What Has – and Has Not - Been Learned about Monetary Policy in a Low Inflation Environment? A Review of the 2000s.

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I. Introduction

As the world economy recovers from the worst financial crisis and deepest, most synchronized global slump in 75 years, policymakers, regulators, and academics are focusing intensely and appropriately on lessons to be learned. Given the magnitude of the crisis, the depth of the recession and the concerns about a sluggish global recovery, there are certainly many questions to answer. Among the most important are:

Are inflation expectations 'well anchored'?

What, if any, influence should asset quantities and/or prices have on monetary policy?

Do we have sufficient confidence in our alternative monetary policy tools to stabilize the economy at the zero lower bound?

The way one answers these questions depends importantly on the conclusions one has drawn about the conduct of monetary policy in last decade and the role of monetary policy, if any, in contributing to the crisis. The subtitle of this paper *is not* ' I Told You So' and for a good reason. I didn't, and it wasn't because I was shy. Rather, as will be discussed later, I, like the vast majority of economists and policymakers, suffered – in retrospect – from Warren Buffet's 'lifeguard at the beach' problem: "you don't know who is swimming naked until the tide goes out". In Section II, I first review and then offer my own assessment of the pre- crisis consensus about inflation targeting and the role of asset prices and quantities as an influence on policy in an economy in which inflation – and inflation expectations – are, or at least appear to be, well anchored. I also discuss the 'great leveraging' that accompanied the much better publicized 'great moderation' and the role played by the shadow banking system in funding it. In Section III I review the Fed's policy during the last decade for setting the federal funds rate before hitting the zero lower bound in December 2008. Although my focus is on the Fed, the Bank of England and - to a lesser extent - the ECB followed a similar playbook and will face similar issues going forward. In Section IV, I review Fed policy since hitting the zero bound, focusing on the significant quantitative and credit easing programs introduced in November 2008 and March 2009. In Section V , I conclude with a discussion what the experience of the last decade has – and has not, at least yet – taught us that would inform the way we answer the above questions.

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II. Success, Self Congratulation, and Swimming Naked

II.1 Pre Crisis Consensus

Svensson (2002) and Goodfriend (2007) provide thoughtful summaries and perspectives on the pre - crisis consensus about inflation targeting monetary policy. Walsh (2009) and Bean (2009) provide comprehensive post-crisis updates, raising important questions insufficiently appreciated before the crisis and suggesting, at least to this reader, less professional consensus now than before the crisis. This Jackson Hole consensus as summarized well by Bean et al. (2010) embraced the following seven pillars

1. Discretionary fiscal policy was seen as generally an unreliable tool for macroeconomic stabilization.

2. Monetary policy, conducted via setting a path for the expected short term interest rate, was therefore to be assigned the primary role for macroeconomic stabilization.

3. Because the transmission mechanism for monetary policy was presumed to operate mainly through longer-term interest rates. expectations of future policy rates were central and credibility of policy was essential to anchor these expectations.

4. Central bank instrument – if not goal - independence of the political process was important to supporting central bank credibility.

5. Setting targets for intermediate monetary aggregates (as proposed by Milton Friedman (1970)) or credit aggregates (as proposed by Ben Friedman (1983)) - with the exception of the ECB's twin pillar strategy – fell out of or never gained favor. This occurred as historical velocity relationships between these aggregates , nominal GDP growth, and inflation a ppeared to break down. Under flexible inflation targeting, monetary policy would be focused on anchoring expected inflation by keeping realized inflation at or close to target over an appropriate time horizon Because of short-run stickiness of wages and prices, central banks would face and would recognize a short run trade off between output gaps and inflation. Some central banks such as the Fed, operated under specific dual mandates; for others without a dual mandate, flexibility in terms of the horizon over which the inflation target would be achieved would be incorporated so that excessive volatility of output could be avoided.

6. The efficient markets paradigm was seen as a working approximation to the functioning of real world equity and especially credit markets. The growing role of securitization in credit markets, especially in the US, was seen as a stabilizing innovation that reduced systemic risk by distributing and dispersing credit risk away from bank balance sheets and toward a global pool of sophisticated investors. While asset prices might well drift away from fundamental value and for long periods of time, 'bubbles' were difficult enough to identify ex ante so that the role for monetary policy was to limit collateral damage to inflation and economic activity when they burst.

7. Price stability and financial stability were seen as complementary and not in general at risk of conflict. Financial markets were presumed to be well regulated, sometimes – as in the case of the Fed with bank holding companies - by the very central banks that were conducted monetary policy. Other central banks, such as the Bank of England, made virtue of the fact that they were not involved in supervision and regulation of financial markets.

As noted above, pre-crisis discussions of monetary policy took financial stability for granted, and workhorse models used for teaching (Clarida, Gali, Gertler 1999, 2002; Woodford 2003) and even the much larger models used for policy analysis routinely assumed financial frictions were irrelevant for policy design. Svensson (2009) well summarizes the pre – crisis consensus among policymakers and academics on the role of asset market variables in an inflation targeting strategy:

> "Asset prices will affect policy to the extent they are deemed to affect the forecasts of the central bank's target variables that is, inflation and resource utilization. Suppose, however, that a large asset-price increase is deemed to be fragile and a possible bubble, with a significant risk for a future collapse. Suppose further that a future collapse is deemed to have undesirable consequences for future inflation and resource utilization. Then the bank faces a delicate situation. It is possible that a policy-rate path with a higher policy-rate in the near future will be deemed to dampen asset-price increases in the near future and also reduce the risk or size of a collapse in the more distant future, thus undershooting the inflation target in the near term but providing a more stable development of inflation and resource utilization in the medium and longer term. These are examples of situations when the central bank may choose to respond to asset-price developments. However, the reason for these responses is that the central bank is concerned with the repercussions for inflation and resource utilization, not with the asset prices as such. **That is, asset prices are not target variables; they do not enter the loss function.** There is no scope for any mechanical adjustment of asset prices or bubbles. The central bank's reaction will not be stable but shift with its judgment… It is [not] productive to discuss these issues directly in terms of the central bank's reaction function, for instance as modifications of a Taylor rule (Svensson (2009), p. 10)."

It is important to understand the point that inflation forecast targeting central bank following the approach outlined by Svensson should find it desirable to lean against swings in asset prices and quantities, *to the extent these swings enter the central bank's forecast of inflation or the output gap*. To illustrate some key points, it will be useful to consider a simple example that extends Clarida , Gali, and Gertler (2000). Let $z_t = [\pi_t, y_t, r_t, h_t]$ with y_t the output gap, π_t inflation, r_t the policy rate, and h_t an asset price or quantity. Suppose the central bank uses a VAR to forecast the economy:

$z_{t+1} = Dz_{t-1} + u$

Now, a simple forward looking Taylor rule model can be written as

$r_t = \theta E[\pi_{t+1} \mid z_{t-1}] + f E[y_{t+1} \mid z_{t-1}] + \nu_t$

where it will be noted that the asset market variable h_t does not directly enter the Taylor rule.

Using the VAR

$E[\pi_{t+1} \mid z_{t-1}] = \mathbf{1}D\ z_{t-1}$

where **1** is the vector [1, 0 ,0 ,0]. And similarly for $E[y_{t+1} \mid z_{t-1}]$.

Substituting back into the forward looking Taylor rule, we can write a reduced form Taylor rule which is the interest rate equation in the VAR model.

$$r_t = (\theta D_{11} + f D_{21})\pi_{t-1} + (\theta D_{12} + f D_{22})y_{t-1} + (\theta D_{13} + f D_{23})r_{t-1} + (\theta D_{14} + f D_{24})h_{t-1} + \nu_t$$

The scalar D_{14} is the regression coefficient of the lagged asset market variable in forecasting inflation while D_{24} is the regression coefficient in forecasting the future output gap based on the lagged asset price. Under certain circumstances, inflation targeting central banks can safely ignore asset market variables in the conduct of monetary policy unless these prices and quantities specifically alter the central bank's *inflation* forecast (Bernanke and Gertler (1999) present a model in which this is the case). But this is not a general result for a central bank with a dual mandate such as the Fed. Even if $D_{14} = 0$, so that asset prices or quantities have no incremental predictive content for CPI inflation, to the extent that exogenous fluctuations, for example, in financial frictions or leverage induce inefficient volatility in output or the capital stock relative to the first best potential, a central bank following a forward looking Taylor rule should still lean again such asset market moves when $D_{24} > 0$ by raising the policy rate *even if the asset price or quantity itself does not enter the objective function.* Walsh (2009, p. 28) states the case well:

> "Financial frictions, which have generally been absent from the consensus model of monetary policy, affect both the monetary policy transmission process *and generate distortions in the real economy*. These distortions interact with nominal rigidities. Just as time varying tax and subsidies may constitute a better tool for deal with markup shocks, targeted and time varying financial regulations are better instruments than monetary policy for mitigating many of the effects of these frictions. But if regulation fails to do so, central banks cannot ignore financial frictions and financial stability. Dealing with distortions involves operating in the world of the second best, and financial market disturbances may force central banks to make trade-offs among their inflation and output objectives.

Although there is an influential theoretical literature on the credit channel of monetary policy (Kiyotaki and Moore, 1997, Benanke, Gertler and Gilchrist, 1999, Iacoviello, 2005), for a variety of reasons these mechanisms were largely absent from DSGE models at central banks at the time of the financial crisis. In these models asset markets are often assumed to be complete , asset prices are redundant as they are completely pinned down by exogenous fundamentals (productivity, time preference) and asset quantities are irrelevant. The Modigliani-Miller theorem holds, which implies that balance sheet positions do not affect real decisions. The monetary transmission mechanism is simplified to focus on a path for the short term interest rate which influences' consumption and investment directly without any role for financial intermediation either via bank or the security markets. Virtually all DSGE models in use before the crisis 'assumed away' financial frictions more generally and ignored the role of asset quantities, leverage, and collateral constraints which can be crucial influences on the business cycle even when asset prices are 'rational' and fully explained by 'fundamentals' that include a realistic set of asset market variables.

