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A Monetary Analysis of the Liquidity Trap with an Application to the USA

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ABSTRACT

Keynes emphasized a specific situation in which the liquidity preference becomes absolute, leading to monetary policy ineffectiveness when nominal interest approaches the zero-bound rate. This situation was termed a liquidity trap (LT) by Robertson and was popularized by the Hicks-Hansen framework (IS-LM). Early macroeconomic textbooks characterized the LT as the Keynesian case against the classical one. The "lowflation" environment experienced in the USA and Europe again brought the LT to the forefront. The quantitative easing monetary policy was introduced in Japan and better applied in the USA and EMU as a solution to overcome the LT. The macroeconomic mainstream contends that the LT is essentially a money demand problem, whereas we propose another interpretation; the current situation should be interpreted as a "banking problem" that impedes the transformation of the monetary base into money supply. To prove our thesis, we study the behavior of the USA money multiplier and the income velocity of money by comparing an earlier period with the 2007-2008 crisis period. Using a VAR and a VECM model, we compare the normal situation of monetary policy efficiency with the situation of LT monetary policy inefficiency. We prove that the LT focus should not be placed on the demand for money but rather on the behavior of the money supply – more specifically, on banks' behavior leading to the transformation of the monetary base into the money supply.

KEY WORDS: Liquidity trap, money supply, monetary base multiplier, ARIMA, VAR and VECM models

JEL Classification: E12, E3, E4, E51, E6

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"But do not be reluctant to soil your hands, as you call it. I think it is most important. The specialist in the manufacture of models will not be successful unless he is constantly correcting his judgment by intimate and messy acquaintance with the facts to which his model has to be applied" (Keynes, 1973, p. 300)

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1. Introduction

Until Krugman's alarm (Krugman, 1998) concerning Japan, the liquidity trap (LT) was a concept related to old Keynesianism and a curiosity in the USA history of monetary policy. The current new situation in the USA and EU has resuscitated interest in this phenomenon from a historical and theoretical perspective. We present the original and modern meanings of LT, episodes of it, and policy measures designed to escape its stagnant equilibrium. These analyses are mainly supported by a horizontal demand for money,

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but we propose another view. We claim that the LT is a money supply disease. The monetary authority is effective at increasing the monetary base to huge levels; however, it is ineffective at increasing the money supply. If banks do not lend money to the private sector, then the demand for goods and services is stagnant. Our models about the income velocity of money and the money multiplier together with the VAR and VECM representation of interest rate, monetary base and money supply confirm our thesis.

Besides a short introduction, our paper is organized in four sections. Section 2 addresses several topics that facilitate understanding of the LT phenomenon and our thesis. (2.1) discusses the concept of an LT – the Keynesian definition, its origin and critics of the concept. In the second subsection (2.2), the current LT definition and its implications are analyzed. In the third subsection (2.3), we briefly point out to several LT episodes with the objective of showing that an LT is not a curiosity emanating from the minds of some creative economists but quite the opposite. This section also addresses the issue of how to free the economy from the LT vicious circle (2.4). Our thesis about LTs is presented at the end of this section (2.5). In the empirical part of the paper (section 3), we first present a data description (3.1); we then study the behavior of the income velocity of money and the money multiplier, and with the help of VAR and VECM models, we confirm our thesis about the LT phenomenon (3.2) for the USA. Finally, in section 4, we conclude.

2. A Reassessment of the LT Literature

2.1 Keynesian Definitions of LT

Keynes (1936, p. 191) suggested that the expression of absolute liquidity-preference applies to the situation we know currently as a liquidity trap (LT). (Tobin, 1947, p. 128) used the expression "Keynesian impasse" to express the same situation. The expression LT was created by (Robertson, 1940). It was known by (Hicks, 1937); however, its popularity is due to Hansen (1953) and and Sutch (2009). Robertson invented the expression to illustrate the consequences of a money demand negatively sloped on the saving-investment process (Boianovsky, 2004). The standard Hicks-Modigliani-Hansen unemployment equilibrium model (Patinkin, 1974) based on the assumption of Keynesian interest rate regressive expectations became the source for the LT explanation. The situation of an LT explained through the term structure of interest rates, proposed by Keynes and accepted by Hicks, was replaced by the idea that the floor of the long-term interest rate does not depend on uncertainty (Kaldor, 1939) and (Robinson, 1951). The demand for money has been at the heart of this latter idea.

The LT was the main reason for the role ascribed by macroeconomic textbooks of the 1960s to fiscal policy; they identified a "Keynesian case" (Modigliani, 1944, p. 56[1]), where "nobody will be willing to hold nonphysical assets except in the form of money", (Modigliani, 1944, p. 53). Consequently, "Any increase in the supply of money to hold now fails to affect the rate of interest" (Modigliani, 1944, p. 55). The general theory (GT) was consequently conceived as "the Economics of Depression" (Hicks, 1937, p. 155).

The refusal of the LT came from different schools and was based on arguments not related to the demand for money. (Patinkin, 1974, p. 9) defends against the conventional IS-LM model explanation of sustainable but less than full employment with an alternative one based on the GT "generated by the fact that the rate of interest falls too slowly in relation to the marginal efficiency of capital" (italics in the original). The less than full employment situation was due to the dynamics of investment decisions and not to the behavior of the demand for money. Haberler (1937) and Pigou (1943) argued that the deflation that characterized the LT hypothesis leads to an increase in agents' real income (a shift to the right of the IS curve), which would be sufficient to start an economic recovery (the "Pigou effect"). This old mechanism was recovered by (Ireland, 2005), who retained the essential ingredients of it. The consumption behavior would eliminate the existence of the LT. Monetarists such as Friedman (1956), Brunner and Meltzer (1968) argued that the demand for liquidity would never become absolute and that monetary policy would therefore remain effective if unconventional policies, which Friedman called a "money gift", were adopted. Those policies consisted of establishing a higher target for the monetary base growth or diversifying open market securities purchases with special focus on longer-term maturities. These authors deny the specific Keynesian behavior of demand for

money, however; they confine their analysis to an automatic transmission from the monetary base to the money supply, which is contestable.

Since the time when these issues were discussed, a long period elapsed during which the LT stayed dormant. It was the time of Jean Fourastié's *trente glorieuses*, the growing inflation of the 1960s with the eclipse of the Phillips curve, and the rational expectations revolution of the 1970s, which led to the consigning to limbo of not only the LT framework of analysis but also most of the Keynesian ideas about over saving and insufficient aggregate demand. We had "thrown out the baby with the bath water" until the seminal article of (Krugman, 1998).

2.2 Current Definitions of LT

In the framework of the IS-LM model, the LT phenomenon is interpreted as a situation of perfect substitutability between money and bonds at a (near-)zero short-term nominal interest rate; thus, this irreducible interest floor becomes a binding constraint making ineffective traditional procedures of monetary policy (Auerbach & Obstfeld, 2004; Benhabib, Schmitt-Grohé, & Uribe, 2002; Buiter & Panigirtzoglou, 1999; Eggertsson, 2006; 2008; Hanes, 2006; Krugman, 1998; Rhodes, 2011; Sutch, 2009; Svensson, 2006). Additionally, in current times, central bankers' reputation for maintaining a stable, low inflation rate is also an important factor pushing interest rates to near-zero values (Sumner, 2002).

Currently, the LT is associated with many different environments. (Buiter & Panigirtzoglou, 1999) call the LT "an inefficient equilibrium". Comparing it with zero gravity or near-absolute-zero temperature, (Blinder, 2000) writes, "It may indeed be a new world", and (Pollin, 2012) stresses the specific environment characterized by high unemployment, high inequality, household wealth collapse and fiscal austerity policies that go along with an LT. This last description is not far from what (Modigliani, 1944, p. 56) named in the past the "Keynesian case" or (Hicks, 1937, p. 155) the "Economics of Depression", when he used a horizontal LM curve.

