**US Banks’ Behavior since Lehman’s Collapse, Bailout Uncertainty and the Choice of Exit Strategies**

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October 30 2015

ABSTRACT

This paper documents a dramatic post-Lehman slowdown in the rate of growth of US banking credit in spite of a huge accumulation of banks’ reserves at the Fed. Appealing to results in a theoretical background paper the banking credit arrest in the immediate aftermath of Lehman’s collapse is explained in terms of an increase in bailout uncertainty triggered by the Lehman event. The strong persistence of this phenomenon is explained in terms of a crisis induced toughening of banking regulation along with a persistent increase in probabilistic awareness to low bailout probabilities (or, equivalently an increase in uncertainty aversion) within a multiple priors framework. The paper also documents a dramatic decrease in total net new (non treasury) bond issues due mainly to the disappearance of mortgage related bonds along with an increase in net new issues of corporate bonds. Those phenomena explain why, in spite of a huge expansion of the monetary base, inflation has been subdued 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. One lesson from this comparison is that the current risks of inflation are very small. The penultimate section of the paper discusses alternative exit strategies as well as various tapering triggers.

**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 huge quantities of liquidity into the US economy. As a matter of fact the cumulative rate of base money growth during the six years following this event is similar to the rate of base money expansion through a bit more than half of the 1921-1923 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 during the six years following Lehman’s collapse is a meager 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 the behavior of banking credit during the first two years following the Lehman event to an increase in probabilistic awareness about the likelihood that the US government will not bailout the creditors of large delinquent financial institution in the future. Although it revived somewhat during 2012 the lull in banking credit persisted through 2013. The paper also argues that additional factors, triggered by the crisis, like the need to rebuild balance sheets and tightening of regulation, contributed to the lenghtening of this credit slowdown.

Except for net new issuance of corporate debt that actually increased during the first two years following the Lehman event net new issues of all other non federal bond categories collapsed and were predominantly negative through 2013. Those categories include mortgage related and asset backed bonds, municipal bonds and federal agency securities. Although, in the aggregate, the increase in corporate debt partly offset the reduction in banking credit it is likely that this reallocation of funds did not compensate medium and small enterprises whose access to the capital market is limited in comparison to large corporations.

Net new issuance of treasury securities actually increased during the first two years following Lehman’s collapse. This reflects the flight to safety. Nonetheless total net issuance of bonds including the net issuance of treasury securities went down in comparison to the pre-Lehman era.

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 accumulation of banks’ reserves at the Fed following the downfall of Lehman Brothers. Appealing to results in a theoretical background paper the second section explains the evidence in the preceding section in terms of a short term shift in in the demand for banks’ liabilities due to an increase in bailout uncertainty in the immediate aftermath of Lehman’s collapse. The strong persistence of banking credit arrest in spite of huge excess reserves is explained in terms of an increased probabilistic awareness to low bailout probabilities within a multiple priors framework along with subsequent toughening of banking regulation triggered by the crisis. The third section documents a dramatic decrease in total (non treasury) net new bond issues as well as a partially offsetting increase in corporate bond issues. The evidence from section 2 is then used, in section 4, to explain why inflation has been and still is extremely low in spite of a huge expansion of the monetary base.

Section 5 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 6 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 choice and timing of exit strategies are discussed in section 7. 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 long-term rate of growth.[[2]](#footnote-2) 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 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 banking credit 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.



Those figures suggest that Lehman’s downfall marks a watershed in the behavior of US banks credit 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 the next section.

