The Case for Unencumbering Interest Rate Policy at the Zero Bound

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I. Introduction

Much has changed since my exploration of negative nominal interest rate policy in a paper for the 1999 Federal Reserve System conference "Monetary Policy in a Low Inflation Environment."[1] Since then, negative nominal interest rate policy has gone from a theoretical possibility to practical reality in much of the advanced world. In light of these developments, my current paper makes the case for unencumbering interest rate policy altogether so that negative nominal interest rates can be made freely available and fully effective as a realistic policy option in a future crisis.

At this writing, short-term policy rates are -0.4 percent in the euro area, -0.75 percent in Switzerland, -0.5 percent in Sweden and -0.10 percent in Japan, having been introduced in June 2014, December 2014, February 2015 and January 2016, respectively.[2] As a consequence, negative nominal interest has moved out along the yield curve over time. German 10-year yields fell below zero for the first time in June 2016. Ten-year government bonds are lately offering negative nominal interest in Denmark, Japan, the Netherlands and Switzerland. The amount of global sovereign debt with negative

nominal yields surpassed $10 trillion in May 2016, up 5 percent from April.

As for the United States, the yield on the benchmark 10-year Treasury closed below 1.4 percent for the first time in July and the 30-year Treasury sold at a record-low yield just below 2.2 percent. A survey by *The Wall Street Journal* taken in December 2015 indicated that over half of the economists who responded thought it somewhat or very likely that the federal funds rate would be back near zero within the next five years. The same article pointed out that no other central bank in the advanced world that has raised rates since the 2007-09 crisis has been able to sustain them at a higher level, including central banks in Australia, Canada, the euro area, Israel, South Korea and Sweden.[3]

These extraordinary developments, the prospect of low or negative nominal interest rates for the foreseeable future, and the protracted period in which policy rates have been immobilized at or near the zero bound, e.g., Japan since 1995, the United States since 2008, the U.K. since 2009, the euro area since 2009 and Switzerland since 2010—testify to the urgency of unencumbering interest rate policy at the zero bound altogether.

First and foremost, the zero interest bound should be removed—much as the gold standard and fixed foreign exchange rate encumbrances were removed in the 20th century—to free the general price level from the influence of relative prices over which monetary policy has little control. The gold standard was abandoned so that fluctuations in the gold price of goods would no longer destabilize the price level. Fixed foreign exchange rates were abandoned to insulate domestic price levels from movements in the international terms of trade. Those encumbrances were abandoned so that central banks could pursue monetary policy independently to stabilize domestic employment and inflation without costly subsidiary policies highly disruptive of international relations, trade, and finance. Likewise, the zero interest bound encumbrance on monetary policy should be removed so that movements in the intertemporal terms of trade can be reflected fully in interest rate policy to sustain price stability and full employment with a minimum of inefficient and costly alternative policies.

A simple model borrowed from a 2002 paper of mine is employed to identify the underlying determinants of the intertemporal terms of trade and its counterpart the natural interest rate that interest rate policy must respect in order to stabilize employment and inflation over the business cycle. With the help of the model, we identify a range of factors at work around the world today tending to depress the intertemporal terms of trade and the natural rate of interest consistent with stable employment and inflation. Broadly speaking, these factors portend a plausible pessimism about expected future relative to current income prospects that fuels a desire to move wealth and consumption to the future via saving, thereby depressing the intertemporal terms of trade and the natural rate of interest.

Reflecting the plausible pessimism that has been growing for some time, the zero bound encumbers interest rate policy today because nominal market interest rates around the world have drifted precipitously lower in the past two decades. For instance, average inflation-indexed 10-year bond rates in the United States and around the developed world have fallen steadily from 4 percent in the mid-1990s to around zero percent today. With inflation stabilized at or below 2 percent and inflation expectations well-anchored, nominal bond yields have declined to historic lows, too. Also depressing the nominal bond rate, net compensation for risk transfer, i.e., the term premium, has fallen from around 2 percent in the mid-1990s to near zero today plausibly reflecting the shift from cyclical inflation risk to cyclical deflation risk.

The problem for monetary policy is that low long-term nominal rates leave little or no room for short-term nominal interest rates to cycle below long-term nominal rates as usual over the business cycle. Moreover, the secular decline in long-term nominal interest rates reflects underlying factors likely to persist—low inflation expectations, downward pressure on the intertemporal terms of trade and downward pressure on the price of risk transfer in long bonds. It is only a matter of time before another cyclical downturn calls for aggressive negative nominal interest rate policy actions.

One could argue based on the evidence that the zero interest bound has not been much of an impediment to monetary policy in practice.

To be sure, aggressive negative interest rate policy actions in the immediate aftermath of credit turmoil might have short-circuited much of the contractionary dynamics of the Great Recession. But despite interest rate policy having been immobilized near zero around the developed world for a prolonged period there was no deflation spiral, and the unprecedented expansion of central bank balance sheets has stabilized inflation reasonably well, even if somewhat below various inflation targets.

In any case, the effectiveness of more balance sheet stimulus is questionable. Credibility against deflation, should it be lost, will be difficult to regain with interest rate policy immobilized at the zero bound. Central banks will be tempted to rely even more heavily on balance sheet policy in lieu of interest rate policy, in effect exerting stimulus by fiscal policy means via distortionary credit allocation, the assumption of credit risk and maturity transformation, all taking risks on behalf of taxpayers and all moving central banks ever closer to destructive inflationary finance.

Interest rate policy is far superior to these alternatives, being necessary and potentially sufficient for countercyclical stabilization purposes. Interest rate policy is by far the most flexible, the least intrusive of markets, and has proven capable of targeting low inflation. Moreover interest rate policy can be managed credibly, reasonably free of politics, by an independent central bank because it makes little use of fiscal resources. Interest rate policy is merely about shadowing the natural interest rate to yield the best stabilization of employment and inflation that monetary policy alone can deliver.

