

**Monetary Policy Implementation:**  
**Making Better and More Consistent Use of the Federal Reserve's Balance Sheet**

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**Summary**

Immediately after its January 2019 meeting, the Federal Open Market Committee (2019*b*) released a “Statement Regarding Monetary Policy Implementation and Balance Sheet Normalization.” The statement highlights two points of consensus that shape the FOMC’s monetary policymaking strategy. First,

the Committee intends to continue to implement monetary policy in a regime in which an ample supply of reserves ensures that control over the level of the federal funds rate ... is exercised primarily through the setting of the Federal Reserve’s administered rates, and in which active management of the supply of reserves is not required.

Second,

the Committee continues to view changes in the target range for the federal funds rate as its primary means of adjusting the stance of monetary policy ... [ but ] ... would be prepared to use its full range of tools, including altering the size and composition of its balance sheet, if future economic conditions were to warrant a more accommodative monetary policy than can be achieved solely by reducing the federal funds rate.

In other words, the FOMC will continue to target the federal funds rate using the floor system it introduced in December 2015, at the start of the current tightening cycle. Under that

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floor system, the Federal Reserve adjusts the interest rate it pays on bank reserves to bring about desired changes in the federal funds rate itself, while operating with a balance sheet that remains considerably larger than it was before the financial crisis and Great Recession of 2007-09.

Additionally, the FOMC will retain its traditional practice of conducting monetary policy via federal funds rate targeting. If or when the federal funds rate target again approaches its lower bound near zero, however, the FOMC may bring back quantitative easing – large-scale asset directed at lowering longer-term interest rates – to deliver additional economic stimulus during a severe recession.

On the surface, both points of consensus and the strategies they imply seem sensible. The first panel of figure 1 shows that, as the FOMC has raised the interest rate paid on reserves in a series of nine steps since December 2015, it has succeeded in pushing the federal funds rate higher. Mechanically, the new floor system works.

The remaining panels of figure 1 confirm that, despite the novelty of the operating procedures used to engineer them, these increases in the funds rate have had effects traditionally associated with monetary policy tightening. M2 growth has declined noticeably. Growth in real residential investment – typically, the most important interest-sensitive component of aggregate spending – has slowed markedly as well. Spending on consumer durables has moderated somewhat, too, though it remains strong. And core inflation, as measured by annual changes in the price index for personal consumption expenditures excluding food and energy, has stabilized at a level just below the FOMC’s two-percent long-run target. Based on their effects so far, therefore, the FOMC’s new procedures and strategies also appear successful.

Success so far, however, has come within a most favorable economic environment, featuring robust growth in jobs, accelerating gains in wages and income, and continued low and

stable inflation. Looking ahead, especially with the certainty that, sooner or later, the next recession will arrive, it's only prudent to look for limitations that might prevent the FOMC's strategy from being as effective as it could be, in times of stress as well as calm.

Along those lines, it is helpful to note that the FOMC's Statement and the policy strategy it outlines reflect Committee members' longstanding practice of interpreting and evaluating monetary policy actions with exclusive reference to their effects on interest rates. Within this analytic framework, balance sheet policy often appears as something else: a distinct tool for influencing credit market conditions.

The alternative, monetarist framework outlined here emphasizes, instead, that all monetary policy actions have direct implications for the size and composition of the Fed's balance sheet. The monetarist framework suggests that quantitative easing, as implemented during and after the crisis and recession of 2007-09, would have been more effective if the Fed not started paying interest on reserves at the same time; it also points to unnecessary risks in the FOMC's decision to continue operating with a very large balance sheet. The monetarist framework implies that monetary policy can be made more effectively, in a consistent and rule-like manner, both at and away from the zero lower interest rate bound.

### **Interest Rate Policy and the Monetarist Critique**

What is monetary policy? For most FOMC members, monetary policy means managing interest rates.<sup>1</sup> Today, as always, FOMC members see themselves as tightening monetary policy through

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<sup>1</sup> Meulendyke (1998) and Thornton (2006) describe the role of interest rates in Federal Reserve policymaking strategy since the mid-1980s. Cook (1989) goes back even further, arguing that the reserves targeting procedures used from 1979 through 1982 disguised policy actions taken to manage interest rates instead.

actions that raise interest rates. When the next easing cycle begins, they will see themselves, similarly, as making policy more accommodative by lowering interest rates.

In normal times, the federal funds rate target serves as the focal point for the FOMC's interest rate policy. After lowering the federal funds rate target to a range near zero in December 2008, the FOMC shifted its direct focus to longer-term interest rates instead. Through their clear and detailed exposition of this FOMC view, Swanson and Williams (2014) show that policy maneuvers including forward guidance and quantitative easing appear "unconventional" only in that they replaced more direct manipulation of the federal funds rate target. Their goal was the same: to increase aggregate spending by lowering interest rates. As discussed by Belongia and Ireland (2019a), this approach to monetary policymaking via interest rate management derives theoretical support through popular New Keynesian models, which imply that monetary policy actions affect the economy exclusively through their effects on current and expected future interest rates.

