



The Troubling Economics and
Politics of Paying Interest on Bank Reserves:
A Critique of the Federal Reserve's Exit Strategy

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Abstract

The Federal Reserve has recently activated its newly acquired powers to pay interest on reserves of depository institutions. The Fed maintains its new policy increases economic efficiency and intends it to play a lead role in the exit from quantitative easing. This paper argues it is a bad policy that (1) has a deflationary bias; (2) is costly to taxpayers and that cost will increase as normal conditions return; and (3) establishes institutional lock-in that obstructs desirable changes to regulatory policy. The paper recommends repealing the Fed's power to pay interest on bank reserves. Second, the Fed should repeal regulation Q that prohibits payment of interest on demand deposits. Third, the Fed should immediately implement an alternative system of asset based reserve requirements (liquidity ratios) that will improve monetary control and can help exit quantitative easing at no cost to the public purse. Now is the optimal time for this change. Lastly, the paper argues the new policy of paying interest on reserves reveals the troubling political economy governing the actions of the Federal Reserve and policy recommendations of the economics profession.

Keywords: Interest on reserves, asset based reserve requirements, liquidity ratios.

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I Introduction

In a recent speech prepared for the Committee on Financial Services of the U.S. House of Representatives, Federal Reserve Chairman Ben Bernanke (2010) outlined the Federal Reserve's strategy for exiting its current emergency monetary policy of quantitative easing. A key element of the strategy involves paying interest to banks on their holdings of reserves, thereby incentivizing them to hold those reserves rather than lend them out. In this fashion, the Fed intends both to raise market interest rates and to deactivate the massive quantity of emergency liquidity it has injected into the financial system, thereby nullifying the inflation threat that liquidity might otherwise pose. The economic logic is as follows: "By increasing the interest rate it pays on reserves, the Federal Reserve will be able to put significant upward pressure on all short-term interest rates, as banks will not supply short-term funds to the money market at rates significantly below what they can earn by holding reserves at the Federal Reserve Banks (Bernanke, 2010, p.7)."

The Fed's proposed strategy rests on its new statutory authority to pay interest on banks' holdings of reserves, given to it by Congress in October 2008. The granting of that new power was a bi-partisan decision, supported by both Democrats and Republicans. This paper argues the new policy represents a blunder, which will result in bad policy and is potentially very costly to the public purse.

The process by which the new power was won also illustrates the troubling political economy that underpins Federal Reserve policymaking and the provision of monetary policy advice. The goal of paying interest on bank reserves has been an element of a long-waged neoliberal campaign for financial deregulation. The irony is that the Fed

finally achieved this power just as the financial crisis was bringing into question neoliberal economics and the excesses of financial deregulation.

This paper recommends that Congress repeal the Fed's authority to pay interest on reserves. Second, the paper recommends repealing regulation Q that prohibits the payment of interest on demand deposits. This will facilitate the exit from quantitative easing at no cost to taxpayers, while also benefiting depositors. Third, it recommends the Fed implement a system of asset based reserve requirements (liquidity ratios) that has multiple policy benefits. As with repeal of regulation Q, asset backed reserve requirements can assist the exit from quantitative easing by absorbing banks' excess reserves and it too does so at no cost to the public purse.

II The campaign to pay interest

The Fed's new power to pay interest on banks' reserve holdings was established by the Financial Services Regulatory Relief Act of 2006. Under that act the Fed was authorized to begin paying interest beginning October 1, 2011. Subsequently, under the Emergency Economic Stabilization Act of 2008 the effective date was brought forward to October 1, 2008. On Monday October 6, 2008 the Fed announced it would start paying interest on reserves and it is currently paying an interest rate of 0.25 percent.

The Federal Reserve's desire to pay interest on bank reserves should be understood as the part of a three decade long campaign for financial deregulation. The original impulse came from a long-standing view among economists that required reserves on demand deposits represent a tax on deposits. The argument is that this tax generates economic inefficiency because it induces agents to reduce their holdings of money, giving rise to unnecessary transaction costs and misallocations of capital (Mayer,

1966). The microeconomic logic is that forcing banks to hold required reserves increases the cost of deposits as a source of finance for banks. Banks therefore reduce what they are willing to pay to attract deposits and depositors then reduce their deposits with banks.