With these advantages in mind, the final portion of the paper describes in detail three methods by which the zero bound on interest rate policy can be unencumbered completely. The three methods in turn would: 1) abolish paper currency, 2) introduce a market-determined flexible deposit price of paper currency, and 3) provide electronic currency (to pay or charge interest) at par with deposits. Each method is assessed for its effectiveness, technological requirements, institutional modifications, potential for expedited implementation and acceptability with the public at large.

II. Price Stability and the Evolution of Monetary Policy in the 20th Century

The theoretical case for stabilizing the price level has its origins in Irving Fisher's *The Purchasing Power of Money* (1911) and in Knut Wicksell's *Interest and Prices* (1898, 1936); the practical case was made in Keynes' *A Tract on Monetary Reform* (1923). Instability in the purchasing power of money—first during the Great Depression and later during the Great Inflation—came to be understood as detrimental for employment and output. Eventually, central banks came to be seen as having the power to control inflation via their control of the monetary base, short-term interest rates and the money supply. At the close of the 20th century, central banks were given operational independence to use their policy instruments to target low inflation.[4] Monetary policy had to be freed from the gold standard and fixed foreign exchange rate encumbrances so that the price level could be freed from destabilizing influences stemming from fluctuations in the gold price of goods and the international terms of trade, respectively.

II.i. The Gold Standard and the Gold Price of Goods

Under the gold standard, the price level may be expressed as the product of the money price of gold and the gold price of goods: money/goods = (money/gold)(gold/goods). The classical gold standard committed governments 1) to maintain a fixed money price of gold and 2) to satisfy a minimum required gold reserve ratio against currency and bank deposits, respectively. The fixed money price of gold encumbrance thereby tied the price level directly to the gold price of goods. A rise (fall) in the gold price of goods would cause inflation (deflation).

The gold price of goods was determined by a variety of forces impacting the supply and demand for gold such as cost conditions in gold mining, the demand for jewelry, industrial demand and the strength of economic growth underpinning the demand for money and its required gold backing.[5] Fluctuations in any of the underlying determinants of the gold price of goods would feed into the price level under a gold standard.

Central banks worked increasingly during the 20th century to offset the influence of gold flows on their respective price levels. Central banks forced to buy gold at the pegged money price of gold sterilized the gold inflows, effectively raising their gold reserve ratios against currency and deposits, rather than allowing the gold inflows to generate inflationary growth of the money supply. Such behavior raised the world demand for gold, depressed the gold price of goods and created global deflation pressure. Those countries losing gold, and thereby under pressure to deflate their domestic money supplies and price levels, chose instead to reduce minimum required gold reserves against currency and deposits, to impose direct controls of one sort or another, or to devalue their money in terms of gold.[6] The gold standard was finally abandoned completely in the early 1970s so that fluctuations in the gold price of goods could be reflected in the money price of gold without destabilizing the general price level.

II.ii. Fixed Foreign Exchange Rates and the International Terms of Trade

The international terms of trade—the A good price of B goods—may be expressed in terms of the respective money prices of domestically produced goods and the nominal exchange rate as: A goods/B good = [(B money/B good)/(A money/A good)](A money/B money). A fixed foreign exchange rate encumbers monetary policy by tying the ratio of money prices of domestically produced goods directly to the international terms of trade. For instance, with a fixed A money price of B money, an improvement in country A's terms of trade, i.e., a fall in the A good price of B goods, forces inflation in country A or deflation in country B. Conversely, a deterioration in country A's terms of trade forces deflation in country A or inflation in country B.

The international terms of trade is determined by the relative supplies and demands for A goods and B goods in global markets. For example, relative goods supplies depend on relative labor productivities and relative employment in the trading partners; and relative goods demand depends on relative home biases and the balance of trade.

In practice, a fixed exchange rate regime tends to encumber the monetary policy of the smaller trading partner more than that of

the larger. The smaller trading partner is subjected to fluctuations in both the international terms of trade and the larger trading partner's money price of its domestically produced goods. For instance, to resist imported inflation the smaller trading partner would want to raise interest rates. But higher interest rates would attract foreign currency inflows that must be purchased to maintain the fixed exchange rate, and then sterilized by the costly sale of debt to prevent excessive money growth. Conversely, lower interest rates to resist imported deflation would lead to a loss of international reserves in support the fixed exchange rate with the prospect of a devaluation, disruptive speculation and the imposition of some sort of direct controls.

Fixed exchange rates have been abandoned among many of the worlds' major currencies since the 1970s so that: 1) floating exchange rates could reflect underlying fluctuations in the international terms of trade, 2) central banks could pursue interest rate policies independently to stabilize domestic employment and inflation and 3) monetary stabilization policy could operate without costly subsidiary policies highly disruptive of international relations, trade, and finance.[7]

III. The Zero Interest Bound and the Intertemporal Terms of Trade

The zero interest bound is an encumbrance on monetary policy to be removed, much as the gold standard and the fixed foreign exchange rate encumbrances were removed, to free the price level from the destabilizing influence of a relative price over which monetary policy has little control—in this case, so movements in the intertemporal terms of trade can be reflected fully in interest rate policy to stabilize employment and inflation over the business cycle.

The simple model presented below borrows from Goodfriend (2002a): 1) to describe the determinants of the intertemporal terms of trade and its counterpart the natural interest rate, 2) to explain how and why interest rate policy must shadow the natural interest rate in order to stabilize employment and inflation, and 3) to show why the zero lower bound potentially encumbers interest rate policy.

Consider an economy populated by households that live for two periods, the present and the future. Households choose current and

future consumption to maximize lifetime utility given an ex-ante real interest rate "r" at which they can lend or borrow with certainty. Let $\rho > 0$ be a psychological rate of time preference. For concreteness, let utility u(c) = log c, so that u`(c) = 1/c.