Of course , while there was a pre – crisis consensus on inflation targeting monetary policy and the role that asset prices and quantities should play in guiding that policy, it was not unanimously shared. Researchers at the BIS and some prominent academics (Friedman 2004) had for some years leading up to the crisis offered critiques of the inflation targeting consensus and since the crisis, have called for major changes in that consensus. According to this critique, the inflation targeting monetary policy pursued by many central banks suffered from several defects. The focus on inflation and output stabilization resulted in a path for interest rates that did not sufficiently reflect the dangers that arise when an asset price boom is coupled with a credit boom. The focus on price stability, combined with the fact that many central banks had limited or no supervisory role meant, according to this view, that they ignored or failed to incorporate into their rate setting decisions the very real, systemic threats arising from credit and asset price booms that had been building during the 'Great Moderation'. Finally, confining monetary policy to setting a path for the short term interest rate in retrospect proved insufficient in many countries to cushion booms and busts in real economic activity and inflation resulting from excesses in financial markets. According to this view, it is not clear that any feasible path for the policy rate would have sufficed and thus, a that set of regulatory macroprudential instruments will, going forward, be required to complement the traditional instrument of policy of setting a path for the short term interest rate. As the BIS points out in its 2009 Annual Report

> "It is not surprising that government officials and market participants were largely deaf to the alarms. A common response was: "Even if you are right, and the financial system is in danger, what do you want me to do?" Monetary policymakers' only available instrument was the short-term interest rate, and there was a broad consensus that this tool would be ineffective against the alleged threat. At the macroeconomic level, the expectation was that price stability would be enough and that asset and credit booms would self-correct. And at the microeconomic level, officials

> believed that investors' self-interest would lead them to pay attention to the risks inherent in what they purchased and act as their own regulators. The narrow focus on regulated institutions, combined with a belief in the efficacy of self-regulation, meant that officials were insufficiently alert to system-wide threats. And across countries, markedly differing views about what could and should be done sharply limited progress on what turned out to be an international problem. Discussions of the need for someone to monitor and address the risk in the financial system as a whole mostly fell flat. Numerous central banks took their financial stability objectives seriously…. [but] in the industrial economies – especially the United States, where the problem was becoming the most severe – there was little discussion of what types of tools policymakers might try to use to combat the property and credit booms, and the consequent build-up of systemic risk. And it is easy to see why. Making what would have been wholesale changes to the monetary and regulatory policy frameworks in many countries would have presented nearly insurmountable political and intellectual difficulties. Why would anyone risk such a move when the existing apparatus appeared to be working so well? (BIS Annual Report 2009, pp. 11-12)."

II.2 A Great Moderation but also a Great Leveraging

It is startling to note in the US the chasm that emerged during the 'great moderation' between credit extended to the household and non-financial business sectors – much of it through the 'shadow banking' system to be discussed below - as compared against nominal GDP. This was the 'great leveraging' that accompanied the 'great moderation' (see Figure 1). For example, in 1984, 3.5 trillion dollars of nominal GDP supported 3.5 trillions dollars of private credit outstanding. By 2007, 14 trillion dollars of nominal GDP supported – until it didn't - *25 trillion dollars* of private, non financial credit outstanding. Of course, debt levels are supported not only by income – as measured by nominal GDP – but also by asset valuations themselves. Indeed, throughout the great credit boom, household net worth rose to record levels, hitting 64 trillion dollars in 2007 (up from a mere 12 trillion back in 1984). With household asset values rising faster than debt – and nominal GDP, debt *appeared to be* sustainable and, as a result, too few questions were asked for too long by too many (and I certainly don't exempt myself) about the implications of this surge in non financial leverage which , at least in retrospect, was itself the source for much of this asset price appreciation (certainly land values, but with debt buybacks, also equity valuation in the real word in which Modigliani-Miller doesn't hold). It was just presumed that with inflation tame and GDP growing reliably along its 'great moderation' path, the widening chasm between private credit and nominal GDP could be ignored, much as the roughly coincident breakdown in the velocity of the monetary aggregates was ignored.

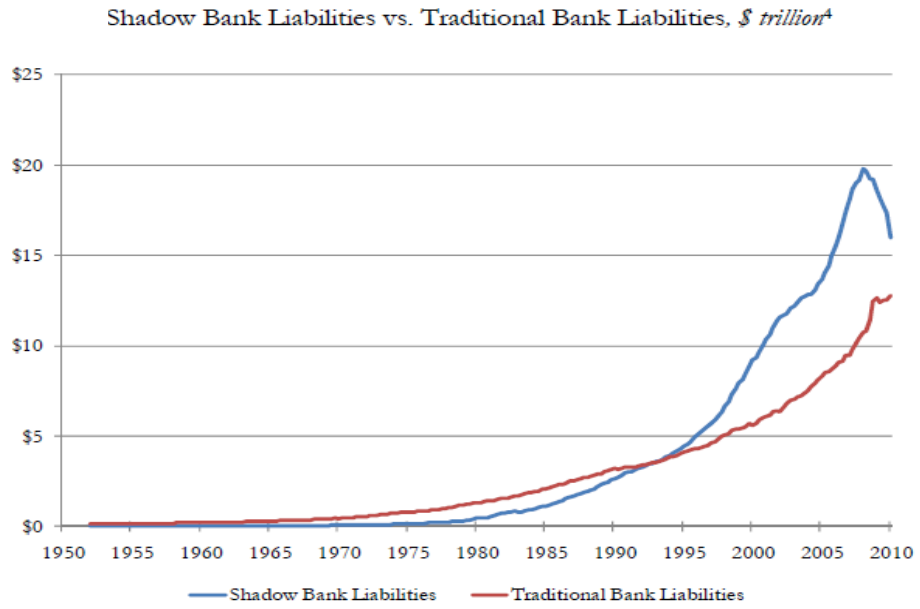


Figure 1: The Great Leveraging (Source: Pozsar et. al.)

It is worth reflecting for a moment on reasons why all this leverage – and the rise in aggregate demand it supported - did not result in inflation or – at minimum a rise in inflation expectations, because if it had, I am confident that central banks would have reacted to it. The surge in leverage did not put upward pressure on inflation for several reasons. The financial globalization that occurred during these 25 years, and more recently the excess of saving relative in investment opportunities and resulting reserve accumulation in many emerging and commodity exporting countries (Bernanke (2005)), opened up a huge global market for US fixed income securities. These bonds were dollar denominated, and with the dollar the global reserve currency, they enjoyed privileged access in global portfolios. As a result of this inflow of foreign capital, the US was able to finance record and ever rising current account deficits. The leverage financed rise in aggregate demand that would have been inflationary in an closed economy was not inflationary in the open economy as imports rose to meet the demand and as global supply rose faster to meet the greater global demand. The dollar did not depreciate on average during the great moderation – and thus was not on average a source of inflation - as the current account widened from zero in 1991 to 7 percent of GDP in 2007 because financial globalization on net increased global demand for US assets, both equities and bonds. So the rise current account deficit contributed to a flatter Phillips curve. But Phillips curves appear to have become flatter globally, and not just in countries running large current account deficits (White 2007). And as Clarida, Gali, and Gertler (2002) show in an open economy DSGE model, for plausible parameter values an open economy Phillips curves derived from micro foundations does indeed become flatter as the economy becomes more open.

Financial history suggests "never again" eventually becomes "this time it is different" and as Rogoff and Reinhart (2009) remind us, throughout history "this time it is different" eventually sets the stage for the next financial crisis. This is especially true when, as emphasized by Minsky (1982) , the "this time it is different" wisdom supports and encourages greater and greater use of leverage which in turn supports asset prices which in turn support more leverage. And importantly, this channel is missing in the justly celebrated and influential Bernanke – Gertler model (1999) presented at Jackson Hole in 1999. In that model, the bubble affects real activity in two ways. First, there is a wealth effect on consumption, although that effect is presumed to be rather modest. Second, because the quality firms' balance sheets depends on the market values of their assets rather than the fundamental values, a bubble in asset prices affects firms' financial positions and, thus, the premium for external finance. Although bubbles in valuations affect balance sheets and, thus, the cost of capital, B and G assume that—conditional on the cost of capital—firms make investments based on fundamental considerations, such as net present value, rather than on valuations of capital including the bubble. This assumption rules out the arbitrage of building new capital and selling it at the market price cum bubble - the Ponzi finance stage of a bubble in the Minsky nomenclature. In the case of the current crisis, the this time it was supposed to be different because securitization and the expertise of the ratings agencies in assessing default risk correlations across various tranches of structured products was in theory supposed to make the financial system *more stable and reduce systemic risk. The system was supposed to be more stable because CDOs and ABS would diversify and distribute credit risk among a large global pool of sophisticated investors and away from an excessive concentration on the balance sheets of the too big to fail institutions that were issuing these securities.* Of course it was recognized that originate and distribute business model of the 'shadow banking system' had its flaws – the primary one being that issuers, *because they were presumed not to retain material exposure to the securities they issued,* had poor incentives to select the best credits to include in the ABS structures. But the cost of poor security selection would be spread, it was thought, among millions of investors around the world who bought these securities and not by the banks that issued these securities. And for those investors – including as it turned out systemically important bank holding companies - who were nervous about the credit quality of the CDOs they purchased, well they could just buy credit default protection – from AIG among others! - who it was just *assumed,* had the internal risk controls necessary to limit exposure to a level that would not bring down the firm, let alone the global financial system. It was supposed to be the brave new world of 'originate and distribute' financial intermediation and for twenty years it was – until in July 2007 when it was no longer.

An explicit assumption deployed by the rating agencies and the investment banks to price these complex structures was that default probabilities – and crucially their correlations – were drawn from a distribution from which realized cash flows from different tranches would cluster close to historic means**.** In the event, historical default correlations were a poor guide to the realized default profiles, and thousands of 'investment grade' CDO deals were downgraded to junk, costing their holders – who in the end turned out to include the very financial institutions that issued them – hundreds of billions of dollars. This was the Lucas critique at work and with a vengeance. The

entire securitization edifice was constructed based on ratings handed out by agencies that used historical correlations of default probabilities for securitization tranches in which a systemic crisis had never before occurred. This in turn made it easier to securitize more and more credit that had never been securitized before via a 'shadow banking' system that, as it would turn out, held put options on systemically important institutions (Pozsar et. al.(2010)) . Which in turn made it more likely that crisis, once it began, would become systemic and as it did so, for the historical correlations to break down once defaults began to occur.