This effect is compounded by regulation Q which prohibits payment of interest on checking accounts. Consequently, instead of paying explicit interest (money payments) on such checking accounts, banks compete to attract checkable deposits by paying implicit interest (such as small gifts) and engaging in service quality competition. However, because implicit interest is less attractive to depositors than explicit interest, regulation Q's prohibition of interest payments further reduces the demand for checkable deposits.

The technical economics of this is shown in Appendix 1. The simple logic is as follows. When banks receive a dollar of deposits they must hold some of that deposit as required reserves. Banks therefore reduce slightly the payment they are willing to pay depositors to reflect the fact they receive less than a full dollar they can actually lend. However, if banks are paid interest on required reserves, that raises the worth of deposits to banks. They will then pay higher interest to depositors, thereby eliminating the distortion caused by reserve requirements.

This efficiency argument was the initial argument for paying interest on reserves, but it only applies to required reserves. Subsequently, the argument was broadened to justify paying interest on total bank reserves which consist of required reserves and excess reserves (reserves held by banks in excess of regulatory requirements).

The new argument was that paying interest on total reserves would improve the efficiency of monetary policy control over interest rates. The claim is having the Federal

Reserve pay interest on reserves would set a floor to the short-term interest rate, preventing it falling below the target because no bank would lend reserves for less than they could get from the Fed.

The interesting feature about this argument is that it first gained widespread currency at the beginning of the noughties when inflation was the concern. At that time the U.S. government was running a budget surplus and there was talk of the Federal debt eventually being paid off. That would have left the Federal Reserve without Treasury bonds to conduct open market interest rate operations, and therefore unable to raise interest rates to check inflation. The answer to this was having the Fed pay interest on reserves, thereby establishing an interest rate floor it could raise at will.

However, by 2006 the notion of a vanishing Federal debt had itself disappeared owing to the persistent large Bush - Cheney budget deficits, yet the idea of paying interest on reserves persisted. By 2008 the threat of inflation had been replaced by a threat of deflation, yet the Fed insisted on implementing its new power to pay interest despite the fact that it was an anti-inflation policy rather than an anti-deflation policy.

III Downsides of the new policy

The downsides of the new policy have already become apparent and they threaten to get worse over coming years. A first downside is the payment of interest on reserves has contributed to deflationary pressures by increasing the attractiveness to banks of holding reserves relative to lending.

In the current recession the economy has been hit by a fall in aggregate demand and a contraction of bank lending. At the same time banks are sitting on massive liquidity

holdings in the form of excess reserves.¹ Paying interest on reserves (albeit the current low rate of 0.25 percent) makes holding reserves relatively more attractive compared to holding other assets. In terms of the banking firm, it raises the marginal return to holding reserves, thereby inducing banks to shift finance from other activities (like lending) to reserves. The policy of paying interest on reserves has therefore been deflationary at a time the Fed has been trying to stimulate the economy.

Sumner (2009) has called for not just suspending payment of interest on reserves, but for taxing bank holdings of reserves.² This would induce banks to shift out of reserves into other asset categories – like lending. In terms of the bank model, a tax on reserves would make the marginal return on reserves negative, making them unattractive relative to other asset holdings.

Suspending interest on reserves or even taxing banks' excess reserves would also fit with the "asset market Keynesianism" of economists like DeLong (2009) and Farmer (2009). These economists argue the crisis is in part due to the collapse of asset prices and the solution is to push up asset prices. Suspending interest payments or taxing excess reserves would fit with this asset market perspective since banks would have an incentive to buy assets instead of holding reserves. If they bought government bonds that would push down the bond interest rate and help finance the budget deficit. Lower interest rates would also help stimulate investment, while the higher price of bonds would increase

¹ The massive increase in excess reserves is the result of the Federal Reserve's large purchases of mortgage backed securities that financial market participants have been unwilling to purchase.

