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What Caused the Great Recession in the Eurozone?

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Abstract: Since 2008, the Eurozone has undergone two recessions, which together constitute the "Great Recession." The combination of a decline in output and disinflation as well as a persistent decline in inflation suggests that contractionary monetary policy was one factor. This paper makes two methodological points. First, in analyzing the causes of the Great Recession, it is important to distinguish between credit and monetary policy. Second, a multiplicity of estimated models can "explain" the Great Recession. In practice, economists choose between models through an associated narrative that adds additional information about causation.

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The Great Recession, which encompassed back-to-back recessions in the Eurozone, has reinvigorated debate over the causes of recession. Given the prominence of disruptions to financial markets, it has also generated controversy about the desirability of central bank "inflation targeting." Especially, should central banks add a measure of financial stability to their traditional objectives for output and inflation (Curdia and Woodford 2009; Woodford 2012).[1] Answers are complicated if the origin of the Great Recession lay in a combination of contractionary monetary policy and disruption to financial intermediation. The discussion here of recession in the Eurozone suggests this possibility and makes two methodological points.

First, it is essential to distinguish monetary policy from credit policy. "Monetary policy," considered as the central bank reaction function for setting its policy rate, exercises its influence on the nominal expenditure of the public through its influence on the term-structure of the risk-free interest rate. The "stance" of monetary policy, the central bank's impact on stabilizing or changing growth in nominal expenditure, derives from the interaction of this risk-free term structure with the "natural" term structure. The latter is derived under the assumption of perfectly flexible prices and reflects the way in which the real rate of interest reconciles the desire of households to smooth consumption with unevenness in the expected availability of the consumption good. "Credit policy" concerns how the central bank influences financial intermediation. In terms of the models discussed below, credit policies affect the external finance premium that firms face.[2]

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[1] Riva and Perez-Quiros (2015, 557) are critical of incorporating macroprudential policy:

> The comparison of the forecast performance of models that include credit with other global models shows that there is no significant gain from introducing credit.… [O]ur results indicate that the role of credit in the identification of the economic cycle … is very limited…. [C]redit can describe the past but not infer the future.

[2] The analytical distinction made here is not common among policymakers. The more common practice is to characterize monetary policy in terms of the level of the policy rate and to characterize credit policies as "liquidity" enhancing programs that facilitate the "transmission" of monetary policy. In the United States, it is natural to think about how the Federal Reserve's reaction function shapes the behavior of the risk-free term structure of interest rates because there is a term structure

Second, narrative complements model. While identification of the shocks that produce a recession requires a model, all models are abstractions and incorrect in significant ways. Moreover, a multiplicity of models exists capable of fitting any given time series. In practice, economists use a model in conjunction with a (often implicit) narrative. The narrative brings in information from outside the model that renders plausible the association of a model's shocks, which are unobservable, with observable time series. The narrative here suggests that the monetary policy of the European Central Bank (ECB) was contractionary at times even though its credit policies were stimulative. At the same time, the reader should keep in mind that both monetary disorder and financial-market disruption work through financial markets and are therefore inherently difficult to separate.

Aoki (2001) serves here as the basic New Keynesian (NK) framework. Because Aoki (2001) contains a flexible-price and a sticky-price sector, it is useful for discussing the effects of the commodity-price shock that unfurled from summer 2004 through summer 2008 again in 2010 and 2011. With the Aoki model as background, one can then discuss how alternative estimated NK DSGE models with financial frictions add to an understanding of the Great Recession.

Section 1 discusses how the basic NK model can make explicit long-standing monetarist criticisms of a monetary policy that creates negative output gaps in order to control inflation. Section 2 asks how expansion of the basic NK model to include financial frictions modifies these implications. Section 3 provides one narrative of the Great Recession. It highlights how in 2008 and

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for government securities. In the Eurozone, in contrast, with the absence of a supranational risk-free Euro bond, the focus of attention is more naturally on the disparate banking systems of each member of the Eurozone. Credit-market interventions appear attractive as a way of facilitating the "transmission" of monetary policy and appear less abstract than monetary policy. The arguments here, however, point to the importance of a clear distinction between monetary and credit policy and to the importance of getting monetary policy right as the foundation.

2011 the ECB effectively attempted to lower headline inflation by creating a negative output gap. Section 4 discusses the credit policies of the ECB. Section 5 puts the decline in output associated with the decline in inflation in the Great Recession into the perspective of estimates of the "sacrifice ratio." Section 6 offers concluding comments.

1. Monetarism and the basic NK model

In *A Program for Monetary Stability*, Milton Friedman (1960) criticized policies of aggregate-demand management. His critique is pertinent to the current debate over the desirability of "inflation targeting" especially because he stated it in the context of criticism of a simple feedback rule for eliminating misses in the price level from target. In practice, given the "long and variable" lags between changes in the policy instrument and in inflation, such a rule effectively entails manipulation of an output gap as an intermediate target for eliminating misses of an inflation target.[3] Later, Friedman (1968 [1969]) developed his argument further in a critique of attempts by the central to exploit Phillips curve trade-offs between inflation and an output gap.

Although monetarists focused their criticisms on the procyclical behavior of money, they attributed that behavior to the cyclical inertia introduced by central banks into the setting of their interest-rate targets (Friedman 1984, 27; Poole 1978, 105). In the stop-go era, after cyclical troughs and during economic recovery, the Federal Reserve postponed raising the funds rate in order to speed a decline in the negative output gap. Similarly, 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 (Hetzel 2008, chs. 23-25; 2012, ch. 8).

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[3] Friedman (1960, 88) wrote: ["M]onetary changes have their effect only after a considerable lag and over a long period and that lag is rather variable…. Under these circumstances, the price level … could be an effective guide only if it were possible to predict, first, the effects of non-monetary factors on the price level for a considerable period of time in the future, second, the length of time it will take in each particular instance for monetary actions to have their effect…."

Friedman (1960) proposed that the central bank make money grow at a low, stable rate. The underlying hypothesis was that as long as the central bank provides a stable nominal anchor in terms of the domestic price level the price system works well to ameliorate cyclical fluctuations. Alternatively, major cyclical fluctuations derive from central bank interference with the price system. His k-percent money rule would have provided that nominal anchor while letting the price system determine real variables. The basic NK model explains how central banks controlled inflation after the disinflations of the early 1980s in this spirit, albeit without money targets.

That is, they abandoned recourse to Phillips curve trade-offs and instead relied on the way in which a credible rule shapes 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 nominal prices for multiple periods. They conditioned that nominal price setting through aligning the expectation of inflation of firms in the sticky-price sector (core inflation) with their inflation targets.

In the absence of markup shocks, if the central bank maintains price stability in the sticky-price sector so that actual and expected inflation equal zero, it also maintains the aggregate output gap equal to zero (Aoki 2001, eq. 33). Blanchard and Gali (2007) characterized this combination of price stability and a zero output gap as “divine coincidence,” a model characteristic noted in Goodfriend and King (1997). With divine coincidence, in order to maintain price stability in the sticky-price sector and the output gap equal to zero, the central bank should maintain the real rate of interest equal to the natural rate of interest, which is the real interest rate with price flexibility (Aoki 2001, eq. 50). That is, it should let the price system work freely to determine real variables.

Because high headline (aggregate) inflation in the Eurozone in 2008 and 2011 reflected a commodity-price shock emanating from the influence of internationally-determined prices on

inflation in the flexible-price sector, the ECB should have accommodated it. Aoki (2001, 57 and 75) stated this implication of the NK model:

> [T]here is a trade-off between stabilizing the aggregate output gap and aggregate inflation, but … there is no trade-off between stabilizing [the] aggregate output gap and stabilizing core inflation…. [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.

2. Adding frictions in financial intermediation to the basic NK model

In the context of the basic NK model with no financial frictions, consider first shocks that create a wedge between the household's intertemporal rate of substitution in consumption and the risk-free real rate of interest. To this end, Smets and Wouters (2007, equation 2) add a shock to the Euler equation. The Board of Governors EDO model adds a wedge in the budget constraint between the policy rate and the return on bonds held by households (Chung et al 2010, equation 12). In Aoki (2001, eq. 1), the shock enters directly in the household utility function. For example, an intertemporal preference shock that causes households to value future consumption relatively more highly than current consumption lowers the natural rate of interest.

The way in which one interprets this variety of shock, termed here a "demand shock," depends upon the narrative adopted. In Aoki (2001), it is natural to interpret it as a savings shock. That is, with a positive savings shock, at the existing interest rate, households want to transfer additional consumption from the present to the future.[4] Regardless of the interpretation of the shock,

[4] Although practitioners use the shock as a portmanteau variable for capturing an increase in risk, the implicit financial frictions are not modeled in the basic NK model. It is also hard to talk about risk in a linear model because risk concerns tail outcomes captured by higher order moments of the correlation between expected rates of return and consumption.

the implications for monetary policy remain the same. Consider a positive savings shock, which manifests itself as an increased demand for the risk-free asset.

