General Disequilibrium: the Hidden Conflict between Fractional Reserve Banking and Economic Theory

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Abstract: Banking systems based on ledger entries, held against fractional reserves of physical currency, using double-entry book-keeping have played a key role in Western monetary systems for several centuries. Over this period economic analysis has wrestled with both the esoteric treatment of the daily and familiar form of money within the banking system, and with understanding the economic role of the monetary system itself. A complex emergent system based on statistical multiplexing techniques introduced many centuries before they were developed in other fields, the banking system has consequently both influenced economic analysis, and been subject to it, as repeated attempts have been made to regulate its behaviour. Unfortunately, a long history of thought stretching from Hume to the current day repeatedly demonstrates that no economic theory of money has ever survived contact with the indignities that the daily operation of the banking system inflicts on the unit of economic measurement. We will argue that by introducing perturbations into the monetary system over time scales that were effectively invisible in day-to-day economic activity, the banking system has been a major obstacle preventing the development of a complete and causally based understanding of the monetary and financial framework underlying modern economies.

Keywords: banking, emergent systems, cash-liability money dichotomy.

1 INTRODUCTION

The complex arrangement of double-entry book-keeping ledgers, bank notes, loans, reserves and capital that slowly developed into today's banking system has always occupied a precarious economic niche. Too convenient to be abandoned, and too unstable to be left alone, it has been the subject of political discussion and repeated attempts at regulation for over three centuries. Our understanding of the monetary system it facilitates has developed in tandem, an intricate dance of theoretically based arguments on the role of the monetary system within the economy and the causes of its financial crises, resulting in regulatory frameworks that attempted to impose economic order on the banking system's behaviour. As theorists attempted to impose on the banking system their views of its proper behaviour, banking systems have imposed on the economy the results of their misconceptions. The consequences of continuous and subtle mutations in the regulation of the supply of money and credit to the economy, and the distortions caused from the use of money as a unit of measurement without recognition of its abnormal behaviour as a measure, are clearly visible in economic theory today. Uniquely, of all the sciences, economics has arrived in the 21st century without a clear consensus on its fundamental components, and indeed without even an uncontested definition of its fundamental unit of measurement—money.

What exactly do economists mean when they use the word money? Historically, the liability bank deposit used for the vast majority of financial transactions today was either

ignored by economic theorists, or treated as an inconvenient or even fraudulent complication. However, from the point of fractional reserve banking's introduction, money consisted of two separate entities. A payment made into a bank, created an asset deposit of the money being paid in, and a liability deposit, representing the customer's claim on that asset. Two very different entities, both commonly referred to under the general rubric of 'money' by the economic literature, with critically different roles and behaviours within the financial system.

A 21st century perspective of long-term money supply series clearly shows that a 'background noise' of continuous increases in the quantity of both money represented in liability bank deposits, along with occasional sharp contractions, has played out ever since the introduction of fractional reserve banking. This increase occurred at varying rates depending on time and country. While the causes and effects of this behaviour have received considerable attention, a similarly long perspective on economic theory also shows that this feature of the monetary system has never been fully integrated into economic or social analysis. Greenlaw (1958), commenting on France in the 1780s, aptly illustrates the entire problem:

> An infallible sign that the wealth of the country was increasing was that the population was growing rapidly and the prices of commodities, land and houses were steadily rising. … while later we are informed that the number of banks had also increased greatly under Louis XVI.

The most likely of several interpretations of this information is that the introduction of fractional reserve banking was rapidly inflating the money supply. What actual increase in possessions and living standards might have been occurring is impossible to deduce, but the subsequent French Revolution in 1789 is a less than compelling argument for an era of general prosperity. (Greenlaw 1958)

The definitions of money used today in economics are more complex, but they are also more confused. The official monetary measurements of many countries typically include a mixture of both asset and liability banking deposits. In some cases forms of debt under the label of 'near-money' are also included. There are many incongruities, a distinct lack of standardization, and even what appears to be occasional double counting. For example, banks classify money that is deposited with them as an asset, and simultaneously create a matching liability—the bank deposit. Consequently, adding the total of the banking system's asset cash deposits (base money, or M0 in the United States), to the total of its liability deposit accounts (M1 and M2), will effectively count physical deposits twice. Similar issues occur with money market funds, which are mainly held in short-term commercial paper (debt), but can also include deposits in the banking system.

Do these obscure technicalities matter? We are talking about the unit of measurement for the entire economy. Even within the limited domain of pure monetary analysis, it is easy to show that as a direct consequence confusion abounds. For example, in a recent paper by Koo (2011), the M4 measure in the United Kingdom is used in comparison with the M2 measure in the United States to support the claim that neither country's money supply has increased, despite quantitative easing. By virtue of their very different compositions, the American M2 and the British M4 measure are not directly comparable, and in fact the American M2 measure has increased from $8 trillion to $11 trillion over the period reported by Koo, reflecting a slightly over $1 trillion increase in asset money attributable to the TARP program, and a $2 trillion increase in liability bank deposits.[1] Meanwhile, in the United Kingdom the M2 measure, which is similar if not identical to the American M2[2], shows an 18-month contraction which was masked in the M4 measure by the latter's inclusion of debt and the asset-money deposits in large part created by quantitative easing. Koo's claim that the 'loans and leases in bank credit' component of the Federal Reserve H.8 release has dropped is correct, but in the same table government treasuries (a form of debt) have increased, and net bank lending has of course increased, matching the increase in the money supply.

These kinds of distinctions are rarely drawn in general discussions of economic theory and policy, where the specifics of banking system operations are usually abstracted or overlooked. Be that as it may, only if it can be formally demonstrated that these distinctions are immaterial can the specifics of money within the banking system be legitimately ignored, and as the previous paragraph demonstrates, this is not the case. Since the banking system itself consists of a complicated set of book-keeping rules, which vary over time, and sometimes, as is the case currently in the Eurozone, within it: the problems of an already complex discussion have now been considerably multiplied.

How far though would chemistry or physics have advanced, if scientists still believed that the sole components of matter were earth, water, fire and air?

Even the most fundamental relationship of money to the economy through its influence on the price level still lies open to question. As Knut Wicksell (1898) illustrated early in the 20th century, there are very real problems with the quantity theory of money in economics, which attempts to establish the relationship between money, prices and economic transactions in the economy, one of which he illustrated as follows:

> Let us suppose that several individuals, A, B, C, D, etc., have been given credit (e.g. merchandise credit) by one another, so that A owes money to B, B to C, C to D, etc. The repayment of these debts requires that a certain sum of money shall pass from A to B, from B to C, etc. If all the promissory notes fall due on the same date and involve equal sums, then repayment can be accomplished in a very short space of time and with the aid of the same pieces of money. (Wicksell 1898)

Since this observation is equally applicable to direct exchanges of money between A, B, C and D for goods of equivalent price, it provides, if not justification for economists to abstract money out of their equations, certainly some sympathy. Price provides no information about supply in this situation, in direct contradiction to the quantity theory. Masked by the continual expansion of its supply since the introduction of fractional reserve banking, is an underlying reality that money simply does not behave like other units of measurement and this is not only due to variations over time in its quantity.