² This is a variant of the proposal made by the German economist Silvio Gesell (1862 – 1930) for stamped money, only Sumner's suggestion applies to just banks. Keynes spoke well of Gesell's proposal in *The General Theory of Employment, Interest and Money*, 1936, p.353 – 358.

wealth and stimulate consumption spending. Paying interest on reserves has the exact opposite effect.

The one positive of such payments is that it increases bank profits, helping rebuild bank balance sheets. However, that makes payment of interest on reserves a hidden subsidy to banks, and there are likely better ways government can spend revenues than subsidizing the banking system.

A second downside is the burden of paying interest on reserves promises to increase significantly over time. As of the end of the 3rd quarter 2009, the Fed's balance sheet showed \$848.1 billion of depository institution reserves placed with the Federal Reserve. Table 1 shows the cost of paying interest on banks' reserves. At the current 0.25 percent interest rate the cost is \$2.15 billion. If the Fed's target interest rate rises to 3 percent, the cost rises to \$25.44 billion which is a very large amount of money. The total annual discretionary budget of the U.S. Department of Labor was \$12.1 billion in 2009. Alternatively, capitalized at an interest rate of four percent, the value of \$25.44 billion of income is \$636 billion or almost five percent of GDP in 2009.

< Insert Table 1 here >

This is a direct cost to the taxpayer. The current system has the Fed transferring profits it makes from its holdings of government, agency, and private debt to the Treasury. Now, those payments to the Treasury stand to be reduced by payments to banks of interest on reserves. These payments will occur at a time of extreme fiscal austerity when tax rates may be raised, spending cut, and even Social Security benefits may be lowered.

The payments also run counter to the widespread political sensibility that the profitability and bonus payments of banks are excessive. Yet, now, the public purse will be increasing those profits (and presumably those bonuses). At a time when there is a political and economic case for taxing the financial system to shrink it, the Fed has smuggled in a policy that subsidizes bank profitability.

In short, the payment of interest on the total reserves of banks has analogies with a leveraged buyout of the Fed, only the banks have not had to put up any capital. The result is a *de facto* conversion of the Fed's profits into interest payments to banks.

Chairman Bernanke is clearly sensitive to this issue. Footnote 8 of his speech (Bernanke, 2010) makes the claim:

“Increases in the interest rate paid on reserves are unlikely to prove a net subsidy to banks, as the higher return on reserve balances will be offset by similar increases in banks' funding costs. Indeed, on balance, banks' net interest margin will likely decline when short-term rates rise.”

The first part of this footnote is untrue. The banking system now holds massive excess reserves. The only way those reserves can be extinguished is if (1) depositors withdraw deposits and increase cash holdings; (2) banks payback their Federal Reserve discount window borrowings; (3) the Federal Reserve sells government bonds and other assets it holds; (4) there is a gradual run-off through repayment of bank loans and private securities held by the Fed; and (5) the Federal government runs a budget surplus and destroys the tax receipts it receives. This makes it difficult for banks to extinguish reserves and banks are essentially compelled to collectively hold the reserves currently in the system. *Ergo*, paying banks interest on reserves must increase bank profitability.

Arguing otherwise is like saying: “paying interest on the public’s holdings of currency will not increase the public’s income”.

Appendix 2 provides a technical analysis of the economics of paying interest on reserves. Under the old system, reserves produced seignorage for the Federal government. To acquire reserves banks had to give over Treasury bonds to the Fed, thereby saving the government the interest on those bonds. Under the new system that seignorage is given back to the banks in the form of interest on their reserve holdings. Some of this interest payment, related to required reserves held by banks, will be passed on to depositors. However, interest payments on banks’ excess reserve will be retained by banks. Moreover, to the extent that banks decide to hold excess reserves rather than buy bonds, this lowers bond prices and raises interest rates. Consequently, there is an additional indirect interest rate cost to the Treasury.

