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A Monetarist Critique of ECB Monetary Policy in the Great Recession

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Robert L. Hetzel
Federal Reserve Bank of Richmond

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Robert L. Hetzel

Federal Reserve Bank of Richmond

robert.hetzel@rich.frb.org

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Abstract: Since 2008, the Eurozone has undergone two recessions, which together constitute the Great Recession. The explanation offered here attributes them to contractionary monetary policy. Interpreted in a way consistent with monetarist principles, the New Keynesian model provides the framework for identifying the precipitating shocks as monetary.

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Since 2008, the Eurozone has undergone two recessions (Figure 1). A monetarist explanation in terms of contractionary monetary policy can account for them.[1] Because of its generality, the New Keynesian (NK) model can serve as a framework for testing this monetarist hypothesis.

The analysis adopts the monetarist methodology used in order to attribute causation for cyclical fluctuations to monetary disturbances. Milton Friedman believed that economists would never know enough about the structure of the economy in order to build and estimate models capable of offering numerical predictions of the evolution of the economy.[2] As illustrated in Friedman and Schwartz (1963), he instead provided historical narrative organized around a small number of hypotheses in order to explain a diverse set of historical episodes.

Along with the hypothesis that the monetary arrangements of a country determine the behavior of prices, a fundamental monetarist hypothesis is that the empirical correlation between nominal and real instability arises from monetary instability. A corollary is that if countries put into place monetary arrangements that prevent monetary disturbances from becoming a source of instability the price system will work well to prevent major cyclical instability. In this respect, the NK model offers a guide as to when the central bank should allow the price system to work in an unhindered way. As defined here, "unhindered" means avoiding any attempt to create an output gap in order to manipulate a Phillips curve relationship between output and inflation. The NK model restricts the kinds of shocks that make optimal attempts to exploit Phillips-curve trade-offs. For shocks to preferences and technology, it should stick to an objective of price stability in the sticky-price sector and allow the price system to work unhindered.

The European Central Bank (ECB) has a single mandate—price stability. However, the issue is in the Great Recession in response to high headline inflation generated in the flexible-price sector how should it have pursued this goal? Should it have relied on a rule that establishes credibility for nominal expectational stability in order to control price setting in the sticky-price sector while allowing the price system to work unhindered to maintain an output gap equal to zero? Alternatively, was it desirable to reduce high headline inflation through creation of a negative output gap? The answer offered here is that the ECB attempted inappropriately to create a negative output gap in response to a commodity-price shock (negative terms-of-trade shock), which is like a negative technology shock.

Section 1 exposits the model. Section 2 discusses how to give empirical substance to the central bank's rule in order to provide a baseline that allows the price system free rein to control the output gap but also allows for periodic attempts to exploit a Phillips curve trade-off. Section 3

[1] The standard exposition by Milton Friedman does not provide a model. For example, Friedman (1989) began only with a statement of the long-run neutrality of money and then continued with a list of empirical regularities that he and Anna Schwartz had identified concerning the cyclical properties of money. Since the early 1980s, the increased interest-sensitivity of and volatility in money demand has limited the applicability of these observations.

[2] The ideal of building and estimating models with microeconomic foundations is the organizing principle in macroeconomics. The issue is whether economists can succeed in providing micro-foundations to the degree necessary in order to achieve a consensus that there is a "true" model whose estimation provides reliable identification of shocks. For a skeptical view of the adequacy of estimated DSGE models for identifying shocks, see Chari, Kehoe, and McGrattan (2009).

associates this baseline with Bundesbank policy starting in the 1980s. Like other central banks, in response to the experience of the 1970s, the Bundesbank made price stability its central objective but did not rely on manipulating an output gap in order to achieve it. Section 4 examines ECB monetary policy during the Great Recession. Section 5 summarizes.

1. The NK model and divine coincidence

Equation (1) is the consumer's Euler equation.[3]

(1) $r_t = \rho + \sigma(E_t \Delta y_{t+1})$

with y_t the log of real output and Δy_{t+1} the percentage change in output between periods t and t+1, ρ the consumer's rate of time preference, σ the intertemporal elasticity of substitution in consumption (with consumption equal to output). The real rate of interest r_t equals $r_t \equiv i_t - E_t \pi_{t+1}$ with i_t the gross nominal interest rate and π_{t+1} the inflation rate between periods t and t+1.

The natural rate of interest, r_t^n, which is given to the central bank and shown in (2), is

(2) $r_t^n \equiv \rho + \sigma E_t \Delta y_{t+1}^n$.

The issue addressed here is when the central bank should allow the price system to work in an unhindered way in order to maintain equality between the real rate, r_t, and the natural rate, r_t^n. As evident from (1) and (2), doing so implies a rule that maintains equality between $E_t \Delta y_{t+1}$ and $E_t \Delta y_{t+1}^n$ - between expected real growth and natural (potential or trend) real growth.

Equivalently, one can state the issue by expressing (1) in terms of output gaps as (3).

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

with the output gap ($\tilde{y}_t \equiv y_t - y_t^n$), expressed in logs, equal to the difference between real output and natural output. Natural output is the value of output that would obtain with price flexibility and is given exogenously to the central bank. Solving (3) forwards yields

(4) $\tilde{y}_t = -\frac{1}{\sigma} \sum_{k=0}^{\infty} \left(r_{t+k} - r_{t+k}^n \right)$

A baseline rule is then a rule that keeps the real rate equal to the natural rate and thus the output gap equal to zero and also maintains equality between expected growth in real and natural output.

Introduction of a Phillips curve (5) allows one to ask when the central bank should deviate from the baseline rule by attempting to exploit a trade-off between inflation and the output gap.

(5) $\pi_t = \beta E_t \pi_{t+1} + \kappa \tilde{y}_t + \mu_t$.

[3] The NK model exposited below follows Gali (2008).

The coefficient β is the inverse of ρ. Standard practice is to write (5) under the assumption that the central bank has an inflation target of zero. Implicitly, (5) is $\pi_t - 0 = \beta(E_t\pi_{t+1} - 0) + \kappa \tilde{y}_t + \mu_t$. The μ_t are markup shocks of price over marginal cost. They are not "inflation shocks" originating in the flexible-price sector. The model applies to inflation in the sticky-price sector, that is, to firms that set prices for multiple periods, not to inflation in the flexible-price sector.[4]

As illustrated by (5), if the central bank maintains price stability in the sticky-price sector, so that $\pi_t = 0$ and $E_t\pi_{t+1} = 0$, it also maintains the output gap, $\tilde{y}_t$, equal to zero. Blanchard and Gali (2007) characterized this combination of price stability and real stability as the divine coincidence first highlighted by Goodfriend and King (1997).[5]

If the central bank maintains price stability, it also maintains the nominal interest rate equal to the natural real rate, $i_t = r_t = r_t^n$, which is a manifestation of divine-coincidence. Equation (6) is one representation of a rule that produces this result.[6] Equation (7) introduces the term $(\pi_t - \pi_t^{nz})$ in order to capture deviations of the policy rate from the divine coincidence benchmark. This term provides for a time-varying, positive (non-zero) inflation target (π_t^{nz}).

