The zero lower bound and the financial instability hypothesis

An inquiry into the arcane of monetary policy

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Abstract

Monetary policy at the zero lower bound has generated a lot of controversies. This paper reviews the arguments in new theoretical perspective. Drawing the lessons of the financial crisis, it adopts Minsky’s financial instability hypothesis and links it to Wicksell’s macroeconomic framework. The coupling makes the natural interest rate an endogenous variable in the financial cycle. Taking account of the nature of money that is not just another financial asset, the framework explains that the natural interest rate can turn negative in a severe financial crisis, which drives the money rate to the lower bound.

The framework vindicates entirely the pre-commitment to keep ultra-loose monetary policy beyond the beginning of the recovery until conditions of robust growth have been recovered. The paper also surveys the empirical studies that have tried to measure the efficacy of long-term asset purchases in Japan, in the US and in the UK. Then it moves to the design of post-crisis monetary policy.

The main argument is the following: macro prudential policy is not only the prolongation of prudential regulation and supervision. It should be embedded into monetary policy. Central banks should be given a dual mandate of price and financial stability to mitigate the endogenous financial cycle. A dual mandate does not preclude independence, but it requires accountability to a democratic sovereign institution and cooperation with other entities responsible of economic policy. As far as the operating procedure is concerned, the paper advocates a generalization of the policy rule to credit aggregate dynamic and the complementary use of quantitative instruments as far as necessary.

Key words: zero lower bound, natural interest rate, deleveraging, forward guidance, asset purchase.

JEL: E44, E52, E58
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Introduction: the challenge of monetary policy

Standard monetary analysis goes astray in front of the zero lower bound of interest rate (henceforth ZLB). The headwinds unleashed by the mega financial crisis that has started in the summer of 2007 have alarmed most commentators, bewildered by the huge swelling of central bank balance sheets. Terrible calamities ahead are predicted: central bank losses, negative equity and runaway inflation. It means that neither the raison d’être of central banks, providing ultimate liquidity as much as it is needed, nor the financial deleveraging in the private sectors are well understood.

More fundamentally the instability of finance is grossly underestimated under the efficient market hypothesis, which makes the basic tenet of theoretical thinking in finance. Money being split from finance in conventional thinking and balance sheet constraints in the private sector having no relevance in standard macroeconomic models, the existence and the persistence of ZLB are misinterpreted.

In the macro dynamic stochastic general equilibrium (DSGE) models, the instability of finance has no room. The methodology is that of an exogenous shock disturbing an otherwise equilibrium economy. The dynamic interaction between finance and the economy is even less understood, since the shock is supposed not to alter behavioral relationships. Structural parameters and latent variables are supposed known by policy makers. The models are stochastic but tolerate no uncertainty.

It is the type of unrealistic assumptions that Richard Koo denounced, when he explained why Western advisers were unable to account for the length of the economic stagnation in Japan. Lengthy and painful deleveraging changes the objective of economic agents: minimizing debt replaces maximizing profit or utility as usually defined. While widespread because of the former debt-induced asset price bubble, such attempted deleveraging induces a huge contraction in borrowers’ spending. If the interest rate cannot drop enough to incentivize savers to offset the slump in demand because it hits the zero lower bound, depressive and deflationary forces continue as long as the new lower preferred debt ratio is not reached. It is not even necessary that the interest rate actually reaches zero to produce a restraining impact on spending, as can be seen in the Euro zone. The liquidity trap arises at positive interest rate, as long as the natural rate gets below what the central bank wants it to be.

Empirically macro DSGE simulations grossly underestimate both the magnitude and the persistence of adverse shocks, as we will see in surveying the performances of a large array of models in assessing the efficacy of monetary policy under ZLB. For the time being, let us say that, under a Taylor rule with a 2% inflation target, the average prediction for ZLB following an exogenous adverse shock is the following: the fed funds rate hits 0 about 5% of the time and the episode lasts 4 quarters with minor effects on the macro economy. A recession the depth of what was observed in 2008-09 should arise less than once in a century according to those models. Not only did it happen twice in 80 years on worldwide scope and two in less than 20 years if one includes Japan, but the present ZLB episode has already lasted 4 years and is far from being over.

Those theoretical and empirical shortcomings mean that a theoretical framework linking endogenous financial instability and the liquidity trap is in order. It can be sketched in drawing insights from Minsky’s financial instability hypothesis and the Wicksellian theory of inside money. The purpose is to explicitly relate the zero lower bound to deleveraging and the latter to the reversal of endogenous dynamic leveraged asset financing. The macroeconomic impact gets dramatic because, as shown by Eggertsson and Krugman, the aggregate
demand/supply schedule is upset while the aggregate demand curve becomes upward sloping under ZLB.

The so-called “unconventional” monetary policies can be well-understood in this framework and the proper questions can be asked. Why are the predicaments of monetarism broke? What are the channels of monetary policy under ZLB? Why should central banks make commitments over their future course of actions? Why should they keep their policy rate at its lower bound well after deleveraging has been completed? What are the tools of exit policy? Which principles should central banks follow to conduct monetary policy in unstable market finance environment under uncertainty?

Section I will discuss the controversies surrounding the framework of monetary policy triggered by the financial crisis and will draw insights from non-monetarist theoreticians. Section II will be devoted to explaining monetary policy under ZLB and will survey the findings about its performance in the US, the UK and Japan. It will also highlight the differences between Fed and ECB. Section III will acknowledge which strategies central banks are preparing for exit and will take stand on the revision of monetary doctrine to pursue the dual objectives of price and financial stability.

1. Controversies over monetary policy under conditions of financial instability

What is market finance? Orthodox theory would answer: the efficient market hypothesis. Indeed there is nothing wrong with efficient market as long as it is taken for what it is: a dynamic equilibrium. What is wrong is pretending that it drives economic behavior in real time and that it can be a useful compass for economic policy.

In a dynamic equilibrium there is no past, present and future. Time is entirely homogenous. It is why it is possible to conceive a representative agent that faces only an intertemporal budget constraint and maximizes utility of consumption. In such a world there is no balance sheet constraint. The Modigliani Miller theorem demonstrates that financial structures have no bearing on the equilibrium. All asset prices are uniquely determined according to their “fundamental values”, which are equal to their market prices. Since all prices are equal to marginal utilities, fair value accounting is equivalent to market value. Conversely money is neutral: the quantity of money is proportional to a nominal price level index as an equilibrium condition, when all other equilibrium relationships have settled. In no sense does it mean that an increase in the quantity of money “causes” inflation in real time. Making the equilibrium stochastic changes nothing to the logic, since all the states of the world and their probability distributions are known equally by all market participants. In such a world, shocks can only be exogenous and are just thought experiments, allowing a jump from one equilibrium to another. No wonder if DSGE models cannot reproduce the features of financial crises.

However economic agents and economists alike are embedded in real time. Everyone faces uncertainty because past and future are qualitatively different dimensions of time, as Keynes forcefully explained but was not understood to say the least. From the past one can draw imperfect information and calculate correlations between different sets of variables. Yet one cannot pretend that they are worth for the future. The latter is the realm of expectations, which are conjectures about possible worlds. Contrary to the past, which is contingent to known events if not causal, the future is counterfactual and reflexive. Conjectures on the future are choices among a priori unlimited possibilities. The one that is chosen reverberates on the present at a particular date. But another could have been realized as well. The magic of the market is not to reveal fundamental values. It is to coordinate expectations, e.g. beliefs of market participants. The present outcome is the achievement of coordination by the future.
This coordination is self-fulfilling. At any given time it is a focal point that results from the interaction of the reflexive beliefs about what one thinks the others think. There are different modes of coordination. Some are strategic complementarities. The attractor is a predictor acting as a prophet, not because he or she knows the future, but because he or she knows how to make his or her own belief shared. Another model is conventional by polarization on a latent economic variable. It has nothing to do in principle with a fundamental value. Nonetheless the dynamic equilibrium that is compatible with the latter belongs to the possible states of the world. Even so there is no compelling reason that it will be chosen. The variable that is the catalyst of the polarization of beliefs at any given time can be any news about economic indicators, political declarations or any other event.

If market finance is driven in real time by self-fulfilling coordination of counterfactual beliefs about the future, what does make it prone to speculative bubbles followed by financial crises? Debt enters the picture: credit cycles and endogenous financial crises defined as credit booms gone busts. This is Minsky’s financial instability hypothesis.

1. The financial cycle and macroeconomics: BIS findings

A key feature of financial dynamics under uncertainty is that momentum, not mean-reversion drives asset market prices. Momentum means that price trajectories over time proceed from self-reinforcing interactions between perceptions of value and risk (Borio, 2012). Mean-reversion arises over 15 to 20 year financial cycles through booms and busts ((figure 1). Because the financial cycle has a much longer time span than the decision-making horizon of both market participants and policy makers, it is beyond their ability to adjust to the nature of financial instability. It is why procyclicality dominates macro dynamics. When dynamic is driven by momentum, imbalances accumulate in stocks of assets. Stock disequilibria persist in asset value/GDP and debt/GDP and impinge upon flow variables (net credit/GDP) both in the upward and downward phases of the financial cycle. Because macro DSGE models ignore balance sheet structures entirely they are structurally unable to capture financial cycle features and therefore to reproduce the salient features of financial crises.

