US Banks' Behavior since Lehman's Collapse, Bailout Uncertainty and the Timing of Exit Strategies

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ABSTRACT

This paper documents a dramatic post-Lehman slowdown in the rate of growth of US banking credit and in net new bond issues in spite of a huge accumulation of banks' reserves at the Fed. Appealing to results in a theoretical background paper the credit arrest in the immediate aftermath of Lehman's collapse is explained in terms of a short term shift in banks' and bond holders portofolios due to an increase in bailout uncertainty triggered by the Lehman event. The strong persistence of this phenomenon is explained in terms of a more persistent increased probabilistic awareness to low bailout probabilities (or, equivalently an increase in uncertainty aversion) within a multiple priors framework. This point of view explains why, in spite of a huge expansion of the monetary base, inflation has been so low since Lehman's collapse.

Since the Lehman's event cummulative base money in the US expanded at a rate similar to the cumulative rate of increase of base money through more than half of the post WWI German hyperinflation. During the six years between September 2008 and September 2014 cumulative inflation in the US has been a bit over **twelve percent** while the cumulative rate of inflation following the **same base money expansion** in Germany led to a **twenty four-fold** cumulative increase in the price level. An important reason for this dramatic difference is that in the US today the Fed's high powered monetary expansion is not translated into credit and new purchases. By contrast in post WWI Germany the monetary expansion was immediately used by government to purchase goods and services. This comparison has important implications for the timing and dosage of exit strategies. In particular it implies that mopping up of liquidity should be directly related to future accelerations in banking credit and in net new bond issues.

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Introduction

The collapse of Lehman Brothers in September 2008 along with the decision not to bail it out is probably the most traumatic financial event of the twenty first century. In the aftermath of the financial panic that ensued the Federal Reserve injected, and is still injecting, huge quantities of liquidity into the US economy. As a matter of fact the cumulative rate of base money growth since that event is similar to the rate of base money expansion through a bit more than half of the 1922-1924 well known German hyperinflation. In Germany this resulted in a twenty four-fold increase in the price level. By contrast the cumulative rate of inflation in the US since Lehman's collapse is a bit over twelve percent.

This dramatic difference in rates of inflation in the face of similar liquidity injections constitutes a challenge to the quantity theory of money and begs for an explanation. The paper argues (and documents the fact) that a substantial part of the explanation is due to the behavior of US banks that chose not to expand credit in spite of the fact that about two thirds of the Fed's gigantic liquidity injections took the form of reserves accumulation at the Fed. More fundamentally, the paper relates this behavior to a, post Lehman, increase in probabilistic awareness about the likelihood that the US government will not bailout the creditors of large delinquent financial institution in the future. A similar argument applies to the behavior of credit flows through the bond market. As a matter of fact, the panic generated by the decision not to bailout Lehman Brothers totally immobilized the flow of net new bond issues between 2008 and 2012. However, when this trauma recedes banks are likely to utilize their huge excess reserves to renew credit expansion and the bond market is likely to rebound.[2] At that point the risks of inflation will increase making it advisable to mop up some of the liquidity in synch with the increase in the flow of total credit. This point of view implies that the evolution of banking credit and of net new bond issues can be used as indicators for the timing and dosage of future exit strategies.

The paper is organized as follows: The first section following this introduction documents the dramatic slowdown in the rate of growth of banking credit and the huge

[2] Although banking credit and net new bond issues experienced partial revivals in 2012 and 2013 respectively there still is substantial uncertainty about the permanence of those changes.

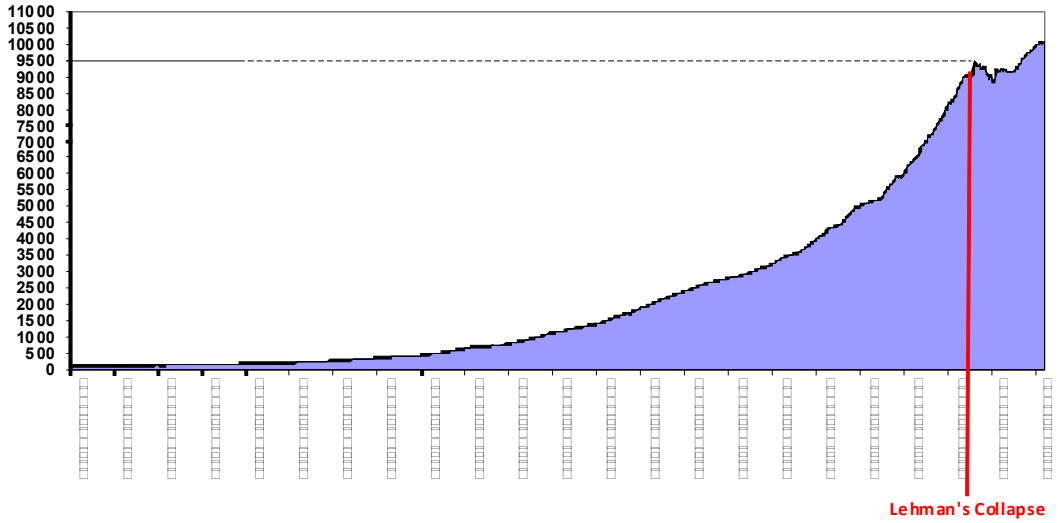
accumulation of banks' reserves at the Fed following the downfall of Lehman Brothers. The second section documents the behavior of net new bond issues before and after the Lehman event. Appealing to results in a theoretical background paper the third section explains the evidence in the two preceding sections in terms of a short term shift in banks' and bond holders portofolios due to an increase in bailout uncertainty in the immediate aftermath of Lehman's collapse. The strong persistence of those two phenomena is explained in terms of an increased probabilistic awareness to low bailout probabilities within a multiple priors framework. Section 4 explores the view that post crisis toughening of banking regulation is behind the persistent slowdown in credit and argues that it is unlikely to directly be the major reason for the post-Lehman anemic credit growth. The results from section 3 are then used, in section 5, to explain why inflation has been and is still well under control in spite of a huge expansion of the monetary base,

Section 6 observs that since the Lehman event cummulative base money in the US expanded at a rate similar to the cumulative rate of increase of base money through about half of the post WWI German hyperinflation. It compares and contrasts the response of inflation to those elevated levels of monetary expansion in the US today and in Germany during the hyperinflation. Section 7 discusses the institutional and other differences between the US today and Germany then that led to those dramatic differences. Based on this it argues that, although the quantity theory of money is a good starting point for understanding the relation between money and prices, there are other important factors. Implications for the timing and dosage of exit strategies are discussed in section 8. In particular it is suggested that mopping up of liquidity should be directly related to future accelerations in banking credit and in net new bond issues. This is followed by concluding remarks.

1. Evidence on banking credit and reserves holdings before and after Lehman's collapse

There has been a dramatic shift in the behavior of the US banking system in terms of both credit growth and reserves' accumulation since the collapse of Lehman Brothers in September 2008. . Between January 1947 and August 2008, total US banking credit expanded at an average yearly compound rate of 7.15%. Since Lehman's collapse until June 2011, this rate dropped to a mere 0.65% – about one tenth - of its previous normal

Figure 1: Total US commercial banks' credit (Billions of $): January 1947- August 2013



Source: Cukierman (2013), "Monetary policy and institution before, during, and after the global financial crisis", **Journal of Financial Stability**, 9, 373-384

long-term rate of growth.[3] Credit growth temporarily picked up to 5.22% between July 2011 and December 2012 but slowed back down to 0.76% between January and August of 2013. Figure 1 illustrates this dramatic change in the behavior of US banking credit prior to and after the downfall of Lehman Brothers. The figure clearly shows that, after increasing rapidly between the early eighties and mid-2008, credit expansion decelerated sharply after September 2008.

