, in which the theory of money and the theory of production are inseparable (Skidelsky, 1992). One important aspect of this, brought to light by Robertson following the publication of The General Theory, is that in a Keynesian economy, endogenous money creation is logically necessary if the economy is to expand. A Keynesian economy cannot operate with an exogenously given supply of money as in verticalism. One way to ensure that money is endogenous is to simply assume that the supply of money is infinitely elastic, known in the literature as horizontalism. In this view, prior savings cannot be a constraint on current investment and it follows that the level of economic activity is determined by effective demand. Using a multi-agent systems model, this paper shows that real economies, especially those subject to recurrent financial crises, can be neither horizontalist or verticalist. Horizontalism overlooks microeconomic factors that might block flows from savers to investors, while verticalism ignores an irreducible ability of the system to generate endogenous money, even when the monetary authority does everything in its power to limit credit creation.

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1 Introduction

The notion that investment-led growth is accompanied by endogenous money creation is a central leitmotif of Post-Keynesian macroeconomics. This paper shows that endogenous money is in fact logically entailed by Keynesian theory since, otherwise, prior savings determines investment rather than animal spirits, the utilization of capacity, the interest rate or any of the other arguments typically found in Keynesian investment functions. Were the supply of credit infinitely elastic, as in the horizontalist’s account, the quantity of money in the system would clearly be determined endogenously, but trivially so. As recent critics have pointed out, the horizontalist model is too passive and ultimately incompatible with the propagation of financial disturbances into the real economy (Palley, 2013). Verticalist models, on the other hand, assert that the monetary authority can indeed fully control the money supply and in turn the level of output and employment. In so doing they offer an equally untenable account in their claim that financial shocks are fully and immediately transmitted to the real economy.

The paper shows that the inadequacies of both the verticalist and horizontalist models lie in their inherent blindness to underlying microfoundations. Rather than reprise the standard assortment of representative agent microfoundations of New Keynesian models, however, this paper suggests an alternative view based on multi-agent systems (MAS) models. It is seen that endogenous money emerges as a rigorous, well-defined and

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irreducible concept. Barring a statistical fluke, large multi-agent systems will always generate endogenous money, irrespective of the desire on the part of the monetary authority to limit credit creation. At the same time, not all credit-worthy demand for bank loans results in money creation at the microeconomic level, and this has an important impact on macroeconomic outcomes.

The model of the paper builds on an existing MAS model due to Setterfield and Budd (2011) as modified by Gibson and Setterfield (2013), which has roots in the structuralist tradition (Pasinetti 1981; Taylor 1983, 1991). Most multi-agent systems model the financial system in isolation from the real-side economy, as stand-alone models. Here a simple model of real-financial interactions is presented in which multiple, heterogeneous firms and financial agents, or banks, are interconnected in a two-layer network. Financial nodes are connected by edges or links on one level while firms on a second level are connected through by edges that represent sales and purchases of goods and services. The financial subnetwork is sparsely connected to the real subnetwork as described in detail below. Although the model is simplified, it realistically captures many essential features of stand-alone financial models, as well as those of structural models with wage and price rigidity on the real side, from which Keynesian insights are often derived.

The core of the argument is found in the asynchronous nature of MAS models. It is seen that even if the monetary authority attempts to thwart money creation it will be generally powerless to do so if savings and investment decisions are made asynchronously, that is, separated in time. Even if the time intervals are short, on the order of milliseconds, the non-contemporaneous nature of these decisions, as captured in MAS models, leads to endogenous money creation. At some point in the evolution of the computational system, conflicting claims on deposits arise that can only be resolved by way of endogenous money. This does not mean, however, that money creation is best viewed as horizontalist. On the contrary, the system-wide endogeneity of money is highly circumscribed by agents’ individual behavior as they update private information flows in light of the influence of their neighbors and respond to microeconomic constraints in the credit-creation process.

The paper is organized as follows. The next section discusses the central role and historical evolution of endogenous money theory in Keynesian macroeconomics. The third section presents a small two-firm prototype analytical model, that when stripped down to its essentials conveys the basic mechanisms on which the larger multi-agent model is built. Section four outlines the generalization of the analytical model to a full multi-layered, multi-agent system, and identifies asynchronicity as essential to a coherent conception of endogenous money. Section 5 concludes.

