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MONETARY POLICY SURPRISES OVER TIME

by Marcello Pericoli* and Giovanni Veronese *

Abstract

We document how the impact of monetary surprises in the euro area and the US on financial markets has changed since 1999. We use a definition of monetary policy surprises that singles out movements in the long end of the yield curve, rather than those that change nearby futures on the central bank reference rates. By focusing only on this component of monetary policy our results are more comparable over time. We find a hump-shaped response of the yield curve to monetary policy surprises, both in the pre-crisis period and since 2013. During the crisis years, Fed path-surprises, largely through their effect on term premia, account for the impact on interest rates, which is found to be increasing in tenor. In the euro area, the path-surprises reflect shifts in sovereign spreads and have a large impact on the entire constellation of interest rates, exchange rates and equity markets.

JEL Classification: E44, E52, F31, G14.
Keywords: monetary policy surprises, unconventional monetary policy.

Contents

* Bank of Italy, DG Economics, Statistics and Research

1 Introduction[1]

The global financial crisis has sidelined the traditional tool of expansionary monetary policy and central banks have resorted to unconventional policies, including forward rate guidance, large-scale purchases of private and public securities and the broadening of the pool of assets eligible as collateral. This increased dimensionality of monetary policy operations complicates the task of finding a concise measure of the stance of monetary policy, and even more in defining private sector expectations over it, potentially invalidating any attempt to rely on simple event-study methods.

Measuring the effect of monetary policy news on asset prices hinges on the possibility to extract the surprise component contained in policy announcements. In periods of conventional monetary policy, when the stance is well summarized by the level of short-term nominal interest rates, identification of the surprise is achieved by computing the difference between the central bank's announcement concerning the official rate or the monetary policy stance and the "ex-ante" expectation of this announcement. With announcements occurring at well defined dates, the *event study approach* introduced by Kuttner (2001) and Bernanke and Kuttner (2003) has been used extensively to assess how financial markets react to monetary policy surprises, as well as to achieve identification of monetary policy shocks in VAR models (Cochrane and Piazzesi, 2002).

Still, if one is willing to consider a *composite* effect of monetary policy surprises on other asset prices, a measure of monetary policy surprise can be recovered by examining the "joint" movement in government bond yields around announcements. Looking at the shifts along the entire term structure, rather than at very short end, allows to detect also movements in long rates induced by announcements on forward guidance as well as on asset purchases, which have been the key policies used by central banks in the recent years. According to this logic, Wright (2012) and Rogers et al. (2014) define a monetary policy surprise using the first principal component score of the 2-year, 5-year and 10-year US Treasury futures to capture the movements in the US term structure induced by announcements. They then abstract from the question of the efficacy of monetary policy in affecting government bond yields, which they take as their input, and attempt to measure the *pass-through* from a given "average" shift in yields onto other asset prices.

We embrace this approach to document the reaction of several asset prices to monetary policy surprises in the euro area and in the United States. Since the analysis spans pre-crisis years as well as the most recent period of unconventional monetary policies by the European Central Bank (ECB) and the US Federal Reserve (Fed) we do not attempt to estimate these reactions over a common sample, but rather split it into more homogenous periods.

We distinguish three different periods to account for the substantial changes in monetary policy frameworks and instruments over these years. Namely, we define a **pre-crisis** period from January 2000 until November 2008, the official start of the first Quantitative Easing

[1]The views expressed are those of the authors and do not necessary represent those of the Bank of Italy. We thank for useful comments Chiara Scotti, Marcello Miccoli, Alessandro Secchi, an anonymous referee and participants at the Bank of Italy workshop "Unconventional Monetary Policy: effectiveness and risks" (Oct. 2016). We also thank John Rogers for kindly sharing his dataset.

program in the US. The second period, which we label **crisis**, runs from November 2008 to December 2012, a few months before the first "tapering" announcement by the US Fed. The last period, which we label **post-crisis**, runs from January 2013 to September 2016, the end of our sample.