The central bank can neutralize the impact on the economy by lowering its policy rate in line with the natural rate. In doing so, it satisfies the increased demand for the risk-free asset. The real world counterpart is that with an interest rate target, the increased demand by households for insured deposits is met by an increased supply of deposits. It is plausible that the Lehman bankruptcy on September 15, 2008 produced a sharp decline in the natural rate of interest.[5] However, if the central bank puts inertia into declines in the policy rate relative to the natural rate as occurs with an inertial Taylor rule, nominal rigidities require that real income decline in order to offset the incipient increased demand for the risk-free asset.[6] As documented in section 3, the ECB was slow to lower its policy rate after the increase in summer 2008 because of its focus on headline inflation.[7]

An NK model like Smets-Wouters (2007), SW, uses a representative household with no financial intermediation. Christiano, Motto, and Rostagno (2010 and 2013), CMR, allow for financial intermediation and thus for financial frictions. Their model includes savers and investors whose rates of intertemporal substitution differ in a time-varying way due to a financial friction. An

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[5] To the best of the author's knowledge, none of the papers estimating NK models for the Eurozone includes estimates of the natural rate of interest. One paper contains a measure of the "unconditional flexible-price output gap" for the period 1999Q1 through 2010Q1 (Vetlov et al 2011, Fig. 2.2). This measure declined by about 7 percentage points from 2008Q1through 2009Q1 (10 percentage points through 2010Q1). For the United States, also using a DSGE model and for the comparable period 2008Q1 through 2009Q1, Gali et al (2012) estimated a decline of about 6 percentage points for the output gap and 12.5 percentage points for the natural rate of interest. Numbers kindly supplied by Rafael Wouters.

[6] Fève et al (2009, 13) repeat for Europe the monetarist critique contained in the above references to Friedman (1984) and Poole (1978): "[T]he form of monetary policy, namely monetary policy inertia, has played an important role in the large and persistent increase of the real interest rate and the sizeable output losses that have followed from disinflation policies of the eighties."

[7] An additional way in which financial disruption and monetary disorder can be mutually reinforcing is through disinflation, which increases the real value of debt in an unanticipated way.

external finance premium that moves negatively with the net worth of firms creates a financial-accelerator mechanism that amplifies the effect of macroeconomic shocks on economic fluctuations. A "credit-risk" shock in the form of a positive exogenous shock to the external finance premium caused by the belief that the productivity of firms has become more dispersed exacerbates default risk and captures the idea of a financial crisis.

In the basic NK large-scale DSGE model without financial frictions, a demand shock like a positive savings shock would by itself raise investment by lowering consumption.[8] Similarly, in a model with financial frictions, a credit-risk shock that depresses investment increases consumption (see for example, Kollmann et al 2016, Fig. 3e). Models that include financial frictions then also include demand shocks. As noted, with demand shocks, the central bank can neutralize the impact on the real economy by following the change in the natural rate with the policy rate. At the same time, adding a friction in addition to sticky prices creates one more objective in the central bank's objective function. The central bank should go beyond the divine coincidence that entails tracking the natural rate and trade off among objectives (Carlstrom et al 2010). Optimal policy in a financial crisis would require missing the inflation and output objectives on the upside, however, not the downside as occurred in the Great Recession.

It is instructive to review the results of DSGE estimation for the Great Recession in the Eurozone keeping in mind that demand shocks, which affect the household's intertemporal preferences for consumption, possess consequences for the real economy only if the central bank does not neutralize them by allowing its policy rate to vary in line with the natural rate of interest. Smets et al (2010, Figures 3 and 4) includes a decomposition of real GDP that extends through

[8] In order to generate the simultaneous decline in consumption and investment characteristic of recession, one can include a marginal efficiency of investment (MEI) shock that increases the relative price of investment in terms of the consumption good.

2009Q2 for two models. One is the New Area-Wide Model (NAWM) based on SW (see Christoffel et al 2008) and the other is the CMR model. For the recession quarters 2008Q3 through 2009Q2, the NAWM model shows demand, policy, and international shocks as the major determinants of the decline in GDP. For these same quarters, the CMR model shows demand, technology, and financial shocks as all significant contributors to the decline in GDP. Christiano et al (2010, Figure 18a) basically repeat these results for the CMR model with a somewhat different grouping of individual shocks into more inclusive combinations. Over the interval 2008Q3 through 2009Q2, the most significant shocks are demand shocks, capital formation shocks, which create a wedge between the risk-free rate and the cost of external finance to firms, and technology and markup shocks. In 2009Q1 and Q2, the first two of these shocks dominated.[9]

Neither the basic NK model nor the NK model with financial frictions can reconcile for the Great Recession an assumption of optimal monetary policy with the observed combination of a decline in output below trend and inflation below target as well as the persistent shortfalls of inflation from target.[10] The monetarist and NK DSGE approaches both suggest cyclical inertia in the central bank's policy rate as a source of monetary shocks (Hetzel 2012, Chs. 7 and 12; 2008, Chs. 23-24). Nevertheless, empirical estimation of the NK model reveals how hard it is to distinguish between shocks that reflect disruption to financial intermediation and shocks that reflect monetary disorder,

[9] The CMR model shows "policy" shocks making a small positive contribution to GDP. However, such shocks measure the policy rate relative to the Taylor rule benchmark not relative to the natural rate of interest.

[10] Fève et al (2010) make this point for the countries of the Eurozone for an earlier period: "Using euro area data and structural vector autoregressions (SVARs), we identify disinflation shocks as the only shocks that drive nominal variables to a lower long-run level. We find that in the immediate aftermath of a disinflation shock, the euro area enters a persistent recession."

that is, central bank interference with the operation of the price system. Neither shock is directly observable while both manifest themselves through increased uncertainty in financial markets.

3. A narrative account of the Great Recession

Figure 1 shows cyclical peaks in 2008Q1 and 2011Q1 for real GDP growth. Figure 2 shows real GDP growth for the core countries of the Eurozone and the main peripherals. In Figure 2, for the first recession, the basic coincidence of the series indicates a common shock among Eurozone countries. In the second recession, the near coincidence of peaks also suggests a common shock but the severity of the downturn for the peripheral countries indicates the severity of the capital flight they experienced (Hetzel 2014).[11]

Figure 3 shows the real (inflation-adjusted) one-year Euribor rate constructed by subtracting forecasted inflation using the ECB's Survey of Professional Forecasters from the Euribor rate. Use of the one-year Euribor rate accounts for the forecast by financial markets of the near-term path of the ECB's MRO (main refinancing operations) rate. With each recession, the real interest rate declines significantly only well after the cyclical peak. The Eurozone economy weakened after 2001Q1but in contrast the real rate of interest had already begun a steady decline after 2000Q3.

Figure 4 shows that prior to 2008 the ECB had moved its policy rate in a "lean-against-the-wind" way without imparting significant inertia to it. Figure 4 plots changes in the ECB's MRO 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

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[11] One common explanation for the Great Recession points to a collapse of speculative excess in the peripherals characterized as a "boom-bust cycle … not unlike the subprime bubble" (Honkapohja 2014, 261-2). This explanation suggests counterfactually that for the first recession the initial decline in output should have started in the peripheral countries and spread subsequently to the core countries and that the decline in output should have been significantly more pronounced in the latter.

[12]The Markit purchasing manager's index, PMI, and industrial production yield similar graphs.

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.

Econometric evidence is consistent with the hypothesis that the ECB's control of inflation occurred mainly through the way in which a credible rule conditioned price-setting in the sticky-price sector rather than through manipulation of an output gap. Based on estimation of a Taylor rule, as an average over the first decade of the ECB's operation, Aastrup and Jensen (2010) concluded:

> 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.

Goldman Sachs (2016a, "Exhibit 1: ECB's response to inflation varies across time") highlighted the departure in the 2008 period by estimating a Taylor rule using real-time data with a rolling coefficient on core inflation. The coefficients on the inflation term fluctuate around zero until 2008 when they jump to 2 and only decline to zero at the end of 2012. That is, in 2008 when the ECB became concerned about headline inflation well above its target, it began to respond directly to inflation and as a result to create a negative output gap.

In 2008, both core inflation and expected inflation remained close to the objective of 2% or somewhat less with the latter declining only after mid-2013 (Figures 6 and 7). As shown in Figure 8, which graphs the Euro price of oil and the CRB Commodity Spot Price Index, the price of oil began

to rise in 2004 followed by commodity prices in 2006.[13] Starting in late 2007, this commodity price inflation passed into headline inflation (Figure 6).[14]

The jump in commodity price inflation reduced household real income. Figure 9 shows the cessation in 2007Q3 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 2.8% 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. Instead, in July 2008, it raised the MRO rate from 4.0% to 4.25% (Figure 4). Moreover, the ECB's

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[13] In early 2004, the price of oil was €25 per barrel. It 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 presumably because of an offsetting 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: 1.6% (2007Q4), .2% (2008Q1), -.6% (2008Q2), and -1.9% (2008Q3).

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

[17] As shown in Figure 9, the persistent decline in real income after 2007Q3 is consistent with households forecasting a persistent decline in their income and consequently a reduction in the natural rate of interest. Blanchard and Gali (2007, 36) noted, "The effects of changes in factors such as the price of oil … appear through their effects on natural output." The persistence of the commodity price shock first from 2004 through summer 2008 and then from 2009 through 2011 suggests a reduction in the natural rate of interest through pessimism about growth in natural output. It is also plausible that the 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 left-tail risk can lower the natural rate of interest, see Rietz (1988) and Guvenen et al (2014).

communications caused markets to anticipate further increases in rates. Figure 10, which plots the difference between 12-month and 1-month Euribor rates, suggests that from the beginning of 2008 until fall 2008 markets expected a significant increase in rates.[18] The ECB lowered rates only when headline inflation fell (Figure 11). The decline in 2009 in both core inflation and in real output is consistent with contractionary monetary policy (Figures 1 and 6).

The ECB explained its actions in 2008 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 3.2% over the interval 2003Q1 through 2007Q4 to 4.1% in the first three quarters of 2008. 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 order to keep headline inflation at 2%. It did so by raising rather than lowering its policy rate when economy went into recession.