2 Money and production

In Keynesian macroeconomics, endogenous money creation within the private sector is understood to accompany the income-generating process. Indeed, when economic activity is demand-led, endogenous money creation is logically necessary for real expansion to be feasible (Chick 1983). This observation is certainly not new and appears, for example, in Robertson’s discussion of the multiplier concept (Robertson 1940). If saving depends on income whereas investment spending does not, then absent a change in the propensity to consume, saving cannot initiate a change in income whereas investment can. And if investment does change, then so, too, will income and hence saving—this last change restoring the equality of saving and investment characteristic of macroeconomic equilibrium in a closed economy with no fiscally active government sector.

1The precise structure of the financial network is seen to be crucial to the propensity of the model to experience a financial crash. See Gibson and Setterfield (2013).

2There is here a clear link between the disaggregated version of the standard structuralist model of this paper and the rich history of multi-sectoral analysis in Keynesian macroeconomics (Pasinetti 1981). For the methodological claim that MAS modeling is consistent with the pre-analytic vision of Keynesian theory see Bucciarelli and Silvestri (2013). For numerical simulations of the model discussed in this paper, see Gibson and Setterfield (2013).

3As will become clear, the argument here centers on the financing of fixed capital formation and the fact that economic activity takes time, specifically, that adjustment to equilibrium is not instantaneous. See Arestis (1987, pp.10-11) for similar arguments regarding the importance of endogenous money creation for the expansion of working capital by firms, when production takes time so that the costs of production must be incurred before revenues accrue from the sale of output.

4See Chick (1983, pp.257-63) for a discussion and reconfiguration of Robertson’s model.
Before equilibrium is restored, however, these adjustments have monetary implications: if investment spending is equal to saving initially, so that the value of current saving is exactly sufficient to fund the value of current investment spending, then investment spending can increase above its current level if and only if additional credit is created. As Chick (1983) writes:

... [i]f the investment is not financed it will not take place ... one needs to back demand with purchasing power. The solution to the problem lies in the capacity of banks to create credit in excess of current saving, and so finance investment in excess of current saving. Chick (1983, p.189)

Chick (1983) notes that there is a historical as well as logical dimension to this process: the independence of investment from prior savings presumes the rise of commercial banks with the capacity to create credit in excess of saving. Banks act as more than mere conduits or intermediaries for existing saving and hence effectively relax the constraint that would otherwise be imposed by prior savings on investment spending. For Keynesians this is received wisdom, but it is based on one-sector, aggregate analysis. There is no explicit account of the timing of flows of deposits and withdrawals from individual banks.

Certainly a sufficient condition for real expansion in Keynesian systems is provided by the horizontalists (Moore 1988; Lavoie 2007), but the necessary condition for endogenous money is only that the elasticity of the supply of credit be non-zero (Pollin 1991; Dow 2007). Under these conditions, the monetary authority cannot prevent banks from responding to the incentive of higher interest rates by creating more credit. The result is an upward-sloping credit supply curve in interest rate-quantity of credit space. Whether banks require an incentive in the form of some increment in the interest rate is not central to the argument. From this perspective an upward-sloping credit supply curve is just a variation on the theme of horizontalism (Palley 2013). Endogenous money is the normal state of the macroeconomic system, whatever the slope of the credit schedule.

Verticalists, by contrast, describe a world in which this endogenous creation of money goes to zero. In this case, the supply of money is infinitely inelastic. Here again, however, the onus of the argument is on the behavior of banks in a homogeneous banking system. A vertical credit supply function is simply a limiting case as the responsiveness of banks to the incentive of higher interest rates diminishes. It is the limit as the desire to create endogenous money goes to zero. In the verticalist model, it is only in the limit as the inelasticity of the credit supply curve goes to infinity that the central banks wields control of the money supply from the banks. In any other state, money is endogenous.

As Palley (2013, pp.414-22) has recently argued, the process of credit creation is not adequately captured by horizontalism, even when emended to allow for an upward-sloping credit supply schedule. It fails to take into account capital and reserve requirements, access to finance through the Federal Funds and discount window as well as liquidity preference on the part of the public. The critique successfully rejects the perfectly elastic supply of finance of the horizontalists. Palley’s version of the structuralist model adds welcome detail to an evidently oversimplified account. Embracing rational expectations as the equilibrium concept for the structuralist model, however, the final product is more closely aligned with standard, textual accounts of the supply and demand for money. In particular the model is entirely consistent with the representative agent methodology; no heterogeneous agents are present and the properties of the system do not emerge from their interaction.