**Figure 1. The financial and business cycles in the US**

![Figure 1](image)

Source: Drehman and alii (2012)

The financial cycle is measured by the evolution of an index combining private credit growth, credit/GDP ratio and house price variations, the business cycle is measured by the variations of the output ratio. Both cycles differ widely in frequency (16 to 20 against 5 to 8 years) and in magnitude. Because the financial cycle lasts much longer than the business cycle, there are unfinished recessions (like the 2001-02 recession occurring while the credit-induced asset price momentum is in full swing. This is the time for major errors in monetary policy.
However one can see that the financial cycle was subdued in the era of the so-called financial repression. It means without surprise that the financial cycle depends on financial structures. The latter co-determine financial dynamics and monetary regimes.

In an era of financial repression (1960’s and 1970’s) the macro disequilibria inherent to capital accumulation show off in inflationary spirals and are dealt with quantitative monetary policy. The business cycle is larger in amplitude than the financial cycle, which is subdued. In an era of financial liberalization (1980’s onwards), inflation is subdued and disequilibria accumulate in balance sheets and show off in magnified financial cycles. As will be demonstrated below, standard monetarist doctrine loses pertinence entirely in the latter era. The so-called great moderation boasted by central bankers is the screen behind which they have left the financial momentum to feed on itself.

What is the link between the observation of the financial cycle and macroeconomic analysis? Because the financial momentum drives both debt and wealth/GDP widely aside any long-run equilibrium values in standard growth models, the financial cycle influences decisively the natural interest rate, e.g. the net marginal return on capital. Therefore the macroeconomic side of the financial cycle leads directly to a reassessment of Wicksell’s monetary theory.

2. The financial cycle, the natural interest rate and monetary policy

Debt introduces debtors’ commitment to repay. In the efficient dynamic equilibrium, debt repayment of debtors and income of creditors are embodied in the budget constraints. The debt relationship is made symmetrical because the equilibrium risk-adjusted return compensates exactly creditors for the risk they take. In the perfect world regulated by the efficient market hypothesis, the equilibrium price of debt, e.g. the real neutral rate (r*), is equal to the net marginal return of capital, e.g. the marginal productivity of capital (MPK) minus the depreciation ratio (δ): r* = MPK-δ

It is the rate at which the incentives to invest equal the intentions to save when the latter are such that consumption per capital is maximized (figure 2).

**Figure 2. The real equilibrium rate of interest**
In equilibrium the balance between ex ante saving (desire to save) and ex ante investment (intention to invest) is the same as the ex post identity I=S because rational expectations make the notional ex ante equilibrium come true. Wicksell calls it the natural rate \( (r_n) \). Under the efficient market hypothesis, the natural rate and the equilibrium real rate are identical.

It can be demonstrated that the real neutral rate is equal to the optimal potential growth rate. The nominal neutral rate combines the conditions that define \( r^* \) and the neutrality of money. With \( P_t \) the level of the price index at \( t \) and \( P_{t+1}^* \) its expectation at \( t+1 \), the nominal neutral interest rate fulfills the equilibrium condition (Fisher equation):

\[
\frac{(1+r^*)(P_{t+1}^*)}{P_t} = (1+r^*)(1+\pi_t^u) = (1+i^*)
\]

Or, if the linear approximation is admissible, \( \pi_t^u \) is expected inflation:

\[
i^* = r^* + \pi_t^u
\]

In the real world where past, present and future are different dimensions of time and the present I=S is governed by the coordination of beliefs about conjectures on the future, saving has no relevance for the determination of macro variables. Aggregate saving is nothing but income not consumed, a purely passive variable. The active variable that drives capital accumulation and impinges upon asset prices is financing, e.g. the amount of cash flow that can be gathered as acceptable means of payments by the economic agents that plan to acquire assets, be they productive investment or existing assets. Cash flow is itself generated by new money, e.g. credit flows that create leverage, including all forms of financial engineering that allow the decoupling of credit from standard bank money creation.

The natural rate \( r_n \) is still the net marginal return on capital. But it becomes an increasing function of leverage. The credit-induced asset price appreciation feeds the momentum that links new credit flows/GDP to expected asset price rise in a round-about process. Because the asset price dynamic is quite decoupled to inflation, monetary policy ruled by inflation targeting remains loose in the boom phase of the business cycle, reinforcing the persistence of stock disequilibria well over the time span of the business cycle (figure 3a). The market rate \( i \) is much too low to induce any mean-reversion. The structural disequilibria shows off in the natural rate being persistently higher than the market rate in typical Wicksellian drift away from “fundamental” equilibrium: \( r_n > i^* > i \)

Conversely the downward phase of the financial cycle is dominated by balance sheet deflation (Koo, 2008). The more debtors want to deleverage, the more pronounced is asset price decline and the lower the natural rate with the simultaneous decline of the marginal productivity of capital, the rise in the depreciation ratio and the slump in inflation (figure 3b). The debt deflation phase is characterized by: \( i_n < i < i^* \)

Under uncertainty, debt creates credit risk because repayment is not warranted. The flow of repayments being compelling, debt creates a potential causal relationship in the future. It is why debt overhang involves protracted credit flow restraints a long time ahead. Moreover the ability and willingness to repay being unknown to the creditors, the relationship between debtors and creditors is asymmetrical. Debtors face balance sheet constraints because creditors are willing to lend up to a limit depending on their assessment of credit risk. In the boom phase the debt limit is pushed upward all the more than asset price expectations become more optimistic. The debt limit falls dramatically while any doubt about the sustainability of debtor balance sheets corrodes the prevailing optimistic beliefs.
Figure 3a. The euphoric stage of credit expansion and asset price rise

High confidence:  
Low money market rate  

Expansion in borrowing against collateral

Financial leverage ↑

Speed-up in the supply of credit

Higher collateral value induces high natural rate

Asset prices rise to bubble highs

Figure 3b. The depressive stage of credit contraction and asset price slump

Retarded rise of money rate

Contraction in borrowing against collateral

Financial leverage ↓

Reduction in credit supply

Depreciation of collateral value induces low natural rate

Asset prices plummet

Therefore the attitude of lenders toward risk can provide insights on the critical transition between the phases described on figures 3a and 3b. Lenders are financiers who rely on leverage to improve the return on their invested capital, as long as the yield on assets is higher than the cost of borrowings. The imperative of finance is: “borrow more to earn more”. Asset price rises feed on themselves because the increased demand is supported by higher leverage ratios, themselves financed by money creation. The latter is not shackle because borrowing is channeled in the financing of asset price rise and does not show off in the conventional consumer price index. Therefore the marginal yield on capital assets, the natural rate of interest \((i_n)\) is an increasing convex function of the new credit/income ratio \((\Delta D/Y)\) of the private sector, since speculation on asset prices, which boosts the return on invested capital, is a runaway process in euphoria (figure 5).

The massive expansion of leverage in the quarter of century preceding the global financial crisis has been well-documented by the BIS (Borio and Lowe, 2002). New historical data (Schularick and Taylor, 2011) bring fresh historical comparisons that emphasize the importance of financial innovations to support the length and strength of the euphoric phase.
The long-sustained credit expansion was nurtured by new sources of bank funding: debt securities, credit derivatives, structured credit. As a consequence the correlation between credit and money aggregates in the usual sense (M2 or M3) has become looser. It is important to outline the microeconomic behavior of banks underpinning the rise in ΔD/Y in the private sector.

Banks determine their capital provisions for non-expected losses on their total credit portfolio $a_i$ in computing their Value-at-Risk $V_i$ at the confidence threshold $c$, so that:

$$\Pr(a_i < \bar{a_i} - V_i) \leq 1 - c,$$

where $\bar{a_i}$ is the face value of credits. Let us start from a situation where bank assessment of credit risk leads them to fix their capital provisions $e_i$ so that: $V_i = e_i$. Credit supply at this level of provisions pushes asset prices higher. Since assets are collateral of credits, the asset portfolio of banks becomes $a'_i > a_i$ and their capital $e'_i > e_i$ for any bank $i$. In the meantime the tail of the probability density function becomes thinner because the rise in asset prices lowers the probability that the losses would be higher than the confidence threshold. Henceforth the VaR becomes $V'_i < V_i$. Because banks have a surplus of capital to use, their own leverage ratio $\lambda_i = a'_i / e'_i$ increases with the rise of $a_i$ and the decline of $V_i$ (figure 4). Therefore banks lend more and ΔD/Y rises in the non-bank private sector. The lending swells the demand for assets and appreciates asset prices. Capital gains raise the yield of assets at an accelerating pace with the momentum. It is why the natural rate $i_n$ overtake the long-run equilibrium rate $i^*$ and diverges more and more as indirectly depicted on figure 1. Because the dynamic is a momentum, $i^*$ has no chance to be an attractor of a smooth mean-reverting adjustment. Mean reversion to fundamental values occur only in the very long run through booms and busts.

One can now understand the Minsky’s moment of the financial crisis. Because $i_n > i^*$, the asset price rise is not sustainable in the long run under the Wicksellian framework. It is why the asset price rise is a bubble. It promises imaginary flows of income that people believe in since their expectations of capital gains are fulfilled as long as the bubble stands. But it is the very nature of a bubble that those flows will not materialize. Any fortuitous event can reveal the overextension of balance sheets. However the date of the price reversal and its magnitude are entirely unknown, because they are endogenous to the coordinated self-fulfilling counterfactual expectations.