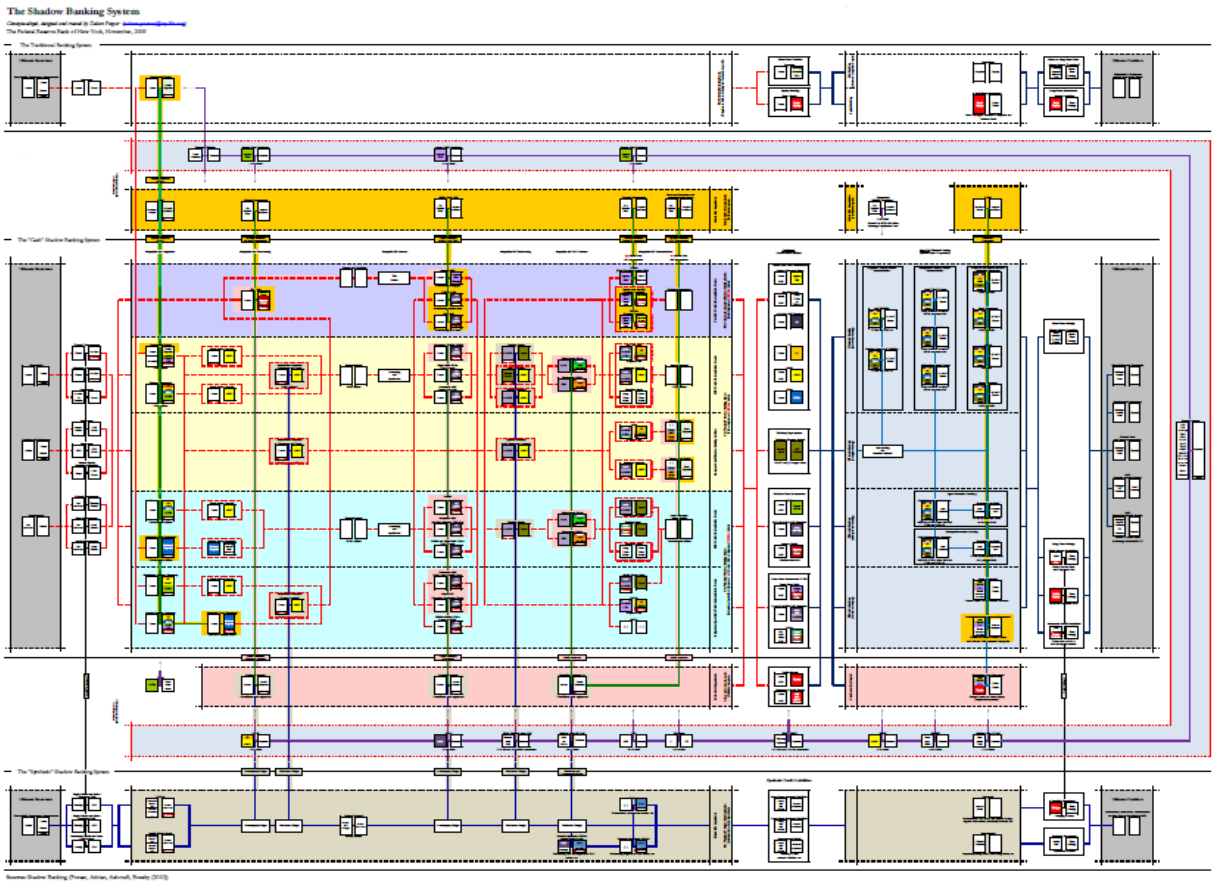
III.3 The Shadow Banking System

In sum, it would seem that the supervision and regulation of US investment and commercial banks during the great moderation was based on *an assumption about how the financial system was supposed to work, not upon sufficient knowledge about how the financial system actually worked.* To illustrate this point, I quote at length from the superb July 2010 New York Fed Staff Report Number 458 'Shadow Banking' (Pozsar et. al):

> The rapid growth of the market-based financial system since the mid-1980s changed the nature of financial intermediation in the United States profoundly. Within the market-based financial system, "shadow banks" [became] particularly important institutions. Shadow banks are financial intermediaries that conduct maturity, credit, and liquidity transformation without access to central bank liquidity or public sector credit guarantees. Examples of shadow banks include finance companies, asset-backed commercial paper (ABCP) conduits, limited-purpose finance companies, structured investment vehicles, credit hedge funds, money market mutual funds, securities lenders, and government-sponsored enterprises. Shadow banks [became] interconnected along a vertically integrated, long intermediation chain, which [intermediated] credit through a wide range of securitization and secured funding techniques such as ABCP, asset-backed securities, collateralized debt obligations, and repo. This intermediation chain…. is the shadow banking system.
>
> *The shadow banking system [grew to rival] the traditional banking system in the intermediation of credit to households and businesses. Over the past decade, the shadow banking system provided sources of inexpensive funding for credit* ***by converting opaque, risky, long-term assets into money-like and seemingly riskless short-term liabilities.*** *Maturity and credit transformation in the shadow banking system thus contributed significantly to asset bubbles in residential and commercial real estate markets prior to the financial crisis.*
>
> …[T]he shadow banking system became severely strained during the financial crisis because, like traditional banks, shadow banks conduct credit, maturity, and liquidity transformation, but unlike traditional financial intermediaries, they [lacked] access to public sources of liquidity, such as the Federal Reserve's discount window, or public

sources of insurance, such as federal deposit insurance. **The liquidity facilities of the Federal Reserve and other government agencies' guarantee schemes were a direct response to the liquidity and capital shortfalls of shadow banks and, effectively, provided either a backstop to credit intermediation by the shadow banking system or to traditional banks for the exposure to shadow banks.**

Figure 2: The Shadow Banking System (Pozsar et. al.)



With the benefit of hindsight (excepting rare examples such Rajan (2005) and McCulley (2007) two of very few to foresee the essential contours of the growing *systemic* instability being created by the shadow banking system) and authoritative, post-mortem research such as that in the Pozsar et. al., it seems clear – at least to this author - that the financial crisis and the credit and securitization bubble that preceded it resulted not only from spectacular failures in securities markets - to allocate capital and price default risk - but serious failures also as well by policymakers to adequately understand, regulate, and supervise these markets. Policymakers, academics, and market participants simply *didn't know what they didn't know*. They assumed that either it couldn't happen (after all, AAA securities 'never' default), or if it did, it would be systemically unimportant. Until the tide went out. But by then it was too late.

III: A Forward Looking Taylor Rule meets the Zero Lower Bound

In this section, I first review and assess Fed policy since 2000 with comparison to *a* forward looking Taylor rule benchmark. For concreteness, when I refer to *the* Taylor rule, I refer to John Taylor's original policy rule equation and with his original parameters. The focus will be on the policy path chosen for the Federal Funds rate until December 2008 when the Fed, de facto if not de jure, hit the zero lower bound. I next review the Fed's 2009-2010 quantitative easing programs to purchase Treasuries and mortgage backed securities. Of course, the Fed during the crisis introduced a number of innovative programs and measures to provide liquidity, secured by a wide assortment of eligible collateral, to commercial and later – after Bear Stearns - investment banks, as well as the TALF program support new issuance of asset backed securities that funded credit cards, auto loans, and student loans. A detailed review of these effective, timely programs – most since wound down - as well as programs introduced to support the commercial paper market, is beyond the scope of the present paper but a chart (Figure 9) is included for reference. As emphasized by Pozsar et.al. "The liquidity facilities of the Federal Reserve and other government agencies' guarantee schemes were a direct response to the liquidity and capital shortfalls of shadow banks and, effectively, provided either a backstop to credit intermediation by the shadow banking system or to traditional banks for the exposure to shadow banks."

At the outset of the crisis, the Fed pursued a textbook policy response. Perhaps that's not surprising given that Ben Bernanke is a successful textbook author, but what *is* interesting is how well a real time forward – looking Taylor rule that describes the Greenspan Fed's policy after the bursting of the equity bubble also accounts for the Bernanke's Fed policy in 2007-2008 easing cycle. In this section, I review and extend the approach introduced in Clarida (2008) to calibrate and compute a forward looking Taylor rule (FLTR) using real time financial market data. I then use the resulting Taylor rule to interpret and evaluate Fed policy until the Fed Funds rate hit the ZLB in December 2008.

It is standard now to estimate forward looking Taylor rules of the form

$$r_t = \overline{rr}_t + \pi^* + \theta\ E_t\{\pi_{t+n} - \pi^*\} + f\ E_t\{\tilde{y}_{t+m}\}$$

using an instrumental variable/GMM approach (CGG (1998; 2000)). The approach introduced in (CGG (1998)) uses first stage regressions of inflation and the output gap on a set of macro instruments to estimate the forward looking Taylor rule and test the cross equation restrictions implied by the theory. Often in this work, it is assumed, following Taylor, that the 'neutral' real interest rate is constant.

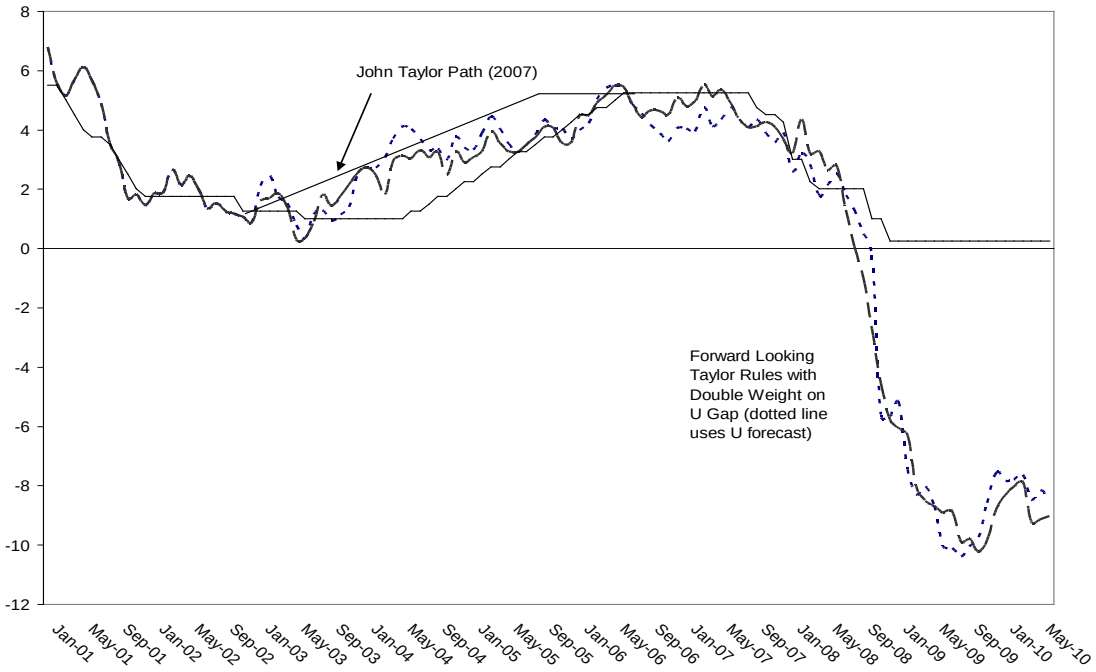
Clarida (2008) suggests an alternative approach for calibrating a forward looking Taylor rule that makes use of real time financial data on real interest rates on inflation indexed bonds and breakeven inflation – the difference between the yield on a nominal bond and an inflation indexed bond. A potential advantage of this approach is that it may be robust to specification error arising from equating first stage regressions of inflation on a set of macro instruments with evolving central bank expectations of inflation. In particular, it is potentially robust to regime changes, learning, and structural shifts that have impacted expectations about future real interest rates and inflation. It is also an intuitive way to allow for a time varying real interest rate. We do this by using

variation in forward real interest rates relative to a constant risk/term premium as an indicator of where the financial markets think real rates will settle down after business cycle influences dissipate. For the US, we use 5 year forward real interest rates computed from the yields on TIPS with 10 years and 5 years to maturity to extract these forward rates.

The approach is straightforward. Instead of projecting realized inflation on a set of macro instruments to proxy for expected inflation, we use the financial market data on break even inflation. Break even inflation is just the difference between the nominal yield on a 5 year government bond and the yield on a 5 year inflation indexed bond. We allow for a constant risk premium to compensate risk averse investors for the inflation risk they take on with a nominal government bond. We also allow for time variation in the 'neutral' real interest rate. Instead of building a macro model for the neutral US real interest rate, we extract from the TIPS yield curve a forward real interest rate. We select the 5 year TIPS yield 5 years forward for two reasons. First a consistent data series on 5 year TIPS yields 5 years forward is available from Bloomberg going back to 2000. Second, the business cycle/monetary policy influences on short term real interest rate can plausibly be expected to have died out after 5 years, at least in expectation. As with break even inflation, we allow for a constant term premium in the TIPS yield curve to account for a positive slope between unobserved expected real policy rate 5 years forward and the 5 year forward TIPS yield. When investors price the real yields on 5 year and 10 TIPS, they are also pricing 5 year TIPS 5 years forward. Under our restriction of a constant real term premium, variation in this real yield 5 years forward can provide information about where the markets think real yields will be after near term business cycle and monetary policy impacts have dissipated (which they presumably will, at least in expectation, after 5 years). Finally, for our output gap measure we use an unemployment gap with an Okun's law coefficient of 2.5 and a natural rate of 4.75, which is consistent with the Fed's medium term forecasts at the time. For θ, I use John Taylor's preferred value of 1.5. However, for f it appears that the Greenspan and Bernanke Fed's place a greater weight on stabilizing the output gap than would a John Taylor Fed, and I use a value of 1, or twice John Taylor's preferred value of 0.5. The results are shown in Figure 3. For the unemployment variable, we use the actual unemployment rate (solid black line) to back out the output gap for the FLTR. The dotted line shows the FLTR computed using Bloomberg surveys of the year - ahead unemployment or, when available, the Fed's year - ahead forecast of the unemployment rate. The combined adjustment for the real term premium and inflation risk premium is 50 basis points.