While it might be said that Palley (2013) provides a “grittier” account of the monetary creation process than horizontalism, grittiness is not the same as granularity. The latter is typically afforded by heterogeneous agent models that explore in detail how microeconomic decision-making and macro properties of the system
Palley (2013, p.41) senses that just such a model is needed, in that horizontalism represents the banking sector as a single entity...[that] risks promoting a fallacy of division whereby it is mistakenly believed that what holds for the system as a whole also holds for individual components of the system. 

Yet Palley seems to be content to replace one representative agent model with another, albeit more complicated, but without explicit heterogeneity within the banking system. The MAS framework, proposed in more detail in the continuation, begins with decentralized local interactions among heterogeneous agents and its system-wide properties emerge from their interplay as the model propagates through time (Epstein, 1999, p.41). While not without its own drawbacks, this framework can shed some new light on the debate between horizontalists, structuralists and verticalists.

3 A multi-sector formalization of money and production

Consider initially the equilibrium solution to a demand-determined real-side model in which the number of firms is \( n = 2 \). There is only one good, the price of which is fixed at unity. Output, \( x_i \) for \( i = 1, 2 \), is a share, \( \theta \) (for firm 1) and \( 1 - \theta \) (for firm 2) of aggregate demand, which is the sum of consumption and investment. Workers consume all their income while consumption of capitalists is income less savings. Equilibrium is defined by the balance of supply and demand for each of the two firms

\[
\begin{align*}
    x_1 &= \theta \left( (1 - s_1 \pi_1)x_1 + (1 - s_2 \pi_2)x_2 + g_1 K_1 + g_2 K_2 \right) \\
    x_2 &= (1 - \theta) \left( (1 - s_1 \pi_1)x_1 + (1 - s_2 \pi_2)x_2 + g_1 K_1 + g_2 K_2 \right)
\end{align*}
\]

Here capitalists save a fraction \( s_i \) of their profits \( \pi_i x_i \), where \( \pi_i \) is the profit share of output, \( \pi_i = (1 - l_i)/x_i \), where \( l_i \) is the cost of labor per unit of output. Investment is given by \( g_i K_i \), where \( g_i \) is an accumulation function that depends on last period’s capacity utilization rate. Normalizing by \( K_1 \), the capital stock of firm 1, so that \( k = K_2/K_1 \), the model can be expressed as

\[
\begin{align*}
    u_1 &= \theta \left\{ (1 - s_1 \pi_1)u_1 + g_1 + \left[ (1 - s_2 \pi_2)u_2 + g_2 \right] k \right\} \\
    s_1 \pi_1 u_1 + s_2 \pi_2 u_2 k &= g_1 + g_2 k
\end{align*}
\]

where the rate of capacity utilization of the \( i \)th firm is

\[ u_i = x_i/K_i. \] (2)

The second equation is simply the savings-investment balance for the economy as a whole. The firm’s financial surplus \( f_i \) per unit of capital in each firm is given by

\[ f_i = s_i \pi_i u_i - g_i. \]

Figure 1 shows the solution to the two-sector model when the savings rates are given. Start with last period’s capacity utilization of firm 1, measured in the negative direction on the ordinate. Given \( u_{1t-1} \), the level of investment undertaken by firm 1 is determined by the dotted line in the third quadrant, labeled \( g_1 \). To get total investment, shown by the solid line in the same quadrant, add \( g_2 k \), which also depends on a given level of lagged capacity utilization for firm 2. The sum is total investment normalized by \( K_1 \), the right-hand side of equation 1b. The 45-degree line in quadrant 2 reflects this quantity onto the positive ordinate, and in turn determines total (normalized) savings in the current period, shown by the solid line in the first quadrant. Given \( u_2 \) in the current period from figure 2 there is only one level of \( u_1 \) consistent with total savings equaling total investment and that level is shown in figure 1 as \( u_{1t} \) on the positive abscissa. The
Figure 1: Saving and investment of the surplus firm

dotted line in the first quadrant, labeled $s_1 \pi_1 u_1$, shows the savings of the first firm on the positive ordinate as a function of its current capacity utilization. The reflection of the first firm’s investment onto the positive ordinate confirms a financial surplus for firm 1.