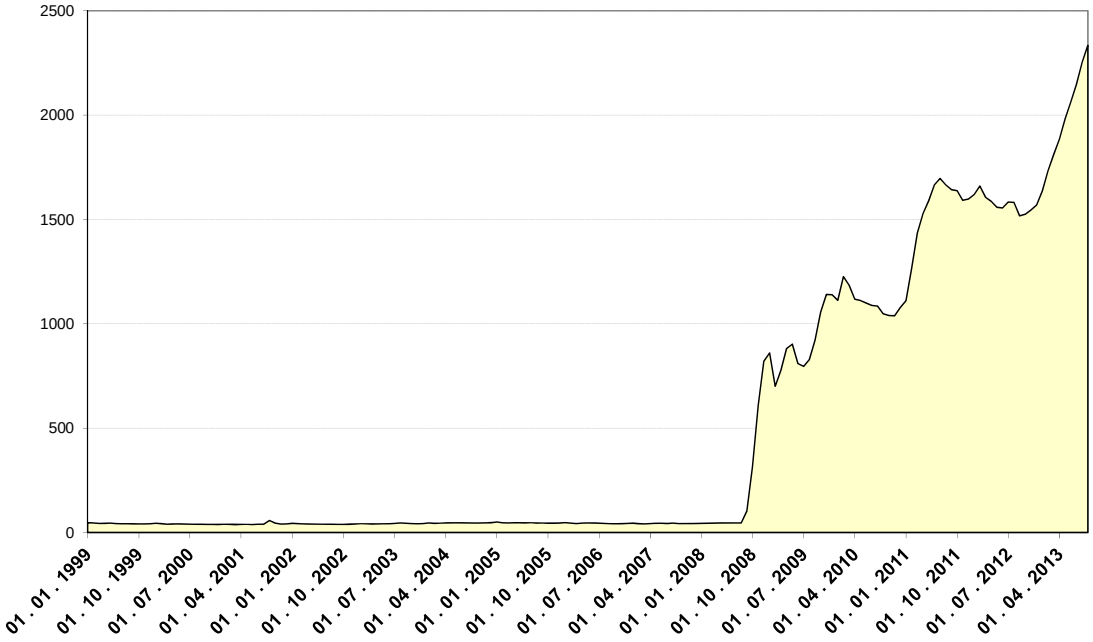
An even more dramatic break – before and after September 2008 – can be observed in the behavior of total US bank reserves. Their annual long-term normal rate of

[3] It even shrank by over 3.5% during 2009.

increase between January 1999 and August 2008 is about half a percent. After the Lehman event and up to April 2011, this annual rate accelerated to 100%. Figure 2 shows the accumulation of US banks reserves after September 2008. At the end of August 2008, total banking reserves stood at about $ 46 billion. A year later they were eighteen times larger!!! They did decline moderately during the second half of 2010 and then increased again by about sixty percent till the end of April 2012. In spite of this, largely policy induced, increase in reserves the rate of growth of banking credit remained anemic.

Another way to appreciate the magnitude of the change in the behavior of US banks prior to and after the Lehman event is to compare the ratio between their total reserves and their total credit before and after this event. For a sustained period of time and up to August 31 2008, this ratio did not deviate much from half a percent. As illustrated in Figure 3, it shot up dramatically immediately following Lehman's demise reaching 12.62 percent on November 30, 2009 (a twenty four fold increase in the ratio). Thus, in spite of a huge policy induced increase in reserves post Lehman banking credit growth was minimal and even negative in 2009. In terms of reviving the growth of banking credit the quantitative easing operations of the Fed were basically "pushing on a string".

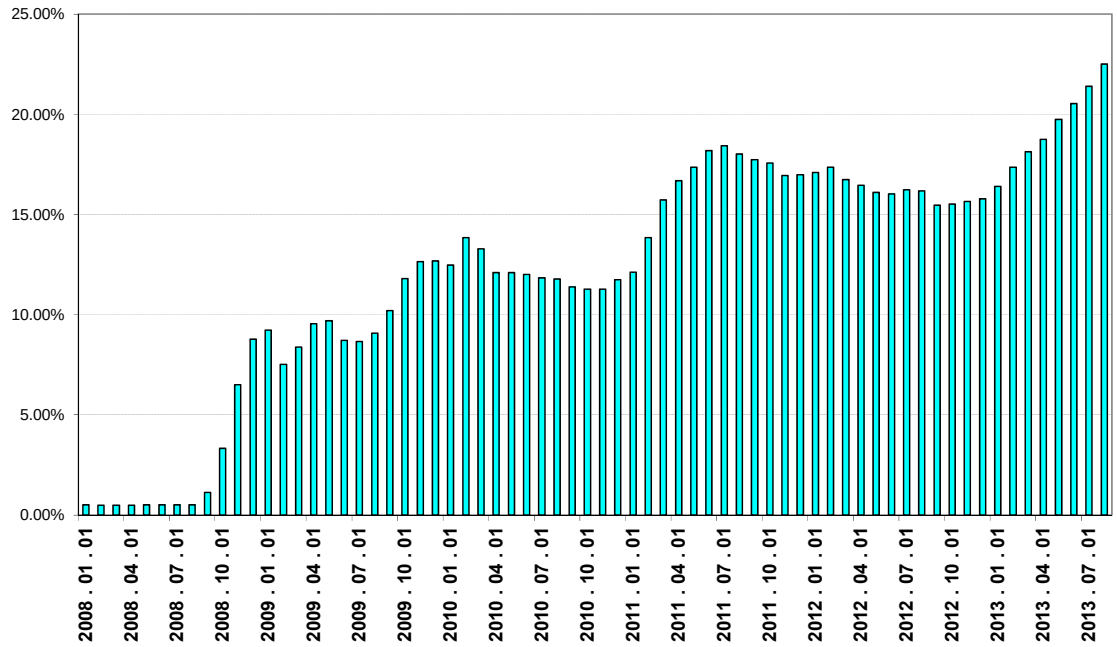
Figure 2: Total Reserves of US Depository Institutions
(Billions of $)



Source: Federal Reserve Website

Those figures suggest that Lehman's downfall marks a watershed in the behavior of US banks raising a fundamental conceptual question about the reasons for the shift. In view of the Fed's actions and the general political climate prior to the collapse it is not hard to support the argument that the decision not to bailout Lehman was a surprise that increased bailout uncertainty in the immediate aftermath of the collapse. In conjunction with aversion to bailout uncertainty on the part of banks this argument can explain the reluctance of US banks to lend during the initial post Lehman period. But, in view of the subsequent demonstration, by both the US government and the Fed, of the resolve to avoid a repetition of Lehman's type events it is harder to explain the **persistence** of banks cautious behavior since then. This issue is taken up in section 3.

Figure 3: Total reserves as a percent of total banking credit in the US commercial banking system: January 2008- August 2013



Source: Bloomberg - Ticker: ALCBBKCR Index and Federal Reserve Website

2. Evidence on total net new credit flows before and after Lehman's collapse

A substantial part of credit flows in the US occurs through bond issues in the capital market.[4] This section complements the banking credit evidence in the previous section by presenting data on total new credit flows via the banking system as well as through the US bond market. Figure 4 shows the yearly volumes of total, net of redemptions, new bond issues excluding treasury bills (in pink) and net new banking credit flows (in blue). The yearly data in the Figure highlights the huge decline that occurred in total net new credit between 2007 and 2008. Most of this decline is due to the collapse in net new issues of bonds that went down from over 2.5 trillion $ in 2007 to a small negative number in 2008. Net new banking credit also experienced a serious decrease of "only" 47 percent between those two years but managed to remain positive.

