Working Paper Series

Can Monetarists Explain Recession in the Eurozone?

WP 13-07R

Robert L. Hetzel
Federal Reserve Bank of Richmond

THE FEDERAL RESERVE BANK OF RICHMOND
RICHMOND ▪ BALTIMORE ▪ CHARLOTTE

Can Monetarists Explain Recession in the Eurozone?

Robert L. Hetzel

Federal Reserve Bank of Richmond

robert.hetzel@rich.frb.org

August 14, 2015

Working Paper No. 13-07R

Abstract: Since 2008, the Eurozone has undergone two recessions, which together constitute the "Great Recession." During this Great Recession, monetary policy displayed the hallmarks criticized by monetarists. As a consequence of concern for high inflation, the central bank put inertia into downward movements in its policy rate while the economy weakened, and money growth declined. The Great Recession is one observation supporting the monetarist hypothesis that contractionary monetary policy is a necessary condition for a severe recession.

JEL: E52 and E58

The author is senior economist and research advisor at the Federal Reserve Bank of Richmond. He gratefully acknowledges helpful criticism from Ernst Baltensperger, Mark Bills, Yongsung Chang, Douglas Diamond, Michael Dotsey, Marvin Goodfriend, Joshua Hendrickson, Andreas Hornstein, Peter Ireland, Thomas Lubik, Christian Matthes, Alberto Musso, Edward Nelson, Andrew Owen, Ricardo Reis, Kurt Schuler, Felipe Schwartzman, Peter Welz, and Alexander Wolman, as well as participants in seminars at the Bundesbank, European Central Bank, Swiss National Bank, and the Banca D'Italia without implicating any of these individuals in the exposition. Miki Doan, Samuel Marshall, Raymond Wong, and Steven Sabol provided invaluable research assistance. The views in this paper are the author's not the Federal Reserve Bank of Richmond's or the Federal Reserve System's.

Macroeconomics is an exercise in using models to disentangle causation from correlation. Typically, popular explanations of recession have highlighted the correlation in boom periods between the optimism about the future of households and the accumulation of debt followed in bust periods with the correlation between pessimism and debt deleveraging. Correlation becomes causation as a consequence of animal spirits that produce a shift in sentiment that turns a collapse in speculative excess into a scramble for liquidity. In contrast, the monetarist view highlighted the correlation between nominal and real disorder. Friedman and Schwartz (1963a) used historical narrative in order to highlight monetary disorder produced by forces adventitious to the working of the price system as the determinants of nominal disorder. The corollary of the monetary-disorder hypothesis as the cause of economic instability is that the price system works well to mitigate economic fluctuations provided the central bank implements a monetary rule that does not interfere in its operation.

Section 1 reviews the empirical regularities emphasized by monetarists and investigates their applicability to the recent Eurozone Great Recession. Section 2 provides an overview of the empirical regularities that characterized the monetary policy of the ECB's predecessor the Bundesbank following the post-1980s disinflation period. One of the defining characteristics of the earlier 1970s stop-go era was the effort by central banks to exploit a Phillips-curve trade-off by imparting inertia to changes in the policy rate relative to cyclical changes in the economy. The overview here represents such attempts as departures from the benchmark "lean-against-the-wind" procedures used by the Bundesbank and other central banks after the end of the stop-go era.

Section 3 exposits the Aoki (2001) version of the New Keynesian model with a flexible-price and sticky-price sector. In the nonactivist or "divine-coincidence" formulation, the central bank should maintain price stability and let the price system keep the output gap at zero. It corresponds to the monetarist policy prescription that the central bank should follow a rule that provides for a stable nominal anchor and lets the price system determine real variables. In the activist formulation, which emphasizes cost-push or markup shocks, the central bank can improve on economic outcomes by taking advantage of Phillips curve trade-offs.

Section 4 provides a narrative overview of the Great Recession in the Eurozone. It highlights how the European Central Bank (ECB) attempted to lower headline inflation by creating a negative output gap. Section 5 investigates the importance of financial disturbances as opposed monetary disturbances. Section 6 infers the existence of a negative monetary shock from the decline in trend inflation and asks whether a shock of that magnitude can plausibly have caused the Great Recession.

1. Monetarist markers of contractionary monetary policy

Milton Friedman and Anna Schwartz (1963b) highlighted the antecedence of cyclical peaks in money growth relative to cyclical peaks in output. Friedman and Meiselman (1963) then attacked the Keynesian model by arguing that money did a superior job of predicting output than did various measures of exogenous expenditures. Monetarist influence reached its peak in the 1970s stop-go era when the cyclical behavior of money growth superimposed on a rising trend predicted cyclical fluctuations in the economy and rising trend inflation. In the 1970s, monetarist narrative emphasized the cyclical inertia in the adjustment of the funds rate.[1]

[1] See Poole (1978, 105). Friedman (1984, 27) wrote: "Rising concern about inflation, and growing recognition of the role played by monetary growth in producing inflation, led Congress in 1975 to require the Federal Reserve to specify targets for monetary growth…. In practice, it continued to

After cyclical troughs and during economic recovery, the Federal Reserve postponed raising the funds rate in order to speed the decline in the magnitude of the negative output gap. Analogously, the Fed was slow to lower the funds rate as the economy weakened prior to and after cyclical peaks in order to create a negative output gap that would lower inflation. In the post-World War II period, an empirical regularity of monetary policy is that when the Fed became concerned with inflation, it raised the funds rate persistently and then maintained it at a cyclically high level while the economy weakened. Although the Fed avoided the language of trade-offs, it was attempting to exploit a Phillips curve relationship (Hetzel 2008, chs. 23-25; 2012, ch. 8).

The empirical regularities highlighted by monetarists reappear in the Eurozone Great Recession. Figure 1 shows cyclical peaks in 2008Q1 and 2011Q1 for real GDP and real final sales to domestic purchasers. Figure 2 shows real counterparts for the ECB policy rate, the main refinancing operations (MRO) rate, and the one-year Euribor rate constructed using forecasted inflation from the ECB's Survey of Professional Forecasters. With each recession, the real interest rate declines significantly only well after the cyclical peak. As shown in Figure 3, which plots nominal GDP growth and M1 growth lagged four quarters, in each recession, the monetary deceleration that accompanied this downward rate inertia predicted the decline in nominal GDP growth. In the way documented by Meltzer (2009) and Romer and Romer (1989) for the United States, these episodes corresponded to attempts by the ECB to lower inflation.

A central part of the monetarist identification of empirical regularizes is a characterization of the central bank's policy rule that associates cyclical interest rate inertia with attempts to exploit a Phillips curve trade off. This task is complicated by two factors. First, central banks have traditionally used the language of discretion rather than rules. As a result, it is necessary for the economist to generalize about their behavior. Second, understandably, economists search for econometric shortcuts. That search appears most noticeably in the empirical Taylor rule literature.

Estimated Taylor rules are reduced forms and as such elements of central bank decision making show through. First-difference, inertial Taylor rules are especially useful (Orphanides and Williams 2002). They capture the constraint placed on policy makers from lack knowledge of the output gap and the natural real rate of interest. In a lean-against-the-wind fashion, policy makers move the policy rate away from its prevailing value based on sustained rates of change in rates of resource utilization that indicate persistent output growth above or below trend.

What is problematic is the use of realized inflation in Taylor rules. That creates the impression that central banks manipulate an output gap in order to eliminate misses in their inflation target. However, in the post-disinflation period in the 1980s, central banks moved away from those procedures. Instead they adopted rule-like behavior that created the expectation of nominal stability. That expectation conditioned the price-setting of firms setting nominal prices for multiple periods. The central bank could then move the policy rate in a lean-against-the-wind fashion that tracked the

---

target interest rates, specifically the federal funds rate, rather than monetary aggregates, and *continued to adjust its interest rate targets only slowly and belatedly* to changing market pressure. The result was that the monetary aggregates tended on average to rise excessively, contributing to inflation. However, *from time to time, the Fed was too slow in lowering rather than raising the federal funds rate*. The results were a sharp deceleration in the monetary aggregates and an economic recession." (italics added)

natural rate of interest (Hetzel 2008, Chs. 13-15, 21). The following section illustrates these procedures for the ECB's predecessor the Bundesbank.

2. The anti-Phillips curve policy of the Bundesbank

In the post-World War II period, many countries experimented with aggregate-demand policies designed to engineer low, stable unemployment. Based on period-by-period discretion, policy makers attempted to trade off achievement of low unemployment against the cost predicted from a Phillips curve relationship (Hetzel 2008, 2013a and 2013b). The repeated failures of those policies produced a sea change in policy. In the 1980s, central banks adopted rules that abandoned attempts to exploit Phillips curve trade-offs and instead allowed the price system to work unhindered to cause the interest-rate target to track the natural rate of interest.[2]

Like other central banks, in response to the inflation of the 1970s, the Bundesbank made price stability its central objective and rejected manipulation of an output gap in order to achieve it. After floating the Mark upon leaving the Bretton Woods system in March 1973, the Bundesbank adopted a target for "central bank money" (akin to the monetary base). However, the governments of Chancellors Brandt and Schmidt favored a policy of full employment. During the 1970s, the Bundesbank engaged in a "dirty float" in which it resisted appreciation of the mark against the dollar through lowering interest rates (von Hagen 1999).

The creation of the European Monetary System (EMS) of fixed exchange rates in March 1979 with the prospect it carried for lowering interest rates in order to defend the exchange rate against the mark of weaker currencies like the French franc consolidated opinion within the Bundesbank in favor of a policy of price stability organized around money targets. The Bundesbank then emerged as the dominant central bank in the EMS with the mark as the anchor currency (von Hagen 1999, Hetzel 2002). The initiation of money targets as a device for signaling the Bundesbank's commitment to price stability began with the reduction in the announced money range in 1979 (Baltensperger 1999).[3]

In the 1980s, the Bundesbank derived its money targets using the equation of exchange. Critically, it used as a measure for output growth an estimate of potential growth taken to be 2 percent. In 1985, it combined that measure with a low value of its inflation target intended to approximate price stability. When combined, these two measures expressed "the estimated growth of potential output in nominal terms" (Baltensperger 1999, 458).[4] The Bundesbank made credible its intention to achieve price stability through signaling its commitment to make aggregate nominal expenditure grow in line with potential output.

---

[2] On the move to rule-based policies designed to shape inflationary expectations in contrast to the earlier policies based on exploiting Phillips-curve trade-offs, see Hetzel (1986, 2008a, 2008b, 2012a), Goodfriend (2004), and Goodfriend and King (2005).

[3] Unlike the ECB in 2008, the Bundesbank in the 1980s and 1990s never experienced a persistent inflation shock that raised headline inflation above core inflation. It never had to decide between targeting core and headline inflation.

[4] Neumann (1997, 178) wrote, "[T]he target rate of monetary expansion is based on the Bundesbank's expectations about the rate of change of normal output and the trend rate of change in velocity rather than on the expected actual changes of output and velocity."

The Bundesbank never adopted the reserves/money multiplier targeting procedures recommended by monetarists. The money targets were never operational intermediate targets chosen to achieve the inflation objective, set at 2% starting in 1986. The Bundesbank established wide bands (3 percentage points) for its money targets and in practice missed its them as often as it achieved them.[5] Nevertheless, the money targets rendered the inflation target credible through the seriousness with which the Bundesbank explained misses.[6]

The Bundesbank controlled the rate on repurchase agreements encased in a corridor. The upper limit was the Lombard rate, which allowed for bank borrowing in the event of financial stringency. The lower limit was the discount rate, which allowed for short-term, rationed borrowing. The Bundesbank "steered" the market's expectation of the persistence of the short-term rate through accompanying changes in the repurchase rate with changes in the Lombard and discount rates and through the maturity of the repurchase agreements it entered.

The money targets communicated the commitment to follow a rule that stabilized inflation and, as a result, provided a nominal anchor through the way in which they tied down the expectation of inflation.[7] In the context of nominal expectational stability, the Bundesbank moved its rate target in order to counter unsustainable weakness and strength in the economy.[8] Baltensperger (1999, 455 and 461) provided an example of the LAW character of policy:

> [I]n the course of 1982 the German economy suffered … a further cyclical setback…. Real GDP contracted by 0.9 percent in 1982, employment fell, and the unemployment rate rose to 6.7 per cent…. [T]he Bundesbank oriented its monetary policy … towards bolstering economic recovery, cutting interest rates repeatedly in 1982 and at the start of 1983…. [I]n 1983 M_I expanded by 8 per cent [above the targeted range of 4% to 7%].