Monetarist economists have often argued that exclusive focus on interest rates in monetary policy analysis and evaluation can lead to incomplete or even incorrect conclusions. Most famously, Friedman and Schwartz (1963a, pp.299-300) reinterpret the Great Depression as a "tragic testimonial to the importance of monetary forces" manifested not through movements in interest rates but instead by the fact that "from the cyclical peak in August 1929 through the cyclical trough in March 1933, the stock of money fell by over a third." Brunner and Meltzer (1963) are even more explicit in linking the Depression to fundamental flaws in the analytic framework that Federal Reserve officials used to understand monetary policy and its effects. According to Brunner and Meltzer (p.348), "since interest rates had fallen to much lower levels in 1930 and 1931 than in either of the earlier recessions, virtually all of the members of the Open

Market Committee agreed that policy was ‘easy.’” Had they considered the sharp decline in the money stock instead, they would have recognized that policy was, instead, much too tight.

Hetzel (2018a) emphasizes that, despite the theoretical power and predictive accuracy of the monetarist framework developed and expounded in the 1960s by Friedman, Schwartz, Brunner, and Meltzer, it was not until years later that widespread support developed for the view that the central bank is ultimately responsible for controlling the aggregate nominal price level and can do so, most effectively, by exploiting its role as monopoly supplier of base money. In the early 1980s, that public recognition allowed the Federal Reserve, under Chair Paul Volcker, to finally restore stability after two decades of high and volatile inflation by restraining the growth rate of money.

Today, central bankers continue to stress the importance of their policy strategies and actions for maintaining low and stable inflation. Yet, they have resumed their older practice of designing those strategies and taking those actions with almost exclusive attention to interest rates and correspondingly little if any reference to trends in the growth rate of money. Just like before, the monetarist framework helps in resolving misunderstandings and correcting mistakes that can follow from the overly narrow consensus view.

A few basic monetarist principles help show, for example, how even under its current floor system, the Fed must still control the supply of base money to stabilize the aggregate nominal price level or inflation as its rate of change. The same basic principles point to changes in strategy that would make the quantitative easing more effective for delivering monetary stimulus at the zero lower bound. By referring to these basic principles, therefore, the FOMC could conduct monetary policy in a more consistent, rule-like manner, regardless of the level of short-term interest rates.

## **Basic Monetarist Principles**

The monetarist framework builds on two basic principles of macroeconomics: the classical dichotomy and the doctrine of long-run monetary neutrality. The classical dichotomy draws the distinction between real variables, which are measured in units of physical goods or services, and nominal variables, which are measured in dollars. In a market economy, relative prices adjust to keep in balance the supply of and demand for individual goods and services, thus pinning down the behavior of real variables. It is up to the central bank, meanwhile, to conduct monetary policy to determine the aggregate nominal price level and, by extension, all other nominal variables as well.

The doctrine of long-run monetary neutrality states that the central bank can do this by exercising its monopoly power over the supply of base money: currency plus bank reserves. All else equal, any change in the supply of base money generates a proportional change in the nominal price level. It follows from these principles that the Fed can achieve any target for inflation it sets for itself, in the long run, by appropriately choosing the growth rate of base money.

As Hetzel (2012, 2018*b*) explains, Keynesians and monetarists tend to hold different views of the forces generating short-run, cyclical departures of real and nominal variables from their long-run growth paths. Keynesians see spontaneous waves of optimism and pessimism – fluctuating “animal spirits” – as an important source of excessive volatility in asset prices and, working through that channel, consumer and business spending as well. Thus, in the Keynesian framework, it becomes part of the Fed’s role to adjust monetary policy to smooth out these fluctuations and fine-tune the economy.

Monetarists, by contrast, interpret relative price movements – including capital asset price movements – as an equilibrating force that helps the economy respond most efficiently to shocks. In the monetarist framework, therefore, the Fed’s principal role is to conduct monetary policy in a way that makes movements in the aggregate nominal price level as predictable as possible. This entails following a simple rule that is announced in advance. The monetarist strategy aims to remove monetary policy itself as a source of fluctuations and thereby create an environment of nominal stability within which the market system can best deliver robust growth in spending, income, and jobs.

Monetarists cite the historical and statistical evidence assembled by Friedman and Schwartz (1963*a*, 1963*b*) to support their view that business cycle fluctuations will tend to be mild and short-lived *except* when monetary policy generates unnecessary volatility in money growth and inflation that interferes with the workings of the price system. Monetarists extend Friedman and Schwartz’s historical account through the 1970s, observing that the Federal Reserve’s attempts to fine-tune the economy then led, not to lower unemployment at the cost of higher inflation as the Keynesian Phillips curve trade-off promises, but rather to the worst of both worlds: high and volatile unemployment and inflation. Finally, monetarists emphasize that over the period from the late 1980s through the 1990s when, according to Taylor (1993), Federal Reserve policy did track closely the prescriptions of a simple and easy-to-understand rule, the US economy experienced a phase of remarkable nominal and real stability known as the “Great Moderation.”<sup>2</sup>

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<sup>2</sup> See Hetzel (2013) for a monetarist interpretation of the Great Inflation of the 1970s and Nelson (2008) for a comparison of Milton Friedman and John Taylor’s arguments for monetary policy rules.

