

The Nature of The UK's Endogenous Money System, and Basel III's Impact on Post-Crisis Lending

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This study aims to determine the impact of Basel III on the UK's credit supply. Endogenous money theory is used to discuss the credit supply. Horizontalism implies unrestricted short term lending, while structuralism incorporates liquidity preference of central banks and commercial banks in the short run. Basel III's regulatory framework is then outlined, and its theoretical effect on the UK endogenous money system is discussed, attempting to put Basel III into the theory's framework. In order to provide evidence on Basel III's impact, time series econometric analysis to compare M4 growth, M4 lending growth, and the rate of change of UK commercial banks' assets is used. M4 growth represents the level of reserves accommodation by the Bank of England, and M4 lending growth represents UK commercial bank lending. The inclusion of the rate of change of UK banks' assets captures the broad effect of Basel III's framework, and determines how the Bank of England as well as UK banks respond to increased capital requirements. This study tests for structural breaks in tandem with Figureical analysis to determine that changes in the relationship between banks and the Bank of England correspond with Basel III's date of implementation.

1. Introduction

The financial sector plays a pivotal role in modern economic prosperity. Capital markets are vital for allowing the production process to prevail, without the banking sector most firms would struggle to produce goods and services. Banks transform maturities and liabilities to match the preferences of savers and borrowers, allowing firms to borrow funds needed for cash flow. It is the intrinsic size of banks which allow them to exploit economies of scale, which also leads to great risk in the economy. This is because as banks become larger, they become responsible for more deposits, meaning that if a large bank takes on excessive risk it could result in the loss of national deposits. The financial crash of 2008 was a stark reminder of the consequences that occur when the financial system gets risk management wrong.

Liquidity crisis from the drying up of credit channels forced the UK government's hand into bailing out Northern Rock (Giles, 2008). Such a rescue of the UK's banking system was necessary to prevent further economic instability. However, the UK government sacrificed its debt GDP ratio as the rescue plan cost £500 billion, almost as much as an entire year's funding for the UK health service (BBC, 2008).

The severity of the financial crisis and resulting debt burden on governments could be seen as the catalyst for paramount financial regulation. Such regulation was conceived with the motivation of preventing excessive risk taking in the financial system. This should reduce the probability of a crisis in the future, aiming to reduce the need of bank bailouts through prudential systemic controls (Francis and Osborne, 2012, p.803).

Basel III is the response to the 2008 Crisis and comprises regulatory frameworks attempting to standardize measurement of financial risk. Basel III focuses on increasing bank resilience to liquidity demand through the implementation of detailed risk-weighted capital. Regulatory capital is broken down into tiers, Tier 1 and Tier 2. While this is similar to previous Basel accords, Basel III introduces more detailed rules regarding the makeup of regulatory capital and liquidity buffers. Namely, Tier 1 capital must be comprised of common equity and profit, increased from 2% to 7% in total. Additionally, liquidity reforms require banks to adhere to the short term Liquidity Coverage Ratio (LCR). The LCR gives banks' assets a weighting, from 100% to 50%, assigning higher weightings to more liquid and higher quality assets. Effectively, banks must hold greater levels of highly liquid, high quality assets than previously. Basel III capital requirements are to be phased in from 2013, after final guidelines are drafted (KPMG, 2011, pp. 9-10).

The need to reel in risks highlights an important paradigm. That is, the paradigm, or relationship, between the authorities and banking system. In the UK, this relationship is particularly important due to the UK's reliance on financial services as a main contributor to GDP growth (Burgess, 2011). It is now

the role of economic theory to explain the relationship between UK financial authorities and the commercial banking sector. It is the aim of this study to try and determine the relationship between the Bank of England and UK banks before and after Basel III's implementation. In doing so, this study will consider the nature of the UK credit supply using the theoretical framework of endogenous money. The importance of this relationship, is the consequent evaluation of how much control the Bank of England have over UK bank lending.

The structure of this study will begin with an outline of endogenous money theory. Drawing on the writings of classical and more recent authors, the literature review will define the characteristics of endogenous money theory. Additionally, the literature review will consider the two opposing strands of endogenous money theory: horizontalism and structuralism.

After the literature review, Basel III's regulatory framework will be outlined, including details of the timeline for UK implementation. Following this timeline, Basel III's theoretical effects on the Bank of England and UK banks will be evaluated.

Finally, this study utilises econometric analysis of the relationship between the Bank of England and UK banks. The data takes the form of monthly time series data from 2010 – 2015. Key variables are proxies for the UK credit or money supply, UK bank lending, and the change in asset acquisition by UK banks. By employing tests for known structural breaks, the econometric analysis in this study attempts to conclude whether changes in behaviour from UK banks and the Bank of England can be attributed to the Basel III accord.

2. Literature Review of the Debate Between Structuralists and Horizontalists in Endogenous Money Theory

2.1 Endogenous Money Theory

The basic theory of endogenous money stems from Wicksell's development of the stabilising policy rate, whereby Wicksell implements the idea of a credit-based economy and develops the role of central banks and banks into creators of money as well as inflation targeting through interest rate differentials (Humphrey, 2002, pp.60-1). However, it was Kaldor challenged the popular monetarist approach pioneered by Friedman, and in doing so put the endogenous nature of the money supply into debate (Kaldor, 1970, pp.1-18).

The creation of money in modern economies, begins with commercial banks that agree loans with creditworthy borrowers in order to fund the production process. Once loans are made, this credit is deposited in the banking sector, moving between banks as the loan is spent. Thus, loans are a liability for banks as firms and households create liquidity demand by withdrawing the loan from deposits to spend it. Consequently, commercial banks must increase their supply of reserves to meet liquidity

demand, and therefore banks demand reserves as loans increase from the central bank. Central banks are inclined to supply these bank reserves in order to sustain financial stability in the economy, and hence, the demand for reserves is satisfied, increasing the money supply. Therefore, the model of endogenous money shows how demand for loans which create deposits, drive the demand for reserves from central banks (Fontana and Setterfield, 2008, pp.218-219).