In sum, the Bundesbank followed a policy of controlling trend inflation through the creation of the expectation of nominal stability while allowing market forces to determine the real interest rate.

3. The NK model and divine coincidence

The NK model exposited below follows Aoki (2001) with flexible-price and sticky-price sectors but with the addition of a "cost-push" shock to the Phillips curve as in Clarida, Gali, and

---

[5] Neumann (1997, 186) found "that the midpoint [money] target range has no predictive value for actual money growth…."

[6] "[T]he announcement of the monetary target … anchors their [economic agents] expectations. For the central bank, this at the same time implies a binding commitment and an obligation to justify any failure to meet the target" (Baltensperger 1999, 452). See also Beyer et al (2013, 320) and Schlesinger (2002).

[7] See also Neumann (1997, 197).

[8] That is, the Bundesbank ignored estimates of output gaps but moved its rate target in response to growth gaps. Beyer et al (2013, 335) wrote, "[T]he response to the perceived output gap … is close to zero and insignificant under monetary targeting…. [T]he coefficient on the output growth gap … becomes highly significant."

Gertler (1999). There is a single flexible-price good and a continuum of differentiated goods in the sticky-price sector. Household i maximizes (1).

(1) $E_0 \sum_{t=0}^{\infty} \beta^t [u(B_{i,t} C_t^i) - v(A_{i,t} y_t^i)]$

where u expresses the utility from consumption and v expresses the disutility from the household production of the good y_t^i with β the rate of time preference. The B and A are shocks. C_t^i aggregates the household's purchases of the flexible-price good and the differentiated goods with the latter aggregated into an index number. The household's optimal consumption (Euler equation) must satisfy (2).

(2) $$\frac{B_t u'(B_t C_t)}{P_t} = \Lambda_t$$

where P_t is the aggregate price level, which in turn is an average of the price level in the flexible-price and sticky-price sectors. Λ_t is the marginal utility of nominal income.

It also follows that

(3) $\Lambda_t = \beta R_t (E_t \Lambda_{t+1})$

where R_t is the gross nominal interest rate. The aggregate-demand relationship (4) comes from log-linearizing (2) and (3) around the steady state with price stability.[9] The real rate of interest is $\hat{r}_t \equiv R_t - E_t \hat{\Pi}_{t+1}$. $\hat{\Pi}_{t+1}$ is inflation between periods t and t+1. Aggregate output is $\hat{Y}_t$. (The circumflex indicates the percentage deviation from the steady-state value.) The household's intertemporal elasticity of substitution in consumption is σ.

(4) $$\hat{r}_t = \frac{1}{\sigma}\left(E_t \hat{Y}_{t+1} - \hat{Y}_t \right) + \left(E_t \hat{B}_{t+1} - \hat{B}_t \right)$$

Comparable to (4), there is a relationship (5) between the natural rate of interest ($\hat{r}_t^n$) and the natural rate of output ($\hat{Y}_t^n$) where these variables are defined as the values that would occur with complete price flexibility.

(5) $$\hat{r}_t^n = \frac{1}{\sigma}\left(E_t \hat{Y}_{t+1}^n - \hat{Y}_t^n \right) + \left(E_t \hat{B}_{t+1} - \hat{B}_t \right)$$

Using these two relationships, as shown in (6), there is a relationship between the real rate of interest and the natural rate of interest. It depends upon the aggregate output gap ($\hat{G}_t$), which is a weighted-average of the output gaps in the sticky-price and flexible-price sectors with the weights coming from the weights in the consumption aggregator of flexible-price and sticky-price goods. $\hat{Y}_{S,t}^n$ and $\hat{Y}_{F,t}^n$ are the natural rates of output in the sticky-price and flexible-price sectors, respectively. γ assigns relative weights to the sticky-price and flexible-price goods in the consumption aggregator.

---

[9] The more common form of (4) is $\hat{Y}_t = E_t \hat{Y}_{t+1} - \sigma \left[\hat{r}_t - (E_t \hat{B}_{t+1} - \hat{B}_t) \right]$.

$$(6)\quad \hat{r}_t = \hat{r}_t^n + \frac{1}{\sigma}\left(E_t \hat{G}_{t+1} - \hat{G}_t \right)$$

$$(7)\quad \hat{G}_t \equiv \gamma(\hat{Y}_t - \hat{Y}_{S,t}^n) + (1-\gamma)(\hat{Y}_t - \hat{Y}_{F,t}^n)$$

Equation (8) is the NK Phillips curve. The κ_1 and κ_2 constants summarize preference parameters and the degree-of-price-stickiness parameter. The variable $\hat{x}_{F,t}$ is the relative price of the good in the sticky-price sector in terms of the good in the flexible-price sector. As in Clarida, Gali, and Gertler (1999), (8) adds a markup shock (μ_t). $\hat{\Pi}_{S,t}$ is inflation in the sticky-price sector.

$$(8)\quad \hat{\Pi}_{S,t} = \kappa_1(\hat{Y}_t - \hat{Y}_{S,t}^n) + \beta E_t \hat{\Pi}_{S,t+1} + \frac{1-\gamma}{\gamma}\kappa_2 \hat{x}_{F,t} + \mu_t$$

Equation (8) can also be written as (9).

$$(9)\quad \hat{\Pi}_{S,t} = \frac{1}{\gamma}\kappa_1 \hat{G}_t + \beta E_t \hat{\Pi}_{S,t+1} + \mu_t$$

The Phillips curves (8) and (9) are derived under the assumption that the central bank has an inflation target of zero. Inflation then measures deviations from price stability. The μ_t arise out of changes in the extent of monopoly power (the markup) of firms in the sticky-price sector. These markup shocks affect the monopoly power of firms without affecting real marginal cost (Blanchard and Gali 2007, 39; Woodford 2003, 451-2). They do not reflect inflation shocks coming from the flexible-price sector.

As illustrated by (9), in the absence of markup shocks, if the central bank maintains price stability in the sticky-price sector so that $\hat{\Pi}_{S,t} = E_t \hat{\Pi}_{S,t+1} = 0$, it also maintains the aggregate output gap ($\hat{G}_t$) equal to zero. Blanchard and Gali (2007) characterized this combination of price stability and a zero aggregate output gap as "divine coincidence," a model characteristic first noted in Goodfriend and King (1997). Equation (10) is a monetary policy rule that produces this result.[10]

$$(10)\quad \hat{R}_t = \hat{r}_t^n + \alpha_t \hat{\Pi}_{S,t}$$

The rule (11), which includes (10) as a special case, introduces the term $\alpha(\hat{\Pi}_{S,t} - \hat{\Pi}_{S,t}^{nz})$ as a way of marking departures of the policy rule from the divine-coincidence benchmark (10). With (11), the central bank moves its inflation target ($\hat{\Pi}_{S,t}^{nz}$) in order to counter markup shocks.

$$(11)\quad \hat{R}_t = \hat{r}_t^n + \alpha(\hat{\Pi}_{S,t} - \hat{\Pi}_{S,t}^{nz})$$

[10] $R_t = \psi \pi_t$ with $\psi > 0$ is a rule that also achieves the divine-coincidence result. Divine coincidence is an expression of the monetarist hypothesis that if the central bank maintains monetary (nominal) stability the price system will work well to ameliorate cyclical fluctuations (Friedman 1960).

Blanchard and Gali (2007) examined the implications of the NK model for policy. The elimination of price stickiness and firm monopoly power provides a norm for the "welfare-maximizing" level of output. There is also a lower level of output assuming "price-flexibility-only" that eliminates just the friction of price stickiness and yields a lower level of welfare. Shocks that shift both the "welfare-maximizing" and the "price-flexibility-only" level of output equally leave (10) as the optimal policy rule, which implements divine coincidence by stabilizing the price level in the sticky-price sector. With shocks to tastes and technology, the central bank should stick with this baseline rule that keeps the aggregate output gap equal to zero by maintaining price stability in the sticky-price sector.

In principle, a positive markup shock offers an opportunity for the central bank to intervene in the operation of the real economy by raising inflation. By expanding the wedge between price and marginal cost for firms with monopoly power, the increase in monopoly power retracts the price-flexibility-only level of output without affecting the welfare-maximizing level of output. A policy of maintaining price stability is suboptimal in that it requires the central bank to create a negative output gap. In principle, the central bank can produce an optimal amount of inflation and output variability by exploiting a Phillips-curve trade-off.

Equation (12) adds a money demand function.

$$(12) \quad m_t - p_t = y_t - \eta\, i_t$$

The log of nominal money is m_t, the log of the price level is p_t, and the semi-elasticity of money demand with respect to the interest rate is η.

In order to prevent changes in the price level, the central bank must follow a rule that causes nominal money, m_t, to grow in line with real money demand, $y_t - \eta\, i_t$. The divine-coincidence characteristic of the NK model elucidates that rule. With an interest rate target, nominal money is demand determined. The rule (10) disciplines that nominal demand to equal $\hat{Y}_t^n - \eta\, r_t^n$.[11] In a world of stable money demand, monetarists argued that sustained monetary decelerations or accelerations arise out of a monetary policy based on the rule (11) when the rule (10) is appropriate. Money then is an independent source of disturbance to the economy.

The NK model explains how central banks controlled inflation after the disinflations of the early 1980s without recourse to Phillips curve trade-offs instead relying on the way in which rules shape the behavior of forward-looking agents. In the 1980s, central banks moved to the control of trend inflation through creation of an environment of nominal expectational stability that conditioned the way in which firms set prices for multiple periods. They conditioned that price setting through aligning the expectation of inflation of firms in the sticky-price sector with their inflation target.

[11] Friedman (1960) formulated his k-percent rule for low, stable money growth at a time when there existed a monetary aggregate stably related to nominal output and when potential output grew steadily. In this world of stable velocity (stable real money demand and low interest-inelasticity of real money demand), the monetarist hypothesis was that a k-percent rule would implement divine coincidence by both keeping real variables at their natural values and providing for price stability.

4. Using the NK model to organize a narrative account of the Great Recession

The narrative applies the model implications from Aoki (2001, 75):

> [S]uppose there is an increase in the price of food and energy … putting an upward pressure on aggregate inflation…. The central bank could respond with a sharp contractionary policy and reduce aggregate demand by a large amount so as to decrease prices in the sticky-price sector…. However, our model shows that such a policy is not optimal. The optimal policy is to stabilize core inflation.

Based on this normative prescription, the narrative account identifies monetary policy in 2008 and again 2011 with departures from the baseline rule (10) that implements divine coincidence in the absence of markup shocks in favor of (11) that manipulates an output gap.

With the baseline rule, the central bank moves its policy rate in a way that causes the real rate to track the natural rate. Substitution of (2) into (1) in order to eliminate ρ yields (13).

$$(13) \quad r_t - r_t^n = \sigma^{-1}\left(E_t \tilde{y}_{t+1} - \tilde{y}_t \right)$$

A requirement for keeping the real rate equal to the natural rate is to move the policy rate in a consistent way that maintains the output gap equal to zero. In the absence of knowledge of the output gap, central banks move their policy rate away from its prevailing value in an intuitive way that offsets sustained changes in rates of resource utilization. Hetzel (2008a, Ch. 13-15 and 21; and 2008b) called these procedures "lean-against-the-wind (LAW) with credibility." Credibility requires that markets believe that the central bank will move its policy rate ultimately by whatever amount necessary in order to keep inflation equal to target. As noted in section 1, monetarists identify departures from the baseline LAW rule with inertia in reductions in the policy rate as the economy weakens and conversely for strength in the economy.

Until 2008, the monetary policy of the ECB, like the Bundesbank earlier, followed the spirit of (10) as captured by LAW with credibility. Figure 4 plots changes in the ECB's MRO (main-refinancing-operations) rate as a bar chart. As a measure of economic activity, it plots the growth rate in real retail sales.[12] The two periods of increases in the MRO rate (2/2000 to 10/2000 and 12/2005 to 6/2007) correspond to growth measured by retail sales strong enough to lower the unemployment rate (Figure 5). The two periods of decreases in the MRO rate (5/2001 to 11/2001 and 12/2002 and 6/2003) correspond to growth weak enough to raise the unemployment rate.

Figure 6 shows Eurozone inflation and the ECB's policy rate. Consistent with the last observation in footnote 5, for most of the decade until fall 2008, there is little relationship between the two series. Aastrup and Jensen (2010) offered econometric support for the characterization of ECB procedures until the Great Recession as LAW with credibility:

> We show that the ECB's interest rate changes during 1999-2010 have been mainly driven by changes in economic activity in the Euro area. Changes in actual or expected future HICP inflation play a minor, if any, role.