## Money, Prices, and the Balance Sheet

Figure 2 illustrates the monetarist view of what monetary policy can do. Taking note of the units measured along the graph's two axes is key. The horizontal axis measures the supply and demand for base money, measured in nominal terms, that is, in dollars. If  $P$  is the aggregate nominal price level – the “dollar price of goods” – then its reciprocal  $1/P$ , measured along the vertical axis, represents the “goods price of a dollar.” Thus, the figure presents a standard Marshallian supply-and-demand diagram, applied to the monetary base.

In the graph, the downward-sloping blue curve describes the dollar volume of money demanded for each value of  $1/P$ . The convex shape of the demand curve – steep at first, then gradually flattening out – is derived from the observation that variables including the federal funds rate  $ffr$ , the interest rate on reserves  $ior$ , and the level of real GDP  $Y$ , determine banks' demand for *real* reserves and the non-bank public's demand for *real* currency according to a relation of the form

$$\frac{M^d}{P} = f(ffr, ior, Y, \dots). \quad (1)$$

In equation (1), the real money demand function  $f$  is likely to be decreasing in its first argument (since a higher federal funds rate provides an incentive for banks to lend out instead of holding reserves), increasing in its second argument (since a higher interest rate on reserves provides an incentive for banks to hold more funds on deposit at the Fed), and increasing in its third argument (since banks' demand for reserves and the public's demand for currency will both increase with the scale of economic activity). Through the function  $f$ , it is also likely that as the federal funds rate and the interest rate on reserves move up and down together under the Federal Reserve's new floor system, the real demand for base money will remain unchanged, as the floor



system aims to keep the spread  $ffr - ior$ , measuring the opportunity cost to banks of holding reserves, unchanged as well.

Importantly, the graph in figure 2 holds each of these determinants of real money demand fixed. More precisely, the graph identifies the federal funds rate, the interest rate on reserves, and real GDP as variables that can *shift* the money demand curve to the left or to the right. Instead, the graph plots the implied demand for *nominal* base money as a downward-sloping function of  $1/P$ , taking the specific form

$$M^d = \frac{f(ffr, ior, Y, \dots)}{1/P} \quad (2)$$

derived from (1). With the arguments of  $f$  held constant, the downward-sloping blue line traces out the graph of  $y = k/x$ , where  $x = M^d$  (on the horizontal axis) is nominal money demand,  $k$  is the fixed value of  $f$  given its arguments, and  $y = 1/P$  (on the vertical axis) is the reciprocal of the price level.

In the United States, the Federal Reserve and only the Federal Reserve can issue currency and bank reserves. Thus, figure 2 reveals that by exercising this role as monopoly supplier of base money, the Federal Reserve determines the location of the vertical red line and can thereby hit any target it sets for the goods price of money  $1/P$ . This is how, within the monetarist framework, the Fed is described as conducting monetary policy to pin down the aggregate nominal price level.

Figure 3 extends the analysis from figure 2, by showing how the Fed can successfully bring about whatever change in the aggregate nominal price level it desires by conducting open market operations that shift the supply curve for base money. Specifically, the graph shows that when the Fed conducts an open market purchase that injects newly-created base money into the economy, the aggregate price level rises. Conversely, when the Fed conducts an open market

sale of previously-purchased assets that drains base money from the economy, the aggregate price level falls.

Importantly, figures 2 and 3 are not inconsistent with more familiar graphical descriptions of the supply of and demand for reserves, which place the federal funds rate  $ffr$  instead of the reciprocal of the aggregate price level  $1/P$  on the vertical axis. The difference lies only in what is emphasized – or, more precisely, what changes and what is held constant. In the more popular diagram, changes in the federal funds rate lead to movements along the downward-sloping demand curve, while changes in the aggregate price level shift the demand curve. Here, changes in the price level lead to movements along the downward-sloping demand curve, while changes in the federal funds rate shift the demand curve.

But the alternative, monetarist viewpoint illustrated in figures 2 and 3 usefully reminds us that even under a floor system, monetary policy actions taken to influence the aggregate price level *must* eventually be supported by open market operations that change the supply of base money and hence the size of the Federal Reserve's balance sheet.

To see this, note that under a floor system, the Fed first changes  $ior$ , the interest rate it pays on reserves, to bring about a similar change in the federal funds rate  $ffr$ . Initially, the system appears to work based only on a no-arbitrage condition. If the funds rate did not rise in lockstep with an increase in the interest rate on reserves, any bank could borrow reserves at the lower funds rate, deposit those reserves in its account at the Fed to earn the higher interest rate on reserves, and thereby book instantaneous risk-free profits. An excess demand for loans in the interbank market would then put upward pressure on the federal funds rate, until it reached the higher target intended under the floor system. Likewise, if the funds rate did not fall in lockstep with a decrease in the interest rate on reserves, any bank could withdraw funds on deposit at the

Fed, where they earn the lower interest rate on reserves, and lend them out to earn the higher federal funds rate. An excess supply of loans in the interbank market would then put downward pressure on the federal funds rate, until it hit lower target intended under the floor system.