Awareness of this type of problem required knowledge of some of the more interesting features of the banking system, and in particular acceptance of its now notorious propensity to 'manufacture money out of thin air,' and this was slow to develop. Eighteenth and Nineteenth century writers focused on the ability of individual banks to vary the quantity of their physically issued banknotes, and issues arising from trade and accompanying international gold exchanges, which interfered with the gold-based regulatory mechanisms of the banking system. Bank deposits were not generally included in the definition of money, and so their gradual expansion was ignored. While we can assume—simply from the term 'fractional reserve'—that the importance of limiting the expansion of liability-deposit entries against holdings of physical currency had been recognized at least by those controlling the banks, attempts to formalize the calculation of the accompanying multiplier effect do not appear in the literature until the early 20th century. The first appearance of the flawed description of this process found in today's entry-level textbooks appears to be the 1931 Macmillan Report to the British Parliament. Authored by John Maynard Keynes, it predicted a bounded monetary stability that was subject to central bank control. It was a theory even the limited evidence of its time did not support.

Something unusual in the twists and turns of the development of scientific knowledge occurred between that description, and the current day. Rather than developing a deeper and more complete understanding of the operation of the banking system, general knowledge of the complexities surrounding the banking system regressed. Knowledge of the double-entry book-keeping aspects of the system are evident in Keynes' description, and indeed were required to fully appreciate it. That there were important structural and potentially systemic differences between banking systems was also acknowledged; both Lawrence's (1928) attempts to characterize the deposit expansion rate of the US banking system and Watkins' (1938) of the English system include these factors in their analysis, while Keynes (1929) also commented on significant differences within the US system in his Treatise on Money.

British contemporaries of Keynes had reason to believe that their system was stable, since as Laidler (2003) describes, after an extraordinarily periodic series of banking crises in the 19th century, the British system had settled into a period of seeming stability after 1870. The 'British monetary orthodoxy,' as Fetter (1965) described it, would consequently become the template for banking systems worldwide. It relied on a lender of last resort to rescue temporarily illiquid banks, mandatory reserves, convertibility with gold to regulate its lending and resulting monetary expansion, and the productive forces of an empire to sustain it. It lasted forty years.

Economic stability can be a slippery term. The stable feature of the late 19th century British economy was mild price deflation. Similar to today, there were dramatic increases in production from technological development and population growth, as well as a slow but steady increase in the money supply as measured by liability bank deposits, accompanied by a punctuated equilibrium of periodic credit crises. The contemporary perception of its stability owed more to the relative instability being then experienced in mainland Europe and America, whose origins lay partly in bimetallism—a now obscure detail of financial systems where silver occupied a similar role to gold; and in the case of the United States a free-wheeling approach to banking practices in an as yet largely unregulated system.[3]

Price stability however does not imply monetary stability, which is one of the several distinctions between money as a unit of price measurement and as physical units of measurement. Price changes in a market-based economy can have several causes, including increases or decreases in production, increases or decreases in the supply of money, and changes in the supply of credit. It is consequently not possible to know, purely from price measurements, what is actually changing within the economy. Perceived price stability can occur at the same time as monetary expansion as long as it is is matched by productive expansion. Indeed economists frequently state that as long as productive expansion matches monetary expansion the latter is unimportant. A convenient argument given the general uncertainty surrounding the subject. Was the British banking system of this period then truly stable, or was it simply collapsing over a longer period than previously due to the extraordinary increases in production created by the Industrial Revolution?

The perception of stability, but the reality of something else, was to prove a dangerous combination, not only because it led to an unwarranted faith in central bank control of the banking system, but also in gold standard regulation, and in particular in fixed exchange rates between countries. It is in the subsequent attempts in the 20th century to impose international fixed exchange rate monetary systems that we can see some of the large-scale ramifications of the failure by economic theorists to develop their understanding of the banking system. On two separate occasions in the last 60 years, international treaties have been based on assumptions about the behaviour of the system that were not only incorrect, but also guaranteed their eventual failure. The treaties of Bretton Woods in 1944 and of Maastricht in 1992 made commitments to fixed-rate exchange systems between countries with widely different expansion rates in their underlying monetary systems. No explanation appears to ever have been provided as to how such an arrangement could be expected to endure, as the monetary and accompanying credit expansion influenced local price levels at varying rates as a result of the systems expanding out of step with one another. Nor has the presumption that the national central banks had sufficient control over their banking systems prevented this differential expansion from slowly tearing the fabric of the resulting interlinked economies apart.

The subsequent history is either well known or soon will be. Following a period of initial adjustments that were excused as adaptations to the new monetary system, major revaluations within the Bretton Woods agreement occurred with increasingly frequency. Canada devalued in 1962, the United Kingdom and Denmark in 1967, France in 1969, Germany re-valued in 1961 and 1969, Holland in 1961, and Austria and Switzerland in 1971. The absence of any monetary analysis concentrating on the actual mechanics of the system by economists of the period is notable. Katz (1971), writing shortly before the Bretton Woods breakup in 1971, concentrates primarily on observed measurements, in particular variations in rates of inflation and balance-of-payments imbalances as the source of the issues afflicting the agreement: effectively treating these empirical factors as a cause rather than an effect. The same process is now occurring in the Eurozone, where monetary expansion rates in its various national banking systems have ranged from 1.3 in Germany to 3.0 in Spain over its first decade. However, there is no mechanism within the euro for the exchange rate readjustments that prolonged the Bretton Woods agreement. Calls for a banking union to deal with the symptoms of variable monetary expansions ignore the need for the far deeper exploration of its mechanical causes that might still provide practical solutions.

To discuss these issues we must confront their principle cause: the absence of a clear and correct description of the banking system in economics textbooks. In the rest of this paper we will first provide a more detailed description of some simple banking system operations that may provide some clarity to readers unfamiliar with the subject, before proceeding to a detailed review of the flawed descriptions of the operation of the banking system that is found in economics textbooks. We will show how detailed knowledge of the operation of the system is surprisingly critical even at the macroeconomic level, and explore some of the analytical problems that fractional reserve banking has created for economic analysis. We will suggest that a critical and fundamental failing in economic theory to date is the failure to develop an atomic theory of money with concrete definitions of the two different forms of money and their role in the banking system, as well as of their role in a complex network of long-term monetary flows. It is the absence of such definitions that is the root cause of much of the confusion that macroeconomics in particular currently finds itself in. Indeed, only by focusing once again, as researchers did in the 1920s, on the detailed operations of banking, and by developing an atomic theory of money, can we reconstruct an economically relevant theory of monetary and financial operations for 21st-century society.