[12] Use of either the Markit purchasing manager's index (PMI) or industrial production as measures of economic activity yields similar graphs.

Because of the ECB's credibility, expected inflation remained close to the objective of 2% or somewhat less until declining in 2014 (Figure 7). As of 2007 and 2008, core inflation was at target (Figure 8).

As shown in Figure 9, which graphs the Euro price of oil and the CRB Commodity Spot Price Index, commodity prices increased significantly over the interval from late 2003 to mid-2008.[13] Starting in 2007, this commodity price inflation passed into headline inflation (Figure 8).[14] The commodity-price shock that affected the euro-area economy in 2007 and 2008 was an adverse terms-of-trade shock that acted like a negative technology shock. As Blanchard and Gali (2007, 36) noted, "The effects of changes in factors such as the price of oil or the level of technology appear through their effects on natural output" $[y_t^n]$.

The jump in commodity price inflation reduced household real income. Figure 10 shows the cessation in 2007Q2 of the prior steady increase in real disposable income. Growth in real consumption declined after 2007Q3.[15] The smoothed, year-over-year percentage change in real retail sales was 2.5% in April 2007 (Figure 4). It then declined steadily, became negative in April 2008, and was -1.6 in August 2008. Consumer confidence (Economic Sentiment Indicator) peaked in May 2007 and then fell rapidly.[16] The resulting pessimism of households about their future income prospects required a lower real interest rate.[17] Despite a weakening economy after mid-2007, the ECB failed to lower its policy rate (Figure 4). Instead, in July 2008, it raised the MRO rate from 4.0% to 4.25%.

Moreover, the ECB's communications caused markets to anticipate increases in rates. Figure 11, which plots the difference between 12-month and 1-month Euribor rates, shows that from

---

[13] In early 2004, the euro price of a barrel of oil was €25 per barrel. The price rose to €85 per barrel in June 2008. The growth of emerging-market economies, especially, China, India, and Brazil accounted for the increase in the relative price of commodities. For example, in 2000, China accounted for 12% of global consumption of copper. In 2012, the number had grown to 42% (*Financial Times*, 6/3/13).

[14] Initially, the commodity-price shock did not pass through to headline inflation. One explanation is an offsetting negative inflation shock in the form of an appreciation of the euro. From 2002 until mid-2008, the euro appreciated from less than .9 dollars/euro to almost 1.6 dollars/euro.

[15] Over the interval 2004Q4 through 2007Q3, real personal consumption expenditures (PCE) grew at an annualized rate of 2%. Annualized real PCE growth then declined as follows: 1.4% (2007Q4), .2% (2008Q1), -.3% (2008Q2), and -1.2% (2008Q3).

[16] Data from Economic and Financial Affairs page of the European Commission website.

[17] The shock was not a one-time, discrete retraction of the welfare-maximizing and the price-flexibility-only level of output. The negative shocks to households' real income were sustained over time. Households believed that their situation would continue to deteriorate. Although not incorporated into the model, it is plausible to conjecture that the tail risk of a disastrous outcome due to the possible breakup of the Eurozone in 2011 and 2012 exacerbated pessimism about future growth. For a discussion of how disaster risk can lower the natural rate of interest, see Rietz (1988).

the beginning of 2008 until fall 2008 markets expected a significant increase in rates.[18] In terms of the model, the ECB shifted upward the level of the term structure of interest rates. The ECB lowered rates only when headline inflation fell (Figure 6). The decline in 2009 in both core inflation and in real output with the latter accompanied by an increase in the unemployment rate is consistent with contractionary monetary policy (Figures 1, 5, and 8).

The ECB explained its actions by a concern that high headline inflation would exacerbate wage demands of French and German unions.[19] Wage inflation (year-over-year in the business sector) had increased from 3% over the interval 2003Q1 through 2006Q1 to 5.1% in 2008Q1. In terms of the model, one can interpret ECB actions as reflecting the belief that a positive mark-up shock would increase inflation in the sticky-price sector. The ECB then created a negative output gap in the sticky-price sector in order to control headline inflation. A positive analysis of the cause of the Great Recession highlights the inertia in the policy rate relative to the decline in economic activity when a persistent commodity-price shock required a lower real rate.

When the world economy began to recover in mid-2009, commodity-price inflation rose once more and again raised headline inflation (Figures 8 and 9). Turmoil in the Middle East starting in early 2011 also caused oil prices to rise. CPI inflation, which had fallen to -.5% in 2009, rose to 3% by end-2011. Core inflation also rose but remained below the ECB's 2% target (Figure 8). The second commodity-price shock intensified the ongoing decline in real disposable income after 2010Q4. Consumption, which had been recovering slowly, again began to decline after 2010Q4 (Figure 10). Real retail sales peaked in September 2010 (Figure 4). Growth in real GDP peaked in 2011Q1 (Figure 1). The growth rate of real aggregate demand (final sales to domestic purchasers) similarly began falling after 2011Q1 (Figure 1).[20] As in 2008, focused on rising headline inflation, the ECB raised its policy rate twice in 2011, from 1% to 1.25% in April and to 1.5% in July.

The monetary-contraction explanation of the Great Recession has the advantage of simplicity in that it offers a common explanation of each recession of the Great Recession. First, monetary contraction is consistent with the observed decline in core inflation and in output in both recessions.[21] Second, the ECB responded to the commodity-price shock in the same way in each recession.

---

[18] The policy rate R_t in the model should be thought of as the level of the term structure of interest rates, which depends upon the MRO rate and the ECB's communication about its future path. Plausibly, a rate difference between 25 and 50 basis points represents a liquidity premium.

[19] See *Financial Times* (6/5/13, 8). Lucas Papademos (2013, 510), vice president of the ECB, explained, "For more than a year after the outbreak of the global financial crisis, the ECB did not ease monetary policy, as determined by its key interest rates, mainly because it was concerned about the materialization of second-round effects of supply shocks on wage- and price-setting and the potential unanchoring of inflation expectations." The ECB (European Central Bank July 2008, 6) noted at the time: "This worrying level of inflation rates results largely from sharp increases in energy and food prices at the global level…. There is a …very strong concern that price and wage-setting behaviour could add to inflationary pressures via broadly based second-round effects."

[20] From 2010Q2 through 2011Q1, real final sales to domestic purchasers grew at an annualized rate of 2.3%. In 2011Q2, growth fell to -.9%.

[21] Fève et al (2010, 200) "find that in the immediate aftermath of a disinflation shock, the euro area enters in a persistent recession."

Moreover, repeated monetary contraction can explain why in contrast to past experience a strong recovery did not follow a deep recession.

As noted in Section 1, if the central bank follows a rule intended to implement the divine-coincidence outcome, given its interest rate target, the real quantity of money demanded causes nominal money to grow at a rate consistent with price stability. In this environment, money offers no information about the evolution of the economy. However, if the central bank creates a difference between the natural and real rates of interest, the behavior of money becomes informative.

The monetary aggregate M1offers a better measure of transactions demand than M3, which includes a significant amount of debt instruments.[22] Banks issue debt to finance loan growth when loan demand is high. As shown in Figure 12, apart from 2002-2003 and 2012-2013 when banks made up for weak loan demand by holding more government securities, M3 growth and loan growth moved together. For this reason, it is hard to disentangle causation between growth in M3 and in the economy. M3 is a contemporaneous indicator of the economy.

M1 growth slowed starting in mid-2006 and slowed sharply starting at the end of 2007 (Figure 13).[23] Real GDP growth declined from an annualized rate of 2.2% in 2008Q1 to -1.5% in 2008Q2. After falling to near zero in 2008Q3, M1 growth revived. Real GDP growth reached a trough in 2009Q1 with annualized growth of -10.8%. M1 growth fell sharply starting in 2010Q3. Real GDP growth declined from an annualized growth rate of 2.9% in 2011Q1 to -1.2% in 2011Q4.

Unfortunately, the signal to noise ratio is low for the monetary aggregates. In a time of financial turmoil when market participants desire liquidity, they transfer out of the illiquid debt instruments in the non-M1 part of M3 into the liquid demand deposits of M1. From fall 2008 through 2009, investors transferred out of illiquid deposits and debt instruments into demand deposits and inflated M1 without any implications for the stance of monetary policy. One is on firmer ground using M1 growth as a measure of the stance of monetary policy in the first half of 2008 when growth in M1 and M3 both declined and after May 2010 through early 2012 when M1 growth declined while M3 growth remained low (Figure 13).

---

[22] M1 includes currency in circulation and overnight deposits. M3 includes M1 plus time deposits with maturity up to 2 years, deposits redeemable given notification up to 3 months, repurchase agreements, money market fund shares, and debt instruments with maturity up to 2 years. Interpretation of the moderate revival of M3 growth after mid-2014 (Figure 12) illustrates the difficulties in using money as an indicator. Increased growth derived primarily from MFI (monetary financial institutions) accumulation of net external assets, which originated in the increase in the Eurozone's current account surplus. Continued weak loan demand causes MFIs to offer low rates on their debt instruments and encourages investors to hold funds in M1 thereby boosting M1 growth.

[23] In May 2003, the ECB demoted the behavior of money (M3) to a "cross-check" from one of its two "pillars," the other pillar being the behavior of the economy (Deutsche Bank 2013). For example, the *Editorial* in the July 2010 ECB *Monthly Bulletin* (European Central Bank 2010, 6) noted, "[T]he annual growth rate of M3 was unchanged at -.2% in May 2010…. [T]hese data continue to support the assessment that the underlying pace of monetary expansion is moderate and that inflationary pressures over the medium term are contained." The ECB Governing Council left its policy rate unchanged.

5. The interaction of financial crisis and contractionary monetary policy

The monetary-contraction explanation of the Great Recession does not raise problems presented by explanations based on the collapse of speculative-excess. Figure 14 shows real house prices for a number of countries. Nothing in the series suggests speculative excess for the Eurozone as a whole. The most commonly expressed explanation for the Great Recession centers on a collapse of speculative excess in the peripheral countries. Constâncio (2014, 251) pointed to "imbalances [that] originated mostly from rising private sector expenditures, which were in turn financed by the banking sectors…." For the Eurozone, government debt as a percent of GDP declined from 81% in 2005 to 74% in early 2008. As elaborated by Honkapohja (2014, 261-2), "The emergence of a boom-bust cycle" resulted from "the disappearance of interest rate differentials between members of the euro area," which resulted in the "mispricing of risk that characterized the years leading to the financial crisis—a bubble not unlike the subprime bubble…. [T]he convergence of interest rates to low levels provided incentives for countries and private agents in the GIIPS countries to borrow a lot."[24] This explanation suggests both that the initial decline in output should have started in the peripheral countries (the GIIPS) and spread subsequently to the core countries and that the decline in output should have been significantly more pronounced in the GIIPS. As shown in Figure 15, growth in real GDP did decline somewhat faster in the GIIPS than in the core countries, but until late 2009 the behavior of output was quite similar in the two sets of countries.[25]

Any of three financial shocks could have disrupted intermediation throughout the Eurozone. First, in August 2007, cash investors ceased buying the commercial paper issued by banks to finance the holding of subprime mortgages in off-balance-sheet entities called structured investment vehicles or SIVs (Hetzel 2012a, 179). European banks held many of these mortgages (Hetzel 2012a, 242). Uncertainty over the extent to which individual European banks held such mortgages lessened the willingness of European banks to lend to each other in the interbank market. Instead of relying on interbank loans to meet liquidity needs, European banks began to hold additional excess reserves (Heider et al 2009). The ECB accommodated that increased demand. The Eonia rate (the euro equivalent of the funds rate) remained fixed at the ECB's MRO rate. Through its swap lines, the Fed provided the dollars to the ECB that it relent to European banks to replace the dollar funding no longer supplied by money market mutual funds (Hetzel 2012a, 244 and 267). In short, the ECB and the Federal Reserve made certain that funding pressures on European banks did not affect their intermediation function.

Second, the Lehman Brothers bankruptcy on September 15, 2008, precipitated a run of cash investors who ceased funding financial institutions with long-term, illiquid mortgage assets (Hetzel 2012a, Ch. 13). They transferred their funds to the too-big-to-fail banks, conservatively managed institutions, and government debt. The underlying shock was a retraction of the financial safety net to a new, more limited but ambiguous line. However, the euro area economy had already entered into recession by then with real GDP falling at annualized rates of -1.5% and -2.4% in 2008Q2 and 2008Q3, respectively. Industrial production including construction peaked in February 2008.