2.2 Horizontalism and Structuralism

Since the articulation of the endogeneity of money, the slope of the credit supply curve represented in the model has been debated. Originally, the assumption of a flat credit supply curve was pioneered by traditional economists and was characterised by full accommodation of loans and reserves in the financial system. This assumption is known as the horizontalist view (Moore, 1979). However, the structuralist assumption of an upward-sloping credit supply was conceived to explain lending as a non-elastic, managed process, where commercial banks are active in choosing who they lend to (Arestis and Sawyer, 2006). The debate began as an effort to declare either a horizontal or upward sloping credit supply curve as the accepted general assumption in the endogenous money system. Kaldor and Moore spearheading arguments for horizontalism and the condition of total accommodation by the central banks, as a lender of last resort to commercial banks (Moore, 1979).

With a view to bring a more realistic approach to endogenous money theory, the emergence of structuralism brought more depth to the debate, with Dow and Dow building an argument for limited central bank accommodation and production of reserves (Dow and Dow, 1989). In defence of horizontalism, Moore and Kaldor drew on evidence of compulsory accommodation of predetermined credit lines such as overdrafts, which cause commercial banks to produce credit without question, and in turn receive backing from the central bank (Lavoie, 1996). This produced the question of how the market for credit worked in practise, which both Goodhart (1989) and Moore (1991) attempted to answer. Goodhart suggested that the commercial banks are able to supply a certain volume of credit based on the demand for credit, but overall changes in the demand for credit is not a complete view of the demand for reserves, as demand for reserves will be offset either partially or fully by portfolio adjustments to account for extra credit risk. However, Moore argued against Goodhart, articulating that the demand for credit was interdependent with the supply of credit, which Moore named the “haircut theory of money”, whereby the supply of credit may never exceed the demand for credit, because loans are created on demand and not kept as stock (Moore, 1991). However, in arguing the interdependence of credit supply and demand, it was conceded that the long-run credit supply curve was indeed slightly upward sloping (Moore, 1991).

The horizontalist author, Mark Lavoie, attempts to counter the structuralist arguments that banks have a liquidity preference and actively managed their lending (Dow and Dow, 1989). Lavoie proposed that

a series of stepped horizontal credit supply curves were indeed compatible with mainstream economic theories of the IS-LM model, and that horizontalism and structuralism were themselves compatible. They did not have many differences in policy implications, except for disagreement over whether central banks have control over the creation of credit through interest rate policy and regulation (Lavoie, 1996). Structuralists viewed the short run as similar to the long run, because the central bank could exert control over the credit supply through open market operations which manipulate short term interest rates and restrict lending, perhaps because central banks must hold reserves in order to target inflation (Fontana, 2003, p.300).

Structuralism continued to develop, as Dow counters each of the three main arguments for horizontalism. Dow (1996) describes how banks have historically increased credit supplies with increases in deregulation, and conversely how credit supplies decreased during the credit crunch of the 90s. This evidence is pitched against the first two horizontalist views that banks can innovate effectively to overcome regulation, and that commercial banks can fully rely on the lender of last resort function of the central bank. This structuralist example of fluctuating credit supplies with changes in the wider economy is reinforced by Dow's commentary of counter-cyclically fluctuating interest rates and risk, which cause debt/equity ratios, the resources of financial institutions, and borrowing to fluctuate pro-cyclically. Dow then counters Moore's (1988, pp.24-26) third argument for horizontalism. Moore's argument hinges on evidence of unused overdraft facilities, but Dow employs evidence of overdraft rationing by commercial banks cutting off funding to small firms, to show that commercial banks are not simply quantity takers, and they appear instead to actively manage their lending (Dow, 1996). In support of the generalised liquidity preference of banks, Dow describes how Minsky (1975) and Keynes (1972, pp. 153-154) come to the similar conclusion that the creation of credit is reduced by commercial banks when the perceived level of risk increases. Keynes and Minsky arrive at this conclusion through their distinct theories of financial instability and uncertainty, both providing evidence supporting the structuralist argument of non-accommodation and banks actively managing credit risk.

2.3 Summary of Literature Review

While both structuralism and horizontalism argue the details of exactly how the central bank attempt to control commercial bank lending, they both have similarities within their makeup. Perhaps most importantly is the agreed phenomenon that the central bank controls commercial bank lending with partial success in the long run, where horizontalists conceded an upward sloping credit supply curve in the long run. Liquidity preference of commercial banks, and prevailing liquidity preference of central banks in the short run are the key differences between horizontalists and structuralists.

3. Basel III Regulation and Actions of the Bank of England Since 2008

3.1 Background and Key Issues to Consider

Despite debate over the nature of the financial system, 2008's financial crisis exposed the financial system's fragility, giving society reason to believe that the financial sector can be significant in causing economic shocks down to a microeconomic level (Bruneau *et al.*, 2012, p.225). The financial sector's importance to the stability of the global economy has led to a new banking regulatory framework in the form of Basel III following 2008. This framework builds on the underpinning logic of its predecessors, Basel I, II, and 2.5. All of Basel's accords focus on assigning risk to asset classes and applying a lower limit of regulatory capital to each class, but where each banking act adds greater depth to the classification of each tier of assets, with increasingly detailed capital rules (Pakravan, 2014, p.210).

There are important key aspects of this new regulation and the financial system to consider in order to determine the nature of the endogenous money system within the UK, and whether this paradigm has changed since Basel III's regulatory change. Firstly, it is important to determine how regulation affects commercial bank lending behaviour, as Dow's application of commercial bank liquidity preference suggests commercial banks actively manage their lending, and tend to reduce lending after significant banking regulation (Dow, 1996, pp.488 and 500-502). Secondly, it is equally important to determine how the central bank responded to commercial bank lending and consequential demand for reserves. This will give insight into how much control the Bank of England has over commercial bank lending, because it will consider how Basel III could have affected bank lending behaviour, and reserves accommodation. In essence, the two components to be considered; accommodation of reserves demand by the central bank, and the liquidity preference of commercial banks, offer insight into the existence of structuralism or horizontalism.