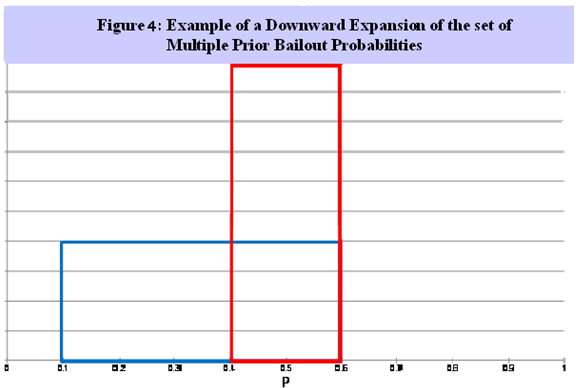


1. **Change in probabilistic awareness to low bailout probabilities and other explanations for the persistent shift in the portofolio of US banks following Lehman’s collapse**

This section develops the argument that the virtual arrest in the creation of banking credit during the first two years immediatly following Lehman’s collapse is consistent with the view that the Lehman event temporarily raised bailout uncertainty. The persistence of banking credit slowdown over 2011-2013 is explained, along with other more conventional mechanisms, by a persistent increase in probabilistic awareness on the part of banks and their creditors to the possibility that even systemically important financial institutions (SIFI) will not always be bailed out.[[3]](#footnote-3)

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 and non-negligible probability of bailout. However they were not certain in the Knightian sense about the likelihood of such bailouts. Following Cukierman and Izhakian (2015) (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.[[4]](#footnote-4)

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 4.[[5]](#footnote-5) More generally I will refer to sets of bailout probabilities with non zero mass as sets to which individuals are **probabilistically aware** to.[[6]](#footnote-6) Using this terminology we can refer to an increase in the set of multiple priors as an **increase in probabilistic awareness**.



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

At least for the first two years following the Lehman event this mechanism appears to provide a reasonable explanation for the dramatic decrease in banking credit. But, in view of the subsequent policy actions 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 to levels similar to those that existed in the pre-Lehman’s era.

However, in spite of some pickup in 2012 , the lull in banking credit persisted through 2013.[[7]](#footnote-7) There are several non exclusive economic explanations for this phenomenon. First is the need of banks to rebuild their equity positions that deteriorated in the wake of the September 2008 panic. This was reinforced by toughening of banking regulation through the 2010 Dodd-Frank Act and related channels. The imposition of tougher capital requirement (CAR) and liquidity coverage ratios under Basel III since 2010 along with stress tests and the imposition of limits on the ability to move securitized assets off balance sheet limited the ability and willingness of banks to extend credit. Although the increase in CAR is being phased in gradually the advance announcement of such future measures impacts banks’ decisions before the actual regulation becomes effective. The effect of the Basel III net stable funding ratios (NSFR) to be gradually imposed on large banks in the future is similar. In addition, by lowering the value of assets of households and businesses, the crisis reduced the value of acceptable (to banks) collateral assets. Since the above mechanisms were triggered by the financial crisis there is a sense in which, beyond its immediate impact, the crisis induced longer term processes that increased the persistence of credit slowdown.

Beyond those economic explanations the multiple priors framework outlined above provides an additional possible explanation for the persistence of low credit growth. This framework 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 corporations, households, banks and other financial institutions 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. This increase in ambiguity (or uncertainty) aversion is likely to persist long after bailout ambiguity (or uncertainty) has returned to the vicinity of 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 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, households and corporations 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.

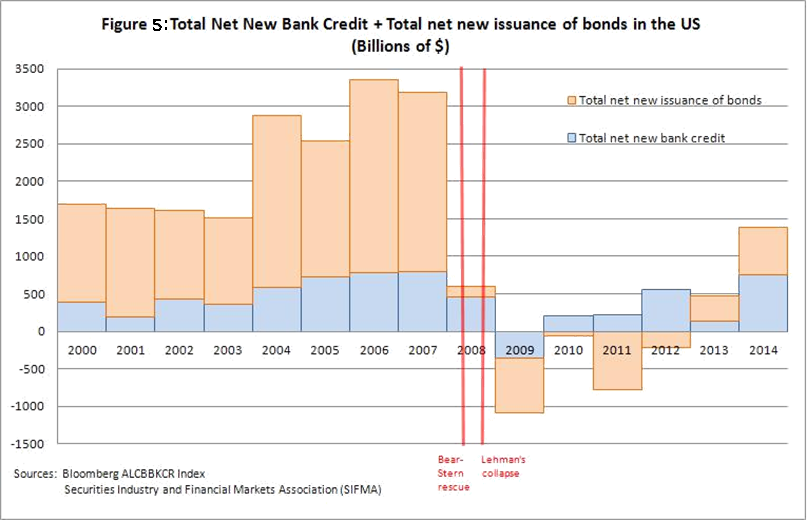
While, dramatic unexpected events like Lehman’s downfall are likely to immediately raise the probabilistic awareness of individuals to the relevance of low bailout probabilities. the return (if any) to previous, less pessimistic, levels of probabilistic awareness following appropriate reforms is likely to be sluggish. 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.