Loan growth remained healthy until the economy entered recession. Loans to the private sector from banks (MFIs) averaged 10.7% year-over-year from May 2006 through May 2008 (Figure

[24] GIIPS refers to Greece, Ireland, Italy, Portugal and Spain. Vitor Constâncio was vice president of the ECB. Seppo Honkapohja was a member of the Board of the Bank of Finland.

[25] The core countries are Austria, Belgium, Finland, France, Germany, and the Netherlands.

12). Only in June 2008, did loan growth begin to fall below 10%.[26] Similarly, after the recovery took hold in 2009Q3, loan growth recovered steadily until peaking in 2011Q3 and then declined. In contrast, the recovery in domestic demand aborted earlier. Growth in real final sales to domestic purchasers fell from 2.3% over the 2010Q2 to 2011Q1 interval to -.9% in 2011Q2. The ECB provided funding to banks experiencing funding difficulties. On October 8, 2008, the Governing Council announced a policy of "full allotment" in which banks could borrow whatever amount they desired at the interest rate on MROs. Longer-term loans became the norm.[27]

Third, from mid-summer 2011 to mid-summer 2012, investors fled the sovereign debt markets of the peripheral countries, most noticeably, Italy and Spain out of fear that they would exit the Eurozone. Attribution of the renewal of recession to this debt crisis, however, conflicts with the timing of events. Sovereign credit default swap spreads for Italy and Spain started their climb to alarming levels in mid-2011. In early July 2011, the spread of two-year yields on Italian over German debt climbed above 2% and reached 7% in late November 2011. However, the Eurozone economy had already begun to weaken after 2011Q1. The timing suggests causation going from the economic weakness to a debt crisis rather than the other way around.[28]

6. The quantitative impact of a monetary shock

Even if one believes that contractionary monetary policy contributed to the Great Recession, there remains the issue of the magnitude of that contribution. In general, estimated DSGE models can fit the data. For example, the Federal Reserve Bank of New York (FRBNY) DSGE model explains the Great Recession in the United States as caused by financial shocks represented by the spread between the Baa corporate bond and 10-year Treasury yield. Those shocks interact with financial frictions and sticky prices and wages to produce recession. As pointed out by Chari, Kehoe,

---

[26] In an environment of contemporaneously weakening economic activity and falling loan demand, it is hard to disentangle the causal impact on bank lending due to tightening lending standards. The July 2008 "Euro Area Bank Lending Survey" (European Central Bank 2008) reported:

> The most important factor in the net tightening continued to be a deterioration in expectations about the economic outlook…. Banks reported that net demand for loans to enterprises and households continued to be negative in the second quarter of 2008.

[27] De Andoain et al (2014) documented instances of "fragmentation," that is, episodes in which banks in some Eurozone countries paid a premium to borrow in the interbank market. The most significant occurred at yearend 2011 before the introduction of the LTRO (long-term refinancing operations) program providing multi-year financing to banks by the ECB. However, they concluded, that "Overall, the evidence suggests that non-standard measures such as long-term liquidity operations were broadly effective in dampening market tensions" (De Andoain et al 2014, 11).

[28] The spread in the interest rates on loans made to corporations in Germany and France compared to Italy and Spain only began to widen in July 2011along with, not prior to, the end of recovery from the first recession. In 2011, the unemployment rate rose sharply in Italy and was already above 20% in Spain. Plausibly, this interest rate spread reflected a normal risk premium and was therefore not indicative of a failure of financial intermediation.

and McGrattan (2009), such shocks are portmanteau shocks that stand in for more fundamental shocks. The shock could either be an animal spirits shock or a monetary policy shock.[29]

The FRBNY model does attempt to measure monetary policy shocks, but the issue is whether an estimated model can identify them. The ideal would be to use the model to identify the natural rate of interest and to isolate divergences from the real rate of interest caused by the central bank's policy rule. Friedman (1968 [1969]), however, contended that economists lacked the detailed structural knowledge of the economy required in order to identify the natural values of real variables. That conclusion is reinforced by the fact that monetary policy makers do not organized their decision making using an analytical framework based on reaching consensus over the values of natural variables like the natural rate of interest, the natural rate of unemployment, and the potential rate of output and output gap. For example, as evident in current debate, there is no consensus over why real rates of interest have remained so low since late 2008. Work by Guvenen et al (2014) suggests that standard models do not capture essential nonlinearities.[30]

As a second-best alternative to model simulation, one can note the reduction in inflation in the Eurozone and assume that only monetary policy can cause such a sustained reduction. One can then go to the sacrifice-ratio literature, which measures the cost in terms of lost output produced by a reduction in inflation, and ask whether the reduction in inflation in the Eurozone is consistent with a significant recession. The first thing to note is that estimated Phillips curves have become very "flat," a fact that implies a high sacrifice ratio. Atkeson and Ohanian (2001) noted that lagged inflation does a better job of predicting inflation than do Phillips curves, which include resource slack as an explanatory variable. In the Phillips curves of estimated DSGE models, expected inflation rather than resource slack is the major determinant of inflation.

In a DSGE model, the sacrifice ratio is a model property. With credibility, the central bank can lower inflation without cost by lowering its inflation target. Because expected inflation is the dominant variable that explains realized inflation, however, lowering inflation below target while the target continues to determine expected inflation will imply a high sacrifice ratio. Unlike DSGE models, in the FRB/US model of the staff of the Board of Governors, the public can adjust its beliefs about the central bank's inflation target. Kiley et al (2006) noted:

> [A]gents' beliefs about the FOMC's long-run inflation objective respond only slowly to changes in actual inflation, in a manner consistent with survey evidence on expectations formation. Moreover, inflation is only modestly responsive in the short run to changes in resource utilization. Together these effects cause the long-run sacrifice ratio in FRB/US to be relatively large: Permanently reducing the inflation rate in FRB/US by 1 percentage point requires keeping the unemployment rate above the NAIRU by roughly a full percentage point for six years.

---

[29] In the model, the former would be $\left(E_t \hat{B}_{t+1} - \hat{B}_t \right) < 0$.

[30] "[W]e find that the variance of idiosyncratic shocks is not countercyclical. Instead, it is the left-skewness of shocks that is strongly countercyclical: during recessions, large upward earnings movements become less likely, whereas large drops in earnings become more likely" (Guvenen et al 2014, 621).

How well does this sacrifice ratio of 6 do in explaining Eurozone experience? Figure 16 shows inflation for the goods and the services sector. As an approximation, services sector inflation is used as a proxy for inflation in the sticky-price sector. Over the interval 2007Q2-2008Q3 to 2013Q4-2015Q2, services-sector inflation fell 1.4 percentage points from 2.6% to 1.2%. Over the period January 1999 through the cyclical low in May 2008, the unemployment rate averaged 8.6%. Over the succeeding period from June 2008 through June 2015, the unemployment rate averaged 10.6%. If the former figure is taken as the NAIRU, the unemployment rate rose on average 2 percentage points above NAIRU for 7 years. These figures imply a sacrifice ratio of 10, considerably higher than 6.

One factor that would bias downward the Board staff estimate of the sacrifice ratio is the assumption that expected inflation adjusts in line with falling inflation, albeit slowly. Measured by the EBC SPF (Survey of Professional Forecasters), near-term expected inflation began to fall in 2014 (Figure 7). However, as of the 2015Q3 survey, long-term predicted inflation remained at 1.9%. Ball and Mazumder (2015) highlighted "the missing deflation," that is, given the high unemployment in the Great Recession, why has deflation failed to materialize? They point to anchored expectations. Neverthess, the increase in the unemployment rate in the Eurozone probably originated in part from other disturbances, for example, the disruption caused by the capital flight crisis in 2011-2012 (Hetzel 2015).

7. Concluding comment

In 2008 and again in 2011, the Eurozone experienced a negative terms of trade shock in the form of a commodity-price shock. That shock raised inflation in the flexible-price sector. Rather than concentrating on inflation in the sticky-price sector (core inflation), the ECB created a negative output gap in order to keep headline inflation at its 2 percent inflation target. Optimal policy would have entailed concentrating on inflation in the sticky-price sector and lowering the policy rate in order to maintain a zero output gap in the sticky-price sector. The evidence presented by the Great Recession in the Eurozone is consistent with contractionary monetary policy being necessary for negative real shocks to translate into significant recession.

References

Aastrup, Morten and Henrik Jensen. "What Drives the European Central Bank's Interest-Rate Changes?" University of Copenhagen, November 2010.

Aoki, Kosuke. "Optimal Monetary Policy Responses to Relative-Price Changes." *Journal of Monetary Economics* 48 (2001), 55-80.

Atkeson, Andrew and Lee E. Ohanian. "Are Phillips Curves Useful for Forecasting Inflation?" Federal Reserve Bank of Minneapolis *Quarterly Review*, Winter 2001, 2-11.

Ball, Laurence and Sandeep Mazumder. "A Phillips Curve with Anchored Expectations and Short-Term Unemployment." International Monetary Fund Working Paper, WP/15/39, February 2015.

Baltensperger, Ernst. "Monetary Policy under Conditions of Increasing Integration (1979-96)." in *Fifty Years of the Deutsche Mark*. Oxford: Oxford University Press, 1999.

Beyer, Andreas; Vitor Gaspar; Christina Gerberding; and Otmar Issing. "Opting Out of the Great Inflation: German Monetary Policy after the Breakdown of Bretton Woods." in *The Great Inflation: The Rebirth of Modern Central Banking*, Michael D. Bordo and Athanasios Orphanides, eds. Chicago: The University of Chicago Press, 2013, 301-346.

Blanchard, Olivier and Jordi Gali. "Real Wage Rigidities and the New Keynesian Model." *Journal of Money, Credit, and Banking* 39 (February 2007), 35-65.

Chari, V. V.; Patrick J. Kehoe, and Ellen R. McGrattan. "New Keynesian Models: Not Yet Useful for Policy Analysis." *American Economic Journal*: *Macroeconomics* 1 (January 2009), 242-66.

Clarida, Richard, Jordi Gali and Mark Gertler. "The Science of Monetary Policy: A New Keynesian Perspective." *Journal of Economic Literature* 37 (December 1999), 1661-1707.

Constâncio, Vitor. "The European Crisis and the Role of the Financial System." *Journal of Macroeconomics* 39 (March 2014), 260-271.

De Andoain, Carlos Garcia; Peter Hoffmann; and Simone Manganelli. "Fragmentation in the Euro Overnight Unsecured Money Market." European Central Bank Working Paper Series, No. 1755, December 2014.

Deutsche Bank Research. *Focus Europe*. "ECB reaction function(s)." September 13, 2013.

Diamond, Douglas W., Yunzhi Hu, and Raghuram G. Rajan. "Pledgeability, Industry Liquidity, and Financial Capacity Cycles." Chicago Booth School of Business, September 15, 2014.

European Central Bank. "Editorial." *Monthly Bulletin*, July 2008, 5-8.

_____. "Editorial." *Monthly Bulletin*, July 2010, 5-8.

_____. The Euro Area Bank Lending Survey, July 2008.

Fève, Patrick; Julien Matheron; Jean-Guillaume Sahuc. "Disinflation Shocks in the Eurozone: A DSGE Perspective." *Journal of Money, Credit and Banking* 42 (March-April 2010), 289-323.

Financial Times. "Beijing returns to global metals market." June 3, 2013, 15.

_____. "ECB's untimely change of mind." June 5, 2013, 8.

Friedman, Milton. *A Program for Monetary Stability*. New York: Fordham University Press, 1960.

_____. “The Role of Monetary Policy (1968)” in Milton Friedman, ed., *The Optimum Quantity of Money*. Chicago: Aldine, 1969, pp. 95-110.

Friedman, Milton and David Meiselman. “The Relative Stability of Monetary Velocity and the Investment Multiplier in the United States, 1897-1958.” in *Stabilization Policies*. Commission on Money and Credit. Englewood Cliffs, N. J.: Prentice-Hall, 1963b, 165-268.

Friedman, Milton and Anna J. Schwartz. *A Monetary History of the United States*, 1867-1960. Princeton: Princeton University Press, 1963a.

_____. “Money and Business Cycles.” *Review of Economics and Statistics* 45 (February 1963b), 32-64.

Goodfriend, Marvin. “The Monetary Policy Debate since October 1979: Lessons for Theory and Practice.” in “Reflections on Monetary Policy: 25 Years after October 1979.” Conference at Federal Reserve Bank of St. Louis, October 7 -8, 2004.