As can be seen from the chart, this real time forward - looking Taylor rule does a good job of describing funds rate path of Greenspan/Bernanke Fed during this decade. This is the case whether one uses contemporaneous unemployment or the year ahead forecast. Importantly, this calibration of the forward looking Taylor rule – unlike the one estimated by CGG (2000) using GMM and linear projections of realized inflation on a vector of macro instruments - does not incorporate interests rate smoothing. The half life of deviations of the funds rate from the this forward looking Taylor rule is quite short, only 3 months. This is consistent with Rudebusch (2006) who challenges the interest rate smoothing explanation for Fed policy.

Figure 3: Taylor Rules



As can be seen from the chart, the Fed eased right on its FLTR path – with double weight on output gap – using publically available, rolling *forecast* of future unemployment, with similar results using actual unemployment. That is Bernanke followed following the path of ease in 2007-2008 that Greenspan did in 2001 – 2002. Bernanke himself has attributed the fall in real interest rates during the last decade to a 'global saving glut' (Bernanke (2005)). This indicates that the Fed takes the global influence on US neutral real interest rates seriously. Greenspan during his tenure alluded to the 'conundrum' , a situation in which the Fed's influence over long term interest rates is much diminished compared to previous periods, a phenomenon which has been attributed to the globalization of the financial markets in a world of (explicit or implicit) inflation targeting (Greenspan (2007)). According to this analysis, variations in the neutral real interest rate, perhaps due to the 'global saving glut' and enhanced financial integration in a world of inflation targeting central banks, played an important role in Fed policy this decade. It is also clear from the chart that asset prices and quantities appeared to play a minor role in accounting for the funds rate path during the last decade over and above any influence they may have had on inflation, unemployment, or real rate expectations.

One episode in which policy deviates for some time from this rule is June 2003 – November 2005. John Taylor (2007;2008) has recently been critical of Fed policy during this period, and argues that this policy mistake by the Fed – keeping the funds rate at 1 percent for a 'considerable' period and then, beginning in June 2004, hiking at a pre-announced 'measured pace', was a significant contributing factor to the housing bubble. The counter factual path for the federal funds rate during this period suggested by Taylor in 2007 is shown on the chart. It is important to note that , given assumed weight of $f = 1$ for the FLTR coefficient on the output gap, *and given the real time data available to the Fed at the time on forward real interest rates, break even inflation, and the*

unemployment rate , the Fed's policy in the 2001-2003 easing cycle to cut the funds rate to 1 percent by June 2003 was entirely consistent with this Taylor rule, as was the policy in the subsequent rate hike cycle to increase the funds rate to 5.25 percent. No doubt, the low short term interest rates that prevailed in 2003-2005 contributed, via the then - popular adjustable rate mortgages that many sub prime borrowers took on, to some extent to the housing bubble. But in light of factors discussed above – the explosive growth in the shadow banking system and the global saving that held down long term bond yields – I doubt whether or not any plausible alternative path for the Federal Funds rate in 2003-2005, including that implied by John Taylor's original rule, would have prevented the credit bubble which extended to all corners of the securitization markets and the shadow banking system: credit cards, auto loans, students loans, home equity loans, 'leveraged' loans. Simulations reported in Bean et. al (2010) support this judgment. Jarocinski and Smets (2008) do find that accommodative shocks to US monetary policy can account for *some* of the rise in housing prices during this period, but even absent these accommodative shocks house price inflation in their empirical model would have been running at 7 to 8 percent a year instead of 10 – 11 percent a year. Clearly, there is not a professional consensus on this point. However, it should be recalled that the Fed *was* raising interest an ultimately by an amount fully consistent with "a" forward looking Taylor rule for a central bank that places substantial weight on the output gap. Figure 5 provides a real time decomposition of the observed federal funds rate into respective contributions to the FLTR of the output gap, expected inflation, and the neutral nominal interest rate (sum of the neutral real interest rate plus an assumed inflation target of 2). The residual is shown in Figure 6.

Bernanke (2010) defends Federal Reserve policy over the 2003-2005 period, arguing that policy rates implied by conventional backward looking Taylor rules can be, and in this episode, are misleading benchmarks for evaluating Fed policy. As with the forward looking Taylor rule depicted above, central banks usually set policy not on the basis of past inflation but rather their expectations of future inflation. Based on Fed transcripts and minutes now available, as well as meetings between Fed and Treasury officials that I attended at the time, during 2002-3, the FOMC was concerned that core inflation (which fell from 2.7 percent year over year in December 2001 to 1.1 percent in December 2003) was drifting well below the Fed's implicit target and that, in the absence accommodative policy and with unemployment at least 1.5 to 2 percentage points above the Fed's implicit Nairu and continuing to increase 18 months after the end of the recession, headline inflation could well follow. The Fed at that time was also reluctant to deploy quantitative easing via direct purchases of longer duration treasuries, although that option was discussed. While Bernanke finds that using Greenbook inflation forecasts instead of actual inflation in an otherwise standard Taylor rule eliminates much of the difference between the target Federal Funds rate and the prescribed Taylor rule rate, break even and survey measures of inflation began to rise noticeable in July 2003 and remained elevated – relative to prior experience – until the onset of the financial crisis in the summer of 2007. Its seems plausible to conclude that the Fed's language stating that the Funds rate would remain at 1 percent for a 'considerable period' and that, after June 2004, the funds rate would be normalized at a 'measured pace' should be seen as efforts to guide market expectations away from a path of continued disinflation.

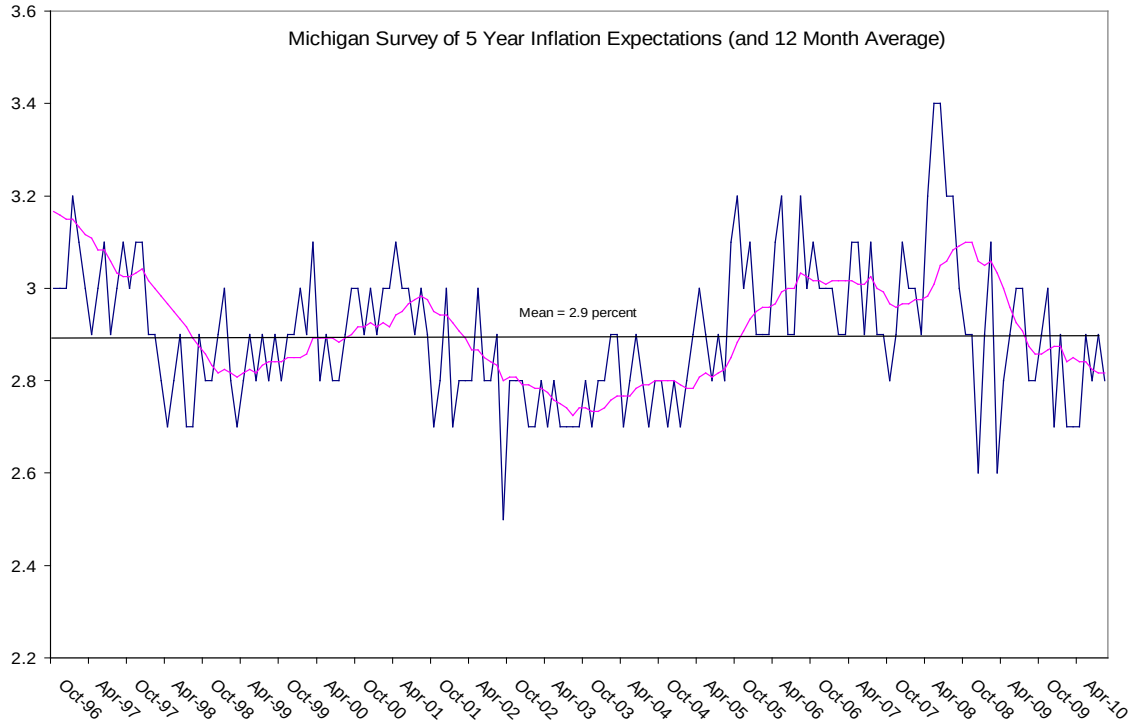


Figure 4: Michigan Inflation Survey

IV: September 2008 to the Present: The Zero Bound and Quantitative Easing

Amidst the financial turmoil that was the autumn of 2008, the Fed cut the funds rate aggressively, first by 50 basis points (from 2 to 1.5 percent) on October 7th in a coordinated action with other major central banks, then by 50 basis points three weeks later at a scheduled meeting of October 28th, and finally by 75 basis points at the scheduled meeting of December 15th, bringing the funds rate to 25 basis points. As the chart above makes clear, although financial conditions were clearly on the Fed's radar, the forecasted rise in unemployment, the fall in expected inflation, and the decline in the neutral policy rate (all of which were no doubt important influences on forecasts of unemployment, inflation, and the neutral policy rate) can fully account for the Fed's decision to go to the ZLB. Indeed, if anything, the Taylor rule paths shown above imply hitting the ZLB several months *sooner* than the Fed actually did. So at least in this case, it is hard to make the argument , as some have suggested, that the Fed sought to ease aggressively after Lehman to 'send a signal'. The forward looking macro data, and the Fed's prior reaction function, fully justified going to the ZLB without any additional motivation required.