[4] The stock of US private bonds is about three times larger than the stock of banking credit. Further detail appears in section 5 of Cukierman (2014).

However, in 2009 both net new bond issues as well as net new banking credit were in negative territory.

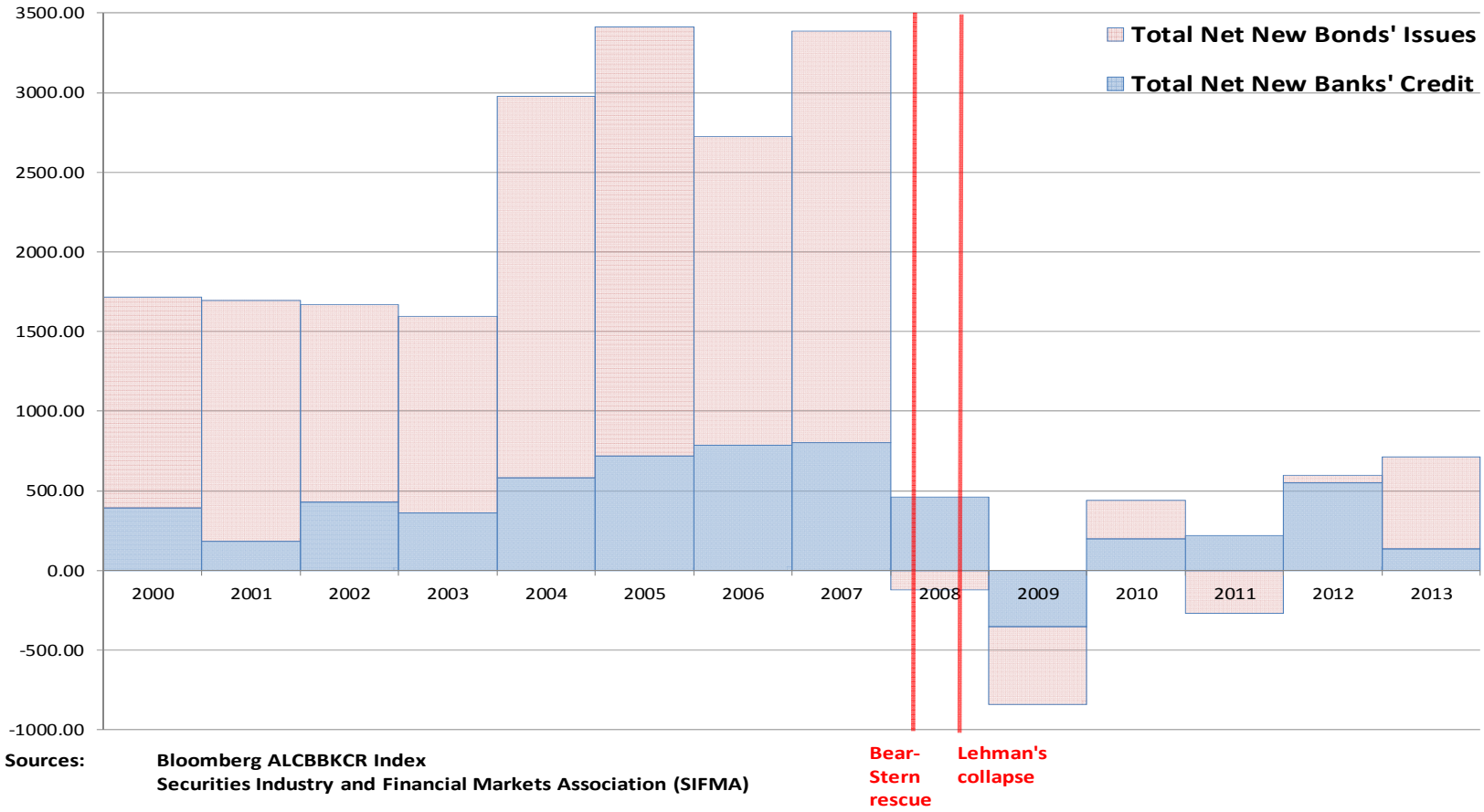
Thus, the collapse of capital market credit preceded that of banking credit by up to a year. It appears, therefore, that events like Bear-Stern's partial rescue and sale to JP Morgan Chase in March 2008 along with a sequence of downgrades by rating agencies during the second half of 2007 had an earlier impact on credit through the capital market than on banking credit. Although banking credit picked up during 2012 this revival subsided in 2013. Capital market credit experienced a modest revival in 2013 but is still substantially lower in comparison to the pre-crisis years.

Figure 4 suggest that the slowdown in total net new credit is rather persistent. In particular, the data shows that over the five years following the decision not to bailout Lehman total net new credit from both banks and the capital market was essentially zero. Even if we exclude 2009 and 2010 and focus on total net new credit over 2011-2013 total average net new credit is a meager 117 billions per year. The average corresponding figure over the 2000-2003 period, that preceded the great credit acceleration during the buildup of the subprime credit bubble, is 1327 billions per year. Thus, even several years after the coup-de-grace dealt by the Lehman event total new credit in the US is still less than ten percent of what it used to be in non bubbly years.[5]

[5] Interestingly, over the 2009-2013 period the share of banking credit rose to uncharachteristically high levels for the US.

Figure 4: Total Net New Banks' Credit + Bonds' Issues - US

(Billions of $)



Sources: **Bloomberg ALCBBKCR Index**
Securities Industry and Financial Markets Association (SIFMA)

3. Persistent changes in probabilistic awareness and/or in ambiguity aversion as an explanation for the persistent shift in the portofolio of US banks

This section develops the argument that the persistent slowdown in both net new bond issues and net new banking credit is consistent with the view that the Lehman event induced a persistent increase in banks' probabilistic awareness to the possibility that even systemically important financial institutions (SIFI) will not always be bailed out.[6] The starting point of the analysis is that prior to the crisis banks and other financial markets participants, like pension funds, believed that, in case of financial difficulties, there is a positive probability of bailout. However they were not certain in the Knightian sense about the likelihood of such bailouts.

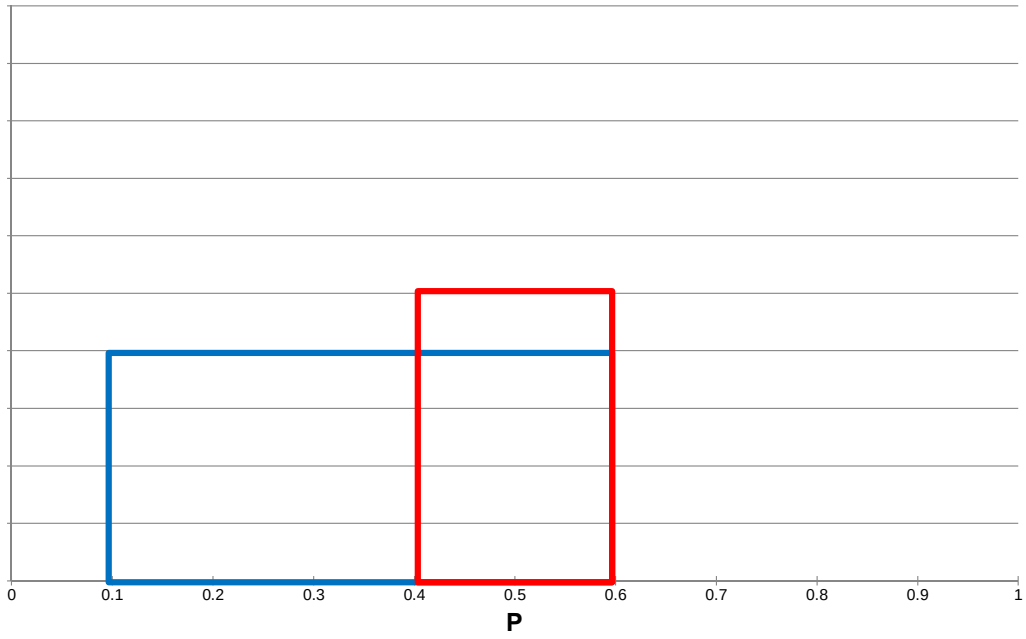
Following Cukierman and Izhakian (2014) (CI in the sequel) bailout uncertainty is modeled by using the multiple prior framework proposed by Gilboa and Schmeidler (1989). In this framework subjective bailout **risk** is captured by postulating that there exists a **single** probability, P, that in case of insolvency on the part of a bank government (G) or the central bank (CB) will pay the bank's debt to creditors. Subjective **uncertainty** about bailouts is introduced by assuming that banks and other financial market participants are not certain about the probability, P, of a bailout and entertain the view that there is a whole range of apriori bailout probabilities with positive mass.[7]