A majority of the LT interpretations continue to be addressed in terms of the demand for money behavior. The problem of money supply is rarely taken into consideration. When it occurs, it is exclusively confined to the monetary base behavior. Svensson (2003, p. 147) stated that the confusion between the monetary base (MB) and money supply effects is notorious. Krugman (1998, p. 141) explicitly says, "Base and bonds are viewed by the private sector as perfect substitutes". This statement may undoubtedly be true for banks but is certainly not true for the "private sector". No wonder that those authors reached the conclusion that monetary policy is ineffective due to the behavior of the demand for money. Some authors looked at the MB; however, they went no further. For example, (Brunner & Meltzer, 1968, p. 12) give another interpretation for monetary policy ineffectiveness: "the banks desired to hold excess reserves and were unwilling to lend"; nevertheless, they dismissed that explanation in the absence of evidence supporting it, as Sumner (2002) also did. A similar interpretation is given by Svensson (1999; 2003), who claims that the increase in the MB beyond the satiation point is ineffective on prices and quantities. Krugman (1998, p. 140) recognizes the impossibility of increasing the "monetary aggregates" despite the MB increment, but he categorically points out that the crucial problem does not lie in the banking sector, since the solution to the problem is the creation of inflation expectations. Nevertheless, he does not explain how those expectations can be effective in the absence of money supply growth. Pollin (2012) shows that at least for the 2007-2008 crisis, there is no satiation level for the MB in the USA; thus, the problem lies in the transformation of the MB into money supply. Buera and Nicolini (2014) show how there is also in the current situation a credit-crunch problem. Moreover, without an increase in the money supply, we cannot expect the reduction in longer interest rates that will affect consumption and investment (Svensson, 2003). The lending activity of banks is the process through which the monetary base is transformed into money based on individuals' and firms' balances.

For Eggertsson and Woodford (2003) in an LT situation, the demand for money is less than the supply for money. This thesis is rather debatable, since the money demand for hoarding conducive to idle money balances and the absence of bank credit that reduces money supply should be taken into consideration. (Rhodes, 2011) prefers the expression "liquidity sump", according to which individuals want to convert income flows exceeding basic income into money (liquid assets). If

this description portrays the current LT situation, then the money supply should grow faster, but it is not doing so.

What are the consequences of the usual definition of an LT? Monetary policy is ineffective at achieving full employment or reversing the downward slide in prices in an LT context (Auerbach & Obstfeld, 2004; Benhabib, Schmitt-Grohé, & Uribe, 2002[2]; Eggertsson, 2005; Eggertsson, 2008) support the idea that even in an LT, large-scale open market operations are a powerful instrument for fiscal policy. Thus, fiscal policy should be a substitute for the ineffectiveness of monetary policy. Bernanke (2000), Orphanides and Wieland (2000) and Pollin (2012) recommended *ad hoc* solutions to change the rigidity of high values of longer rates of interest under an LT. The IS-LM model with the independence of the two curves is not an appropriate framework for these proposals. Nevertheless, the door was opened for the fiscal channel at the end of Keynes' most cited passage, (Keynes, 1936, p. 207): "Moreover, if such a situation would to arise, it would mean that the public authority itself could borrow through the banking system on an unlimited scale ...". In our opinion, this statement conveys, in practice, the recognition that we should analyze the LT situation due to the 2007-2008 crisis in terms of the money supply. The lending activity of banks is the process through which the monetary base is transformed into money supply.

2.3 LT Episodes

The Krugman seminal paper is responsible for the recent interest in LT episodes (Krugman, 1998). ECONLIT records 36 articles up to 1997 and 162 from 1999 to June 2014. In addition to Krugman, other authors such as (Auerbach & Obstfeld, 2004; Bernanke, 2000; Eggertsson & Woodford, 2003; Shirakawa, 2002; Svensson, 2006) deserve to be mentioned due to their analysis of the LT episode that occurred in Japan in the 1990s. Additionally, (Eggertsson, 2008; Hanes, 2006) are good references for the early 1930s LT episode in the USA (1933).

Fisher's explanation (Fisher, 1933) about the Great Depression relies on debt deflation. A very appealing explanation envisages LT episodes as a process that may not return to equilibrium. More specifically, it explains why the dynamics of deficient or stagnant global demand and money supply are perpetuated in a vicious cycle of decreasing prices, increasing debt value, and decreasing global demand. This explanation was used to explain Japan 1990 (Eggertsson & Krugman, 2012; Koo, 2009) and is also presented in (Svensson, 2003).

In our opinion, what we have now are different episodes of massive creations of high-power money by central banks. These experiences are known by the term "quantitative easing" (QE), and they were applied first in the early 2000s in Japan and then after the beginning of the 2007-2008 crisis in the United States, the United Kingdom, Japan, and the Euro Area (Fawley & Neely, 2013). man.

2.4 How to Escape an LT

Buiter and Panigirtzoglou (1999, p. 17) consider that the real issue is not how to eliminate an LT but how to avoid it: "Targeting a higher rate of inflation after you are caught in the trap would be like pushing toothpaste back into the tube". However, this position does not eliminate the need to end an LT situation when it occurs. Under an LT, the anemic aggregate demand is negatively influenced by household deleveraging and has to be compensated for or reversed by unconstrained agents (), (Eggertsson & Krugman, 2012; Guerrieri & Lorenzoni, 2011; Hall, 2011; Korinek & Simsek, 2014; Mian & Sufi, 2010).

The traditional Keynesian policy proposal to eliminate an LT was based on the displacement to the right of the IS curve by means of a fiscal policy stimulus. This approach was used to justify the "American fiscalism" position. The idea of fiscal stimulus nevertheless remains current, mostly through future price increases and consequently by changing the intertemporal budget constraint of governments (Benhabib et al., 2002; Eggertsson, 2008). Another kind of policy is to increase money supply by choosing a money growth target that will be responsible for inflation growth that will consequently change the intertemporal budget constraint of private agents and of the government (Benhabib et al., 2002; Krugman, 1998). These proposals are usually based on some version of government's function as the spender of last resort. In this case, this monetary strategy is the other face of fiscal policy, and at the limit, "it is government debt that determines the price level" (Eggertsson, 2003, p. 5). Burget and Schmidt (2015) show that the efficiency of this policy

depends on the government debt level, and Evans and Honkapohja (2005) show that fiscal policy must be supported by money supply growth. The most radical proposition comes from (Cochrane, 2015, p. 10), following which the fiscal stimulus should be regarded as "totally useless (...) government spending"[3], or in the words of (Krugman, 1998), government must "commit to being irresponsible".

The effects of increasing government spending correspond to one of the particularities of the LT. What in normal times will reduce the natural level of output will in an LT increase equilibrium employment (Eggertsson, 2008). Thus, government spending becomes self-financing; tax revenues will increase enough to pay for higher spending (Erceg & Lindé, 2014).

Let us now focus on the money supply side of the LT. Two problems should be envisaged in terms of money supply. The first problem is the decrease in the velocity of money. The second results from the fact that an increase in money supply in a credit money economy is the outcome of banks anticipating solvable credit demand. The first problem is very similar to the situation of over-saving considered by Keynes, which led this author to cite Silvio Gesell in the GT. (Gesell, 1916, p. 123) proposed a tax on currency of "one-thousandth of its face value weekly, or about 5% annually", to increase the velocity of money to stabilize the general level of prices. The increase in money velocity will attenuate the decrease in aggregate demand in an LT (Buiter & Panigirtzoglou, 1999). The second problem is reflected in the much reduced value of the money multiplier and could be solved by "an excess reserve tax" (Edlin & Jaffee, 2009) and (Pollin, 2012) or, equivalently, by the imposition of a maximum reserve level (Dasgupta, 2009). Examples of this kind of measure were represented by the reduction of the deposit facility interest rate from 0% to -0.10% following the ECB's decisions on 5 June 2014 and on 4 September 2014 to -0.20%, which also applied to excess reserves. The decision made by the Bank of Japan on 29 January 2016 to apply a negative rate of -0.1% to current accounts that financial institutions hold in it is also a good example. The obvious objective of these kinds of measure is to increase the value of the money multiplier by expanding banking credit to firms and individuals.