The explosion of the price of collateral entails the deterioration of bank credit, hence the contraction of bank asset value $a_i$. Capital provisions $e_i$ must absorb the losses. Meanwhile the VaR spikes higher because banks must revalue the thickness of the tail distribution of losses. Therefore the leverage of banks $\lambda_i$ collapses dramatically. Facing repayments and unable to rollover their debts, non-bank private agents must deleverage all the more, the higher is the slump in asset prices. Both from the demand and the supply side of new credit, ΔD/Y declines abruptly, so that the natural rate gets lower than the neutral real rate while inflation expectations abate. The nominal natural rate gets lower than the money rate: $i_n < i$, inducing the central bank to loosen monetary policy.

One can now identify precisely the difference between smooth financial cycles and financial cycles cum crises. In the former, $i_n$ declines but remains positive. Therefore a standard reaction function of central banks (Taylor-rule type) can do the job of reinitiating spending in lowering the policy rate under the lower natural rate. That was Greenspan’s risk management doctrine that induced an aggressive reduction in the policy rate much stronger than the predicament of the Taylor rule (Greenspan, 2004). In so doing, he nurtured the financial cycle despite the temporary slowdown in the business cycle. In the latter, the natural real rate is so depressed and inflation expectations so low that the nominal natural rate turns $< 0$. The central
bank lowers its policy rate to zero, but the policy rate remains above the natural rate. It is the *liquidity trap*.

Eggertsson and Krugman (2012) show that, in this configuration, the larger the decline in $\Delta D/Y$, the larger the fall in output and price level. With a large deleveraging, the aggregate demand/supply schedule becomes atypical because the aggregate demand curve gets upward-sloping in the real income/price level mapping. The reason is that a lower price level, instead of triggering spending, increases the real value of the debt. Borrowers consume less and savers have no incentive to consume more while market interest rate has been stuck at zero, since the opportunity cost of holding money has disappeared. Spending declines with prices, making the aggregate demand schedule (AD) upward-sloping. In this configuration, supply-side policies to boost productivity or lower wage cost, e.g. policies trying to shift the aggregate supply curve lower, is counterproductive. It lowers output instead of increasing it (figure 6). The result of such policy is Fisher’s deflationary spiral. Therefore the following question is: what are the degrees of freedom left to the central bank at the zero lower bound to get the economy out of this trap?

**Figure 4. The co-expansion of bank leverage and asset prices**
Figure 5. The natural interest rate as a function of the ratio of new credit to added value in the private sector

![Diagram of the natural interest rate function](image)

Figure 6. Impact of supply-side policies under normal circumstances and under ZLB

![Graphs comparing normal circumstances and ZLB](image)

3. What is the zero lower bound and how can the central bank lower the whole yield curve?

It has been shown here above that debt deflation drives real output lower if monetary policy is passive. In turn, continuous deceleration of the growth rate, let alone outright recession, reduces expectations of future inflation, diminishing the chances that the nominal natural rate will recover positive values any time soon. The central bank must break the unholy combination of debt restraint and too low inflation expectations, while facing the zero lower bound on its policy rate.

Let us explicit the restraint of the zero lower bound on optimal monetary policy:

\[ i = \max \{ 0, i_n \} \]
The equation can be rewritten:
\[ i = i_n + \max\{0, -i_n\} \]

When \( i_n \) is >0, \( i = i_n \) is Wicksell’s optimal policy in a credit economy with inside money. When \( i_n \) is <0, \( i = 0 \).

The second equation is obviously that of a synthetic financial product, compounding a riskless bill whose yield is the natural interest rate and the purchase of a put option sold by the central bank whose strike price is 0 and the premium is 0 (it is a free option). The put option guarantees the zero rate to holders of money when the natural rate has turned <0. It is sold by the central bank on the opposite of the natural rate (figure 7).

Figure 7. Profile of the policy rate with zero lower bound

When the intrinsic value of the option is >0, the nominal interest rate is too high, though at zero or slightly above zero, to bring the economy back towards the natural rate. However an option has a time value. The forward rates reflect the value of the option for their particular terms; so do the long rates which embody expected future short rates.

Let us suppose first that investors are risk-neutral. The yield of a zero-coupon bond bought at time \( t \) with a maturity \( T \) is given by the equation:
\[ (1 + i_{n,T})^T = (1 + i_{n+1})(1 + f_{t+1}^1)(1 + f_{t+2}^1)...(1 + f_{t+T-1}^1) \]

where \( i_{n+1} \) is the one-period short rate and the \( f_{t+n} \) forward rates are the market expectations of the future short rates. If the linear approximation is admissible:
\[ i_{n,T} = \frac{1}{T}(i_{t+1} + f_{t+1}^1 + f_{t+2}^1 + ... + f_{t+T-1}^1) \]

More generally let us consider the \( n-m \) periods forward rate \( m \) periods ahead. In a risk neutral world it is equal to the expected future rates at respectively \( n \) and \( m \) periods. Therefore it approximates the slope of the yield curve between both future dates.
\[ i^n_{t+n} - i^m_{t+m} = \left( f^n_{t+m} \right) \]

The central bank can affect the yield curve if she influences future expected short rates. This is the policy called *forward guidance* that will be studied in the second section of the paper.

Long rates are also affected by a term premium because the volatility of forward rates have an amplified effect on the volatility of bond prices. It is why risk-adverse investors demand a premium to compensate for the risk of capital losses. When there is a term premium the equation linking long rates along the yield curve becomes:

\[ i^n_{t+n} - i^m_{t+m} = k + a(f^n_{t+m}) \]

Both the slope and the curvature of the yield curve are affected. Under ZLB the term premium depends on the time value of the option because the latter is an increasing function of the volatility of future short rates. We will see in section 2 that this volatility can be reduced by forward guidance and under certain conditions by asset purchases of the central banks. In indulging to so-called “non-conventional” policies, the central bank can lower the whole yield curve (figure 8).

**Figure 8. Yield curve with and without forward guidance**

![Yield Curve Diagram](image)

This effect on the yield curve is called the *policy duration effect* because the commitment to prolong the zero short term rate is history-dependent.

1. **The demise of monetarism under the zero lower bound**

It is well-known that Milton Friedman liked full-scale experiments to test the inflationary impact of money expansion. He boasted the post-World War I inflation, since money created during the war was obviously exogenous to post-war economic conditions. When forced cash balances accumulated by households during the war were unloaded, inflation flared up because real production had obviously not recovered the elasticity to accommodate pent-up demand. It was a unique illustration of Friedman’s money-dropped-from-helicopter metaphor.

However Friedman thought that the opposite was true. An excess demand for money should be easily accommodated by central money creation he called high-powered money. It is why, when Japan slipped into deflation in early 2000’s, he had a ready-made solution to give an advice that fitted with the quantity theory of money: print as much base money as necessary as a counterpart of buying any available asset. Soon aggregate nominal expenditure will increase and Japan will get out of deflation. The Bank of Japan introduced her program in March 2001 to increase hugely the supply of bank reserves much beyond the level required to
keep the policy rate at zero. There was little effect on aggregate nominal expenditures; economic activity remained sluggish and deflation continued (Ugai, 2007). Why was there so sweeping a denial to Friedman’s contention?

What is peculiar with monetarism is the belief of a direct link between the monetary base ($M_0$) and nominal aggregate expenditure ($PY$) irrespective of the level of interest rates and the nature of the assets that are bought by the central bank. Box 1 sums up the simple analytical framework of the monetarist doctrine. It helps understand why it went wrong.

It is the same confusion as the one pinpointed above about the financial market hypothesis: an equilibrium condition is interpreted as causal relationship real time. In real time dynamic analysis there is no way that money can affect prices independently of interest rates. A stable relationship, supposing that it exists in the time span relevant for monetary policy, observable when short term interest rates are positive, disappears when they are at or around zero.

Pure monetarism makes three strong assumptions. First, the money supply ($M_1$ or $M_2$, it is ever specified which one is relevant) is a multiple of $M_0$ and this money multiplier $m$ is stable. Second, on the demand side the velocity of money ($V$) is stable. It follows that what is just an identity $MV=PY$ is transformed in a causal relationship. Third, the market economy with flexible prices is always in equilibrium, which means that $y$ is equal to potential GDP, therefore not affected by money. Combine the three assumptions and you find that $M_0$ drives $P$ in the most mechanical way: the inflation rate is equal to the rate of growth in the monetary base.

Is it surprising that this pseudo-proportionality collapsed entirely in ZLB conditions provoked by the slump in asset prices? The velocity of money is the inverse of the demand for real cash balances. The transaction motive may define a stable function if technologies of payments are independent of financial developments. However, if it is true that financial transactions do not pertain to $PY$, they influence $M$. The huge fluctuations in financial transactions within the financial cycle are reflected in the variations of $V$. However the main problem arises with the holding motive. It is impossible to abstract from the interest rate. The money demand function can only be well-defined and stable if banks face a substantial opportunity cost of holding excess reserves and if this cost is reasonably stable. It is what collapses under ZLB conditions (box 1). The opportunity cost of holding reserves is nil or even negative if the central bank pays a modicum interest rate on reserves, while money market rates are about zero.

Under such conditions, as Michael Woodford remarks, the demand for reserves becomes infinitely elastic. Whatever increase in the quantity of central bank money is matched by an equivalent increase in the demand for reserves which has become unbounded. This is the meaning of absolute liquidity preference. In such circumstances any expansion in the supply of bank reserves has no effect on aggregate demand, be they real expenditures or the price level.