In principle, the class of rules represented by (7) is optimal because it includes (6) as a special case. The NK model distinguishes between shocks that limit optimal policy to allowing the price system to work unhindered to keep the output gap at zero, represented by (6), and shocks that offer in principle a desirable trade-off between inflation and the output gap represented by (7).

(6) $i_t = \rho + \sigma E_t \Delta y_{t+1}^n + \alpha\pi_t$

(7) $i_t = \rho + \sigma E_t \Delta y_{t+1}^n + \alpha(\pi_t - \pi_t^{nz})$

The class of rules represented by (7) allows for the "markup" shocks in (5). Blanchard and Gali (2007) identify them as disturbances to the markup, μ^p, of price over real marginal cost.[7] They

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[4] More generally, Mankiw and Reis (2003, 1058) show that "[T]he weight of a sector in the stability price index depends on the sector's … sluggishness of price adjustment."

[5] Divine coincidence is an expression of the monetarist hypothesis that if the central bank maintains monetary stability the price system will work well to ameliorate cyclical fluctuations.

[6] Indeterminacy is ruled out by the assumption that the central bank will behave in a way that eliminates undesirable equilibria even if one never observes such behavior.

[7] Firms in the sticky price sector, which exercise monopoly power, set prices so that the markup of price over marginal cost (relative to its steady-state level) is zero. That is, $mc + \mu^p = 0$, where mc is (the logarithm of) real marginal cost and $\mu^p \equiv \log\left(\frac{\varepsilon}{\varepsilon - 1}\right)$. Markup shocks affect the monopoly power of firms (ε) without affecting real marginal cost, mc (Blanchard and Gali 2007, 39). Woodford (2003, 451-2) classifies markup shocks as shocks to the degree of inefficiency of the natural rate of output.

contrast shocks that alter the economy's technologically-feasible production possibilities frontier (the efficient level of output) with markup shocks. Blanchard and Gali (2007, 38) offer as an example of the former a shock to the physical inputs in the production function (9), where M_t is an input and N_t is labor input.

(9) $y_t = M_t^{\alpha} N_t^{1-\alpha}$

A disturbance to the efficient level of output, shown in (9) by changes in M_t, alters equally the natural (flexible-price-equilibrium) level of output (y^n) along with the efficient level of output. In response, the central bank should maintain the price level constant and keep the output gap at zero. The normative guide for the central bank remains divine coincidence. In contrast, a markup disturbance makes it optimal for a central bank to engineer transitory inflation or deflation. Because such a shock changes the flexible-price level of output without changing the efficient level of output, maintaining price stability and keeping the output gap equal to zero increases the welfare-relevant output gap. The central bank should use its power to affect real variables due to nominal price rigidities in order to offset the effects of such a shock on output.[8]

Equation (10) adds a money demand function.

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

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 avoid the need for the price level to change, the central bank must follow a rule that causes nominal money, m_t, to grow commensurately 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. A rule like (7) disciplines that nominal demand to equal $y_t^n - \eta\, r_t^n$. That fact is important for understanding the monetary control procedures of the Bundesbank before 1999 and for interpreting money as an indicator.

2. Identification of the central bank's reaction function

Giving empirical content to a general policy rule in a way that distinguishes between (6) and (7) over different intervals of time entails the interaction of the model and empirical generalization based on observation of the policy process.[9] The challenge arises because central banks do not characterize their actions as emerging from a rule.

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[8] A monetarist position is that the central bank lacks the knowledge of the structure of the economy required in order to implement (7) in a way that trades off between inflation and an output gap. Also, in a repeated game, monopolists would come to anticipate inflation engineered by the central bank. For the purposes of this paper, it is not necessary to take a stand on the issue of whether a central bank in practice could actually implement a rule like (7) without destabilizing the economy.

[9] There is a vast empirical Taylor-rule literature. While this work contains many useful insights, the resulting reduced-forms fail to capture the key role played by the monitoring by central banks of financial markets, especially, with respect to inflationary expectations and with respect to the way in which the term structure of interest rates moves in response both to incoming "news" on the economy and to the policy actions of the central bank.

Guidance from the model starts with the reasons for abandoning the standard IS-LM/ Phillips-curve-augmented model of the 1970s in favor of the NK model. 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 in terms of inflation using a Phillips curve relationship (Hetzel 2008a, 2013a and 2013b). The repeated failures of aggregate-demand management produced the intellectual sea change that encouraged work on the NK model.

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. The policy rule aligns the expectation of inflation of firms in the sticky-price sector with the inflation target. 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. Second, the model limits the class of shocks whose impact on output could in principle be ameliorated through exploitation of an inflation-output trade-off. In the 1980s, central banks adopted rules that allowed the price system to work unhindered by causing the interest-rate target to track the natural rate of interest.[10]

Organization of empirical generalizations about the actual rule usefully begins with the problems the central bank must solve given its use of a short-term interest rate as the policy variable. To start, central bankers lack a detailed, structural model (a large-scale econometric model) of the economy capable of identifying the natural (flexible-price) values for variables such as the real rate of interest, unemployment, and potential output (equivalently the output gap).[11] Policy debates are not structured around forming a consensus over numerical gaps between actual and natural values of output, employment, and the real interest rate as the basis for an analytical determination of the rate target. Standard procedure is to raise the rate target above its prevailing value if output is growing at a rate that strains rates of resource utilization, and conversely. Former FOMC chairman William McChesney Martin termed these procedures "lean-against-the-wind" (LAW).

The choice of a short-term interest rate as the target variable creates another problem because the transmission of monetary policy depends upon the behavior of the entire term structure of interest rates. An essential ingredient of the rule followed by the central bank is communication of the degree of persistence the central bank intends to impart to changes in its rate target. The starting point is the LAW practice of constraining the sign of changes in the rate target to be either positive or negative over significant intervals of time with inflection points occurring only infrequently. One way that central banks communicate the extent of their concern about the strength or weakness in the economy and thus the degree of persistence markets should expect in changes in the rate target is by accompanying changes with discount rate changes.

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[10] 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, 2012a), Goodfriend (2004), and Goodfriend and King (2005).

[11] Forecasts from quarterly, structural models of the economy can help in organizing forecasts given the discipline they impose on making an overall estimate of growth consistent with sectoral estimates. However, such models require continual ad hoc adjustments in order to make reasonable near-term forecasts and exhibit forecast errors only slightly lower than rule-of-thumb forecasts (Hetzel 2012b).