Demand policies will be ineffective if individuals expect that the inflation values prevailing during the LT period will return (Krugman, 1998) and (Rhodes, 2011) or if they anticipate that monetary authorities will continue to choose the interest rate following a Taylor rule (Eggertsson & Woodford, 2003). Both situations are counter to the idea that central banks can create the amount of money they wish. When (Bernanke, 2000, p. 5) writes that "(t)he monetary authorities can issue as much money as they like", we should read "money" as "base money" and not as "money stock".

A third alternative to eliminate the LT consists of a sustainable reduction of long-term interest rates through the supply of reserves in exchange for foreign currency and long-term government bonds (Hanes, 2006). This effect may be achieved through loan-guarantee programs (especially) to smaller firms (Pollin, 2012) that will reduce their risk premiums. To be successful, this effect has to countervail the moral-hazard problem and the inefficiency in the credit market that it will create. Following (Orphanides & Wieland, 2000), a commitment by the central banks to very low short-term interest rates is sufficient to reduce long-term interest rates. Bernanke (2002) proposed an operational procedure to guarantee high prices to future government bonds in unlimited quantity. This alternative is countered by (Svensson, 2003; 2006), who points out that expectations of higher future price levels are more effective. Svensson (2001; 2002; 2006) and Jeanne & Svensson (2007) proposed what the former calls the "Foolproof Way" to eliminate the LT. This approach consists of a price-level-increasing target path, currency depreciation with currency peg and a zero-interest rate until positive results from price-level targets have been reached. However, Bernanke regards the monetary base as a sufficient condition to change expectations about price increases, which is a wrong deduction during an LT episode because, as mentioned above, in an LT situation, the money supply does not react to increases in the monetary base.

Mierau and Mink (2013) presented evidence on a weak relationship between excess comovements in economies affected by financial crisis, suggesting that the researcher should focus more deeply on domestic aspects of crises. In another paper Mierau and Mink (2016) built a model where money supply has a central role through a "bank equity multiplier". The positive temporal correlation between banking equity values

and the supply of bank money allows these authors to propose bank recapitalization as a way out of the crisis. Their analysis makes a clear and fruitful distinction between the concepts of zero lower bound interest rate and LT. In our opinion, bank recapitalization is a necessary but not sufficient condition to increase the money supply.

2.5 Our Thesis

The dominant traditional view anchors the LT phenomenon in the demand for money. However, according to our own point of view, we should analyze the phenomenon as a rupture in the money supply mechanism. The central issue is the banking sector. Banks do not create money, because they do not hold reserves to lend; instead, they consider that there is no acceptable level of risk from bank credit demand. The proposals to eliminate the LT based on the creation of inflation expectations should be compatible with money supply targets and should be anchored in realistic forecasts of bank lending.

The analysis of the LT has limitations that are a direct consequence of the framework of analysis initially used – the IS-LM model. This model has two black boxes (BB) in terms of monetary policy: (1) the oversimplification of the relationships between the central bank (CB) and the banking system and (2) the neglect of the relationships between banks and the nonbanking sector (Dale & Haldane, 1993). The first BB leads to ignoring that the LM curve depends on the operational targeting of the CB (refinancing interest rate or monetary base) (Bofinger, 2001, p. 85-90), and to assuming that banks have a passive role in the transmission of monetary policy. In an LT situation, the chain represented by the monetary base multiplier is broken; consequently, this monetary transmission mechanism does not work. By ignoring banking credit demand, the second BB ignores money creation, i.e., money supply. The LM curve represents the equilibrium between the demand and supply of money. Money demand is dependent on income, and its value is always finite; thus, an LM curve represented by a horizontal curve makes no sense. An LM horizontal supposes infinite banking lending to the economy for an infinite value of income. The derived idea of a near-zero velocity of money in an LT situation is also incorrect.

We have by now experienced a considerable period of an ex ante strategy for monetary expansion (Fawley & Neely, 2013), and we focus on the quantitative easing in the U.S.A. The concept of QE refers to a set of unconventional monetary policy measures related to changes in the structure and/or in the balance sheet size of central banks and massive asset purchases by introducing high-power money in huge amounts, seeking to facilitate access to credit for nonfinancial agents. There are two historical episodes, identical in shape but nevertheless different in content, under such policies: by the Bank of Japan after Japan's Lost Decade and by the Fed during the period after the 2007-2008 Financial Crisis.

The strategy adopted by the Fed can be divided into two phases: the first, beginning in 2008, was marked by an ad hoc approach centered on the left side of the balance sheet (assets) – purchase of longer-maturity assets (Treasury notes and Treasury bonds), ignoring the usual Treasury bills (maturity less than 1 year). The objective was to promote monetary expansion by reducing the liquidity premium.

The second phase was characterized by operations on liabilities – the U.S. Treasury resorted to loans beyond its needs, depositing excess funds in its accounts into the Fed. The action therefore focused on the reduction of the risk premium, which reveals a paradigm shift in the Fed action during the implementation of QE. At first, the financial crisis was seen as a problem of illiquidity; thereafter, the Fed adopted an approach of troubleshooting the solvency of the financial sector. Thus, the objective was to increase the supply of credit to the nonfinancial sector of the economy.

In an LT episode, banks have excess reserves; however, they do not lend them. The situation is not one of excess demand for money but of a shortage of bank credit. Thus, the money supply is stagnant. Therefore, global demand is sluggish, and inflation expectations are not far away from zero, if not in negative values.

The problem in terms of diagnosis is about the rupture of the money multiplier and about a cure for the spender side of the economy. Government must borrow money to spend it immediately, and "conditions" have to be offered to banks such that they are willing to lend money to firms, even if this situation creates a moral hazard problem.

The classical analysis of active/idle balances, (Humphrey, 1974; 2004) is currently ignored; however, it is highly enlightening. In an LT episode, the level of idle balances grows, a situation equivalent to an excess of

money supply. The government could borrow these balances and spend them, even if this operation increases the borrowing interest rate. Is this operation in contradiction to the classical policy measure of reducing the interest rate to near-zero values? No, it is not. If idle balances are transformed into active balances, the increase in global demand will contribute to money supply growth, while the LT major problem relies on the money supply mechanism. Consequently, special emphasis should be accorded to the proposition that without solvable banking credit demand, the supply of money will not increase[4].

3. Empirical Analysis

In principle, we have four possibilities for testing our thesis: Japan, the USA, the UK and the EMU. The Japanese economy is very specific in terms of the great symbiosis between financial and political interests (Kanaya & Woo, 2000); also, due to late and inappropriate policy measures (Iwamara, Kudo, & Watanabe, 2006), it has evolved into a "long-term LT". These reasons support the exclusion of the Japanese LT from our empirical analysis. The situation in the EMU is different. Apart from the difficulty in understanding the crisis experienced by former president of the ECB Jean-Claude Trichet, two other important facts prevent us from analyzing the situation in the EMU. First, at the beginning of the crisis, the ECB practiced a policy of compensation by lending to banks with deposit auction offers. Second, base money declined from 2013 until the beginning of 2015. With Mario Draghi, some of the ineffective policy actions that could be learned from the Fed policy have been counteracted by ECB decisions. One such decision (June 2014) creates a "tax" on excess bank reserves. To study the LT paradigm with such changes in monetary policy is not a good choice if we want to express it empirically with an appropriate short-term model. Consequently, two remaining possibilities are offered: the USA and the UK. The dimensions of the international importance of the USA dollar, the activist central bank and its creative policy led us to apply our thesis to the USA economy.