3.2 A Timeline for the Implementation of Basel III in the UK Financial System

Basel III has one key date of UK implementation to consider, January 2013. However, the frameworks for Basel III were developed at different times, and have different completion dates. Therefore, there are other dates to consider. Basel III's adoption starts in December 2010, when the banking supervision committee published greater capital requirements and liquidity reforms to the UK.

Basel's focus turned to systemically important banks in October 2012 and July 2013. The committee announced that domestically and global systemically important banks would be assessed on the level of loss absorbency they had. These assessment frameworks, G-SIB and D-SIB outline the exact method for standardizing loss absorbency (BCBS, 2014. p.7). The frameworks or principles above create Basel III and require banks to hold a greater short term buffer of highly liquid, high quality assets which can

be sold in the event of liquidity shortage. This should give banks greater resilience to large market losses with, and therefore make the financial system more stable (BCBS, 2014, p.16).

January 2013 saw the main UK date of Basel III implementation. In January 2013 capital requirements initially created in December 2010, and the rules for the Liquidity Coverage Ratio (LCR) were implemented in the UK.

3.3 Theoretical and Empirical Impact of Basel III on Central Bank Reserves Accommodation and Commercial Bank Lending Behaviour (Liquidity Preference)

3.3.1 Changes in Commercial Bank Lending Behaviour During Basel III's Implementation

Basel III requires that banks restructure to hold a greater volume of risk-weighted capital in relation to their eligible capital, as well as short term liquidity buffers (KPMG, 2011, p.5). Due to the cost to banks of holding more capital, it might be suggested that Basel III's framework causes commercial banks to be cautious of lending, and therefore banks are more likely to try and reduce the extent to which they have to hold expensive high quality assets by reducing lending. The empirical literature shows commercial banks altering their asset portfolios in light of higher capital requirements corresponding with the idea that higher capital requirements reduce lending incentives. When adjusting portfolios, commercial banks are seen to change their lending based on capital requirement targets set by regulatory bodies, reducing loans as to reduce costs from holding risk weighted assets (Francis and Osborne, 2012, pp.812-815). It would seem that evidence of credit rationing by commercial banks corresponds to Dow's definition of structuralism, where banks themselves have a liquidity preference from which they derive an interest rate for loans based on the perceived risk of borrowers in response to loan demand (Dow, 1996, p.503). Therefore, the conception and implementation of the Basel III framework is described here to potentially provide evidence of structuralism within the UK financial system, as the new lending restrictions might cause banks to have to increase the price of loans to reflect the costs of holding greater volumes of capital, if banks do not absorb the increase in lending costs in other ways (Di Biase, 2012, p.1275) such as, aforementioned reductions in loans to reduced risk-weighted assets as capital requirements increase.

However, the horizontalist arguments of Lavoie, might suggest that although Basel III increases the cost of borrowing, banks will still be willing to lend to borrowers, given that the banks themselves are compliant with Basel III's framework. This is because banks may simply increase the interest rate on loans and then supply the quantity of loans demanded at that new price, before demanding reserves from the central bank. Hence, the effect of Basel III's framework on the credit supply curve might not be characterised just by looking at the impact on commercial banks and financial institutions. The central bank's level of reserves accommodation must be considered.

3.3.2 Changes to the Bank of England Framework Regarding Financial Sector Control

The failure of Northern Rock has provided the catalyst for the Bank of England (BoE) to implement banking reforms, with the 2008 report from the treasury committee (TC) highlighting causes of the run as well as analysing key issues with the banking sector's structure as a cause of bank failures. The TC's report showed that the BoE failed to implement adequate action, and provide liquidity to Northern Rock quickly enough. The BoE could have reduced the instability of the wider banking sector following the run on Northern Rock if it had provided liquidity sooner, not just to Northern Rock, but to other solvent banks as well (Winters, 2012, p.5). This finding has promoted the BoE to restructure its framework for providing liquidity, because the 2008 crisis has shown how the central bank must act quickly in order to retain macroeconomic stability.

The BoE has also acknowledged the potential moral hazard that might arise as a result of providing reliable liquidity to banks. Moral hazard may cause commercial banks to neglect managing their liquidity risk because they believe the central bank will always provide reserves. Nevertheless, the TC suggest that active policy is potentially more beneficial than allowing the private markets to determine the appropriate level of risk (Winters, 2012, pp.21-23). This is because the need for liquidity provision by the central bank is acknowledged as a key component for financial stability, which is under-supplied in the private market due to its public good status. Hence, the BoE looks to provide liquidity to avoid financial crises (Winters, 2012, pp.48).

Part of the reason that the BoE is encouraged to provide commercial banks with reserves is due to Basel III's greater, or more thorough, capital requirements. Therefore, Basel III's framework could prove the effective tool for allowing the central bank to create reserves upon demand, without risking inadequate commercial bank risk management (Winters, 2012, pp.6 and 75). This is because Basel III requires banks to comply with aforementioned rules or risk legal action, setting the commercial banks in a paradigm, where they will have to manage their risk and asset portfolios to a sufficient point determined by financial experts, before being able to operate, and subsequently demand reserves. This reduces the risk of moral hazard when the BoE create reserves, because the commercial banks will always have to manage their own risk by law. Therefore, Basel III's framework could give the BoE greater freedom to accommodate reserves demand because the rules of the new regulation provide a legal pressure on banks to manage their own risk appropriately. However, this is not conclusive, because commercial banks can transfer the pressure of meeting Basel III's capital requirements onto the central bank. Consider the situation where; the central bank might feel obliged to provide reserves to a systemically important commercial bank, if that bank claims it is not able to meet Basel III's liquidity requirements. Therefore, the situation remains where the BoE might seek to restrict bank lending, because certain banks are not managing risk effectively.