An increase in bailout uncertainty is then modeled as an expansion of the set of binomial multiple priors distributions. To illustrate, suppose that prior to Lehman's downfall markets believed that the possible range of P is between 0.4 and 0.6. so that all other bailout probabilities were considered to be irrelevant. A post Lehman increase in bailout uncertainty can then be modeled as an expansion of the set of P's with positive mass to (say) the range between 0.1 and 0.6. This is illustrated in Figure 5. More generally I will refer to sets of bailout probabilities with non zero mass as sets to which

[6] A precise definition of the term "probabilistic awareness" appears later in this section.
[7] Hansen and Sargent (2008) use the idea of multiple priors to explore the consequences of parameter uncertainty for the behavior of the economy.

individuals are **probabilistically aware** to.[8] Using this terminology we can refer to an increase in the set of multiple priors as an **increase in probabilistic awareness**.

Figure 5: Example of a Downward Expansion of the set of Multiple Prior Bailout Probabilities



Based on a set of axioms similar to those postulated by Von Neuman-Morgenstern to derive the expected utility theorem Gilboa and Schmeidler (1989) show that, when faced with multiple priors, individuals should choose the best action against the worst possible distribution (the Maxmin criterion). Continuing the preceding illustration this means, within the CI framework, that prior to the Lehman event creditors maximized expected utility as if bailout probability was 0.4, and after it, as if it was 0.1. CI explore the implications of such a change within a 3 sectors general equilibrium model of the financial system and show that it leads to a general contraction of credit, a

[8] The adjective "probabilistic" is needed in order to distinguish it from the term "awareness" in modern decision theory. The latter refers to states of natures that individuals know might realize as opposed to states they are completely unware of like Taleb's (2007) black swans prior to their discovery in Australia. Although Figure 5 assumes for simplicity that the distributions of binomial bailout probabilities both before and after Lehman's collapse are uniform the arguments in the text do not depend on the particular form of those distributions. .

general increase in borrowing rates and in extreme cases to total credit arrest.

Interestingly, modern decision theory implies that an expansion of the set of multiple priors can occur either because bailout uncertainty has increased, because the aversion to this uncertainty has increased or because of a combination of both factors. Thus, beliefs are not the sole determinant of an individual's subjective set of priors. His attitude toward bailout uncertainty may also matters. In particular, suppose two individuals share the same subjective information, i.e., they both believe the same set of bailout probabilities are possible. Then modern decision theory implies that the set of multiple priors of the less ambiguity averse individual is a subset of the set of multiple priors of the more ambiguity averse individual (Theorem 17-(ii) in Ghirardato and Marinacci (2002) and Klibanoff, Marinacci and Mukerji (2005), page 1872).

Within the context of the CI result this implies, that credit contraction following Lehman's downfall may be due to either an increase in uncertainty about P. or to an increase in aversion to this uncertainty, or to both factors. Modern decision theory refers to uncertainty about the relevant distributions as "ambiguity" and to aversion to such uncertainty as "ambiguity aversion". When individuals are indifferent to ambiguity the multiple priors framework can be collapsed to a single probability distribution by compounding. But in all other cases behavior may generally depend on both ambiguity and ambiguity aversion.

Suppose now, taking the CI analysis as a point of departure, that the initial consequence of Lehman's collapse was to raise both bailout ambiguity as well as the aversion to this ambiguity. On top of making individuals and banks more aware about their level of ignorance this event also raised their aversion to this ignorance. Bailout probability distributions that were effectively given zero mass prior to the collapse were catapulted into the forefront of individuals' probabilistic awareness and led them to behave more cautiously. However, in view of the subsequent policy reactions of the US government and the Fed it should have gradually become clear to the public that those institutions will go to great lengths to prevent the recurrence of a Lehman type event. It therefore appears reasonable to believe that, within a year or two after this event bailout ambiguity receded possibly to levels similar to those that existed in the pre-Lehman's era.

However this supposition is inconsistent with the persistent slowdown in the rate of growth of banking credit and the persistently elevated reserve ratio.

A possible resolution of this seeming puzzle is that the increase in ambiguity aversion triggered by Lehman's collapse is likely to persist long after bailout ambiguity (or uncertainty) has returned to its previous level. The impact of a largely unanticipated traumatic event to which individuals were probabilistically unaware to prior to the event is likely to permanently enlarge the set of multiple priors and with it the probabilistic awareness (or belief) that low probabilities of bailout are possible.

This is reminiscent of the Psycholgical literature that deals with Post Traumatic Stress Disorder (PTSD). A PTSD is an anxiety disorder that may develop if a person encounters an unexpected extreme traumatic stressor such as war personal assault, confinement or a severe car accident (Javidi and Yadollahie (2012)). Although they need not result in deep psychological disorders, dramatic economic events such as Lehman's collapse are likely to permanently alter individuals probabilistic beliefs in a pessimistic direction. The high visibility of Lehman's event implies that most if not all financial market participants are likely to have been affected.

This idea may be restated in terms of modern decision theory as follows: Following the Lehman's event the probabilistic awareness of individuals to low bailout probabilities permanently increased and this led to a permanent enlargement of the set of multiple bailout probabilities toward lower bailout probabilities. This point of view may be more acceptable to mainstream economic thinking since it attributes the change in the set of multiple priors to a change in beliefs rather than to a change in attitudes toward ambiguity.

While, dramatic unexpected events like Lehman's downfall are likely to immediately raise the probabilistic awareness of individuals to the relevance of low bailout probabilities. the return (if any) to previous, less pessimistic, levels of probabilistic awareness following appropriate reforms is likely to be sluggish. The implications of this view for the timing of exit strategies are explored later.

Economists are generally loathe of explaining behavior in terms of changes in preferences. However, following largely unanticipated traumatic public events this tendency may blind the profession to important dynamic elements of reality. This

statement is true in general as well as in the particular case of ambiguity aversion. An example from a completely different area provides an illustration of this claim. According to the Non-Life Insurance Rating Organization of Japan (NLIRO) stricken Fukushima prefecture, bearing the brunt of the huge earthquake and tsunami that devastated the region at the beginning of 2011, saw rates of new earthquake insurance coverage increase almost threefold in the aftermath of the earthquake (Majirox news, August 24 2011). Provided this event did not appreciably change the beliefs of individuals about the objective probability distribution of such events this evidence is consistent with the view that, following the trauma caused by the tsunami, the set of multiple priors concerning such events expanded mainly because of an increase in ambiguity aversion rather than in ambiguity. The analogy to the Lehman's event should be self explanatory.