What imparted the distinctive character to LAW procedures subsequent to the disinflations of the early 1980s was the way that central banks monitored financial markets for stability of inflationary expectations. (See Goodfriend 1993 on inflation scares.) The commitment to maintain the expectation of low, stable inflation required communication of a commitment to effect whatever cumulative increase in the policy rate was required in response to above-trend growth in output in order to prevent trend inflation from rising above target. Analogous statements hold for the occurrence of sustained weakness. Hetzel (2006, 2008a, Ch. 13-15 and 21; 2008b) termed these procedures "lean-against-the-wind with credibility," or LAW with credibility and associated them with the Great Moderation, which followed the disinflations of the early 1980s.

The identification assumption made here is that LAW with credibility implements (6). Although central banks do not maintain stability of the price level, LAW with credibility maintains the expectation of inflation equal to their inflation target. With this rule, they do not respond to fluctuations in headline inflation, which contains significant noise from the flexible-price sector. However, maintaining expected inflation equal to the inflation target keeps core inflation (ex food and energy) quite steady. The LAW search procedure for moving the rate target causes the real interest rate to track the natural rate. As shown in (4), causing the real rate to track the natural rate stabilizes the output gap.

Central banks lack a direct measure of the term in (6) showing growth in expected natural output ($E_t \Delta y^n_{t+1}$). In practice, they estimate persistent changes in the output gap measured by sustained changes in the degree of utilization of resources. LAW with credibility effectively assures markets that changes in the policy rate will cumulate to whatever extent required to maintain equality between $E_t \Delta y_{t+1}$ and $E \Delta y^n_{t+1}$, that is, between expected real growth and sustainable real growth. That assurance causes the entire term structure of interest rates to respond to incoming information on the economy in a stabilizing way reflecting changes in real forward rates not inflation premia.

The empirical association of LAW with credibility with (6) allows identification of the departures represented by (8). In practice, departures have typically occurred when central banks became concerned with inflation. In that event, they raised their policy rates until the economy weakened and then maintained a cyclically high level of rates while it weakened. Although central banks do not use the language of trade-offs, they attempted to create a negative output gap in order to lower inflation. An analogous statement holds for times when unemployment was the main concern. Departures from (6) appear in the data as inertia in the policy rate relative to cyclical turning points (Hetzel 2008a, Ch. 23-25 and 2012a, Ch. 8).

3. The Bundesbank and LAW with credibility

Bundesbank policy after 1980 provides an example of a rule intended to accomplish the divine-coincidence result. 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 an 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. That policy allowed the Bundesbank to rally public opinion against the government's desire to subordinate policy to the EMS system. The Bundesbank then emerged as the dominant central bank in the EMS system with the mark as the anchor currency (von Hagen 1999, Hetzel 2002). The initiation of money targets as a credible device for signaling the Bundesbank's commitment to price stability began with the reduction in the announced money range in 1979 (Baltensperger 1999).[12]

In the 1980s, the Bundesbank derived its money target 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).[13] That formulation highlighted the intention of the Bundesbank to cause aggregate nominal expenditure to grow in line with potential output as the prerequisite for price stability. Although the Bundesbank never adopted the targeting procedures recommended by monetarists using a reserves/money multiplier, its procedures captured the spirit of the Friedman (1960) k-percent rule for money but with the goal of stabilizing nominal output growth at a noninflationary rate. In doing so, it not only accorded primacy to the inflation target but also precluded the pursuit of objectives based on a strategy of manipulating output gaps.

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 targets as often as it achieved them.[14] Nevertheless, the money targets rendered the inflation target credible through the seriousness with which the Bundesbank explained misses.[15]

Operating procedures focused on a short-term market interest rate 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 controlled a day-to-day money market rate using the rate set on repurchase agreements. It "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 into which it entered.

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[12] 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.

[13] 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."

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

[15] "[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).

LAW with credibility provides a natural characterization of Bundesbank policy. 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.[16] In the context of nominal expectational stability, the Bundesbank moved its rate target in order to counter unsustainable weakness and strength in the economy.[17] 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%].

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

Adjusted for the fact that central banks target inflation rather than price stability, the class of rules represented by (6) implies maintenance by the central bank of trend inflation equal to target through credibility for a rule that controls the price setting of firms in the sticky-price sector while allowing the price system to work unhindered in order to determine real variables. In contrast, (7) is consistent with departures from this benchmark that incorporate an attempt to control inflation through manipulation of an output gap. Initially, the monetary policy of the ECB, like the Bundesbank, followed the spirit of (6). As shown in Figure 2, expected inflation remained close to the ECB's objective of 2% or somewhat less until 2014. As shown in Figure 3, after 2000 and before 2009, core inflation never deviated more than about half a percentage point from target. Figure 4 shows Eurozone inflation and the ECB's policy rate (the MRO or main-refinancing-operations rate). For most of the decade until fall 2000, there is little detectable relationship between the two series.

Because of its credibility, the ECB had the latitude to pursue a LAW policy of responding in a consistent way to growth gaps. Figure 5 plots changes in the ECB's MRO policy rate as a bar chart. As a measure of economic activity, it also plots the growth rate in real retail sales.[18] The two periods of increases in the MRO rate (2/2000 to 10/2000 and 12/2005 to 6/2007) correspond to increases in the growth rate of the economy measured by retail sales strong enough to lower the unemployment rate (Figure 6). The two periods of decreases in the MRO rate (5/2001 to 11/2001 and 12/2002 and 6/2003) correspond to growth in retail sales weak enough to raise the unemployment rate.

Aastrup and Jensen (2010) offer econometric support for the characterization of ECB procedures until the Great Recession as LAW with credibility:

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

[17] 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."

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

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.

As shown in Figure 7, which graphs the CRB Commodity Spot Price Index, commodity prices increased significantly over the interval from late 2003 to mid-2008.[19] Starting in late 2007, this commodity price inflation passed into headline inflation (Figure 3).[20] 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]. In (9), M_t declined in a persistent way.

The ECB then raised rather than lowered its policy rate as the economy weakened. In July 2008, the ECB raised its MRO rate from 4.0% to 4.25%. In 2008 while economic activity declined, the ECB raised rather than lowered its policy rate (Figure 5). Moreover, the ECB's communications caused markets to anticipate increases in rates. Figure 8, which plots the difference between 12-month and 1-month Euribor rates, shows that until the end of 2008 markets expected a significant increase in rates. After economic recovery commenced in mid-2009, markets again expected an increase in rates. Only in mid-2012 did they reverse that expectation.[21] As shown in Figure 5, the smoothed year-over-year change in real retail sales, which began to weaken after August 2007, fell to -1.6 in August 2008. The ECB lowered rates only when headline inflation fell (Figures 4 and 5).

The ECB explained the motivation for its actions by a concern that high headline inflation would exacerbate wage demands of French and German unions.[22] 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 this wage

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[19] 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). See Eickmeier and Kűhnlenz 2013.

[20] Initially, the commodity-price shock did not pass through to headline inflation (Figure 3). 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.

[21] Plausibly, a rate difference between 25 and 50 basis points represents a liquidity premium.

[22] 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 (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."