The marginal utility of current consumption is $\frac{1}{C_1}$, where C_1 is planned present consumption. By lending, a price-taking household can exchange one unit of current consumption for "1 + r" units of future consumption. In other words, the intertemporal terms of trade is "1 + r". For instance, a higher ex-ante real interest rate "r," means a more favorable intertemporal terms of trade. The future marginal utility value of the proceeds of the loan is $(1+r)\frac{1}{C_2}$, where C_2 is planned future consumption. The present discounted marginal utility value of foregoing one unit of current consumption for future consumption is: $(\frac{1+r}{1+\rho})\frac{1}{C_2}$. Lifetime utility is maximized by equating the marginal utility of present and future consumption yielding the so-called Euler Equation: $\frac{C_2}{C_1} = (\frac{1+r}{1+\rho})$.[8] Not surprisingly, the more favorable (unfavorable) is the intertemporal terms of trade, the more (less) a household would like to lend to move consumption from the present to the future.[9]

Denote future income prospects as $\frac{a_2}{1+\mu_2^*}$, where a_2 is future labor productivity, $\frac{1}{1+\mu_2^*}$ is future hours worked, and μ_2^* captures future taxes, regulations, markups, or other distortions that reduce equilibrium hours worked.[10] Presuming that households plan to consume all future income, substitute future income prospects for future consumption in the Euler Equation to express present aggregate demand as

$$C_1^D = \frac{1+\rho}{1+r}\left(\frac{a_2}{1+\mu_2^*}\right).$$

Let current "potential output" be $Y_1^P = \frac{a_1}{1+\mu_1^*}$, where a_1 and μ_1^* are current values of their future counterparts, and potential output is the level of output that sustains the trend (possibly zero) rate of inflation. To target low inflation and stabilize employment as best it can, interest rate policy must shadow the so-called natural rate of interest "r^N," the real interest rate that makes aggregate demand conform to

potential output.[11] To express the natural interest rate in terms of its fundamental determinants, solve for the interest rate that equates $C_1^D = Y_1^P$ and take logs, yielding: $r^N = \rho + g + \mu_1^* - \mu_2^*$, where ρ is the rate of time preference, g is expected productivity growth, μ_1^* and μ_2^* capture taxes, regulations, markups, or other distortions adversely impacting current and expected future income, respectively. Roughly speaking, the natural interest rate "r^N" is the interest rate that makes desired aggregate lifetime consumption plans conform to present and expected future potential output, respectively—where potential output is the level of available consumption that sustains full employment and price stability.

The important point is that the natural interest rate (r^N) and its counterpart the natural intertemporal terms of trade ($1 + r^N$) are governed by household beliefs about future relative to current income prospects. For instance, if households expect zero productivity growth and no change in distortions, then the equilibrium natural interest rate will equal the rate of time preference ($r^N = \rho$) because that is the natural interest rate that clears the credit market at zero borrowing and lending. In this case, the equilibrium natural interest rate exactly offsets the preference for consuming in the present, so households are content with a flat lifetime consumption plan that conforms to static expectations for potential output.

On the other hand, if future income is expected to exceed current income, because productivity is expected to grow or because tax, regulatory, markup, or other distortions are expected to be reduced, then households would want to borrow against their brighter expected future income prospects to bring some consumption forward in time. In so doing, households would drive the natural intertemporal terms of trade higher and the natural interest rate above the rate of time preference ($r^N > \rho$) to the point where the higher equilibrium natural interest rate again clears the credit market, this time making households content with the upward-sloping lifetime consumption plan that conforms to optimistic beliefs regarding future relative to current income prospects.

Most relevant for today's historically low interest rates is the pessimistic case. If households foresee little productivity growth and expect future hours worked to decline relative to current hours worked because future taxes, regulations, markups, or other distortions are expected to exceed current distortions, then households would try to lend in order to move wealth and consumption from the present to the future where consumption is expected to be more valuable at the margin. In so doing, such pessimistic beliefs drive the natural interest rate below the rate of time preference ($r^N < \rho$) to an equilibrium where the adverse movement in the natural intertemporal terms of trade deters households from wanting to lend, clears the credit and goods markets, and makes households content with a lifetime consumption plan that conforms to pessimistic beliefs regarding future relative to current income prospects.

The problem for monetary policy is that the zero bound might prevent interest rate policy from accommodating a very low or negative natural rate of interest that pessimism about future relative to current income prospects may necessitate. In this sense, the zero interest bound could encumber interest rate policy in a manner analogous to the gold standard and the fixed exchange rate encumbrances—by exposing the price level and employment to fluctuations in a relative price over which monetary policy has little control. Specifically, if the nominal policy rate (R) is prevented from going very far below the zero bound, and expected inflation ($E\pi$) is too low or negative, then the real policy rate $r^p = R - E\pi$ might be unable to shadow the natural interest rate. The positive spread between the policy rate and the natural rate ($r^p - r^N > 0$) would then precipitate a deficiency of aggregate demand relative to potential output that would create a deflationary contraction of employment and output to a degree depending on the expected magnitude and persistence of the spread.

IV. Why the Zero Bound Encumbers Interest Rate Policy Today

The zero bound encumbers interest rate policy today for two sets of reasons. First, an exceptional range of identifiable, pessimistic global factors has for some time been plausibly putting downward pressure on the intertemporal terms of trade and the natural interest rate.

Second, inflation-indexed bond rates around the developed world have declined precipitously in the past two decades, reflecting that growing plausible pessimism. Low inflation expectations together with the factors depressing real interest rates portend exceptionally and persistently low nominal interest rates. So there is little room at the zero bound for short-term interest rates to cycle below long-term rates as usual over the business cycle.