Goodfriend, Marvin and Robert G. King. “The New Neoclassical Synthesis.” NBER *Macroeconomics Annual*, eds. Ben S. Bernanke and Julio Rotemberg, 1997.

_____. “The Incredible Volcker Disinflation.” *Journal of Monetary Economics* 52, (July 2005), 981-1015.

Guvenen, Fatih; Serdar Ozkan; and Jae Song. “The Nature of Countercyclical Income Risk.” *Journal of Political Economy* 122, 2014, 621-660.

Hagen, Jűrgen von. “A New Approach to Monetary Policy (1971-8).” in Deutsche Bundesbank, ed., *Fifty Years of the Deutsche Mark*.” 1999, 403-38.

Heider, Florian; Marie Hoerova, and Cornelius Holthausen. “Liquidity Hoarding and Interbank Market Spreads: The Role of Counterparty Risk.” Working Paper Series No. 1126, European Central Bank, December 2009.

Hetzel, Robert L. “Monetary Policy in the Early 1980s.” Federal Reserve Bank of Richmond *Economic Review* 72 (March/April 1986), 20-32.

_____. “German Monetary History in the Second Half of the Twentieth Century: From the Deutsche Mark to the Euro.” Federal Reserve Bank of Richmond *Economic Quarterly* 88 (Spring 2002), 29-64.

_____. *The Monetary Policy of the Federal Reserve: A History*. Cambridge: Cambridge University Press, 2008a.

_____. “What Is the Monetary Standard, Or, How Did the Volcker-Greenspan FOMC’s Tame Inflation?” Federal Reserve Bank of Richmond *Economic Quarterly* 94 (Spring 2008b), 147-171.

_____. *The Great Recession: Market Failure or Policy Failure?* Cambridge: Cambridge University Press, 2012a.

_____. “Should Greece Remain in the Eurozone?” Federal Reserve Bank of Richmond *Economic Quarterly*, forthcoming.

Honkapohja, Seppo. “The Euro Area Crisis: A View from the North.” *Journal of Macroeconomics* 39 (March 2014), 260-271.

Kiley, Michael, Thomas Laubach, and Robert Tetlow. “Optimal-Control Policies.” Board of Governors of the Federal Reserve System, memo to Members of the Federal Open Market Committee, June 20, 2006.

Meltzer, Allan H. *A History of the Federal Reserve*, vol. 2, Book 2, 1970-1986. Chicago: University of Chicago Press, 2009.

Neumann, Manfred J. M. “Monetary Targeting in Germany.” in ed. Iwao Kuroda. *Towards More Effective Monetary Policy*. New York: St. Martin’s Press, 1997, 176-198.

Orphanides, Athanasios and John C. Williams. “Robust Monetary Policy Rules with Unknown Natural Rates.” *Brookings Papers on Economic Activity*, 2:2002, 63-145.

Papademos, Lucas. “The Great Inflation: Lessons for Central Banks.” in Bordo, Michael D. and Athanasios Orphanides, eds. *The Great Inflation: The Rebirth of Modern Central Banking*. New York and London: The University of Chicago Press, 2013, 503-511.

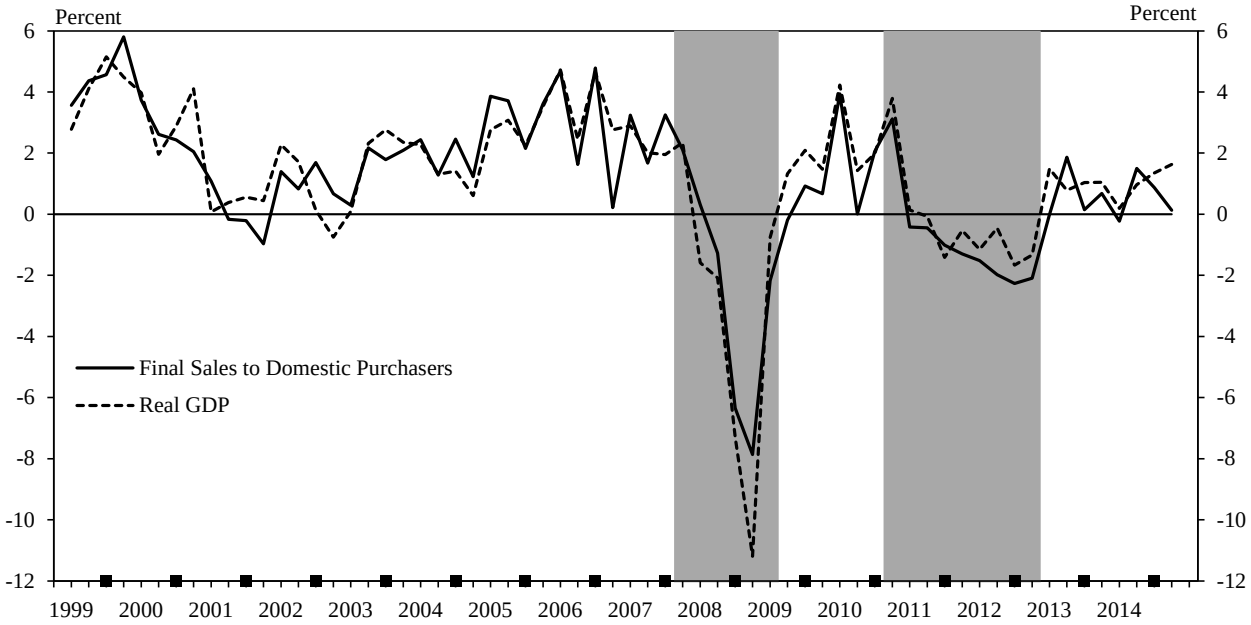
Poole, William. *Money and the Economy: A Monetarist View*. Reading, MA: Addison-Wesley Publishing Company, 1978.

Rietz, Thomas A. “The Equity Risk Premium: A Solution.” *Journal of Monetary Economics* 22 (1988), 117-131.

Romer, Christina D. and David H. Romer. “Does Monetary Policy Matter? A New Test in the Spirit of Friedman and Schwartz.” in NBER *Macroeconomics Annual 1989*, vol. 4, pp. 121-170.

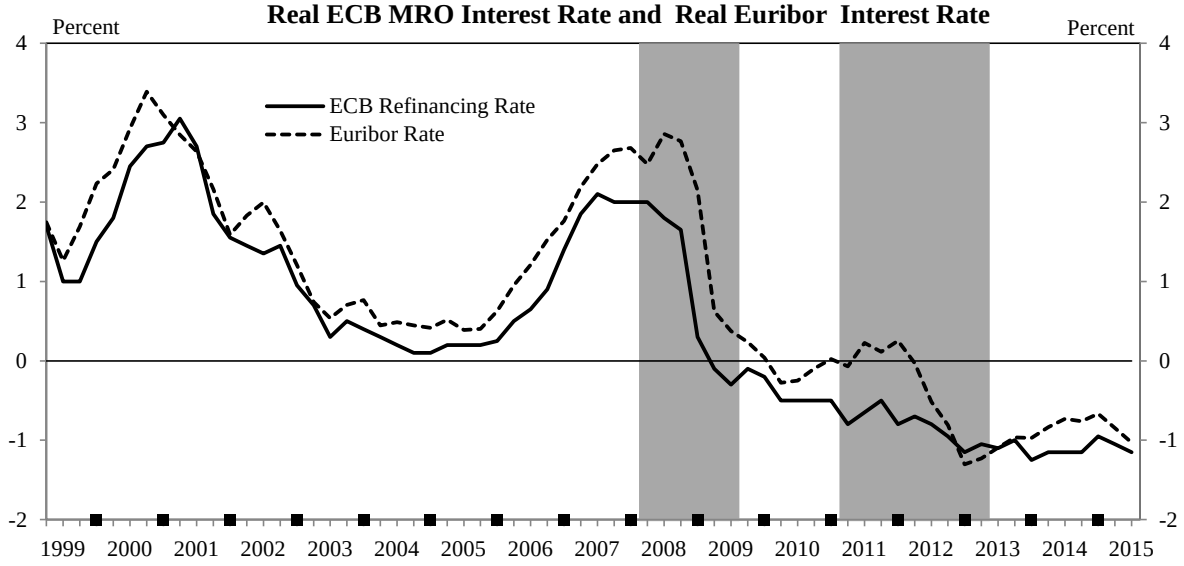
Schlesinger, Helmut. “The Bundesbank and Its Money Supply.” in B. Scheffold, ed., *Exogeneity and Endogeneity—The Money Supply in the History of Economic Thought and in Modern Policy*. Marburg: Metropolis Varlag, 2002.

Figure 1
Growth in Real Output and Real Demand



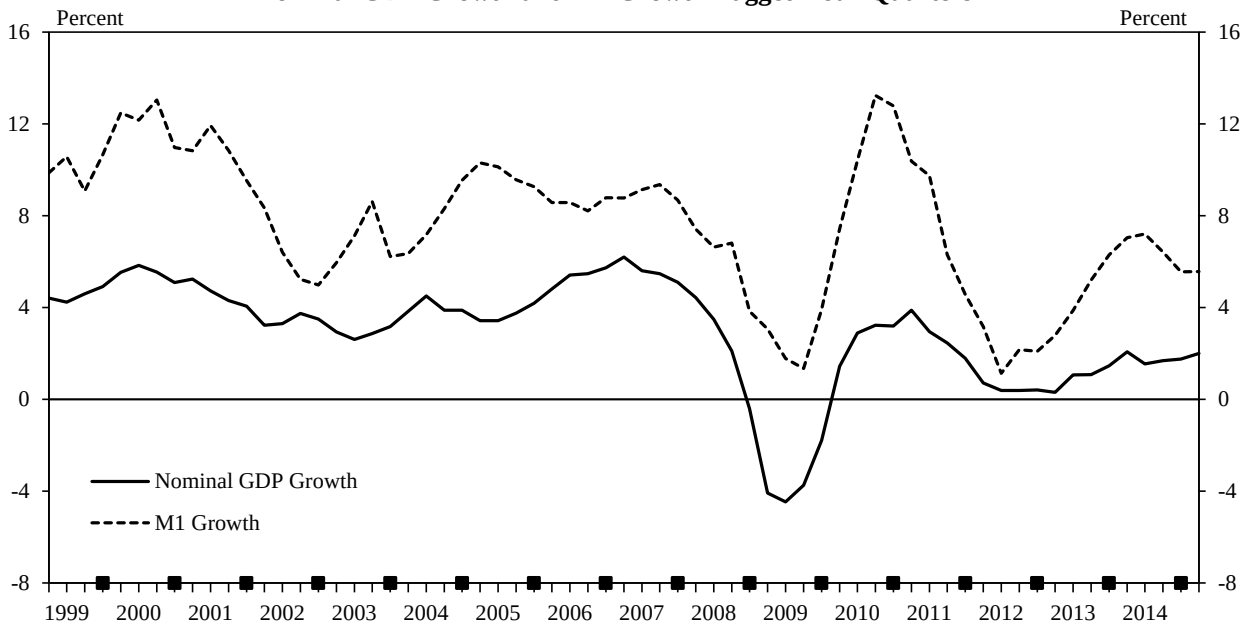
Notes: Quarterly observations of quarterly annualized percentage changes in real final sales to domestic purchasers and real GDP. Final sales to domestic purchasers is GDP - exports + imports - change in inventories. Shaded areas mark recessions with cycle peaks 2008Q1 and 2011Q1. Heavy tick marks indicate fourth quarter. Source: Haver Analytics.