In order to have facilitated the change in the internal terms of trade between the core countries of the Eurozone with the peripheral countries required by the cessation of capital flows into the latter, the ECB should have allowed higher price and wage inflation in the core countries like Germany.

inflation would increase inflation in the sticky-price sector. It could not have reflected concern for a transitory increase in monopoly power (a positive markup shock) because the ECB did not raise its inflation target as provided for by (7).

A normative assessment of ECB policy entails a difficult counterfactual. In the absence of contractionary monetary policy, perhaps union demands for higher wages in order to compensate for high headline inflation would have passed into inflation in the sticky-price sector. A positive analysis of the cause of the Great Recession, however, highlights the inertia in the policy rate relative to the decline in economic activity.[23] The ECB created a negative output gap when a negative terms-of-trade shock required a lower real rate in order to prevent emergence of a negative output gap.

The negative impact of the shock on households appears in the way in which the jump in commodity price inflation reduced the real income of households. Figure 9 shows the cessation in 2007Q2 of the prior steady increase in real disposable income. Growth in real consumption peaked in 2007Q3.[24] Consumer confidence (Economic Sentiment Indicator) peaked in May 2007 and then fell rapidly[25]. The resulting pessimism of households about their future income prospects required a lower real interest rate.[26] The decline in 2009 in both core inflation and in real output with the latter accompanied by an increase in the unemployment rate (Figures 1, 3, and 6) is consistent with contractionary monetary policy.

The monetary-contraction explanation of the Great Recession has the advantage of simplicity in that the same hypothesis explains the occurrence of back-to-back recessions. The euro and world economies began to recover in mid-2009. In the past, strong recoveries had followed deep recessions. However, growth in real GDP peaked in 2011Q1 (Figure 1). In the second recession, a sequence of events unfolded in a way similar to the first recession.

When the world economy began to revive, commodity price inflation rose and again raised headline inflation. 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 3). The second commodity-price shock intensified the

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[23] As shown in (4), the central bank can keep the real rate above the natural rate ($r_t > r_t^n$) by creating a strong contemporaneous negative output gap that causes households to anticipate a return of output to a higher, normal level. Another possible factor in maintaining cyclically high real rates at the start of a recession is a household utility function containing as an argument negatively-signed consumption growth. That is, the difficulty of adjusting to a lower level of consumption offsets the desire of households to save despite increased pessimism about future consumption prospects.

[24] Over the interval 2004Q4 through 2007Q3, real personal consumption (PCE) expenditures 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).

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

[26] Although not incorporated into the model, it is plausible to conjecture that tail risk of a disastrous outcome due to the possible breakup of the Eurozone in 2011 and 2012 and later concern over inability of the ECB to conduct expansionary monetary policy through a QE (quantitative easing) policy of buying government debt exacerbated pessimism about future growth. For a discussion of how disaster risk can lower the natural rate of interest, see Rietz (1988).

ongoing decline in real disposable income. Consumption, which had been recovering slowly, again began to decline after 2010Q4 (Figure 9). Real retail sales peaked in September 2010 (Figure 5). The growth rate of real aggregate demand (final sales to domestic purchasers) began falling after 2011Q1.[27] Similarly to 2008, concentrating on the increase in headline inflation, the ECB raised its policy rates twice in 2011, from 1% to 1.25% in April and then to 1.5% in July (Figures 4 and 5).

The monetary-contraction explanation has another advantage in that it possesses implications for money growth and inflation: both should decline.[28] The monetary aggregate M1 is used here under the assumption that it offers a better measure of transactions demand than M3, which includes a significant amount of debt instruments.[29] Banks issue debt to finance loan growth when loan demand is high. As shown in Figure 10, 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 move 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 2006Q3 and slowed sharply starting in 2007Q4 (Figure 11).[30] Real GDP growth declined from an annualized growth 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

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[27] Final sales to domestic purchasers is GDP minus the change in inventories minus exports plus imports. It is a measure of domestic demand while GDP is a measure of output. From 2010Q2 through 2011Q1, real final sales to domestic purchasers grew at an annualized rate of 2.3%. In 2011Q2, growth fell to -.9%.

[28] 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 interferes with the unhindered operation of the price system and creates a difference between the natural and real rates of interest, the behavior of money becomes informative.

[29] 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.

[30] 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* (ECB 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 rates unchanged.

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 12).

A monetarist explanation of the Great Recession does not raise problems presented by the common explanation based on an unwinding of speculative excess. Figure 13 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 originating 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…."[31] 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."[32]

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.[33] As shown in Figure 14, 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.

Possibly, a debt crisis could have disrupted financial intermediation throughout the Eurozone. 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). 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.

In contrast, loan growth remained healthy even while the economy entered recession. Loans to the private sector from banks (monetary financial institutions or MFI) averaged 10.7% year-over-year from May 2006 through May 2008 (Figure 10). Only in June 2008, did loan growth begin to fall below 10%.[34] Similarly, after the recovery took hold in 2009Q3, loan growth recovered steadily

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[31] For the Eurozone, government debt as a percent of GDP declined from 81% in 2005 to 74% in early 2008.

[32] 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.

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

[34] 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.

until peaking in 2011Q3 and then declining sharply. In contrast, the recovery in domestic demand aborted earlier. As noted in footnote 18, growth in real final sales to domestic purchasers fell from 2.3% over the 2010Q2 to 2011Q1 interval to -.9% in 2011Q2.

There is little evidence that the subprime crisis disrupted financial intermediation. 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 as well as American 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 short-term 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 cash investors (Hetzel 2012a, 244 and 267). In short, central banks made certain that funding pressures on European banks did not affect their intermediation function.

Attribution of the Eurozone recession to a debt crisis received popular support from events occurring from mid-summer 2011 to mid-summer 2012 when investors fled the sovereign debt markets of Italy and Spain. 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.[35]

5. Concluding comment

The NK model distinguishes between two categories of shocks with different implications for monetary policy. With shocks to tastes and technology, the central bank should concentrate on the objective of price stability in the sticky-price sector (stability of core inflation) while allowing the price system to work unhindered to maintain the output gap at zero. With markup shocks, the central bank can in principle improve welfare by trading off between the objectives of price stability and a zero output gap.

In 2008 and again in 2011, in response to a negative technology shock in the form of a commodity-price shock, the ECB created a negative output gap in order to prevent the accompanying high headline inflation from passing into inflation in the sticky-price sector. It did not allow the price system to work unhindered in order to keep the output gap at zero. Contractionary monetary policy as the explanation of the Great Recession has the advantage that it explains both cycle peaks and predicts the decline in both output and inflation that followed.

[35] 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.

