

What are the limits on Commercial Bank Lending?

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Abstract

Analysis of the 2007-8 credit crisis has concentrated on issues of relaxed lending standards, and the perception of irrational behaviour by speculative investors in real estate and other assets. Asset backed securities have been extensively criticised for creating a moral hazard in loan issuance and an associated increase in default risk, by removing the immediate lender's incentive to ensure that the underlying loans could be repaid. However significant monetary issues can accompany any form of increased commercial bank lending, and these appear to have been overlooked by this analysis. In this paper we propose a general explanation for credit crises based on an examination of the mechanics of the banking system, and in particular its internal controls on the supply of credit. We suggest that the current credit crisis is the result of multiple failures in the Basel regulatory framework, including the removal of central bank reserve requirements from some classes of deposit accounts within the banking system, allowing financial instruments representing debt to be used as regulatory capital, and in particular the introduction of securitized lending which effectively removed a previously implicit control over the total quantity of lending originating from the banking system. We further argue that the interaction of these problems has led to a destabilising imbalance between total money and loan supply growth, in that total lending sourced from the commercial bank sector increased at a faster rate than accompanying growth in the money supply. This not only created a multi-decade macro-economic debt spiral, but by increasing the ratio of debt to money within the monetary system acted to increase the risk of loan defaults, and consequentially reduce the overall stability of the banking system.

Introduction

Research on the causes of the current series of multi-national credit crises has implicated securitized lending, and other innovative financial instruments, primarily for removing the burden of the financial consequences of loan default from the issuers of successfully securitized loans as discussed by Diamond [1], and for the creation of an opaque system of interlinked borrowing as described by Gorton [2]. Nyberg also cites general systemic problems in the banking system [3], and evidence presented by Schularick and Taylor [4] also points to rapid credit expansions being a strong predictor of financial crises since 1870. There has however been relatively little focus on the precise reason why securitized lending originating within the banking system, and the creation of accompanying trading markets in securitized debt should cause such large scale systemic problems, whereas a long history of corporate and government bond debt instruments in a similar trading environment has not been considered similarly problematic.

Although public attention is often drawn to seemingly dramatic increases in government debt, a larger source of borrowing growth in many countries appears to have been debt originating from the banking system. While part of the increase in both forms of debt is due to the underlying growth of the money supply, it is clear from Figure 1¹ which shows mortgage debt for the United States over the last 25 years, in comparison with the total amount of outstanding US Government Treasuries, that mortgage debt has been increasing at a significantly faster rate. Growth in banking debt considerably exceeded that of government borrowing up until the credit crisis of 2007, at which point a sizeable increase in government debt occurred as a result of intervention to rescue the American banking system from collapse.

¹Data from the Federal Reserve Bank's Flow of Funds Z.1 series. Care has to be exercised with all monetary data owing to the continuous expansion of the unit of measurement, i.e. the money supply. Data in this figure has consequently been normalised for growth in the money supply with a base of 1983, using the M2 money supply measure (Table H.6) with the Money Market funds component removed. (Money market funds are primarily held in short term debt instruments. Total US money supply growth for this period was approximately 4 times.)

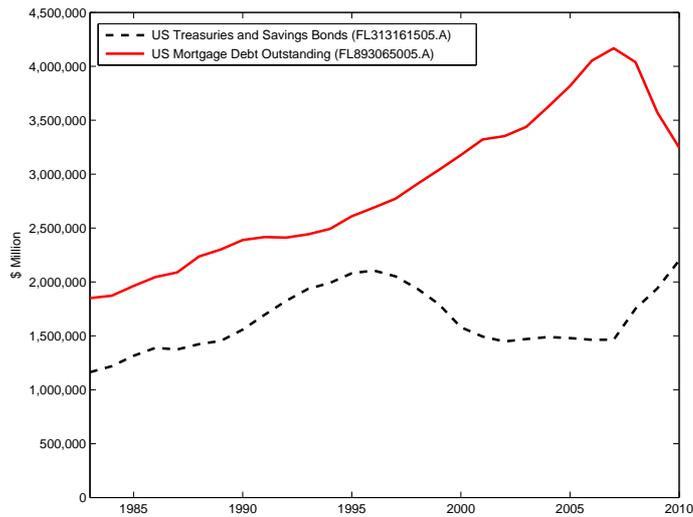


Figure 1: US Mortgage Debt vs US Government Debt

The question of why bank lending was able to expand so considerably, and by extension what limits apply to it, is of particular interest in understanding the periodic excesses in lending and borrowing that have come to be termed credit bubbles. If there is no limit on lending originating from the banking system, and the growth in credit is being supplied from there, then there should be no particular mystery about the cause of credit bubbles. Any increase in the supply of debt is liable to trigger a simple positive feedback loop if the asset being purchased is in limited supply. If housing developers are borrowing money to buy land for example, then the price they can pay is determined by the supply of loans. If an increase in bank lending causes more money to be created to purchase these assets, then the price of the asset will rise, amplifying the signal that asset prices provide to investors, and increasing the demand for loans. The resulting feedback loop is likely to be particularly vicious if the asset can then be used as collateral for another loan, either through sale, or remortgaging against the new value of the property, since a direct debt/price feedback loop will be created. The 1920's stock market bubble in the US provides an interesting example of this where margin loans were used to finance share purchases, with the shares so purchased then acting as collateral for further borrowing.

Conversely if there is a limit on the total quantity of bank lending, but expansion of the loan supply from the commercial banks has not reached it, then a credit bubble could be regarded as an unusually large variation in credit demand within known limits. In this case policy towards controlling the damage caused by credit bubbles could be simply directed to detecting and preventing this increase. It would then be straightforward to detect asset bubbles simply by monitoring changes in the supply of credit to the economy.

A possible explanation for credit bubbles then is that current theoretical models of banking equilibrium are incorrect, and that in practice failures in banking regulation or the invention of novel financial instruments and banking practices allow the system to enter periods of unrestricted loan supply growth, with major and consequent distortions in that part of the money and loan supply that is controlled by institutions performing reserve based lending. To explore this explanation in the context of the 2007 credit crisis, we will first discuss the theoretical model of the banking system and its deficiencies, and the current situation with respect to the Basel regulatory frameworks. We will then explore the specific features of some financial instruments, notably Asset Backed or Mortgage Backed securities, which challenge the integrity of this framework, and examine the empirical evidence for these effects.

1 Theoretical Models of the Banking System

1.1 Fractional Reserve Based Lending

Banking as we understand it today has emerged over several centuries from a set of practices first established in Northern Europe by medieval goldsmiths and traders [5]. It initially developed as a form of statistical multiplexing whereby access to physical money in the form of gold was managed through day to day bookkeeping practices, operated under the assumption that only a fraction of the underlying liabilities (customer deposits of gold) would be requested at any one time. Based on this assumption goldsmiths would make short term loans to other customers, and as the chits used to represent gold deposits began to be exchanged directly, a bank based monetary system developed. Over time this system has mutated into today's almost entirely electronic transfer based system, while still retaining the bookkeeping practices of the original system.