Figure 2
Real ECB MRO Interest Rate and Real Euribor Interest Rate



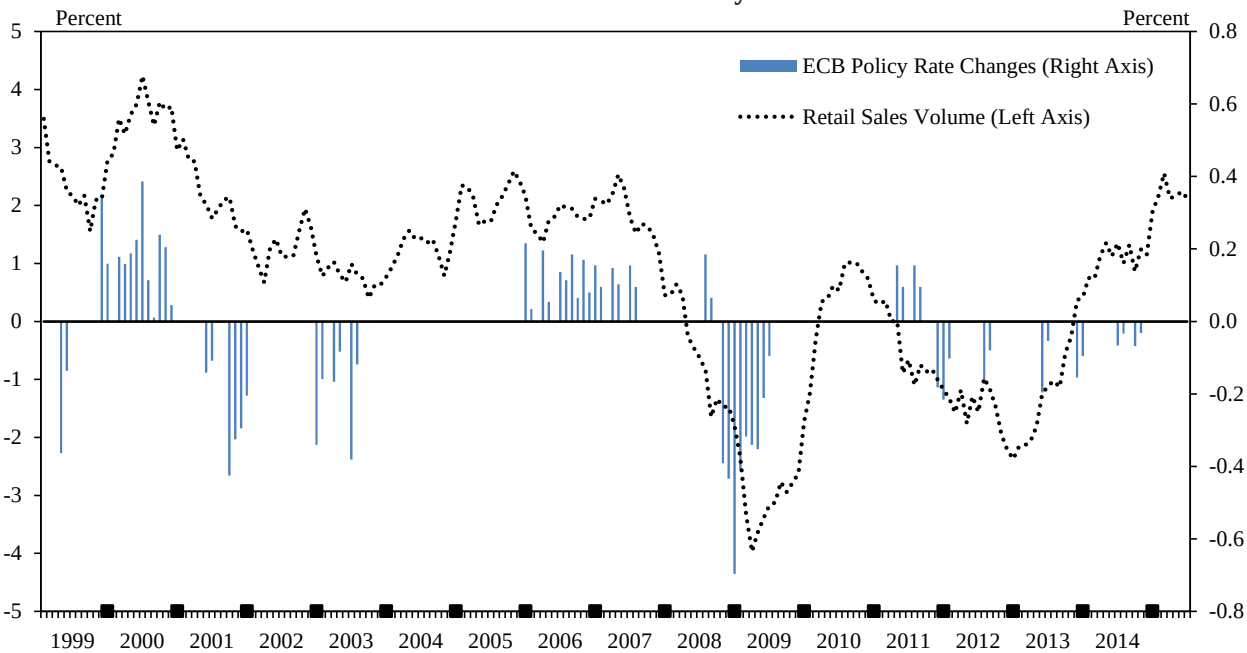
Notes: Quarterly observations of real ECB MRO (main refinancing operations) and real one-year Euribor interest rates are constructed by subtracting one-year ahead inflation forecasts from ECB Survey of Professional Forecasters mean point estimates.. Shaded areas mark recessions with cycle peaks 2008Q1 and 2011Q1. Heavy tick marks indicate fourth quarter. Source: ECB and Haver Analytics.

Figure 3
Nominal GDP Growth and M1 Growth Lagged Four Quarters



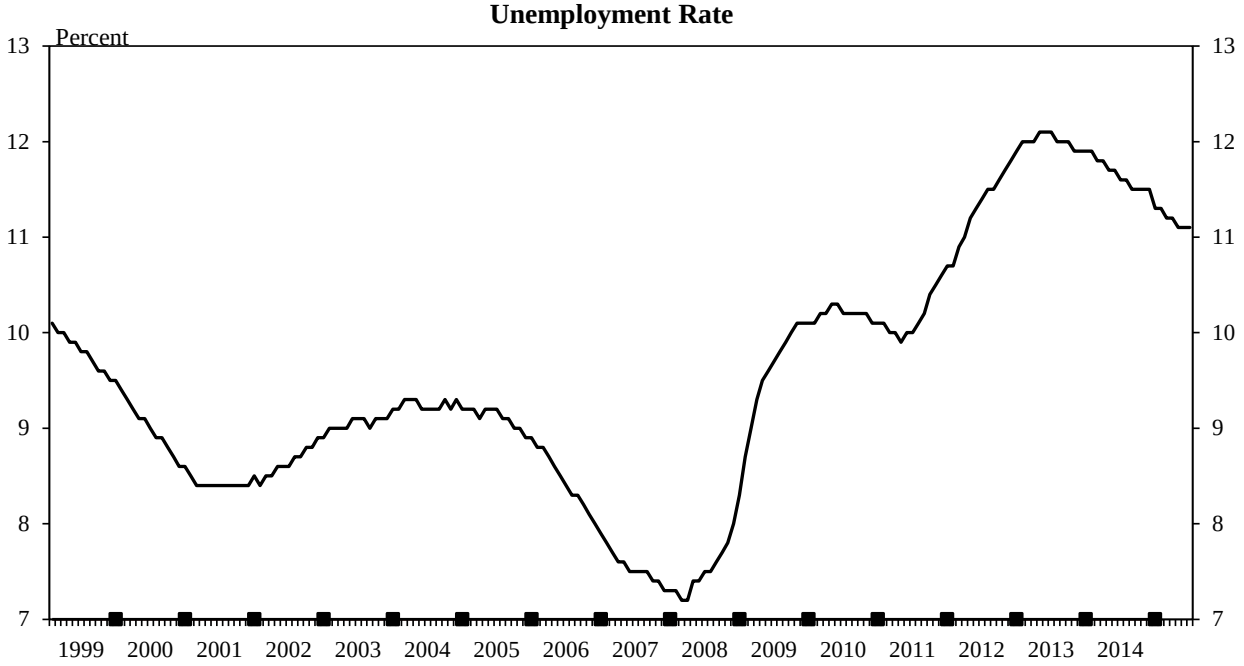
Notes: Quarterly observations of four-quarter percentage changes. M1 is lagged 4 quarters. M1 adjusted tor a reclassification in June 2005 that produced a one-time discontinuity. Heavy tick marks indicate fourth quarter Source: Eurostat and Haver Analytics.

Figure 4
Retail Sales and ECB Policy Rate



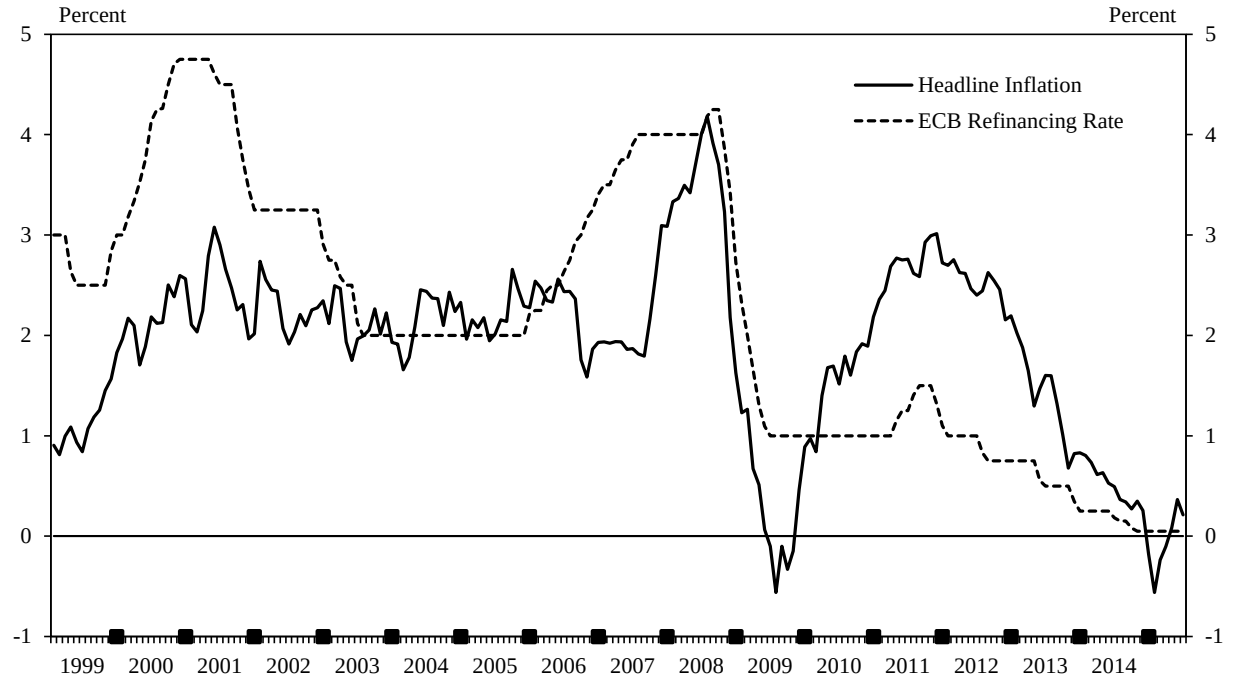
Notes: Retail Sales Volume is the three-month moving average of the year-over-year percentage change in the EA 17: Retail Sales Volume Index (SA/WDA, 2010=100). ECB Policy Rate is the Main Refinancing Operations (MRO) Rate. Because changes in the MRO rate occur within the month and data are monthly, the changes are distributed over two months. Heavy tick marks indicate fourth quarter. Source: Eurostat & Haver Analytics.

Figure 5
Unemployment Rate



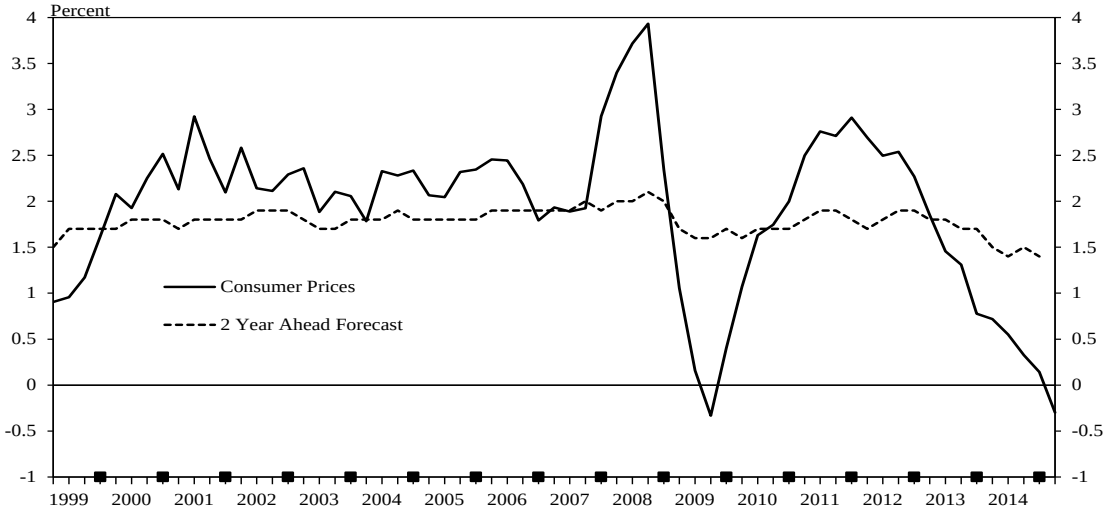
Notes: Unemployment rate for the Euro Area. Heavy tick marks indicate December. Source: Eurostat and Haver Analytics.

Figure 6
Inflation and ECB Policy Rate



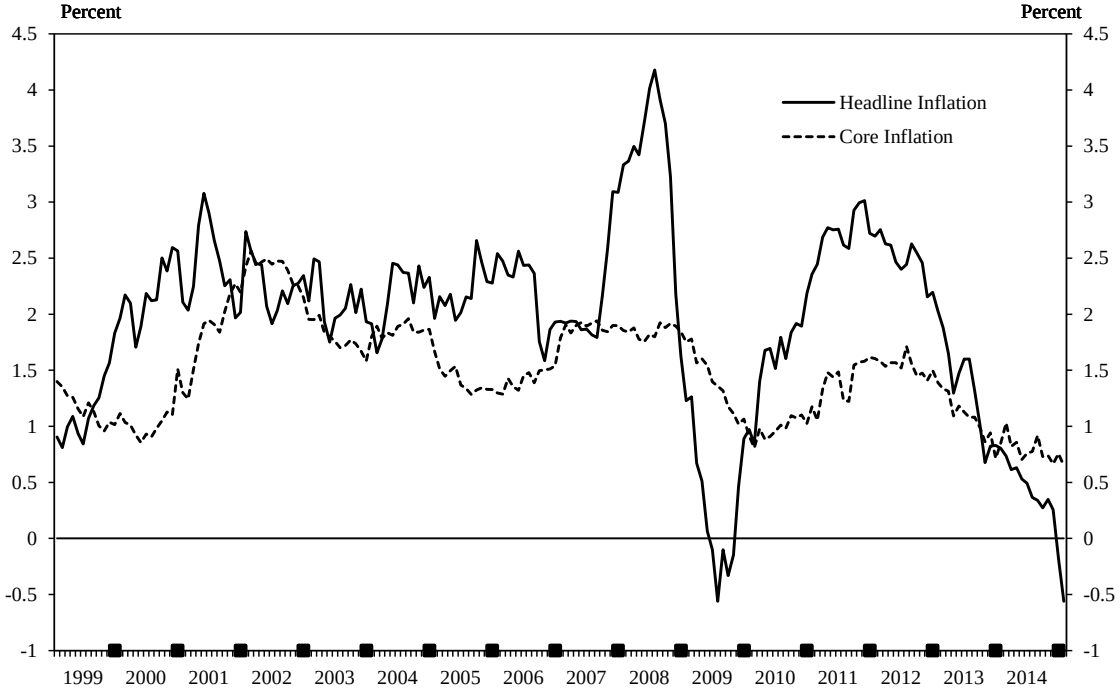
Notes: Monthly observations of 12-month percentage changes in Harmonized Index of Consumer Prices. ECB refinancing rate is the Main Refinancing Operations Rate. Heavy tick marks indicate December. Source: ECB and Haver Analytics.