IV.i. Global Factors Depressing the Intertemporal Terms of Trade

Consider first the plausibility of pessimism with regard to higher future taxes. This seems understandable given the large and growing overhang relative to GDP built up in the United States and around the world in recent decades of public debt and mandatory government spending commitments on social security, health care, pensions and other transfers.[12] For instance, Reinhart, Reinhart and Rogoff (2012) point out that "the recent financial crisis and recession has left a [legacy of] historically high and rising level of public indebtedness across the advanced economies … a massive overhang of public and private debt ... ."[13] They point out that today the average level of gross public debt to GDP in advanced countries as a whole exceeds the 90 percent threshold that in their study of 26 episodes since 1800 of public debt overhang in advanced economies appears to slow the expected growth of potential output significantly. Moreover, they warn that "the public debt is projected over the next decade or two to rise from its already high levels in many advanced economies, as the contingent liabilities now built into old-age programs come to pass … [and] many advanced economies face a quadruple debt overhang of public, private, external, and pension debt."[14]

According to the model, households pessimistic about higher future taxes and lower hours worked would depress the intertemporal terms of trade as they attempt to move wealth and consumption to the future where the consumption is expected to be more valuable at the margin. Such behavior is evident in today's exceptionally low government bond rates, trading below their respective national inflation targets with negative nominal yields in many cases. Although the current situation may be more extreme than past episodes,

Reinhart et al., report that it is not unheard of, noting that "it is quite possible to have a 'no drama' public debt overhang, which doesn't involve a rise in real interest rates or a financial crisis. Indeed, in 11 of our 26 public debt overhang episodes, real interest rates were on average comparable, or lower, than at other times."[15]

Low interest rates lighten the debt load, and governments may be able to refinance and extend the maturity of low interest debt. At best, however, such efforts defer but don't reduce the present value of higher future taxes backing the public debt. And the debt load is only part of the problem of financing the huge overhang of government spending commitments. Moreover, a willingness by markets to finance longer maturity debt at low interest would indicate a belief that factors depressing interest rates today are likely to persist.

Nor are businesses taking advantage of exceptionally low interest rates to finance investment in physical, organizational, or technological capital. Perhaps a contraction in potential hours worked is holding back the complementary investment. Growing industrial concentration and increasing regulatory burdens such as that evident in the United States may also be decreasing business dynamism.[16]

Businesses no doubt see themselves in the "crosshairs" of much higher future taxes to help finance the mandatory government spending. So the before-tax rate of return hurdle for investment is elevated by the same expectation of higher future tax rates that depresses the intertemporal terms of trade and the natural interest rate. From this perspective, business investment is being held back by a problem reminiscent of the "debt overhang" problem in corporate finance: a large portion of value created by new business investment is likely to go not to business owners themselves, but in higher taxes to back publicly mandated spending.[17]

A range of disparate developments around the world consistent with the model have also been working to depress the intertemporal terms of trade and the natural rate of interest. First, rising income inequality within many if not most countries around the world has for some time been creating political economy conditions evermore favorable to tax and transfer policies.[18] Second, falling population

growth around the world means a slower expansion or contraction of future hours worked to support social security and healthcare for the elderly.[19] Third, global GDP is increasingly made up of output from less developed countries with less secure property rights, less stable politics and less security in old age.[20] Fourth, waning support for liberalization of international trade portends a slowing if not a loss of future gains from trade. Fifth, productivity growth has been slowing throughout the developed world since the late 20th century, and in developing and emerging economies since the 2007-09 credit turmoil, plausibly due to the aforementioned developments, although a slowing of opportunities for technical progress may also be to blame.[21] Sixth, a growing awareness of looming downside risks due to the incapacitation of monetary and fiscal stabilization policies may be increasing precautionary saving.[22]

IV.ii. The Precipitous Decline in Long-Term Market Interest Rates

Reflecting a plausible pessimism that has been growing for some time, the zero bound encumbers interest rate policy today because nominal long-term market interest rates around the advanced world have drifted lower in the past two decades. Inflation premia in market interest rates have been low and stable in keeping with the global credibility of central bank inflation targets. However, the ex-ante real interest rate component of nominal bond rates has declined precipitously since the mid-1990s in the United States and around the advanced world. For instance, King and Low (2014) report that average inflation-protected interest rates on 10-year government bonds for the G-7 excluding Italy, and for United States alone, ranged around 4 percent from 1985 to 1997, around 3 percent from 2000 to 2002 and around 2 percent from 2003 to 2008. Since then, 10-year real rates fell steadily to around -1 percent in mid-2013, and have ranged from around 0.5 percent to 0 percent ever since.[23] According to the model, central bank policy rates have had no choice but to follow the intertemporal terms of trade and the natural interest rate lower to avert what otherwise would have been a deflationary contraction of employment and output.

This is not the whole story, however, because inflation-indexed bond yields reflect more than the intertemporal terms of trade itself. Long-term bonds bundle two services: 1) bonds move wealth and therefore consumption to the future at the intertemporal terms of trade and 2) bonds transfer risk and provide cyclical insurance. Hence, the inflation-indexed bond rate reflects underlying factors determining the equilibrium intertemporal terms of trade *and* other factors determining the compensation or payment for bearing bond price fluctuations that may occur before the bond reaches maturity.

The intertemporal terms of trade and the risk transfer components of U.S. 10-year inflation-indexed bond rates can be separated using a time series of the long-run natural interest rate for the United States from 1980 to 2014 constructed by Laubach and Williams (2014), where the latter is the real expected federal funds rate consistent with the economy operating at its full potential once transitory shocks to aggregate supply or demand have abated. Laubach and Williams' estimate of the long-run natural rate was about 3½ percent in the late 1980s, fluctuated between 3 percent and 2 percent as it trended down to about 2 percent in 2007, then fell by nearly 2 percentage points during the 2007-09 recession, and has remained near zero ever since, completing an unprecedented decline to an historic low over the past half-century. The decline in the trend growth rate of potential output accounts statistically for nearly one-half of the decline in their estimated natural rate.[24]

A comparison of U.S. 10-year inflation-indexed bond rates with the Laubach-Williams long-run natural rate estimates shows that before 1990 the term premium (net compensation) for risk transfer was around 1 percentage point. The term premium peaked at 2 percentage points in the mid-1990s, followed a declining trend interrupted by a temporary increase above 1 percentage point in the early part of the Great Recession, and then settled between 0.5 percent and 0 percent.