Since our study spans years of both conventional and unconventional monetary policies, we identify a particular dimension of monetary policy surprises, which we deem to be more comparable across these different periods. In particular, we flesh out the component affecting the longer-end of the yield curve – rather than the one leading to changes in nearby futures on the central bank reference rates. To this end we follow Gürkaynak et al. (2005), the first to propose a decomposition of surprises into a "path-component" and a "target"one. They show how in the US the path component, even in the years before the global financial crisis, represented an important dimension of monetary policy decisions, with instead decisions taken by the Federal Open Market Committee (FOMC) of the Fed regarding the target rarely being a surprise. After the global financial crisis, with official rates falling towards zero and with the adoption of forward guidance and quantitative easing measures, the component relating to the target undoubtedly lost further relevance as a source of monetary surprises, while the path component gained further prominence.

By describing the effects of monetary policy surprises on a wide range of asset prices we can provide some indication on the underlying channels activated by the ECB and the Fed across these different periods. We find that during the "pre-crisis" period path-surprises, both in the US and the euro area, propagate through the entire domestic term structure of interest rates with a hump-shaped pattern. For the euro area the shifts of the yield curve are also very similar across countries, as sovereign risk was priced uniformly. A contractionary path-surprise by the Fed leads to a US dollar appreciation and an increase in US stock market, the latter suggesting a positive revision to expected excess equity returns. A similar finding holds for the euro area, with the euro appreciating against the US dollar and stock market indices in the four largest euro area economies rising.

In the "crisis-period" the impact of US monetary policy path surprises along the term structure is no longer hump-shaped but it is increasing in tenor. This reflects largely the effect of movements in bond term premia, consistent with the functioning of a duration channel of monetary policy. Fed surprises have a modest spillover on other countries' bond markets and their impact operates mainly through the US dollar exchange rate. Conversely, in this period characterized by the sovereign debt crisis and the response by the ECB to contrast the re-denomination risk, ECB surprises are now akin to a shock in the spread between sovereign yields of core and more vulnerable euro area economies. Unsurprisingly, ECB surprises leading to a reduction in sovereign spreads determine a marked increase in euro area stock prices (Krishnamurthy et al., 2015), and lead to a appreciation of the euro.

In the final "post-crisis" period the transmission of monetary surprises to other asset prices becomes more in line with the "pre-crisis" period. In particular, in the US the yield curve response morphs back to its conventional hump-shape pattern, although the term-premium component still accounts for a sizable fraction of the shifts. In the euro area, as a result of the fading away of the euro-area breakup fears, interest rates across the main economies respond in the same direction to monetary policy surprises, with different magnitude and

direction. Furthermore, path-surprises associated to the ECB forward guidance and Asset Purchase Programme (APP) impact significantly euro-area term premia, while the response of sovereign risk premia remains muted.

The paper is organized as follows. Section 2 briefly reviews the literature on the impact of surprises on asset prices. Section 3 describes the data. Section 4 introduces our definition of monetary policy surprises, Section 5 presents our methodology to identify their impact, and Section 6 the results. Section 7 concludes.

2 Literature review

A standard problem in empirical macro/monetary economics is separating exogenous changes in monetary policy from endogenous responses of monetary policy to the economy. One approach is to use daily or intra-daily data on days of monetary policy announcements – Kuttner (2001), Bernanke and Kuttner (2003), Gürkaynak et al. (2005), Gürkaynak et al. (2007). This literature assumes that unexpected changes in monetary policy can be proxied by changes in the futures on the federal funds rate, since expected changes should be already priced in the pre-announcement quotes.

Daily data may well not be enough to resolve the issue of endogeneity, as some monetary policy announcements occurred in response to weak macroeconomic reports released earlier in the same day. The potential endogeneity problem may be even greater for two-day event windows. The literature addresses this identification problem either by using intra-daily data or by identifying surprises through heteroskedasticity – Rigobon (2003), Rigobon and Sack (2003), Rigobon and Sack (2004). Nevertheless, Gürkaynak et al. (2005) show that results obtained using daily data are not dissimilar from those with intra-daily data, especially for monetary policy surprises events after 1994. However, Gürkaynak et al. (2005) and Hanson and Stein (2015) note that it takes markets time to impound news about the future path of rates contained in FOMC statements, but it takes almost no time to impound news about the current target, i.e. it appears to take longer-term yields more time to fully react to FOMC announcements. Thus, Hanson and Stein (2015) choose a window long enough to span the period of elevated post-announcement price volatility using a a two-day window. This consideration takes us to our modeling strategy for identifying monetary policy surprises; we use daily, as opposed to intra-daily, quotes to take into account both the time needed by markets to digest rationally monetary surprises and the different information released about the target rate and future path of interest rates – see for example Brand et al. (2010) who exploits the institutional feature of the ECB communication, characterized by rate announcements at 13.45 London Time, followed by a press-conference. In the Appendix we present some evidence on the persistence of changes in intra-daily asset prices around monetary policy announcements.