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**Box 1. The analytics of monetarism**

**Money supply**

Base money ($B$) = Currency in circulation ($C$) + bank reserves ($R$)

$C$ is a proportion of deposits ($D$) by non-bank agents: $C = \gamma D$

Reserves are required ($RR$) or willingly held ($ER$):

$R = RR + ER = \mu D + \lambda D$
\( \mu \) is determined by the central bank and \( \lambda \) is a function of the opportunity cost of holding excess reserves.

The money supply is: \( M_s = C + D \)

One can define the money multiplier:

\[
m = \frac{(C + D)}{(C + R)} = \frac{(1 + \gamma)}{(\mu + \lambda + \gamma)}
\]

Under ZLB, \( \lambda \) becomes indeterminate and the whole money supply schedule collapses

**Money demand**

The aggregate money demand function is defined by:

\( M_d = P \cdot L(i, Y) \)

\( P \) is the price level, \( Y \) real national income and \( i \) the nominal rate of interest on short-term non-monetary assets. The function is alternately expressed as a demand for real cash balances:

\[ M_d/P = L(i, Y) \]

This function is well-behaved only if \( L'(<0 \text{ and finite. Under ZLB it becomes infinite.} \)

**Money market equilibrium**

\( M_s = M_d \)

The schedule determines \( i \) and \( M \) in normal circumstances. Under ZLB, the money demand schedule becomes vertical and confounded with money supply. The monetary equilibrium is indeterminate.

Considering now the long run, Schularick and Taylor bring new historical data for 14 developed countries over 140 years. They compute long-run trends in credit and money aggregates. They find a marked change in regime before and after World War II. Before World War II, the gold standard was the universal regime, disturbed but not quite swept away in the aftermath of World War I. Money and credit aggregates were highly correlated, making the money view a reasonable narrative for the history of the price level, with inflationary and deflationary episodes shaped by the upward and downward phases of financial cycles. After World War II it is quite another story. In the Bretton Woods era, both money and credit recovered from their collapse during the war. But structural shifts occurred that developed from the 1970’s onwards.

Both credit/GDP and credit/broad money have risen systematically and very substantially. The correlation between money and credit has dramatically declined because banks’ access to non-monetary sources of finance has become a paramount factor of leverage, which drives aggregate credit supply. Financial markets at large, not money markets narrowly defined, have become the fuel of spending. Conversely have become lenders-of-last-resort for the entire financial system because they must underwrite the entire funding of banks in times of stress.

Comparing the real effect of financial crises in the two eras, the authors find that real output losses are grossly of the same magnitude. At a first glance it is puzzling because monetary policies have been much more active after fiat money replaced gold as the ultimate source of liquidity. What is strikingly different is the impact on nominal prices. Before World War II financial crises brought about sharp deflation, so that the price level was grossly stable on average over the entire financial cycle. After World War II, with the exception of Japan up to now, there has been no extended period of deflation.
The explanation of these findings lies in the predominance of credit. As demonstrated above the driver of the whole capitalist economies is the momentum of credit-induced asset price bubbles. For real output, credit matters, not money. Because of the huge volatility in leverage, instability of credit in financial cycles have dire real consequences, contrary to the view of the “great moderation”, entirely rebutted by the global financial crises of the last few years. However credit is so important that the financial system must be rescued in any time of stress. It is why all central banks have developed risk management, be they consciously adopt Greenspan’s put as Ben Bernanke does, or speak a double language as Mario Draghi does. 

Whatsoever, the paramount importance of credit vindicates empirically the Wicksellian framework of this paper to link credit-financed asset price dynamic and interest rates. In the second section monetary policy under ZLB will be assessed with this framework in mind.
II. Monetary policy under zero lower bound

The theoretical interpretation of ZLB as the option value of money has pointed out the rationale of monetary policy. It should engineer higher price expectations through the forward rates to match the negative natural real interest rate, even though the nominal policy rate is stuck at the zero bound. If successful, forward rates will diminish and the lower rates will reverberate on long rates. The whole yield curve will become flatter.

As already mentioned, the tools of monetary policy in such circumstances are forward guidance and asset purchases. They will be reviewed one after the other. Then empirical findings of scholars that have tried to measure the efficacy of those policies will be surveyed.

1. Forward guidance

In his Jackson Hole 2012 speech, Ben Bernanke has emphasized that forward guidance is not an unconditional promise. It is informed by a monetary policy rule. But the usual Taylor rule does not work anymore. The peculiar profile of interest rates due to the financial crises must be acknowledged and taken care of.

Why are long-term expectations so important under ZLB? What is utterly important is the impact of expectations after short rates have ceased to be under ZLB constraint. Michael Woodford points out that expectations about the conduct of monetary policy after the constraint ceases to bind will have a magnified effect on current conditions. It is why central banks must pre commit optimally to the policy rate at zero for some time after the point at which a central bank using a forward-looking Taylor rule would begin to raise its policy rate. The date T until which the policy rate should be kept to zero depends on the length of time for which the natural rate of interest remains abnormally low. To generate a desirable outcome, central banks must convey clearly their intentions. Since the natural rate is not directly observable, the Fed has chosen a benchmark closely linked to her mandate: short-term rate will be kept at or near zero as long as the unemployment rate remains above 6.5% providing that inflation remains contained, meaning \( \leq 2.5\% \). Furthermore the figures are not automatic triggers, they are alert indicators. What they will trigger is an in-depth deliberation within the FOMC to judge if a change in the stance of monetary policy is warranted or not. Other indicators of the labor market will be considered. A range of inflation rates between 2.25 and 3% will be examined, depending on the information given by surveys measuring how strongly inflation expectations are anchored.

The reason for this policy, departing clearly from inflation targeting even with Fed’s characteristics, is the acknowledgment that the financial crisis has substantially altered the macroeconomic path. The Fed does not believe that the long-run path of the economy has been changed. Ben Bernanke stated it most clearly at Jackson Hole. But the FOMC understands that the depth and length of deleveraging in the private sector create downside risks that must be counteracted. The economy has accumulated a large loss in GDP relative of what would have occurred in the absence of the financial crisis, had trend growth continued since 2007 (figure 6). To fill the gap the US economy must run for several years at above trend growth. Whether zero bound policy would be lifted too early, expectations might raise forward rates and steepen the yield curve too soon. The loose policy the economy needs to catch-up its wealth losses would be denied and monetary policy would fail to deliver its social utility: improving the real performances of the economy. This philosophy of money is obviously at the opposite of the quantity theory of
money and the conduct of monetary policy quite at odds with monetarism, and for good reasons.

Figure 9. Cumulative loss in GDP relative to pre-crisis trend

There are both a loss in real GDP and below target price level due to cumulative negative gaps in inflation. Considering these findings, Woodford argues that a better criterion for deciding when exit policy arises should be a nominal GDP target path. The fed could pledge to maintain its policy rate at lower bound as long as nominal GDP remained below a target path, which is the path the FOMC would have followed if policy had not been constrained by a negative natural rate since late 2008. Once the chosen path has been achieved, the Fed funds rate should be raised to keep a steady growth rate of nominal GDP thereafter.

With or without a shift to nominal GDP target, Fed’s strategy is far away from the ECB struggle against Eurozone crisis. Of course, differences in mandates are blatant. One cannot say that ECB is outright monetarist. Nevertheless she is not accountable for mass unemployment, nor is she for too low levels of prices. Therefore notable differences, outlined by William White (2012), stand out between Fed and ECB.

The Fed and the ECB have both activated “non-standard”, e.g. non monetarist, measures. However their purposes are widely different. The Fed does it because negative natural rate due to private sector deleveraging precludes the working of monetary policy in the usual sense: the predicted reaction of economic agents to the change in short-term interest rates. ECB activates non-standard measures to fight the fragmentation of the money market, hoping that she can restore the normal channels of monetary policy. As argued above, the Fed pre commits to zero interest rate for an extended period of time and precisely defines the conditions of exit. The ECB does not pre commit to anything. As we will see below,
the Fed purchases a large array of assets, including mortgage bonds and liabilities of non-financial corporations. She does not care much about potential losses in her balance sheets. A balance sheet view for a central bank is a narrow view, which does not understand the unique role a central bank performs in the economy. Her objective is not to make money and avoid losses. It is to enhance the welfare of the whole population. A central bank can perform very effectively with negative equity on her balance sheet, as long as she controls the value of money, e.g. the price level. Earling Weidmann’s lamentations, because the Bundesbank might have to take losses on her loans in Target 2, one might wonder how distant alternative conceptual views in central bank doctrine can be! Even if Mario Draghi has detached himself from this patrimonial conception of central banks, ECB lends only to banks, admittedly in non-usual terms under LTRO programs. When she ventures to lend to sovereigns, it is with lots of restrictions attached. Furthermore the Fed does not make fuss of so-called “fiscal dominance”. She knows that, under ZLB conditions, fiscal and monetary policies are logically and intrinsically intertwined. On the contrary under its SMP program, ECB has made only limited purchases entirely sterilized. In lending to banks she has indulged in repos, so obsessed she is with exit. Therefore it is high time to analyze the second tool of monetary policy under ZLB: asset purchases.

2. Asset purchases

It has been demonstrated in the first section that quantitative easing in the usual sense, e.g. central bank purchase of short-term assets, has no impact on any economic variable, since short-term assets and money become perfect substitute under ZLB. No other asset prices will be affected either, once the opportunity cost of holding bank reserves has fallen to zero. The only remaining possibility for the central bank is to buy long-term assets directly. However Woodford points out that this policy is not pure quantitative easing. It can be understood as a combination of the creation of new reserves by purchasing short-term securities and an operation twist that sells the short-term securities to buy long-term securities that might be Treasury bonds or other financial assets. Short term securities are cancelled out in the balance sheets of the central bank. If something is working, it cannot be quantitative easing per se. it is the program of targeted asset purchases. How can it work?