2 MONEY, CREDIT AND THE FRACTIONAL RESERVE BANKING SYSTEM

Fractional reserve banking practices introduced a new form of money within the economy, an entry on a deposit ledger within the accounting framework provided by double-entry bookkeeping. Although the status of bank deposits as equivalent to physical currency was first recognised in the 1820s by Pennington and others[4], the subsequent debate on whether this accounting entry enjoyed the same status as physical tokens of money lasted well into the 20th century. Traces of it can still be found in claims that 'money is debt,' with continuing confusion arising from its presence on both sides of the balance sheet: as an asset in the form of physical money and regulatory reserve requirements, and as a liability in the form of a customer's deposit, and in some forms of equity. By the end of the 19th century though, Dunbar (1887) was reporting that over 90 per cent of all financial transactions were being performed within the banking system. In today's largely computerized systems, it is probably the status of physical cash as fully equivalent to bank deposits that should be questioned.

The existence of two separate but equal forms of money within the same system suggests a more fundamental definition might be useful, if only to avoid the somewhat tedious debates on the validity of these different forms of money. For the purposes of this paper we will borrow a definition from complex systems, namely that each unit of money at the smallest subdivision for its currency, is a discrete bit of information. Information, in the sense that Shannon (1949) defined, has the specific meaning of a single, indivisible and unique piece of information, and is a foundational construct of data communications and networking theory.[5] Using this definition we can unify the concept of money under a single general description, whilst still being able to discriminate between its different forms in the monetary systems by being specific about the type of money in question and its position in the banking ledgers—for example liability money (customer bank deposits) or asset money, which can be either physical deposits of cash or electronic equivalents, while the reserve account represents a liability deposit at the central bank. Even with a unified definition, we still have to carefully distinguish the different types of monetary information being used, as they are not necessarily interchangeable—for example, there is no direct way to transfer a unit of asset money from a bank's balance sheet to a liability money deposit at the same bank; the rules of double-entry bookkeeping explicitly forbid this operation.[6]

More importantly, we sidestep the discussion of whether physical, fiat, or deposit money is truly money. They are all forms of money in its definition as information, and we can concern ourselves with the more important issue of the systemic behaviours that result from the operations performed on these different forms of money. This also leads us to a convenient definition of debt as a contractually committed flow of money over time, and by extension the treatment of the larger credit system as a networked system of debt relationships through which monetary flows are conducted. This not only develops naturally from the role money plays within society as a unit of communication, but also allows us to integrate money within the framework offered by complex systems, and in particular, real time network systems analysis, from which the definition of information originates.

3 EMERGENCE

Double-entry bookkeeping processes and procedures were originally introduced at the end of the 13th century as described by Lee (1977). They are a sophisticated technology in their own right, as well as being an early example of a forward error-correction algorithm.[7] Double entry bookkeeping required that each individual financial transaction be simultaneously recorded as two separate actions, a (debit, credit) tuple on two separate ledger accounts. These transactions were based on the accounting equation:

$$\text{Assets} = \text{Liabilities} + \text{Equity}; \quad (1)$$

or, in its longer form:

$$\text{Assets} = \text{Liabilities} + \text{Equity} + (\text{Income} - \text{Expenses} - \text{Dividends}). \quad (2)$$

It is worth observing that neither of these equations can be regarded as mathematical identities, since the units of their components do not match; there are also order of evaluation issues in (2) if bracketing is not strictly observed.

The single bookkeeping operation, which effectively created the banking system, is the record of the deposit of physical money, leading to the creation of a corresponding liability entry in the ledger, representing the deposit thus:

[Debit Cash (asset), Credit Customer Account (liability)]

This simple operation would eventually pave the way for a complete disassociation between the physical money deposited and the ledger entry acknowledging the deposit.

Initially it simply allowed physical gold to be deposited at the early goldsmith bankers for storage. The customer received a receipt; the goldsmith provided safe storage for his or her gold.[8] Significantly though, individual gold deposits were regarded as interchangeable. The customer received a receipt for an equivalent amount of gold, rather than the actual pieces of gold that they deposited.

From this first step of fiscal separation, all that was required for a modern banking system to develop were three additional developments, each of which can be seen as a natural emergent step from the facilities that double-entry bookkeeping provided. On the customer side, the receipt for a fixed amount of gold at a reputable storage location was used in lieu of the gold itself—thereby avoiding the hazards of carrying precious metals to and from a known location in an era before the introduction of police forces. As goldsmiths then became aware of the relative permanence of their physical holdings, they began to provide short term loans of gold, effectively introducing statistical multiplexing between their gold holdings and their customer deposits. The final step needed for the banking system we recognize today was a development of the use of simple instructions as a substitute for actual gold exchanges which would allowed direct transfers between customer accounts—cheques.

Technology would replace hand-written receipts with recognizable bank notes, and eventually restrictions on their issuance. A centralized meeting place, originally a convenient tavern[9], would develop into intricate clearing algorithms to manage the exchange of cheques between banks, as illustrated by Campbell-Kelly (2010). Short-term shortages of physical money caused by a variety of systemic problems, but visibly taking the form of bank runs, would lead to central banks and their role as the lender of last resort. As the system in Britain began to stabilize, or at least experience longer periods between crises, a belief grew in the ability of central banks to control the entire system. The army of clerks employed in 19th century cities to manage the day-to-day bookkeeping surrounding banking gave way in the 20th century to the computer and network technology which provides the pervasive electronic monetary systems in use today.[10] What though of the nature of money?

4 MONETARY PAYMENTS

The immediate consequence of fractional reserve banking practices were that transfers of money between two parties could now be conducted in three different ways. Physical tokens of money could be exchanged directly between individuals; but there were now also two ways to perform a ledger exchange between two bank deposits, either by direct ledger operations for customers of the same bank, or critically using an accompanying exchange of asset money for customers at different banks.[11] When customer deposits were transferred between banks with cheques or other financial instruments, physical money was used as an intermediary. This introduced a dependency within the banking system on physical money—to perform exchanges with other banks—that was critically important for the stable operation of the banking system, but effectively removed asset money from contributing materially to the price level.[12] The book keeping operations[13] were:

Originating Bank	*Receiving Bank*
(Credit cash, Debit customer account)	(Debit cash, Credit customer account)

However, if the originating bank did not have enough asset money to make the transfer, then it was illiquid. This could create short-term flow issues, even when the bank could predict that there was sufficient future income from its loan book to cover its obligations. While in principle a bank can completely predict its future status this way, the technology and mathematical support for this would not be developed until the 20th century, and only in the early 21st century would Taufemback and Da Silva (2011) first consider applying Erlang queueing theory, which was originally developed in the 1920s for engineering telephone exchange capacity, to the problem of bank reserve management.