The decline in the term premium on long bonds since the mid-1990s plausibly reflects the fact that cyclical risk in the U.S. economy has gradually shifted from "inflation-fighting risk"—when higher interest rates to fight inflation precipitate a joint collapse in bond prices and consumption, to "deflationary-recession risk"—when

lower interest rates to fight deflation and weak income and consumption precipitate a rise in bond prices.[25] Inflation-indexed bond yields will embed *compensation* for cyclical risk transfer to the extent that interest rates rise (and bond prices fall) during "inflation-fighting" recessions when consumption is low and more valuable at the margin. On the other hand, bond yields will embed *payment* for cyclical insurance to the extent that interest rates fall (and bond prices rise) during "deflation-fighting" recessions.[26]

On five occasions since the 1960s the Fed precipitated recessions by raising interest rates aggressively to fight inflation.[27] The last inflation scare occurred in 1994-95, possibly explaining the briefly elevated term premium in the mid-1990s. By overcoming the 1994-95 inflation scare without a recession, the Fed secured credibility for low inflation that remains in place to this day, plausibly accounting for the subsequent decline in the term premium.[28] The decline in the term premium after 2003 follows the first "deflation scare," when the Fed pushed the federal funds rate down to 1 percent to head off a deflationary recession.[29] The temporarily elevated term premium in the early part of the Great Recession may reflect the perceived inflation-fighting risk before the panic in late 2008. But the failure of inflation to materialize in conjunction with the immobilization of interest rate policy at the zero bound can explain the decline in the term premium from 2008 to 2013 as long bonds came to be valued increasingly for their cyclical insurance against deflationary recession.

The problem for monetary stabilization policy is that low long-term nominal interest rates leave little leeway for the usual cyclical decline of short rates *below* long rates in the recovery from recession. To stimulate the recovery from each of the eight recessions experienced in the United States since 1960, the Federal Reserve pushed the federal funds rate more than 2½ percentage points below the 10-year nominal Treasury bond rate, and on five of those occasions the Fed cut the federal funds rate over 3½ percentage points below the bond rate. Low long-term nominal interest rates today reflect underlying forces unlikely to dissipate any time soon—low inflation expectations, downward pressure on the intertemporal terms of trade and downward pressure on the (term premium) price of risk transfer in long-term bonds. So the zero bound likely will remain an encumbrance on monetary policy

indefinitely. It is only a matter of time before another cyclical downturn calls for aggressive negative nominal interest rate policy actions.

V. The Urgency of Unencumbering Interest Rate Policy

One could argue based on the evidence that the zero interest bound has not been much of an impediment to monetary policy in practice. To be sure, aggressive negative federal funds rate policy actions in the immediate aftermath of the credit turmoil might have blunted much of the contractionary dynamics of the Great Recession. But despite interest rate policy having been immobilized near the zero bound around the developed world for a prolonged period, there was no deflation spiral, and inflation has stabilized reasonably well, even if somewhat below various inflation targets, with the implication that the zero interest bound has not mattered very much in practice.

It should be no surprise, however, that inflation and inflation expectations have remained reasonably well anchored against deflation. Theory and evidence suggest that inflation is only weakly sensitive to the output gap when inflation expectations are securely anchored to an inflation target as has been the case for central banks around the advanced world.[30] Moreover, the historical association between the output gap and deflation is overwhelmingly driven by monetary policy. Consider U.S. monetary history. The 1920-21 deflationary recession was created by a severe tightening of monetary policy driven by binding minimum gold reserve requirements. Deflation during the Great Depression was driven by the banking crises and the collapse of the money supply.[31] The intermittent periods of disinflation during the Great Inflation period from the mid-1960s to the mid-1980s were due to the deliberate tightening of monetary policy against inflation.[32] To the contrary, the Federal Reserve pursued unprecedented balance sheet stimulus to counteract deflation and contraction in the aftermath of the Great Recession of 2007-09.

Today, however, expansive central bank balance sheet stimulus is increasingly ineffective. Negative nominal interest rate policy actions would have to be relied upon in the next recession. Based on the history discussed above, given the current 1½ percent 10-year Treasury yield in the United States today, the federal funds rate would have

to be taken down at least to -1 percent and more likely to -2 percent to stimulate recovery from the next cyclical downturn. As discussed detail in Section VI, it is questionable whether such persistently negative nominal interest rates would be feasible given current institutional arrangements that freely accommodate the demand for paper currency at par.[33]

What's more, even if the requisite negative cyclical interest rate policy actions could be sustained, they would likely exert considerably less stimulus in the presence of the zero bound than otherwise. The reason is that aggressively negative nominal interest rate actions would simultaneously signal a central bank's pessimism. Ordinarily, such pessimistic signals could be overcome with even more aggressive actions, if need be. But not at the zero bound. The zero bound fundamentally weakens countercyclical monetary policy because it deprives interest rate policy stimulus of "follow through." With "follow through" encumbered by the zero interest bound, aggressive negative interest rate policy actions and the pessimism they signal could easily be counterproductive by causing the natural interest rate to fall as much or more than the negative interest rate policy action itself.

Furthermore, pressure to rely more heavily on balance sheet policy in lieu of interest rate policy will tempt central banks increasingly to exert stimulus via fiscal policy initiatives such as 1) the monetary funding of credit to the private sector, 2) the monetary funding of a bond market carry trade.[34] Such balance sheet policies are poor substitutes for interest rate policy as general-purpose stabilization policies involving as they do distortionary credit allocation, the assumption of credit risk and maturity transformation—all taking risks on behalf of taxpayers, all involving the central bank in controversial fiscal policy matters, and all moving the central bank ever closer to destructive inflationary finance.

Continuing the point, balance sheet policies may have a useful role to play in financial stability independently of interest rate policy, as imagined in my 2002 paper in the Federal Reserve Bank of New York *Policy Review*; and as acknowledged in my 2011 assessment of Federal Reserve policy in the credit turmoil. However, interest rate policy is far superior as a general-purpose stabilization policy. Why? Interest

rate policy is necessary and possibly sufficient for countercyclical stabilization purposes. Interest rate policy can be implemented with a minimal central bank balance sheet free of credit and interest rate risk. Interest rate policy is far more flexible, less intrusive of markets, and unencumbered interest rate policy has proven capable of credibly stabilizing inflation. Moreover, interest rate policy can be managed decisively by an independent central bank reasonably free of politics because it makes little use of fiscal resources. Interest rate policy merely shadows the natural interest rate to yield the best stabilization of employment and inflation that monetary policy can deliver.