A central bank, once it hits the ZLB, has three complementary strategies available to lower bond yields further and to boost asset prices. First, the central bank can offer *forward guidance* promising to keep future policy rates low for an extended period and, once it commences to normalize policy , to hike rates at a measured pace (Eggertson-Woodford (2003); Walsh (2009)). Second, the central bank can pursue *quantitative*

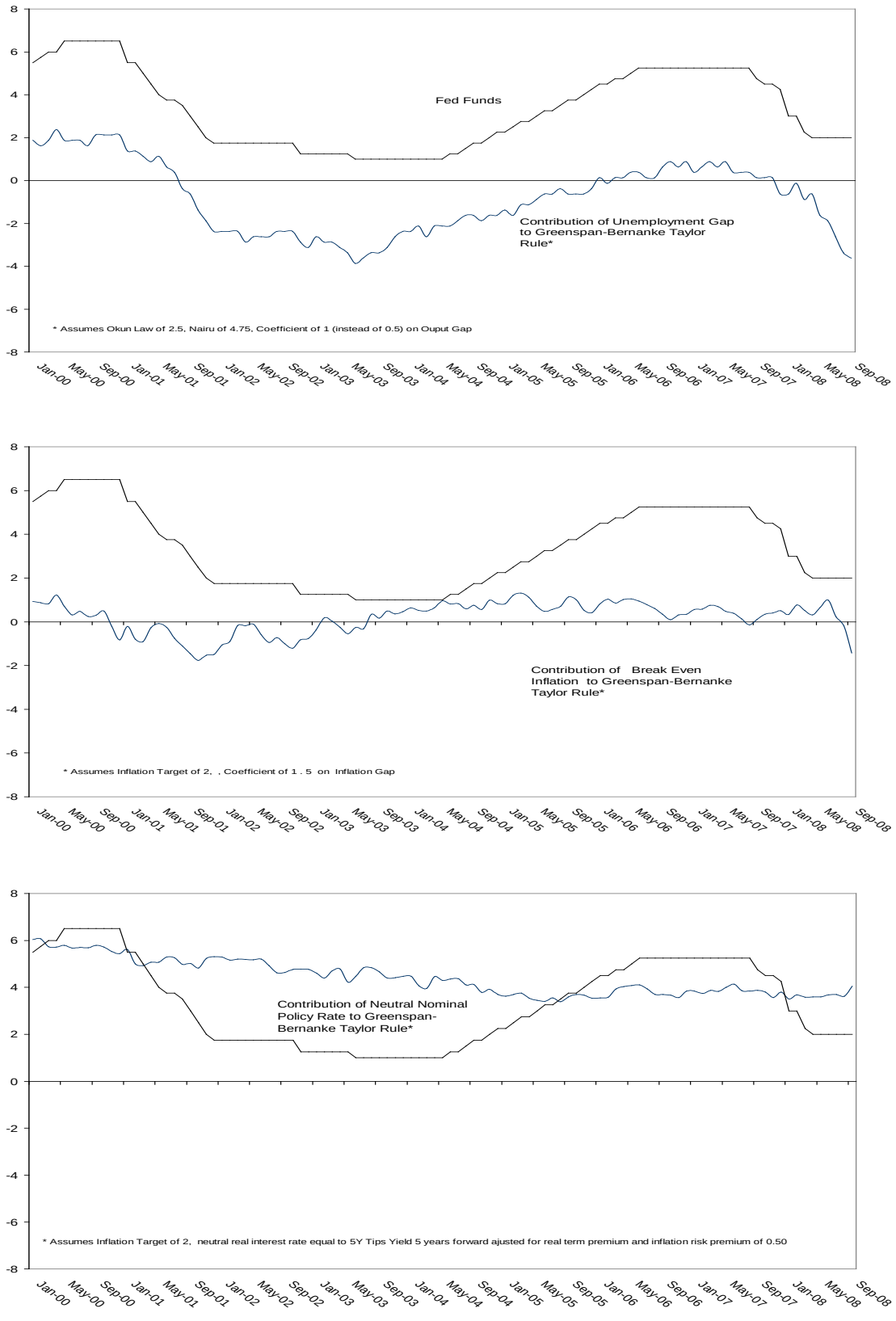


Figure 5: Historical Decomposition of Federal Funds Rate from the FLTR

easing by printing money to buy longer dated government bonds. Third the central bank can pursue *credit easing* by printing money to buy select private sector debt obligations such as residential mortgages (the Fed), corporate bonds (the Bank of England), or covered bonds (the ECB). Both QE and CE can be characterized, in the current parlance, as *large scale asset purchase* (LSAP) programs. In another variant of credit easing, featured as part of the Fed's TALF program, the central bank prints money to lend to private sector vehicles that purchase portfolios backed by *newly originated* consumer or commercial loans. In TALF, these loans were for terms of three years and at favorable rates compared to what was available to similar vehicles outside the Fed program. Importantly, TALF loans from the Fed were 'without recourse' which meant that the Fed bore credit risk to the extent that losses on these portfolio's exceeded the initial haircut (the difference between the amount lend by the Fed and the value of the collateral at the time of initial purchase). Before moving on, we should mention a fourth strategy of available to central banks, a sterilized *large scale asset swap* (LSAS) under which the the size of the central bank balance sheet is unchanged but the composition is changed. The Fed can be thought of pursuing an LSAS policy with its August 2010 decision to maintain the size of its balance sheet by purchasing treasuries as its portfolio of MBS rolls off, as of course can the Ecb with its May 2010 program to sterilize its purchases of debt issued by select European sovereigns who prices had plunged on market concerns of default or forced restructuring.

As emphasized by Levin, Lopez-Salido, Nelson, Yun (2010), in the context of the benchmark DSGE models not only can forward guidance be effective in stabilizing the economy in the face of a contractionary demand shocks, the literature actually leaves little if any scope for any further improvements in stabilization performance via quantitative easing (credit easing is *per se* not of interest in these models as there is no private credit market. However, for a recent extension that includes credit spreads and a role for credit easing, see Curdia and Woodford (2009; 2010)) Importantly these results pertain to optimal policy *under commitment* . But, as emphasized by Bean et. al (2010), because forward guidance policy works by boosting expectations about future inflation, it faces the time consistency problem that the central bank lacks the incentive to stick to this strategy once economic conditions have improved and the ZLB episode is no longer binding.

Discussion and assessment of the actual practice of forward guidance as a viable monetary policy strategy when policy hits the ZLB often fails to distinguish this policy strategy from the alternative under which the central bank simply communicates that policy rates are likely to stay low because, and only so long as, output and inflation are expected to stay low. Although this is sometimes called a policy of 'conditional commitment' that characterization is potentially misleading, because this is in practice a policy of discretion and should not be expected to deliver the substantial benefits that credible commitment can , in theoretical models in which the central bank is simply *assumed* to have a commitment technology , deliver. In my judgment, most (all?) central banks most (all?) of the time - the Fed included - pursue policies of discretion, and while such transparency may contribute to better central bank communication, such policies are – and are usually seen by the financial markets to be – polices of discretion. In this regard, Fed communication during the 2003-2004 episode discussed above is instructive. As discussed in Levin et.al. (2010), after the August 2003 meeting, the

FOMC provided explicit forward guidance about the likely evolution of its funds rate target. It maintained the target federal funds rate at 1 percent (having cut it by 25 basis points at the June meeting) and stated that "the risk of inflation becoming undesirably low is likely to be the predominant concern for the future. In these circumstances, the Committee believes that policy accommodation can be maintained for a considerable period." The minutes of that FOMC meeting state that "while the Committee could not commit itself to a particular policy course over time, many of the members referred to the likelihood that the Committee would want to keep policy accommodative for a longer period than had been the practice in past periods of accelerating economic activity." The "considerable period" language was retained through the end of 2003. From May 2004 through the end of 2005, FOMC statements indicated that "the Committee believes that policy accommodation can be removed at a pace that is likely to be measured." *However, and crucially, committee also underscored the conditional nature of this forward guidance by stating that "the Committee will respond to changes in economic prospects as needed to fulfill its obligation to maintain price stability."* This conditionality was introduced in June 2004—the point at which the FOMC began raising the target federal funds rate at a pace that was indeed measured, hiking by 25 basis points at 17 consecutive meetings (13 chaired by Alan Greenspan and 4 chaired by Ben Bernanke), until reaching 5.25 in June 2006.

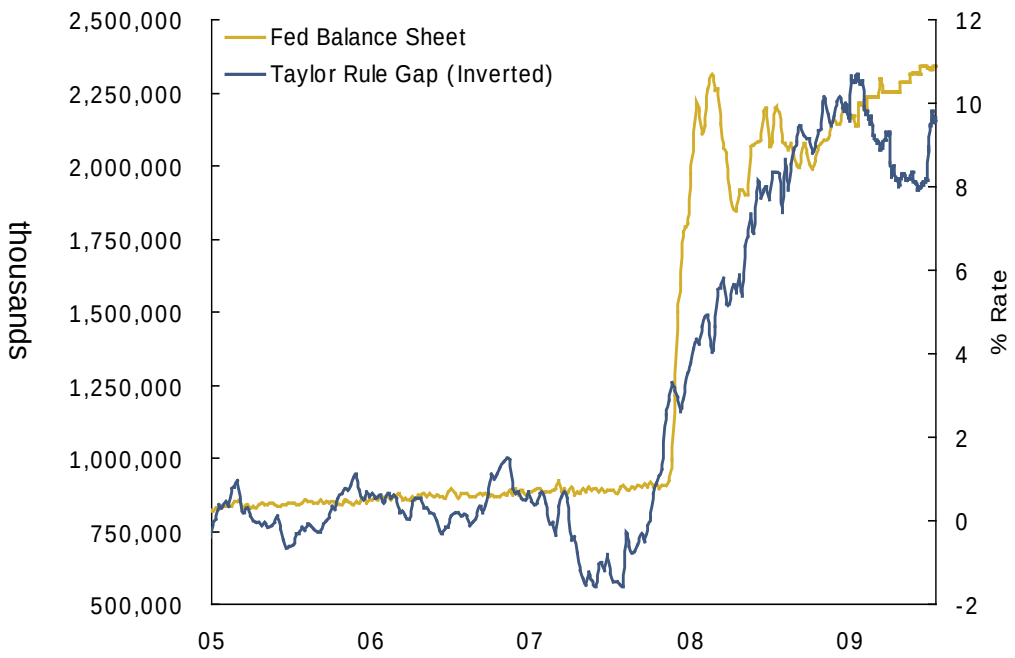
As emphasized by Walsh (2009), the inability of the Fed in the present circumstances to make a credible commitment to promising future inflation poses a potentially serious constraint on stimulating the economy.

> In fact, rather than promising future inflation, policymakers seem to be concerned that expectations of future inflation remain anchored. In testimony before the House Committee on Financial Services in July (2009) Federal Reserve Chairman Bernanke stressed that the Fed would prevent a rise in inflation as the economy recovers from the current recession, stating "....that it is important to assure the public and the markets that the extraordinary policy measures we have taken in response to the financial crisis and the recession can be withdrawn in a smooth and timely manner as needed, thereby avoiding the risk that policy stimulus could lead to a future rise in inflation." Mishkin 2009 is explicit in arguing that even in a financial crisis it is imperative to keep inflation expectations anchored. While a decline in inflation expectations at the ZLB would boost real interest rates and worsen the downturn, a rise in inflation expectations would, as Mishkin notes, significantly affect future inflation and could be counterproductive. And commitment policies require that any promise to inflate in the future must be carried out; failing to do so would remove the possibility of influencing expectations if the ZLB were encountered again in the future. If the central bank lacks the high degree of credibility implicit in the optimal commitment solution or is unwilling to let inflation expectations rise, the ZLB does pose a serious constraint on stimulating the economy. And when policy is conducted in a

discretionary environment in which the central bank cannot affect expectations directly, the costs of the ZLB rise markedly. Current Federal Reserve policy seems to be inconsistent with the recommendation of the consensus model for optimal policy at the ZLB.