When the world economy began to recover in 2009, commodity-price inflation rose once more (Figure 8). Starting in early 2011, turmoil in the Middle East also caused oil prices to rise. Headline inflation, which had fallen to -.5% in 2009, rose to 3% by end-2011 although core inflation remained well below target (Figure 6). The second commodity-price shock intensified the ongoing

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[18] The policy rate in the NK model can be thought of as the level of the one-year Euribor rate, which depends upon the MRO rate and the ECB's communication about its future path. Some of the upward slope in the term structure is likely due to increased uncertainty raising the term 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 2008a, 6) noted: "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."

decline in real disposable income after 2010Q4. Consumption, which had been recovering slowly, again began to decline after 2010Q4 (Figure 9). Real retail sales peaked in September 2010 (Figure 4). Growth in real GDP peaked in 2011Q1 (Figure 1). Given its focus on headline inflation, the ECB raised its policy rate twice in 2011, from 1% to 1.25% in April and to 1.5% in July.

Monetary-contraction as an explanation has the advantage of simplicity in that it offers a common explanation of each recession. First, monetary contraction is consistent with the observed decline in core inflation and in output in both recessions.[20] Second, the ECB responded to the commodity-price shock in the same way in each recession. Moreover, repeated monetary contraction can explain why in contrast to past experience a strong recovery did not follow a deep recession.

If the central bank follows a rule that keeps the real rate of interest equal to the natural rate, given the accommodation of money supply to money demand implied by an interest rate target, nominal money grows at a rate consistent with the central bank's inflation target. Money then 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.[21] 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 move together.

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

[21] 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.

For this reason, it is hard to disentangle causation between growth in M3 and in the economy. M3 is then a contemporaneous indicator of the economy.

M1 growth slowed starting in mid-2006 and slowed sharply at the end of 2007 (Figure 13).[22] Real GDP growth then declined from an annualized rate of 2.2% in 2008Q1 to -1.2% in 2008Q2. After falling to near zero in 2008Q3, M1 growth revived. Real GDP growth then reached a trough in 2009Q1 with annualized growth of -11.3%. M1 growth fell sharply starting in 2010Q3. Real GDP growth then declined from an annualized growth rate of 3.4% in 2011Q1 to -1.3% in 2011Q4.

Despite possessing some predictive value, the signal to noise ratio is low for M1. 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 thus inflating M1 growth. 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).

4. The interaction of financial crisis and contractionary monetary policy

In the Great Recession, following its "separation principle," the ECB focused monetary policy on headline inflation and focused credit (liquidity) policy on maintaining financial intermediation.[23] As noted by Cour-Thimann and Winkler (2013, 2):

> The ECB's approach to date appears to stand out among central banks: its non-standard measures have been aimed not at providing additional direct monetary stimulus to the

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[22] 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 2010a, 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.

[23] For an overview of the latter, see (European Central Bank 2010b and Gonzalez-Páremo 2013).

> economy but [rather its] non-standard measures are a complement to rather than a substitute for standard interest rate policy.

Cahn et al (2014, 3) made a similar point:[24]

> In response to the 2008-2009 crisis, central banks in most advanced countries embarked in large-scale asset purchase programs. In the euro area … instead, the bulk of non-standard interventions took the form of long-term refinancing operations (LTRO's)…. Through these operations, the ECB aimed at increasing the average maturity of outstanding liquidity, from approximately 20 days before the crisis to more than 200 days in the second half of 2009.

While financial-market disruption must have impacted economic activity adversely in the Great Recession, the two cycle peaks preceded the episodes of the most severe disruption. The first cycle peak occurred in 2008Q1. Real GDP fell at annualized rates of -1.3% and -2.2% in 2008Q2 and 2008Q3, respectively. Industrial production including construction peaked in February 2008. In 2008Q1, stresses in financial markets were still contained, however.

In August 2007, when cash investors ceased buying the commercial paper that financed the holding of subprime mortgages in U. S. banks' off-balance-sheet entities, banks moved them onto their own balance sheets. European banks held many of these illiquid mortgages (Hetzel 2012, 179 and 242). Uncertainty over the extent to which individual European banks held them 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, they began to hold additional excess reserves (Heider et al 2009). The ECB accommodated that increased demand. In August 2007, it introduced fixed rate/full allotment tenders and in October 2008 made them standard. The EONIA rate (the euro equivalent of the funds rate) remained fixed at the ECB's MRO rate.

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[24] The authors use a DSGE model in which credit policies are stimulative by reducing the interest-rate wedge imposed by banks on financial intermediation. Cahn et al (2014, 2) find that the LTROs "can have large macroeconomic effects … when the separation principle is breached…. that is to say when we force monetary policy not to react to the stimulative effects of LTROs."

The Federal Reserve and the ECB cooperated in order to relieve funding pressures on European banks with dollar liabilities. With the term auction facility, the Fed auctioned dollars to the U. S. branches of European banks. Through swap lines, the Fed provided dollars to the ECB, which it relent to European banks to replace the dollar funding no longer supplied by money market mutual funds (Hetzel 2012, 244 and 267). Only with the Lehman bankruptcy in September 2008, however, did the amounts outstanding in this facility jump significantly.[25]

Loan growth remained healthy until after the economy entered recession in 2008Q1. Bank loans to the private sector (MFIs) averaged 10.7% year-over-year from May 2006 through May 2008 (Figure 12). Only in June 2008, did growth fall below 10%.[26] By these measures, funding pressures were manageable through the cycle peak.[27] After the recovery took hold in 2009Q3, loan growth recovered steadily until peaking in 2011Q3. Economic recovery, however, aborted earlier. Growth in real GDP fell from 3.4% in 2011Q1 to zero in 2011Q2 and Q3 and to -1.3% in 2011Q4.

From mid-summer 2011 to mid-summer 2012, investors fled the sovereign debt markets of the peripheral countries, most noticeably because of their size Italy and Spain, out of fear that they would exit the Eurozone. Sovereign credit default swap spreads for Italy and Spain started their

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[25] Before Lehman, swap amounts outstanding averaged about $50 billion (Goldberg et al 2010).

[26] In recession, it is hard to separate disruption to financial intermediation as a causal factor from reduced demand due to a weakening economic outlook. The July 2008 "Euro Area Bank Lending Survey" (European Central Bank 2008b) 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] Significant disruption did occur with the Lehman Brothers bankruptcy on September 15, 2008. It precipitated a run of cash investors who ceased funding financial institutions with long-term, illiquid mortgage assets. They transferred their funds to the too-big-to-fail banks, to conservatively managed institutions, and into government debt. The underlying shock was a retraction of the financial safety net to a new, more limited but ambiguous line (Hetzel 2012a, Ch. 13).

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 (Figure 1). The timing suggests causation going from the economic weakness to a debt crisis rather than the reverse.

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 (Figure 14). 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.

The year 2011 illustrates the difference between monetary and credit policy. In the last half of 2011, ECB lending to banks in the peripheral countries jumped. Consider ECB lending to Spanish banks, which replaced loans previously made by German banks. German banks placed the reserves gained from calling in their loans in the ECB's deposit facility. In effect, the ECB became the conduit for lending by German banks to Spanish banks. The increase in the size of the ECB's balance sheet indicated a stimulative credit policy, that is, a supportive effect on financial intermediation. The ECB's credit policies were largely successful in limiting increases in money-market spreads like Euribor-OIS (Goldman Sachs 2016b).[28]

Also in 2011, in April and July, the ECB tightened monetary policy by raising its policy rate. As late as the April 2012 *Editorial* in the ECB *Monthly Bulletin* (April 2012, 5), the ECB Governing

[28] De Andoain et al (2014) sought instances of "fragmentation:" 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 LTROs (long-term refinancing operations) on December 8, 2011 providing three-year financing to banks by the ECB. 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).

Council retained hawkish language on inflation: "Inflation rates are likely to stay above 2% in 2012, with upside risks prevailing." Only in July 2012 did the Governing Council guide the EONIA rate toward zero by cutting the MRO rate from 1% to ¾% and the deposit rate to zero. As late as May 2012, the ECB had still ruled out forward guidance, the essence of which is pre-commitment. In response to a question, Mario Draghi (5/3/2012, 4) responded, "[A]s we always say, we never pre-commit."[29] As implied by indexed swap markets, in mid-2011 the expected time for inflation to return to 2 percent was almost 9 years. After falling briefly, in mid-2012, it returned to that value but then rose to 20 years after summer 2014 (Goldman Sachs, 4/2/15, 3).

5. 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 magnitude. One way to arrive at an estimate is to draw on the sacrifice-ratio literature, which measures the cost in terms of lost output produced by a reduction in inflation. The first thing to note is that estimated Phillips curves have become "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. With expected inflation the dominant determinant of trend inflation, contractionary monetary policy in an environment of central bank credibility implies a high sacrifice ratio. In reference to the FRB/US model of the staff of the Board of Governors, Kiley et al (2006) noted:

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[29] Kang et al (2015) documented that equity markets responded positively to the Fed's interest rate cuts but negatively on average to the ECB's rate cuts. They attributed the difference to the belief by markets that the cuts by the Fed manifested its commitment to restore full employment while the cuts by the ECB simply conveyed pessimism about the economy. Kang et al (2015, 45) used ECB communication to argue that "When commodity prices were pushing inflation up, the ECB sought to nip it in the bud; but when commodity prices pushed inflation down, the ECB preferred to wait in anticipation of a return to more normal inflation rates." In contrast, after the 2009 cycle trough, the FOMC sought to anchor expected inflation while using forward guidance to stimulate the economy.

> [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.

How well does this sacrifice ratio of 6 do in explaining Eurozone experience? For the first recession, from 2008Q1 through 2010Q2, the unemployment rate rose 3 percentage points from 7.3% to 10.3% while the inflation rate in the services sector (sticky-price sector) fell 1.3 percentage points from 2.6% to 1.3% (Figures 5 and 15). With 7.3% as NAIRU and average unemployment over this period of 8.8%, unemployment averaged 1.5 percentage points above NAIRU for 2.25 years. Roughly, the sacrifice ratio would be 2.6. For the second recession, from 2011Q1 through 2013Q2, the unemployment rate rose 2.1 percentage points from 10.0% to 12.1% while the inflation rate in the services sector fell .2 percentage points from 1.6% to 1.4%. With 10.0% as the NAIRU and average unemployment over this period of 11.1%, unemployment averaged 1.05 percentage points over NAIRU for 2.25 years. Roughly, the sacrifice ratio would be about 12.