4. Post crisis toughening of capital requirements and changes in probabilistic awareness to low bailout probabilities as explanations for the persistence of credit arrest

Another possible explanation for the large and persistent credit arrest documented in section 2 is that regulatory tightening of capital requirements (CAR) in the post-crisis era became a binding constraint on credit expansion making the existence of huge excess reserves irrelevant. Although this argument may have some merit it is unlikely to be the main reason for the post-crisis credit arrest for several reasons. First, CAR are directly relevant only for the banking system while, as documented in Figure 4, credit arrest engulfed banks as well as the capital market. Second, regulatory changes cannot provide an explanation for credit arrest in the first two to three years following Lehman's collapse. The Dodd-Frank Act was enacted only in 2010 and significant changes in the US regulatory capital framework were introduced only after mid 2012.

Third, the recent tightening of CAR through the adoption of a modified version of Basel III CAR by US banking regulators will be phased in only gradually between 2013 and 2017. In addition the US banking system was well capitalized, on average, both before and after the crisis. In 2009, when the required ratio between regulatory capital

and risk weighted assets was 8%, the actual average value of this ratio was around 13%. The corresponding 2009 figures for Tier 1 capital were between 4 and 6 percent for required capital and around 11% for actual capital. Required regular CAR from US banks were recently raised to 10.5% and required Tier 1 capital was raised to 8%. The actual average regular capital ratio in 2013 was a bit over 14% and actual Tier 1 capital was over 12% implying that, even recently, the increase in CAR on US banks has not been a major obstacle to the extension of banking credit.

Finally, during the initial phases of the crisis the Fed injected equity capital into the banking system by buying banks stocks. The fact that banks bought those stocks back within two to three years yields further support to the view that CAR did not constitute a first order hindrance to the extension of banking credit in the post Lehman era. Admittedly it is possible that other aspects of tighter regulation like living wills, stress tests and public discussions about the possibility of "bailins" discouraged the extension of credit by banks as well as through the capital market. But, in a deeper sense, those changes in regulation and in CAR were driven by increased awareness on the part of both politicians and regulators that allowing financial markets to believe that bailouts are likely involves unacceptable systemic risks. On this view some of the persistence in the financial markets' increased awareness to low bailout probabilities can be traced back to post-crisis permanent changes in the regulatory framework.

5. Why is the inflationary impact of the highly expansionary monetary policies since Lehman's collapse so muted?

Since Lehman's collapse the balance sheet of the Fed and high powered money more than tripled. In spite of these huge quantitative easing (QE) operations and a persistently low policy rate at the zero bound US inflations remains low (Details appear in Cukierman (2013)). To believers in a basic version of the quantity theory this might appear surprising at first blush. However, if due to the slowdown in credit growth since the Lehman event higher order monetary stocks like M1 and M2 did not keep up with the growth in high powered money this phenomenon would be more understandable.

Due to the fact that the bulk of QE operations are done through open market purchases of bonds a large part of the liquidity injected by the Fed takes the form of

banking reserves.[9] As shown in previous sections, in spite of this huge accumulation of reserves, banking credit increased very little or not at all breaking the transmission to higher order monetary stocks. Either because of "flight to safety" reasons or because of low demand for credit, or for both reasons the portofolio of the banking system in the post Lehman era dramatically shifted away from the extension of new credit. Essentially, banks passively absorbed the high powered money supplied by the Fed – a phenomenon strongly reminiscent of the textbook liquidity trap. Between Lehman's collapse and May 2014 base money in the US quadrupled. But, due to banks' reluctance to lend, only a fraction of this extraordinary base expansion took the form of increases in higher order monetary stocks. Between June 2008 and September 2013 high powered money (H) increased by 306% while M1 and M2 increased by only 84% and 41% respectively. As a consequence the inflationary impact of this expansion was and still is muted.

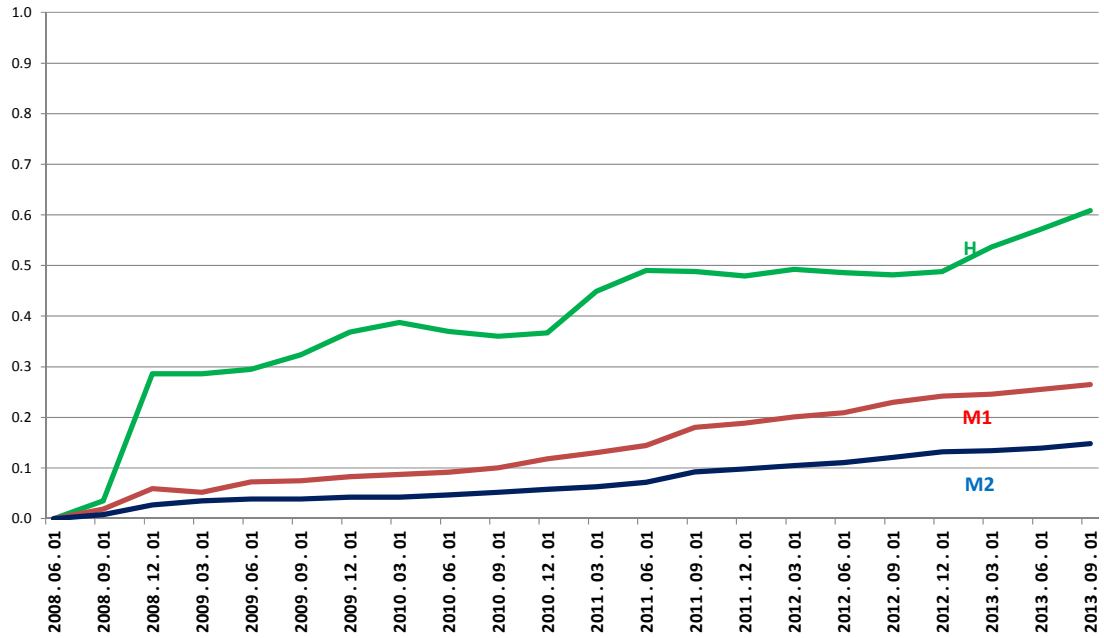
Figure 6 shows the evolution of H, M1 and M2 on a logarithmic scale between June 2008 and September 2013. Since the levels of all three stocks are normalized to 1 in June 2008 the three curves in the figure highlight the differences between the cumulative rates of increase of each of those stocks since that date (note that, since the scale is logarithmic the slope of a curve at each date shows the rate of growth of the stock at that date). The figure dramatizes the fact that, since mid 2008 H expanded much more than either M1 or M2. Interestingly, M1 whose main function is to facilitate transactions, grew more than M2. The relatively slow growth of the latter in comparison to narrow money reflects the public's substitution away from interest bearing asset into M1 due to the very low level of short term interest rates since the end of 2008.

The period since the downfall of Lehman is obviously very special. It is therefore useful to compare the relative behavior of the monetary base, M1 and M2 to their behavior during normal times. To provide such a benchmark Figure 7 replicates Figure 6 in the pre-Lehman collapse era (between December 1999 and June 2008). The first obvious (and previously documented) difference between their behavior before and after the Lehman event is that, in the second period, the monetary base expanded at much higher rates than during normal times. But the most striking observation is that, in spite

[9] By contrast the ECB injects liquidity mainly through self liquidating repos. The consequences of those different policy procedures for the behavior of banking reserves are explored in Cukierman (2014).