A third downside of paying interest on reserves is that it obstructs needed regulatory reform by creating institutional “lock-in.” In the past, I have advocated a system of asset based reserve requirements (ABRR) as way of regulating the banking system (Palley, 2000, 2003, 2004, 2010). That idea is now gaining currency, albeit referred to as regulatory liquidity ratios rather than ABRR, and the International Monetary Fund is talking approvingly of the idea (Blanchard et al., 2010).³

³ A sign of the changing times is evidenced by the following story. In a 2002 conference at the Council on Foreign Relations I presented a paper arguing for asset based reserve requirements to supplement inflation targeting. The argument was inflation targeting is not enough. This was at the height of the Greenspan anti-regulation era and many well known influential economists and policymakers were in the room. The idea met with scornful silence and the conference organizer subsequently reneged on his offer to publish the paper. Now, suddenly the idea of asset based reserve requirements is popping up everywhere under the guise of regulatory liquidity ratios.

ABRR require financial firms to hold reserves against different classes of assets, with the regulatory authority setting adjustable reserve requirements on the basis of its concerns with each asset class. One concern may be an asset class is too risky; another may be an asset class is expanding too fast and producing inflated asset prices.

By obliging financial firms to hold reserves, the system requires they retain some of their funds as non-interest-bearing deposits with the central bank. The implicit cost of forgone interest must be charged against investing in a particular asset category, reducing its return. Financial firms will therefore reduce holdings of assets with higher reserve requirements and shift funds into other lower-cost and thus relatively more profitable asset categories.

The reserve requirement on assets is an explicitly intended penalty - a tax (which can be set at zero) on each asset category designed to discourage creation of that asset category. Payment of interest on reserves establishes a pattern that is the exact opposite. It therefore establishes institutional lock-in by shifting regulatory arrangements in the opposite direction, making the challenge of implementing ABRR more difficult.

IV Where next?

The clear conclusion is the Federal Reserve's new policy of paying interest on reserves is a flawed policy and should be immediately changed. The Fed has increased the supply of reserves through purchases of Treasury bonds and mortgage backed securities that have expanded its balance sheet. It now needs to deactivate those reserves and later raise interest rates. The Fed's proposed exit strategy is to deactivate reserves by paying interest on them, thereby inducing banks to passively hold excess reserves.

Instead, the Fed should look for other more desirable ways to increase the demand for reserves.

One measure is to abolish regulation Q and allow banks to pay interest on demand deposits. That would increase the demand for deposits and thereby increase banks' demand for reserves to back those deposits. Not only does this help with the exit strategy, it also has other benefits. Allowing interest payments on demand deposits will attract funds back to the banking sector, yielding three benefits. First, it will increase demand deposits which are a stable form of financing given the existence of deposit insurance. Second, it will remove the interest penalty on depositors who are disproportionately middle and low income households. Third, it will increase economic efficiency by eliminating a financial market distortion that encourages households to engage in a risky chase for yield by investing in other asset classes.

A second measure is to authorize and instruct the Federal Reserve to implement a system of ABRR that applies to all financial intermediaries. An ABRR system has numerous benefits including provision of a new set of policy instruments that can target specific financial market excess and asset bubbles, leaving interest rate policy free to manage the overall macroeconomic situation; providing an automatic stabilizer that generates automatic monetary restraint because the financial sector must hold more reserves when asset values rise or when the financial sector creates new assets; providing a policy tool that can encourage public purpose investments such as inner city revitalization or environmental protection by setting low (or no) reserve requirements on such investments; and increasing seignorage revenue for governments by increasing the demand for reserves.

Furthermore, ABRR are highly germane with regard to the exit strategy debate because they increase the demand for reserves. Consequently, a system of ABRR provides an alternative to Chairman Bernanke's proposed exit strategy – and one that imposes no interest cost on the public purse. By raising asset reserve requirements the Fed can deactivate much excess liquidity.

Now is the optimal time to implement a new regulatory system. Regulatory transitions often involve costly disruption, but the current environment means those costs can be avoided. That is because banks are flooded with liquidity, as reflected in their holdings of excess reserves. Consequently, imposing ABRR now would likely have a near-zero impact because banks have more liquidity than they need. In the language of microeconomics, the economic constraint imposed by ABRR would be non-binding so that it would not immediately impact the lending and business activity of banks. In contrast, adopting ABRR in a time of normal interest rates and liquidity scarcity would be a shock to financial markets as it would force an immediate increase in loan rates and a contraction in lending.