The estimated sacrifice ratio for the first recession appears consistent with historical experience while the estimated sacrifice ratio for the second recession appears implausibly high (see also Ball and Mazumder 2015). For the second recession, it thus seems likely that the increase in the unemployment rate originated to a significant extent in the disruption to financial intermediation associated with the capital flight crisis in 2011-2012 (Hetzel 2014). At the same time, the decline in services sector inflation to 1.3% in 2016Q1 is inconsistent with the expansionary monetary policy appropriate if the central bank's reaction function includes mitigation of financial frictions (Carlstrom et al 2010).

6. Concluding comment

In 2008 and again in 2011, the Eurozone experienced a commodity-price shock, which raised inflation in the flexible-price sector. Rather than concentrating on core inflation (inflation in the sticky-price sector), 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 core inflation and lowering the policy rate in order to maintain a zero output gap in the sticky-price sector. In both episodes, disruptions to financial intermediation would have called for expansionary monetary policy. If the pessimism from the financial crisis in fall 2008 and again after mid-2011 lowered the natural rate of interest, then the credit policies of the ECB would have been insufficient to stem recession without more aggressive reductions in the policy rate combined with forward guidance.

Two different responses to the Great Recession are possible. Central banks could add the mitigation of financial frictions to their reaction function by adding a response to variations in credit spreads, to the degree of leverage in the financial system, or to the cyclical behavior of credit. Alternatively, they could concentrate on the design of an optimal reaction function assuming no credit frictions and then use credit-market interventions in an ad hoc way in order to deal with disruptions to financial-market intermediation. With either choice, it is important for policymakers to maintain a clear distinction between monetary policy and credit policy.

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.

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

Cahn, Christophe; Julien Matheron; and Jean-Guillaume Sahuc. "Assessing the Macroeconomic Effects of LTROS." Banque de France Document de Travail No. 528, December 2014.

Carlstrom, Charles T.; Timothy S. Fuerst; and Matthias Paustian. "Optimal Monetary Policy in a Model with Agency Costs. *Journal of Money, Credit and Banking*, Supplement to Vol. 42, No. 6 (September 2010), 37-70.

Christiano, Lawrence; Roberto Motto; and Massimo Rostagno. "Financial Factors in Economic Fluctuations." European Central Bank. Working Paper Series, No. 1192, May 2010.

_____. "Risk Shocks." NBER Working Paper 18682, January 2013.

Christoffel, Kai; Günter Coenen; and Anders Warne. "The New Area-wide Model of the Euro Area." European Central Bank Working Paper Series No. 944, October 2008.

Chung, Hess T.; Michael T. Kiley; and Jean-Philippe Laforte. "Documentation of the Estimated, Dynamic, Optimization-based (EDO) Model of the U.S. Economy: 2010 Version." Finance and Economics Discussion Series, Federal Reserve Board, Washington D.C., 2010-29, 2010.

Cour-Thimann, Philippine and Bernhard Winkler. "The ECB's Non-Standard Monetary Policy Measures." European Central Bank Working Paper Series No. 1528, April 2013.

Curdia, Vasco and Michael Woodford. "Credit Spreads and Monetary Policy." NBER Working Paper 15289, August 2009.

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.

Draghi, Mario. "Introductory Statement to the Press Conference (with Q&A)." European Central Bank. Barcelona, May 3, 2012.

European Central Bank. "Editorial." *Monthly Bulletin*, July 2008a, 5-8 and May 2011, 5.

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

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

_____. “Article: The ECB’s Response to the Financial Crisis.” *ECB Monthly Bulletin* October 2010, 59-74.

_____. “Editorial.” *Monthly Bulletin*, April 2012, 5-6.

Fève, Patrick; Julien Matheron; Jean-Guillaume Sahuc. “Inflation Target Shocks and Monetary Policy Inertia in the Euro Area.” Document de Travail No. 243, Banque de France, August 2009.

_____. “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.

_____. “Monetary Policy for the 1980s.” In *To Promote Prosperity: U.S. Domestic Policy in the mid-1980s*, ed. John. H. Moore, Stanford: Hoover Institution Press, 1984, 23-60.

Gali, Jordi; Frank Smets; and Rafael Wouters. “Slow Recoveries: A Structural Interpretation.” National Bureau of Economic Research WP 18085, May 2012.

Goldberg, Linda S.; Craig Kennedy; Jason Miu. “Central Bank Dollar Swap Lines and Overseas Dollar Funding Costs.” NBER Working Paper No. 15763, February 2010.

Goldman Sachs. European Economics Analyst: Euro Area Inflation Expectations and QE: Moments of Truth.” Economics Research, April 2, 2015.

_____. “European Economics Analyst: Explaining Time-Varying Rate Sensitivity to Inflation in the Euro area.” Economics Research, May 5, 2016a.

_____. “European Economics Analyst: Unconventional Monetary Policy and Financial Stability.” Economics Research, June 9, 2016b.

Gonzalez-Páremo, Jose Manuel. “Innovations in Lender of Last Resort Policy in Europe.” In Gerard Caprio, Jr., ed., *Handbook of Safeguarding Global Financial Stability: Political, Social, Cultural, and Economic Theories and Models*. London: Elsevier, 2013, 435-442.

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

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

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

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

_____. "ECB Monetary Policy in the Great Recession: A New Keynesian (Old Monetarist) Critique," Federal Reserve Bank of Richmond Working Paper, 13-07R, July 2013.

_____. "Should Greece Remain in the Eurozone?" Federal Reserve Bank of Richmond *Economic Quarterly* 100, (3rd quarter 2014), 241-278.

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

Kang, Dae Woong; Nick Ligthart; and Ashoka Mody. "The European Central Bank: Building a Shelter in a Storm." Griswold Center for Economic Policy Studies Working Paper 248, Princeton University, December 12, 2015.

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.

Kollmann, Robert; Beatrice Pataracchia; Rafal Raciborski; Marco Ratto; Werner Roeger; and Lukas Vogel. "The Post-Crisis Slump in the Euro Area and the US: Evidence from an Estimated Three-Region DSGE Model." Federal Reserve Bank of Dallas Globalization and Monetary Policy Institute. Working Paper No. 269, February 2016.

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.

Rivas, Maria Dolores Gadea and Gabriel Perez-Quiros. "The Failure to Predict the Great Recession—A View through the Role of Credit." *Journal of the European Economic Association* 13(3) (June 2015) 354-559.

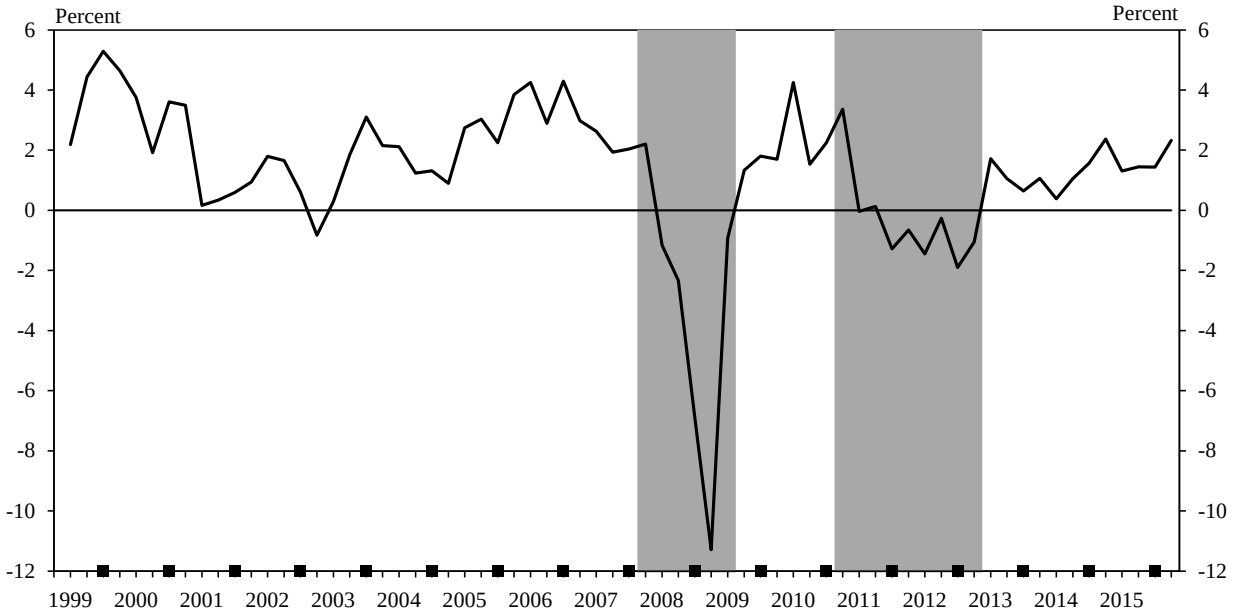
Smets, Frank; Kai Christoffel; Günter Coenen; Roberto Motto; and Massimo Rostagno. "DSGE Models and Their Use at the ECB." *Journal of the Spanish Economic Association Series*. Vol. 1, March 2010, 51-65.

Smets, Frank and Rafael Wouters. "Shocks and Frictions in US Business Cycles: a Bayesian DSGE Approach." *American Economic Review* 97 (2007), 586-606.