We first describe our database and present descriptive analyses of the variables of interest. We then test our thesis about the existence of an LT for the USA economy after 2008, based on which an LT is a banking problem and not a money demand problem. The econometric study is conducted in two stages, (A) and (B). In the first stage (A), we study the evolution of the income velocity of money and the money multiplier. We compare the actual values during the financial crisis with the forecasting values obtained since its beginning. With this analysis, we focus on two characteristics of an LT: the decline of the money velocity that is usually acknowledged but exaggerated and the decline of the money multiplier that is usually ignored. In the second stage (B), we build and estimate two reduced money supply models (a VAR and a VECM) to draw conclusions about the responses of the variables to shocks. The shock value is equal to the standard deviation of the estimation for each variable, which will enable us to evaluate the impact of money supply policies (such as QE) on the U.S. economy. We have divided the period of study (1959:01 to 2013:10) into a "normal period" (1959:01 to 2008:03) and a "crisis period" (2008:04 to 2013:12); we associate the latter with a possible LT period. We retain March 2008 as the end of the normal historical period for two reasons. On March 18th, the Fed announced the third reduction in less than a month in the Federal Funds Rate target, announced that the economic outlook had weakened further, and recognized the considerable stress on financial markets and the reduced levels of inflation expectations (Labonte & Makinen, 2008). These actions revolutionized monetary policy that had been in place since the 1950s and began a new period of nonconventional policy measures. The second reason is the rupture in the money multiplier value (Figure 2), which was accompanied by a very short lag in the income velocity of money (Figure 1). The evolution of the money multiplier ends a period of normality prevailing since the 1950s. The subsequent period, which we call the crisis period, corresponds to what different authors characterize as an LT period (Brycz, 2012; Krugman, 2010; 2013; Pollin, 2012).

3.1 Data and Descriptive Analysis

The database is from FRED (Federal Reserve Bank of St. Louis) and contains monthly values between 1959:01 and 2013:10. The variables are the output (LYR), the nominal interest rate (R), the consumer price index (LP), the monetary base (LMB) and the monetary aggregate (LM1). All variables except the nominal interest rate are in logs and are seasonally adjusted (SA). LYR refers to real GDP at 2009 prices

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Table 1. Characterization of relevant variables (values in %)

Variables	Full period	1st period	2nd period
Real GDP a.g.r.	3.12	3.35	1.04
M1 a.g.r.	5.15	4.25	13.6
Price Level a.g.r.	3.88	4.14	1.63
Monetary Base a.g.r.	8.64	6.51	30.05
Income Velocity of money a.g.r.	1.93	3.24	-0.09
Money Multiplier a.g.r.	-0.22	-2.12	-12.65
R	4.93	5.46	0.24

Note: a.g.r. = average growth rate

in billions USD. This variable was converted from quarterly to monthly data using the Denton-Cholette method (Dagum & Cholette, 2006, pp. 80-82; Sax & Steiner, 2013). R is the Effective Federal Funds Rate, the actual values of the operational target of the Fed monetary policy. LP is a measure of monthly prices of a set of goods and services purchased by consumers, with 1982-1984 as the base year. LMB refers to the adjusted monetary base of the Federal Reserve of St. Louis. LM1 is the narrow definition of money supply in the U.S. Lv measures the income velocity of money (=LYR+LP-LM1), while Lm measures the money multiplier (=LM1-LMB).

The evolution of the money stock (M1) and of the monetary base (MB) reflect the breakdown in the money supply mechanism. Looking at their characterization in Table 1, we perceive a great increase in the values of M1 and a huge MB growth in the second period, after 2008:03. These evolutions hide a completely difference picture in terms of the transmission mechanism of monetary policy. The relationship between the monetary base and the money supply can also be perceived through the evolution of the money multiplier, which exhibits a rupture in the second period.

By the conventional ADF test, all the variables in the levels are I(1), and this result is almost always confirmed by the KPSS test of stationarity (see Table A.1 in the Annex).

3.2 Econometric Analysis

In the following, we study the evolution of the income velocity of money and the money multiplier (**A**). Bearing in mind that these variables are I(1), we applied augmented distributed lag (ADL) models that are equivalent to error-correction models (EC) (Hassler & Wolters, 2006; Johnston & Dinardo, 1997). Our statistical and econometric estimations were done using R except for the VAR and VECM models, which were estimated using JMULTI version 4.24 (2009) (Lütkepohl & Krätzig, 2004).

In an LT, the velocity of money, Lv, will tend to minimum values corresponding to an increase in the amount of idle money. The following general ADL model was investigated:

$$Lv_t = c + a(L)Lv_{t-1} + b(L)R_t + \varepsilon_t \quad (1)$$

where $a(L)$ and $b(L)$ are lag polynomials with maximum order of 6. For all estimated regressions, we choose lags by the likelihood ratio criterion. Model estimates and statistics are shown in Table 2.

AR1 and Reset tests exclude the presence of autocorrelation of the errors and of model misspecification, respectively. The coefficient of the interest rate is positive as expected and statistically significant at 1%. The forecast for the crisis period, considering a confidence interval of 90%, is shown in Figure 1.

Table 2. OLS, 1959:03-2008:03 (T = 589), for Lv

HAC standard errors, bandwidth 6 (Bartlett kernel)			
	Coeff.		
Const	0.0053*	R^2=0.999	AR1: F(1,584) = 0.139
R_1	0.0005***	σ=0.006	RESET: F(2, 583) = 1.864
Lv_1	1.2683***	F(3,585) =1324137	
Lv_2	-0.2693**		

Note: The last statistic in the second column is an LM test for the null of all coefficients beyond the constant. In the third column, we have an AR1 LM test and a RESET with the squared and third exponent.

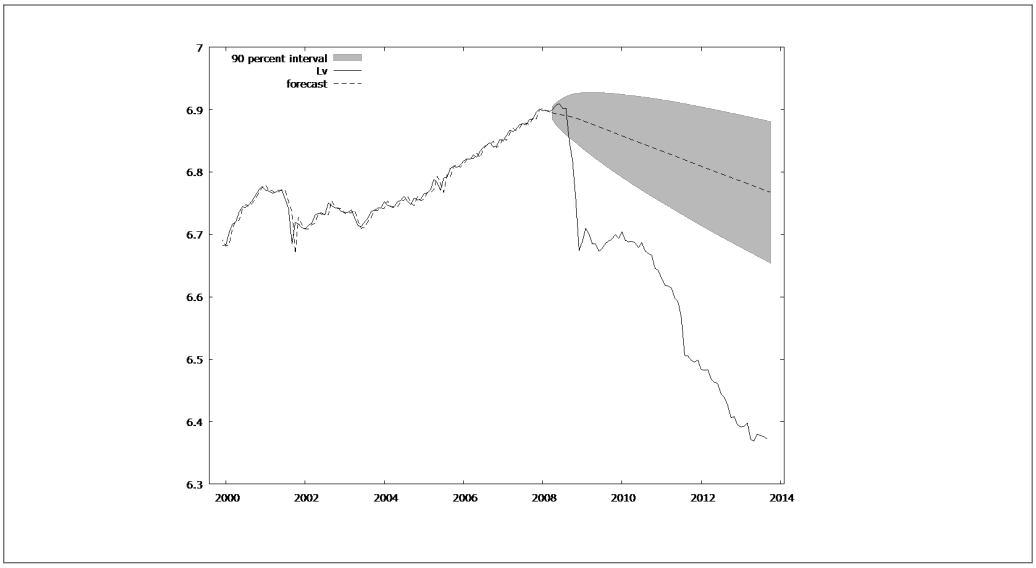

Figure 1. Income velocity of money (MI)

The velocity of money fell far beyond what was expected from the previous behavior, which can be interpreted as a situation of "excess money" because a substantial part of the stock of money is inactive (the fall was 40% compared to the forecast value). This evolution is in accordance with our representation of an LT.