**3. Evidence on total net new credit flows and net bond issuance by issuers before and after Lehman’s collapse**

A substantial part of credit flows in the US occurs through bond issues in the capital market**.**[[8]](#footnote-8)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 5 shows the yearly volumes of total, net of redemptions, new bond issues excluding treasury bills (in orange) 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. However, in 2009 both net new bond issues as well as net new banking credit were in negative territory.

The decrease in net new bond issues was not distributed evenly across different categories of bonds. There was a dramatic and sustained decrease in net new issues of mortgage related and asset backed bonds. From a peak of over one trillion and a half in 2006 net new issues of those bonds became negative in 2008, remained in negative territory in every single year until 2013, and rose modestly above zero only in 2014. Net new issues of federal agencies securities and municipal bonds also plunged into negative territory for a good number of years following Lehman’s collapse. Figure 7 shows that the sum total of net new issues of those four categories decreased from over a trillion and a half in 2006 and 2007 to less than half a trillion in 2008. This sum was persistently negative in every year between 2009 and 2013 and essentially zero in 2014. Although they differ in terms of absolute magnitudes the time paths of each of the components of this sum are qualitatively similar to the behavior of the total. In terms of magnitudes the total sum is dominated by movements in mortgage related and asset backed bonds.

By contrast the time path of net new issues of corporate bonds is quite different. Although those issues decreased from about 400 billions in 2007 to less than 200 billions in 2008 they actually increased to roughly 500 and 600 billions over 2009 and 2010 respectively (Figure 6). Possible reasons for this contrast are discussed later in this section. However since the increase in net new issues of corporate bonds was substantially smaller than the collapse of mortgage related and asset backed bonds total net new non federal bond issues were still in negative territory as can be seen from Figure 5.



The flight to safety that engulfed the world in the wake of the subprime crisis substantially raised the demand for treasury securities. From less than 200 billions in 2007 net new issues of treasury securities rose to roughly 1.3, 1.5 and 1.6 trillions in

2008, 2009 and 2009 respectively. As a consequence total new issues of bonds including those of the federal government remained consistently in positive territory after Lehman’s downfall. However, in comparison to the pre-Lehman’s period and as suggested by Figure 8, the increase in treasury securities did not fully offset the impact of the virtual disappearance of net new issues of mortgage related and asset backed bonds between 2008 and 2013.

The dramatic decrease in mortgage related and asset backed bonds is due to the realization by investors in the wake of the crisis that their ability to measure and manage the risks associated with these types of instruments is substantially lower than what they had believed prior to the outbreak of the crisis. The increase in corporate bonds during 2009 and 2010 partially reflects a substitution between these defunct mortgage instruments and corporate bonds due to the perceived increase in the relative riskiness of mortgage related bonds and asset backed securities. It also implies that, the demand for credit by large corporations with good access to the capital market remained substantial in spite of the recession induced by the subprime crisis. The quantitative easing operation of the Fed also contributed to this trend through liquidity injections and by using forward guidance to keep long term rates low.

The analysis of an increase in bailout uncertainty from section 2 provides a more focused explanation for the expansion in corporate issues along with the collapse in mortgage related and asset backed bond issues during the first two post-Lehman years. Prior to the decision not to bailout Lehman’s creditors the mass given to high probabilities of bailouts of **financial** institutions was relatively high. Following the decision not to bailout Lehman’s creditors this mass shifted to lower bailout probabilities (in terms of Figure 4 the mass shifted from the red rectangle to the blue one). There was no similar pre-Lehman beliefs about high probabilities of bailout for **non financial** enterprises, and if there were some, they did not change much between the pre and the post Lehman eras. As a consequence non financial corporate bonds became attractive relatively to mortgage and asset backed bonds.