The standard description of this system found in most textbooks describes a simple recursive process where loans are made against deposits, and the money they represent is re-deposited into the banking system, creating a damped recursive feedback process that acts to expand the total quantity of bank loans and bank deposits. As each new deposit is created a required fraction of the deposit is held back as a reserve by the bank, with the remaining deposits providing backing for further loans. Since its inception this relationship between money and lending within the banking system has consequently exerted an independent influence on the price level to that performed by physical money whenever transfers are made from within the banking system, for example by writing cheques²

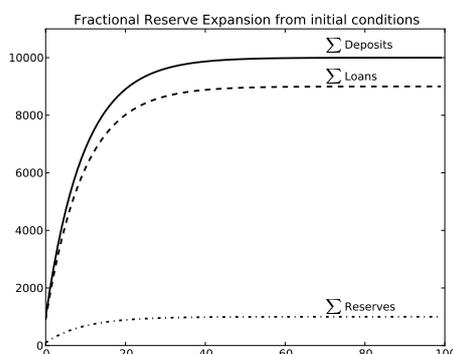


Figure 2: Theoretical Expansion of the Money Supply from initial conditions.

Figure 2 shows the theoretical behaviour of the banking system as described in foundational economic textbooks such as Mankiw [6]. With a reserve requirement of 10% the eventual expansion of the money supply is 10 times the original deposit into the system, and that of the loan supply, 9 times the original deposit. Under this theoretical model, the bank originated loan supply is always constrained to be a fraction of the money supply, 90% in the example shown, and cannot exceed the money supply. The actual behaviour of the US money supply over the last 40 years is shown in Figure 3 and of the loan supply in Figure 5.

The simplified textbook description appears to have originated in the 1931 Macmillan report to the British Parliament [7] and appears to have been authored by Keynes [8]. It did not include either loan repayments or loan defaults, and was probably only intended as a simplified explanation for the deposit expansion process the implications of which were being explored by economists at that time [9]. It incorrectly suggests that reserves were a fraction withheld from the customer's deposits, in reality the fractional reserve is an additional amount of money held by banks on deposit at the central bank.

One correct implication of the textbook model is that the limit on commercial bank loans would always be a fraction of the total amount of deposits in the banking system, and that bank lending would expand or contract in a fixed proportion with the quantity of deposits. In the textbook model, once expansion reached the limits imposed by reserve requirements, new loans could only be made as the principle on existing loans was repaid, freeing up loan capacity. Both the money and loan supplies could vary within these limits though. For example if loans

²Since Gold Standard era regulation rested on prescribed relationships between physical notes and coins, and the *price* of gold reserves, the influence of direct transfers within the banking system on the general price level would have been a destabilising factor.

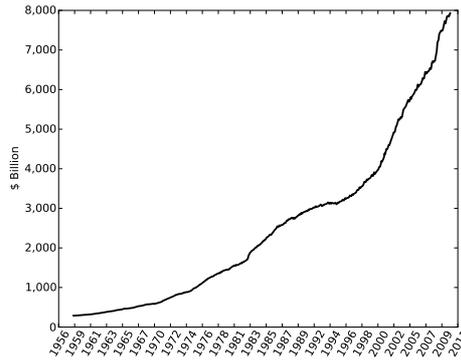


Figure 3: US M2 with Money Market funds removed: 1959 - 2010

are repaid faster than they are made then the money supply will contract as the expansion process reverses. This behaviour is rarely seen, but is economically dangerous since although market based mechanisms can over time adjust most prices in the economy, they do not apply to fixed monetary contracts such as loans. Hart [10] in his analysis of the behaviour of the US banking system during the later years of the 1930's Great Depression attributes net repayment of debt with removing more money from the money supply than the earlier wave of bank failures had.³

Loans within the economy can consequently be classified into two different types, transfer loans such as bonds and treasuries, which are a direct exchange of debt for money, and reserve based loans which are issued by banking institutions. The distinction between the two types of lending is important, since operations on the two types of debt are not equivalent. Some financial operations such as transfer or sale have no impact within the larger monetary system when performed on transfer loans, but can cause systemic side effects when performed on commercial bank loans, as will be shown below.

1.2 Basel Capital Reserve Based Lending

In most countries today the operational and regulatory framework of the banking system has changed significantly from the theoretical model described above, particularly with respect to the fractional reserve requirement which has been increasingly removed. In the American system the full reserve requirement is limited to "Net Transaction Accounts"⁴, which are a small proportion of total deposits. The focus of bank regulation has shifted to the "Capital Reserve Requirements", which represent a mixture of shareholder equity, reserves against loss, and subordinated debt the total quantity of which is based on a complex series of risk based analyses of the bank's loan book. [11].

When losses occur on a bank's loans, the amount lost is first covered from profits and then from regulatory capital. If these are not sufficient, bank failure and loss of bank deposits can occur. Consequently the Basel accords concentrate on regulating the capital reserve requirements of individual banks on a risk weighted basis in order to prevent bank failure through inadequate loss provision. The full title of the Basel Accords is the "International Convergence of Capital Measurement and Capital Standards", they do not attempt to provide regulation over money creation through the lending mechanism, nor any form of systemic regulation of the behaviour of the entire banking system.⁵

The accords approach this task by establishing minimum requirements for the ratio of the value of the capital reserve in relation to the total loan capital of loans made by the bank. To be well-capitalised under American federal bank regulatory definitions, which is a requirement to avoid extra supervision, a bank's regulatory capital holding must be at least 10% of its risk adjusted loans. Risk adjustment applies to the type of the loan being made, for example mortgages have a risk adjustment weighting of 50%, so banks can lend twice as much in proportion

³ Money supply induced deflation should not however be confused with price deflation resulting from increases in the supply of goods, which is generally a sign of increased prosperity as more goods become available at cheaper prices.

⁴In the USA, reserve requirements are 10% on Net Transaction accounts, and 0% on non-personal time deposits and Euro currency liabilities. <http://www.federalreserve.gov/monetarypolicy/reservereq.htm>

⁵Pillar 2 of the Basel Accords is a commitment to regulatory enforcement and overview. However, this pre-supposes that the behaviour of the underlying system is sufficiently well understood that it can be appropriately regulated.