We consider that the normal transmission mechanism of monetary policy does not work in an LT situation. The banking sector does not transform "high-power money" into money supply, money that circulates in the economy. This capacity of the banking sector can be measured by the money multiplier (Lm). The ADL model for Lm is the following:

Table 3. OLS, 1959:06-2008:08 (T = 591), for Lm

HAC standard errors, bandwidth 6 (Bartlett kernel)			
	Coeff.		
Const	-0.0004	R^2=0.999	AR1: F(1,580) = 0.327
R_1	-0.0015***	σ=0.005	RESET: F(2, 579) = 2.058
R_2	-0.0003	F(9,581) = 497137	
R_3	0.0007		
R_4	-0.0004		
R_5	0.0011**		
Lm_1	0.945***		
Lm_2	0.0104		
Lm_3	0.1985***		
Lm_4	-0.1543***		

$$Lm_t = c + a(L)Lm_{t-1} + b(L)R_t + c(L)LYR_t + d(L)LP_t + \varepsilon_t$$

where the terms a(L), b(L), c(L) and d(L) are lag polynomials. We continue to consider the period prior to 2008:08 and the period post 2008:09. The Lm model excludes LYR and LP, keeps R with a polynomial lag of order 5, and the dependent variable has a polynomial lag order equal to 4. The estimated model is in Table 3

The sum of the coefficients associated with lagged Lm is approximately 1 (1.001), for a standard deviation of 0.0005. Again, problems of autocorrelation and misspecification are absent. The dynamic forecasts of the money multiplier for the crisis period, with a 90% confidence interval, are in Figure 2. The evolution of Lm shows evidence of a relative stability of the money multiplier, a result supportive of monetarist authors' views. The least we can say about the evolution of its values during the crisis is that the fall was brutal (for instance, in 2013:10, the difference between the actual and the forecast value was 74%).

In our opinion, these two models, (1) and (2), are a confirmation of the appropriateness of our division into the proposed periods and allow an adequate characterization of the LT for the second period

At stage (B), we analyze the LT from the point of view of money supply. In our models, the ordering of the variables follows the decreasing degree of exogeneity, which is a theoretical reason to use the Cholesky decomposition to simulate shocks in variables (Enders, 2015, p. 297). This order is without consequence in terms of impulses if the correlations between the VAR equation residuals are less than 0.2 in absolute value (Enders' rule of thumb). This last rule was always verified in the models below.

We consider the following scenario: the central bank opts for a policy of money creation, increasing the monetary base; however, banks, due to either rearrangement of their assets or the reduction of their lending capabilities, do not increase the money supply. In this situation, monetary policy is ineffective. To verify this hypothesis, we build a reduced model in which the interaction between the monetary base and money supply (LMB and LM1) variables are studied. The model is applied to the two subperiods previously defined. We analyze the effectiveness / ineffectiveness of monetary policy with a VAR in an LT situation through a comparison of the results from different shocks in the two periods.

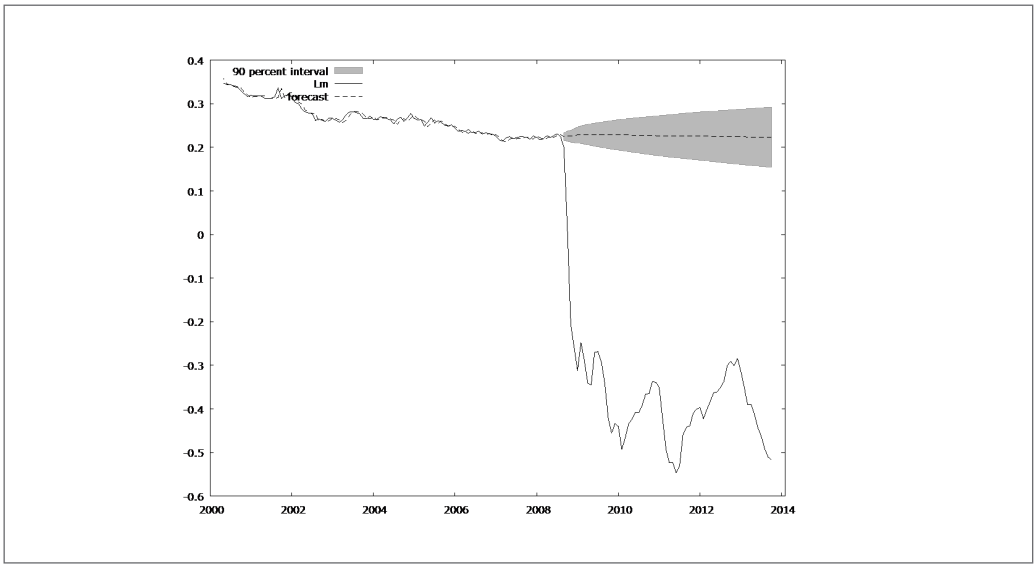

Figure 2. Money multiplier

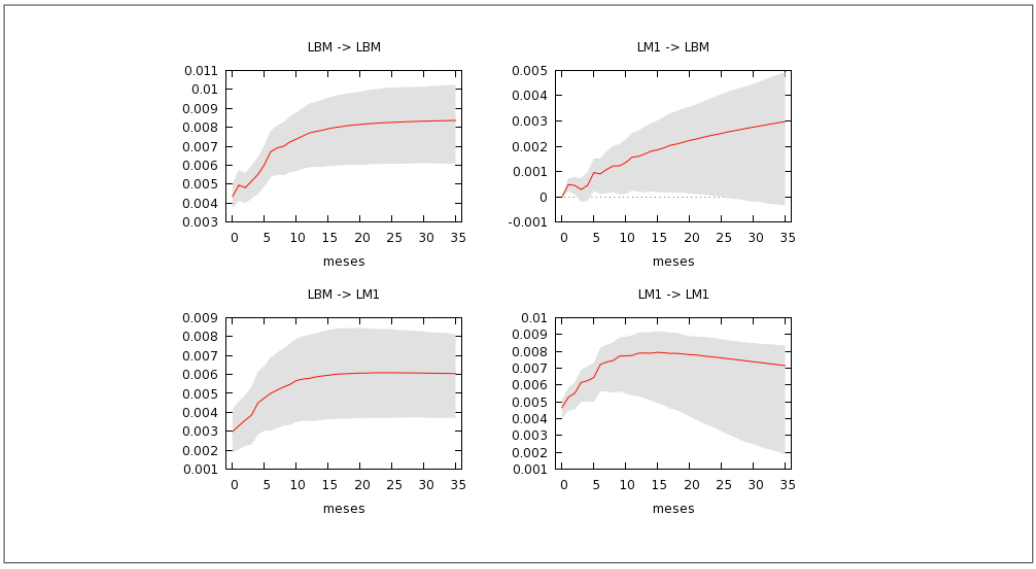

Figure 3. Money supply and money demand shocks (VAR – 1st subperiod)

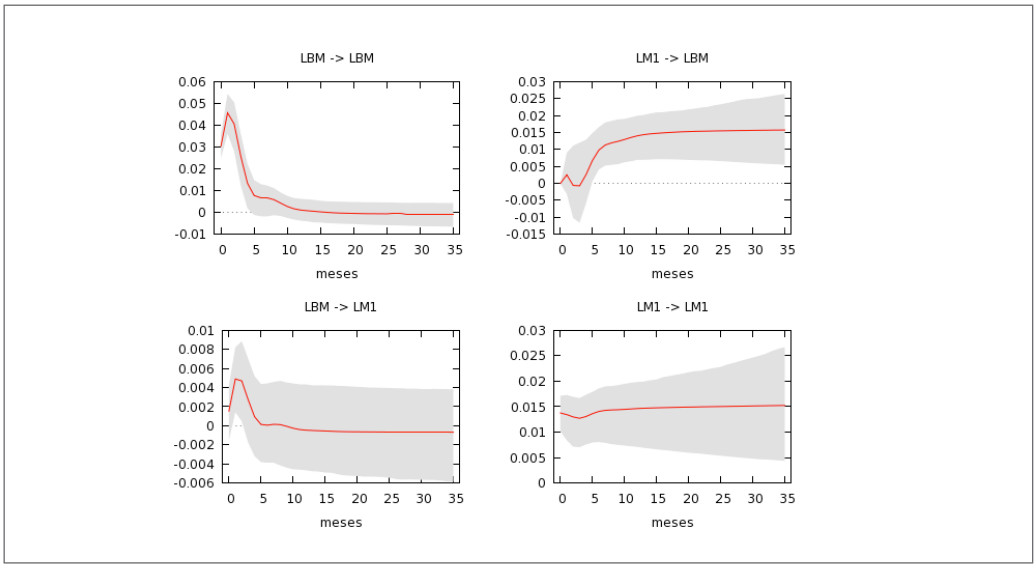

Figure 4. Money supply and money demand shocks (VAR – 2nd subperiod)

The order of the VAR for the first subperiod is 7 and for the second period is 3. Since both variables are first-order integrated, we have also applied the Johansen cointegration test to verify whether we could have a long-term relationship between these two variables. The lags chosen for the test correspond to those of the VAR model minus one, and we never retained any cointegration vector. For both subperiods, the Cholesky decomposition was retained. In the first subperiod, no autocorrelation of order 1 problems was detected (first line of Table A.2 in the Annex). Tables A.3 and A.4 in the Annex contain the values of the variance decomposition for LMB and LM1, respectively.