Both ideas that Basel III either reduces the demand for bank reserves, or has little effect in reducing reserves demand, have contrasting implications for structuralism and horizontalism. The first idea, i.e. that Basel III will reduce commercial banks' demand for reserves, would suggest that the BoE would not have to create reserves as freely, because commercial banks will have adjusted the capital stances to accommodate extra loans as by the Basel III accord. This represents a structuralist paradigm as defined by Goodhart, where the continuous active management of lending by commercial banks is prevalent (Goodhart, 1989). However, the second idea where commercial banks simply demand reserves in order to meet Basel III's requirements implies free creation of reserves by the BoE and a horizontalist paradigm, because commercial banks can avoid Basel III's rules by demanding liquidity from the BoE.

3.4 Summary of Basel III Implications for the Bank of England and Endogenous Money System

Implementation of Basel III's framework suggests two initial points to consider. Firstly, that there is evidence of credit rationing by central banks in light of new regulation. This provides evidence of structuralism whereby commercial banks actively manage lending in order to meet the requirements of Basel III. Secondly, Basel III's implementation seems to imply that the BoE would be more willing to supply reserves to the banking sector, given the framework's enforcement of standardised risk measurement in the financial sector. This inspires confidence in the banking system by the central bank, allowing them to operate as an accommodating lender of last resort without the risk of a moral hazard.

4. Methodology

To measure the nature of the endogenous money system and how bank regulation might have affected this system, the variables within the modern endogenous money system must be identified.

4.1 Components of Endogenous Money

When defining the money supply, the BoE's definitions of money aggregates show that M4 is an encompassing measure of money. This is because it includes: deposits, commercial paper, bonds, floating rate notes, repo claims, bank paper holdings, notes and coins (Bank of England(1), 2016). Therefore, M4 is the ideal measure of credit, because it includes the monetary base and reserves, which might otherwise be excluded from different broad money aggregates. Worthy of note is that credit supply is indifferent to the money supply within traditional endogenous money theory (Humphrey, 2002, p.60). It is important to include various forms of money and credit for the model in this study, because such markets facilitate open market operations, which alter the credit supply; for example, repo market manipulation is caused by the central bank changing the cost of rolled over

liabilities (repos) held by commercial banks. The result is that banks demand less reserves from the central bank, because these reserves are more expensive. Therefore, reserves can be reduced through demand manipulation (Chick and Dow, 2002, pp.601-605). M4 growth will capture the changes in the credit supply caused by open market operations, such as repo rate manipulation. Therefore, M4's broad measure of money in the economy includes the monetary base, as well as credit balances between the BoE and commercial banks, corresponding to bank reserves. Including a measure of reserves and the money base is imperative to determining the nature of the credit supply. Hence, M4 growth is useful for measuring changes in central bank accommodation.

When measuring bank lending, M4 lending growth will be used to capture credit growth within the economy. M4 lending growth measures growth in private sector lending by UK banks and other monetary financial institutions (MFIs) (Bank of England (2), 2016). The exclusion of intermediate financing MFIs and intermediation services makes M4 lending a streamlined measure of credit within the economy, which should accurately capture UK loan growth. This is because it excludes extensive securities and derivatives markets which do not represent creation of loans.

4.2 Banking Regulation & Basel III

While M4 growth is the dependent variable representing the UK money supply change, and M4 lending growth is to be the main independent variable used as a proxy for total UK credit creation, it is also important to consider the other variables. Most notable of course is a measure of changes in commercial banks' risk weighted capital. This is because Basel III regulation requires banks to adjust their portfolios to reflect extra risk. Therefore, including banks' asset growth will provide a proxy for banks' response to Basel III as they accumulate high quality, highly liquid assets. Measuring such an effect enables the model to see if there might be evidence of commercial banks adjusting their portfolios to account for risk (Goodhart, 1989, p.33).

4.3 Economic Variables

The structuralist view includes the liquidity preference of commercial banks themselves (Dow, 1996, p.503), hence, the inclusion of changes in yield prices, gold, unemployment, and CPI will all be used to attempt to capture the effect of economic stability on the relationship between credit creation and money creation. Finally, as the demand for credit is arguably positively correlated with economic performance in terms of GDP (Calza *et al.*, 2001. p.12), the production and services indexes will be used as monthly proxies for UK output and economic performance in place of GDP growth, which is measured quarterly.

4.4 How the Variables are Interpreted

Under a structuralist view, it would be expected that bank lending might not be fully accommodated by central bank reserves creation, as the central bank instils “Frown costs” on banks by increasing repo rates (Arestis, and Sawyer, 2006, p.40). Therefore, commercial banks may need to obtain more liquid assets when creating loans, in order to satisfy immediate liquidity demand of customers who wish to spend the loan. By acquiring and selling liquid assets instead of raising liquidity by borrowing funds from other institutions, commercial banks do not further increase their liabilities in the balance sheet. This is because selling assets leaves the banks with cash, which is an asset, instead of loaned funds, which create a liability on the balance sheet (Arestis, and Sawyer, 2006, pp.258-259).

However, where a change in banking assets is lower than the relative change in bank lending (M4 lending), a horizontalist view might be taken in the short run. This is because the extra liquidity demanded by loan creation is not fully funded by banks raising liquidity through acquisition of assets, because bank assets change at a slower rate than M4 lending. Instead, banks must satisfy liquidity needs by demanding central bank reserves. In this study, the horizontalist situation of commercial banks raising liquidity through central bank reserves, should be accompanied by a high coefficient relating M4 lending growth to M4 growth, reflecting central bank reserves accommodation. However, the structuralist definition states that the central bank can limit provision of reserves to the banking sector, ultimately, through controlling short term interest rates which restrict loan supply, because higher interest rates reduce the demand for loans and reserves (Arestis and Howells, 1996, p.459). The exact level of resistance that the central bank can exert is not clearly defined, therefore, notable short run disparity between M4 and M4 lending might be considered as structuralism. This is because horizontalism argues for no restriction of reserves provision in the short run.