These arguments are not wrong, only incomplete. Under a floor system, the FOMC's Statement correctly notes that "active management of the supply of reserves is not required." But active management of reserves is not required only in the short run, while the aggregate price level remains unchanged.

Consider, for example, the effects of an increase in the interest rate on reserves, intended to produce, through the floor system, a similar increase in the federal funds rate. The FOMC increases its federal funds rate target to accomplish what? To bring about a decrease in the aggregate price level, relative to where it would be, absent the monetary policy tightening! As the price level  $P$  falls, while the spread between the federal funds rate  $ffr$  and the interest rate on reserves  $ior$  is held fixed, the volume of real reserve balances actually held by the banking system increases, even as the volume of real reserves desired, as described by the function  $f$  from equation (1), remains unchanged. Each individual bank, therefore, will attempt to reduce its holdings of unwanted reserves by increasing its lending, putting downward pressure on market rates of interest, including the federal funds rate.

How will the FOMC "defend" its federal funds rate target against what it perceives as a shift in, as opposed to a movement along, the reserves demand curve? By conducting an open market operation! Specifically, by conducting an open market operation that drains reserves

from the banking system and restores equilibrium in the money market with a lower aggregate price level and a higher interest rate on both reserves and federal funds.<sup>3</sup>

Federal Reserve officials, describing these events as they unfold in real time, might refer to the open market operation as a technical adjustment intended to offset a shift in banks' demand for reserves – a consequence rather than a cause of the declining aggregate price level. But a monetarist would emphasize, instead, that the open market operation is essential for bringing about the decrease in the supply of base money that allows the aggregate price level to fall, given the fixed spread between the federal funds rate and the interest rate on reserves maintained by the floor system. In other words, for the Federal Reserve, the floor system serves to implement monetary policy, while adjustments in the monetary base are merely technical details. Monetarists see it the other way around: the Fed controls the supply of base money to implement monetary policy, while the floor system is just a set of technical details.

Why are these distinctions important? Mainly because they reveal that *any* monetary policy action undertaken to change the aggregate price level *must* be supported, sooner or later, by an open market operation that changes the supply of base money and hence the size of the Fed's balance sheet proportionally. There is no way to fully separate monetary policy from the size of the Fed's balance sheet. To the contrary, conducting monetary policy inevitably requires changes in the size of the balance sheet.<sup>4</sup> By highlighting this link, instead of obscuring it behind

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<sup>3</sup> Ireland (2014) makes these arguments in more detail using a dynamic, stochastic, general equilibrium New Keynesian model, augmented with a competitive banking system that demands reserves supplied by the Fed; Ireland (2017) restates the same arguments, using graphs of the more familiar form, with interest rates instead of the aggregate price level measured along their vertical axes.

<sup>4</sup> McCulloch suggests another possibility: that when, under a floor system, the Fed pays interest on reserves at a level that is at or above the federal funds rate target, banks' demand for real reserves as described by an equation like (1) becomes infinitely elastic. In this case, the nominal

the workings of the floor system, FOMC members could better explain to the public that quantitative easing at the zero lower bound is not fundamentally different from federal funds rate targeting during more normal times. Both are mechanisms for adjusting the monetary base to maintain aggregate price stability. Both are mechanisms, too, for bringing about changes in the term structure of interest rates that affect aggregate spending and, through that channel, inflation as well.

The monetarist viewpoint illustrated in figures 2 and 3, however, also works to expose a potential flaw in the way quantitative easing was implemented, specifically, during the period from 2008 through 2015 while the FOMC held its funds rate target close to zero. Again, unlike more popular descriptions of the reserves demand curve as a function of interest rates that gets shifted by changes in the aggregate price level, figures 2 and 3 depict the reserves demand curve as a function of the price level that gets shifted by changes in interest rates. With this distinction in mind, figure 4 simulates the combined effects of two separate policy initiatives undertaken by the Federal Reserve during and after the financial crisis. First, quantitative easing – large-scale purchases of US Treasury bonds and mortgage-backed securities – though aimed more directly at lowering long-term interest rates, also dramatically expanded the supply of bank reserves and the size of the Fed’s balance sheet. Considered by itself, this “unconventional” policy would have

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money demand curves drawn in figures 2 and 3 would have vertical segments, indicating regions where real money demand is no longer uniquely determined by (1). It may then be true that the Fed could bring about changes in the equilibrium price level without using open market operations to adjust the supply of base money and the size of its balance sheet. But, as McCulloch emphasizes, in that case the floor system would work, more generally, to leave the aggregate price level indeterminate. The analysis here rules out this interesting case by assuming that, even when  $ior$  exceeds  $frr$ , there remains some curvature in the function  $f$ , so that the demand for real balances remains well-defined. McCulloch’s suggestion deserves further consideration, however, since it may explain why, under the FOMC’s floor system, inflation has run persistently below target.

had the fully conventional effect of increasing the aggregate price level or, more precisely, of preventing inflation from falling sharply below target in response to the adverse shocks that triggered the crisis and recession in the first place. As the same time, however, the Fed also began paying interest on reserves, shifting, in figure 4, the demand curve for base money far to the right.