There were now significant differences between the treatment of physical money and its virtual counterpart on the deposit ledger, but all might still have been well for economic theory had operations involving physical cash been the only way that liability deposits could be created within the banking system. However, the accounting framework also allowed lending instruments to be created, and this was accounted similarly to cash deposits. Loans were entered identically to a cash deposit at the receiving bank:

[Debit loan, Credit customer account]

Repayment involved two separate operations—payment of principal was simply removed from both sides:

[Credit loan principal, Debit customer account]

whilst interest payments took place entirely on the liability/equity side, as the customer's account was debited, and the bank's interest income account was credited:

[Debit Customer Account,
Credit bank interest income account]

This last operation provides a very simple answer to the question of the direct effect changes in interest rates have on the supply of money and credit from the banking system, and that is in most banking systems, none. Interest payments are simply a flow of money between a bank's customers and the bank. If the bank maintains the same spread between its saving and lending rates, then there is also no effect on the bank's total income. However, there can be second-order effects from interest rates if bank profitability, or the loan default rate, are impacted.

Control of the amount of lending performed by banks depended on practices developed by the goldsmiths, and these were primarily empirical, derived from observation of the day-to-day demands for money on the asset side of the balance sheet (physical cash and gold), and the need to ensure that these did not exceed the bank's actual holdings. Several centuries before the technique would be introduced to solve bandwidth contention in radio communications, the banking system was using statistical multiplexing, balancing the use of a small amount of physical money that was nominally the bank's asset against a much larger amount of liability money that represented their customer's deposits.

The result—as shown in Figure 1—was a system facilitating monetary exchanges that effectively operated through two independent circulating systems comprising two different forms of money, with a poorly understood interchange mechanism connecting them.

Bank loans thus created 'money out of thin air'—in the form of bank deposits—by adding to the quantity of money held in deposit ledgers at banks. However, recognition of the significance of this depended on the definition of money, and in the 19th century money was the physical medium, not its virtual equivalent. While the steady increase in bank deposits did not escape attention, especially after the 1844 Act in Britain mandated regular reports by banks on their holdings, it does not appear to have been correctly attributed. Dun (1876) for example, comments on the London joint

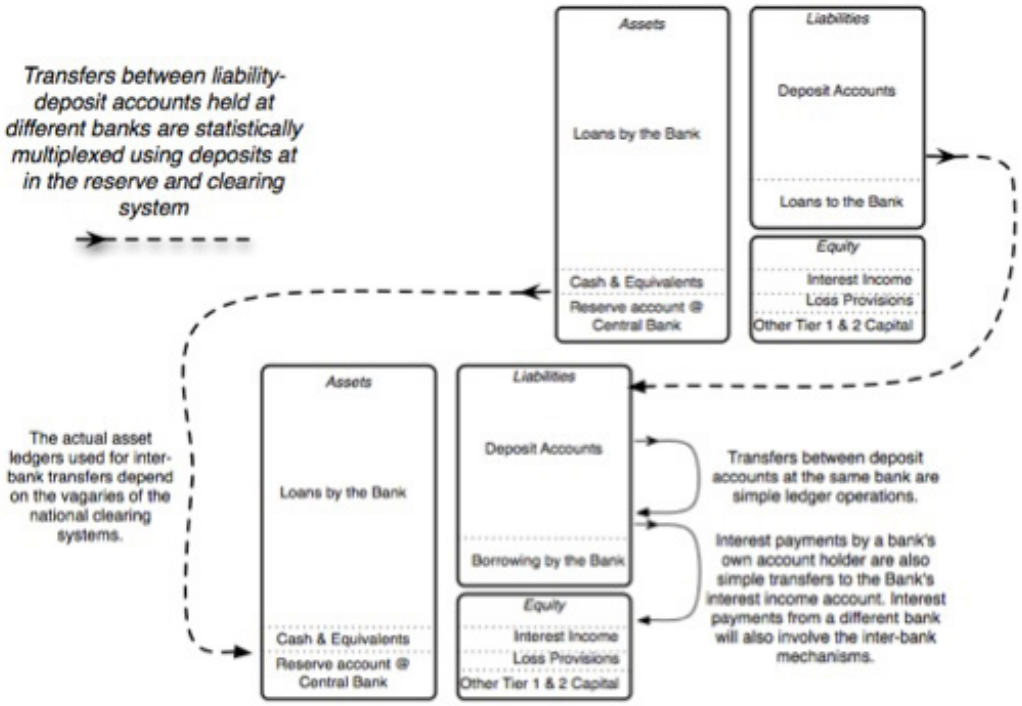

Figure 1: Monetary transfers within the banking system.

stock banks 1844-1847 that '[t]he increase of money lodged here shown is no less than 1010 per cent; an enormous augmentation, even if allowance be made for the absorption of several large private banks,'[14] but ascribes this to the physical deposit of cash money 'lodged,' rather than making the causal link to lending activities.

As economists did become more aware of the internal dynamics of the banking system, theories of credit began to be developed, and the origins of the unfortunate idea that 'money is debt' can be traced to Macleod (1889). The complication that money in the form of a customer's liability deposit is created at the same time as a debt instrument (a loan), does not imply an absolute identity in the scientific context, nor should it. A loan represents a contractual commitment by the borrower to provide a flow of monetary payments over time: hence money is not debt—debt is a flow of money.

If the originating bank for any reason was unable to satisfy a demand for a withdrawal against an account in good standing a bank run could be triggered. This could occur from requests for physical withdrawal, but also from a larger flow of direct transfers to another bank from its deposit accounts—since this relied on matching transfers of asset-money between banks.[15] Since there was no such danger with direct transfers between a bank's own customers, a slow process of consolidation began to occur, favouring banks which were either sensitive enough to these network effects to organize their customers activities to favour deposit transfers conducted entirely within their own ledgers, or geographically isolated enough from other banks for this not to be an issue. These direct ledger transfers also discretely added to the supply of money, and consequently there was an accompanying, but all but invisible influence on the price level from that source, which when it acted on the price of gold also influenced one of the regulatory elements of the entire system.

5 BANK LENDING

Intertwined with the new form of money, was a new form of lending, the bank loan, which was also subtly but significantly different from other forms of lending within the economy. Distinct from other lending, when a bank loan was created, money was created in the form of a bank deposit, and when it was repaid this money was destroyed. It is the regulation of these two processes on a day-to-day basis, across the entire banking system, that determines whether the part of the money supply being lent is expanding or contracting.[16] From the privileged perspective of 21st century access to long-term time series we know that the alternately expanding and contracting 'equilibrium' portrayed by Keynes and others was simply not there. The part of the money supply represented by bank deposits was, with rare exceptions, continuously expanding. Even under gold standard regulation, bank loans carried the significant side effect of deposit growth. Meanwhile, the occasional contractions which could be caused either by inter-bank flow issues or by high loan default levels caused considerable economic dislocation, as the delicate network of loans and monetary flows that economic activity increasingly relied on was disrupted, not only by reduced quantities of money in the economy, but also by liquidity issues in the interchange/bank-clearing mechanisms.