4.5 Rationale for Using First Differences

All variables used show changes in their underlying economic factor. It makes theoretical sense to analyse the causal effect of each variable on the dependent variable through their relative changes. For example; although banks demand reserves based on the absolute value of short term liabilities outstanding (such as new loans acting as deposits), it is the central bank’s response to credit creation via the change in bank lending which is of interest. This is because horizontalists and structuralists disagree on the existence of short term reserves accommodation.

4.6 The Timeframe

The time period which is being tested here, from November 2010 to August 2015, is ideal for analysing the relationship between the BoE and commercial banks. This is because the base interest rate has remained static throughout the entire period. Therefore, based on empirical data in the Euro area,

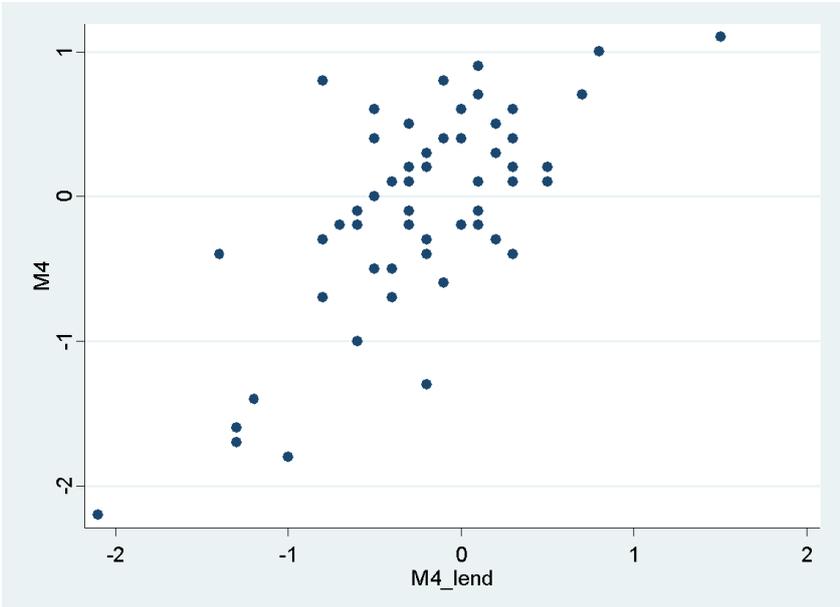
which suggest that the demand for loans was negatively correlated with both short term and long term interest rates (Calza, *et al.*, 2001, p.12), it will be assumed in this study that the effect of the policy interest rate on the demand for loans is not relevant. Additionally, the model includes the change in yield and gilt market rates. Therefore, the effect of market interest rates on the demand for credit and reserves creation, if there is any relationship, will be included in the model (Frieman, *et al.*, 2010. pp.15-16).

5. Multivariate Time Series Model

Here, the study presents the findings from the data. The main variables defined earlier are proxies for the credit supply, bank lending, and bank assets. In order to answer the question proposed by this dissertation, two characteristics of the economy given by this data must be assessed. The first is that either structuralism or horizontalism exists within the dataset. The second characteristic is that the rules given by Basel III’s regulatory framework have a significant impact on the growth of the money supply.

5.1 Initial Trends in the Data for 2010-2015

Figure 1: Reserves and Lending Growth, 2010-2015



Source(s): This study’s own interpretation of Bank of England statistics.

The scatter suggests a positive relationship between monthly reserves and lending growth rates. This suggests that in this time period the UK might show characteristics of the endogenous theory of money, thus supporting the theory discussed to this point in the study. However, no causality can be claimed without appropriate modelling for the time series.

5.2 Regression Analysis

5.2.1 Feedback Effects within the Endogenous Money System

Comparing the models (5) and (8), it is clear that using M4 growth as the dependent variable instead of M4 lending growth, yields a model with higher explanatory power. This is because the R-squared figure is greater when M4 growth is the dependent variable as opposed to using M4 lending growth as the dependent variable instead. Using M4 growth as the dependent variable corresponds to the earlier defined endogenous money system within the UK, whereby the creation of credit by commercial banks causes the central bank to generate reserves. Therefore, the main analysis to be conducted in this dissertation will focus on results from model (5), where M4 growth is the dependent variable. However, note that the literature suggests that there is some feedback effects from the creation of credit and the creation of reserves, where the creation of reserves might result in the creation of credit. This is because an increase in reserves might cause an increase in loan demand (Karagiannis, *et al.*, 2011. p.390). This coincides with the findings in the data, where both models (5) and (8) suggest that M4 growth and M4 lending growth are statistically significant independent variables respectively. By assessing the two separate models together, it is concluded that in this data set that there are probably positive feedback effects between money supply growth and lending growth.