At the time of this writing. the Fed is promising to keep interest rates low for an 'extended period' because macroeconomic conditions warrant, and are expected to warrant, that policy for an extended period. This is policy by discretion. It cannot, in and of itself, be expected to be effective in stabilizing the economy as is promised in the theoretical literature in which the central bank *by assumption* can credibly commit to policies that are not time consistent. Moreover, as emphasized by Levin et. al. (2010) , even in DSGE models under commitment, results pertaining to the stabilizing effects of forward guidance appear to be sensitive to the specification of the shock process and to the interest elasticity of aggregate demand. In particular, these authors find that while forward guidance is effective in offsetting natural rate shocks of moderate size and persistence, macroeconomic outcomes are poor for larger and more persistent shocks. They conclude that. "while forward guidance could be sufficient for mitigating the effects of a 'Great Moderation'-style shock, a combination of forward guidance and other monetary policy measures—such as large-scale asset purchases—might well be called for in responding to a 'Great Recession'-style shock. The Fed, thankfully, knows this and in the fall of 2008, having exhausted its options under Plan A after hitting the zero lower bound, put in place Plan B(alance sheet).

Figure 6: Gap Between Funds Rate and the FLTR versus Size of Fed Balance Sheet

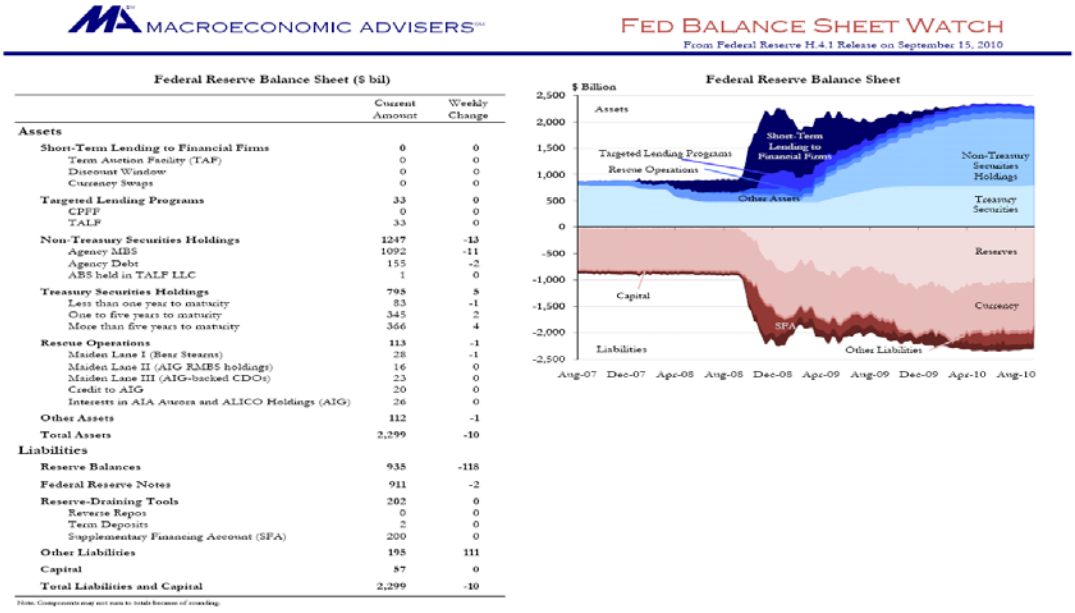


As can be seen from Figure 6, during the first year of the crisis, while the Fed did a number of innovative things, one thing it did not do was to print money The overall size of the Fed's balance sheet was roughly constant from August 2007 – September 2008. But in the fall of 2008 as the financial crisis became global and world credit, equity, and interbank markets teetered on the verge of collapse, the Fed began an explicit, massive LSAP campaign. In the first several months, the program was directed at providing liquidity to the secured lending (repo), commercial paper, and the bank funding (libor) markets (liquidity that, as Pozsar et. al. document, "provided either a backstop to credit intermediation by the shadow banking system or to traditional banks for the exposure to shadow banks.") But in November 2008 , the Federal Reserve announced purchases of housing agency debt and agency mortgage-backed securities (MBS) of 'up to' $600 billion. In March 2009, the FOMC decided to substantially expand its purchases of agency-related securities and, as well, to purchase longer-dated Treasury securities , with total asset purchases of up to $1.75 trillion, an amount twice the magnitude of total Federal Reserve assets prior to 2008. The FOMC stated that the increased purchases of agency related securities should "provide greater support to mortgage lending and housing markets" and that purchases of longer-term Treasury securities should "help improve conditions in private credit markets."

Gagnon et. al. (2010) and Neely (2010) provide an excellent overview of the design, implementation, and impact of the LSAP program on financial markets. The literature has tended to focus on the lowering of the yield curve term premium as the primary channel through which an LSAP can impact bond yields. When the Fed buys mortgages or long term bonds, it reduces the amount of those securities held by the public while at the same time increasing the amount of short-term, risk-free bank reserves held by the private sector. In order for investors to be willing to make those portfolio balance adjustments, expected returns on the purchased securities must decline. This is not in dispute. The question is: by how much will bond yields falls for any given size Lsap program. Or to put it the other way, for any given desired reduction in bond yields, how big does an Lsap program need to be? As Gagnon et. al. rightly emphasize, the portfolio balance effect on bond yields, in contrast to the forward guidance strategy that can be effective under commitment, has nothing to do with the expected path of short term interest rates. This is important because in practice, LSAPs have not been used as a signal that the future path of short-term risk-free interest rates would remain low. As discussed in Svensson (2003), because it is longer real interest rates that affect aggregate demand, a reduction of long nominal interest rates could reduce long real rates and contribute to an escape from the liquidity trap regardless of the expected path for the policy rate.

Many scholars gave been skeptical that Lsap programs can be an effective monetary policy tool once the zero lower bound has been reached. For example, Goodhart (1992, p. 327) states that "studies of the effect of relative debt supplies (at the long, medium, and short end) on the yield curve have not found any strong, significant effect," and similar criticisms have been offered by Walsh (2009). Also, as Levin et. al. (2010) point out, the argument about non-traditional policies' effects is a ceteris paribus argument. Lsap programs might exert downward pressure on bond yields, but by doing so contribute to an improvement in the economic outlook or a rebound in inflation expectations which could in turn raise long-term rates .

Figure 7: Fed Balance Sheet September 2010 (Source: Macroeconomic Advisers)



MACROECONOMIC ADVISERS

FED BALANCE SHEET WATCH

From Federal Reserve H.4.1 Release on September 15, 2010

Federal Reserve Balance Sheet ($ bil)

	Current Amount	Weekly Change
Assets		
Short-Term Lending to Financial Firms	0	0
Term Auction Facility (TAF)	0	0
Discount Window	0	0
Currency Swaps	0	0
Targeted Lending Programs	33	0
CPFF	0	0
TALF	33	0
Non-Treasury Securities Holdings	1247	-13
Agency MBS	1092	-11
Agency Debt	155	-2
ABS held in TALF LLC	1	0
Treasury Securities Holdings	793	8
Less than one year to maturity	83	-1
One to five years to maturity	345	2
More than five years to maturity	366	4
Rescue Operations	113	-1
Maiden Lane I (Bear Stearns)	28	-1
Maiden Lane II (AIG RMBS holdings)	16	0
Maiden Lane III (AIG-backed CDOs)	23	0
Credit to AIG	20	0
Interests in AIA Aurora and ALICO Holdings (AIG)	26	0
Other Assets	112	-1
Total Assets	2,299	-10
Liabilities		
Reserve Balances	935	-118
Federal Reserve Notes	911	-2
Reserve-Draining Tools	202	0
Reverse Repos	0	0
Term Deposits	2	0
Supplementary Financing Account (SFA)	200	0
Other Liabilities	195	111
Capital	57	0
Total Liabilities and Capital	2,299	-10

Note: Components may not sum to totals because of rounding.

I think that, in the context of present circumstances, much of the existing literature either misses entirely or under-appreciates how robust an Lsap program *can* be at lowering bond yields and/ or credit spreads *regardless of the credibility of the central bank's future commitment to the policy, how expectations are formed, or how equilibrium term premium are determined.* This is because **a central bank can everywhere and always put a floor on any nominal asset price (or set of nominal asset prices) for as long as it wants regardless of 1) how 'credible' it's commitment is 2) how expectations are formed or 3) how term or default premia are determined.** As argued by Svensson (2003), while it may be difficult *ex ante* to determine how large an Lsap program would need to be to reduce bond yields because of difficulties in estimating the determinants of the term premium, this need not be an impediment to using Lsap as an important stabilization tool. As suggested by Bernanke (2002) himself, the central bank simply needs to stand ready to buy government bonds with maturities at that point on the curve whose yields it wants to cap by posting a bid each day at the minimum nominal prices it stands ready to support. It may choose to make this price public in advance, or to lay out a forecast of how long the price support program will last, or to describe an exit strategy based upon observable macroeconomic conditions. *But these features are not required to cap the yield at whatever level the central bank deems desirable.* So long as the central bank is willing to buy an unlimited volume of those bonds (potentially including the entire outstanding stock) at the interest rate it wishes to put a ceiling on, it will succeed. And of course, the above reasoning also applies directly to an Lsap program targeted at corporate bonds or mortgage backed securities. The central bank can, if it so desires, robustly put a ceiling on the yield of *any* bond, public or private, it chooses to target.

It is important to note *what I am not* suggesting. I am of course not suggesting a central bank can *peg* any bond price at any level – in the present context put a *floor* on any interest rate or credit spread as well as a ceiling - because that would require *selling* as well as *buying* whatever quantity the market required to hold the asset at that price. As the central bank's holding of any asset are finite, asset price pegs (think currency pegs) can be and are regularly attacked, and these attacks can either be uniquely determined by fundamentals (Henderson and Salant (1977)) or self fulfilling (Obstfeld (1996)). And so an interest rate or credit spread *pegging* scheme would be subject to the Wicksell critique (see Woodford (2003) for the definitive discussion). In practice, an effective Lsap program will generally need to be combined with a communications strategy that *credibly* lays out the mapping from observable macro data (inflation, unemployment) to the exit from the strategy. To be clear, I am suggesting an Lsap policy of *discretion* that needs to be time - consistent with the central bank re – optimizing once the desired macro outcomes are achieved. As such, I am not suggesting an Lsap program combined with an announced *price level* – as opposed to an inflation - trigger. Such a policy is *not* time consistent (Woodford (2003); Clarida – Gali- Gertler (1999)) and, in my judgment, runs the danger of confusing rather than anchoring inflation expectations. Although this is sometimes called a 'just do it' strategy, the problem is that, absent a commitment technology, public and the markets know it won't get done!