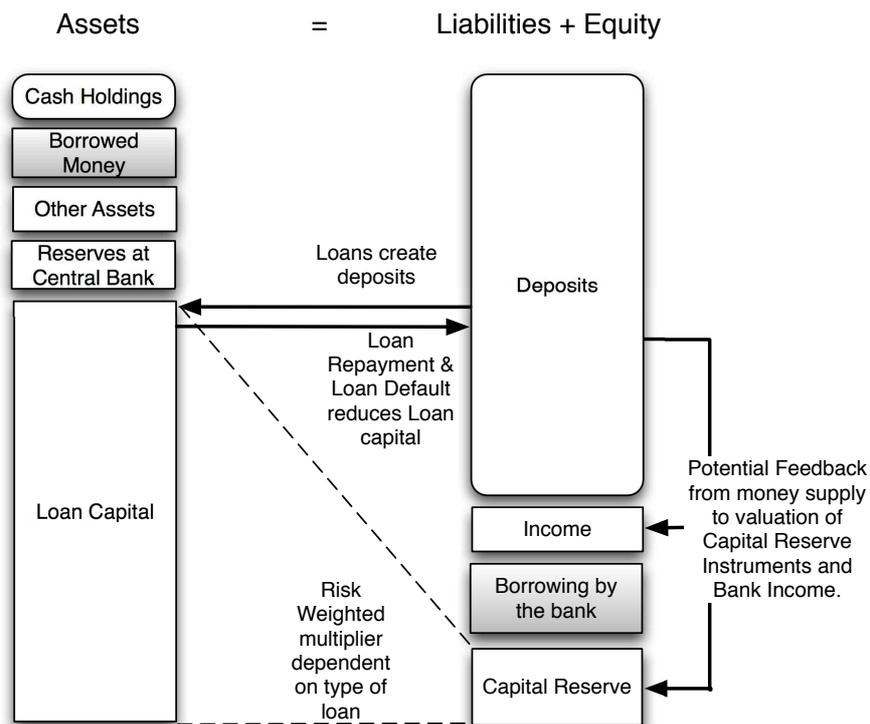


Figure 4: Regulatory framework of Basel Based Banking Systems.

to their regulatory capital holdings for mortgages than for other types of loans. As Acharya points out [12] this can bias banks towards certain types of loans, and in particular Basel II assigned government bonds rated AA- or higher a 0% risk weighting. Changes in risk ratings can also be highly problematic owing to the accompanying multiplier effects on allowed lending.

Figure 4 shows a simplified illustration of this framework within the context of the accounting framework maintained at each bank, with arrows indicating some of the potential feedback loops. The total quantity of loans issued by a bank in the diagram is effectively regulated by the multiple of lending allowed by its risk weighted capital (shown as dashed lines), and the local status of its *liabilities = assets + equity* accounting identity. Loans that have been sold by the banks to non-bank entities (i.e. MBS and ABS) are not shown on the diagram.

The expansion of money in the form of bank deposits under this framework is nominally constrained by the combination of reserve requirements at the central bank, the capital reserve, and the amount of money in customer accounts on deposit at the bank. Reserve requirements at the central bank are limited in their effectiveness, both by the presence of deposit accounts that do not have a reserve requirement, by the ability of banks to borrow from each other to support their reserve requirements, and by the necessity of government and central bank intervention should reserves prove insufficient for the entire system. There are no limits on the total amount of capital reserves that can be held by the entire banking system, and capital holdings can be increased from profits as required. Customer deposits are being continuously created and removed by the act of loan creation and repayment, and will increase while the rate of new lending exceeds the rate of loan repayment and default. Monetary and loan supply contraction is also a possibility if the rate of new lending falls below this level. Taken together, it would seem that equilibrium behaviour would be an unlikely outcome for this system.

1.3 Modern Monetary Theory

Attempts within Economics to develop a more complete theory of the banking system are broadly categorised under "exogenous" theories where deposits create loans, and "endogenous" or post-Keynesian theories where lending creates deposits. Interestingly many endogenous money authors such as Lavoie [13] continue the tradition set by

Keynes of omitting loan repayment and default, and there seems to be a general aversion to presenting the historical context of a system whose rules vary considerably between time and place. The focus on credit also frequently overlooks the role of money in establishing the price level, and thereby providing a critical economic signal, and the unfortunate reality that credit and money are directly linked within the banking system is rarely addressed simultaneously. Although Minsky's financial instability hypothesis [14] does consider the role of financial debt relationships relative to financial activity, it does not consider the operational mechanics of the banking system in sufficient detail to uncover the intrinsic mechanisms for this instability.

Both theories of money contain accurate observations of some aspects of the banking systems' behaviour, but neither offers a complete system analysis, and in a recursively defined system to debate whether loans create deposits or deposits create loans is quintessentially tautologous. Further problems are created by their inclusion within economic theories of supply and demand for money and credit, and definitions of money as debt that can be traced to the origins of money as bills of account. This is particularly noticeable with the proponents of monetary circuit theory [15] and the idea that there is a demand for money and credit which determines the system's behaviour. Certainly historically there have been periods where physical shortages of money caused significant problems, and Fischer [16] provides a fascinating account of such problems in the medieval ages. However one of the considerable advantages of the banking system was that it alleviated these issues, and discussion in particular of the demand for money tends to overlook the interaction with the price level that occurs when the money supply itself increases. Debates over the demand for credit also fail to consider that the system itself provides a very clear signal when insufficient demand occurs(it contracts), absent which behaviour it can be safely assumed that limits on loan supply are dominating.

Even a simple simulation of the textbook model with loan repayments suggests that this is a system whose behaviour is sensitive to many conditions [17], and it is probably this failure to consider the multiple and separate causes of gross macro-economic features such as price deflation and credit expansion originating from seemingly minor differences between banking systems that have created significant problems for any purely empirically based analysis. Determining how any given currency's banking system will behave over time is challenging, complete and testable descriptions of their regulatory frameworks are not currently provided by any central bank. There is also considerable confusion in the monetary statistics themselves, with no consistency in either the measures being used, or the components used within them. The definition of M2 used for the Euro for example, is significantly different from that provided by the Federal Reserve Banks for the US dollar, and differs again from that used in other countries.

2 Failures in Systemic Regulation

2.1 Asset Backed Securities

Asset Backed Securities(ABS) are freely traded financial instruments that represent packages of loans issued by the commercial banks. The majority are created from mortgages, but credit card debt, commercial real estate loans, student loans, and hedge fund loans are also known to have been securitized [18] The earliest form of ABS within the American banking system⁶ appears to stem from the creation of the Federal National Mortgage Association (Fannie Mae) in 1938 as part of amendments to the US National Housing Act, a Great Depression measure aimed at creating loan liquidity. Fannie Mae, and the other Government Sponsored Enterprises buy loans from approved mortgage sellers, typically banks, and create guaranteed financial debt instruments from them, to be sold on the credit markets. The resulting bonds, backed as they are by loan insurance, are widely used in pension funds and insurance companies, as a secure, financial instrument providing a predictable, low risk return.