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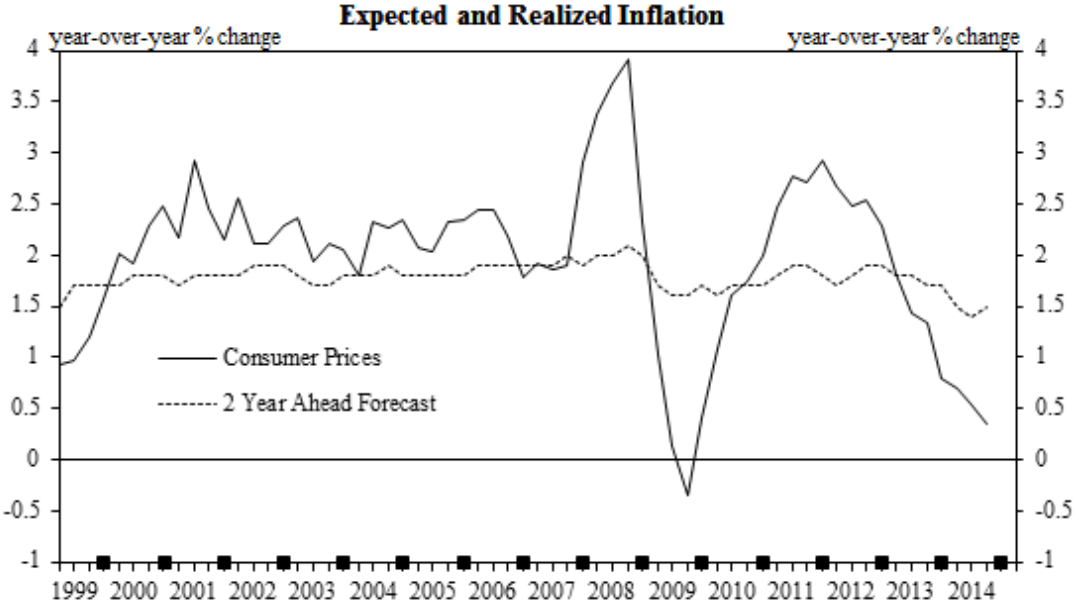
Figure 1
Growth in Real Output and Real Demand

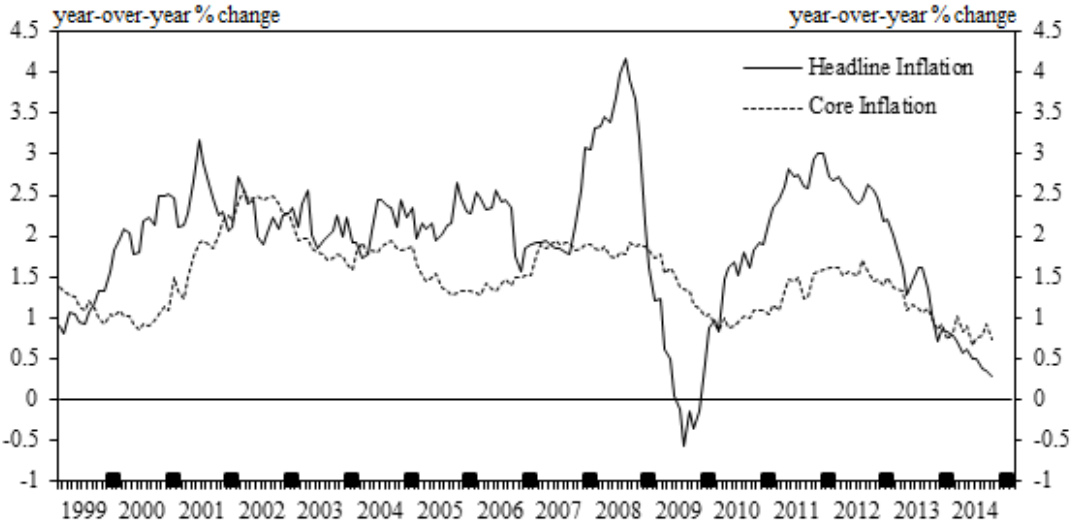
Notes: Quarterly observations of quarterly annualized percentage changes in real final sales to domestic purchasers and real GDP. Final Sales to Domestic Purchasers is defined as GDP - Exports + Imports - Change in Private Inventories. Heavy tick marks indicate fourth quarter of year. Source: Haver Analytics.

Figure 2
Expected and Realized Inflation



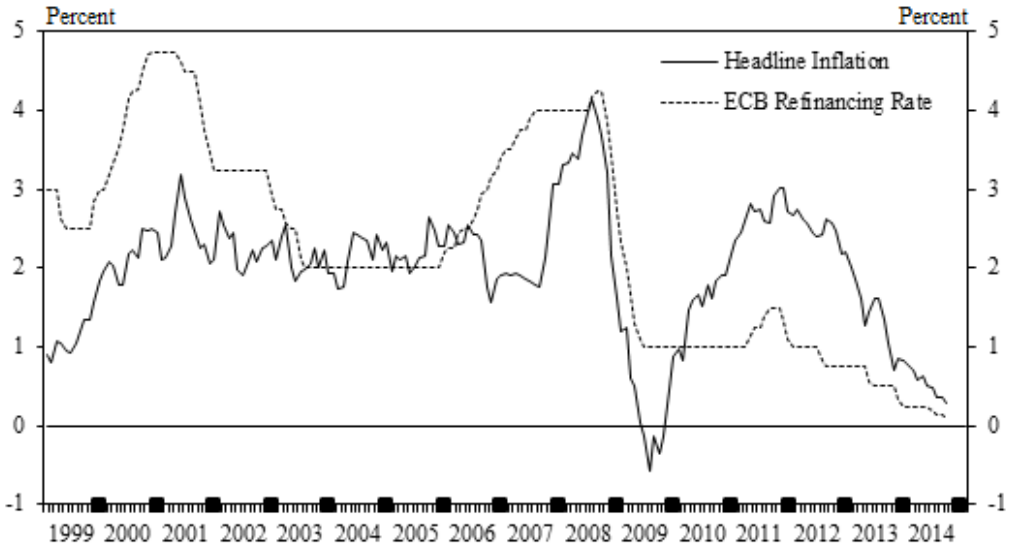
Notes: Quarterly observations of four-quarter percentage changes in Harmonized Index of Consumer Prices. Inflation forecast is from Survey of Professional Forecasters Mean point estimates: Two Years Ahead. Heavy tick marks indicate fourth quarter of year. Source: Haver Analytics and ECB.