This problem was introduced by another significant difference between bank lending and loans made elsewhere, in the form of the relationship between interest payments and loan-default handling. Interest payments on normal loans are direct transfers of money between two parties. When interest on a bank loan is paid, a similar transfer occurs, but from the customer's deposit account into the bank's interest income liability account. Losses on loans are then first treated as an expense, and deducted from interest income, before the bank's interest income is recognized and paid out to meet bank expenses or as dividends. The consequence is that when either form of loan goes into default, the lender loses money; when non-bank loans go into default, the money their capital represents is still circulating in the economy somewhere, and thus there are no risks of larger side-effects due to monetary contraction. Bank loans behave a little differently. There is a limited zone where money can be destroyed, and then re-created through lending, effectively substituting new lending for bank profits. Within this 'quantum zone' banks and the larger monetary system are immune to the effects of loan losses. Indeed, compared to a bank with no defaults, a bank experiencing a manageable default rate would support a slightly higher rate of new lending, at the price of somewhat reduced profits.

If a bank's profit or loss provisions are not sufficient to cover losses though, then the bank must deduct the loss from its capital holdings. Capital accounts are classified as equity, but although treated identically to liabilities by the accounting equations relied on for economic analysis, they can comprise a mixture of liability money in ledger accounts (retained interest income for example), and financial instruments such as preferred stock that represent asset money deposits. There can also be regulatory requirements for capital holdings and loss provisions that must be maintained by banks. If bank

loan defaults exceed that which can be covered from loss provisions and profits, then the regulatory mechanisms force the bank to restrict or contract its lending, and as a consequence contract its contribution to the liability money supply. In the limit, loan losses that exceed the various forms of loss provisions that are made on the right hand (equity and liability) side of the ledger can only be made up over time from interest income flows. As these flows are money-supply neutral, external intervention is then required to maintain the level of money in the economy.[17] The practical realities of individual bank stability are far more interesting than the simplistic description of depositor-initiated bank runs that typically occupy introductory texts in economics.

Less visible is the problem of changes to the regulatory structure, for example mandated increases in loss provisions or capital holdings. This is currently occurring as part of the Basel 3 adjustments, and it can also impact the bank's short term ability to lend, again with potential long-term macroeconomic impact as well as considerable confusion in the resulting economic analysis. The recent contraction in the British money supply, for example, appears to be caused by the combination of a high default rate and the Basel 3 requirement for the banks to increase their capital holdings, temporarily inhibiting their ability to increase lending.

Table 1: Amount of new lending from loan repayment vs. monetary expansion with $1,000,000 total

Loan Duration	*New Lending originating from Capital Repayment*	*Monetary Expansion to create equivalent lending*
10 years	100,000	10%
25 years	40,000	4%
40 years	25,000	2.5%
100 years	1,000	1%

Within a hypothetically stable banking system where loan securitization is not allowed[18]—maintaining a constant supply of money and credit—the amount of new lending or investment provided by the banking system would depend entirely on the amount of capital repayment on existing loans, as well as the 'quantum buffer' offered by loss provisions and income, and loan defaults. Unless loan securitization is involved, if the total quantity of bank-originated lending is increasing, there is necessarily an accompanying increase in the liability deposit money supply. It is instructive to consider the quantities involved. Table 1 shows the amount of annual new lending from loan repayment versus the monetary expansion required for the same amount of new loans, assuming loan repayment is evenly distributed and all loans within the banking system are made for the same duration. By comparison, the annual expansion of the US M2 monetary measurement was 7 per cent between March 2012 and 2013. Even with relatively low rates of monetary expansion, new lending created by monetary expansion of liability deposits dominates over that made available from loan repayment.

The economic conundrum is that the two are intertwined. Whatever role credit creation plays in the economy, when it originates in the banking system it is necessarily accompanied by monetary creation.[19] When it comes from elsewhere, for example from government borrowing, then there is no accompanying money creation. There is consequently a significant difference between the monetary impact of increased government borrowing directly from its citizens, versus increased borrowing from/lending by commercial banks, a difference that seems to have escaped many economists, including Keynes.

6 FAILURE MODES

As is not uncommon with complex systems, there can be far more causes of failure than there are symptoms. While the bank run receives the most attention in the literature, banking failure can have multiple causes. Even a well-run bank is at the mercy of long-term monetary flows within the system, and a pattern of asymmetric lending from one region to another can easily set up unbalanced monetary flows that will over decades cause bank failure due to liquidity failure as it loses asset money to another bank. Rules surrounding non-performing loans are also critical: a bank may appear to be solvent, and indeed be able to cover its day-to-day expenses from a small amount of interest income, but no longer be able to supply new loans, as capital is no longer being repaid—the 'zombie bank' phenomenon.

Lending effects within the banking system are however not confined to the liability side of the banking sheet. Short-term loans of asset money are also made between banks to cover day-to-day reserve fluctuations, and these create the possibility of systemic cascade failures in the event of bank failure, requiring government intervention to prevent monetary collapse. In the modern banking system, the relatively clean divide between asset lending and liability money on

19th century balance sheets has been broken down by the extension of these originally short-term measures to longer duration loans within the 'capital markets' of asset money which banks then re-lend. Not only does this increase the system's intrinsic instability, but it has increased the need for government intervention to prevent a collapse of the entire system, as the asset side of the bank's balance sheet, which is considerably leveraged, is far more vulnerable to individual loan defaults than the liability side.[20]

7 ECONOMIC THEORIES OF THE BANKING SYSTEM

The parallel development of the banking system and modern economic theory has meant that the former has been subjected to several divergent evolutionary forces. Initially the most critical was the ability of individual banks to learn to manage the complex set of relationships described above, and to prevent failure from short-term liquidity failures if more physical cash or gold was demanded than they could satisfy. This led to the empirical discovery, and later to the requirement for minimum reserve requirements, typically 25 per cent or more in the 19th century. [21] It also introduced the role of the central bank as the lender of last resort so as to backstop short-term shortages of asset money (liquidity), which could be expected to be resolved over time as the bank received more funds from its existing loan portfolio, as compared with actual insolvency issues which could not.

An understandable desire by society to prevent bank failures from causing economy-wide cascade failures through their impact on commerce, and also to prevent use of these mechanisms for deliberate fraud, led to demands for regulation and reform throughout the 19th century. Successful regulation of the banking system would however have required a systemic and complete understanding of its operations, and as we will see this was not available. Rather each participant in the system argued for their perceived local interests. While banks do not profit directly from the creation of money involved in lending, they 'grow' as a result, and over time receive more total interest income from the increased loan book: while banks may make money, they earn income. Inevitably there was and is an intrinsic conflict between the banking sector's objective in fulfilling its capitalist role to earn money, and society's desire for a stable monetary system, which requires control over the actual process of manufacturing it.