As shown, LMB is mainly explained by itself (93%), while it explains 37% of the variance of LM1. This model is stable since the roots associated with the VAR lie inside the unit circle (Figure A.1 in the Annex).

We will identify an LMB shock as a money supply shock and an LM1 shock as a money demand shock (Figure 3)[5]. A money supply shock causes, in the period up to the present crisis, an increase in the money supply that stabilizes after almost a year. A mon-ey demand shock has a very reduced effect on the monetary base and after one year is almost negligible. Thus, the role of monetary authorities through money supply policy is clear and corresponds to what is expected theoretically. At the same time, we confirm the characteristic of exogeneity for the monetary aggregate M1.

We now present the second subperiod VAR. There are no problems of autocorrelation of order 1 (second line of Table A.2 in the Annex). The values of the decomposition of the variance of the two variables is shown in Tables A.5 and A.6 of the Annex.

We find a strong participation of LM1 in the variance of LMB (53%), showing an unusual effect in terms of monetary theory. Regarding the variance of LM1, LMB has virtually no explanatory role, unlike what happened in the first subperiod, and LM1 is explained almost by itself (99%). The model is stable since the inverse of the roots lie inside the unit circle (Figure A.1 in the Annex).

A shock of money supply quickly cancels out its effects on LM1, and its effects can never be taken as nonzero (Figure 4). In turn, money demand shocks significantly and durably affect LMB. Contrary to what happened before the crisis, money supply shocks do not exert any growth effect on money circulating in the economy. It can be concluded that for the period

Table 4. Johansen test: Lag order = 6, 1959:07 – 2008:03, Unrestricted constant

Rank	Trace test	Lmax text	Trace test (C)
0	55.28***	43.09***	55.28***
1	12.20	11.22	12.20
2	0.979	0.979	0.979

Note: The last column refers to the trace test corrected for sample size (df=566).

under review, monetary policy based on money supply shocks is ineffective in preventing the emergence of a situation of deflation.

Hoffman and Rasche (1996) marked a new route in monetary empirical research with cointegration (C-I) monetary modeling. Their review of the literature was revolutionary, both theoretically and empirically. Indeed, they pointed out that a suitable econometric model in accordance to the theoretical framework is needed. More precisely, if the demand for money is considered an exogeneous variable, it should be treated empirically; likewise, the same applies to prices and interest rates. We propose a model with the rate of interest, the monetary base and the income velocity of money (R, LMB and Lv). For the first subperiod, the optimal order of the VECM for the Johansen test is 6. We see (Table 4) that we cannot reject the existence of one vector for C-I.

The sign of the short-term adjustment coefficient (α) is negative; thus, the process is stationary. As we did above, we retain the Cholesky decomposition to obtain the variance decomposition and responses to shocks. For this VECM, we do not have problems of autocorrelation (third line of Table A.2. in the Annex). In Tables A.7, A.8 and A.9 in the Annex, we have the values of the decomposition of the variances. Both R and LBM are mostly explained by themselves, while R has a share of 42% in explaining Lv, which corroborates the importance of the interest rate in the transmission mechanism of monetary policy. Again, the VAR roots are inside the unit circle (Figure A.2 in the Annex).

In Figure 5, we have the results from the different shocks. We identify a shock on R as a money supply "price shock", a shock on the monetary base as a money supply "quantity shock" and a shock on the velocity of money as a money demand shock. The effects of a "price shock" on the velocity of money are positive and permanent. A "quantity shock" has positive and permanent effects on the monetary base. Concerning the effects on the velocity of money, a "quantity shock" reduces the velocity of money in the short term and cannot be considered different from zero after 10 months (in terms of the expected value, it is always negative, although it approaches zero over time). In short, money supply policies have clear effects on the interest rate, the monetary base and the velocity of money, while money demand shocks only have a significant effect on the interest rate.

For the second subperiod, 2008:04 to 2013:10, the VAR model has order 6, suggested by the likelihood ratio; thus, we will use the Johansen test with 5 lags (Table 5). The value of α, the adjustment coefficient, is negative; thus, the process is stationary. This model presents problems of autocorrelation of order 1 (last line of Table A.2 in the Annex).

Tables A.10, A.11, and A.12 in the Annex include the variance decomposition of the variables in the VECM. The fact that LMB and Lv have shares of 70% and 2.9%, respectively, in the explanation of R is explained by the period under analysis. QE policy is a combination of an increase in the monetary base and a decrease in the interest rate; the relatively lower velocity of money has a reduced impact on the evolution of interest rates. The money velocity has also a reduced impact on the evolution of the monetary base (Table A.11). The variance of this last variable is explained by the interest rate (14%) and by itself (85%). The variance of the velocity of money is explained almost in equal parts by itself and by the monetary base (Table A.12). It is also important to highlight the fact that R

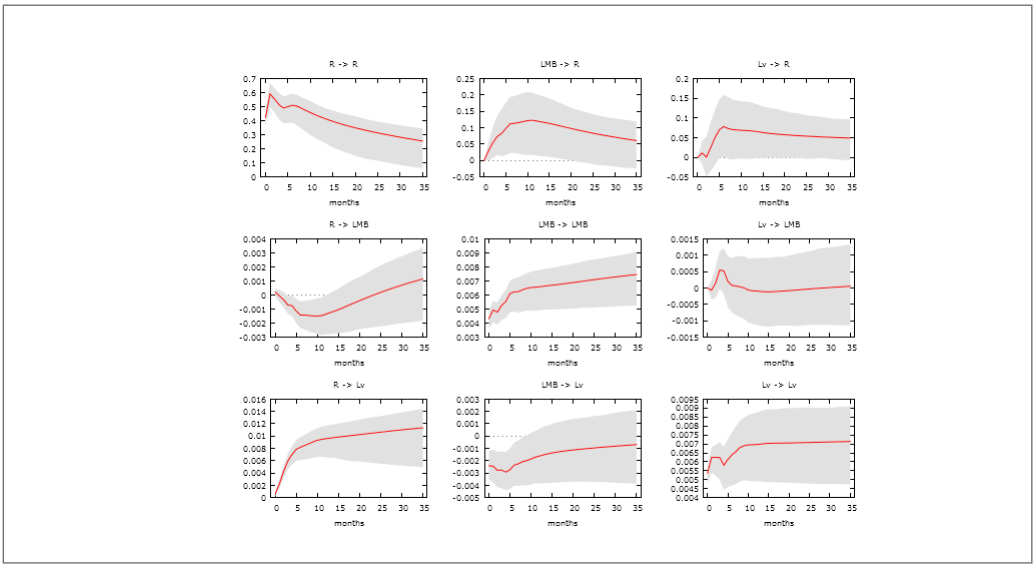

Figure 5. Money supply and money demand shocks (VECM – 1st subperiod)

Table 5. Johansen Test: Lag order =5, 2008:04 – 2013:09, Unrestricted constant

Rank	Trace test	Lmax text	Trace test (C)
0	33.25**	24.70**	33.25**
1	8.55	8.53	8.55
2	0.021	0.021	0.021

Note: The last column refers to the trace test corrected for sample size (df=566).

loses explanatory power on Lv, which may be an indicator of a possible ineffectiveness of the MP during the crisis period. Finally, the model is stable since the associated roots lie inside the unit circle (Figure A.2 in the Annex).