Figure 7
Expected and Realized Inflation



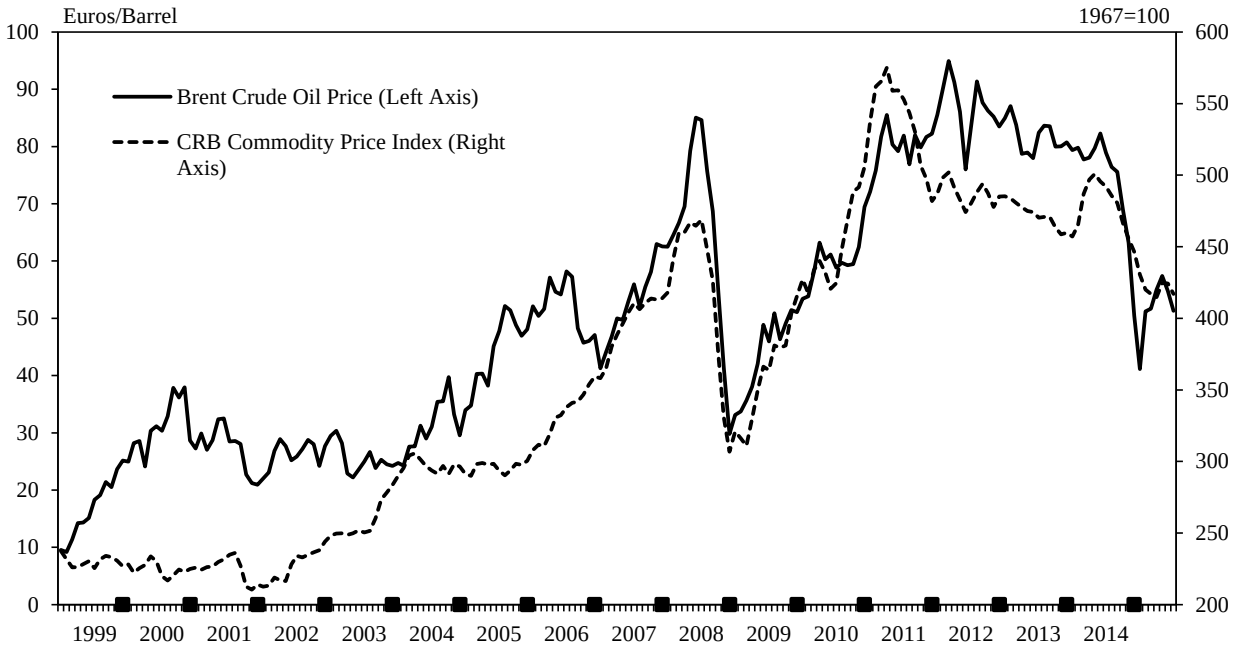
Notes: Quarterly observations of four-quarter percentage changes in Harmonized Index of Consumer Prices. Inflation forecast is from ECB Survey of Professional Forecasters mean point estimates: two years ahead. Heavy tick marks indicate fourth quarter of year. Source: ECB and Haver Analytics .

Figure 8
Headline and Core Inflation



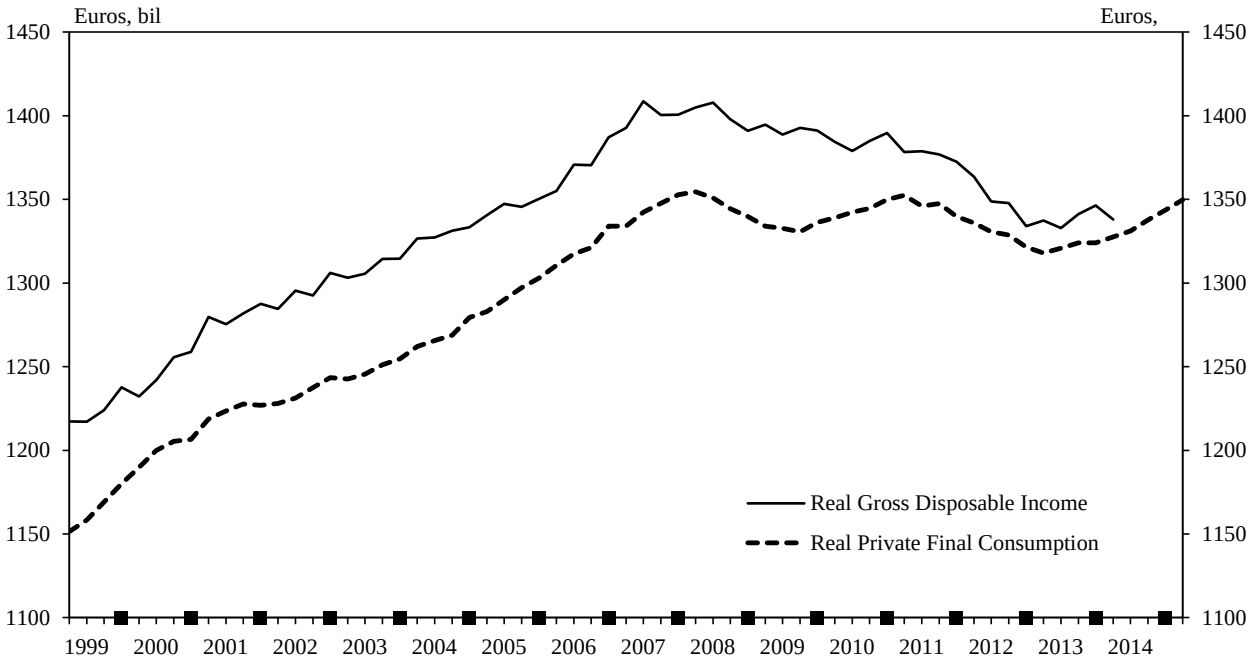
Notes: Monthly observations of 12-month percentage changes. Headline inflation is the harmonized CPI. Core inflation excludes energy, food, alcohol and tobacco. Heavy tick marks indicate December. Source: ECB and Haver Analytics.

Figure 9
Brent Crude Oil Price in Euros and CRB Commodity Spot Price Index



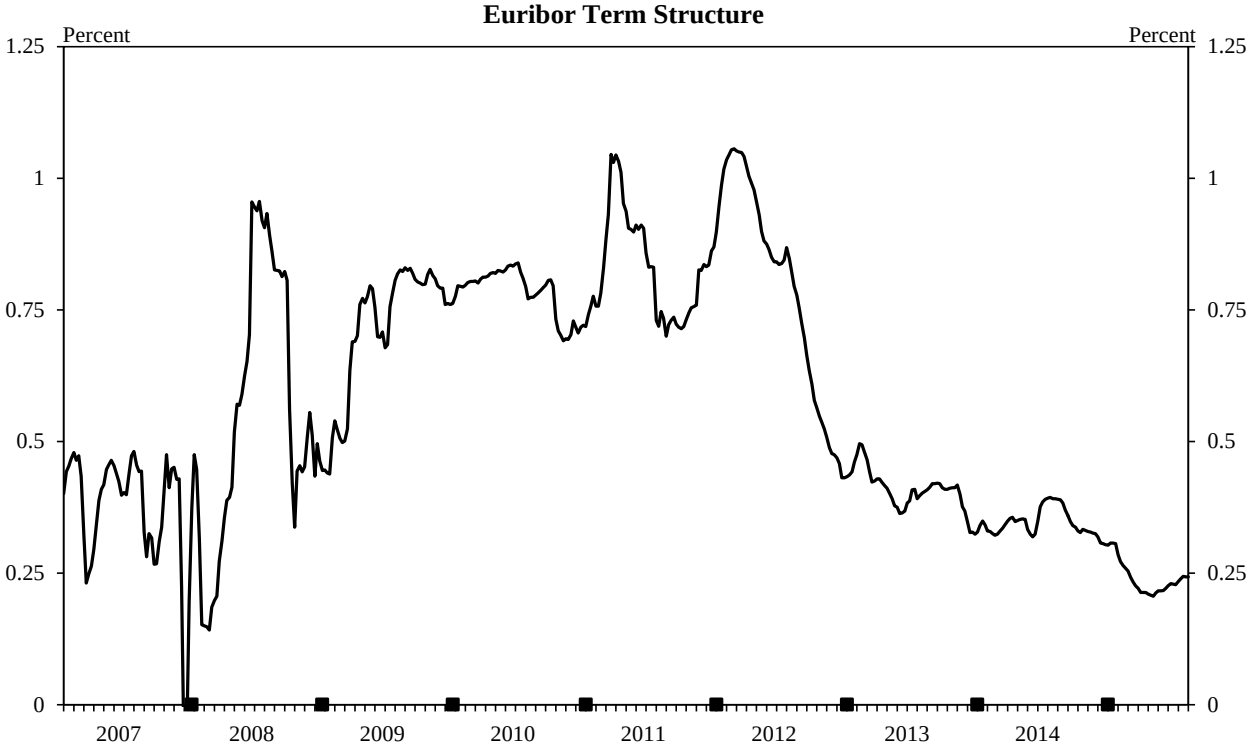
Notes: Brent crude oil price multiplied by the EUR/US$ spot exchange rate. CRB Spot Commodity Price Index: All Commodities (AVG, 1967=100). Heavy tick marks indicate December. Source: Reuters-CRB Commodity Index Report and Haver Analytics.

Figure 10
Real Gross Disposable Income and Private Consumption



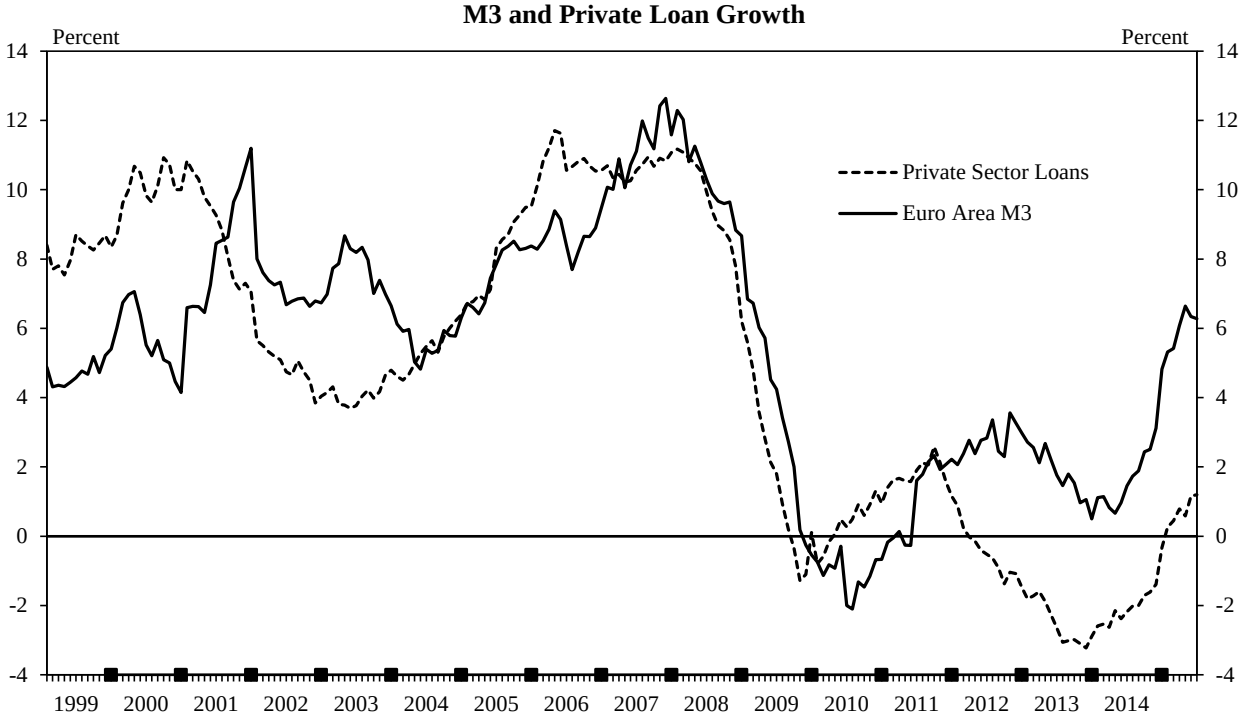
Notes: Real gross disposable income is defined as gross disposable income divided by harmonized consumer price index times 100. Heavy tick marks indicate fourth quarter. Source: Eurostat and Haver Analytics.