The creation of a more general form of Mortgage Backed Security is credited to Bob Dall and the trading desk of Salmon brothers in 1977 by Lewis [20]. Lewis also describes a rapid expansion in their sale beginning in 1981 as a side effect of the United States savings and loans crisis. The concept was extended in 1987 by bankers at Drexel Burnham Lambert Inc. to corporate bonds and loans in the form of Collateralized Debt Obligations(CDOs), which eventually came to include mortgage backed securities, and in the form of CDO-Squared instruments, pools of CDO. (For an excellent work on the history of these instruments see Mackenzie's paper on the sociology of the knowledge of these instruments within the financial community [21].)

Analysis of the systemic effects of Asset Backed Security has concentrated chiefly on their ability to improve the quantity of loans, or loan liquidity, which has been treated as a positive feature by Greenspan [22]. Wolfe [23]

⁶Ludwig Von Mises, [19] writing in 1912 describes the Austro-Hungarian Bank "refusing to issue bills ... to increase the difficulty of speculative repurchase of home securities from abroad", suggesting that a loan sale problem may also have been present at that time.

also noted that securitization allowed banks to increase their return on capital by transforming their operations into a credit generating pipeline process, but didn't consider the effects of this mechanism on the larger banking system. Shin [24] has also analysed their effect on bank leverage and the stability of the larger financial system within an accounting framework. He highlights the significance of loan supply factors in causing the sub-prime crisis. Although his model appears not to completely incorporate the full implications of the process operating within the capital reserve regulated banking system as described below, it presents an alternate, matrix based analysis of the uncontrolled debt expansion that these instruments permit.

The systemic problem introduced by asset backed securities, or any form of sale that transfers loans made by commercial banking institutions outside the regulatory framework is that they allow banks to escape the explicit reserve and regulatory capital based regulation on the total amount of loans being issued against customer deposits. This has the effect of steadily increasing the ratio of bank originated loans to money on deposit within the banking system.

The following example demonstrates the problem using two banks, A and B. For simplicity fees related to loans and ABS sales are excluded. It is assumed that the deposit accounts are Net Transaction accounts under current US banking requirements⁷, and therefore carry a 10% reserve requirement, and that both banks are "well capitalised" under FDIC and Basel treaty definitions, and that the risk weighted multiplier for the capital reserve for these loans is also 10.

The example proceeds as a series of interactions as money flows between the two banks. The liabilities (deposits) and assets (loans) are shown, with loans being separated into bank loans, and Mortgage Backed Securities(MBS), depending on their state.

Initial Conditions: To simplify Bank B is shown as having made no loans, and has excess reserves at the central bank to maintain the balance sheet. The normal inter-bank and central bank lending mechanisms would enable the bank to compensate for temporary imbalances during the process under normal conditions. All deposit money used within the example remains on deposit at either Bank A or Bank B. On the right hand side of the table the total amount of deposits and loans for both banks is shown.

Table 1: Unregulated Increase in Leverage through Loan Sales

Initial Conditions							
Bank	Loans	Assets		Liabilities		Σ Deposits	Σ Loans
		MBS	CB Reserve	Deposits	Capital		
A:	1000	0	100	1000	100	2000	1000
B:			1100	1000	100		

Step 1: Bank A creates a \$1000 Mortgage Backed Security from the loan on its balance sheet.

Table 2: Unregulated Increase in Leverage through Loan Sales

Step 1							
Bank	Loans	Assets		Liabilities		Σ Deposits	Σ Loans
		MBS	CB Reserve	Deposits	Capital		
A:		1000	100	1000	100	2000	1000
B:			1100	1000	100		

Step 2: The securitized loan is sold to the *depositor* at Bank B. \$1000 is paid to Bank A from that depositor in payment for the loan. Bank A now has no loans outstanding against its deposits, and the securitized loan has been moved outside of banking system regulation. Note that total deposits at the two banks have temporarily shrunk due to the repayment of the loan capital at A. The actual transfer of the deposits between the banks is facilitated through the reserve holdings which also function as clearing funds.

⁷Feinman [25] has a review of current and previous reserve requirements within the US system.

Table 3: Unregulated Increase in Leverage through Loan Sales

Step 2							
Bank	Assets			Liabilities		Σ Deposits	Σ Loans
	Loans	MBS	CB Reserve	Deposits	Capital		
A:			1100	1000	100	1000	1000
B:			100		100		
<i>Mortgage Backed Securities: \$1000</i>							

Step 3 As Bank A now has no loans against its deposits, and is within its regulatory capital ratios, it can make a new \$1000 loan. The funds from this loan are deposited at Bank B. The sum of the deposits rises as a result as does the quantity of loans. Note that the transfer of the loan money from Bank A to Bank B again goes through the reserve holdings in the clearing system and restores the original balance at Bank B.

Table 4: Unregulated Increase in Leverage through Loan Sales

Step 3							
Bank	Assets			Liabilities		Σ Deposits	Σ Loans
	Loans	MBS	CB Reserve	Deposits	Capital		
A:	1000		100	1000	100	2000	2000
B:			1100	1000	100		
<i>Mortgage Backed Securities: \$1000</i>							

Step 4 Bank A securitizes the loan made in Step 3 repeating *Step 1*.

Table 5: Unregulated Increase in Leverage through Loan Sales

Step 4							
Bank	Assets			Liabilities		Σ Deposits	Σ Loans
	Loans	MBS	CB Reserve	Deposits	Capital		
A:		1000	100	1000	100	2000	2000
B:			1100	1000	100		
<i>Mortgage Backed Securities: \$1000</i>							

Step 5 Bank A sells the MBS to the *depositor* at Bank B, repeating *Step 2*.

Table 6: Unregulated Increase in Leverage through Loan Sales

Step 5							
Bank	Assets			Liabilities		Σ Deposits	Σ Loans
	Loans	MBS	CB Reserve	Deposits	Capital		
A:			1100	1000	100	1000	2000
B:			100		100		
<i>Mortgage Backed Securities: \$2000</i>							

Step 6 Bank A makes a new loan which is deposited at Bank B, repeating *Step 3*

Table 7: Unregulated Increase in Leverage through Loan Sales

Step 6							
Bank	Assets			Liabilities		Σ Deposits	Σ Loans
	Loans	MBS	CB Reserve	Deposits	Capital		
A:	1000		100	1000	100	2000	3000
B:			1100	1000	100		
<i>Mortgage Backed Securities: \$2000</i>							

Step 7 Bank A securitizes the loan made in Step 6, repeating *Step 4*

Table 8: Unregulated Increase in Leverage through Loan Sales

Step 7							
Bank	Assets			Liabilities		Σ Deposits	Σ Loans
	Loans	MBS	CB Reserve	Deposits	Capital		
A:		1000	100	1000	100	2000	3000
B:			1100	1000	100		
<i>Mortgage Backed Securities: \$2000</i>							

Since the Deposit and Loan positions of the two banks are identical in all respects in Steps (1,4), (2,5), (3,6) and (4,7) the process can continue indefinitely, resulting in expansion of the total commercial bank originated loan supply independent of central bank control.