V The troubling political economy of interest on reserves

The Fed's new policy of paying interest on total bank reserves provides a case study of the troubling political economy that now governs monetary policy and financial regulation. The policy is flawed and potentially very costly to the public purse. There are better ways to conduct monetary and regulatory policy yet they never got a hearing. Instead, the new policy was smuggled through as part of the neoliberal agenda and it is only getting scrutiny because of the extreme nature of the financial crisis and Great Recession.

The new policy benefits the banks and is supported by them -- at least there is no evidence of banks opposing the measure. There is no evidence of opposition to the passage of the measure from the economics profession, and the Fed lobbied a long time for the measure. Governor Kohn (2004) made it the lead request in his testimony on regulatory before the Senate Committee on Banking, Housing, and Urban Affairs on June 22, 2004. The regional Federal Reserve banks were also enlisted in the effort, with the Federal Reserve Bank of New York taking a leading advocacy role by providing technical justifications for the system (Keister et al, 2008).

Nor does Congress come off well as there is no evidence that it sought testimony critical of the proposal. Finally, nor do progressive institutions in Washington, D.C., come off well as the measure was enacted without a whisper of criticism. This reflects a historic disinterest and lack of attention to financial issues by Washington's progressive think-tanks and the labor movement.

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Table 1. Interest cost of paying interest on bank reserves.

Reserves deposited with the Fed (Sept. 2009)	Interest rate	Cost
\$848.1	0.25%	\$2.12b
\$848.1	1.0%	\$8.48b
\$848.1	3.0%	\$25.44

Appendix 1. The economics of banking firms.

Banks can be thought of as multi-input multi-output firms. On the input side they use finance that comes in many different forms – including shareholder equity, demand deposits, savings accounts, certificates of deposit, and commercial paper. On the output side they allocate finance across different uses – including commercial loans, consumer loans, mortgage loans, Treasury bills, and Treasury bonds.

Profit maximizing banks therefore a) equate marginal costs across different sources funds so that all sources of funds cost the same at the margin; b) equate marginal revenues across applications of funds so that all applications earn the same at the margin; c) equate marginal costs with marginal revenues so that no profitable opportunities are left unexploited. This gives rise to the condition

$$(A.1) MR_1 = \dots = MR_N = MC_1 = \dots = MC_M$$

where MR = marginal revenue on each of the N different asset types banks hold, and MC = marginal costs on each of the M different sources of bank funding.

One source of bank funding is the federal funds market for which the marginal cost is

$$(A.2) MC_{FF} = i_{FF}$$

where i_{FF} = federal funds interest rate. A second source of funding is demand deposits for which the marginal cost is

$$(A.3) MC_D = [1 + k]i_D$$

where i_D = implicit and explicit interest on each dollar of deposits, and k = required reserve ratio for deposits. Equating the two marginal costs yields

$$(A.4) i_D = i_{FF}/[1 + k]$$

The Federal Reserve's money market interest rate sets the base cost of finance for banks. Banks are then willing to incur implicit and explicit interest costs of providing deposits that are slightly less than this base cost because deposits bear reserve requirements. When banks receive a dollar of deposits they must hold k cents as required reserves and they effectively only receive $[1 - k]$ dollars for lending. Banks therefore reduce the interest rate they are willing to pay to reflect the fact they receive less than a full dollar they can actually of lend.

Appendix 2. The economics of paying interest on reserves.

The cost to the Federal Reserve of paying interest on total reserves can be illustrated with a simple model of banks' demand for reserves.