Of course, the Fed as of the time of this writing has not specifically implemented Lsap programs with an explicit, public ceiling on bond yields. Instead, as discussed above, the Fed's Lsap programs specified in advance (but in two distinct announcements November 2009 and March 2010) programs to purchase a total 1.25 trillion dollars of agency pass though securities (across a range of coupons), 300 billion of US Treasuries (mostly in the 'belly' of the Treasury curve) , and 200 billion of agency debentures. To put these numbers in some context, 1.25 trillion dollars of agency Mbs represented roughly 25 percent of the outstanding supply and nearly 30 percent of the supply in the hands of the public (netting out the agencies' own holdings of Mbs). In terms of flows, the net issuance of mortgages during the 15 months of the Mbs program (gross issuance net of repayments) was roughly 600 billion dollars, *so that Mbs purchases by the Fed were twice the net supply of Mbs into the market during the tenure of the program*. The 200 billion dollars of agency debenture purchases represented roughly 10 percent of the outstanding supply, while the 300 billion of Treasuries represented just 3 percent of the outstanding supply and roughly 15 percent of the net issuance in 2009). While it may be tempting to look for effects on these programs on a market by market basis (with say the Mbs program impacting mortgage *spreads* and the Treasury program impacting the level of nominal risk free interest rates), as Gagnon et. al. remind us, that would not be the correct approach. Fixed income markets for Treasuries, agencies, and Mbs pass – though securities (especially now that credit risk is no longer a factor impacting Mbs yields with the agencies now under a conservatorship arrangement with the US Treasury) tend to reflect, at least in part, the amount of *duration* that is taken out of or added to the market by Fed programs or new issuance. Gagnon et. al. calculate that as of January 2010, the $300 billion in completed Treasury purchases equaled $169 billion 10-year equivalents, agency debt purchases of $164 billion equaled $59 billion 10-year equivalents, and agency MBS purchases of $1160 billion equaled $573 billion 10-year equivalents.

Thus, the $1625 billion in completed purchases as of January 2010 (which was of comparable magnitude to the net issuance of Treasuries during this period) equaled roughly $800 billion 10-year equivalents. Gagnon et. al estimate that, when completed in March 2010 , the Lsap programs represented $850 billion of 10-year equivalents, which was roughly 6 percent of nominal Gnp. Using both event study methodology and time series analysis, Gagnon. Et. al. conclude that

> By reducing the net supply of assets with long duration, the Federal Reserve's LSAP programs appear to have been successful in reducing the term premium. The overall size of the reduction in the 10-year term premium appears to be somewhere between 30 and 100 basis points, with most estimates in the lower and middle thirds of this range. In addition to this reduction in the term premium, the LSAP programs had an even more powerful effect on longer term interest rates on agency debt and agency MBS by improving market liquidity and by removing assets with high prepayment risk from private portfolios…. We show that these reductions in interest rates primarily reflect lower risk premiums rather than lower expectations of future short-term interest rates (pp. 4, 28)

To me, these results make sense and appear to be in the right ballpark given the particular way the Fed set up and communicated the November 2008 and March 2009 Lsap programs . If anything, I believe they understate the impact these programs had on Mbs yields. This is because even though the Fed did not announce an explicit ceiling for Mbs yields, the program was seen by many market participants as implicitly targeting a ceiling on mortgage rates, specifically the 'par' coupon that applies to recently issued mortgages. As can be seen, those who had that expectation were not disappointed.

Figure 8: Impact of Fed MBS Purchase Announcement

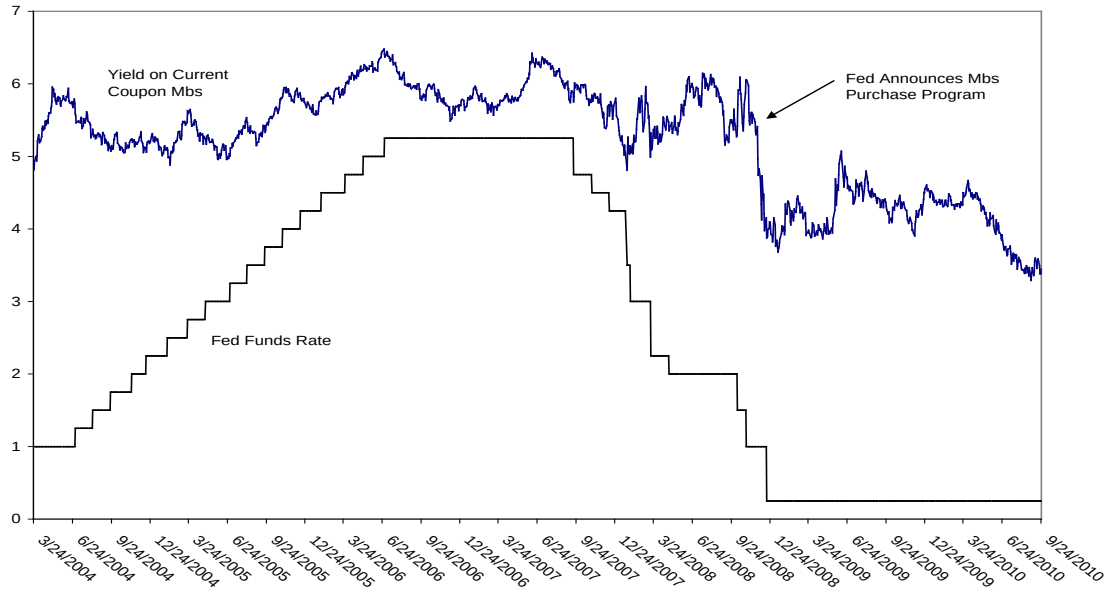
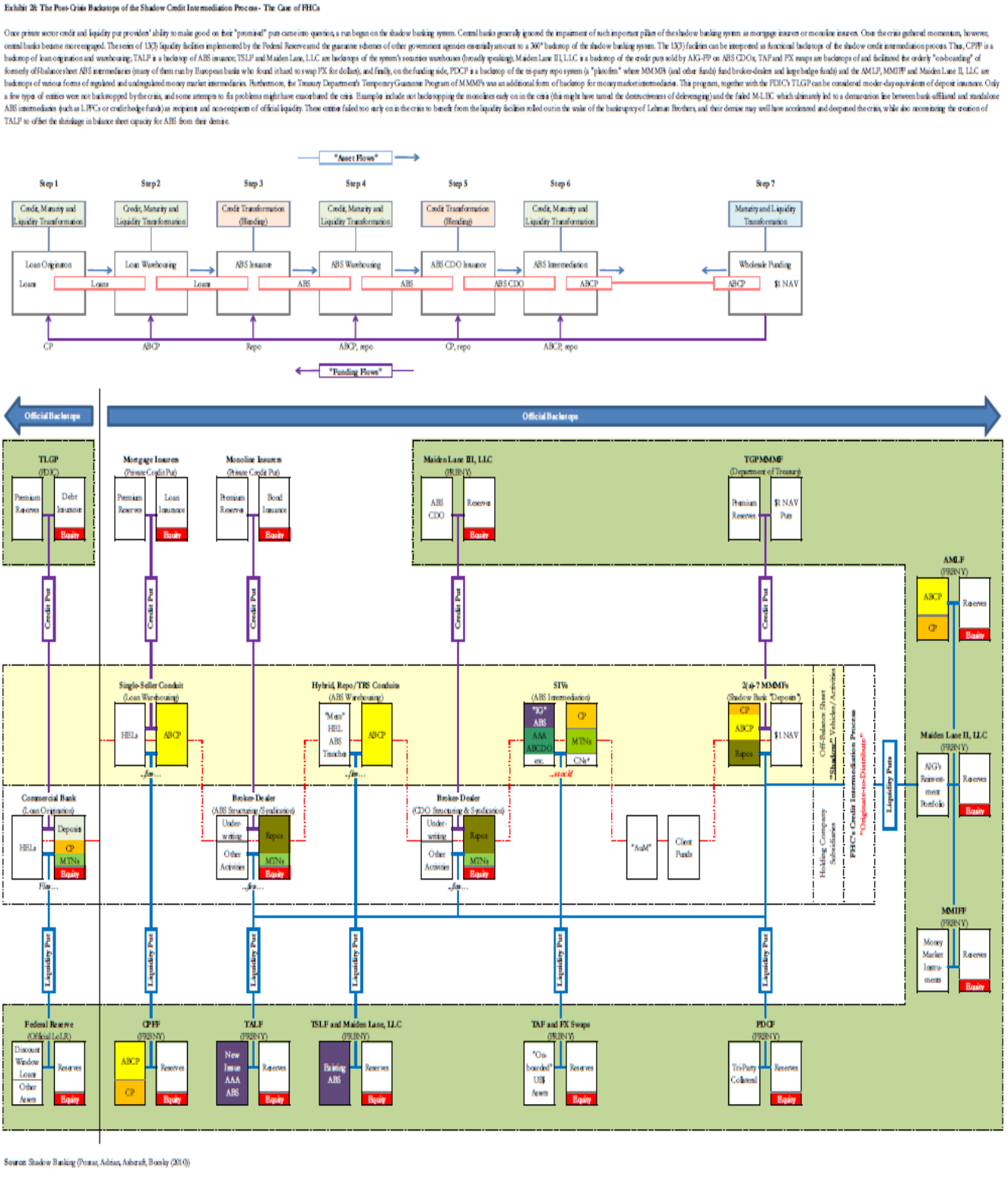


Figure 9: Liquidity and Backstops Provided to Shadow Banking System (Pozsar et. al.)



Source: Shadow Banking (Pozsar, Adrian, Ashcraft, Boesky (2010))

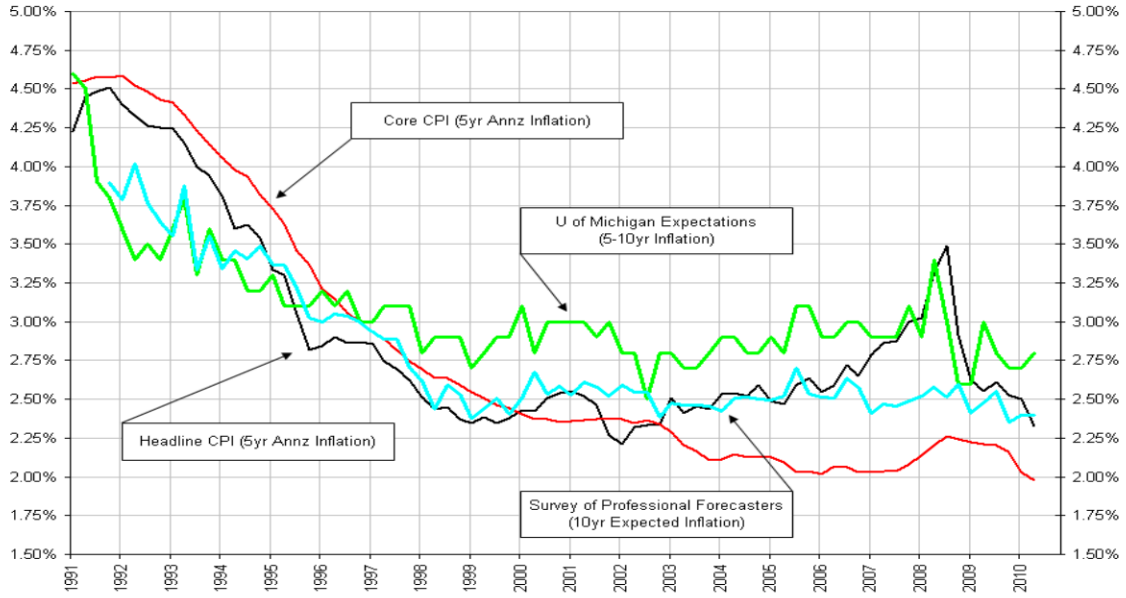
V. Concluding Remarks: What We Know and Don't Know in 2010

Drawing on the above, I will in this section offer some reflections on what we know and, unfortunately, don't know about monetary policy in the low inflation environment in which we find ourselves in September 2010. I will address the following topics: i) how well anchored are inflation expectations and Phillips curve slopes? ii) going forward, what will be the appropriate role for asset quantities and prices in informing monetary policy path for the federal funds rate? iii) do we have sufficient confidence in our alternative monetary policy tools to stabilize the economy at the zero lower bound.