With the introduction of unconventional monetary policies identifying monetary policy surprises is more challenging, because when short-term interest rates are close to their lower bound asset purchases become a new policy tool. Before the global financial crisis Gürkaynak et al. (2005) and Gürkaynak et al. (2007) had already pointed out that only considering

changes in the target federal funds rate may not be enough to capture announcements effects on the path of forthcoming federal funds rates. To this end, they extract principal components of yields not only from futures on short-term interest rates, but also from longer-tenor yields. They interpret the resulting first two factors, after a suitable rotation, as a "current federal funds rate target" factor and a "future path of policy" factor.[2]

In line with this approach, some authors propose to measure monetary policy surprises from shifts across the whole term structure. Thus, Rogers et al. (2014) build a monetary policy surprise taken from the entire term structure of US interest rates (or Treasury futures). Swanson (2015) estimates two dimensions of monetary policy during the 2009-2015 zero-lower bound (ZLB) period in the US and shows that, after a suitable rotation, these two dimensions can be interpreted as "forward guidance" and Large-Scale Asset Purchase (LSAP) programs. The sizes of the forward guidance and LSAP components of each announcement after meetings of the FOMC between 2009 and 2015 correspond closely to identifiable features of major FOMC announcements over that period. Forward guidance has relatively larger effects on the longest-maturity Treasury yields and essentially no effect on corporate bond yields, while LSAPs have large effects on those yields but essentially no effect on short-term Treasuries. Both types of policies have significant effects on medium-term Treasury yields, stock prices, and exchange rates.

An alternative strategy is to assume that the entire announcement is unexpected and thereby attribute to it the entire jump in asset prices, both government bond yields and other assets. This is the approach followed by several authors (Gagnon et al., 2011; Krishnamurthy and Vissing-Jorgensen, 2011) who provide an assessment of the effects of the LSAP in the US, by adding up the jumps in asset prices recorded in short windows around the key Fed LSAP announcements. This method was used more recently to investigate the effects of the ECB APP on various asset prices, by considering the 22 January 2015 announcement in isolation (Georgiadis and Grab, 2015) or by cumulating the effects recorded on several carefully selected APP announcement dates, spanning from the first hint of such a policy in September 2014 as in Altavilla et al. (2015).[3]

The literature has discussed two channels at work during unconventional monetary policies. The first is the "signaling channel", activated by the central bank communication or guidance, which can influence expectations about its policy decisions and restore confidence in the financial system. The second is the "portfolio-balance channel", activated by central bank asset purchases, that in turn may be distinct in the "duration channel" in tranquil times, and the "scarcity channel" at times of financial distress (Krishnamurthy and Vissing-Jorgensen, 2011; Altavilla et al., 2015; Swanson, 2015). We do not attempt to disentangle these two channels. In fact, "forward guidance" can impact long-term interest rates by means of a reduction in monetary policy uncertainty that tightens long-term premia; similarly, asset

[2]The authors find that both rate changes and statements have important but differing effects on asset prices, with statements having a much greater impact on longer-term Treasury yields.

[3]Another approach attempts to estimate the surprise component of asset purchases relying on survey data among investors, regarding the size and the timeline of these programs. However, information on these is quite limited in terms of data availability and the representativity of the investors' beliefs from these surveys is rather incomplete.

purchases may impact long-term targeted assets as well as the several other assets returns – even at the short-end of the maturity spectrum – through portfolio reallocation by investors.

For the US Gilchrist and Zakrajšek (2013) analyze the transmission of unconventional monetary policy estimating the effect of Fed LSAP announcements on corporate credit risk. The authors employ a heteroskedasticity-based approach to estimate the structural coefficient measuring the sensitivity of market-based indicators of corporate credit risk to declines in the benchmark market interest rates prompted by the LSAP announcements. The results indicate that the LSAP announcements led to a significant reduction in the cost of insuring against default risk for both investment-grade and high-yield corporate credits, measured by the CDX indexes – baskets of CDSs on corporate bonds.