Figure 11
Euribor Term Structure



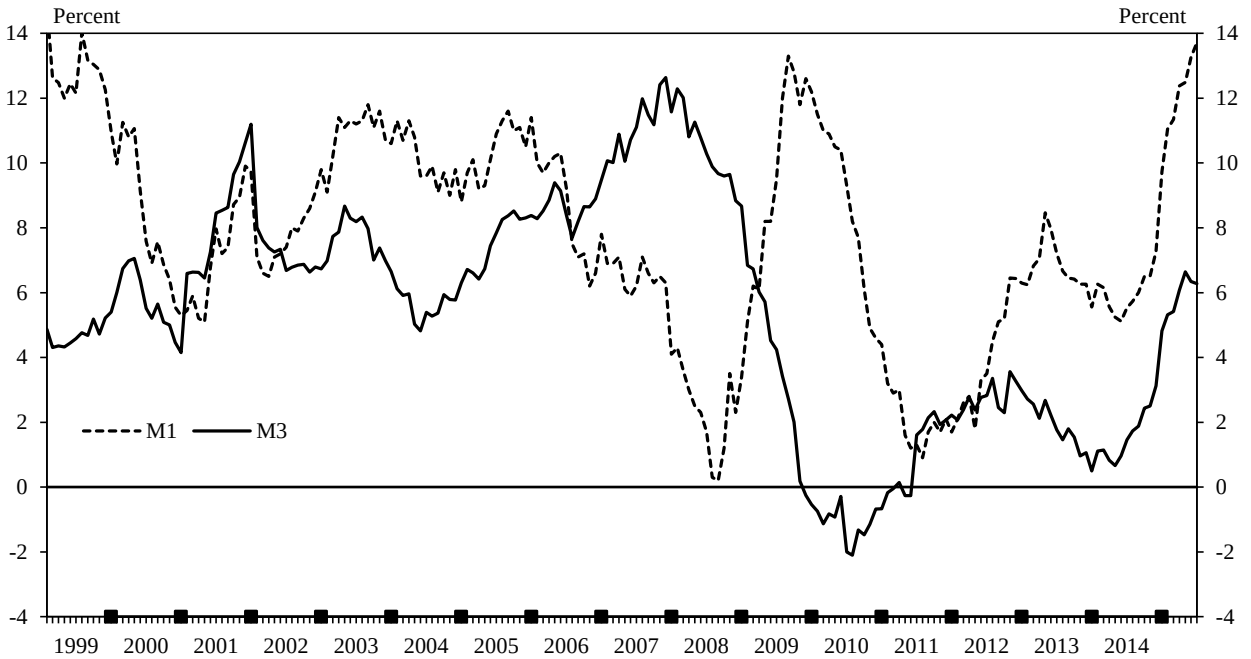
Notes: Difference between 12 month and 1 month Eurobor interest rates. Heavy tick marks indicate December. Source: ECB and Haver Analytics.

Figure 12
M3 and Private Loan Growth



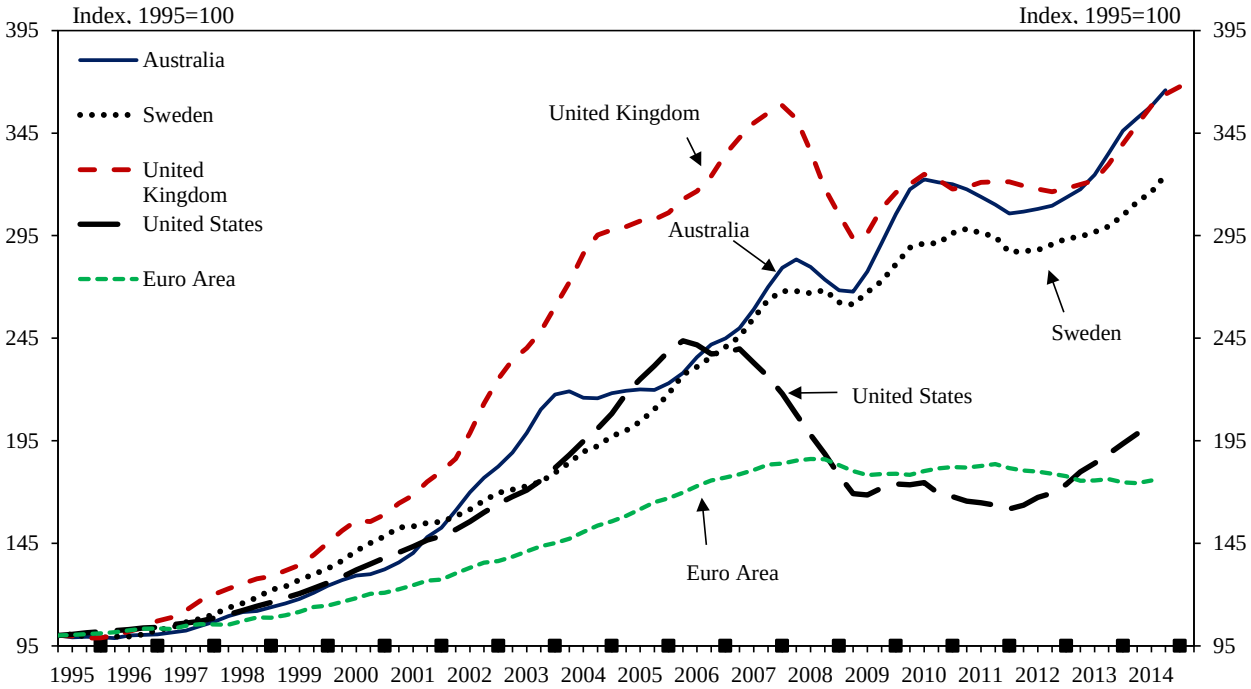
Notes: Monthly observations of twelve-month percentage changes in M3 and loans to private sector by monetary financial institutions. Heavy tick marks indicate December. Source: Eurostat and Haver Analytics.

Figure 13
Money Supply



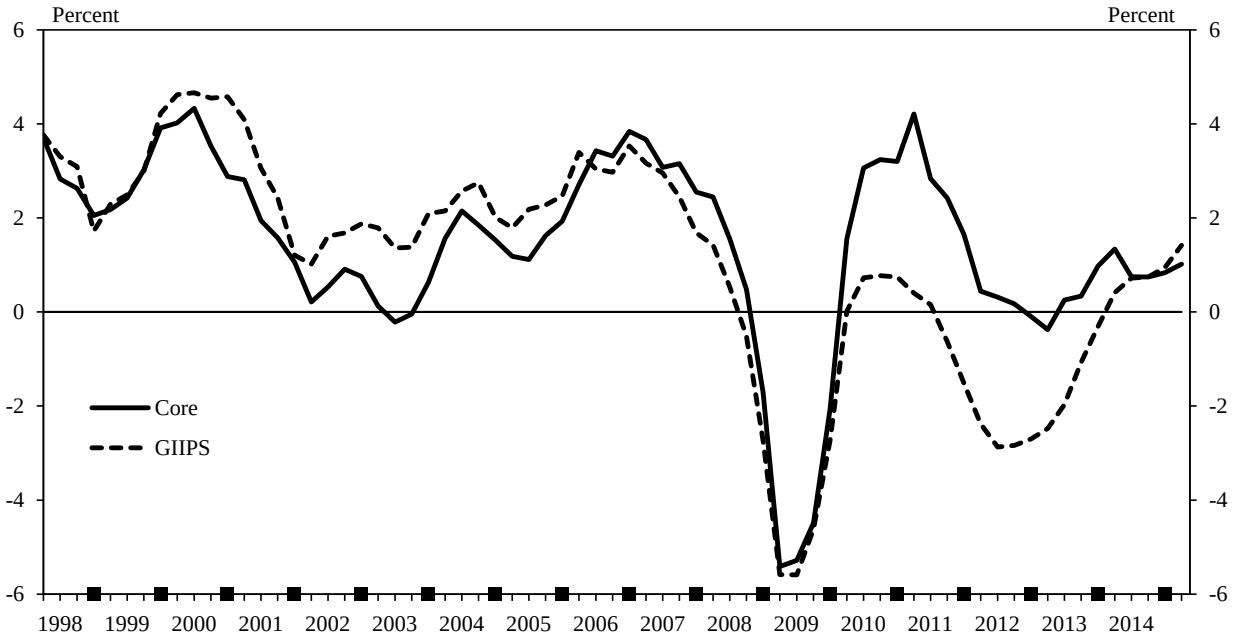
Notes: Monthly observations of twelve-month percentage changes in M1 and M3. Heavy tick marks indicate December. Source: Eurostat and Haver Analytics.

Figure 14
Real House Prices



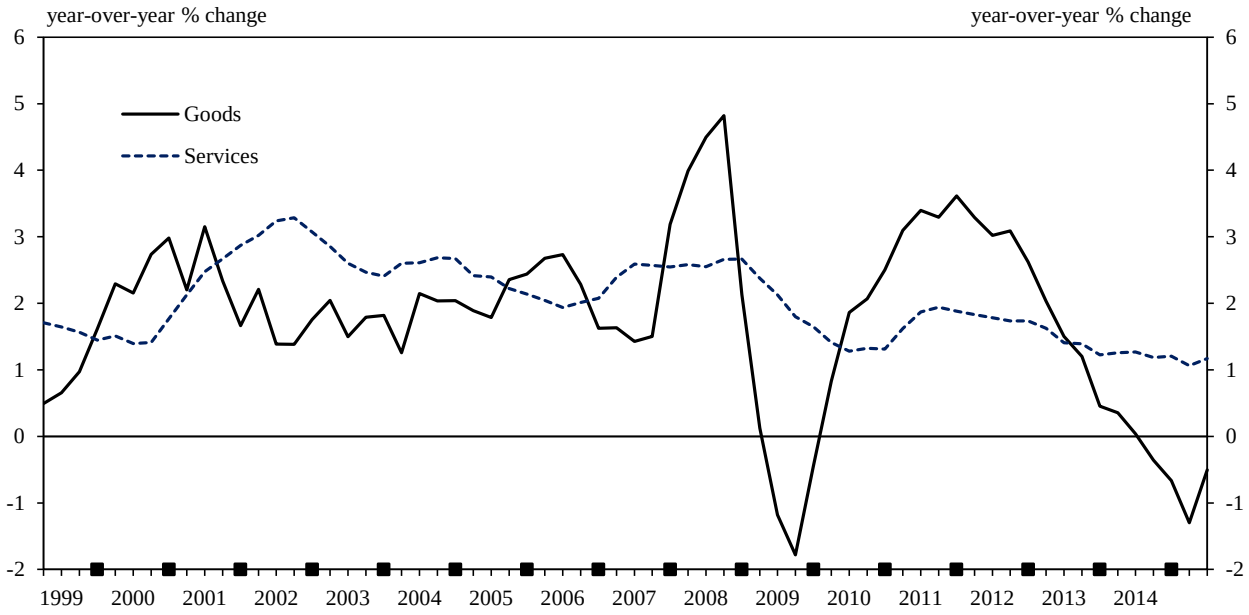
Notes: Quarterly data. Heavy tick marks indicate fourth quarter of year. Source: Haver Analytics.

Figure 15
Growth in Real GDP for Core and GIIPS Countries



Notes: Four-quarter percentage change in real GDP for core countries (Austria, Belgium, Finland, France, Germany, and Netherlands) and the GIIPS (Greece, Ireland, Italy, Portugal, and Spain). Heavy tick marks indicate fourth quarter . Source: Haver Analytics

Figure 16
Inflation



Notes: Quarterly observations of Harmonized CPI. Heavy tick marks indicate fourth quarter. Source: Eurostat and Haver Analytics .