The model is described as follows:

(B.1) $TR^d = T(i_{FF}, i_R, i_B, D)$	$T_{i_{FF}} < 0, T_{i_R} > 0, T_{i_B} < 0, T_D > 0$	[Bank demand for reserves]
(B.2) $i_R = \alpha i_{FF}$	$0 \leq \alpha \leq 1$	[Interest rate paid on reserves]
(B.3) $i_B = i(i_{FF}, i_R, E)$	$i_{i_{FF}} > 0, i_{i_R} > 0, i_E > < 0$	[Bond interest rate]
(B.4) $L = L(i_L, \dots)$	$L_{i_L} < 0$	[Loan demand]
(B.5) $i_L = [1 + m(i_B, i_R)]i_{FF}$	$m_{i_B} > 0, m_{i_R} > 0$	[Bank loan interest rate]
(B.6) $R = TR^d$		[Federal funds market clearing condition]
(B.7) $L + TR^d = D$		[Banking sector balance sheet]

where TR^d = banks' demand for total reserves, i_{FF} = federal funds rate, i_R = interest rate paid on reserves by the central bank, i_B = short term bond interest rate, E = vector of variables concerning expected future interest rates and economic conditions, D = bank deposits, L = bank lending, i_L = bank loan rate, and m = bank mark-up over the base cost of finance. The signs of partial derivatives are indicated by the inequality signs.

Equation (B.1) describes banks' demand for total reserves. The demand depends negatively on the federal funds interest rate which is the opportunity cost of holding reserves ($T_{i_{FF}} < 0$). It depends positively on the interest rate paid on reserves ($T_{i_R} > 0$). It depends negatively on the short term bond interest rate ($T_{i_B} < 0$) as bonds are another alternative application of bank funds. Lastly, it depends positively on the volume of bank deposits ($T_D > 0$). However, because bank loans create deposits against which reserves must be held, lending is the ultimate determinant of the volume of deposits in the system.

Equation (B.2) determines the interest rate paid on reserves, where α is a coefficient chosen by the Fed. Prior to October 2008, this rate was institutionally set at zero so that $i_R = 0$. Under the new operating regime this interest rate is $i_R = i_{FF}$.

Equation (B.3) determines the current bond interest rate. It depends positively on the federal funds interest rate and the interest rate paid on reserves. The latter effect is because bonds and reserves are substitutes in bank portfolios.

Equation (B.4) determines bank lending, which is equal to loan demand. Loan demand in turn depends negatively on the bank loan interest rate.

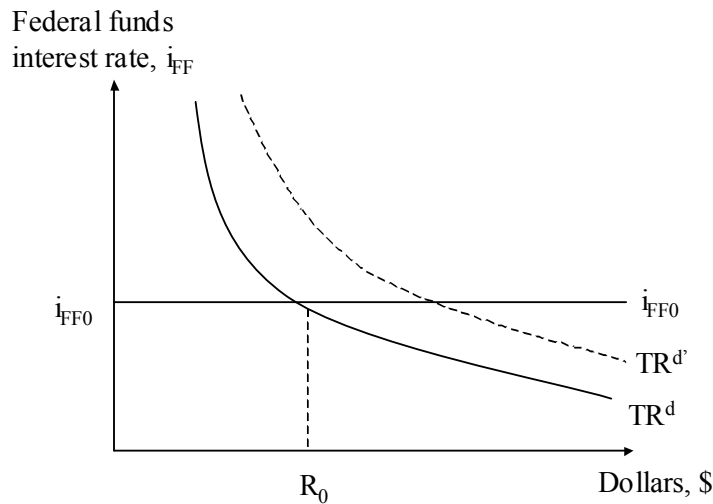
Equation (B.5) determines the bank loan rate, which is a mark-up over the base cost of finance for banks. That base cost is the federal funds interest rate. The mark-up may be positively affected by the returns on other applications of funds available to banks.

Equation (B.6) is the federal funds market clearing condition which holds the demand for reserves must equal the supply of reserves at the going federal funds rate.

Equation (B.7) is a simplified version of the banking sector's aggregate balance sheet constraint, which holds loans plus reserves (assets) must equal deposits (liabilities). The supply of reserves is therefore equal to $R_0 = D - L$

Figure 1 illustrates the federal funds market. The downward sloping schedule is banks' demand for total reserves. Initially, the Federal Reserve is not paying interest on reserves so that $i_R = 0$ and it has a funds target of i_{FF0} . Given initial conditions the quantity of reserves emitted by the central bank is R_0 .