VI. Three Methods of Unencumbering Interest Rate Policy at the Zero Bound

A central bank transmits negative nominal interest rate policy to the economy as follows. By acquiring securities or lending to particular institutions, the central bank forces enough bank reserves into the banking system to satiate the banks' demand for reserves. The banking system as a whole cannot rid itself of excess reserves created by the central bank. Banks attempting to lend excess reserves to each other put downward pressure on the interbank interest rate. Banks will not lend to each other below the interest rate they can earn by holding reserves at the central bank. So the excess supply of reserves in the banking system presses the interbank interest rate down to the interest-on-reserves floor. As long as the central bank pays nonnegative nominal interest on reserves, there is zero lower bound on the interbank interest rate.[35]

The central bank forces the nominal interbank rate below zero by charging banks a per-period, per-dollar (negative nominal interest rate) "storage fee" for reserve balances held at the central bank.[36] To avoid negative interest on reserves, banks again attempt to lend excess reserves to each other and force the interbank rate down to the negative interest-on-reserves floor.

The negative interbank rate represents a negative cost of loanable funds for individual banks. Hence, cost minimization and competition among banks create commensurate downward pressure on alternative sources of loanable funds such as wholesale deposits and certificates of

deposit. Likewise, Treasury bill rates are pulled below zero; and bank loan rates are put under downward pressure.[37] Depending on the term premium and the depth and expected persistence of negative nominal policy rates, longer-term Treasury rates may be pulled below zero too. As long as nominal policy rates are only slightly negative and expected to be so temporarily, banks are reluctant to "pass through" negative interest to retail deposit rates for fear of driving away legacy depositors, ordinarily highly stable and lucrative.[38] But fully unencumbered interest rate policy expected to push nominal interbank rates deeply and persistently below zero would tend to pull retail deposit rates down too.

The long-standing commitment by central banks to accommodate the deposit demand for paper currency at par limits the extent to which a central bank can pursue negative interest rate policy.[39] Under current arrangements a sustained, deeply negative nominal interest rate policy would precipitate a dangerous disintermediation of banks and money markets financed by the central bank's provision of paper currency at par for deposits. The cost of handling, storing and insuring paper currency, the greater versatility of deposits for facilitating transactions and banks' reluctance to pass through negative interest rates to retail depositors all create considerable leeway for policy to push nominal interest rates below zero without encouraging a run to paper currency. A central bank can raise the cost of exercising the paper currency option further by discontinuing the issuance of large denomination bills, or charging banks and the public whenever paper currency is paid out or received.[40] However, the central bank risks a chaotic, disorderly loss of control of the deposit price of paper currency should it rely too heavily on such impediments to create more leeway for negative interest rate policy actions. In any case, relying on such impediments could never overcome the lack of "follow through" discussed in Section V that makes the effectiveness of interest rate policy encumbered by the zero bound problematic.

The balance of this section outlines three methods that would unencumber interest rate policy at the zero bound completely. The three methods in turn would: 1) abolish paper currency, 2) introduce a market-determined flexible deposit price of paper currency and 3) provide electronic currency (to pay or charge interest) at par

for deposits. Each method is assessed for its effectiveness, technological requirements, institutional modifications, potential for expedited implementation and acceptability with the public at large.

VI.i. Abolish Paper Currency

The most straightforward way to unencumber interest rate policy completely at the zero bound is to abolish paper currency.[41] In principle, abolishing paper currency would be effective, would not need new technology and would not need institutional modifications. However, the public would be deprived of the widely used bundle of services that paper currency uniquely provides—a generally accepted paper medium of exchange providing transactions services especially for low-value transactions; a readily accessible, safe liability of the central bank; a store of value; a degree of privacy in financial management; and the option to hold money outside the banking system and to withdraw deposits at par as paper currency in times of financial stress. Hence, the public is likely to resist the abolition of paper currency at least until mobile access to bank deposits becomes cheaper and more easily available, ATM charges for access to paper currency become excessive and/or electronic currency substitutes become widely available.[42]

VI.ii. Introduce a Flexible Market-Determined Deposit Price of Paper Currency

Paper currency encumbers interest rate policy at the zero bound today because central banks accommodate the deposit demand for paper currency at par.[43] Central banks resist upward price pressure by satisfying any excess demand for paper currency; and they resist downward price pressure by absorbing any excess supply of paper currency. Long-lasting deeply negative interest rate policy actions are precluded because they would precipitate a widespread destructive disintermediation of financial markets as banks and the public exercised their option to sell negative interest-earning securities to instead hold paper currency at zero interest.

The zero bound encumbrance on interest rate policy could be eliminated completely and expeditiously by discontinuing the central bank defense of the par deposit price of paper currency. The

central bank would still stand ready to exchange bank reserves and commercial bank deposits at par; and it could stand ready to convert different denominations of paper currency at par. However, the central bank would no longer let the outstanding stock of paper currency vary elastically to accommodate the deposit demand for paper currency at par. Instead the central bank could grow the aggregate stock of paper currency according to a rule designed to make the deposit price of paper currency fluctuate around par over time. The paper currency growth rule would utilize: 1) historical evidence relating currency demand to GDP, 2) the estimated interest opportunity cost sensitivity of the demand for currency relative to GDP and 3) the GDP growth rate.

The reason to abandon the pegged par deposit price of paper currency is analogous to the aforementioned reasons for abandoning the gold standard and fixed exchange rate: it is to let fluctuations in the deposit demand for paper currency be reflected in the deposit price of paper currency so as not to destabilize the general price level—in this case to guard against a deflationary contraction of employment and output, and to do so without distortionary and risky balance sheet initiatives involving the central bank in fiscal policy.