Figure 4 is drawn to illustrate the possibility that the shift in reserves supply through three rounds of quantitative easing may simply have accommodated the shift in reserves demand resulting from the transition to a regime based on interest on reserves, with little or no effect on the aggregate price level at all. Its more general implication is that if quantitative easing is interpreted as a way of providing additional monetary stimulus after the federal funds rate reaches its zero lower bound, interest on reserves works in the opposite direction, causing monetary policy to be unnecessarily tight.<sup>5</sup>

Thus, from a monetarist perspective, quantitative easing as implemented, together with interest on reserves, appears less like a monetary intervention intended to stabilize inflation and more like a credit market intervention, intended to stimulate spending by lowering long-term interest rates and, perhaps, by channeling funds specifically towards mortgage lending as well. Put another way, with this combination of policies, the Fed stopped acting like a central bank that controls the supply of base money to stabilize the aggregate price level and more like a private financial intermediary that issues short-term liabilities and uses the proceeds to acquire long-term assets, in general, and to make mortgage loans, in particular.

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<sup>5</sup> With exactly this point in mind, Dutkowsky and VanHoose (2018) suggest that the Federal Reserve might easily provide monetary stimulus to counteract the next cyclical downturn simply by announcing the end of the interest on reserves regime. In figure 4, this policy change would snap the demand curve back to the left, putting upward pressure on the price level to counteract any deflationary impulse causing the recession without any need for further quantitative easing.

Whatever benefits this policy combination may have had need to be balanced against the costs – economic and political – of the Fed’s willingness to expand its balance sheet for non-monetary purposes. These costs, discussed by Ireland (2018) and Plosser (2018), include not only the interest rate risk stemming from the mismatch in maturity between the Fed’s short-term, floating-rate liabilities and long-term, fixed-rate assets but also the risk that the Fed will be pressured by a future President or members of Congress to channel credit to their favored sectors of the economy. The continued presence of these risks suggests that, in the future, quantitative easing should be used, more specifically, for the same purpose as federal funds rate targeting: to manage the monetary base so as to stabilize inflation.

### **Rules to Support Goals**

By focusing solely on interest rates and eschewing all reference to measures of money, the FOMC’s existing strategy draws an unnecessary distinction between monetary and balance sheet policy, while masking the more important one between monetary and credit policy. It requires the Fed to operate with a balance sheet that is unnecessarily large, and perversely limits the continued effectiveness of open market operations at the zero lower bound.

There is a better way. By more consistently describing monetary policy actions as ones that are taken to manage the supply of base money to stabilize the aggregate price level, the FOMC would emphasize that those actions remain effective and are intended to achieve the same goal, regardless of the level of short-term interest rates.

This change in emphasis could be made, even while retaining the FOMC’s preferred practice of federal funds rate targeting during normal times while switching to quantitative easing at the zero lower bound. Hess and Orphanides (2018) argue that this could be done by

adopting a traditional interest rate rule and, at the same time, outlining the specifics of a contingency plan through which quantitative easing would take over whenever the rule prescribes zero or negative rates. This rule and contingency plan could be stated most effectively if it was appended to the FOMC's (2019*a*) existing "Statement on Longer-Run Goals and Monetary Policy Strategy," which, as Orphanides (2018) notes, remains incomplete without these additional elements.

This strategy, though based on the FOMC's existing procedures, nevertheless adopts the monetarist viewpoint that monetary policy works best when it focuses, first and foremost, on maintaining long-run price stability. The strategy also reflects the monetarist position that, by eschewing the temptation to engage in active fine-tuning and instead making monetary policy as predictable and easily understood as possible, central bankers can remove uncertainty about their own actions as a source of instability and allow relative prices to adjust as quickly as possible to help the economy respond efficiently to shocks of other kinds.

An alternative would go further, as suggested by Belongia and Ireland (2017, 2018, 2019*b*), by placing even more emphasis on how monetary policy actions taken to manage the monetary base affect measures of broad money growth as well as interest rates. The analysis here suggests that this approach would impose more consistency and discipline on monetary policymakers, what they do, and how they describe their actions. This approach would also help underscore, in the clearest possible way, that the Federal Reserve is meant to be a central bank, responsible for managing the money supply to control inflation, not a government-operated financial intermediary, capable of circumventing the Constitutionally-mandated federal appropriations process by channeling public funds to specific sectors of the economy without Congressional and Presidential approval.



Either way, however, bringing monetarist principles into the design of monetary policy strategies would help recreate the favorable conditions of the Great Moderation: a background of nominal price stability, within which the market economy produces robust growth in real income, spending, and jobs.