Figure 1. The federal funds rate and the market for reserves.

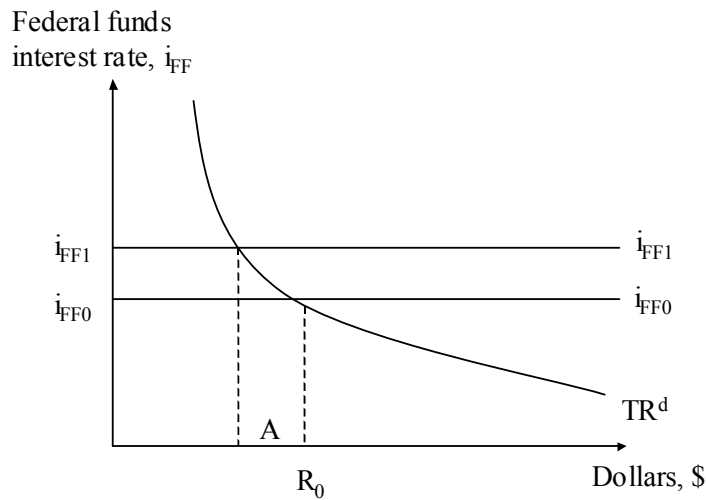


Now suppose the Fed starts paying interest on reserves so that $i_R = i_{FF0}$. This immediately increases banks' portfolio demand for reserves (i.e. the demand for reserves schedule shifts right to TR^d') and creates excess demand for reserves. Balance with the initial supply of R_0 is restored by banks selling bonds, which increases the bond rate (i_B) and causes the demand for reserves to fall back to TR^d .

There are two implications. First, the Fed must now pay interest to banks of $R_0 \times i_{FF}$, whereas before it was paying nothing. Second, the bond rate is higher, which increases the Treasury's cost of borrowing.

The new system also raises the cost of conducting monetary policy over the course of the business cycle, as illustrated in Figure 2.

Figure 2. The effect of increasing the federal funds rate.



Suppose the Federal Reserve wants to raise the target to i_{FF1} . Under the old system the Fed would have had to conduct an open market reserve drain of $\$A$. It would do this by selling $\$A$ of short term bonds, resulting in a reduction in portfolio interest income of the Fed equal to $A \times i(i_{FF1}, \dots)$.

Under the new system the Fed no longer engages in open market reserve drains. Instead, the Fed raises the interest rate it pays banks so that it now pays interest of $[R_0 - A] \times i_{FF1}$. If the demand for reserves is interest inelastic, as seems likely, total interest payments to banks increase. Moreover, the bond rate (i_B) increases relatively more because a higher interest rate on reserves (i_R) makes reserves a relatively more attractive portfolio holding. That means the cost of financing budget deficits could be higher.

Raising the interest rate is always costly to the Fed, but the new system is likely more costly. That is because under the old system the Fed engaged in a marginal sale from its portfolio that caused a small amount of lost portfolio interest income. Under the new system the Fed pays interest on the total stock of reserves (excluding vault cash) held by banks. The cost is higher because the Fed is paying interest on the total stock.

There are two important points. First, the Fed's exit strategy anticipates a period of raising the federal funds rate. *Ceteris paribus*, that will increase total interest payments to the banks. Second, over the course of the entire business cycle the new system stands to be significantly more costly. Thus, suppose over the course of the cycle the federal funds rate averages i_{FF0} and banks' demand for reserves averages R_0 . Under the old system the Fed's portfolio interest income would have approximately averaged $\$R_0 \times i(i_{FF0}, \dots)$. Under the new system the Fed's portfolio interest income will average $\$R_0 \times [i(i_{FF0}, \dots) - i_{FF0}]$. The new system therefore reduces the Fed's seignorage income, but this will be partially offset to the extent banks' demand for reserves is higher in the new system.