The flexible deposit price of paper currency would be determined as follows. For the sake of argument, suppose that negative interest rate policy is passed through fully to deposit rates and money market rates. Negative nominal interest rates would put upward pressure on the deposit price of paper currency. The deposit price of paper currency would be driven above par to the point where it is expected to fall back toward par at a rate equal to the negative nominal interest rate. Along the equilibrium price path, banks and the public would be indifferent between holding deposits or securities paying negative nominal interest, on one hand, and holding paper currency whose value is expected to depreciate at an equivalent rate in terms of deposits.[44] The equilibrating jump in the deposit price of paper currency would be greater the more deeply negative and persistent the central bank's negative interest rate policy actions are expected to be.

The deposit price of paper currency would adjust flexibly much as floating exchange rates adjust to equilibrate the foreign exchange

market when international interest rates differ from each other. More relevant, the flexible deposit price of paper currency would behave as it *actually did* when the payment of paper currency for deposits was restricted in the United States during the banking crises of 1873, 1893 and 1907. Friedman and Schwartz (1963) report that market-determined flexibility in the deposit price of paper currency worked reasonably well in those episodes, writing:

> *"The 1907 restriction involved the refusal of banks to convert deposits into currency at the demand of the depositor; it did not involve, on any large scale, even the temporary closing of banks or the cessation of their financial operations, let alone the permanent failure of any substantial number. It lasted for several months, and once adjustment was made to the use of two only partly convertible media of payment—currency and deposits—could have continued for a much longer period, as in some earlier episodes, without producing an economic breakdown and indeed could have continued in conjunction with economic revival."*[45]

A central bank less favorably disposed to a freely floating deposit price of paper currency could intervene in the style of a "managed" foreign exchange rate policy to produce a "crawling peg" perhaps deemed more consistent with the central bank's intended nominal interest rate policy path.[46] Under current arrangements, however, a managed float would not be without potential complications. For instance, market speculation in anticipation of a negative interest rate policy action would put upward pressure on the current deposit price of paper currency. And central bank intervention to stabilize current deposit price of currency (by accommodating the currency demanded in exchange for deposits) would facilitate a potentially disruptive disintermediation of depository and money market intermediation.[47]

To sum up, the method of unencumbering interest rate policy by floating the deposit price of paper currency is attractive in many ways. The regime completely removes the zero bound encumbrance with relatively few technological or institutional requirements for its implementation. In principle, the deposit price of paper currency could be floated relatively expeditiously, if need be, in a future crisis. Most of what is needed involves clarifying that henceforth taxes

would be assessed in units of deposits and that contracts previously written in the national unit of account would be enforced in terms of deposits.[48] It would also be useful to facilitate currency services if paper currency were made free of capital gains tax. If thought desirable, the central bank could run an asymmetric float—and intervene to absorb the excess supply of currency whenever the deposit price of paper currency threatened to fall below par. The inconvenience of the flexible deposit price of currency might be offset to a degree by the fact that paper currency would perform as a hedge against income and consumption risk, since the deposit price of currency would rise whenever nominal interest rate policy turned negative to fight a recession.

VI.iii. Provide Electronic Currency (to Pay or Charge Interest) at Par with Deposits

Recent advances in payments technology in conjunction with the widespread use of the internet, Wi-Fi, and the smartphone provide a convenient, low-cost alternative to the use of paper currency for point-of-sale transactions. Building on these developments, one can imagine the central bank offering electronic currency as a substitute for paper currency. As a direct liability of the central bank, electronic currency would be as safe as paper currency. A currency card could be issued on a corresponding numbered currency card account. The card could be a bearer instrument in the sense that it could be used to buy goods like a gift card is used today. The currency card could be set up to debit whatever funds are in the corresponding account. Point-of-sale technology is already widely available and equipped to read electronic cards and make direct transfers.

Currency card accounts could offer the payment services that paper currency provides: anonymity, divisibility, generalized purchasing power, portability, safety, a store of value and a fixed deposit price of electronic currency. Crucially, however, because currency card accounts would access electronic balances at the central bank, the central bank could easily pay or charge interest on electronic currency just as central banks pay or charge interest today on electronic reserve balances held by commercial banks.[49] By keeping nominal interest on electronic currency suitably below interest on reserves (and the

interbank rate) the central bank could support maintain the deposit price of electronic currency at par by accommodating the public's demand for electronic currency, much as central banks in the past fixed the deposit price of paper currency at par. Currency card accounts could be issued by and accessed through depository institutions as fully funded, pass-through, 100 percent reserve-backed accounts at the central bank, with payment services provided by banks or by other means. Paper currency could continue to be provided alongside electronic currency with a flexible deposit price of paper currency as outlined in Section VI.ii.

The provision of electronic currency at par with deposits would have many attractive features. The regime would completely remove the zero bound encumbrance on interest rate policy while offering via electronic currency virtually the full range of services that paper currency offered in the past, including the provision of electronic currency on demand at par with deposits. To do so, electronic currency would have to pay below-market interest as did paper currency when its deposit price was maintained at par. Hence, the public would likely find electronic currency an acceptable alternative to paper currency. The main problem is that electronic currency would require investment in banking, central banking and payment system infrastructure before it could be made available.

VII. Concluding Remarks

Removing the zero interest bound is nothing more than the sensible application of monetary economics, progressing along a path that has increasingly unencumbered interest rate policy to sustain price stability and full employment. If the zero bound were removed completely, then interest rate policy could enable the public to enjoy the benefits of a fully stable purchasing power of money. Credibility against inflation is tied to credibility against deflation—the central bank would no longer shrink from action against inflation for fear of having to fall back with little room to act against recession. It would be up to financial regulators to prevent excessive leverage and maturity transformation from precipitating an unstable credit cycle if and when temporarily negative nominal interest rate policy actions are called for against deflationary recession.