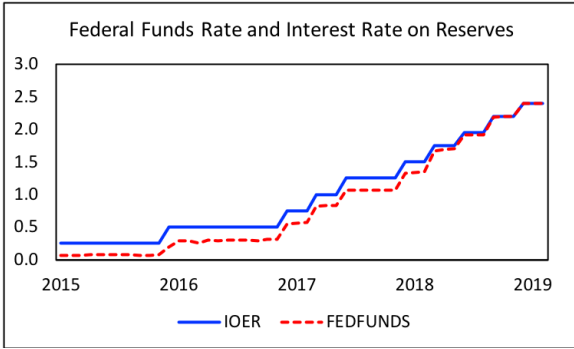
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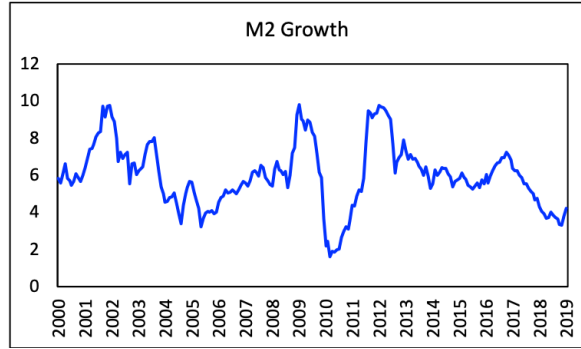
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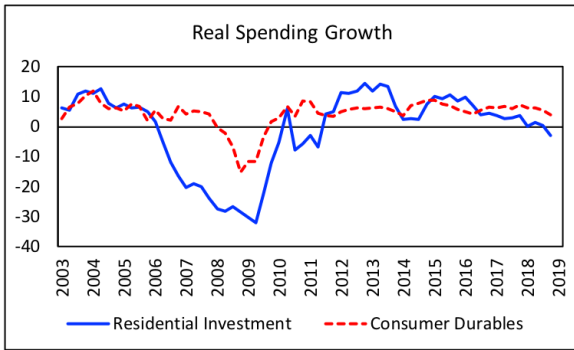
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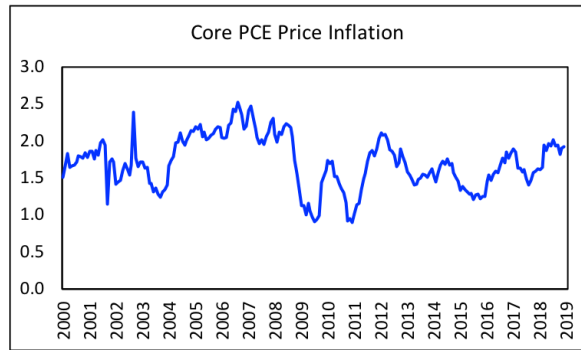
(a)



(b)



(c)



(d)

Figure 1. Monetary Policy Tightening and Its Effects. Panel (a) plots end-of-month values for the interest rate on excess reserves and the effective federal funds rate, monthly, 2015:01 through 2019:02. Panel (b) plots year-over-year percentage changes in the M2 money stock, monthly, 2000:01 through 2019:02. Panel (c) plots year-over-year percentage changes in real private residential fixed investment and real personal consumption expenditures on durable goods, quarterly, 2003:1 through 2018:4. Panel (d) plots year-over-year percentage changes in the price index for personal consumption expenditures, excluding food and energy, monthly, 2000:01 through 2018:12. All data are drawn from the Federal Reserve Bank of St. Louis' FRED database.