Vetlov, Igor; Tibor Hlédik; Magnus Jonsson; Henrik Kucsera; and Massimiliano Pisani. "Potential Output in DSGE Models." European Central Bank Working Paper Series No. 1351, June 2011.

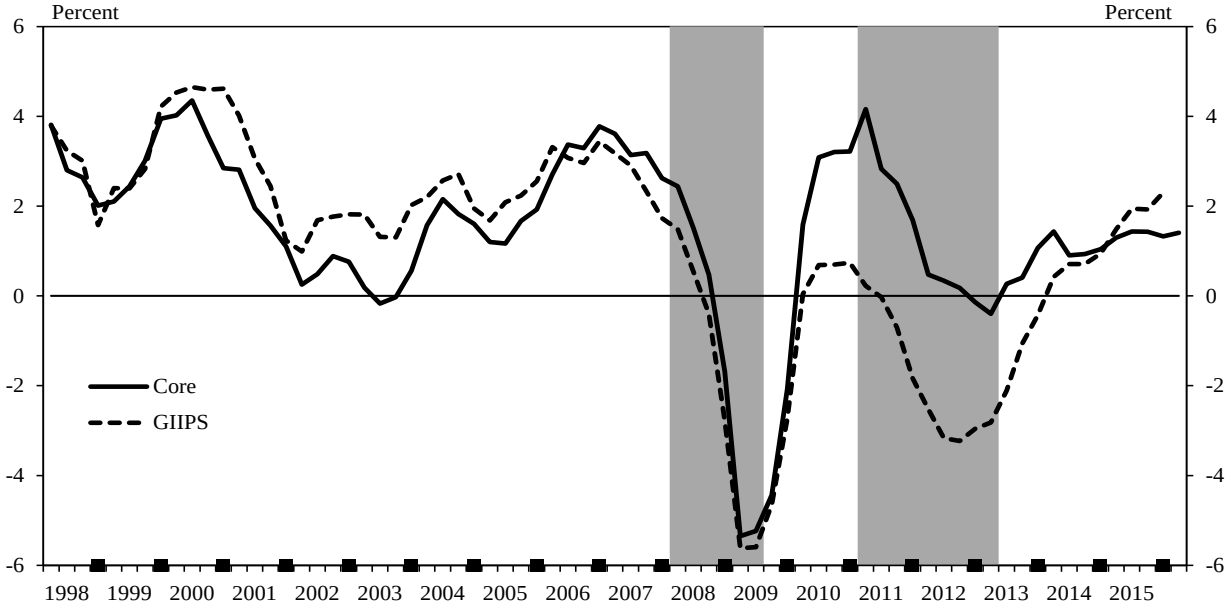
Woodford, Michael. "Inflation Targeting and Financial Stability." NBER Working Paper 17967, April 2012.

Figure 1
Growth in Real GDP



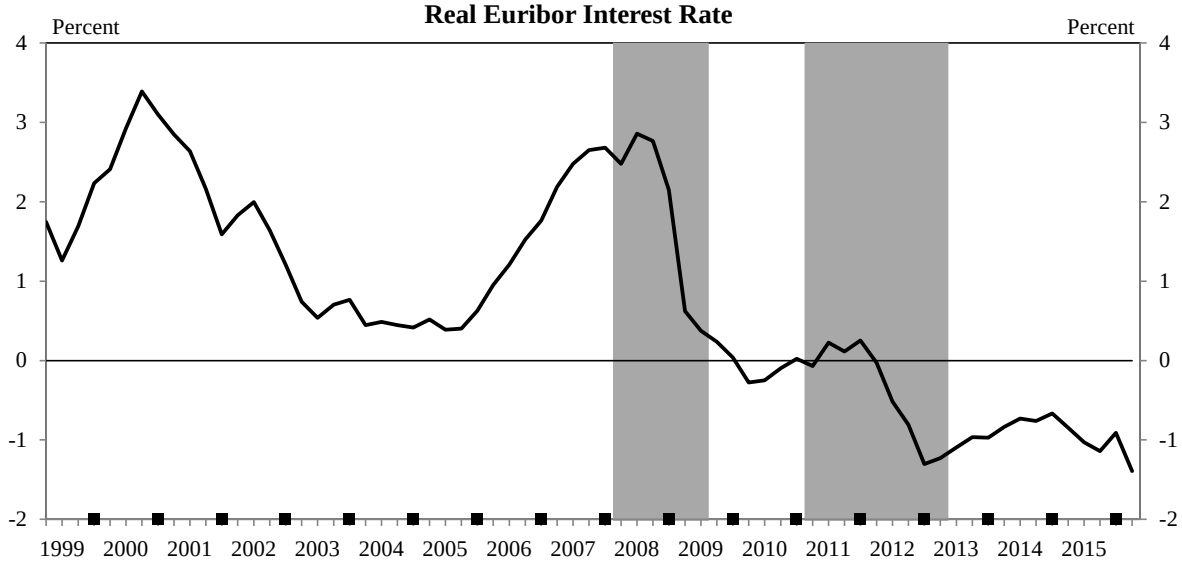
Notes: Quarterly observations of quarterly annualized percentage changes in real GDP. Shaded areas mark recessions with cycle peaks 2008Q1 and 2011Q1. Heavy tick marks indicate fourth quarter. Source: Haver Analytics.

Figure 2
Growth in Real GDP for Core and GIIPS Countries



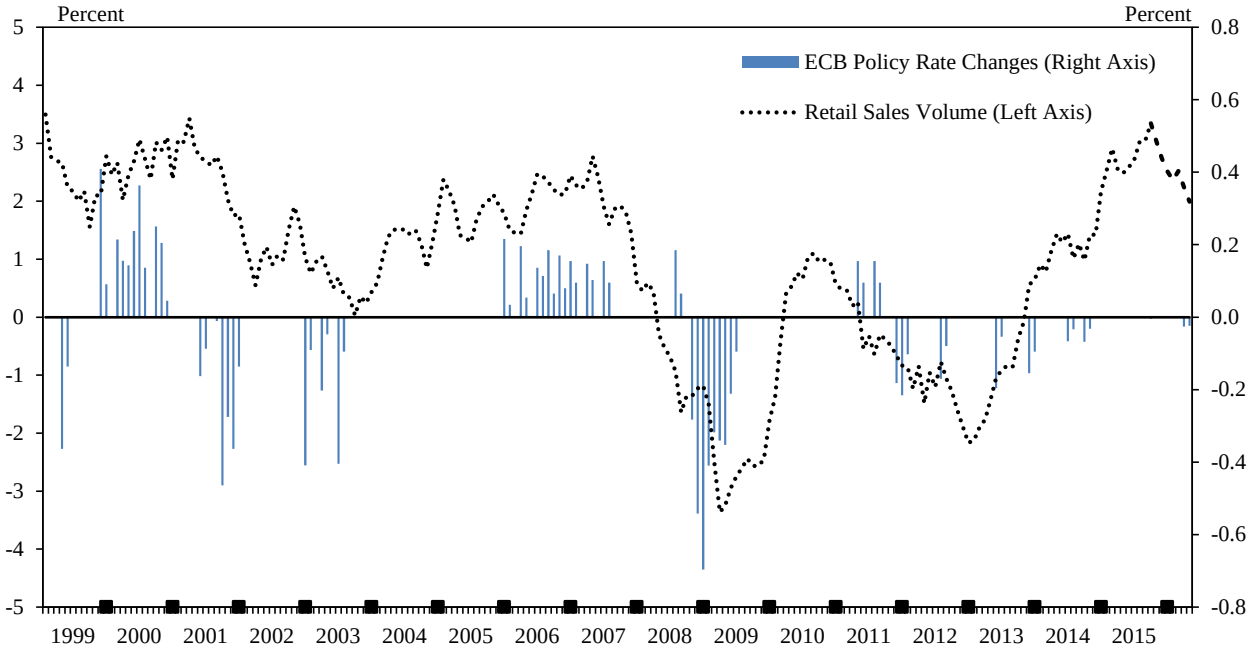
Notes: Four-quarter percentage change in real GDP for core countries (Austria, Belgium, Finland, France, Germany, and Netherlands) and the GIIPS (Greece, Ireland, Italy, Portugal, and Spain). Heavy tick marks indicate fourth quarter . Source: Haver Analytics

Figure 3
Real Euribor Interest Rate



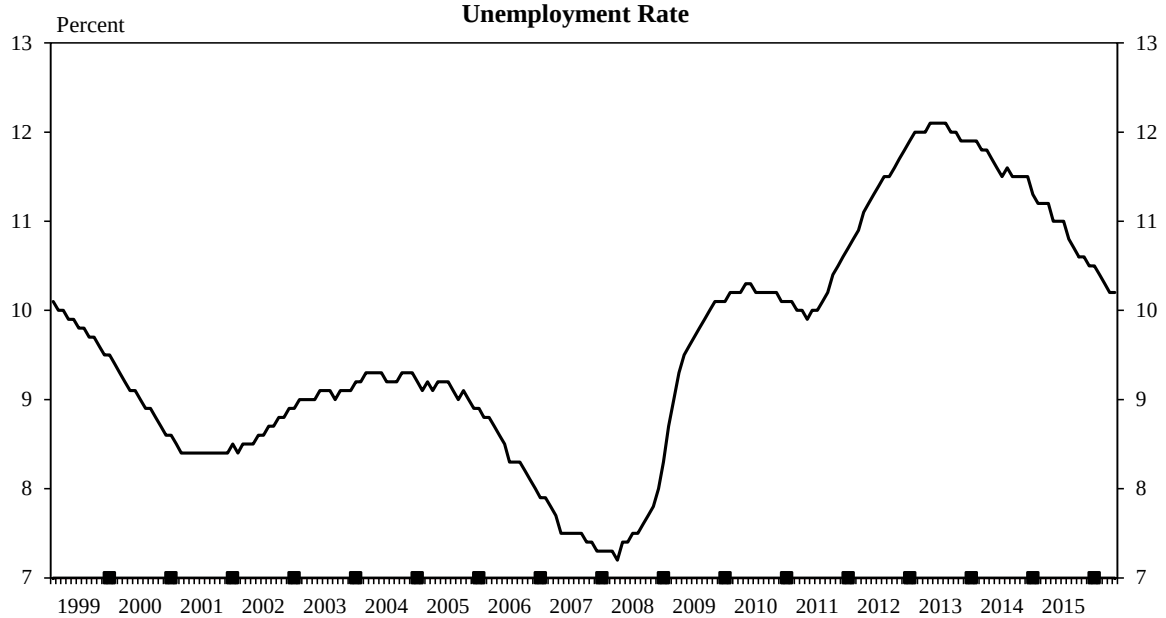
Notes: Quarterly observations of real one-year Euribor interest rates constructed using one-year ahead inflation forecasts from ECB Survey of Professional Forecasters mean point estimates. Heavy tick marks indicate fourth quarter. Source: ECB and Haver Analytics.