As in the previous subperiod analysis, it appears (Figure 6) that a "price shock" has a positive effect on Lv (though not different from zero after 4 months). A "quantity shock" has a negative effect on R for 3 months. A "quantity shock" also has a permanent and positive effect on the variable itself and a negative effect on Lv (although after approximately 2 months, this effect is not different from zero). In short, in terms of monetary policy, a "price shock" or a "quantity shock" are ineffective since they have no significant impact on LMB and Lv. Finally, money demand shocks do not significantly affect R or LMB; however, their own degree of inertia is very high.

Thus, as we have already confirmed with the VAR model, we confirm that monetary policy does not exert significant effects on a nonbanking economy in the second period under analysis, unlike what happened in the first. This second period is likely to be identified as an LT period.

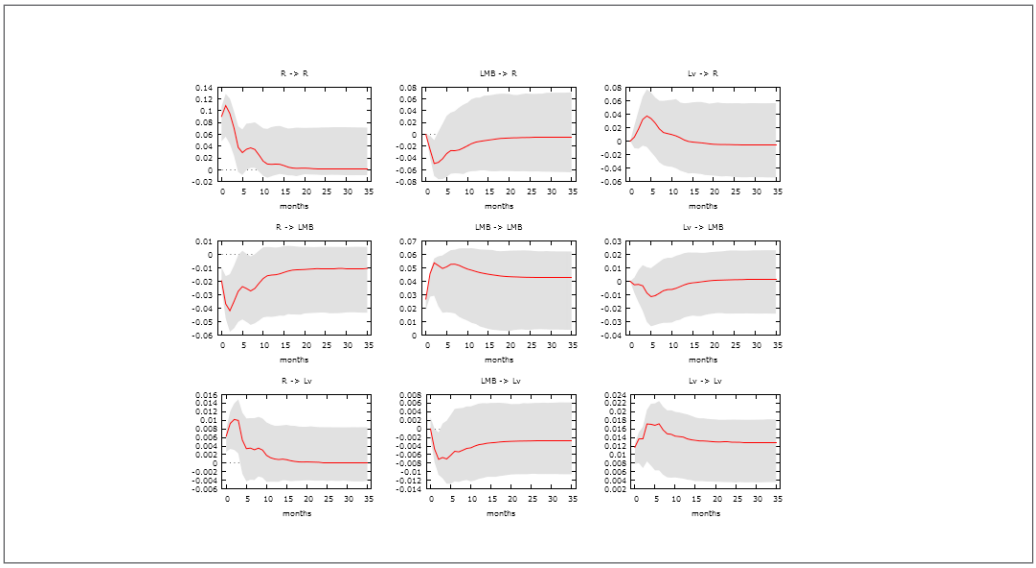

Figure 6. Money supply and money demand shocks (Model B – 2nd subperiod)

4. Conclusion

The focus of this paper is to understand the LT as a phenomenon based on the supply of money and not as a phenomenon based on the demand for money. In other words, we face a "banking problem" in a credit-money economy in the sense that banks do not lend to firms and individuals; thus, the supply of money cannot increase. They act as though they have an absolute preference for central bank money. We started with the definition of LT since its inception in the Keynesian literature to the more recent definitions. We also discussed the consequences of the usual definition and some of the LT episodes. An understanding of the LT should enable monetary authorities to escape its vicious circle. Contrary to the common view that bases the phenomenon of an LT on the demand for money, we claim that it should be envisaged as a money supply rupture.

To test our thesis about LTs, we have looked at the new QE policy adopted by the Fed and its effects on the U.S. economy. We have divided the period of study (1959:01 to 2013:10) into a "normal period" (1959:01 to 2008:03) and a "crisis period" (2008:04 to 2013:12). This last period is identified as having the characteristics of an LT episode. We demonstrate that the decrease of the income velocity of money is important; however, it is far from the almost-zero value predicted by the traditional and current definition. The most important element of an LT is not the evolution of the income velocity of money but the evolution of the money multiplier because of the bank lending behavior; the monetary base is not transformed in money supply.

We have built a VAR model to analyze the evolution of the monetary base and the money supply. For the first period, we prove the exogeneity of the money supply and the null effect of the demand for money over the monetary base. In the second period, a shock to the money supply quickly cancels its effects on M1, and money demand shocks permanently affect the monetary base. The relevant conclusion from this model is that the ineffectiveness of money supply shocks in the current situation from 2008:04 to the present confirm our thesis about the LT.

We have also studied a monetary equilibrium model with short- and long-term relationships between the interest rate (Federal Funds Rate), the monetary base and the income velocity of money. These variables are cointegrated of order 1; thus, we use a VECM model to simulate shocks in the two selected subperiods. Dur-

ing the normal period, the effects of a monetary "price shock" are positive and permanent on the income velocity of money, and a "quantitative shock" has permanent effects on the monetary base. Summarizing our results, money supply policies have clear effects on the interest rate, the monetary base and the income velocity of money, and money demand shocks only have significant effects on the interest rate. The same type of model for the period after 2008:4 yields very different results. A monetary policy "price shock" or a "quantity shock" is ineffective, since they have no significant impact on the monetary base or on the income velocity of money. Money demand shocks do not significantly affect the interest rate or the monetary base. Instead, they exhibit a high level of inertia on themselves. These shock behaviors are also a confirmation of our thesis concerning the lending activity of banks in normal situations and in an LT situation.

Our thesis about the LT considers the banking sector the central problem that might explain it. Banks can create money, but they do not simply do so because they consider that there is no acceptable level of risk from bank credit demand. The creation of inflation expectations as a means of originating incentives for bank borrowing has to be compatible with money supply targets, and these expectations should be realistic, showing adequacy to banking lending. Theoretically, there is another means to increase inflation expectations through government expenditures; however, this latter possibility is not practicable. Almost everywhere, governments are constrained by high levels of indebtedness, which is a serious impediment to exerting their function of spender of last resort.

The greatest limitation of this paper is that we have applied our thesis to only one economy, the USA. In future research, we intend to extend the empirical study about the money supply to the UK and EMU for the period before and after the beginning of the subprime crisis, aiming to also confirm our thesis for these two economies. Additionally, we will address in the framework of the aforementioned empirical study the role of different non-conventional monetary policy measures and of financial regulation.

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Endnotes

[1] *The complete phrase is, "This situation that plays such an important role in Keynes's General Theory will be referred to as the 'Keynesian case'".*

[2] *We only cite a representative paper.*

[3] *Some suggestive examples include "hiring people to dig ditches and fill them up or construct defenses against imaginary alien invasions, to use two classic examples. It also can represent destruction of capital or technological regress – throwing away ATM machines to employ bank tellers, idling bulldozers to employ people with shovels, or even spoons, breaking glass or welcoming hurricanes, to use classic examples."*

[4] *With the exception of direct purchases of private bonds.*

[5] *For all figures with impulse responses, the shadow area corresponds to 90% confidence intervals calculated by bootstrap simulation.*

Appendix

Table A1. Unit root tests

Variable	Det.	L	ADF		1	KPSS	
LYR	C	11	-2.11		6	9.42	***
d_LYR	C+T	12	-5.31	***	6	0.06	
R		9	-1.28		6	2.54	
d_R		10	-6.39	***	6	0.12	***
LP	C	12	-1.44		6	9.35	
d_LP	C	11	-3.20	**	6	1.48	
LMB		12	6.37		6	9.28	
d_LMB	C+T	6	-10.31	***	6	0.10	***
LM1		6	5.08		6	9.38	
d_LM1	C+T	5	-6.92	***	6	0.19	*
Lv	C+T	1	2.27		6	1.66	
d_Lv	C+T	1	-17.2	***	6	0.29	
Lm	C+T	2	-1.48		6	1.01	
d_Lm	C+T	1	-14.71	***	6	0.05	***

Note: Det. = "deterministic variables", l = the lag used for ADF and KPSS the truncated parameter. The stars have the usual meaning for ADF and for KPSS; *** = a P-Value less than the critical value at 10%, ** = the same for 5%, * = for 1%.