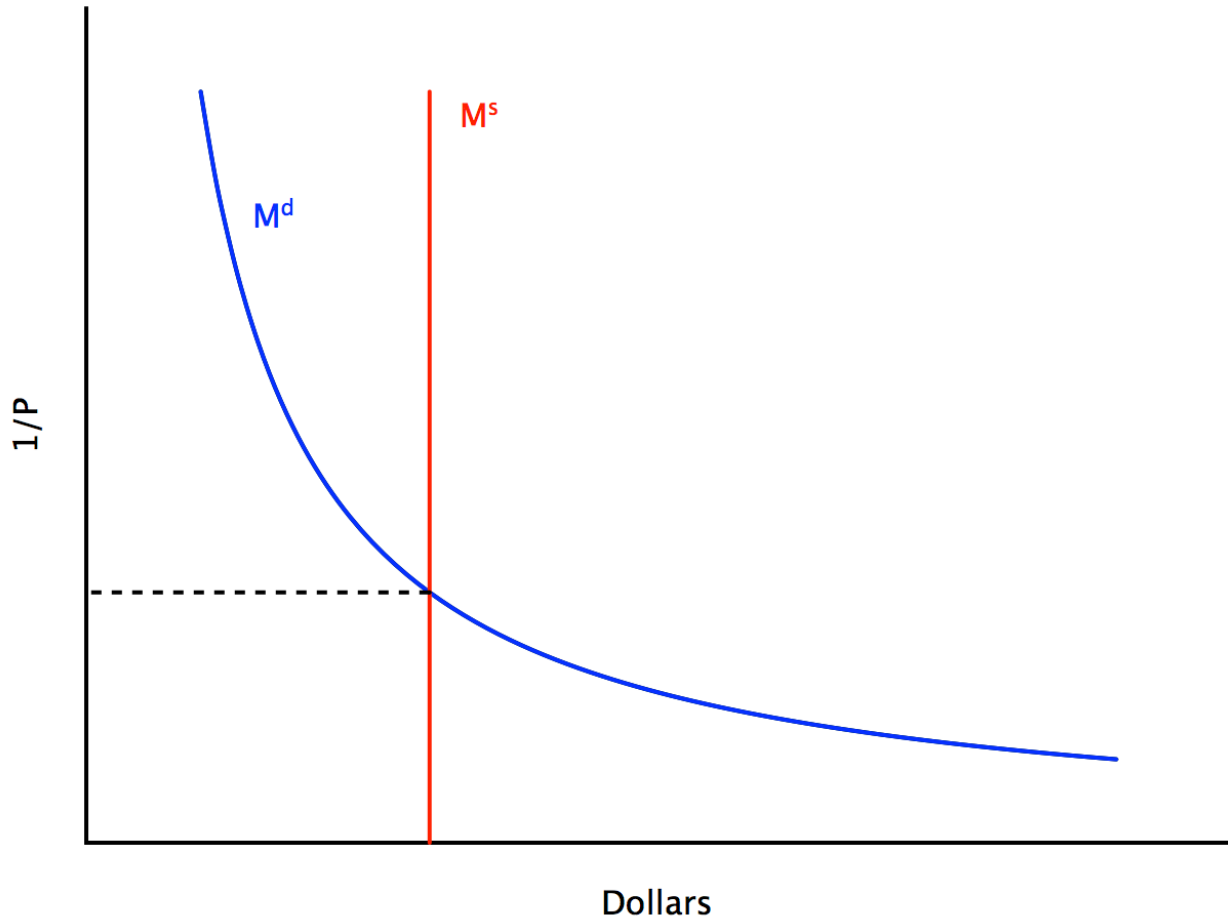


Figure 2. The aggregate nominal price level is determined by the supply of and demand for base money.