This is a simplified version of the flows between loans, deposits, and asset backed securities that occur daily in the banking system. At no point has either bank needed recourse to central bank funds, or broken any of their statutory requirements with respect to capitalisation or reserve requirements where they apply.

The problem is the implicit assumption with reserve based banking systems that bank originated loans remain within the banking system. Allowing the sale of loans to holders outside of the regulated banking system (i.e. to entities other than regulated banks) removes these loans from that control and thus creates a systemic loophole in the regulation of the commercial bank loan supply.

The introduction of loans sales has consequently created a novel situation in those modern economies that allow them, not only in causing a significant expansion in total lending from the banking sector, but also in changing the systemic relationship between the quantity of money in the system to the quantity of bank originated debt, and thereby considerably diluting the influence the central bank can exert over the loan supply. The requirement that no individual bank should lend more than their deposits has been enforced by required reserves at the central bank since the 19th century in Europe, and the early 20th century in the USA. Serendipitously, this also created a systemic limit on the ratio of money to bank originated lending within the monetary system. While the sale of Asset Backed Securities does not allow any individual bank to exceed this ratio at any given point in time, as the process evolves the banking system itself exceeds it as loans are moved outside the constraints provided by regulatory capital or reserve regulation, thereby creating a mechanism for unconstrained growth in commercial bank originated lending.

2.2 The infiltration of Debt Instruments into the Capital Reserve

While the asset backed security problem explains the dramatic growth in banking sector debt that has occurred over the last three decades, it does not explain the accompanying growth in the money supply. Somewhat uniquely of the many regulatory challenges that the banking system has created down the centuries, the asset backed security problem, in and of itself does not cause the banks, or the banking system to "print money".

The question of what exactly constitutes money in modern banking systems is a non-trivial one. As the examples above show, bank loans create money in the form of bank deposits, and bank deposits can be used directly for monetary purposes either through cheques or more usually now direct electronic transfer. For economic purposes then, bank deposits can be regarded as directly equivalent to physical money. The reality within the banking system however is somewhat more complex, in that transfers between bank deposits must be performed using deposits in the clearing mechanisms, either through the reserves at the central bank, or the bank's own asset deposits at other banks. Nominally limits on the total quantity of central bank reserves should in turn limit the growth in bank deposits from bank lending, but it is clear from the monetary statistics that this is not the case.

Individually commercial banks are limited in the amount of money they can lend. They are limited by any reserve requirements for their deposits, by the accounting framework that surrounds the precise classification of assets and liabilities within their locale, and by the ratio of their equity or regulatory capital to their outstanding, risk weighted loans as recommended by the Basel Accords. However none of these limits is sufficient to prevent uncontrolled expansion.

Reserve requirements at the central bank can only effectively limit bank deposits if they apply to all accounts in the system, and the central bank maintains control over any mechanisms that allow individual banks to increase their reserve holdings. This appears not to be the case. In the US system for example, only Net Transaction Accounts (non-interest chequing accounts) carry a reserve requirement, there are no restrictions on inter-bank lending of reserves, and banks can increase their reserve holdings by depositing treasury instruments which can be bought on the open market.

Basel capital restrictions can also limit bank lending. Assets (loans) held by banks are classified by type, and have accordingly different percentage capital requirements. Regulatory capital requirements are divided into two tiers of capital with different provisions and risk categorisation applying to instruments held in them. To be adequately capitalised under the Basel accords, a bank must maintain a ratio of at least 8% between its Tier 1 and Tier 2 capital reserves, and its loans. Equity capital reserves are provided by a bank's owners and shareholders when the bank is created, and exist to provide a buffer protecting the bank's depositors against loan defaults.

Under Basel regulation, regulatory capital can be held in a variety of instruments, depending on Tier 1 or Tier 2 status. It appears that some of those instruments, in particular subordinated debt and hybrid debt capital instruments, can represent debt issued from within the commercial banking system.

Annex A - Basel Capital Accords, Capital Elements

Tier 1

- (a) Paid-up share capital/common stock
- (b) Disclosed reserves

Tier 2

- (a) Undisclosed reserves
- (b) Asset revaluation reserves
- (c) General provisions/general loan-loss reserves
- (d) Hybrid (debt/equity) capital instruments
- (e) Subordinated debt

Subordinated debt is defined in Annex A of the Basel treaty as:

(e) Subordinated term debt: includes conventional unsecured subordinated debt capital instruments with a minimum original fixed term to maturity of over five years and limited life redeemable preference shares. During the last five years to maturity, a cumulative discount (or amortisation) factor of 20% per year will be applied to reflect the diminishing value of these instruments as a continuing source of strength. Unlike instruments included in item (d), these instruments are not normally available to participate in the losses of a bank which continues trading. For this reason these instruments will be limited to a maximum of 50% of tier 1.⁸

⁸Basel Capital Accords. International Convergence of Capital Measurement and Capital Standards. (<http://www.bis.org/publ/bcbs107.pdf>)

This is debt issued by the bank, in various forms, but of guaranteed long duration, and controlled repayment. In effect, it allows Banks to hold borrowed money in regulatory capital. (It is subordinate to the claims of depositors in the event of Bank failure.) The inclusion of subordinated debt in Tier 2 allows financial instruments created from lending to become part of the regulatory control on further lending, creating a classic feedback loop. This can also occur as a second order effect if any form of regulatory capital can be purchased with money borrowed from within the banking system.⁹

The problem this creates arises from interactions with asset backed securities, since it follows from the preceding argument that if the total quantity of loans in the system was in some way fixed, it would not be possible to increase the other side of the balance sheet, regulatory capital and deposits. Unlike the previous example though, the feedback loop through regulatory capital does have money supply implications. We proceed as before to show the flows between two banks.

Initial Conditions Bank A has made loans of \$1000 and Bank B has no loans outstanding. For clarity, it is assumed that Bank A has no other loans except for the loan it is securitizing, and that reserve requirements of 10% apply to all accounts. As the Bank is making loans for mortgages, the regulatory capital risk weighting for its loans is 50%. For the initial loan book of \$1000, this requires a regulatory capital holding of 10% of $1000 * 50\% = \$50$.

Once again, this is the strictest set of conditions that can currently apply.

Table 9: Failure of Regulatory Capital Control

Initial Conditions							
Bank	Assets		Liabilities			Σ Deposits	Σ Loans
	Loans	CB Reserve	Deposits	Income	Capital		
A:	1000	50	1000		50	2000	1000
B:		1050	1000		50		

Step 1: Bank A creates an \$900 MBS, and sells it to the depositor at B for \$990.¹⁰ The \$90 profit is treated as a liability to share holders and held in a income account.