How well anchored are inflation expectations?

Forward (if not near - term) inflation expectation appear, as of this writing, to have declined little since the onset of the crisis in 2007. For example, notwithstanding the level of unemployment, the size of the output gap, and that fact that measures of core inflation are running at or below 1 percent, surveys of future inflation expectations held by public and professional forecasters - as well as break even inflation rates from the TIPS markets - have drifted down relatively little in the last several years and are comfortably close to or even above 2 percent. It is tempting to jump to the conclusion that such evidence 'confirms' that two decades of successful monetary policy have 'anchored' inflation expectations and that these 'well anchored' expectations serve as a bulwark against the US falling into a Japanese – style deflation. Indeed, according to a standard Phillips curve analysis, with such a large output gap (which many forecasters see persisting for several more years at least), the *only* thing keeping the US out of deflation is well anchored inflation expectations.

Figure 9



But do we know that inflation expectations are well anchored? No. All we know is that measures of inflation expectations are adjusting sluggishly to a serious recession and a material decline in core inflation. There are two competing explanations – backward/nervous and forward/optimistic. According to the 'optimistic' view, expectations of inflation are largely if not entirely forward looking. Thus the fact that expected inflation has adjusted only modestly lower during this cycle is the result of the Fed's credibility in being able to promise that inflation in future years will return to 2 percent or above even though at present (and for some time to come) it falls well short of that goal (which of course is not a 'target'). By contrast, according to the 'nervous' view, expectations of inflation appear to have a significant inertial component (Furher – Moore (1995), Mankiw – Reiss (2002)). Thus, the fact that expected inflation has *thus far* adjusted only modestly lower during this cycle may be the result not of Fed credibility to generate inflation *in the future* but rather instead may be result of the fact that the Fed *in the past has* delivered 2 percent inflation. Under this view, if inflation were to fall much below current levels, and certainly were it to turn and stay negative for some time, expectations of dis-inflation or even deflation could become entrenched as they did in Japan and be very difficult, given inflation inertia, to reverse. In my judgment, this is no time for the Fed to 'assume a can opener', that is *to assume* that it has the ability to make a time inconsistent promise generate sufficient future inflation so as to 'anchor' current inflation expectations of in the face of large, and potentially, widening output gap. Because I judge the Fed to be sufficiently 'nervous' about the cost of this low probability outcome, I am cautiously optimistic the US will avoid it. But it is a closer call than I would have imagined several years ago.

The appropriate role for asset quantities and prices in informing monetary policy

Research efforts in academia (Curdia and Woodford (2009;2010); Gertler and Kadari (2009)) and at prominent central banks and international organizations have commenced active programs to model and include realistic financial frictions in DSGE models used for policy analysis. Notable contributions include Christiano, Ilut, Motto, and Rostagno's (2010) work at the ECB and Kannan, Rabanal, and Scott (2010) research at the IMF. Although the attention for much of the pre crisis discussion was on appropriate the role that information that *asset prices* should play in informing monetary policy, the recent work emphasizes, correctly in my judgment, that it is really leverage and the adequacy of capital at banks *as well as shadow banks* that central banks should and likely will be focusing on going forward. Leverage ratios and loss – absorbing capital are key variables in the monetary transmission mechanism that need to be modeled to asses the impact of different policy paths on the economy as well as the scope and scale of fluctuations in inflations and the output gap from shocks to the financial sector, including shocks to credit spreads. However, as for example the work of Kannan, Rabanal, and Scott (2010) makes clear, mechanically appending credit supply variables to a Taylor rule is not likely to produce a robustly better policy in the face of a wide range of shocks. It seems clear that there is no substitute for understanding the source and persistence of shocks hitting the economy as well as the way in the financial institutions - including the shadow banks that survive - intermediate credit, allocate risk

and accumulate explicit or implicit put options against systemically important institutions and/or the Fed or Treasury. Figure 10 from Kannan et. al. shows that appending nominal credit growth to a Taylor - type rule produces superior performance in response to financial shocks, but inferior results in response to productivity shocks. Similarly, providing the central bank with a macro prudential instrument produces superior results when deployed to offset a financial shock, but infer results when deployed to offset a productivity shock. In retrospect, I believe it was not the failure *to include* rudimentary financial frictions in DSGE models that was the problem with the pre - crisis consensus for the *conduct of* inflation targeting *monetary policy* , rather it was instead more fundamentally the failure *to understand* the systemic implications of the financial frictions presented by the shadow banking system (that "changed the nature of financial intermediation in the United States profoundly") that was the problem with the pre – crisis consensus for the *supervision and regulation* of financial markets by the Fed , yes, but also by the SEC, FDIC, Comptroller of the Currency, OFHEO (now FHFA).

Figure 10 (Source: Kannan et. al.)

Parameters and Performance of Policy Regimes in Reaction to Financial Shocks

	Weights under Each Regime				
	Lagged interest rates in monetary policy rule	Inflation in monetary policy rule	Output gap in monetary policy rule	Nominal credit in monetary policy rule	Nominal credit in macroprudential rule
Taylor	0.7	1.5	0.5	. . .	. . .
Augmented Taylor	0.7	1.5	0.5	0.5	. . .
Augmented Taylor + macroprudential	0.7	1.5	0.5	0.5	0.5
Optimized augmented Taylor + macroprudential	0.0	13.2	3.2	0.0	0.8

	Performance			
	Standard deviation of inflation	Standard deviation of output gap	Loss[1]	Ranking
Taylor	0.512	0.624	0.652	4
Augmented Taylor	0.110	0.076	0.018	3
Augmented Taylor + macroprudential	0.092	0.061	0.012	2
Optimized augmented Taylor + macroprudential	0.018	0.040	0.002	1

Source: IMF staff calculations.
[1]Loss equals the sum of the variances of output gap and consumer price index inflation.

. Parameters and Performance of Policy Regimes in Reaction to Productivity Shocks

	Weights under Each Regime				
	Lagged interest rates in monetary policy rule	Inflation in monetary policy rule	Output gap in monetary policy rule	Nominal credit in monetary policy rule	Nominal credit in macroprudential rule
Taylor	0.7	1.5	0.5	. . .	. . .
Augmented Taylor	0.7	1.5	0.5	0.5	. . .
Augmented Taylor + macroprudential	0.7	1.5	0.5	0.5	0.5
Optimized augmented Taylor + macroprudential	0.0	3.5	12	0.3	0.0

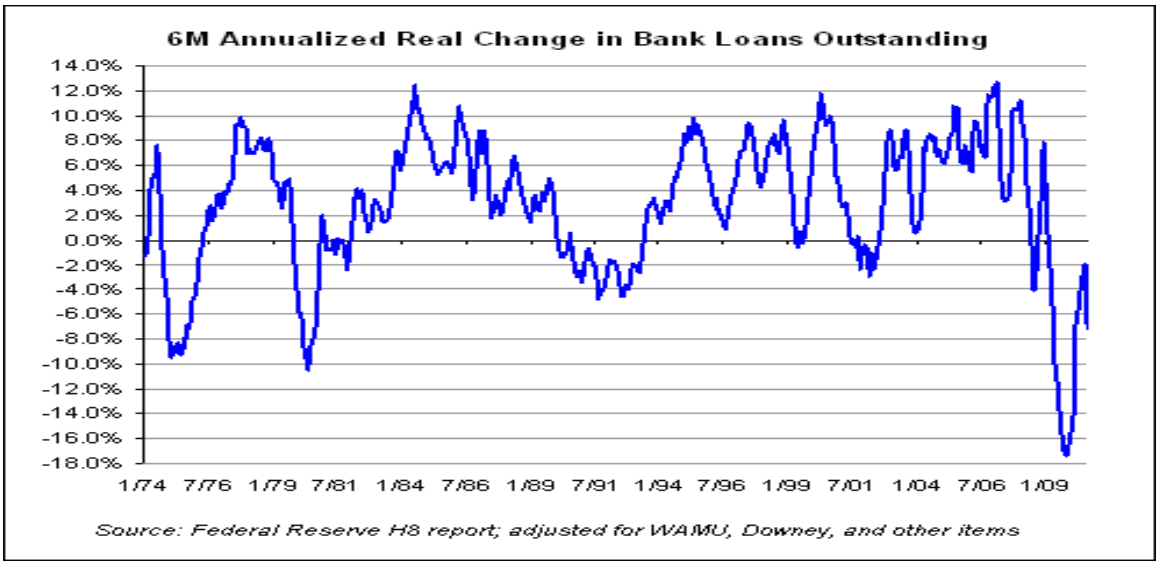
	Performance			
	Standard deviation of inflation	Standard deviation of output gap	Loss[1]	Ranking
Taylor	0.199	0.162	0.066	2
Augmented Taylor	0.184	0.220	0.082	3
Augmented Taylor + macroprudential	0.233	0.276	0.130	4
Optimized augmented Taylor + macroprudential	0.072	0.080	0.011	1

Source: IMF staff calculations.
[1]Loss equals the sum of the variances of output gap and consumer price index inflation.

Do we have sufficient confidence in our alternative monetary policy tools to stabilize the economy at the zero lower bound?

According to monetary theory, central banks have at least two powerful – and complementary – tools to reflate a depressed economy: printing money and supporting the nominal price of public and private debt. As discussed above, a determined central bank can deploy both tools for as long as it wants regardless of 1) how 'credible' it's commitment is 2) how expectations are formed or 3) how term or default premia are determined. There are two fundamental questions. First, can these tools, aggressively deployed, eventually generate sufficient expectations of inflation so that they lower real interest rates? Forward looking models generally predict that the answer is yes. However, the interplay between monetary policy and the yield curve can become complex when central banks are at the zero lower bound (Bhansali et. al. 2009) and central banks seek to provide a "deflation put". Also, as discussed above, given the prominent role that inflation expectations play in inflation dynamics, inflation inertia is the enemy of reflation once deflation set in. A second question relates to the monetary transmission mechanism itself. In a neoclassical world that abstracts from financial frictions, a sufficiently low , potentially negative real interest rate can trigger a large enough inter - temporal shift in consumption and investment to close even large output gap. But in a world where financial intermediation is essential, an impairment in intermediation – a credit crunch – can dilute or even negate the impact of real interest rates on aggregate demand. In the limiting case of a true liquidity trap, *no* level of the real interest rate is sufficient in and of itself to close the output gap and reflate the economy. Credit markets in the US appear at this writing to be bifurcated. Credit spreads on corporate bonds are at low levels and gross issuance is at high volumes, while bank lending, much of it to small and medium sized enterprises, has collapsed to an extent unprecedented in previous business cycles and continues to decline more than a year into recovery. While this does not in itself indicate the US is in a liquidity trap, it does suggest that de - leveraging and the collapse of the shadow banking system that intermediated so much credit before the crisis continue to represent a significant headwind that presents a challenge to policy effectiveness.

Figure 11



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