With only two firms, macroeconomic equilibrium implies that the second firm must be in deficit. Figure 2 shows the solution to the two-firm model with the second firm in financial deficit. Total investment, determined by the solid line in the third quadrant and reflected onto the positive ordinate by the 45-degree line in quadrant 2, is once again equal to total saving. This is shown as a solid line in the first quadrant. Firm 2 is in financial deficit since at $u_2$, its savings, $s_2 \pi_2 u_2 k$, determined by the dotted line in the first quadrant, is less than its investment $g_2 k$, determined by the dotted line in the third quadrant and reflected from the negative ordinate through to the second quadrant.

Even in the simple two-firm example of figures 1 and 2 there is already an implicit financial sector channeling funds between the two real-side firms. It is evident that something could easily go wrong with the flow of funds between firms 1 and 2, however. First, the deficit firm in figure 2 may not be able to borrow at all if it is unable to find a conduit or bank to intermediate. Only if loans are available and meet or exceed the firm’s deficit can the latter invest at its desired level. A second problem lies in the intermediation itself. Despite the existence of a surplus of loanable funds and a potential intermediary, there is no guarantee that a bank might not block the flow of funds, effectively preventing financing from finding its way to the deficit firm. Since banks’ profits depend on facilitating the flow, it may seem natural to assume that they will find an efficient way to channel resources from lender to borrower. If, however, circumstances lead the bank to believe that the deficit firm will be unable to repay the loan, the bank may well defer, effectively preventing the investment that would otherwise take place.

Observe that were the bank to block the flow from the first to the second firm in the example above, the level of activity at which savings comes into balance with investment depends only on the level of investment by the first firm. To the extent that intermediation fails, part of the ex ante surplus of the lending firms simply evaporates. Investment becomes financially constrained, and the system cycles down to an equilibrium in which aggregate savings is equal to aggregate investment at a lower overall level of economic activity. All this is brought about by the unwillingness of the bank to serve as a conduit of loanable funds.
4 A multi-layered network model

The model with just two firms initiates the transition to a full multi-agent system that depends on the microeconomic details of inter-agent communication and negotiation (Gibson and Setterfield 2013). Multi-agent systems do not just allow for a more careful examination of agent interaction but actually require it, since the rules agents follow are singularly responsible for the macroeconomic properties of the system. The examination uncovers some important properties that are concealed in models lacking detail about the activities of individual agents. It is seen, for example, that in asynchronous real-financial interactions, money is unavoidably created. This imputes to multi-agent microfoundations of macroeconomics an alternative interpretation of “endogenous money.” Even if it were possible to engineer a system without money growth, output and employment would eventually cycle down to zero. In an investment-driven Keynesian economy, agents must find themselves creating money in order for real activity to expand over time and most likely, even to maintain the same level of economic activity from period to period.

In the two-sector model above, in which there is only credit and no money creation, the deficit firm can borrow no more than the surplus firm is willing and able to lend. In multi-agent models such as Gibson and Setterfield (2013), however, an additional complication comes into play. These computational models require that agents interact sequentially during each period of time and the interaction is typically random. In the first sweep, agent $i$ interacts with agent $j$ before $k$ interacts with $l$, but in the following sweep, this temporal sequence can change. Contrary to models of general economic equilibrium, in which all agents come into balance at one instant, synchronously, multi-agent systems are typically asynchronous, and randomly so. These approaches are actually much more distinct than they might at first seem.

Consider an economy consisting of two breeds of agents: firms and financial entities, or banks. The model structure is summarized by a multi-level network, as shown in figure 3. The top plane represents the financial sector, nodes that are linked by borrowing relationships that are non-directional in the sense that funds can flow in either direction between financial entities. Observe that these agents are not randomly connected, but are preferentially attached in that the probability that any new node would connect to an existing node is proportional to its degree or number of existing links to other entities (Gibson and Setterfield 2013). The lower level shows firms as nodes, linked by edges that represent flows of aggregate demand across the network. The latter are shown by dotted lines in the plane of the real side, and are simply purchases and sales of commodities and in principle change with demand preferences. Each firm is connected to the financial system though an edge and since there are more firms than banks, two or more firms will be connected to...
the same financial agent. For simplicity, firms do not connect to more than one financial agent, although one financial agent can serve more than one firm.