Figure 4
Retail Sales and ECB Policy Rate



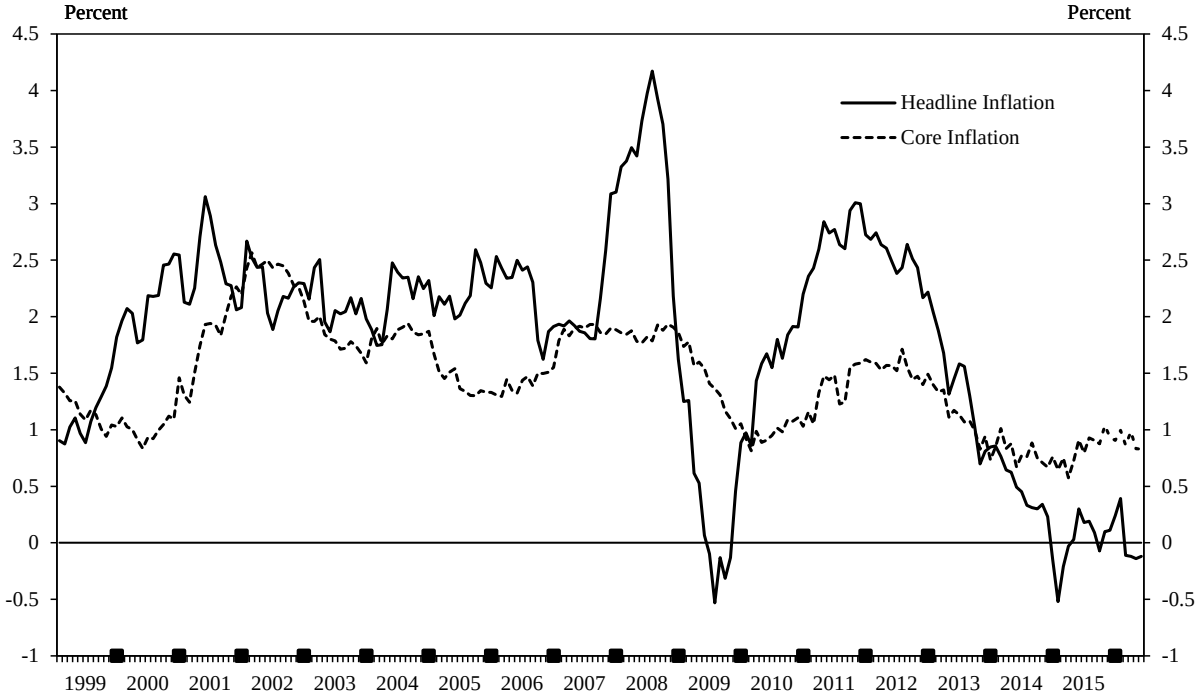
Notes: Retail Sales Volume is the three-month moving average of the year-over-year percentage change in the EA 17: Retail Sales Volume Index (SA/WDA, 2010=100). ECB Policy Rate is the Main Refinancing Operations (MRO) Rate. Because changes in the MRO rate occur within the month and data are monthly,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

Figure 5
Unemployment Rate



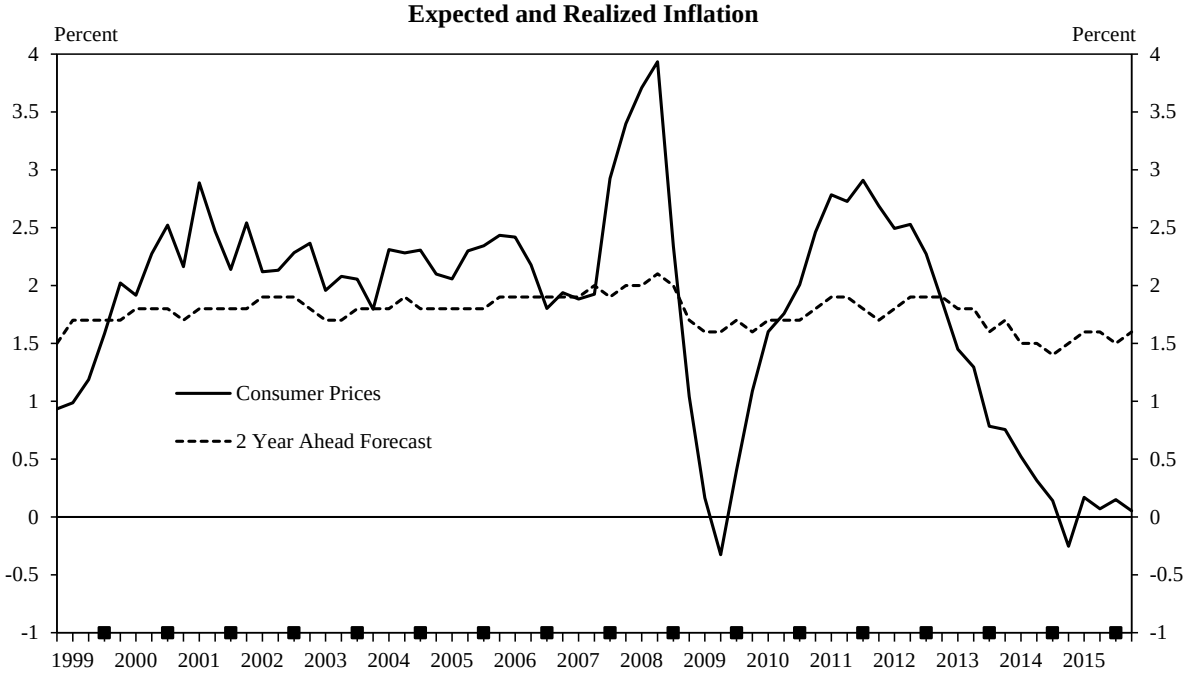
Notes: Unemployment rate for the Euro Area. Heavy tick marks indicate December. Source: Eurostat and Haver Analytics.

Figure 6
Headline and Core Inflation



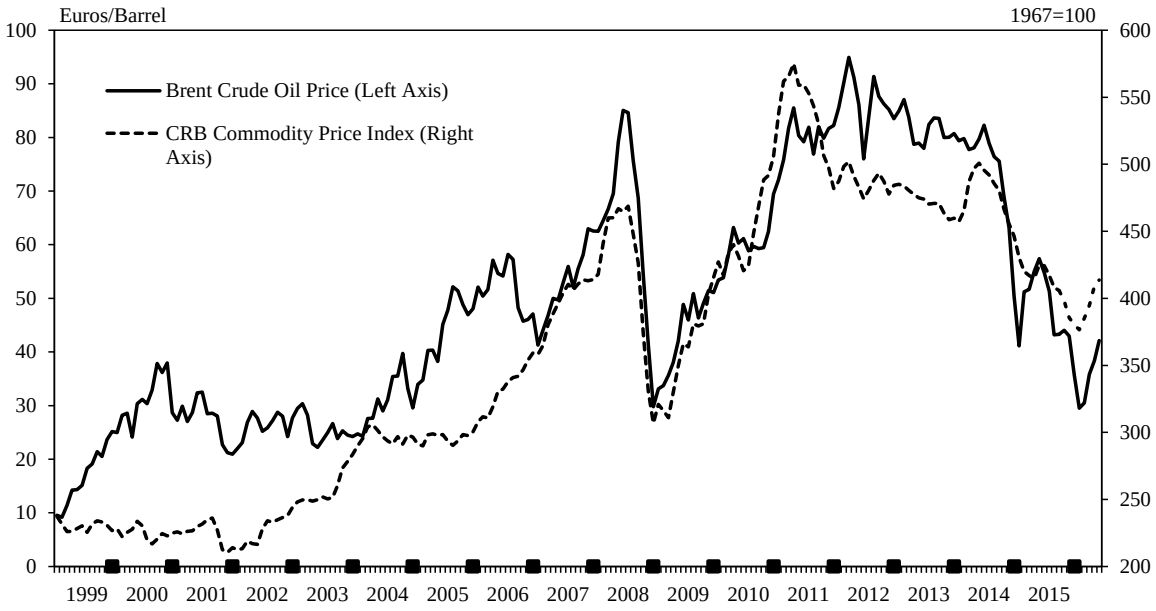
Notes: Monthly observations of 12-month percentage changes. Headline inflation is the harmonized CPI. Core inflation excludes energy, food, alcohol and tobacco. Heavy tick marks indicate December. Source: ECB and Haver Analytics.