**4. Why is the inflationary impact of the highly expansionary monetary policies since Lehman’s collapse so muted?**

Between Lehman’s collapse and September 2014 high powered money in the US more than quadrupled. 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 some 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]](#footnote-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 9 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 10 replicates Figure 9 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 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.





**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]](#footnote-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.

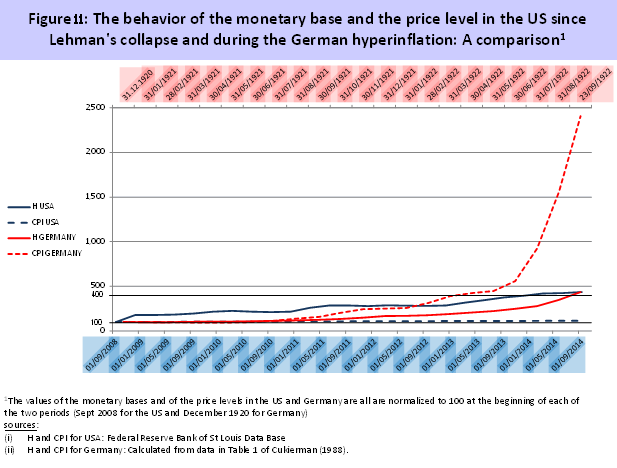
The thinking of policymakers and economists who worry that the exceptional sequence of quantitative easing operations conducted by the Fed since Lehman’s collapse will eventually spark the fires of inflation goes back to the lessons learned from episodes such as the German hyperinflation. It is therefore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

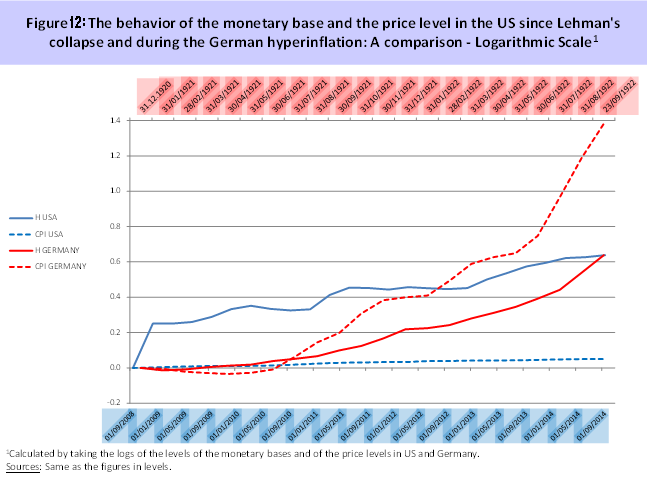
Figure 11 displays the evolution of high powered money and inflation in the US starting in September 2008 till September 2014 and in Germany starting from December 1920. The values of the monetary bases and of the price levels in both the US and Germany are normalized to 100 at the beginning of each of those two periods in order to provide a common comparative scale for the two episodes. [[11]](#footnote-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 base money expansion.

The blue and red lines in Figure 11 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 12 is a replication of Figure 11 for the logarithms of the four indices.[[12]](#footnote-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 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.





**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 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 monetary institutions in 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 a low rate of inflation. 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]](#footnote-13) This difference is critical for the anchoring of inflationary expectations. As highlighted by the New-Keynesians literature the behavior of those expectations has a first order effect on price adjustments in the economy, and therefore on the rate of inflation. [[14]](#footnote-14)

In addition when inflationary expectations go up the speed of price adjustment by firms in the economy goes up as well after a while. This mechanism further reinforces the acceleration in the rate of inflation.[[15]](#footnote-15) This process reached its full impact on inflation in Germany during the second half of the hyperinflation. 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 explicit 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 every week. 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.

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]](#footnote-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.

**Implications for 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 9 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.