Figure 3: Multi-level network structure

4.1 Endogenous money and synchronous multi-agent models

In figure 3, surplus firms are darkly shaded while deficit firms are lightly shaded. This designation changes dynamically in the model so that the figure should be seen as a snapshot in time. If, at any point in time, the client of the $i$th bank is a surplus firm, the change in loanable funds, $\Delta \ell_i$, of bank $i$ is

$$\Delta \ell_i = F_i$$

where $F_i = S_i - g_iK_i$ is the current savings, $S_i$ less investment planned for the next period, $g_iK_i$. If the central bank is unwilling to allow any credit expansion, then investment by deficit firms is limited by the availability of loanable funds. In the standard account, the central bank can prevent money creation by simply limiting loans to

$$\sum_{f^+} F_i$$

where $f^+$ is the set of surplus firms. The crucial asymmetry here is that for surplus firms the financial constraint never binds. In principle, they can always execute their investment plans up to the full extent of their savings in the previous period.\footnote{Note that if a surplus firm elected to spend more than authorized by previous period savings, it would become a de facto deficit firm.} Under this panoply of assumptions, there is no possibility of endogenous money arising in a fully synchronous system.

The synchronous MAS model is logically coherent but has some important and highly unrealistic implications that might not be immediately self-evident. One is that without endogenous money, aggregate savings determine investment. The excess savings of one firm is channeled to another but at no point can aggregate
investment in period \( t \), or \( I_t \), exceed the savings available from the previous period. Since saving also equals investment in the previous period, investment is at best constant over time. This is a serious defect in the simple prior savings model and obviously rules out any important expansionary effects of animal spirits.

Moreover, were this constant level of investment to exceed depreciation, capital stock would then accumulate with each round of investment. With a fixed distribution of capital-output ratios, capacity utilization, \( u_t \) in equation 2, will therefore have to contract. In the standard structuralist model, investment itself depends on capacity utilization. If follows that investment will not even remain constant but will instead fall below its savings-constrained value. Since savings will immediately adjust to this lower level of investment, savings available for investment in the following period will be even less. Since investment cannot escape the constraint of prior savings, the model becomes unstable, cycling down to zero output and employment. The prior savings model, evidently, cannot serve as the foundation for any coherent model of systems with both real and financial components.

It follows that if all savings and investment decisions were made at the same instant in time, the monetary authority could drive endogenous money to zero. In asynchronous models, however, this is generally not possible. Unless events happen to arrange themselves in an highly unlikely way, essentially by fluke, endogenous money will necessarily arise in asynchronous models.

4.2 Endogenous money in asynchronous multi-agent models

With asynchronicity of the multi-agent system in figure 3 an entirely different outcome emerges. The central bank becomes powerless to stop the endogenous creation of money, giving rise to the possibility that investment in this period may exceed the sum of savings in the last. To see this consider a dilemma the surplus firm might seemingly encounter. The surplus firm instantaneously deposits any profits made in the current period with its financial counterpart. Its planned investment for the following period is necessarily less than these deposits since it is by definition a surplus firm. Thus, deposits adequate to cover the firm’s investment plans are present in the firm’s account, but when the firm attempts to use its deposits to purchase capital goods, a problem could arise.

The problem is that there is a time interval \( \Delta t \) in the model between the instant that firms make deposits and the spending down of those deposits for investment purposes. Financial agents in the model, however, are under no obligation to deny a request for a loan from a deficit firm on the grounds that some of its deposits will soon be withdrawn by surplus firms for their own planned investment. All the financial agent perceives is that it is flush with deposits at the moment. Indeed, there is no mechanism in the model to communicate to the financial agent that some of its recent inflow of deposits should be held in reserve to enable their owners to purchase capital goods as planned when the time comes.

This raises the key question: could a financial agent block a surplus firm on the grounds the funds had already been loaned to a deficit firm? In reality, of course, the answer is no: surplus firms are legally entitled to their deposits and so it is only under the extraordinary circumstances of a credit freeze that surplus firms would be barred from using its deposits for investment. In practice, the bank simply creates the money to reinstate the funds of the surplus firm. In this way there is a forced increase in the money supply, whether planned or not, by the monetary authorities. This increase causes the money supply to become endogenous in the sense that the monetary authority is powerless to stop the credit expansion. To prevent this, the multi-agent model could have been designed to require that all the surplus firms make their investments prior to those of the deficit firms. It is clear, however, that this assumption would be entirely arbitrary and impose an unrealistic constraint on the model, not dissimilar to the constraint that all lending and borrowing take place simultaneously.