Table 1: Regression Models using M4 Growth and M4 Lending as Dependent Variables Separately

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Lev	Lev_rob	Lev_outl	Lag	Lag_rob	Lag_outl	Lag_outl	Lag_rob
	b/se	ust	ier		ust	ier	ier	ust
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
M4_lend	0.758** *	0.758***	0.747***	0.732** *	0.732***	0.709***		
	(0.100)	(0.096)	(0.101)	(0.086)	(0.083)	(0.098)		
dlnBank_Asets	15.970 ***	15.970** *	18.344** *	13.324 ***	13.324** *	13.784** *	-9.168**	-9.872**
	(3.792)	(4.659)	(3.824)	(3.323)	(4.049)	(3.775)	(4.477)	(4.385)
dProduction	0.044	0.044	0.056	0.002	0.002	0.005	0.001	0.008
	(0.074)	(0.061)	(0.074)	(0.062)	(0.048)	(0.071)	(0.077)	(0.061)
dYields	0.497	0.497*	0.585*	0.722**	0.722**	0.771**	-0.394	-0.426
	(0.343)	(0.289)	(0.346)	(0.300)	(0.278)	(0.341)	(0.388)	(0.299)
Services	0.314**	0.314**	0.267**	0.288** *	0.288***	0.286**	-0.250*	-0.230*
	(0.124)	(0.127)	(0.125)	(0.107)	(0.102)	(0.121)	(0.137)	(0.124)

LM4				-0.172	-0.172	-0.191	0.122	0.125
				(0.111)	(0.137)	(0.126)	(0.139)	(0.119)
LM4_lend				0.134	0.134	0.147	-0.070	-0.068
				(0.122)	(0.116)	(0.139)	(0.153)	(0.104)
LdlnMFI_Assets				-	-	-	9.689**	10.415**
				13.050***	13.050**	12.140**		*
				(3.595)	(3.665)	(4.084)	(4.732)	(3.724)
M4							0.787***	0.826***
							(0.114)	(0.108)
Constant	0.078	0.078	0.088	0.048	0.048	0.064	-0.108	-0.103
	(0.067)	(0.062)	(0.068)	(0.062)	(0.054)	(0.070)	(0.075)	(0.065)
Number of Observations	57	57	57	56	56	56	56	56
F	19.164	24.410	19.607	18.828	26.849	14.161	6.292	7.790
r ² adjusted	0.619	0.619	0.624	0.722	0.722	0.657	0.435	0.552

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Source(s): This study's own regression test based on Bank of England statistics.

5.2.2 Significance of Data

The statistically significant variables in the model (5) appear to be M4 lending, bank assets and services growth. Therefore, the data suggests that the money supply growth and change in banks' assets are linked. This supports Goodhart's idea that banks do manage their asset portfolios to offset demand for reserves, as the positive coefficient suggests that an increase in bank assets is significant in causing an increase in M4 (Goodhart, 1989, p.33). This finding supports the structuralist viewpoint because the data suggests that UK banks are subject to some pressure to proportionally adjust their risk weighted asset portfolio when demanding reserves. Furthermore, model (8) shows that change in bank assets are a negative determinant of M4 lending growth. This could mean that UK banks restrict their willingness to supply credit because they have to hold more capital assets per loan. This short term negative relationship between bank asset acquisition and bank lending, or credit rationing, supports the claim that banks have a liquidity preference, and contradicts horizontalism, because short run credit rationing should not exist according to horizontalists (Moore, 1991, p.126). To support the existence of a negative relationship between assets acquisition and loan growth, the logic follows that as banks have to hold greater volumes of assets given an increase in loans, those banks will incur a

higher cost from holding those assets, which reduces the incentive to provide loans, hence reducing the growth rate of loans (Aiyar *et al.*, 2016, p.157-160).

5.3 The M4 Lending Growth Rate Coefficient

To determine whether there is support for structuralism or horizontalism, consider the coefficient on M4 lending growth as a determinant of M4 growth. From the data in model (5), we see that M4 lending growth has a positive effect on M4 growth with a coefficient of 0.732. Additionally, the 95% confidence interval shows the M4 lending growth coefficient to be between 0.5641507 and 0.8993713. Moore and Lavoie’s separate definitions of horizontalism both converge to involve the generally unrestricted creation of both credit and central bank reserves, at least in the short run (Lavoie, 1996, pp.279-281). Therefore, we might believe that the model would show horizontalism where the coefficient on M4 lending growth is close to 1 where commercial banks take the price and supply all credit-worthy loans demanded by the private sector. Hence, the central bank would accommodate the demand for new credit by creating M4 growth. Structuralism, on the other hand, would be shown by a coefficient significantly lower than 1, where increases in credit are not proportionally met by creation of reserves reflected M4 growth and an upward sloping money supply curve (Chick and Dow, 2002, p.588).

Table 2: Null Hypothesis: M4 lending growth coefficient is equal to 1:

	Test M4 lending coefficient equal to 1
F Statistic	10.37
P-Value	0.0023

Source: This study’s own regression test based on Bank of England statistics.

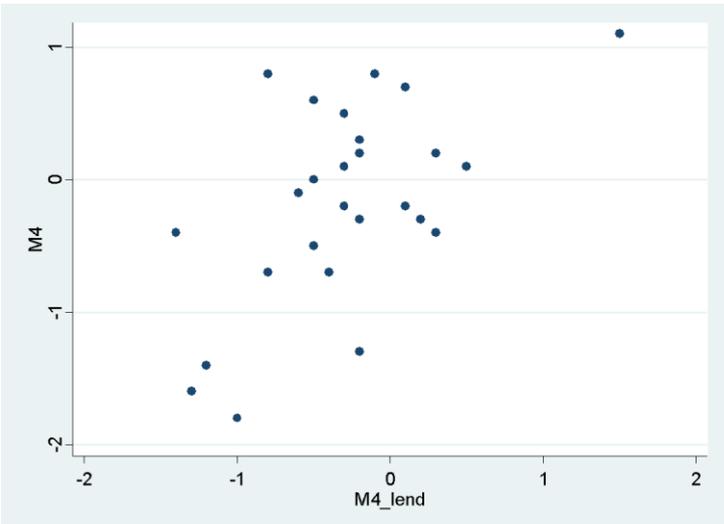
From this test, the P-value is such that the null hypothesis is rejected at the 95% confidence level. This suggests that the coefficient of M4 lending is not equal to 1 over the entire date range. This corresponds with the 95% confidence interval mentioned above (0.5641507 to 0.8993713), which also suggests that M4’s coefficient is less than 1. Based on the discussion in the former Figure, it could be concluded that this evidence contradicts the horizontalist view, because growth in reserves is not fully determined by growth in lending.