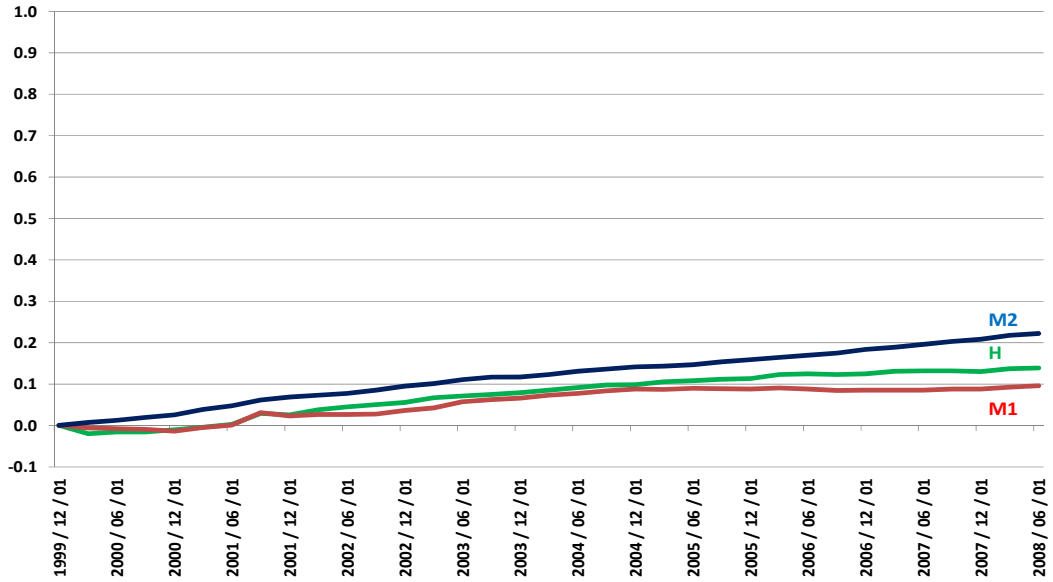
of the huge difference in the rate of growth of the base, between the two periods, the rates of growth of M1 and M2 are not too different across the two periods This observation goes a long way to explain the tameness of inflation in the face of highly expansionary monetary policies. Also during the normal period M2 expanded more than either the monetary base and narrow money and the latter expanded at the smallest rate. This ranking reflects the higher levels of confidence in the financial system and the higher interest rates that prevailed in the benchmark normal period.

Figure 6: Evolution of the Monetary Base (H), Narrow Money (M1) and M2 since Lehman's Collapse – Logarithmic Scale



Source: Federal Reserve Bank of St Louis Data Base

Figure 7: Evolution of the Monetary Base (H), Narrow Money (M1) and M2 between 31/12/1999 and 30/06/2008 – Logarithmic Scale



Source: Federal Reserve Bank of St Louis Data Base

6. A comparison of monetary expansion and inflation since Lehman collapse with monetary expansion and inflation during the German hyperinflation of the nineteen-twenties

The well known German post WWI hyperinflation between 1921 and 1923 provides one of the most dramatic pieces of evidence in support of Milton Friedman's famous dictum that inflation is always and everywhere a monetary phenomenon.[10] As a matter of fact the cumulative rate of base money expansion in the US between Lehman's collapse and September 2014 is of the same order of magnitude as the cumulative rate of German base money expansion during a bit over the first half of the hyperinflation.

The thinking of policymakers and economists who worry that the exceptional sequence of quantitative easing operations conducted by the Fed since Lehman's collapse will eventually spark the fires of inflation goes back to the lessons learned from episodes such as the German hyperinflation. It is therefore instructive to compare and contrast the recent monetary expansions and inflationary experiences since the Lehman event in the

[10] Based on extensive data for this period Bresciani-Turroni (1937) argues that the main driver of the German hyperinflation was the persistently high rate of monetary expansion.

US and during the German hyperinflation, and identify the similarities and differences between those two periods.

Figure 8 displays the evolution of high powered money and inflation in the US starting in September 2008 till September 2014 and in Germany starting from December 1920. The values of the monetary bases and of the price levels in both the US and Germany are normalized to 100 at the beginning of each of those two periods in order to provide a common comparison scale for the two episodes. [11] For the same reason the initial periods of the two episodes are located at the **same** extreme left hand sides of the horizontal axis where the chronological dates for the US are displayed on the lower horizontal axis and those for Germany on the upper horizontal axis.

Between September 2008 and September 2014 base money in the US increased by a factor of 4.35 (435%). In order to compare the inflationary consequences of the **same** monetary expansion in today's US with those of the German hyperinflation 90 years ago the German data is truncated when the cumulative rate of base money expansion equals that of the US between September 2008 and September 2014. This occurs in September 1922 which is about 15 months prior to the end of the hyperinflation. The figure essentially replaces chronological time with time units anchored on identical rates of monetary expansion.

The blue and red lines in Figure 8 refer to the US and Germany respectively. The solid lines stand for the evolutions of the base money stocks and the dashed lines for the evolution of the price levels all in comparison to their respective base periods. Consequently a point on any of the curves shows by how much high powered money or the price level have increased in comparison to their common base period. Figure 9 is a replication of Figure 8 for the logarithms of the four indices.[12] The advantage of the logarithmic scale is that it makes it possible to better visualize small differences between the curves without loss of the entire perspective.

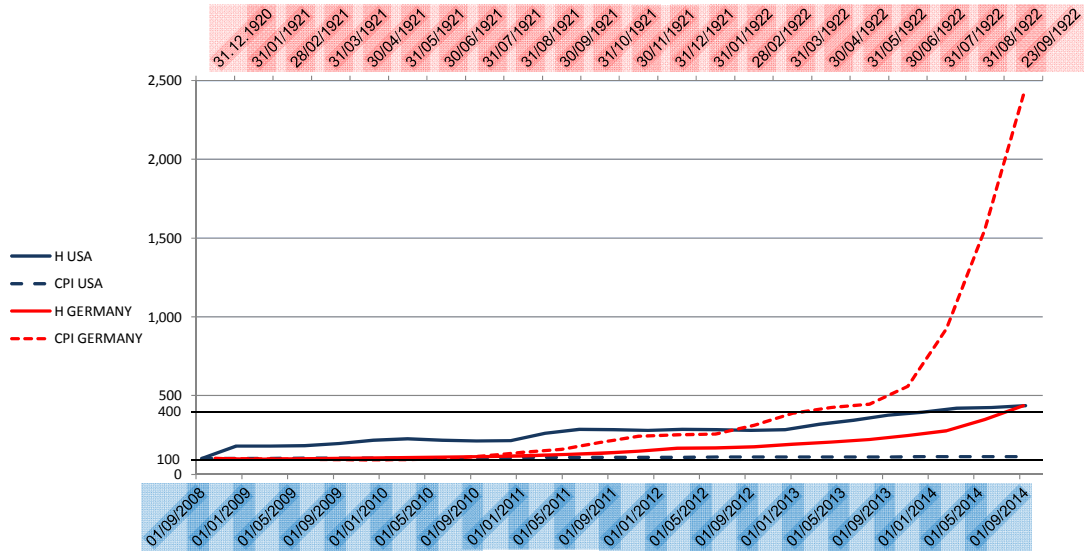
For Germany the figures show that, following a period of about seven months during which the price level increased less than high powered money, there was a

[11] Hence, by construction all four graphs start from a common base of 100.

[12] In both episodes the indices in the initial periods have been normalized to 1 rather than 100 before applying the logarithmic transformation. As a result all the four curves start from zero rather than 100.

persistent acceleration of inflation much beyond the rate of base money expansion. As a consequence the German price level in September 1922 was 24 times higher than in December 1920. During the same period base money increased only by a factor of 4.35. By contrast, in the US the cumulative rate of increase in the price level is much lower than the cumulative rate of base expansion. The cumulative CPI increase between Lehman's collapse and September 2014 is 12.4%. This is obviously miniscule in comparison to the 435% increase in the monetary base.