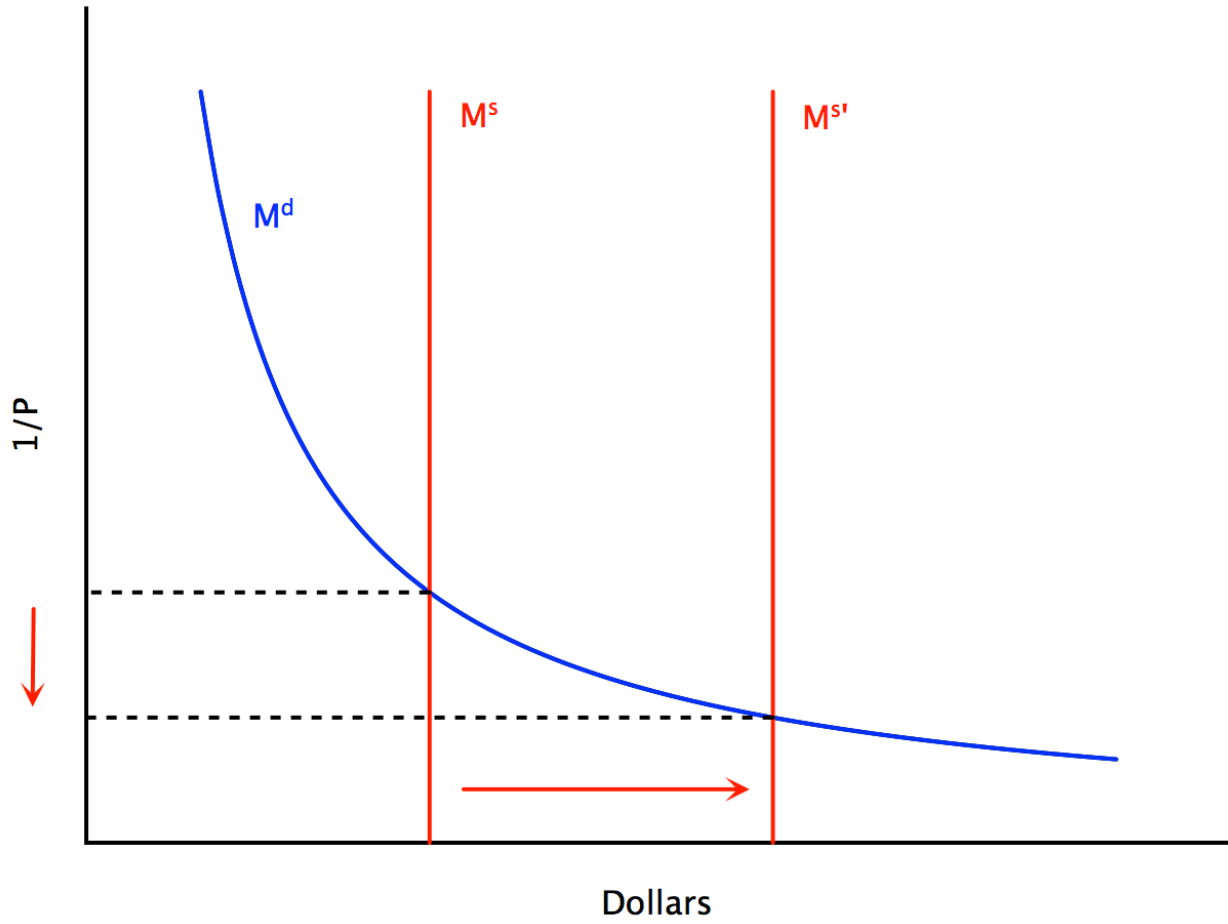


Figure 3. The Federal Reserve conducts an open market purchase, expanding its balance sheet by issuing new reserves and acquiring new assets. The aggregate nominal price level rises.

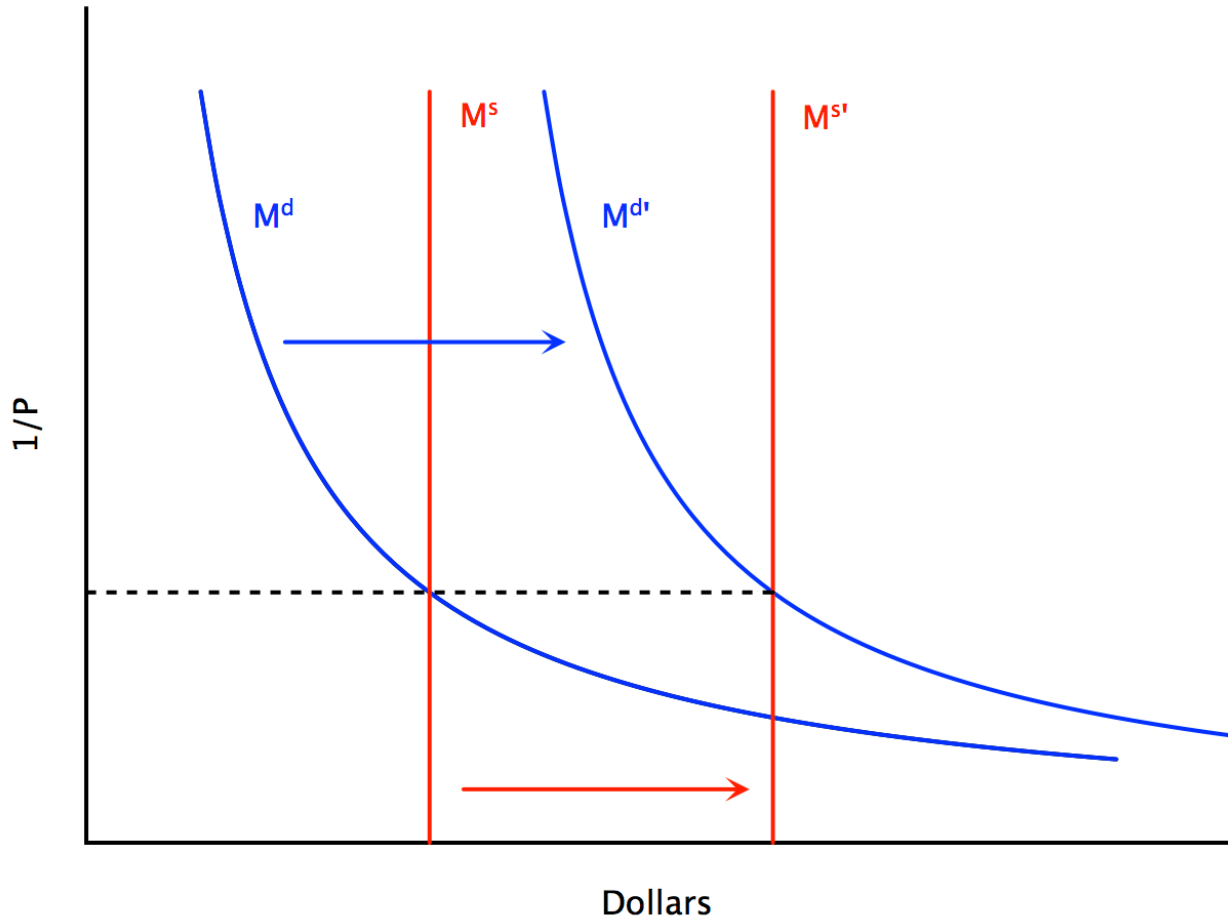


Figure 4. The Federal Reserve conducts an open market purchase, expanding its balance sheet by issuing new reserves and acquiring new assets. At the same time, it increases the interest rate paid on reserves, shifting the demand curve equally far to the right. The aggregate nominal price level remains unchanged.