The full implications of double-entry bookkeeping operations within a system of banks—in conjunction with the different regulatory frameworks in use—never appear to have been fully integrated into economic theory. As present discussions of 'money is debt' and 'credit theories of money' show and multiple definitions of key financial terms such as 'capital' make clear that—uniquely among the sciences—economics never developed an atomic theory consolidating and clearly defining the operations embedded in one of its fundamental systems. While the deposit creation process was clarified by Keynes and others, other critical operations in the banking system such as loan default and interest repayment, and the problem of positive and negative feedback loops within the regulatory mechanisms, were left largely unexamined. Economic reasoning proceeded on statements made about the behaviour of high-level abstract concepts, such as investment, liquidity and so on, without any detailed description of the precise mechanics involved in these mechanisms. Equally overlooked was the vital question of whether a distinction needed to be made between lending originating from within the banking system and outside it.

As a consequence, economic analysis continued without detailed consideration of the banking system, even as the banking system was modified, in no small part due to the influence of economic analysis. In considering Keynesian and other economic theories, we have to not only consider that they were based on an incorrect understanding of their own period's banking system, but also that the banking systems of that time behaved differently from their counterparts today.

8 THE STANDARD TEXTBOOK DESCRIPTION

The origin of the description of the banking system found in economics textbooks appears to be the Macmillan Report to the British Parliament (1931), in all probability written by John Maynard Keynes as reported by Stamp (1931). Taken in its entirety, the Macmillan Report is an interesting and comprehensive review of the banking and economic issues of its time and place. It provides detailed descriptions of the operations of the banking system, the structure of the central bank's balance sheet, and other details that demonstrate an intimate understanding of the finer details of banking mechanics. However, its contents also reflect an unwarranted confidence by at least one of its authors [22] in their understanding of the long-term behaviour of the system for which no strong theoretical basis could be extracted from the academic debates of the period.

It is on page 34 (ibid.) that we find the paragraph that would inadvertently do such lasting damage to economic understanding of the practices of banking:

> A simple illustration, in which it will be convenient to assume that all banking is concentrated *in one bank*[23], will make this clear. Let us suppose that a customer has paid into the bank £1,000 in cash and that it is judged from experience that only the equivalent of 10 per cent of the bank deposit need be held actually in cash to meet the demands of customers; then the £1,000 cash received will obviously support deposits amount to £10,000. Suppose that the bank then grants a loan of £900; it will open a credit of £900 for its customer, and when the customer draws a cheque for £900 upon the credit so opened that cheque will, on our hypothesis, be paid into the account of another of the bank's customers. The bank now holds both the original deposit of £1,000 and the £900 paid in by the second customer. Deposits have thus increased to £1,900 and the bank holds against its liability to pay out this sum (a) the original £1,000 of cash deposit and (b) the obligation of a customer to repay the loan of £900. The same result follows if the bank, instead of lending £900 to a customer, purchases an investment of that amount. The cheque which it draws upon itself in payment for the investment is paid into the seller's bank account and creates a deposit of that amount in his name. The bank, in this latter case, holds against its total liability for £1,900 (a) the original £1,000 of cash and (b) the investment which it has purchased. The bank can carry on the process of lending, or purchasing investments, until such time as the credits created or investments purchased, represent nine times the amount of the original deposit of £1,000 in cash. (Macmillan Report to the British Parliament, 1931: 34)

In its precise details, this description is entirely correct. However, the details must be carefully observed. In particular, all actions must occur in one bank, avoiding the critical complications that arise from the transfer of money from one bank to another. It is equally critical to maintain the difference between the physical deposit of cash (listed on the balance sheet as an asset), and the liability deposit entered against it. What is particularly problematic about this description, in both its original and later forms, is the implied convergence to stability under conditions of sufficient loan demand, which not inconsequentially also provided support for Keynes' more elaborate theories of macroeconomic control. This was not supported even by the data provided in the Macmillan report itself; tables on pages 35 and 37 showed, respectively, a small but steady decline in the English clearing banks' reserve accounts at the Bank of England and cash in hand, against a steadily increasing amount of total deposits in the banking system between 1919 and 1930.

The 1844 Bank Charter Act had required British banks to publish their deposit and reserve information on a weekly basis in national newspapers between 1844 until its partial repeal in 1928. Consequently, 19th century Britain enjoyed a level of transparency about the weekly flows within its banking system that is not available today. As Higonnet (1957) shows, this data demonstrated that there was a continuous expansion in the amount on deposit in the English banking system in the 19th century. This took place against a backdrop of prices that were perceived to cyclically increase and decrease over long periods, a temporal pattern that gained the label of the business cycle. A question that formed part of the difference between the Austrian and Keynesian schools, not apparently recognized at the time, was the nature of the variation of the money and the corresponding loan supply from the banking sector. An assumption that it was naturally increasing and decreasing in response to loan demand is quite different from an assumption that its normal state was continuously increasing, with variations in the rate of expansion, and occasional sharp contractions triggered by cascade failures, which is what the long time series statistics available today clearly show, as illustrated by Laidler (2003).

This is a sensitive question. The co-dependent relationship between new money and debt has wide-reaching implications, both for the control of the system and for its economic influence. Intervening to prevent monetary contraction is a quite different proposition from intervening to support a continued expansion whose immediate benefits are increasingly unevenly distributed in the economy as a direct result of the long-term dynamic process that is thereby triggered. The implication that the source of debt would matter, and that indeed bank lending might well enjoy a subtle long-term advantage over other forms of lending, was also a difficult one to address. Indeed without a clear description of the detailed mechanisms of the banking system at any given time and place, it is impossible to answer these kinds of questions. For example, was the 19th century money supply increase due to a slow increase in gold asset deposits, a faster increase in deposit liability money, or a subtle interaction between the price of gold, used as a regulatory control, and the growth in bank deposits? Each of these might cause similar macroeconomic affects on the price level, but require very different policy interventions to correct adverse consequences.

If we compare and contrast with the description typically found in popular US undergraduate textbooks (e.g. Mankiw 1997), which is shown here as Table 2, we can see that several changes have crept in, presumably in an attempt to clarify the original example. The example given no longer restricts the process to a single bank. Rather a sequence of operations is shown, where loans are being re-deposited between banks, and the important distinction between the physical cash as an asset and the customer's liability deposit has been lost.

Table 2: Textbook description of deposit expansion with a 10% reserve requirement

Bank	*Amount Deposited*	*Loans*	*Reserves*
A	100	90	10
B	90	81	9
C	81	72.9	8.1
D	72.9	65.6	7.29
etc.			