Figure 3
Headline and Core Inflation



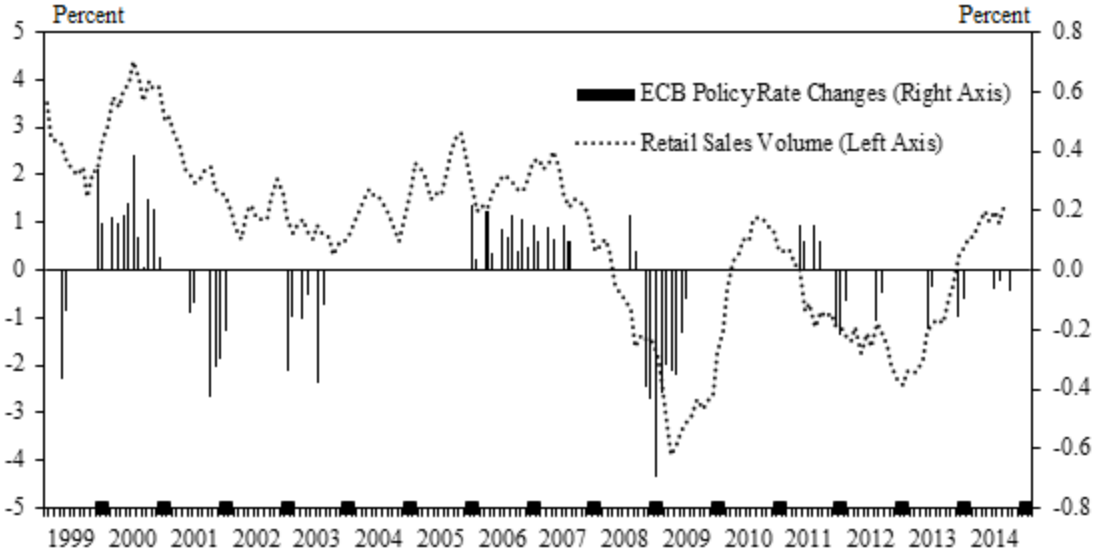
Notes: Headline inflation is the harmonized CPI. Core inflation excludes energy and food. This measure of core also excludes alcohol and tobacco. Monthly observations of 12-month percentage changes. Heavy tick marks indicate December. Source: ECB and Haver Analytics.

Figure 4
Inflation and ECB Policy Rate



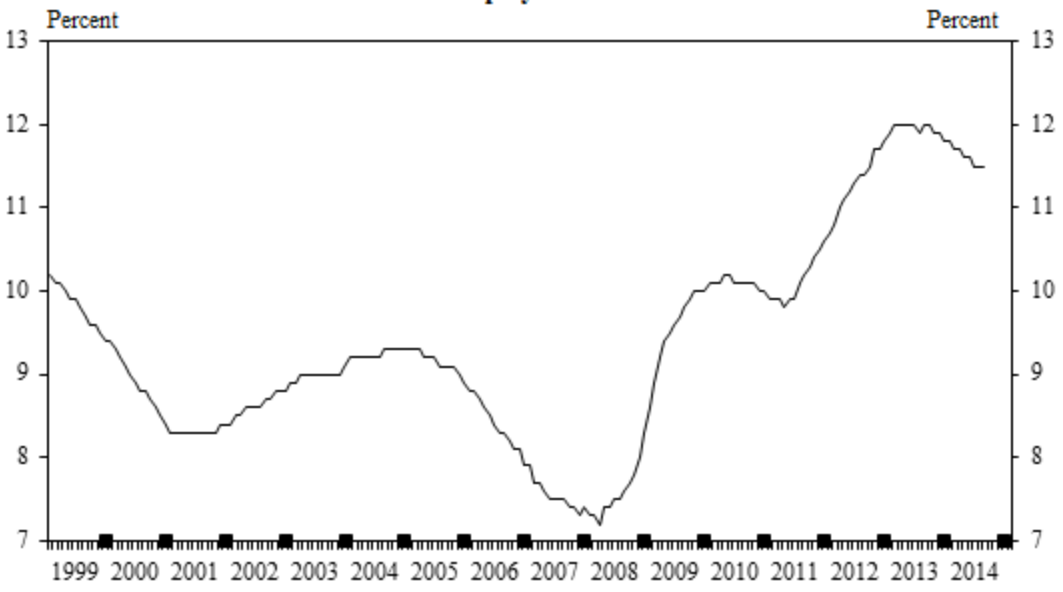
Notes: Monthly observations of 12-month percentage changes in the harmonized CPI. ECB refinancing rate is the Main Refinancing Operations Rate. Heavy tick marks indicate December. Source: ECB and Haver Analytics.

Figure 5
Retail Sales and ECB Policy Rate



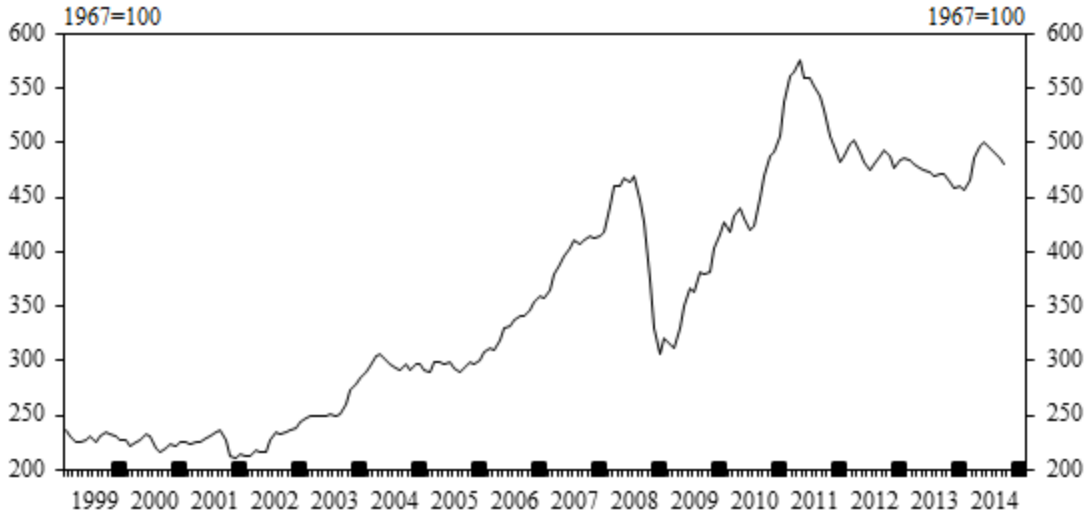
Notes: Retail Sales Volume is the three-month moving average of the year-over-year percentage change in the EA 17: Retail Sales Volume Index (SA/WDA, 2010=100). ECB Policy Rate is the Main Refinancing Operations Rate. Heavy tick marks represent the fourth quarter of year. Source: Eurostat & Haver Analytics.