Figure 8: The behavior of the monetary base and the price level in the US since Lehman's collapse and during the German hyperinflation: A comparison[1]



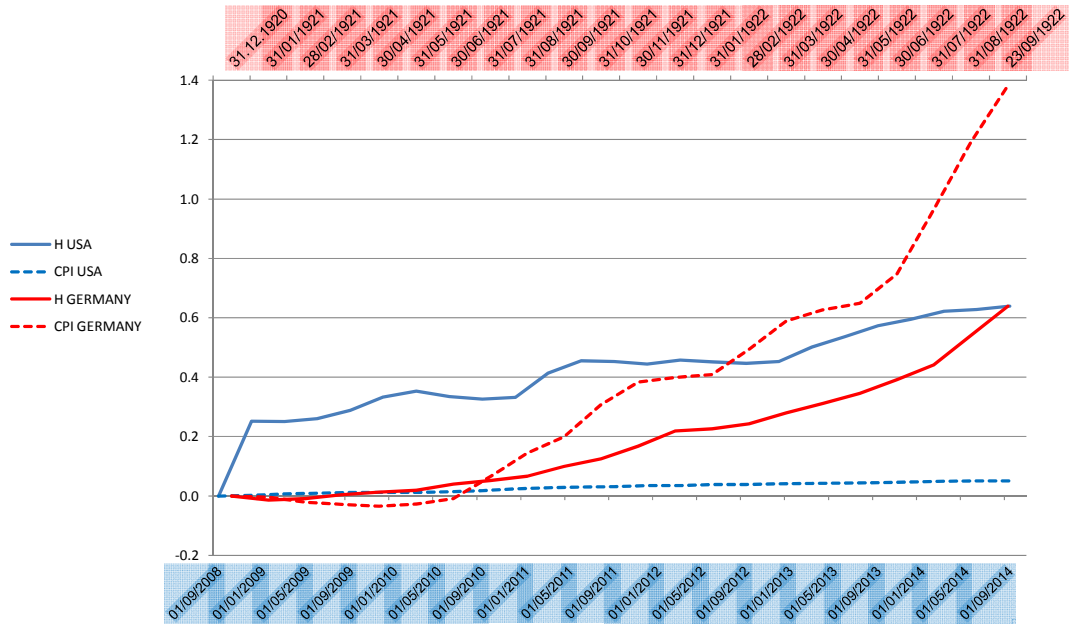
[1]The values of the monetary bases and of the price levels in the US and Germany are all are normalized to 100 at the beginning of each of the two periods (Sept 2008 for the US and December 1920 for Germany)

sources:

(i) H and CPI for USA: Federal Reserve Bank of St Louis Data Base

(ii) H and CPI for Germany: Calculated from data in Table 1 of Cukierman (1988).

Figure 9: The behavior of the monetary base and the price level in the US since Lehman's collapse and during the German hyperinflation: A comparison - Logarithmic Scale[1]



[1]calculating by taking the logs of the levels of the monetary bases and of the price levels in US and Germany.

sources: Same as the figuers in levels.

7. Why are the responses of inflation to identical monetary expansions in Germany then and in the US now so different?

I trust that the dramatic differences between the response of inflation in post WWI Germany and the US today should help convince most readers that the simple quantity theory of money does not suffice to understand the relation between money and prices. There are other (possibly no less important) factors that shape this relation. This section attempts to flash them out by discussing the main differences between Germany then and the US today.

The first difference is related to the discussion in sections 1 and 5 of this paper. Those sections show that about three quarters of the huge monetary base expansion took the form of an increase in bank reserves at the Fed without any appreciable impact on credit growth. As a consequence higher order monetary stocks in the public's portofolio and (relatedly) the transmission to the demand for goods and services was much weaker than suggested at first blush by the figures on base expansion. By contrast in Germany during the twenties practically all the expansion in high powered money was used from the start by Government to finance the state budget. Cukierman (1988, page 47) calculates that during 1921, 1922 and 1923 seignorage financed 56%, 64% and 89% of the German Government budget respectively. In a nutshell, the Fed's base expansion did not translate into demand for goods and services whereas the German monetary expansion was motivated from the start by a strong hunger on the part of Government for seignorage revenues.

Second, policymaking institutions in today's US are completely different from those of Germany during the hyperinflation. The Fed is largely independent from political authorities and commited to an implicit inflation targeting regime. By contrast the Reichsbank (the German central bank during the hyperinflation) was totally under the control of German political authorities. For political reasons related to the structure of war reparations imposed on Germany in conjunction with a post war damaged tax collection apparatus German political authorities had a major incentive to heavily rely on the printing press.[13] This difference is critical for the anchoring of inflationary expectations. As highlighted by the New-Keynesians literature the behavior of those

[13] A detailed discussion appears in section 7 of Cukierman (1988).

expectations has a first order effect on price adjustments in the economy, and therefore on the rate of inflation. [14]

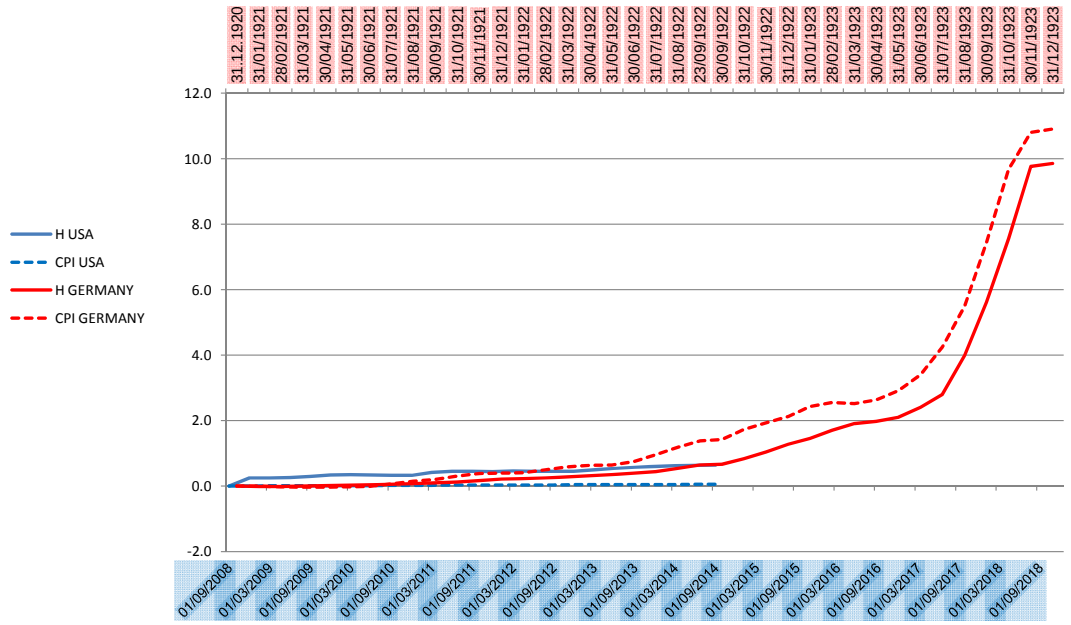
Furthermore after a while, when inflationary expectations go up the speed of price adjustment by firms in the economy goes up and this further reinforces the acceleration in the rate of inflation.[15] This process reached its full impact on inflation in Germany during the second half of the hyperinflation. Since this is not covered in Figures 8 and 9 and in order to give the reader an idea of the orders of magnitude involved Figure 10 extends Figure 9 to the entire German hyperinflationary period on a logarithmic scale. For comparison purposes the blue lines representing recent US monetary expansion and inflation are kept in the Figure.