Source: Mankiw (1997)

Consequently, this example no longer represents the actual process that occurs within the banking system, and indeed is also internally inconsistent. For example, if we assume that the amount deposited is cash, which is a necessary assumption since a reserve from cash is clearly being withheld, then double-entry bookkeeping defines physical cash as an asset, a loan as an asset, and a central bank reserve account (or a reserve of physical cash) also as an asset, thus breaking the fundamental accounting equation in Equation 1. This assumption would then lead to the loan creating a cash deposit, which is equally incorrect. But then the first amount deposited cannot be a liability deposit, without an accompanying asset deposit, and so while classifying 'Amount deposited' as a liability would maintain the accounting equation, with the amounts and reserve requirement stated, it would not in fact be possible for bank A to make any more loans, as it would already be at its 10 per cent reserve ratio limit.

Alternately we have this passage in a popular European textbook, the 6th edition of Burda and Wyplosz (2013):

> An even more interesting and less well-understood fact about banks is that they actually create money when they grant loans—when they create credit. To see why, consider the case of Ms A who receives €1,000 in cash from abroad and deposits it in her bank. Bank No. 1 lends this money as soon as possible to Mr B, another trustworthy customer. Mr B needs the money to buy a sofa. Soon enough, the €1,000, initially deposited by Ms A will be handed over to the store that sold the sofa to Mr B. The shopkeeper now owns this €1,000. Ms A too owns €1,000. As far as she is concerned, her money is in the bank. In fact, she owns a deposit in her bank which is backed by a loan in the amount of €1,000, but the €1,000 in currency is long gone. (Borda and Wyplosz 2013) Precisely for this reason, modern banking is often called a 'fractional reserve banking system.' If the bank figures out that, say, only 10 per cent of the sums that will be deposited will be withdrawn at any point in time, all it needs to do is keep 10 per cent of its deposits in reserves, and it can then lend out the rest. In the case of Ms A's deposit, the bank will keep €100 in cash and lend the remaining €900. In that case, the initial amount of money created is only €900. After it is deposited in Bank No. 2, a new loan of €810 (this is €900 less 10%), will be arranged, and the process will go on as shown.

This restatement of Keynes' description is truer to the original, and clearer in terms of the cash-deposit difference. In one important respect it is erroneous, though. It is incorrect regarding the loan of money to another bank's customer. As with Mankiw´s example, as soon as loan repayments begin, Bank B and any other banks involved in the "process" will become illiquid. Keynes pointed out part of the problem in the next paragraph in the Macmillan Report:

> There is however, a limitation on this process. A bank which is actively creating deposits in this way will naturally find that a considerable part of the cheques drawn against them will be in favour of other banks. It will thus lose part of its cash reserve to those banks and must proceed to limit its loan operations if its normal cash ratio is to be maintained. (Macmillan Report, 1931: 34)

Interestingly, while this is a correct description of a short-term problem that can occur when the loan is made, a larger issue is that exactly the opposite occurs over the long term. Over the entire period of the loan, more money in interest and capital repayments will be received by the originating

bank than it originally lends. If it comes from other banks then its reserves will grow at their expense, providing one explanation for why over time banking systems with large numbers of small banks become systems with small numbers of large banks.

We can only speculate why economic theory took the path it did, and increasingly ignored these fine points of the intricate machinery that is modern banking. It is clear that the description in the Macmillan report could have provided the basis for the development of a far deeper and more complete understanding of its operation, paralleling the contemporary developments in physical science. This might have led to a science of economic systems that rested on solid and demonstrable causal foundations, albeit rather complex ones, rather than a series of assumptions derived from purely empirical observations of a complex system being continuously modified by its own intrinsic behaviour, and that of its observers.

One of many instances where such clarification would have avoided considerable debate can be found in Keynes' and other authors' writings on the 'liquidity preference,' a preference for holding money over other forms of investment. Here once again, the definition of money is important—in a gold standard system, with strict relationships between physical bank notes, bank deposits, and gold holdings, a preference for holding physical cash could indeed alter the behaviour of the banking system, particularly given the multiplier relationships involved. Cash withdrawals and flows of gold in international trade not only affect a bank's asset liquidity, but also its ability to lend. In modern banking systems this explicit tie between physical cash and banking system operation has been largely severed, primarily by the reduction in the general use of physical cash. Bank runs in the era of digital transactions are conducted through electronic transfers. The 'liquidity preference' stays in the banking system; it is simply moved to another bank. There is thus no change in the total quantity on deposit in the entire banking system.

What though did the originator of this term actually mean? According to Keynes:

> The primary effect of a change in the quantity of money on the quantity of effective demand is through its influence on the rate of interest. If this were the only reaction, the quantitative effect could be derived from three elements—(a) the schedule of liquidity-preference, which tells us by how much the rate of interest will have to fall in order that the new money may be absorbed by willing holders, (b) the schedule of marginal efficiencies which tells us by how much a given fall in the rate of interest will increase investment, and (c) the investment multiplier which tells us by how much a given increase in investment will increase effective demand as a whole. (Keynes, 1936: 298)

This passage is hard to interpret without a clear description of the banking operations involved, and clarification of the definition of money being used. A change in the quantity of money originating from the banking system must perforce derive from an increase in lending, so the borrower has already been sourced when this occurs. An increase in the quantity of money and credit from the banking system can also be presumed to affect the price level—so the claim that interest rates 'will have to fall' rests on a hidden assumption of price stability. Credit bubbles have demonstrated repeatedly that price rises can have the opposite effect when there is a general perception of more to come. An increase in asset money on the other hand, as a result of government printing, will trigger an expansion in money and lending, but as many governments have discovered to their cost, the resulting multiplier expansion of deposits within the banking system rapidly overwhelms the monetary system, leading to hyperinflation.

In addition, if a regulatory limit on loan supply has already been reached within the banking system, supply side restrictions will determine new lending, not demand. It is the rate of excess lending over repayment that causes monetary expansion from the banking system, not the interest rate per se.[25]

If Keynes meant that—contrary to his description—loan demand could influence the monetary expansion rate of the banking system, then there is a secondary issue with these assumptions that relates to the composition of bank lending. The British banking system relies on variable rate lending, which is linked to the interest rate of the Bank of England. Changes in that rate affect interest payments across the entire country within weeks. The US Banking system developed differently, with a preference for fixed rate loans over long periods—in the low interest rate environment of 2013 30-year mortgage loans were available at under 4 per cent per year. Iceland's attempt to deal with hyperinflation caused by government seignorage uses loans whose outstanding capital is indexed-linked (see Mallett [2013] for details on the rather unusual arrangements of the Icelandic monetary system). There are significant and systemic differences in the behaviour of these banking systems, and by extension the larger economy, arising from these differences in the fi-

nancial instruments being used for 'investment.' A general theory that makes claims about the monetary effects of interest rate manipulation without accounting for these structural differences is necessarily at best a general theory of the British monetary economy, not of monetary systems in general.

Had Keynes provided us with specific mechanisms to back up his argument, we would be far better able to judge what he was saying. We would for example know what type of money he was referring to, and we would also be able to judge the applicability of his mechanisms to today's quite different banking and monetary systems. He did not, his field did not, and we are left dealing with the complex behaviours of a 21st century financial system with the help of 19th century analytical techniques.