The model thus makes explicit how endogenous money comes about, since if deficit firms have already contracted to borrow in excess of what would be the available surplus, banks have no choice but to create the liquidity when surplus firms are themselves ready to invest. This mechanism provides a multi-agent system micro-foundation for endogenous money. Although deficit firms can and do crowd out other deficit firms,

\[ \text{8To deny surplus firms the use of their own savings is to announce catastrophic financial failure. In this worst-case scenario, a system-wide run on deposits could well occur.} \]
they cannot crowd out surplus firms. In this way the model retains its Keynesian flavor, since it is animal spirits that ultimately allow aggregate investment in period $t+1$ to exceed savings in period $t$.

Observe that if there were no constraint on credit, there would be no reason to distinguish surplus and deficit firms. Firms that lacked sufficient savings from the previous period would simply borrow for investment from bankers who are freely able to create as much money as they want. Monetary policy is then entirely accommodating. While this may be one definition of endogenous money, it seems that to equate endogenous money simply with the absence of any imposed financial constraint does not reflect the centrality of the institutions that define the monetary system (see also [Palley, 2013 pp.417-19]). In this simple but arguably more realistic account of the financial system, time matters and time intervals in which conflicting claims on financial resources can arise imply that money must be inherently endogenous in a way that a central financial authority cannot avoid.

Note that if monetary policy were fully accommodating, nothing prevents the system from expanding without limit. Figure 4 shows two possible limiting cases, derived from the empirical model in [Gibson and Setterfield, 2013]. The upper trajectory corresponds to full capacity utilization, with fully endogenous money and nothing but pure animal spirits guiding the expansion of the economy. Along the lower trajectory the economy is limited by previous savings. This is the synchronous model, described above, and the simulation clearly shows a negative trend to GDP as expected. Any real economy would, presumably, operate inside the shaded region of the figure.

![Figure 4: Credit creation in the multi-agent system](image)

Even with endogenous money, there are other important impediments to smooth growth that are easily captured by the multi-agent model described in figure 3. Intermediation failures can arise, for example, in which either a deficit firm is rejected by the bank or the deficit firm cannot locate a bank willing and able to lend in the local region. If investment by a deficit firm is blocked for either of these reasons, then total investment falls and with it available savings for the next period. Firms that would otherwise have been in surplus now are themselves in deficit if their investment plans are not scaled back to match their savings. With a sufficient contraction of demand, all firms can fall into deficit simultaneously and the result will be a sharp contraction in investment in the following period. None of this is possible in standard real-side models that assume accommodating monetary policy and thereby fail to model important real-financial interactions.

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9This is due to the underlying simplicity of the structuralist model, of course, in that the model ignores diminishing returns, technical change, endogenous growth and other features of more advanced models. The model of this paper includes a highly simplified, demand-driven, structuralist account of the real side only to keep the interaction with the financial side manageable.

10This is usually modeled as a grid.
5 Conclusions

Keynesian economies are more intrinsically monetary than is often recognized. On one hand, an economy is unable to enjoy continuous net expansion without some monetary creation and is unlikely to even maintain a constant level of investment. On the other hand, the view that money creation is always and everywhere fully accommodating masks the still-important role of intermediation as a cause of significant macroeconomic imbalances. It neglects the power of the financial sector to affect real performance by blocking the flow of finance from surplus to deficit firms. In the worst case, models of social learning show that learning can break down, leading to a financial crisis, when agents place time-dependent weights on social and private signals. This is all beyond the scope of this paper, but has been thoroughly addressed elsewhere in the literature.

This paper shows that “endogenous money” need not be associated with the view that banks are passive players in an essentially horizontalist world. Financial agents in multi-tiered network structures retain significant power due essentially to the institutional framework in which they operate. Not only can they lay the groundwork for financial catastrophe and collapse but they necessarily wrest away power from the central monetary authority, power that is essentially bottom up in its nature and resistant to monetary restriction. The key element of the model of this paper is asynchronicity: the fact that if time is built into a model in a careful and realistic way, the non-contemporaneous nature of real-financial interactions will inevitably lead to endogenous money creation.

References