With inflation credibly under control, the public could safely hold long-term nominal bonds free of inflation risk and minimize its exposure to negative short-term interest rates. Thus, we can imagine a mutually reinforcing equilibrium in which the public extends the maturity of its savings and the central bank with the public's support is free to pursue negative nominal interest rate policy on occasion to act against a deflationary contraction in employment and output. The idea of negative nominal interest rates takes some getting used to, but it should be possible to persuade the public that such flexibility is well worth it to provide better employment security and more secure lifetime savings.

Author's Note: The paper benefited from the formal discussant Marianne Nessén and from comments by Troy Davig, Refet Gürkaynak, Robert Hetzel, Robert E. Lucas Jr., Allan Meltzer, Lee Ohanian, Alex Wolman and participants at the 2016 Federal Reserve Bank of Kansas City Jackson Hole Economic Policy Symposium.

Endnotes

[1]Goodfriend (2000).

[2]Vinals et al. (2016)

[3]Hilsenrath (2015).

[4]See Friedman and Schwartz (1963); Goodfriend (1997, 2007); Meltzer (2003; 2009); Romer and Romer (1989); and Taylor (1979).

[5]Barro (1979) and Bordo (1981).

[6]Bordo (1981), Friedman (1961), Goodfriend (1988) and Yeager (1976).

[7]Bordo, Humpage and Schwartz (2015); Broaddus and Goodfriend (1995); Friedman (1953); Obstfeld and Rogoff (1995); Stockman (1980); and Yeager (1976).

[8]Fisher (1930).

[9]The representative (average) household in the model will neither borrow nor lend in equilibrium. So interest rate movements exert no aggregate wealth effect, only the intertemporal substitution effect described in the text. Interest rate movements would exert wealth effects on those households that are either net lenders or borrowers. For instance, if interest rates are reduced, lenders (borrowers) would suffer (benefit from) a negative (positive) wealth effect. The negative wealth effect would lead lenders to cut current *and* future consumption. Hence, for lenders the negative wealth effect of lower interest rates could offset the positive substitution effect and possibly cause lenders to reduce current consumption. However, the positive wealth effect of a decline in interest rates on borrowers would reinforce their incentive to raise current consumption. Thus, for instance, an interest rate cut in a currency union would tend to be received unfavorably in countries which are net lenders and favorably in countries that are net borrowers.

[10]Ohanian et al. (2008), Prescott (2004) and Rogerson (2008).

[11]Output must be consumed contemporaneously in the model; goods are not storable and there is no physical investment.

[12]Congressional Budget Office (2015); Hall and Sargent (2015); Miron (2016); Rauh (2016); and Reinhart, Reinhart and Rogoff (2012).

[13]Reinhart et al. (2012) pp. 69, 84.

[14]Reinhart et al. (2012) pp. 84-85.

[15]Reinhart et al. (2012) pp. 83-84.

[16]Council of Economic Advisers (2015b).

[17]Meyers (1977).

[18]Meltzer and Richard (1981), Dabla-Norris, et al. (2015) and Perri (2013).

[19]Carvalho, et al. (2016), Samuelson (1958) and Walker (2016).

[20]Bernanke (2005) and Goodfriend (2015).

[21]Van Ark and Erumban (2015), Fernald (2015), Gordon (2016) and Summers (2016).

[22]Barro (2006).

[23]Bean et al. (2015), Council of Economic Advisers (2015a) and Rachel and Smith (2015).

[24]Williams (2015), pp. 3-4.

[25]Gürkaynak and Wright (2012), page 55, report an estimated term premium on 10-year U.S. Treasuries that ranges from around 1 percentage point in the early 1970s, peaks above 4 percentage points in the first half of the 1980s and then declines steadily to between 0 and 1 percentage point in the late 2000s. Their findings illustrate the rise and fall of the term premium corresponding to the rise and fall of inflationary go and stop monetary policy. See Clarida, Gali, and Gertler (2000); Goodfriend (1997, 2007); Romer and Romer (1989) and Taylor (1979).

[26]Campbell et al. (2009) and Lucas (1979).

[27]Goodfriend (1993) and Romer and Romer (1989).

[28]Goodfriend (2002b).

[29]Greenspan (2003), pp. 5-6.

[30]Clarida, Gali and Gertler (2000) and Woodford (2003).

[31]Friedman and Schwartz (1963) and Meltzer (2003).

[32]Goodriend (1997, 2007), Meltzer (2009) and Romer and Romer (1989).

[33]Alsterlind et al. (2015), Bech and Malkhozov (2016), Garbade and McAndrews (2012), Haldane (2015), Jackson (2015), Jensen and Spange (2015) and McAndrews (2015).

[34]Goodfriend (2011, 2014).

[35]Goodfriend (2002c).

[36]Goodfriend (2000).

[37]Bech and Malkhozov (2016), Jensen and Spange (2015), Shin (2016), Sveriges Riksbank (2016a) and Vinals et al. (2016).

[38]Gambacorta and Shin (2016) and Sveriges Riksbank (2016b).

[39]Black (1995).

[40]Humphrey (2015).

[41]Buiter (2010) and Rogoff (2014).

[42]Broadbent (2016).

[43]"Deposits" refers to both commercial bank deposits held as reserves at the central bank and deposits held at commercial banks by the nonbank public and by other banks.

[44]Pricing would also take into account the marginal convenience yields for deposits and paper currency.

[45]Friedman and Schwartz (1963), page 167 and Goodfriend (2000), footnote 23.

[46]Agarwal and Kimball (2015), Assenmacher and Krogstrup (2016), Buiter (2010) and Kimball (2015) favor an actively guided, time-varying exchange rate between deposits and paper currency to accompany negative interest rate policy actions.

[47]The above-mentioned authors propose procedures for guiding the deposit price of paper currency over time that could ameliorate such concerns if credibly put in place and widely understood beforehand.

[48]Agarwal and Kimball (2016), pp. 25-26, Buiter (2010), pp. 230-32, and Kimball (2015).

[49]Buiter (2010), Kimball's blog, Goodfriend (2000) reference past proposals to impose negative interest on paper currency as a means of overcoming the zero interest bound.

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