If it ever works, it is through the portfolio-balance effect: the purchase/sale of the central banks affects the relative prices of the assets concerned. The effect can only exists if the two types of assets whose relative supply has been altered in the market are not perfect substitutes in the demand of market participants.

Once again the efficient market hypothesis denies this possibility. In a world of maximizing utility value of representative household with perfect knowledge of the future states of the world, there can be no such price changes. The CAPM theory of asset pricing stipulates that the price of any asset is the discounted value of future flows of consumption, the discounting factor being derived from the representative household’s marginal utility of income in the future states of the world. Because the trade in assets between the central bank and the private sector does not change the real quantities available for consumption, neither the future flows of consumption, nor the household’s marginal utility of income in the different states of the world are modified.

This is the irrelevance theorem we have already faced in the beginning of section I in opposing the efficient market equilibrium and the financial instability hypothesis. Woodford remarks that it can be extended to any model resting on the following
assumptions: first the assets are valued for their pecuniary return only; second there is no other binding constraint than the overall budget constraint. Under those hypotheses any investor can purchase arbitrary quantities of the same asset without debt limit. Irrelevance proceeds from the Modigliani Miller theorem: when the central bank buys asset x financed by selling asset y, investors are willing to purchase more y and divest in x by exactly the amount that undoes the effect of the central bank trade.

There are many reasons for this neutrality not to hold. It is akin to money neutrality, a necessary assumption to assume that all assets are held only for pecuniary reasons. However money is not just another asset. It is held for non-pecuniary motives because it is the universal receptacle of value that is unanimously accepted. It is why money is held for transaction and precautionary motives that invalidate neutrality. Furthermore the non-pecuniary motives are exacerbated under ZLB conditions, because ZLB itself is not an exogenous shock. It is the outcome of the process of deleveraging due to the burst of an asset price bubble. In the aftermath of the financial crisis stress is widespread. When the central bank signals that she is willing to buy some particular asset, she changes the relative risk aversion in holding a given portfolio in favor of this asset.

Another argument to invalidate the irrelevance hypothesis is the nature of Treasury securities. They are not alike other assets because they are links to the sovereign, implying a safety premium due to the peculiar relationship between the State and the central bank as LOLR. This relationship works as long as the debt is domestic and held in the national currency. Obviously those conditions hold for any developed country issuing public debt in the domestic currency. They do not hold in principle for the Eurozone, as much as the ECB is not the LOLR of any public entity. Nevertheless, the financial markets in sovereign debts are so fragmented in the Eurozone that any purchase by the ECB of sovereign bonds with very high safety premium has a spectacular effects in lowering their yields.

The purchase of long-term Treasury securities by the central bank alters the safety premium, thus affecting long-term yields even if there is no change in the expected path of short-term yields. It is a channel of monetary policy that works through term premiums. When the central bank operations are reducing the risk of the private sector in lowering the safety premium on Treasuries, it can eventually induce the private sectors to take more risk in holding other assets in portfolio rebalancing. For this process to arise, it is necessary that the assets the central bank chooses to buy in exchange of her monetary base are imperfect substitutes in private portfolios.

The segmentation of markets is based upon the hypothesis that economic agents have different preferences with respect to maturity and risk composition of financial assets. As already observed, those heterogeneities are magnified under ZLB in one dimension: the separation between the money base and close substitutes on the one side, all other assets on the other side. Nonetheless for central bank purchase programs to have significant economic effects, segmentation must be widespread over a large range of financial assets. Let us see how it has worked in practice.

3. Achievements in practice

ZLB has plagued Japan for many years. Against the views of American scholars, who advocated quantitative easing on a massive scale as soon as the late 1990’s, Richard Koo contented that deleveraging was so severe in the private sector that it was impossible to upturn private spending. Only large public spending could alleviate the depressive forces
of deleveraging on aggregate domestic expenditures. Nonetheless the Bank of Japan (BOJ) implemented quantitative easing (QE) for five years, from March 2001 to March 2006. Hiroshi Ugai (2007) has provided a comprehensive survey of the experiment. Let us say that it did not work on being gauged against the ultimate objective of ending deflation. From 1998 to 2005 price deflation was 3%: a slow but pervasive decline in the general price level.

In implementing her QE program, the BOJ did two things: inundating commercial banks with excess reserves and buying long-term Japanese government bonds (JGBs). Theoretically it has been shown that the expectations channel works through the forward rates thanks to pre-commitment and QE through the term premiums. However the problem in assessing the effects of QE empirically is to disentangle both types of influence on long-term rate changes. Then QE can be broken down into expanding the size of BOJ’s balance sheets and altering the composition of the asset side in purchasing long-term JGBs.

Remember that pre-commitment is maintaining the policy rate at zero after the recovery phase has started to compensate for the failure to lower the policy rate at the level of the negative natural rate while deleveraging was in full swing. It shows off in flattening the yield curve as a consequence of lowering the time value of the option of holding M0, as depicted on figure 5. According to Ugai, the BOJ has interpreted her program of expanding the size of the balance sheet as an enhancement of the policy duration effect. However the impact on overall financial conditions was very small. Kimura and Small (2006) found that the spread between high-grade corporate bonds and Treasury bonds of the same maturity declined 1 to 4 bps for ¥10tns increase in excess reserves.

The effect was obviously much too little to raise aggregate demand and prices. It could not counterbalance Koo’s assumption that deleveraging was an optimal behavior of minimizing debt. Ben Bernanke(1983) had found the same effect in studying the Great Depression in the US. The deterioration of bank balance sheets had dramatically paralyzed financial intermediation whose cost made new credit unaffordable. The flattening of the yield curve might have reduced a bit the cost of funding of financial institutions. But the positive effect did not spill over to the financial system to the whole economy. About the program of buying JGBs to alter the composition of the BOJ’s assets, Kimura and Small found an effect of about the same magnitude on the spreads of high-grade corporate bonds (6 to 8 bps).

After Japan’s disappointing experience, the results of US monetary policy starting in the fourth quarter of 2008 have been much researched. On top of her communication policy called forward guidance, the Fed has indulged in three programs in succession under the heading of quantitative easing:

- the first was the large scale and purchase 1 program (LSAP1) from November 2008 to March 2010. The amount was $1.75trns, of which $1.25trns of MBS. The estimation of the impact on long-term Treasury bonds varies between 40 to 160bps reduction.
- The second was LSAP2 from November 2010 to June 2011. The magnitude was $600bns. It added 15 to to 45bps of diminution in long rates.

Roughly the piling up of both programs and of forward guidance might have lowered the yield on 10-year bonds 80 to 120 bps. It has reduced significantly the cost of the federal debt. Starting in September 2011 to June 2012 and extended thereafter is the Maturity Extension Program (MEP). The size was $650bns until June 2012. It embodies operation twist.
One paper by Hamilton and Wu 2012 found that the Fed purchase of long-term Treasury securities reduces yields in 10-year T bonds and Aaa corporate bonds alike: 14 bps for $400bns purchase, irrespective of being an outright QE (augmenting the size of the central bank’s balance sheet) or an operation twist (selling $400bns of short-term securities). This is quite compatible with the teachings of theory. At zero lower bound, short-term Treasury securities are perfectly substitutable to central bank money. For a more widespread impact on financial markets the Fed must buy risky long-term bonds, for instance real estate mortgages. When she did so, she reduced the default risk on those bonds. The targeted purchase lowered the spread between those bonds and riskless Treasury bonds, since default risk is a factor of segmentation between financial instruments.

Another very interesting paper by Chung, Laporte, Reifschneider and Williams (2012) compares the performances of six models subjected to the same simulation methodology.

Three are structural models. The FRB/US model is a large-scale estimated model of the US economy. Its advantage is a detailed description of monetary transmission mechanisms. Behavioral equations have micro foundations, in the sense that households and firms optimize subject to adjustment costs leading to sluggish adjustment of real activity and prices in relation to shocks, but it is not a DSGE model. Two DSGE are the Smets Wouters and the EDO model. The first supposes that monetary policy is subject to independently and normally distributed monetary policy shocks. The second is specific for the US economy and used by the FR Board. It is by-sectoral with different rates of technological progress. Prices and wages are sticky. The model can accommodate financial, monetary and real shocks. Its handicap is that the estimates are entirely guided by the “great Moderation” without knowledge that this period was also the “Great Financial Drift”. Both DSGE models abstract from uncertainty. Parameters and shock processes are assumed to be constant over time and known by policy makers. Financial shocks if permitted are exogenous.

By contrast the three ad hoc empirical models remove those methodological constraints. They can introduce time-varying parameters, unit-root processes for modeling the natural interest rate and potential output growth. Therefore they are capable of capturing some features of uncertainty. The Laubach Williams model( LW) uses adaptive expectations and a gradual dynamic in responses to shocks, including permanent shock on the real interest rate. The TVP-VAR model estimates a vector of three variables: PCE price index (for core personal consumption expenditures), the unemployment rate and the Fed funds rate. Finally a univariate GARCH model estimates the same variables according to an autoregressive process of order 2.

The purpose of the simulations was to compute 5-year-ahead model forecasts conditional of the state of the economy at the time of forecasting. Model predictions can be assessed regarding the incidence of hitting the ZLB.