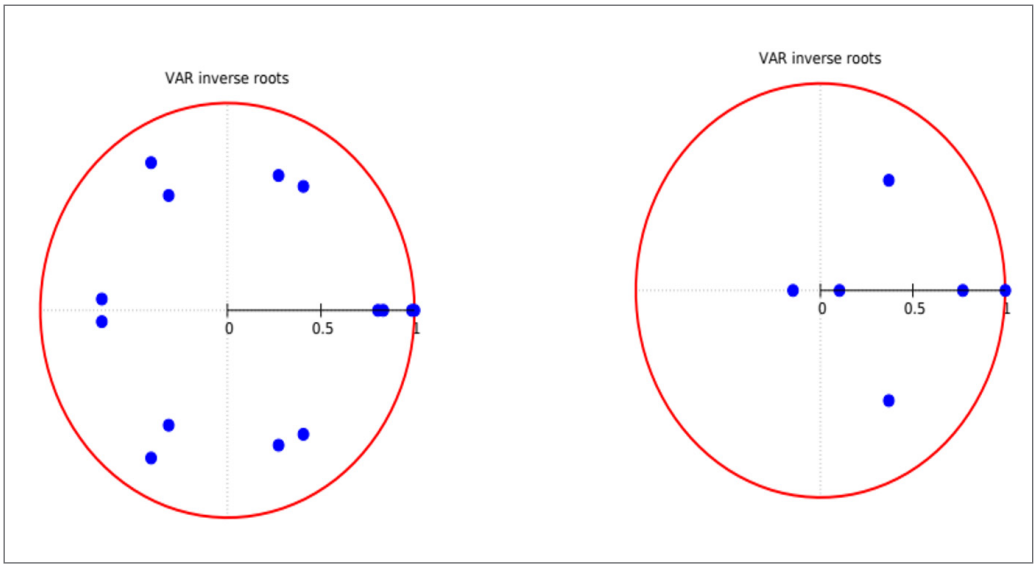

Figure A.1. First and second VAR models

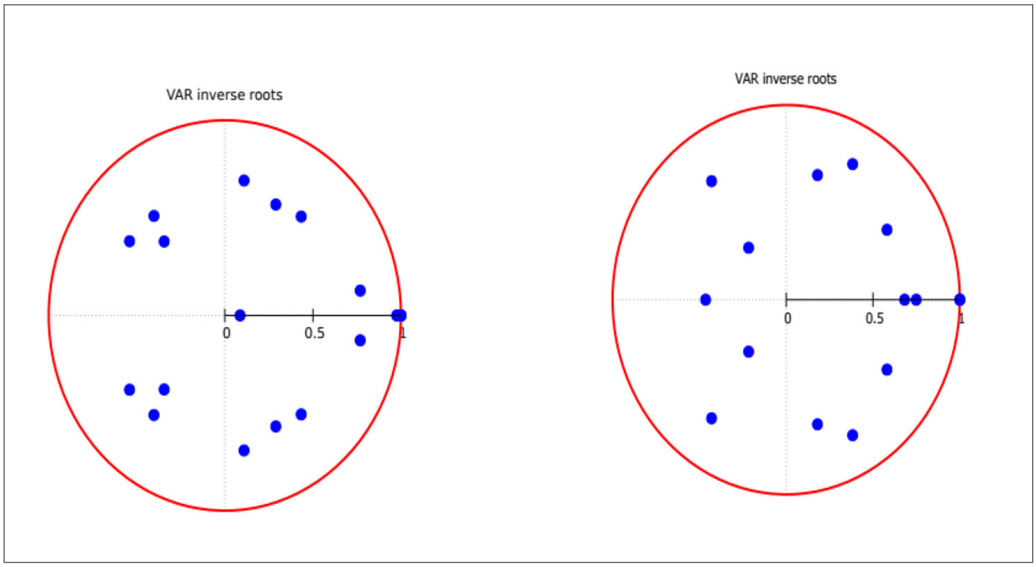

Figure A.2. First and second VECM models

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Table A.2. Tests of autocorrelation of order 1

Model	B-G Chi-squared test	DF	P-Value
1st VAR	1.06	4	0.90
2nd VAR	7.49	4	0.11
1st VECM	12.35	9	0.19
2nd VECM	17.64	9	0.04

Note: B-G = the Breuch-Godfrey chi-squared test value for the null of no-autocorrelation; DF = the number of degrees of freedom.

Table A.3. Variance decomposition for LMB (VAR – 1st subperiod)

Period	Standard error	LMB	LM1
1	0.004	100.00	0.00
12	0.022	97.71	2.29
24	0.036	95.26	4.74
36	0.047	93.19	6.81

Table A.4. Variance decomposition for LM1 (VAR – 1st subperiod)

Period	Standard error	LMB	LM1
1	0.005	29.16	70.84
12	0.028	33.04	66.96
24	0.044	35.33	64.67
36	0.055	37.08	62.92

Table A.5. Variance decomposition for LMB (VAR – 2nd subperiod)

Period	Standard error	LMB	LM1
1	0.030	100.00	0.00
12	0.081	85.99	14.01
24	0.097	61.26	38.74
36	0.111	46.67	53.33

Table A.6. Variance decomposition for LM1 (VAR – 2nd subperiod)

Period	Standard error	LMB	LM1
1	0.014	1.23	98.77
12	0.048	2.44	97.56
24	0.071	1.23	98.77
36	0.088	0.86	99.14

Table A.7. Variance decomposition for R (VECM – 1st subperiod)

Period	Standard error	R	LMB	Lv
1	0.405	100.00	0.00	0.0000
12	1.601	88.74	2.26	9.0021
24	2.068	83.52	4.35	12.1286
36	2.319	81.63	5.23	13.1393

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Table A.8. Variance decomposition for LMB (VECM – 1st subperiod)

Period	Standard error	R	LMB	Lv
1	0.004	0.17	99.83	0.00
12	0.021	3.68	96.17	0.15
24	0.033	2.42	97.46	0.12
36	0.043	1.57	98.32	0.11

Table A.9. Variance decomposition for Lv (VECM – 1st subperiod)

Period	Standard error	R	LMB	Lv
1	0.006	0.88	17.31	81.81
12	0.036	39.53	6.80	53.67
24	0.059	41.16	3.92	53.67
36	0.077	42.32	2.79	54.89

Table A.10. Variance decomposition for R (VECM – 2nd subperiod)

Period	Standard error	R	LMB	Lv
1	0.113	100.00	0.0000	0.0000
12	0.386	40.53	58.1930	1.2785
24	0.524	30.93	66.6899	2.3785
36	0.633	27.30	69.8239	2.8777

Table A.11. Variance decomposition for LMB (VECM – 2nd subperiod)

Period	Standard error	R	LMB	Lv
1	0.0343501	20.9383	79.0617	0.0000
12	0.259556	16.2417	83.0042	0.7541
24	0.387668	14.3206	84.9402	0.7393
36	0.482921	13.7409	85.5314	0.7277

Table A.12. Variance decomposition for Lv (VECM – 2nd subperiod)

Period	Standard error	R	LMB	Lv
1	0.0129823	12.0495	3.8009	84.1496
12	0.074697	2.1950	47.2433	50.5617
24	0.107678	1.1501	49.7129	49.1370
36	0.132694	0.8167	50.5285	48.6548