Figure 6
Unemployment Rate



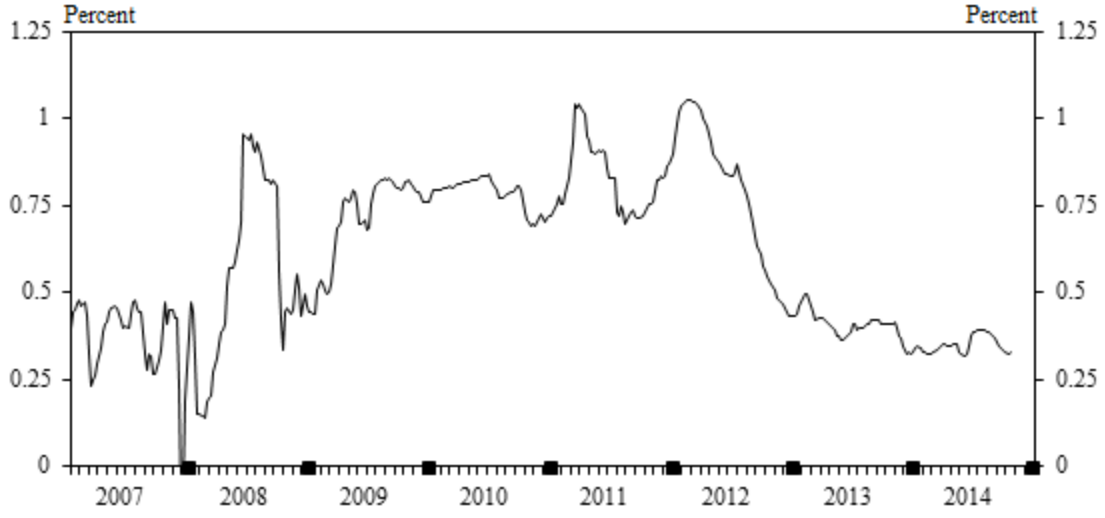
Notes: Heavy tick marks indicate fourth quarter of year. Source: EuroStat and Haver Analytics.

Figure 7
CRB Commodity Spot Price Index



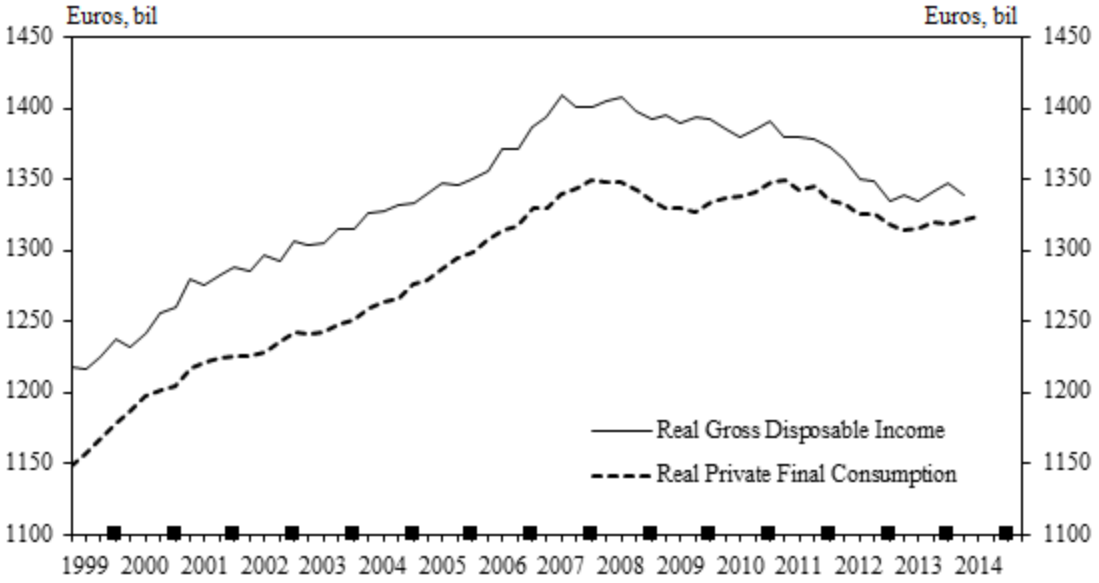
Notes: CRB Spot Commodity Price Index: All Commodities (AVG, 1967=100). Heavy tick marks indicate December. Source: Reuters-CRB Commodity Index Report and Haver Analytics.

Figure 8
Euribor Term Structure



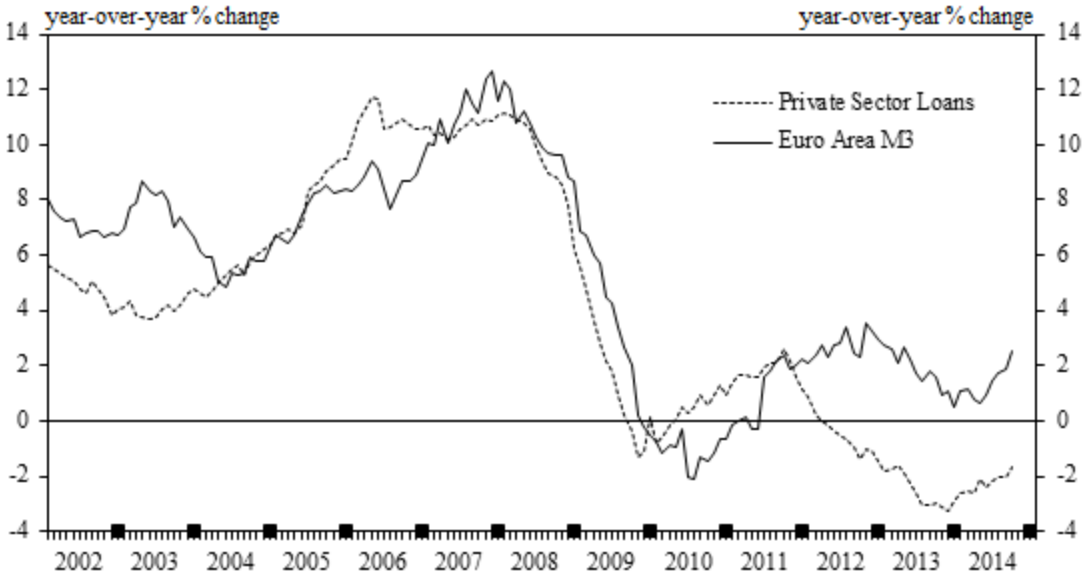
Notes: Difference between 12 month and 1 month Eurobor interest rates. Source: ECB and Haver

Figure 9
Real Gross Disposable Income and Private Consumption



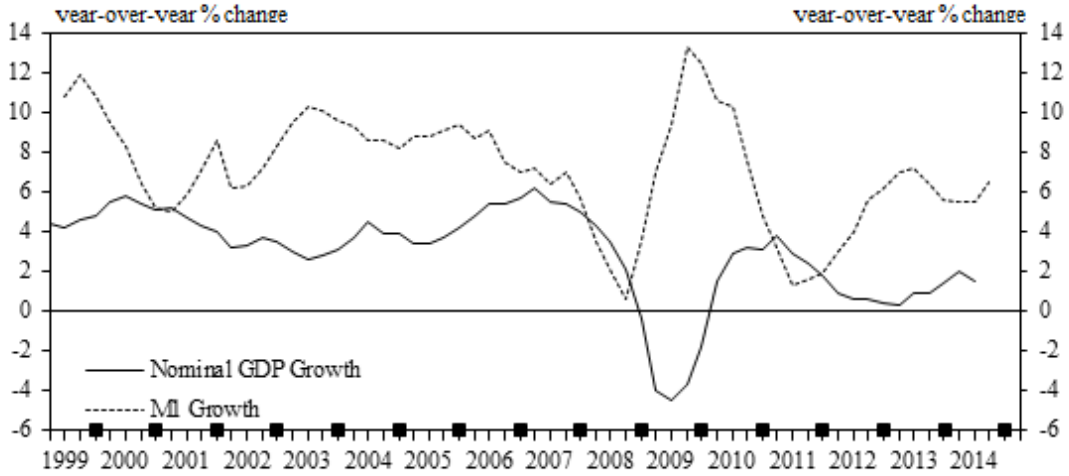
Note: Real Gross Disposable Income is defined as Gross Disposable Income divided by Harmonized Consumer Prices times 100. Heavy tickmarks indicate the fourth quarter of year. Source: Eurostat and Haver Analytics.