Comparing the actual course of events and what the models would have predicted prior to the financial crisis, all models view what happened as extremely unlikely. In all models the three variables, Fed funds rate, output gap and unemployment rate for 2008-2012 are far outside the 95% band! Only inflation behaved in the conditional distribution band. For the probability of hitting ZLB the structural models were the worse, ad hoc models fared somewhat better.

The other question studied was the effectiveness of large-scale asset purchases. Did they ease the ZLB constraint? As much as the efforts of the Fed to ease the adverse consequences of ZLB relied on large-scale-asset purchases to reduce term premiums, they could not be taken by DSGE models, because long rates depend only on expectations of
future short rates, not on term premiums, in those models. Only the FRB/US model, because it describes monetary policy tools and channels in detail, is suited to assess the effects of the Fed’s purchases. The term premium effect is modeled as proportional to the discounted expected future gaps between the ratio of the amount of securities (maturity ≥1 year) held in the Fed’s portfolio/nominal GDP and a trend ratio of such holdings. Therefore the model implies that the magnitude of the decline in the term premium of a particular bond depends on the investors’ expectations of future holdings of the central bank for that particular asset. In FRB/US model simulations it was supposed that the asset portfolio would grow to 2.6trns in 2011, then steadily decline to converge to normal in 2017. The model calculates a decline in the term premium up to 65bps until late 2001, then diminishing effect to 0 in 2017.

The induced macro effects of the Fed’s program depend on assumptions for monetary policy and wage-piece dynamics. With pre-committed forward guidance, the 10-year Treasury bond yield drops by as much as the term premium. Subsequently yields move back towards baseline unless pushed downwards by new announcements. Portfolio-balance effects would fade while economic agents think that the date of portfolio normalization draws nearer. Meanwhile lower long-term rates boost Stock market valuation and depreciate the dollar. A stimulus to real activity should ensue, all other things being equal. The gain in GDP is estimated to be 2 to 3% and in payroll unemployment 1.8million.

Another paper by Christensen and Rudebush (2012) provides insights on the portfolio-balance channel of monetary policy. The authors try to break down the change in yields into its expectations (signaling channel) and time premium (portfolio channel) components. It has also the merit US and the UK response of interest rates to quantitative easing. They study eight announcements made by the Fed on LSAP1 and seven announcements by the BOE on her QE program. Relative to the size of their respective economies the amounts of bonds purchased were similar; so were the reactions of markets. The US cumulative decline in yields on 10-year Treasury bonds was 91bps following the eight announcements. In the UK long-term government bond yields (gilts) declined 100bps after the six announcements. In the UK long-term government bond yields (gilts) declined 100bps after the six announcements.

The authors used an event study methodology to study the response of yields in a comparative way, by means of a dynamic term structure model decomposing long-term yields into expected short rates and term premium. The difference in the results was striking. It was a sweeping rebuttal of the Modigliani Miller theorem. The differences in financial structure matter decisively. In the US 60% of response in the Treasury yields came from lower expectations on future monetary policy. In the UK 100% of the decline in gilt yields came from the fall in term premiums.

Studying the US experience along LSAP1 in more detail, the authors used event study methodology to insulate as much as possible the policy effect from the high degree of interest rate persistence. They used a 1-day window around announcements of bond purchases. They assumed that each announcement was a complete surprise and they narrowed the window enough to reduce the possibility that other news might have affected interest rates at the same time. Looking at a range of maturities, they could check that yields on shorter maturities changed very little if not at all in conformity with the ZLB constraint. On the contrary yield on 5 to 10-year maturities declined 100bps over the eight announcements spanning one year. Looking at OIS rates that measure expectations of Fed funds rates over a given maturity, they found that OIS and Treasury yields were highly correlated. Corporate bond yields declined by less than Treasury yields. The spreads increased the more, the lower the rating quality of the bonds and the shorter the maturity.
The findings indicate market perception of a higher risk of default in the near term at the time of LSAP1 which was implemented only a few months after the apex of the crisis. Finally Libor and swap rates declined in tandem with treasury and OIS rates. It reveals that segmentation in markets was low, in accordance with the main result showing that most of the decline in yields came from expectations.

The UK experience was in sharp contrast. The Bank of England made seven announcements in QE policy between February 2009 and October 2011. Long-term gilt yields declined 45bps while short term yields did very little. Long maturity OIS rates went down only a quarter of gilt rates, as well as Libor and swaps over 5 to 10 years. All these findings confirm the existence of market segmentation.

Finally one might ask the question of cross-country responses. Announcements of bond purchases in US can provide investors worldwide with information on global liquidity. Expectation that the Fed will hold interest rates low for a long period of time can induce other central banks to take the same stance. After LSAP announcements spillovers from US monetary actions onto UK markets occurred. Significantly OIS, Libor and swap rates in the UK declined 70 to 80bps after US announcements, but gilt yields declined much less. It is a clue that the signaling effect of US yields spread over world markets, while the reverse effect of UK announcements on US interest rates cannot be detected.

To conclude this section, Minsky’s hypothesis of financial instability led by credit excesses followed by prolonged deleveraging leading to negative natural interest rates, which transform the regime of monetary policy under ZLB, is vindicated by empirical studies. The efficient market hypothesis is starkly unable to account for the depth and length of the crisis, which has nothing to do with exogenous shocks.

Fed’s experiments in monetary policy are quite useful. They have considerable mitigated the severity of the long adjustment period that follows the distorted balance sheets built in the euphoric time of the financial cycle. The buildup of the crisis was entirely endogenous, so is the process that resorbs it. Mitigating ZLB constraints is part of the way to recovery. One question remains: what about the future of monetary policy?
III. The exit problem and the future of monetary policy

One important consequence of the financial crisis is that it invalidates entirely the doctrine that has been in vogue since the 1980’s. This doctrine has rested on the postulate of complete dichotomy between price stability and financial stability. It reversed a century of central banking. Since Bagehot central banks were primarily lenders of last resort. As Charles Goodhart recently noticed, what central banks can do and no other economic or financial agent can, is issuing ultimate liquidity that is acceptable by everyone. It is the gist of central banking. As Hawtrey used to say, handling it is the art of central banking. On the contrary, the Treasury, Parliament or a council of wise people can define an inflation target as well as central bankers.

The doctrine inspired by monetarism that has led to the exclusivity of inflation targeting, “one objective, one instrument”, has played havoc with financial stability. Ironically, this doctrine undoubtedly was a permissive condition in the decoupling of money and credit that has nurtured the “Great Financial Divergence” under the disguise of the “Great Moderation”. If monetary policy has any future, it is in embodying financial stability as a primary objective again, ending the extravagant rent extraction of the financial sector over the whole economy.

Claudio Borio(2011) summed up the pre-crisis tenets that have gone broke:

- Price stability is a sufficient condition for macroeconomic stability. Only price rigidity can derail macro stability.
- Monetary and financial stability should be separated because financial regulation and supervision need only to be micro.
- Short-term interest rate is the single proper tool to capture the impact of monetary policy on the economy, because government securities at different maturities are perfect substitutes.
- Central banks must only look at their domestic economy in ensuring price stability (“putting one’s own house in order”). Flexible exchange rates will ensure that the whole world is stable because uncovered interest rate parity holds.

Every reasonable people would recognize that those postulates are wrong. But disagreement arises about what to do. What has been agreed upon in the G20 is strengthening regulation and supervision in their own right. It means that the idea of separating the focus on price stability on the one hand and financial stability on the other hand is still alive. A new concept has appeared: macro prudential policy. However, as it has been framed up to now, macro prudential policy does not impinge upon monetary policy. It is more an appendix of micro prudential regulation. The latter has been enriched with Basel III and with stronger supervision for systemic financial entities. The idea is to modulate some of the capital and liquidity ratios imposed to individual banks to give them a counter cyclical flavor.

As far as monetary policy is concerned, central bank strategy explained in sections I and II has gained a large approval, less so the need to prolong it for some time beyond the crisis management phase. Using balance sheet instruments permanently is not an option anyway, because they are no substitute for balance sheet restructuring in the private sector, which has to be completed. It is why exit must be prepared. Then what must be done afterwards?

Critics consider that macro prudential policy, the way it is conceived, will jeopardize central bank independence because it will involve them into banking policy. Nonetheless there is a way out if one has understood what has been pointed out in the first two
sections. Credit aggregates are the drivers of the financial cycle. The transformation of finance has decoupled them from money aggregates. Credit expansion has, and can again despite Basel III rules, triggered momentous rise in asset prices fostering overall financial instability. Therefore macro prudential policy for the sake of overall financial stability should focus on aggregate private sector credit growth. This is a task of monetary policy. Devising a counter-cyclical rule that generalizes the Taylor rule in mixing the concerns of price and financial stability is the job of central bankers.

This section will calm down anxieties about exit policy. Then it will underpin the theoretical foundation for an extended central bank reaction function.

1. Means and opportunity of exit

Fears of adverse side effects of monetary policy at ZLB have been spelled out by William White (2012). He mentions possible misallocations of capital due to abnormally low long-term rates, but he does not give much credence to the likelihood of rising core inflation. One should not confuse inflation proper, which is the decline in the unit value of money due to the persistence of an excess supply of money, with adjustments in relative prices that are reflected in the conventional consumer price index. Of course, there can be bursts of commodity prices due to supply scarcities. They are reversible relative price shocks. It would be absurd to fight problems in particular sectors, which should be dealt with by investments in new production capacities, in making credit more expensive, which would restrict investment. It is also possible that the increase in prices of primary commodities, particularly in agriculture, is structural with the return of pre-industrial absolute scarcities in resources. In that case it will be a Balassa-Samuelson phenomenon that warrants a slightly higher inflation target. One should not forget that the “Great Moderation” was an exceptional era, largely due to the early phase of globalization underlain by the huge increase in the labor force worldwide. The trend rise in wages in China and India signals a new phase of globalization where worldwide inflation will ratchet upwards. In that case it would be unwise to stick to 2% target. It would perpetuate a range of real market rates higher than the natural rate and it would shackle investment permanently.