It would appear at first blush that the currently high level of reserves has the potential to ignite inflationary risks when banks ultimately find it profitable to utilize them in order to substantially expand credit.[[17]](#footnote-17) This is obviously far from being the case currently (November 2015) with latest US inflation hovering around zero and negative inflation rates in Europe. It is nonetheless important to explore the options available to the Fed if and when the large quantities of liquidity injected through the various quantitative easing programs between 2008 and 2014 induce substantial new credit creation.

There are at least two views regarding the Fed’s “tapering” options at this point. One is the traditional view according to which the Fed will have to gradually unload parts of the large bond portofolio it had accumulated during the six years following Lehman’s collapse. The other view, apparently held by policymakers at the Fed, is that the necessary monetary restraint could be achieved, instead, by a gradual increase in the interest rate paid on reserves. This option became available only in 2008 when pre-exiting legislation that prohibited the Fed from paying interest on bank reserves was amended. In the Fed’s Semmiannual Monetary Policy Report from February 24 2010 Chairman Bernanke states in this context:

“*Most importantly, in October 2008 the Congress gave statutory authority to the Federal Reserve to pay interest on banks' holdings of reserve balances at Federal Reserve Banks. By increasing the interest rate on reserves, the Federal Reserve will be able to put significant upward pressure on all short-term interest rates. Actual and prospective increases in short-term interest rates will be reflected in turn in longer-term interest rates and in financial conditions more generally*.”

Thus exiting the recent period of extraordinary monetary expansion can be achieved, in principle, without any reduction in the large Fed’s portofolio accumulated during the six years between Lehman’s collapse.and October 2014. Furthermore, neutralization of the potential inflationary impact of large excess reserves only by means of payment of interest on reserves is currently facilitated by the fact that new, post crisis, regulations under Basel III impose relatively more stringent limitations on the growth of banking credit than reserves do. Those new regulations include, interalia, capital requirements, liquidity coverage ratios and net stable funding ratios for systemically important financial institutions. The coming into being of this post-crisis regulatory package implies that, when the time comes, rates paid on reserves will not have to be increased by as much as they would have had to increase in the absence of this legislation.

In the latter part of his statement Bernanke does not exclude some combination of higher interest payments on reserves along with absorption of liquidity by means of reverse repos and more traditional open market sales. Since both policies induce an increase in interest rates they would appear to be equivalent at first blush. But their distributional consequences are likely to differ. The primary effect of raising interest on banking reserves is to limit the growth of banking credit. By contrast the primary effect of open market sales of bonds is to raise the cost of borrowing on the capital market. Since large corporations obtain a larger fraction of their financing needs from the capital market while small businesses rely relatively more on banking credit the choice of “tapering” instrument affects the relative extent of credit tightening to large corporations relatively to small businesses.

What are the indicators one should look at in order to decide on the timing and the dosage of tightening? The most obvious candidates are the rate of inflation itself and economic activity. The evidence presented in this paper implies that, in order to evaluate the risks of a pickup in inflation one should also look at the behavior of banking credit aggregates, new issues of bonds as well as monetary aggregates such as M1 and M2.

**8. 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 likely to be more persistent. Those persistent memories along with regulatory tightening of banking regulation triggered by the crisis extended the slowdown in banking credit growth much beyond the Lehman’s trigger and induced banks to behave substantially more cautiously than prior to the crisis. A consequences of this cautious behavior is that only a fraction of the huge quantitative easing operations of the Fed were transmitted to an increase in banking credit.

During the five to six years following Lehman’s collapse total net new (non treasury) bond issues practically disappeared due mainly to the collapse in mortgage related and asset backed bonds. This tendency was partially offset by a vigorous increase in net new issues of corporate bonds. The paper conjectures that bond investors did not put a high mass on the probability of bailouts of non financial institutions in the first place and that this mass did not shift appreciably following Lehman’s collapse. As a consequence corporate bonds became relatively more attractive to pension and mutual funds following the collapse. In addition the overall demand for good quality bonds was kept afloat by the quantitative easing operations of the Fed.