During the German hyperinflation central bank actions reinforced a trend of increase in the velocity of circulation of money (Cagan (1956). By contrast, in the US since Lehman's Collapse, the low interest policy of the Fed reduced the velocity of circulation. As previously explained those differences are traceable to differences in the origins of the original shocks along with different institutional setups.

During the German inflation there was no anchor for expectations. As a consequence, as inflation picked up, those expectations ultimately adjusted upward which raised inflation further. By contrast, in today's US, expectations are tightly anchored by the following two institutional devices: 1. Only the Fed decides on monetary policy and the Fed is committed to an implicit inflation targeting regime, 2. Relatedly, the US Government is prohibited from relying on seignorage to finance deficits. Admittedly the Fed has to turn the profits that accrue to it as a result of its **independent** monetary operations to government at the end of each fiscal year. But Government cannot influence the size of those profits in order to taylor them to its fiscal needs. Those two factors contribute a lot to the current credibility of monetary policy in the US and through it to the anchoring of inflationary expectations.

[14] Standard references on New-Keynesian models are Woodford (2003) and Gali (2008).
[15] In terms of the New-Keynesian model this means that the Calvo coefficient changes with the customary level of inflationary expectations. Evidence on this phenomenon appears, interalia, in Lach and Tsiddon (1992) and in Cukierman (2008).

Figure 10: The behavior of the monetary base and the price level in the US since Lehman's collapse and over the entire German hyperinflation: A comparison - Logarithmic Scale[1]



[1]calculating by taking the logs of the levels of the monetary bases and of the price levels in US and Germany.
sources: Same as the figuers in levels.

Last but not least, following WWI Germany had little or no access to international capital markets. As a consequence the main, if not only, way to finance deficits was via monetary expansion. By contrast the US enjoys unparalleled access to both home and international capital markets as well as the priviledge to borrow in its own currency. [16] Thus, US fiscal authorities have no reason to rely on seignorage revenues even in the face of substantial deficits. Consequently, the credibility of low US inflation is backed not only by the law that prohibits government from directly borrowing at the Fed but, more fundamentally, by the US Government easy access to financial markets.

[16] Eichengreen (2011) refers to the ability of the US Government to borrow on international markets in its own currency as an "exorbitant priviledge".

8. Implications for the timing and dosage of exit strategies

In their well known book Friedman and Schwartz (1963) note that an important policy error commited by the Fed during the great depression was that it did not prevent the decrease in the money supply caused by multiple banking failures. This lesson has been well learned by the Fed during the recent crisis who under the leadership of Ben Bernanke injected sufficient liquidity to prevent any decreases in M1 and M2. As can be seen from Figure 5 those stocks actually increased in spite of the Lehman event. But, due to the sluggish growth in banking credit the same liquidity injections created a large pool of excess reserves.

As long as the currently high levels of excess reserves continue to be held willingly by US banks and new bond issues remain low inflationary risks are minimal.[17] But the current high level of excess reserves can potentially support a vigorous expansion of credit and reignite inflation if banks become less pessimistic about the risks involved in expanding the volume of higher yield loans and/ or the demand for credit picks up. An implication of this view is that the level of net new banking credit as well as the ratio of reserves to credit can be taken as early warning signals for the Fed to decide when to start a process of liquidity removal. A similar argument applies to net new bond issues. Substantial and sustained revival in their volume may provide another leading signal for deciding when to start a process of liquidity removal.

The above mentioned signals can also be used as indicators for the **magnitude** of liquidity removal or tapering. Essentially the idea is to gear, interalia, the process of liquidity removal to the rate of increase in the volume of total net new credit.

Due to the post Lehman persistent change in the probabilistic awareness of banks and other capital market participants to the possibilitiy that a low probability of bailout has non zero mass the re-acceleration in credit growth is likely to be gradual leaving sufficient time for the monetary authority to react. The post Lehman anemic evolution of both net new bond issues and net new banking credit shown in Figure 4 supports this view.

[17] See Figures 1 and 3.

9. Concluding remarks

There are several lessons from the discussion in this paper. First bursts of optimism and pessimism that have been attributed to “animal spirits” by Keynes and, more recently, by Akerlof and Shiller (2009) can in some cases be related to major public events. The collapse of Lehman Brothers and the rescue of Bear-Stern are resounding such cases. They led financial markets participants to reevaluate their prior beliefs about the possible set of bailout probabilities in a more pessimistic direction thereby increasing both bailout uncertainty and most likely their probabilistic awareness of low bailout probabilities.

Although the subsequent actions of US policymakers might have reduced this uncertainty after a while, the traumatic probabilistic awareness to the existence of low bailout probabilities is, most likely, more persistent. The substantial slowdown in banking credit and the sustained near collapse in net new bond issues since the Lehman event attest to that. As a consequences of this cautious behavior on the part of banks and capital market participants only a small fraction of the huge quantitative easing operations of the Fed are transmitted to the real economy. This leads to both anemic growth and subdued inflation.

When banks finally become more optimistic those effects will eventually be reversed. But due to the persistence of their newly acquired traumatic awareness to low bailout probabilities this process may be protracted. A practical policy implication of this view is that removal of liquidity from the economy should be synchronized with the endogenous expansion of banking and capita market credit.

A good number of economists worry that the huge liquidity injections since September 2008 will ignite the fires of inflation. Since the cumulative rate of growth of base money in the US following Lehman’s downfall is of the same order of magnitude as the cumulative rate of growth of base money up to a bit over half of the German hyperinflation period of the twenties this worry appears to be based on a solid and dramatic historical precedent. However the inflationary impacts of those two similar monetary expansions are dramatically different suggesting that there are other crucial differences between the two cases. The paper discusses those differences and argues that

they suffice to support the view that, with proper monitoring by the Fed, the risks of inflation in today's US can be kept under control.

Finally, Cukierman and Izhakian (2014) show that, as a theoretical matter, the lower bailout uncertainty prior to an increase in this uncertainty following a traumatic Lehman type event, the larger the pre-crisis credit buildup and the more serious the post crisis credit arrest. An important lesson from this result is that the longer an asset bubble is allowed to expand the more painful will be its downfall if and when it bursts. There is consequently a tradeoff between interfering with credit expansion too early and too late. Earlier interference reduces the probability of a catastrophic bubble burst at the cost of potentially slowing down a healthy growth process.

An important question deliberately left open for future work is how much of the large and persistent slowdown in the creation of credit is due to reluctance to lend and how much to weak demand. One difficulty in disentangling those two effects is that, in addition to return, the willingness of banks (and suppliers of funds on the capital market) to lend depends on their evaluation of the risks involved in lending. Similarly, in addition to the interest they have to pay, demand for credit by borrowers also depends on how they perceive the risks involved in leveraging up in order to invest in productive capital or housing.

It is apriori reasonable to believe that the panic and recession that followed after the decision not to bailout Lehman reduced both the supply and the demand for credit. Nonetheless, in view of the persistence in the banking credit slowdown in spite of the recent pickup in US economic activity it is likely that a non negligible part of the slowdown is due to a continued reluctance to lend. This reluctance can be traced back to the traumatic experiences that followed the decision not to bailout Lehman. The enactment of the Dodd- Frank Act in 2010 probably further reinforced this reluctance on the part of banks. This view is also consistent with the analysis in Acharya, Shin and Yorulmazer (2011) who argue that, due to a strategic acquisition motive, more pessimistic views about the likelihood of bailouts raises the exante incentives of banks to hold liquidity.

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