Table 10: Failure of Regulatory Capital Control

Step 1							
Bank	Assets		Liabilities			Σ Deposits	Σ Loans
	Loans	CB Reserve	Deposits	Income	Capital		
A:	100	1040	1000	90	50	2000	1000
B:		60	10		50		
<i>Mortgage Backed Securities:</i>							
<i>\$900 owned by depositor at Bank B</i>							

Step 2: By paying \$80 of the resulting fees from the MBS sale to its employees in salaries and bonuses, Bank A can increase its deposits to \$1080. It also borrows \$10 as a subordinated loan from the depositor at Bank B and places this loan in its Tier 2 regulatory capital holdings. It could equally have used the \$10 from profits to directly increase regulatory capital, and the same outcome would occur.

⁹In 2007 Glitnir Bank in Iceland provided loans to shareholders in a subsidiary Byr Savings Bank to increase its regulatory capital. Ten of the loans were subsequently ruled illegal as they were made to children between the ages of 1 and 17. There does not appear however to have been any other breach in banking regulations in connection with the loans. http://icelandreview.com/icelandreview/daily_news/?cat_id=16567&ew_0_a_id=351421

¹⁰Public information on the exact proceeds of MBS sales does not appear to be available. All that is necessary for this process to operate is that it is possible to sell the MBS for more than the face value of the loans issued, whether that is achieved through loan fees, securitization commissions, or by some other mechanism. The amount of profit generated from the instrument, will determine the time period of the subsequent money supply expansion.

Table 11: Failure of Regulatory Capital Control

Step 2							
Bank	Assets		Liabilities			Σ Deposits	Σ Loans
	Loans	CB Reserve	Deposits	Income	Capital		
A:	100	1050	1080	10	60	2000	1000
B:		50	0		50		
<i>Mortgage Backed Securities:</i>							
<i>\$900 owned by depositor at Bank B</i>							

Step 3: Bank A can now create a new loan of \$980 which is deposited at Bank B. As a result the total amount of bank deposits in the system, and the corresponding amount of lending increases. Note that A is overcapitalised and over-reserved for this loan, and the actual limit on the size of the loan is the total amount on deposit at Bank A. However, once the loan is deposited at Bank B, Bank A is under-reserved. This shortfall however can be covered from the interbank lending market in the short term, and by increasing its deposit holdings at the central bank in the longer term by purchasing and depositing US treasuries. It could also be resolved by re-classifying a portion of its deposit accounts so that they were no longer classified as net transaction accounts and thus no longer incurred a reserve requirement.

Table 12: Failure of Regulatory Capital Control

Step 3							
Bank	Assets		Liabilities			Σ Deposits	Σ Loans
	Loans	CB Reserve	Deposits	Income	Capital		
A:	1080	70	1080	10	60	2060	1980
B:		1030	980		50		
<i>Mortgage Backed Securities:</i>							
<i>\$900 owned by depositor at Bank B</i>							

As a result of the subordinated loan, in combination with the movement of money around the system with the Mortgage Backed Security, bank deposits are created in the banking system, outside of central bank regulation.

Over the eight years that figures are available for regulatory capital holdings for American banks for example¹¹, the total amount of regulatory capital has approximately doubled from \$629,169,018 in 2001 to \$1,191,116,687 in 2008.

Although the total money supply (deposits) in the example is increasing, the amount on deposit at Bank B is slowly shrinking. This would not occur if Bank A sold the subordinated debt to a depositor at its own Bank, and would be masked if Bank B was also engaged in subordinated debt manipulations. This demonstrates another systemic problem in that institutions that do not engage in aggressive lending practices are at a competitive disadvantage to those that do, creating the very real danger that over time bad banks will drive out the good. Kara [26] provides some evidence that this is indeed the case by examining pricing differences between banks that are more actively engaged in the securitization markets.

Foundational economic textbooks such as Mankiw [6], are very specific about money creation, stating that “the Federal Reserve is responsible for controlling the supply of money in the economy”. Unfortunately, as this example demonstrates, this theoretical control is dependent upon assumptions about implementation details of the current reserve banking system that do not appear to be correct. Central Bank reserve requirements in particular could be used far more effectively than they currently are, and the presence of any non-reserved accounts within a banking system presents a curious oversight in this context.

Another observation that can be made is that excessive profits within the commercial banking system should always be regarded with some suspicion, especially if aggregate statistics also show that the money and loan supplies are “endogenously increasing”. Any malfunction within the regulatory framework will preferentially favour the institutions performing it above those who are not by providing an excess of profits, and result in supra-normal growth for those institutions. This is likely to occur whether or not the individuals controlling the banks are aware of the precise nature of the malfunction, purely from the role of money as an economic signal. This

¹¹Data taken from FDIC Call Reports for American Banks available at <https://cdr.ffiec.gov/public/PWS/DownloadBulkData.aspx>

should not be taken as an argument per se for direct control of bank profits, since that would be merely treating the symptoms; but it is an observation that the precise source of profits from all banking activity deserves careful scrutiny.

2.3 Interbank Lending

Interbank lending is a necessary part of the banking system and is required in order to cover the accounting imbalances created by normal short term flows of deposits between banks, and had already emerged as a feature of the pre-banking goldsmith era in Europe. However, it presents regulatory challenges of its own, as can be inferred from its effective appearance on both sides of the equation in Figure 4. A loan to a bank is represented as a liability, and counted with deposits and capital; the money received from that loan is classed as an asset, and is included in the bank's own cash holdings with their loans and other assets. A race condition appears to exist if while the loan is still present on the bank's account, the bank is able to disperse funds to customer deposits (say by paying salaries and bonuses), allowing additional bank deposit expansion.

When occurring as part of day to day operations, this may represent a very small money creating leak. However the growth of interbank lending in some banking systems suggests a more systemic problem may be occurring.

3 Empirical Analysis

3.1 United States of America

Continuous growth in the deposits and loans controlled by the American commercial banks can be seen in the Federal Reserve statistical tables shown in Figure 5. The total amount of outstanding loans originated by the commercial banks however exceeds the quantity of loans currently under their direct control, as it does not include asset backed securities that have been resold. Detailed figures on ABS issuance and ownership do not appear to be publicly available, but gross figures are available from data provided by the Bank of International Settlements¹².