Figure 7
Expected and Realized Inflation



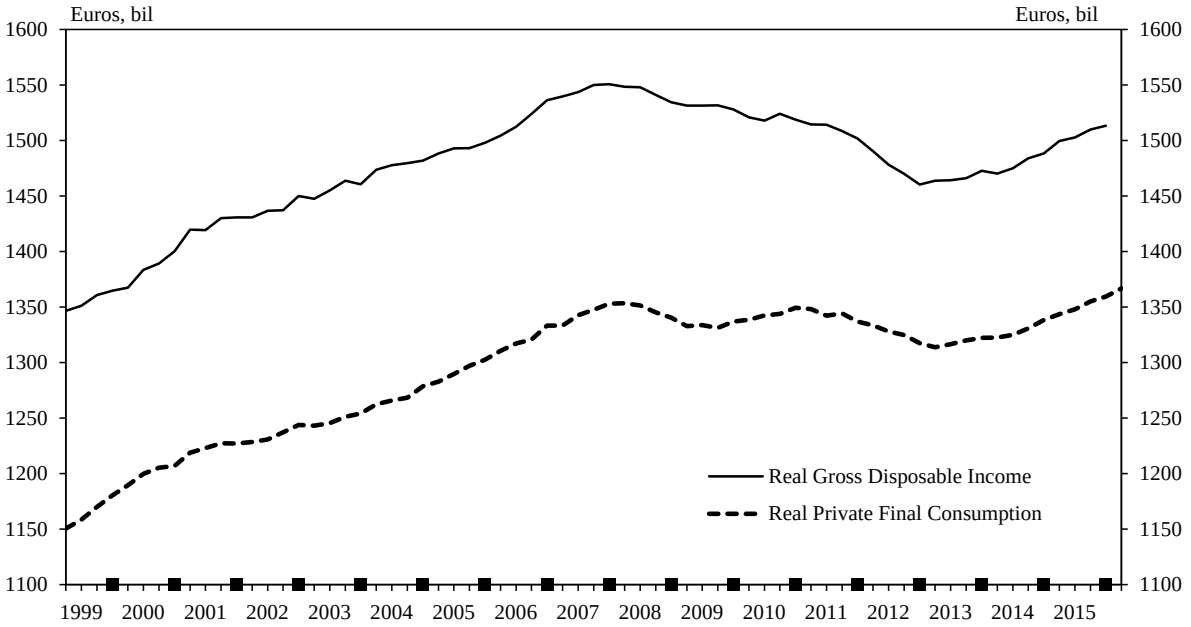
Notes: Quarterly observations of four-quarter percentage changes in Harmonized Index of Consumer Prices. Inflation forecast is from ECB Survey of Professional Forecasters mean point estimates: two years ahead. Heavy tick marks indicate fourth quarter. Source: ECB and Haver Analytics .

Figure 8
Brent Crude Oil Price in Euros and CRB Commodity Spot Price Index



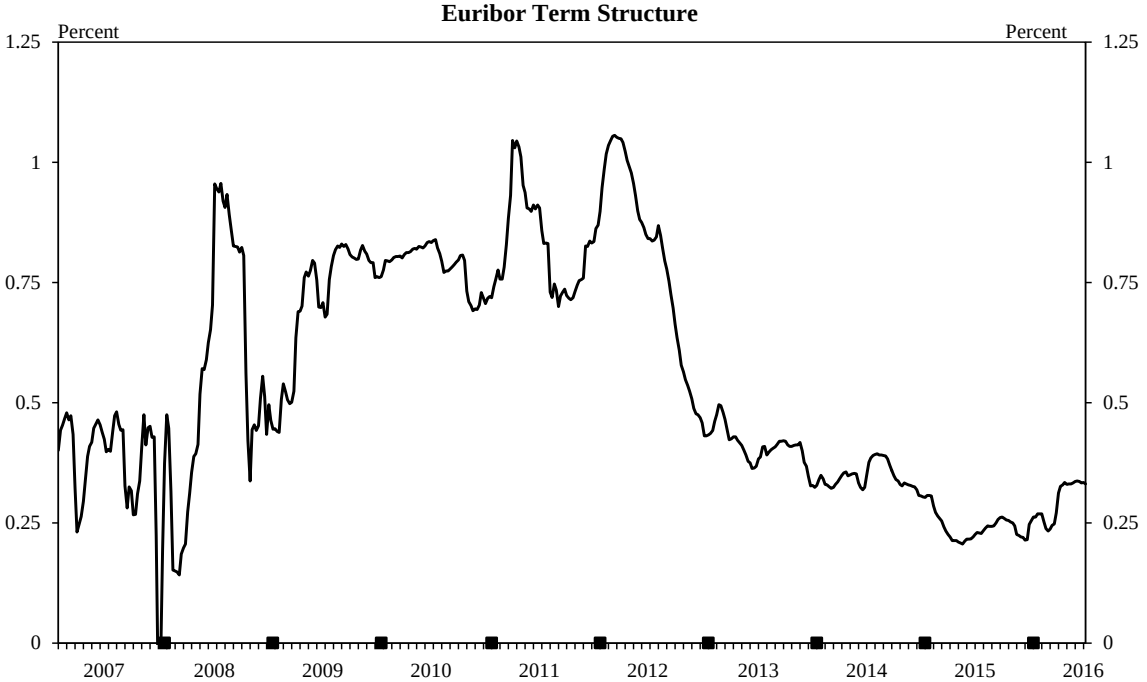
Notes: Brent crude oil price multiplied by the EUR/US$ spot exchange rate. CRB Spot Commodity Price Index: All Commodities (AVG, 1967=100). Heavy tick marks indicate December. Source: Reuters-CRB Commodity Index Report and Haver Analytics.

Figure 9
Real Gross Disposable Income and Private Consumption



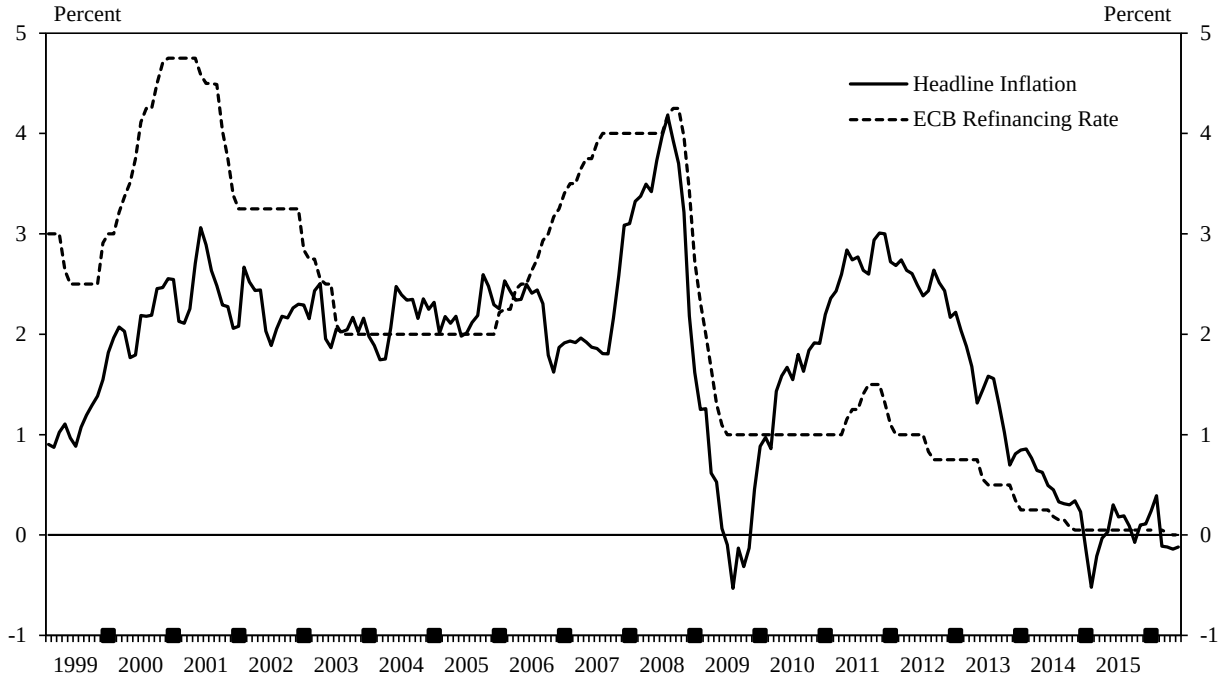
Notes: Real gross disposable income is gross disposable income divided by the harmonized consumer price index times 100. Heavy tick marks indicate fourth quarter. Source: Eurostat and Haver Analytics.

Figure 10
Euribor Term Structure



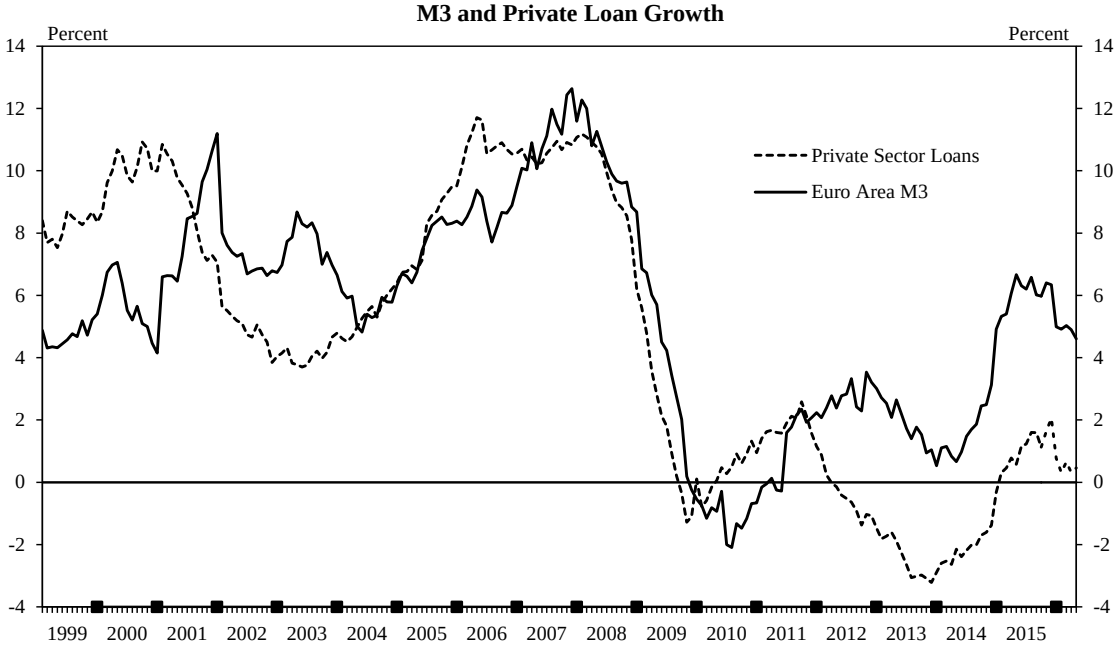
Notes: Difference between twelve-month and one-month Eurobor interest rates. Heavy tick marks indicate December. Source: ECB and Haver Analytics.