Meanwhile excess capacities are widespread. Breakeven inflation expectations extracted from financial market prices are subdued at 2.5%. Furthermore if something is known about price inflation in labor and real sector markets is that expectations are backward-looking and sluggish. Central banks will have all the time to observe alert indicators and to respond to inflationary pressures building-up. With the disappearance of all indexing procedures for a very long time and massive labor unemployment, the possibility of an unexpected burst of inflation expectations in the real side of the economy is a pure phantasm. It does not preclude that some countries feel an acceleration of inflation due to exchange rate depreciation, offset by opposite effects in other countries.

With all these considerations in mind, the FOMC has clearly stated the conditions of exit and motivated them. The FOMC has privileged a simple criterion: maintaining the policy rate close to zero as long as unemployment >6.5%, provided that expected PCE inflation is < 2.5%. As stated by Woodford, a better target might have been based on nominal GDP path: pledge to maintain funds rate at lower bound as long as nominal GDP remains below target path, which is the path the FOMC would have kept if ZLB had not constrained monetary policy since late 2008. Then the FOMC would raise the funds rate to keep a steady growth rate of nominal GDP thereafter.
Finally technical means to absorb excess liquidity whenever it occurs do exist. Of course, excess liquidity is relative to money demand, not to a predefined value in $M_0$. As long as ZLB conditions are active, there cannot be any excess liquidity. Hence absorbing excess liquidity goes hand in hand with initiating the post-ZLB monetary strategy. It is QE in reverse to smooth the transition between the two regimes of monetary policy. The idea is to gently pilot a progressive steepening of the yield curve, compatible with the transition path of nominal GDP growth.

Theoretically the proper means should be asset sales by the central bank. However it is necessary to be careful not to upset some segmented long maturity markets. Adjacent tools can be mobilized for this purpose. The central bank can reactivate required reserves to freeze excess bank reserves. This quantitative policy was activated successfully by the People’s Bank of China. When monetary policy turned restrictive, the central bank raised required reserve ratios several times and modulated them between large banks and small banks. This is a flexible and easily reversible tool, entirely in the hands of central bankers. Finally the central bank can issue non-liquid debt certificates with conditions attached that make banks willing to hold them.

2. A mandate for post-exit monetary policy that embodies overall financial stability

The problem is to conceive a theoretical scheme for monetary policy, encompassing both price and financial stability. To do it both types of risks, inflation and financial instability, must be made commensurable in a single utility function of the central bank. This function must combine the costs of inflation and of financial fragility.

The advantages of inflation are well-known in the short run. It is the possibility of increasing economic activity along the Phillips curve against higher cost and price inflation. However this advantage is curtailed by the rise in inflation expectations if the speed up in the actual rate of inflation persists. The more sluggish are expectations, the longer the gains in economic activity. They will cancel out when expectations of future inflation have caught up with the actual rate of inflation. This is well-known monetarist stuff.

The costs of inflation lie in its volatility. It gives rise to uncertainty in future inflation that has unexpected distributive effects on income and wealth. The higher the rate of inflation, the more uncertain it becomes. When economic agents get conscious of the phenomenon, they can indulge in a catch-up game that triggers an inflationary spiral.

To take care of both advantages and costs of inflation, I will use the exponential form, which makes it easy to determine the optimal inflation rate in writing the first-order condition in logarithm.

The advantage of inflation is: $\hat{p} \exp \left( \hat{p}_a \right)$, where $\hat{p}$ is the actual rate of inflation and $\hat{p}_a$ is expected inflation by the private sector.

The cost of the variability of inflation is: $\exp \left( \hat{p}_a \right)$

The cost of financial fragility demands more attention. There is no standard utility function of the central bank that is embodying it. What has to be done is to capture the systemic risk that the accumulated disequilibria in the financial system imply for the central bank. What has been shown in section 1 is that an inflation target does not guarantee financial stability, because the regime of credit is decoupled from monetary
conditions in the usual sense of a central bank utility function dedicated solely to the risk of inflation. To express this divorce let us introduce a variable called the *degree of mismatch* between the commitment of the central bank for a medium-term inflation target and the regime of credit.

The linkage between Minsky’s financial instability hypothesis and Wicksellian theory of interest rates depicted on figure 2 tells that the regime of credit changes in the financial cycle.

When the natural rate is higher than the equilibrium rate ($r_n > r^*$), credit is in a *debtor regime* since the ratio of new credit/value added by the private sector ($\Delta D/Y$) increases fast and is higher than the ratio corresponding to the Wicksellian equilibrium rate ($\Delta D^*/Y^*$). This is the euphoric phase of the financial cycle where credit and asset prices are rising in a roundabout process.

When the natural rate is lower than the equilibrium rate ($r_n < r^*$), credit is in a *creditor regime*. Deleveraging is under way. It follows that ($\Delta D/Y < (\Delta D^*/Y^*)$).

Now let us consider that the relationship between the central bank and the financial sector is a game where the state of the financial system is represented by a variable $S$ graduated between 0 and 1. $S=0$ is the utmost of the creditor regime ($\Delta D_{low}/Y$ on figure 2). This is the state of the financial system under ZLB conditions. $S=1$ is the utmost of the debtor regime ($\Delta D_{high}/Y$) at the apex of the asset price bubble.

The commitment of the central bank for price stability is expressed in an inflation target and a willingness to reach it. Let us define a commitment index $C$ normalized from 0 to 1. 0 is the strictest commitment (*the hawk*) represented by the ECB who does not care for employment in conformity with her mandate. The loosest commitment 1 (*the dove*) is represented by the Fed who does care for employment, also in conformity with her mandate.

The game depicted on table 1 exhibits compatible and dissonant configurations. On table 1 are represented corner configurations. But there is flexibility because $S$ and $C$ can vary between 0 and 1.

<table>
<thead>
<tr>
<th>Commitment of central bank (C)</th>
<th>Credit regime (S)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Creditor</td>
<td>Debtor</td>
<td></td>
</tr>
<tr>
<td>Tight</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Loose</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

The degree of mismatch is:

$$y = 1 - x = 1 - |C - S|$$

The degree of mismatch is maximum when $x=0$. The central bank is committed to a loose policy regime in setting its interest rate because inflation is low, while credit is accelerating and feeding the momentum in asset prices in a debtor regime. This is what
happened in the years prior to the crisis. Central banks did not feel any need to tighten because inflation was so low. They did not care of the accelerating speed of credit growth. Conversely x=0 if the central bank keeps a positive interest rate while it should be at the lower bound because the natural interest rate is <0 and if she is reticent in purchasing long-term assets. This is the behavior of the ECB contrary to all other major central banks in developed countries. In both circumstances mismatch is high because the central bank follows a pro cyclical policy, giving no or little weight to the dynamic of credit in her utility function. The opposite policy (x=1) is a countercyclical policy to mitigate the magnitude and length of the financial cycle so as to avoid financial crises as much as possible.

Therefore it is reasonable to assume that the cost of financial fragility is increasing with the degree of mismatch y. Using a simple hyperbolic function of y, the cost of financial fragility is expressed as: \( \exp\left(\frac{2y}{1+y}\right) \)

The central bank chooses her inflation target \( \hat{p} \) in maximizing her utility function U for given y and \( \hat{p}_a \)

\[
MaxU = \hat{p} \exp \left( \hat{p}_a \frac{2y}{1+y} \right) \exp \left( \hat{p}^2 + \frac{2y}{1+y} \right)
\]

The first order condition in logs is:

\[-\hat{p}_a - \frac{2y}{1+y} = \hat{p}^2 + \log \hat{p}_a \]

The right hand side is an increasing function of \( \hat{p} \)

It determines an inflation target for given values of y and \( \hat{p}_a \)

\( \hat{p}^* \) is decreasing in inflation expectations and in the degree of mismatch.

To be credible, monetary policy must be such that inflation expectations in the medium term converge on the inflation target: \( \hat{p}^* = \hat{p}_a \)

Combining the condition of credibility and the condition of optimality, one gets:

\[-\frac{2y}{1+y} = \hat{p}_a + \hat{p}^2 + \log \hat{p}_a \implies h \hat{p}_a \]

The above condition determines a range of credible inflation targets whose limits are defined by the extreme values in the degree of mismatch 0 and 1. The limits \( \hat{p}_a \text{min} \) and \( \hat{p}_a \text{max} \) are such that \(-1 = h \hat{p}_a \text{min} \) and \(0 = h \hat{p}_a \text{max} \) (figure 7).

Within this range the commitment of the central bank is trusted. The lower the degree of mismatch, the higher the inflation target within the credible range. In a creditor regime, the central bank must commit to a higher inflation target to keep the economy off the deflation trap and to facilitate deleveraging.
It remains to adapt the theoretical framework to an operational reaction function of the central bank in drawing the teachings of the Minsky Wicksell framework developed in section 1. A variable, linked to the regime of credit, should be added to the arguments of the Taylor rule to modulate the policy rate to changes in the regime of credit in the financial cycle. The relevant variable is the spread \((i_n - i*)\) between the natural rate and the equilibrium rate, whose sign defines the nature of the regime of credit. However the spread and its components are unobservable. One can use the inverse relationship between natural interest rate and new credit/nominal GDP. But this relationship cannot be directly estimated.