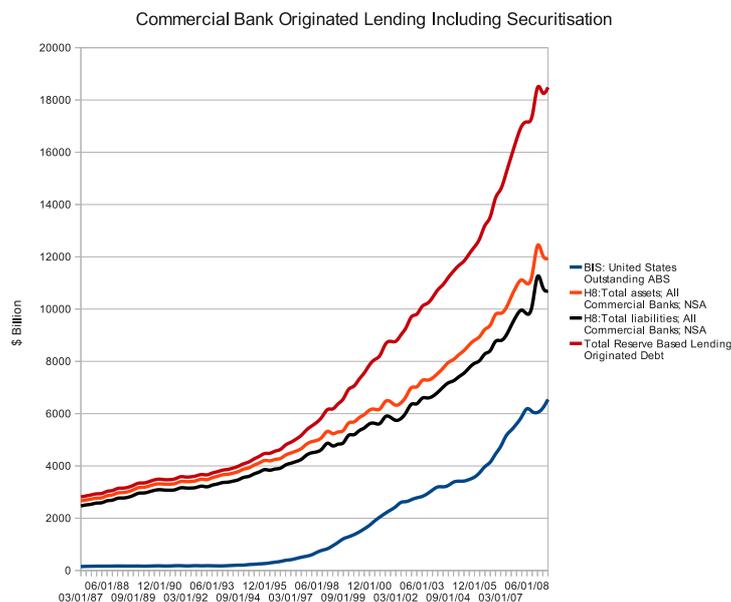


Figure 5: Estimate of USA Commercial Banks total originated debt, vs deposits

Figure 5 also shows the aggregate of US outstanding ABS issuance, and US Banks assets. Figures on Mortgage Backed Security holdings by the US banks, which are the largest part of ABS issuances, are newly available

¹²<http://www.bis.org/statistics/secstats.htm>

(since July 2009) in the Federal Reserve H.8 Table, and show total MBS positions of \$977 billion in October 2009. This indicates that a ballpark estimate for the total excess issuance of loans by the commercial banks within the USA by 2009 was approximately \$5 trillion, or around half their total deposit liability, assuming that BIS figures include securitized lending by the GSE's. Pozsar [27] however, in an extensive review of commercial bank shadow banking activities includes a figure for total liabilities in excess of bank lending of \$16 trillion which is hopefully an over estimate. Figure 5 also illustrates how the growth in total debt is increasing faster than the total of underlying liabilities (money), as a direct consequence of loan securitization.¹³

3.2 Iceland

Iceland is of interest as an example of a very small banking system, operated using Basel rules, with an independent currency. Historically Iceland has experienced continuous stability problems with its banking system since before the break up of the Bretton Woods agreement. Exceptionally high rates of monetary growth followed the breakup, and consumer price inflation during the late 70's and early 80's in Iceland exceeded 50% for several years, peaking at just under 85% in 1983 [28]. A number of measures were introduced as a response, including in 1979 the introduction of index linked mortgages, which indexed principle repayments to the CPI. In 1983 a nationally negotiated agreement imposed a temporary suspension of wage indexation, and wage ceilings. Following this inflation subsided to annual rates during the 1990's that ranged between 5-10%¹⁴.

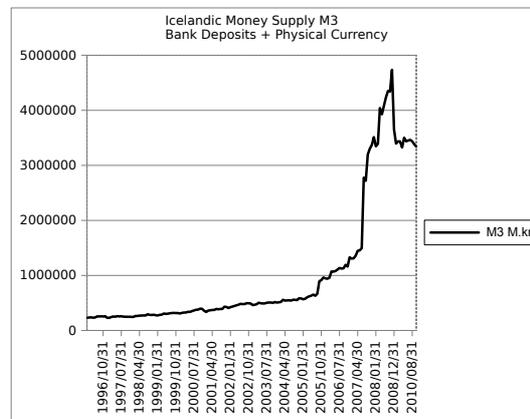


Figure 6: Icelandic Money Supply 1996 - 2010

The Icelandic banks were deregulated and privatised at the end of the 1990's. Figure 6 shows the behaviour of the M3 money supply measure for Iceland since 1996.¹⁵ Following deregulation an accelerated growth in money on deposit with the banks culminated in 2007 during which year the money supply doubled. The proximate cause for the growth as discussed in the Special Report to the Icelandic Parliament [29] was an extraordinary growth in lending by the Banks, accompanied by an expansion in the money supply of ten times in a 7 year period as shown in Figure 6.

Whatever economic consequences might be expected to follow from bank privatisation, a ten times increase in the total supply of money does not accord with either standard economic theory, or the presumption of central bank control over the money supply. In attempting to deal with the situation the Icelandic central bank followed textbook recommendations, and raised interest rates to over 15% in order to stop the monetary expansion. This unfortunately had the reverse effect to that intended since it acted to attract foreign deposits to the system, allowing the Icelandic banks to further increase the amount of deposits that could be used to support the loan supply, and allowed a small number of favourably connected Icelandic businesses to engage in an international borrowing and investment spree, part of which was used to increase regulatory capital holdings in the three main Icelandic

¹³It is not known exactly where the ABS and MBS instruments purchased by the Federal Reserve as part of the Troubled Assets Relief Program(TARP) feature in these statistics.

¹⁴The Annual Report of the Icelandic Central Bank(Sedlabanki Islands) can be found online from 1997 at <http://www.sedlabanki.is/?PageID=178>, and from 1961 at the National Archive and Central Bank Library

¹⁵The Icelandic M3 measure is the sum of all bank deposits and physical currency.

Banks. The regulatory capital growth was accompanied by substantial inter-bank lending, and lending to business associates.

All three of the regulatory problems outlined here appear during the bubble. Then Kaupthing (now Arion Banki) held a rapidly increasing subordinate loan in their capital reserve from 1998, all three banks encouraged employees to buy share capital, and made loans available for this purpose (illegally), and interbank lending between the banks increased considerably [29].

It is clear from the data of the period that there were no effective limits on lending within the Icelandic regulatory framework, but it is worth exploring what would have happened if there had been. The amount of business loans made by the Icelandic banks would have been constrained by the limit. They may still have been made imprudently, and consequent loan default would have been problematic, but there would not have been the accompanying quantitative monetary expansion, and housing speculation triggered by the rapid increases in property prices that accompanied the bubble. Post collapse, the domestic situation in Iceland resembles Japan in that the majority of households are in negative equity, and hold 40 year negative amortisation index-linked mortgages.

4 Credit Bubbles Revisited

At the macro-economic level of the gross statistics of money and loan supply to the economy, the reserve banking system creates a complex interplay between money, debt, supply and demand for goods, and the general price level. Rather than being constant, as implied by theoretical descriptions, money and loan supplies are constantly changing at a rate dependent on the average loan period, and a complex of details buried in the implementation and regulation of any given banking system.

Since the majority of loans are made for years at a time, the results of these interactions play out over a long enough time scale that gross monetary features of regulatory failure, such as continuous asset price inflation, have come to be regarded as normal, e.g. "House prices always go up". The price level however is not only dependent on purely monetary factors, but also on the supply and demand for goods and services¹⁶, which requires that estimates of the real price level versus production be used as described by Dwyer [30]. As a simplification, if constant demand for goods and services is assumed as shown in Table 13, then there are two possible causes of price inflation, either the money supply available to purchase the good in question has increased, or the supply of the good has been reduced.¹⁷ Critically, the former is simply a mathematical effect, whilst the latter is a useful signal, providing economic information on relative supply and demand levels that can be used locally by consumers and producers to adapt their behaviour. Purely arbitrary changes in both the money and the loan supply that are induced by the mechanical operation of the banking system fail to provide any economic benefit, and by distorting the actual supply and demand signal can be actively harmful.