Figure 11
Inflation and ECB Policy Rate



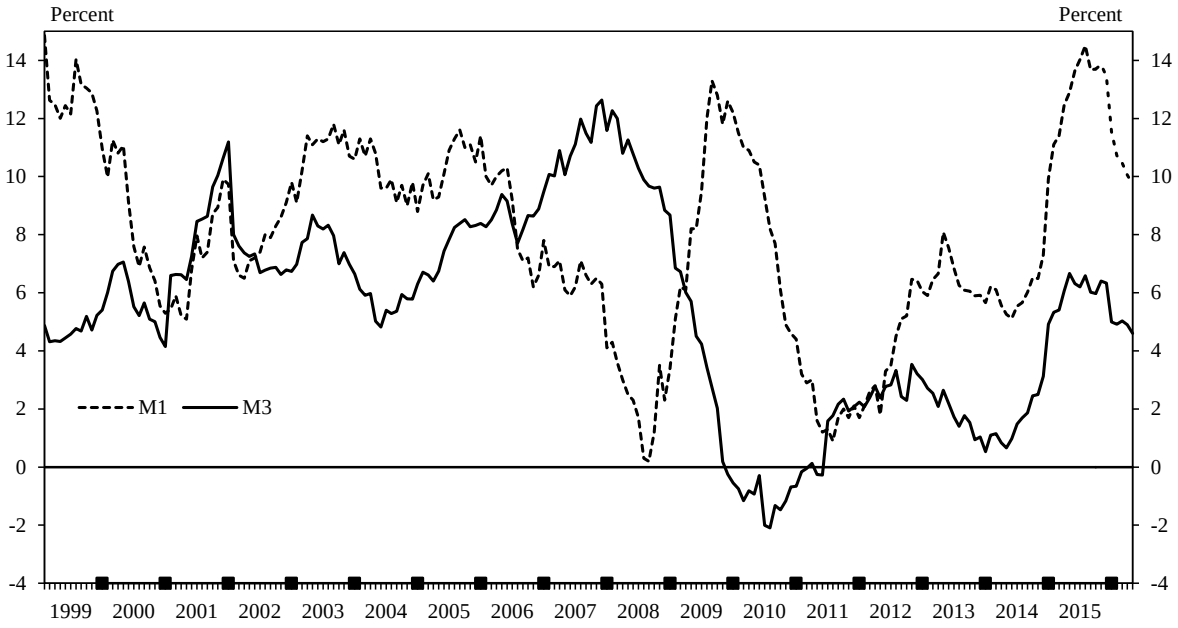
Notes: Monthly observations of 12-month percentage changes in Harmonized Index of Consumer Prices. ECB refinancing rate is the Main Refinancing Operations Rate. Heavy tick marks indicate December. Source: ECB and Haver Analytics.

Figure 12
M3 and Private Loan Growth



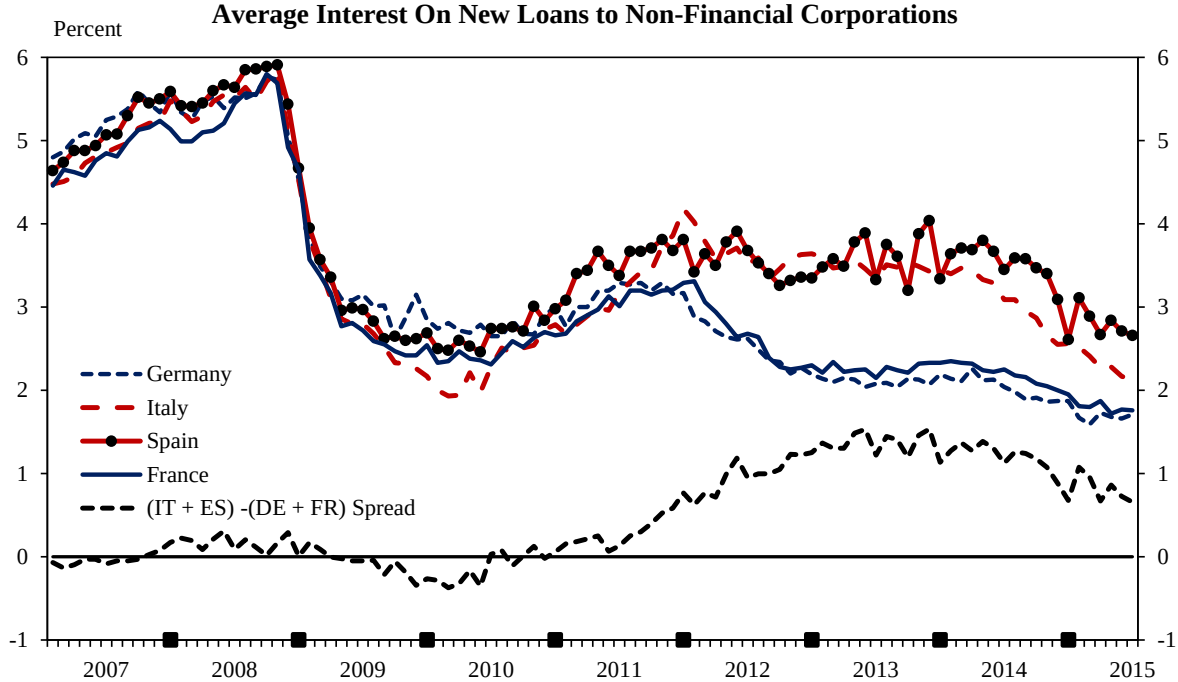
Notes: Monthly observations of twelve-month percentage changes in M3 and loans to private sector by monetary financial institutions. Heavy tick marks indicate December. Source: Eurostat and Haver Analytics.

Figure 13
Money Supply



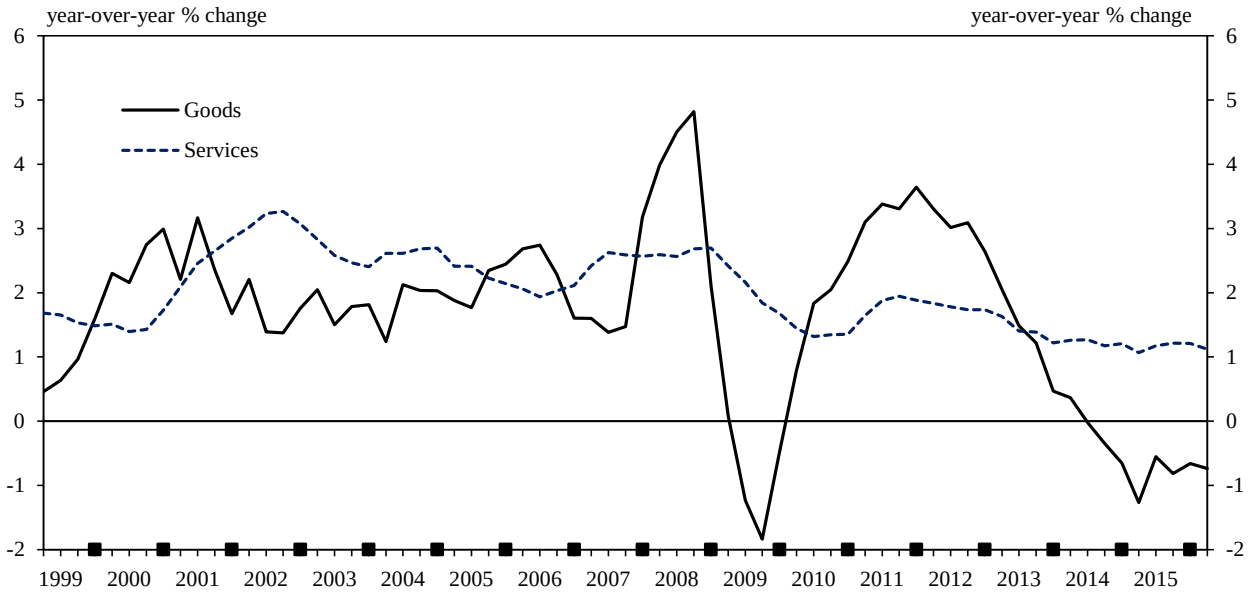
Notes: Monthly observations of twelve-month percentage changes in M1 and M3. Heavy tick marks indicate December. Source: Eurostat and Haver Analytics.

Figure 14
Average Interest On New Loans to Non-Financial Corporations



Notes: Heavy tick marks indicate fourth quarter of year. Spread is between the average of Italy + Spain and Germany + France. Source: ECB and Haver Analytics.

Figure 15
Goods and Services Inflation



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