Figure 10
Money Supply and Private Loan Growth



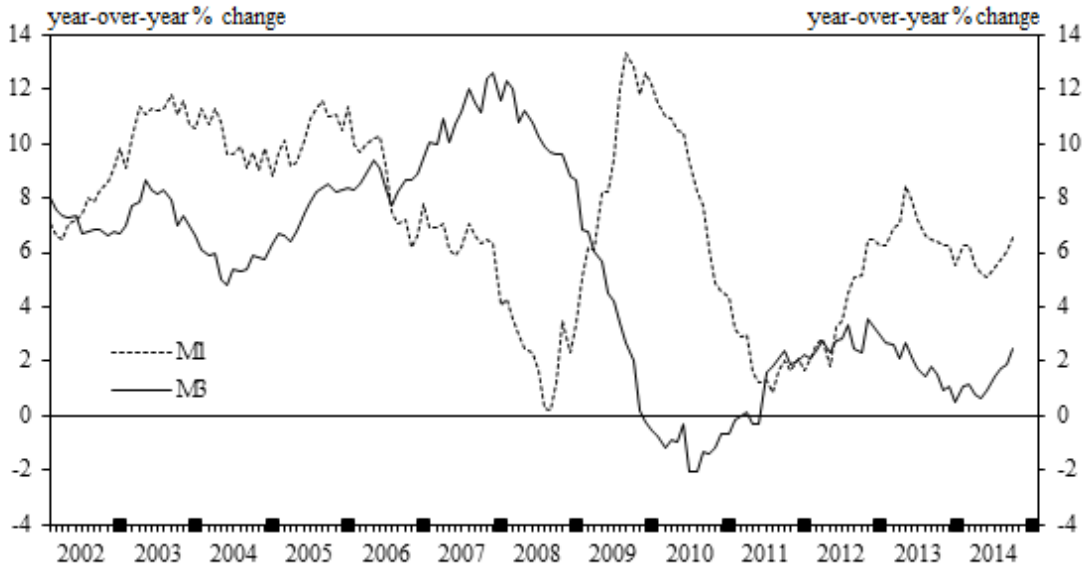
Notes: Monthly observations of twelve-month percentage changes in M3 and loans to private sector by Monetary Financial Institutions. Heavy tick marks indicate December. Source: Haver Analytics and Eurostat.

Figure 11
M1 and Nominal GDP Growth



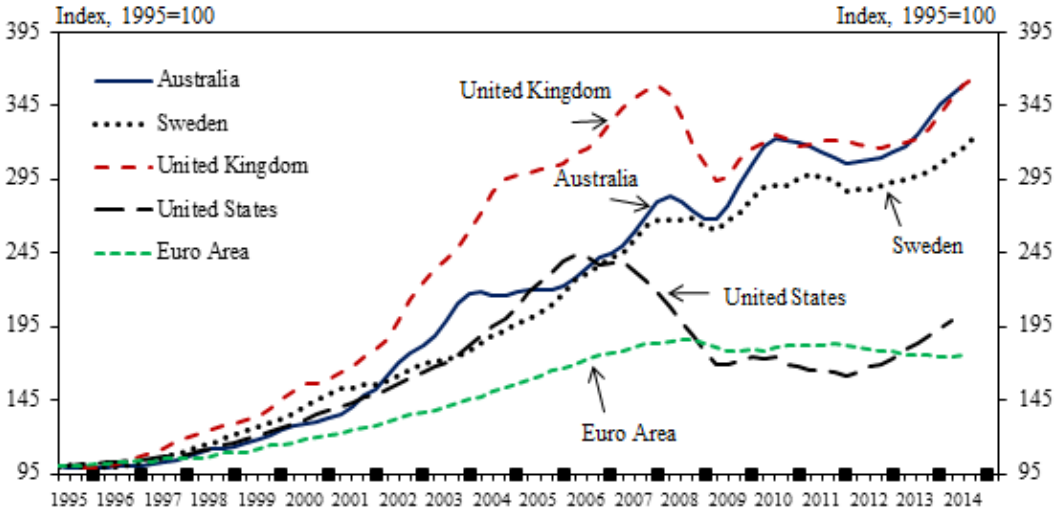
Notes: Quarterly observations of four-quarter percentage changes. M1 data adjusted to account for a reclassification of deposits by a member country in June 2005. Heavy tick marks indicate fourth quarter of year. Source: Eurostat & Haver Analytics.

Figure 12
Money Supply



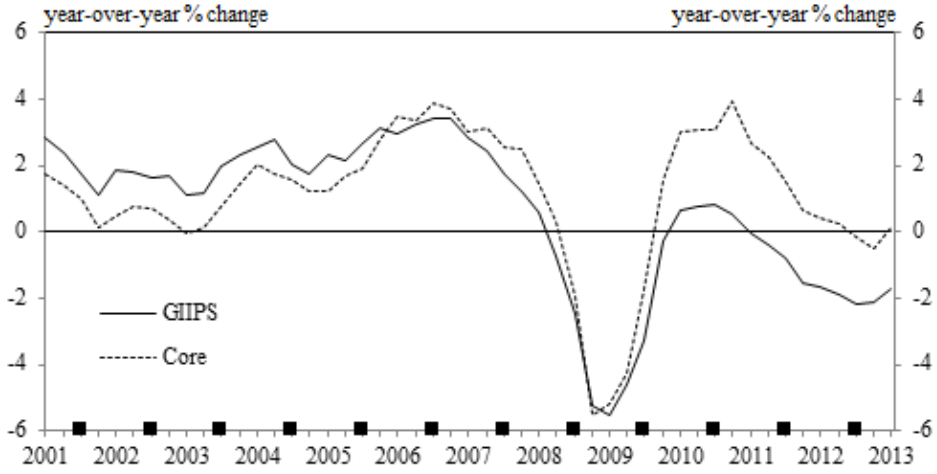
Notes: Monthly observations of twelve-month percentage changes in M1 and M3. Heavy tick marks indicate December. Source: Eurostat & Haver Analytics.

Figure 13
Real House Prices



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

Figure 14
Growth in Real GDP for Core and GIIPS Countries



Notes: Quarterly observations of four-quarter percentage changes 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 of year. Source: Haver Analytics.