Next it is important to consider the effect of Basel III’s framework on bank lending. The data from the model (5) suggests that bank assets are positively significant in the determination of M4 growth. The logic of this follows that as banks lend and increase their positive asset position, shown by a positive change in bank assets, the central bank will be more willing to provide reserves to banks. This may

seem counter-intuitive, because the acquisition of assets by commercial banks should mean that they will have a lower demand for reserves, when in fact commercial banks will still require some proportion of any extra credit they produce in order to satisfy liquidity demand once the credit is created. To summarise this point, commercial banks might acquire assets in order to back up their demand for extra reserves from the BoE, to satisfy immediate liquidity demand from customers. In support of this argument, the literature suggests that banks acquire capital or use the money markets to raise part of the reserves requirements themselves (Winters, 2012, pp.5-6). In this situation, one might say that there is structuralism in the endogenous money system, because commercial banks are being required to build up their risk weighted asset position at some cost before the central bank supply new reserves. The model does show a positive relationship between bank asset acquisition, credit supply and reserves supply. Where the growth in M4 lending and bank assets acquisition are shown to be statistically significant in determining the M4 money supply. This holds some agreement with the aforementioned structuralist system. Therefore, we might conclude that there is evidence to suggest that capital requirements, potentially due to the Basel 3 accord, have an effect of pushing the endogenous money system in the UK towards a structuralist paradigm in the period from November 2010 to August 2015.

5.4 Basel III's Impact on The UK Endogenous Money System

Figure 2: Reserves and Lending Growth, 2010-2013

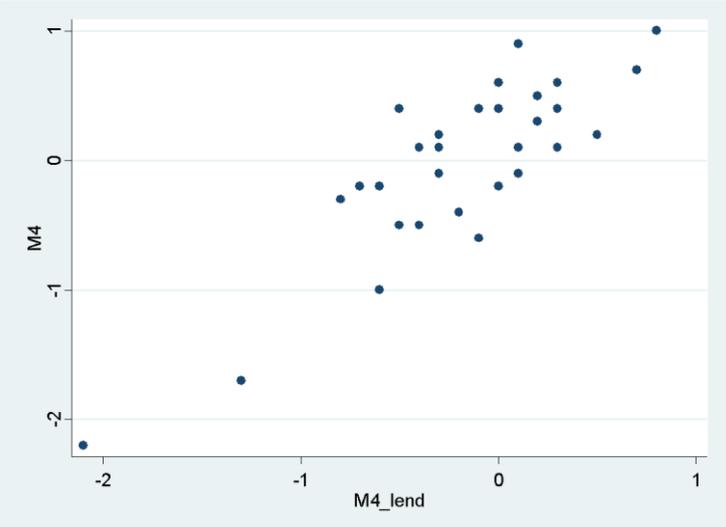


Source(s): This study's own interpretation of statistics produced by the Bank of England.

Figure 2 represents the first period of the data from November 2010 to December 2012. In this first period we see that there is a positive correlation between M4 and M4 lending growth, but this relationship appears to be different to the positive relationship shown in Figure 3. The axes on Figure 2 range from -2 to 1 on the M4 growth axis, while the M4 lending growth axis ranges from -2 to 2. This

suggests that in the time period described in Figure 2 (2010-2012) the positive monthly growth in lending was not matched by the central bank through M4 creation fully. However, the range on Figure 3's axes (from 2013-2015) is -2 to 1 on both the M4 growth and M4 lending growth axes respectively. This suggests that monthly M4 lending growth rates were matched by M4 growth rates. From this visual analysis there is evidence that the relationship between M4 growth and M4 lending growth has changed in this model, suggesting that the Bank of England's level of accommodation of new bank credit may have also changed in this period.

Figure 3: Reserves and Lending Growth, 2013-2015



Source(s): This study's own interpretation of statistics produced by the Bank of England.

5.4.1 Test for a Structural Break

In order test for a change in the relationship between M4 and M4 lending growth more formally, consider a structural break in model (5), robust with lags (note that using lags in this model made no difference to the resulting statistic or P-value). By testing for a structural break might provide more evidence of whether the UK endogenous money system changed when Basel III was introduced.

Table 3: Tests for Known Structural Breaks in the Multivariate Time Series, 2010-2015.

Monthly Date (T = 1 at November 2010)	Chi Squared Value	P-Value
T= 21	28.5559	0.0008
T= 22	19.9964	0.0179
T= 23	16.1480	0.0639
T= 24	16.4867	0.0574
T= 25	16.0441	0.0660
T= 26	13.1306	0.1568
T= 27	14.1200	0.1181
T= 28	15.9406	0.0681
T= 29	13.0347	0.1610
T= 30	14.8348	0.0956
T= 31	13.4450	0.1435
T= 32	13.0250	0.1615
T= 33	12.8172	0.1711
T= 34	10.6850	0.2979
T= 35	11.2204	0.2609
T= 36	11.0047	0.2754
T= 37	14.3585	0.1101
T= 38	12.3076	0.1965
T= 39	9.4634	0.3956
T= 40	6.0510	0.7348

Source(s): This study's own regression test based on Bank of England statistics.

Note: This test uses regression Model (5); Null Hypothesis = No Structural Break.

Table 4: Tests for Known Structural Breaks in the Multivariate Time Series, 2010-2015.