The best is to use what the BIS had advocated for a long time: the gap between the growth in private credit/GDP and a moving average of this variable over the length of the financial cycle, let us say a 10-year moving average. This credit gap \(d_{gap}\) is:

\[
d_{gap} = \left( \frac{\Delta D}{D} - \frac{\Delta Y}{Y} \right) - \left( \frac{\Delta D}{D} - \frac{\Delta \bar{Y}}{\bar{Y}} \right)
\]

The expanded Taylor rule is:

\[
i_t^p = g^* + \pi^* + \alpha \left( \frac{Y_t - \bar{Y}}{\bar{Y}} \right) + \beta (\pi_t - \pi^*) + \gamma d_{gap,t}
\]

Where \(g^*\) is potential GDP growth and \(p^*\) the optimal inflation target.

This is the theoretical policy rate. The central bank must also take account of the persistence effect of monetary policy. Persistence is part of the endogenous financial cycle the central bank wants to mitigate. The policy rate reacts not only to present value but also to past value of the output gap and the credit gap. In the euphoric phase of the financial cycle both are positive and increasing for a given level of the policy rate. If the central bank had already reacted firmly in \(t-1\) in raising her rate, the policy move influences credit
and output in t, reversing the momentum or at least moderating it. The central bank must make account of her past move in deciding her present stance of monetary policy.

The central bank reaction function then becomes:

\[ i^*_t = \kappa + \pi^* + \alpha_1(\frac{Y_t - \bar{Y}}{\bar{Y}}) - \alpha_2(\frac{Y_{t+1} - \bar{Y}}{\bar{Y}}) + \beta(\pi_t - \pi^*) + \gamma_1 d_{gap,t} - \gamma_2 d_{gap,t-1} \]

Finally central banks prefer to smooth out the variation of short-term interest rate:

\[ i_t = (1 - \rho_1) i^*_t + \rho_1 i_{t-1} + \rho_2 (i_{t-1} - i_{t-2}) \]

This is the determination of short-term interest rates post-ZLB whether macro prudential concern has been embedded in monetary policy. Further studies should investigate empirically this type of model to compare the profile of the policy rate before the crisis and what it would have been, had credit growth been taken care of.

Nevertheless it is likely that the extension of a Taylor-like reaction function will not represent a change substantial enough to embody macro-prudential concerns in the framework of monetary policy. The framework must be able to hamper the systemic risk that is threatening in the Minsky moment of the financial cycle. At this moment, endogenously unseen and unchecked build-ups of imbalances change radically the whole financial dynamic. The occurrence of systemic risk that gives rise to financial crisis can be modelled in using the formal tools for analysing coordination failures (Aglietta and Scialom, 2010).

The teaching of the model is the following. With the higher and higher leverage in the banking system, the interbank rate gets higher than the policy rate. The widening spread between them (TED spread) reflects a rising liquidity risk. When the interbank rate is catching up, then getting higher than the natural rate, liquidity risk interferes with credit risk. Uncertainty deepens in the money market because banks become more wary to provide liquidity to one another. It follows that structural instability invades the banking system. It is why the lender of last resort is critical. In taking up the money market, it erases the spread and drives the policy rate sharply down altogether. Nonetheless the collapse of asset prices might have already led the natural rate in negative territory, so that nothing can prevent a long and painful deleveraging.

Therefore a new framework of monetary policy, aiming at preventing systemic risk at the turning point in the financial cycle, must control credit expansion strongly enough to mitigate the momentum in asset markets. It cannot be done with the policy rate alone. For that the dogma of price stability, necessary and sufficient for overall macroeconomic stability, must be broken. The inescapable conclusion is that central banks should pursue a dual objective of financial and price stability and should be empowered with enlarged responsibilities to deliver. Dealing with financial stability is opening a new territory in central bank mandate at the junction of monetary policy and financial regulation. It is well-known that it is impossible to achieve two objectives with a single instrument. The proper tools must affect the balance sheets of financial intermediaries. They are quantitative instruments, microeconomic instruments to achieve macroeconomic objectives, since a macro constraint on credit growth must be distributed on suppliers of credit that indulge in leverage. Multiple instruments can be mobilized: required reserve ratios modulated counter cyclically, Basel III liquidity ratios, capital ratios linked to systematic divergence from trends in specific asset markets.

This is a top-down approach. Since firms belonging to the shadow banking system should be supervised as banks, the reach of the supervisory authorities should be enlarged.
Furthermore a top-down approach can only be implemented if a permanent institutional arrangement is established between the central bank and the supervisory authorities, whenever they are separated from the central bank. Every financial entity, which generates or transmits endogenous risk in credit and derivatives markets, whether due to its size, its interconnections or its leverage, should be labelled a systematically important financial institution. Such an institution should be subject to countercyclical capital requirement against its contribution to systemic risk. This requirement is a proportion of the macro capital requirement deemed necessary by the central bank in the buoyant stage of the financial cycle to keep systemic risk in check. To make this estimate the central bank should implement periodically systematic stress tests on a routine basis all along the financial cycle.

**Conclusion: for a renewed central bank mandate**

Thirty years of unbridled market finance liberalization has led to its logical consequence: a global financial crisis. Had Kindleberger’s historical evidence not been forgotten or discarded by central banks and regulators alike, this dire outcome could have been mitigated. Managing the financial cycle is the way to handle the concern of financial stability. Regulation and supervision of financial entities are necessary but not sufficient. The financial cycle is a macro phenomenon rooted in the very nature of finance, contrary to what the efficient market hypothesis assumes. It is why central banks should be assigned a dual mandate: achieving both price and financial stability. In the last few decades they achieved the former, partly thanks to favorable circumstances in world traded goods and labor markets. But they failed entirely in dealing with the latter.

What is needed is more than Greenspan’s macro risk management, which was hands-off in the upward phase of the financial cycle and busy to put a floor under asset prices to avoid too severe the decline in the natural rate in the downward phase. This “Greenspan’s put”, as it was labeled, created huge moral hazard in the financial system, and coupled with his belief in the virtue of financial innovations, contributed to the building of systemic risk.

For financial stability to be taken seriously, central banks must overhaul their monetary policy doctrine and their subsequent operating procedures. First and foremost they must remember their own origins. Central banks were recognized as lenders of last resort, while the systemic nature of financial crisis had begun to be understood. In market finance, it is not enough to be the lender of last resort of commercial banks; the umbrella of the central banks must extend to the entire financial system. Obviously it requires buying a large array of securities in time of stress, including Treasury bonds, since the latter are linchpins of the financial system.

It follows that the principle of central bank independence must also be renewed especially in Europe. The dogmatic principle “one objective, one instrument”, because the objective of price stability was itself supposed to be independent of any other objective of economic policy, is false and incompatible with the concern of financial stability. Of course, central banks must be entirely independent in the conduct of monetary policy under their mandate. But they must be accountable to a democratic political institution in the Eurozone as well as anywhere else. Furthermore it cannot be possible to pursue a dual mandate without dialoguing with the sovereign about macro-economic conditions and the best economic policy mix. The view of central bank independence, claiming that it precludes any cooperation with other public entities to improve people’s welfare, is caricatural and sectarian indeed.
Because the financial cycle is an endogenous and global phenomenon, macro prudential concerns must be amalgamated into monetary policy. When the financial crisis has not been eschewed and ZLB has been reached and pervaded, ultra loose monetary policy must be pursued for some time after the beginning of the recovery to retrieve the conditions of robust growth. Then a new framework for monetary policy must be established to encompass macro prudential management. This framework must acknowledge the decoupling of credit dynamics from money aggregates and introduce the reaction against private sector credit excessive growth in the policy rule. A relevant set of indicators in credit conditions must be carefully checked to assess the phase of the financial cycle and to detect momentums in the making. The use of quantitative policy instruments to complement the interest policy rule should not be precluded.

All in all it is high time to build the foundations of a new era whereby the devil of financial instability that is allowed to get loose is shackled again for the sake of financing real investment. Reframed monetary policy is an integral dimension of this new era.

**Bibliography**


Adrian T and Shin H.S. (2008c), Financial Intermediaries, Financial Stability and Monetary Policy, Jackson Hall Symposium, 08-2008


Bernanke B., 2012, Monetary policy since the outset of the crisis, Jackson Hole Symposium, August 31


Chung H., Laporte J.P., Reifschneider D. and Williams J. (2012), *Journal of Money Credit and Banking*, suppl. To vol. 44, n°1, February


Fisher I. (1933), The debt Deflation Theory of Great Depression, *Econometrica*, vol1, n°4


Hamilton J.D.and WU J.C. (2012), The effectiveness of alternative monetary policy tools in a zero lower bound environment, *Journal of Money, Credit and Banking*, suppl. To vol.44, N°1


Koo R. (2008), *the holy grail of macroeconomics: lessons of Japan’s great recession*, Wiley

Mac Kinsey Global Institute (2010), debt and deleveraging: the global credit bubble and its economic consequences


Wicksell K. (1907), the influence of the rate of interest on prices, *Economic Journal*, May


Woodford M. (2012), Methods of policy accommodation at the interest rate lower bound, Conference Paper, Jackson Hole Symposium, August 31