Money Supply	Product Supply	Price level
Increases	Constant	Inflation
Decreases	Constant	Deflation
Constant	Increases	Deflation
Constant	Decreases	Inflation

Table 13: Money and Productivity effects on Price Level

Credit bubbles are often explained as a phenomena of irrational demand, and crowd behaviour. However, this explanation ignores the question of why they aren't throttled by limits on the loan supply? An alternate explanation which can be offered is that their root cause is periodic failures in the regulation of the loan and money supply within the commercial banking system. In the current case the introduction of widespread securitized lending allowed a rapid increase in the total amount of lending available from the banking system and an accompanying if somewhat smaller growth in the money supply. Channeled predominantly into property lending, the increased availability of money from lending sources, acted to increase house prices creating rational speculation on their

¹⁶Including financial assets such as shares.

¹⁷Population increases are also a factor, but are usually relatively slow compared to the other factors. Understandably, underlying changes to the money supply itself are an unwanted complication to many theoretical economic analyses, but Bordo [31] provides a more nuanced analysis of price behaviour during the gold standard period supporting the simplistic relationship shown. The claim by Fisher [32] that the velocity of circulation of money can affect the price level, dates from before the multiplicative effect of loan re-deposit was fully understood, and is incorrect.

increase, and over time a sizeable disruption in the market pricing mechanisms for all goods and services purchased through loans. Monetary statistics of this effect such as the CPI for example, were however at least partially masked by production deflation from the sizeable productivity increases over the last decades. Absent any limit on the total amount of credit being supplied, the only practical limit on borrowing is the availability of borrowers and their ability to sustain the capital and interest repayments demanded for their loans.

Owing to the asymmetric nature of long term debt flows there is a tendency for money to become concentrated in the lending centres, which then causes liquidity problems for the rest of the economy. Eventually repayment problems surface, especially if the practice of further borrowing to repay existing loans is allowed, since the underlying mathematical process is exponential. As general insolvency as well as a consequent Fisher [33] debt deflation occurs, the money and loan supply contracts as the banking system removes loan capacity from the economy either from loan repayment, or as a result of bank failure. This leads to a domino effect as businesses that have become dependent on continuously rolling over debt fail and trigger further defaults. Monetary expansion and further lending is also constrained by the absence of qualified borrowers, and by the general unwillingness to either lend or borrow that results from the ensuing economic collapse. Further complications, as described by Bernanke [34], can occur when interactions between currencies are considered, in particular in conjunction with gold based capital regulation, because of the difficulties in establishing the correct ratio of gold for each individual currency and maintaining it, in a system where lending and the associated money supply are continually fluctuating and gold is also being used at a national level for international debt repayments.

The debt to money imbalance created by the widespread, and global, sale of Asset Backed securities may be unique to this particular crisis. Precise details are hard to obtain, but the Bank of International Securities provides national aggregates that suggest the world wide total of outstanding securitized debt to be approximately \$25 trillion US dollars for the period for which statistics are available. Within the Euro zone there also appear to have been considerable variations in the local regulation of lending and loan sales, and this is presumably creating some degree of internal stress within the euro based economies, although a much larger issue there is the different deposit expansion rates within their individual banking systems¹⁸.

Although asset backed security issuance dropped considerably in 2008, as the resale markets were temporarily frozen, current stated policy in several countries, including the USA and the United Kingdom, is to encourage further securitization to assist the recovery of the banking sector. Unfortunately this appears to be succeeding.

5 Conclusion

The Banking System occupies a unique place in the economy acting as it does on the supply of both money and credit, and as has been seen repeatedly with a unique ability to disrupt it. Unfortunately a complete understanding of its behaviour does not appear to have ever been correctly formulated by economic theorists. The Basel framework resting on principles of risk assessment, and capital protection does not appear to have been any more successful at providing systemic stability than any of its predecessors. A complete and verifiable model of the banking system under the variety of regulatory frameworks in use today should be regarded as a research priority, and this is where a complex systems approach can make a valuable contribution, by providing the theoretical basis for a complete evaluation of its systemic behaviour and models of its interaction with the price level and consequent feedback effects.

Such a model could be particularly helpful in guiding corrective interventions. Recommendations based on Keynesian theory, and in particular on the experience of the 1930's Great Depression assume that the underlying banking system and the problems being experienced with it are the same as were seen during that period. Today's banking system is however structured very differently, and the regulatory framework has changed sufficiently that direct comparisons between the two systems are unlikely to be substantive. In particular there is no evidence to suggest that the debt/money imbalance introduced by Asset Backed Securities was present at that time. In today's banking system attempting to correct bank stability problems by injecting more money into the economy may well backfire, as they can cause proportionally more debt to be created, further increasing leverage within the economy.

Finding effective solutions to the problems of the current banking system presents considerable challenges, and putative reformers should bear in mind that this is by any definition an economically critical system, where seemingly insignificant changes can have extremely far reaching effects as the introduction of securitization amply demonstrates. A far more rigorous approach to evaluating proposed changes is urgently needed, and drawing on experience from the safety critical and fault tolerant systems community may be useful in that regard.

¹⁸OECD data for 1999-2009 indicates a range of expansions between 1.3 and 3.0 within the Eurozone's constituent banking systems. (Eurozone OECD Bank Profitability Statistics, Income Statement and Balance Sheet (Source: OECD.StatsExtracts))

Banning asset backed securities at this point in time would effectively remove over \$1 trillion of annual credit issuance, causing a new global credit crisis, with knock on effects on other forms of borrowing. In the longer term, since asset backed securities are money supply neutral once they are outside of the banking system, and since debt has an intrinsic decay function over time as it is repaid, their effect on the economy will slowly decline so the possibility of slowly removing them from the system exists. Similar considerations apply to stabilising the money supply by properly regulating regulatory capital and reserve requirements, in the absence of action on asset backed securities this would only serve to accelerate the growth in the money to debt imbalance in the system. Only a system level intervention to tackle both problems simultaneously would be likely to succeed in the long term.

The changes introduced into the Banking system by the Basel treaties, appear to have been intended to stabilise the banking system against previous problems, by shifting regulatory emphasis to default risk and providing capital buffers as protection. However these changes concentrated on the risk of default at individual banks, there appears to have been relatively little attention given, either to the behaviour of the system as a whole, or the risk of its mechanisms being subverted. Unfortunately, due to the oversight with respect to the interaction of regulatory capital debt instruments, and the increasingly widespread use of Asset Backed Securities, the eventual result may have been to protect the individual members of the system, the banks, at the expense of the structural integrity of the system itself.

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