Monthly Date (T = 1 at November 2010)	Chi Squared Value	P-Value
T= 21	18.0111	0.0350
T= 22	16.0189	0.0665
T= 23	16.5477	0.0563
T= 24	13.0010	0.1626
T= 25	12.2512	0.1995
T= 26	8.1145	0.5226
T= 27	5.9597	0.7439
T= 28	8.9094	0.4457
T= 29	8.3527	0.4990
T= 30	9.2768	0.4121
T= 31	9.0684	0.4310
T= 32	10.5071	0.3110
T= 33	10.6329	0.3017
T= 34	9.4784	0.3943
T= 35	8.7989	0.4560
T= 36	8.5126	0.4834
T= 37	9.3150	0.4087
T= 38	9.4542	0.3964
T= 39	11.0949	0.2693
T= 40	5.2391	0.8130

Source(s): This study's own regression test based on Bank of England statistics.

Note: This test uses regression Model (8); Null Hypothesis = No Structural Break.

From Table 3, the test for a structural break at date 21 shows a chi squared statistic of 28.5559, and a p-value of 0.0008. Furthermore, the test for a structural break at date 22 produces a chi squared statistic of 19.9964 and a p-value of 0.0179. Given these tests, we would reject the null hypothesis that there is no structural break at date 21, and we would also reject the null hypothesis that there is no structural break at date 22. The results of this chow test suggest that the coefficients within the dataset most likely change in July or August 2012 within the model. These dates correspond to the months just prior to Basel III's framework coming into effect within the UK in January 2013, suggesting that Basel III has changed the relationship between the Bank of England and UK commercial banks.

5.5 Summary of Data Analysis

From Figureical and regression analysis, this study concludes a positive relationship between M4 growth and M4 lending. This suggests endogenous money theory holds true for the UK economy in the time period post-crisis. The coefficient on M4 lending is below 1 with 95% confidence, suggesting a structuralist paradigm in the endogenous money system for the overall time period. The data also suggests that an acquisition of assets by UK commercial banks are negatively correlated to bank lending. This implies that the capital requirement and liquidity rules in Basel III's framework probably deter UK bank lending. Finally, the structural change in models (5) and (8) is observed to occur in July 2012. Therefore, it could be suggested that this roughly corresponds with Basel III's main date of implementation, January 2013, and surrounding frameworks.

6. Conclusion

To summarise this study, it is important to consider the aim of the study and the issues it raises. The nature of the UK's endogenous money system in light of Basel III highlights a complex interaction between three main economic agents. These are, the Bank of England, the UK banking sector, and the regulatory authorities.

From the literature, it is clear that there are particular disparities between the original authors relating to endogenous money. Mainly, these disparities relate to the short term composition of the credit supply curve. While in the long term, it seems that the spectrum of arguments within endogenous money theory converge to agree that the authorities are able to exert control over commercial bank lending. However, in the short run horizontalists define the credit supply as being flat, where commercial banks themselves are partial to lend to any quantity of creditworthy borrowers at a given price. In contrast, Structuralist authors apply liquidity preference to commercial banks as well as central banks, suggesting that modern banks are rational, calculated institutions who recognise the need to manage the volume of loans created in response to loan demand changes. Attempting to

measure this complex relationship comes with a great deal of uncertainty. For the proxies used in this study to map lending, reserves accommodation and banking regulation are broad in their attempts to include a vast array of financial instruments and capture a macroeconomic view of the UK financial system. However, using broad proxies, it is difficult to identify causality between specific financial and economic variables.

The analysis of Basel III offers insight into the third mentioned economic agent within the study, regulatory authorities. While horizontalist authors argue that banks proficiently evade attempts to dampen bank lending, it is the sole purpose of financial regulators such as the Basel Committee for Banking Supervision to instil stability and control to the sector. From the analysis, it is suggested that no banking regulation to date implies methods of credit and risk control with magnitude quite like Basel III's detailed framework, and the reason for this stems from the harrowing backdrop of 2008's unprecedented global recession which gave banking authorities cause to target the risk in the financial sector. Such a tool gives central banks a break, of sorts, from having to restrain bank lending, by allowing central banks to provide financial stability as a public good, all the while Basel III lawfully unlevers financial risk at the expense of banks themselves through enforcing expensive safeguarding capital, and reduces the moral hazard associated with a reliable lender of last resort. Banks are expected to conform to Basel III's requirements and declare information regarding their levels of risk through transparent channels defined by Basel III frameworks. Therefore, the Basel III framework provides scope for liquidity preference to be shifted from the central bank to commercial banks, offering a change in the relationship between financial authorities and commercial banks.

The empirical data analysis offers support to the structuralist view that central banks can exert control, at least within the context of this study relating to the Bank of England. The study and data also suggests that Basel III's implementation has given the Bank of England incentive to provide liquidity to the banking sector in the UK. This is drawn from the increased coefficient between M4 lending growth and M4 growth (proxies for credit lending and the money supply, respectively) after Basel III's implementation and also from the Bank of England's own increase in liquidity provision after Basel III. The use of Figureical analysis and tests for structural breaks suggests that Basel III has indeed changed the character of the UK endogenous money system, where commercial banks are now required to show greater liquidity preference by increased accumulation of high quality liquid capital. Whereas the initial paradigm comprised of a more opposed relationship between the Bank of England and UK banking sector. Initially, the Bank of England showed signs of resisting commercial bank lending to some considerable avail through the restriction of M4 growth. However, the relationship after Basel III's implementation changes to show that the Bank of England may have been more lenient on commercial bank lending, allowing M4 lending to determine M4 growth with less central bank resistance. It is the fact that such a change in the endogenous money paradigm seemingly coincides

with Basel III's implementation dates, as determined by tests for structural breaks, that leads this study to suggest that Basel III has indeed proved an effective tool to authorities in reducing UK commercial bank lending, at least in the short run.

Consequently, this study implies a structuralist view is applied to the entire time period of its analysis in the UK, because of the evident control on reserves growth exerted by the Bank of England, coupled with the existence of commercial bank liquidity preferences which adheres to the general structuralist definition. It would seem that the UK money system has changed its nature, from non-accommodation of bank reserves by the Bank of England in 2010 to 2012, to the increased restriction of lending through commercial bank liquidity preference in 2013 to 2015.

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