9 CONCLUSION

Objectively, analysis of the complex of operations and side effects at the core of the monetary system has always posed considerable challenges, especially at the macroeconomic level of analysis. It is formally and mathematically incorrect to equate like with unlike, and yet this is what economists have been forced to do when trying to develop mathematical descriptions of high level abstractions such as investment or capital, or even lower ones such as interest, if they ignore the presence of significant side effects, depending on whether or not the accompanying monetary operations are performed by an institution performing fractional reserve lending.

Economic understanding in the 21st century monetary system consequently rests on a vacuum, lacking the solid foundation of structural understanding that underpins other fields. The problem is not that there is an absence of economic theories about the monetary system, quite the contrary. Rather the problem is determining which of the many are correct, and to which of the equally large number of different banking systems they apply. As is common with many complex systems, empirical data and even mathematical reasoning can be used to support many differing explanations of a system's observed behaviour.

On the other hand we have the banking system itself, a complex and extraordinarily advanced distributed system. It is a moving target for analysis, and it is one that has simultaneously influenced both economic development and the development of economics. Added to this is the problem of what the banking system does to money, which is that it causes its quantity to continuously expand. Consequently measurements made with money are seen to behave like other physical measurements. Government expenditures 'grow' over time, health costs 'rise,' GDP 'grows.' However, the units of other measurements are constant: a centimetre today is the same length as that of a centimetre in 1799. How much of economically measured 'growth' is a result of increased production as opposed to increases in the money supply cannot be determined purely from price data, even if inflation compensations are included. Nor can we say with any certainty that any of the purely theoretical economic arguments—such as general equilibrium theory that implicitly assume a constant money supply—are also applicable to a system where the money supply is continuously increasing. The real world as it appears to economics is very much a special case.

The complexity of these issues has been acknowledged before, if not necessarily in the context of the micro-structure of the banking system. Keynes freely acknowledged the presence of multiple complicating and inter-related factors as supply and demand factors play out in his General Theory, but expressed a faith in simultaneous equations to solve them that experience with the mathematics of non-linear dynamic systems would have quickly disabused him from. But with this problem we can only sympathize; economics has long laboured under significant analytical difficulties, stemming from the absence of formal methods for treating the inherently recursive nature of the relationships that the banking system and the larger economy embody. Recursion, and many of the other techniques used to analyse complex distributed systems, would not be developed until the second half of the 20th century. They came far too late to assist the theories of banking system behaviour that are currently in use.

Ultimately there is only one way out of this collision of impasses: it is to return to the fundamentals of the monetary system and the banking system, armed finally with a 21st century appreciation of complex distributed systems. Only by reassessing what we believe we know about the monetary system, in the context of a far more detailed and thoroughly grounded understanding of the short and long-term influences of the banking system on the economy, can we resolve the long-standing question of which, if any, of the theoretical constructs we have of the monetary system, and its accompanying assumptions, are grounded in reality.

NOTES

1 USA Federal Reserve Statistics Series H.6 Money Stock Measures

2 Bank of England Statistical series LPQVWYH (UK estimate of EMU M2) shows M2 as 2,100,420 in June 2010, falling to 2,021,130 in June 2012 and recovering to 2,091,037 in June 2013.

3 Wicksell (1935) provides an overview of some of these issues in his Lectures on Political Economy, Volume II, Chapter 2, and Klebaner (1990) provides a useful overview of the situation in the United States.

4 Referenced by Arnon (2011: 178) as a memorandum in 1836 and an addendum to Tooke in 1829.

5 See Arndt (2004) for a detailed discussion of information and its measurement within computer science.

6 Strictly, this would require performing a credit to the asset account, and a credit to the deposit account, and all double-entry bookkeeping operations must be performed as a [credit, debit] tuple.

7 Forward error correction techniques introduce extra information into a message that allow a limited number of errors to be detected and corrected without retransmission of the original data.

8 See Quinn (1994) for an excellent overview of the pre-banking goldsmith arrangements.

9 The Five Bells in Lombard Street, London (Nevin and Davis, 1970).

10 The banking industry was an important source of finance for both the early computing and networking industries, with mainframe computers being developed for processing their daily accounting transactions, and X.25 networks in particular developed for inter-bank payments and financial handling. As a result its operations also played a role in the development of computer science, with the development of real-time systems, network and database theory all being heavily influenced by its requirements.

11 Illustrated examples of all double entry bookkeeping operations used in this paper can be found in Mallett (2012).

12 Mechanical issues arising from asset money shortages within banking literature are usually referred to as 'liquidity,' the complication is that these balances can also play a regulatory role on deposit expansion.

13 In double entry bookkeeping, the arithmetic operations accompanying credit and debit depend on the status of the ledger they are applied to. Operations on the right hand side of the ledger (liabilities and equity) follow their English usage; operations on the asset side are opposite. For example, a credit to an asset account reduces its total, and a credit to a liability or equity account increases it.

14 Deposits for the 10 banks are shown increasing from £7,984,000 in 1844 to £88,604,000 in 1874. This is an approximately 30% annual growth rate.

15 Equally, unscrupulous competitors could start rumours of liquidity issues that were liable to rapidly become self-fulfilling—see Sykes (1867) and Klebaner (1990) for an overview of the far more interesting, and considerably less stable, banking environment that developed in the 19th century United States.

16 Although this process is typically described with respect to the expansion of liability deposits, the potential exists for a more limited form to occur through interbank lending on the asset side of the bank's balance sheet.

17 At this point a bank's situation as a day-to-day manager of funds is typically no longer tenable without outside intervention. Over time though as income continues to be received on its remaining assets it will usually be capable of being wound up with relatively small absolute losses. Nor is intervention always as straightforward as it might appear, replacing non-performing loans as assets for example risks interfering with long term reserve regulation mechanisms if they exist.

18 Loan securitization by banks increases the amount of bank-sourced lending, but does not increase the deposit money supply, unlike normal bank lending.

19 Unless the loan is securitized.

20 See Shin (2009) for a description of the Northern Rock failure due to this cause.

21 Nineteenth century banking systems appear to have been just as unstable with 25% reserve requirements, as 21st century ones with 2% reserve requirements or less.

22 Pages 239-281 of the report consist of reservations on its contents expressed by five of its authors.

23 Author's emphasis.

24 Keynes (1936: 298).

25 Under Basel capital regulations, interest rates may have a second-order effect on the behaviour of the system, in that bank capital is now a regulatory control over lending limits, and can generally only be increased from profits. However, this relationship is the inverse to that which Keynes is referring to, i.e. if increasing interest rates positively impacts bank profitability, it would

increase lending expansion rates through increased supply, although this would also depend on the bank's management of the difference between the interest rate paid to savers as opposed to that received from borrowers. Interestingly, Wicksell (1898) also comments that it is a matter of record that price increases are greater with higher interest rates than lower ones.

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