A good number of economists worry that the huge liquidity injections since September 2008 will ignite the fires of inflation (an example is Issing (2012)). 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 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 are minimal and can be kept under control. Furthermore, this can be done even without engaging in open market sales by raising the interest rate paid on bank reserves at the Fed. However, since small and medium size businesses rely relatively more on banking credit using only this tightening instrument for the purpose of exiting would put an excessively large part of the exit burden on such firms. It is therefore advisable to combine the payment of higher interest on reserves with some run of the mill open market sales.

The discussion in this paper is implicitly based on the presumption that the persistent slowdown in banking credit is due to the behavior of banks and of their suppliers of funds like pension and mutual funds. Although this effect along with the recession that ensued might have also reduced demand for banking credit to some extent there are at least two reasons supporting the view that the restriction of credit supply by banks was the dominant factor. First, the fact, documented in section 3, that net new issues of corporate debt went up during 2009 and 2010 suggests that demand for credit by corporations with good access to the capital market was robust in spite of the recession. Given a positive correlation between their demand for credit and that of medium and small size enterprises (that are much more dependent on banking credit) the arrest in banking credit during those years is consistent with the view that it is due mainly to banks’ reluctance to lend.

Second, a recent study of credit card credit ceilings during the recession suggests that banks passed through credit expansions least to households with relatively low FICO scores during the recession (Agarwal et.al. (2015)). Along with the reasonable supposition that the mean FICO score went down during the crisis this implies that the extent of credit rationing by banks rose in the aftermath of Lehman’s collapse supporting the view that the credit slowdown emanated mainly from the side of supply.

The paper argues that the banks’ reluctance to lend can be traced back to a combination of the traumatic experiences following the decision not to bailout Lehman along with regulatory toughening through the Dodd- Frank Act and related legislation. This view is 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.

Finally, Cukierman and Izhakian (2015) 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.

**References**

Acharya, V. V., H.S. Shin and T. Yorulmazer (2011) “Crisis Resolution and Bank Liquidity,” **The Review of Financial Studies**, 24(6), 2166-2205.

Agarwal S., S. Chomsisengphet, N. Mahoney and J. Strobel (2015), “Do Banks Pass Through Credit Expansions? The Marginal Profitability of Consumer Lending During the Great Recession”, CEPR DP No. 10839, September.

Akerlof, G. and R. Shiller, R. J. (2009), **Animal Spirits: How Human Psychology Drives the Economy and Why it Matters for Global Capitalism**, Princeton University Press, Princeton and Oxford.

Bernanke B. (2010), **Semiannual Monetary Policy Report to the Congress**

Before the Committee on Financial Services, U.S. House of Representatives**,** Washington, D.C.**,** February.

Bresciani-Turroni C. (1937), **The Economics of Inflation: A Study of Currency Depreciation in Post War Germany**, Georgew Allen and Irwin, London,

Cagan P. (1956), “The Monetary Dynamics of Hyperinflation”, in M. Friedman (ed.) **Studies in the Quantity Theory of Money**, University of Chicago Press, Chicago, Il.

Cukierman A. (2014), “Euro-Area and US Banks’ Behavior, and ECB-Fed Monetary Policies during the Global Financial Crisis: A Comparison”, in **Money, Regulation & Growth: Financing New Growth in Europe, SUERF Studies**, Number 4, 73-90.

Cukierman A. (2013), [“Monetary Policy and Institutions Before, During and After the Global Financial Crisis”](http://www.tau.ac.il/~alexcuk/pdf/Online%20Published%20Version%2013.2.20.pdf), **Journal of Financial Stability.** 9, 373-384.<http://www.tau.ac.il/~alexcuk/pdf/Online%20Published%20Version%2013.2.20.pdf>

Cukierman, A., and Y. Izhakian (2015)., “Bailout Uncertainty in a Micro founded General Equilibrium Model of the Financial System”, **Journal of Banking and Finance,** 52, 160-179. <http://www.tau.ac.il/~alexcuk/pdf/BU.13.04.01.pdf>

Cukierman A. (2008), “Misperceptions about the Frequency of Price Adjustments and Asymmetric Fed’s Preferences: .An Assessment of their Impact on Inflation and Monetary Policy Under Burns and Miller”, Unpublished Manuscript, Available at: <http://www.tau.ac.il/~alexcuk/pdf/FPAM,%20RAP,%20GM%20&%20Great%20Inflation-11-08%20Revision.pdf>

Cukierman A. (1988), “Rapid Inflation – Deliberate Policy or Miscalculation?”, **Carnegie Rochester Conference Series on Public Policy**, 29, 11-84.

Eichengreen B. (2011), **Exorbitant Priviledge**, Oxford University Press, NY, NY.

Friedman M. and A. Schwartz, (1963), **A Monetary History of the US, 1867-1960**, Princeton, Princeton University Press.

Gali J. (2008), **Monetary Policy, Inflation, and the Business Cycle**, Princeton University Press, Princeton, NJ.

Ghirardato P. and M. Marinacci (2002), “Ambiguity Made Precise : A Comparative Foundation”, **Journal of Economic Theory**, 102(2), 251-289.

Gilboa, I, and D. Schmeidler (1989). “Maxmin Expected Utility with Non-unique Prior,” **Journal of Mathematical Economics**, 18(2): 141-153, April.

Hansen L and T. Sargent (2008), **Robustness**, Princeton University Press, Princeton, NJ.

Issing, O. (2012), “Central Banks – Paradise Lost.” Mayekawa Lecture,

Institute for Monetary and Economic Studies, Bank of Japan, Tokyo, May.

Javidi H. and M. Yadollahie (2012), “Post-Traumatic Stress Disorder”, **Occupational and Environmental Medicine (Review)**, 3(1), January, 2-9.

Klibanoff P., M. Marinacci and S. Mukerji (2005), “A Smooth Model of Decision Making Under Ambiguity”, **Econometrica**, 73(6), 1849-1892.

Lach S. and D. Tsiddon (1992), "The Behavior of Prices and Inflation: An EmpiricalAnalysis of Disaggregated Price Data", **Journal of Political Economy**, 100(2), 349-389, April.

Taleb N. (2007), **The Black Swan: The Impact of the Highly Improbable,** Random House Group

Woodford M. (2003), **Interest and Prices**, Princeton University Press, Princeton, NJ

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2. It even shrank by over 3.5% during 2009. [↑](#footnote-ref-2)
3. A precise definition of the term “probabilistic awareness” appears later in this section. [↑](#footnote-ref-3)
4. Hansen and Sargent (2008) use the idea of multiple priors to explore the consequences of parameter uncertainty for the behavior of the economy. [↑](#footnote-ref-4)
5. The probability masses have been drawn as uniform for simplicity. Any two probability masses over P such that the minimal value of the post Lehman support is lower than its counterpart in the pre-Lehman period can be used to convey the general idea of the figure. [↑](#footnote-ref-5)
6. 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. . [↑](#footnote-ref-6)
7. Details appear in Figure 4 below. In spite of some pickup during 2012 the cumulative rate of growth over 2011-2013 was substantially lower than in the pre-Lehman period. [↑](#footnote-ref-7)
8. 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). [↑](#footnote-ref-8)
9. By contrast, until 2014 the ECB injected liquidity mainly through self liquidating repos. The consequences of those different policy procedures for the behavior of banking reserves are explored in Cukierman (2014). [↑](#footnote-ref-9)
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. [↑](#footnote-ref-10)
11. Hence, by construction all four graphs start from a common base of 100. [↑](#footnote-ref-11)
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. [↑](#footnote-ref-12)
13. A detailed discussion appears in section 7 of Cukierman (1988). [↑](#footnote-ref-13)
14. Standard references on New-Keynesian models are Woodford (2003) and Gali (2008). [↑](#footnote-ref-14)
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). [↑](#footnote-ref-15)
16. Eichengreen (2011) refers to the ability of the US Government to borrow on international markets in its own currency as an “exorbitant priviledge”. [↑](#footnote-ref-16)
17. Figure 3 shows the dramatic, policy induced, increase in the ratio between reserves and credit following Lehman’s downfall. [↑](#footnote-ref-17)