For the euro area Altavilla et al. (2015) evaluate the effects on asset prices of the ECB APP and assess its transmission channels in light of a term structure model with bond supply effects to account for assets with multiple types of risk premia. The model-based predictions for cross-asset price movements are associated with different transmission channels. By means of an event-study around seventeen announcements regarding the APP, they document its sizable impact on asset prices and how the low financial distress prevailing at the time of the program did not undermine its efficacy. According to their estimates, the APP has weakened the scarcity channel, but has reinforced the duration and the credit channels, and facilitated the spill-overs to non-targeted assets.

3 Data

3.1 Asset prices

We use two sets of data. The first comprises a whole array of financial assets that may respond to monetary policy surprises, with the goals of identifying channels of transmission. The second set is used to construct the monetary policy surprise.

The use of several assets and the analysis of their responses allows to identify the underlying channels of transmission, as advocated by Krishnamurthy and Vissing-Jorgensen (2011) and Jarrow and Li (2015). In general, we expect that announcement effects of unconventional monetary policy measures tend to significantly lower yields for a broad set of market segments, with effects generally rising with maturity and riskiness of assets. Targeting assets at long maturity and spanning the investment-grade space may support the duration and the credit channels. At the same time, the degree of financial stress prevailing at announcement of the unconventional measures, may influence the local supply channel and spill-overs to non-targeted assets. Table 1 present a description of the data included in our analysis.

Besides bond yields in some euro-area countries and the US, we consider the three main bilateral-exchange rates (USD/EUR, USD/GBP and YEN/USD), and the main stock market indexes of the euro area, Germany, France, Italy, the US and Japan. Furthermore, we evaluate the impact of our monetary policy surprises on the medium and long term premia implied in government bonds (at the 2-year, 5-year and 10-year maturity). To this end we first compute the term premia using a Gaussian Affine Term Structure Model with three factors

with the methodology described in Pericoli (2013) and Adrian et al. (2013). We also look at movements in expected inflation implied in inflation swaps (at the 5-year and the 5-year forward 5-year maturity), as well as sovereign CDSs and corporate spreads. Finally, we assess the impact of monetary surprises on some measures of volatility in bond markets (the US MOVE index and the option-implied volatility of futures on the 10-year German Bund), volatility of the foreign exchange market (the option-implied volatility of futures on the main cross-exchange rates), a measure of investors asymmetries in the foreign exchange market (the 25δ risk reversal of options on the EUR/USD), the relative cost of funding in USD versus euro (the 1-year cross-currency USD/EUR basis swap) and the price of oil (USD per Brent barrel).

US daily bond yields and inflation swaps are collected at 16:30 London Time – i.e. GMT or GMT+1 during daylight saving time in the UK; German, French, Italian and UK bond yields and inflation swaps at 17:30 London Time; stock market indexes are collected at 17:30 London Time; exchange rates at 16:00 London Time. Fed FOMC announcements are released between 12:30 and 14:15 US Eastern Time that correspond to 17:30 and 19:15 London Time; ECB Governing Council (GC) announcement are released at 12:45 London Time while the press conference with the Questons & Answers session between 13:30 and 15:15. Given the time releases of the asset quotes, we use daily changes for all of the financial variable but for the exchange rates for which we use a two-day average since they are released before the time of the US Fed announcements.

As far as the monetary surprises are concerned, our measures are constructed by using a mix of short-term interest rates and medium- and long-term bond yields – see Section 5 for a precise description. For the United States, to capture the short end of the curve we use the same set of federal funds futures and eurodollar futures rates, with one year or less to expiration, as in Gürkaynak et al. (2005). To this set we add yields from longer-dated bonds, namely the 2-year, 5-year and 10-year Treasury bond yields.

For the euro area, to capture the short end of the term structure, we use the 1-month, 3-month, 6-month, 9-month and 1-year euro Overnight Interest Rate Swaps (OIS). These are a good proxy for expected risk-free interest rates, as they are linked to the overnight interest rates prevailing in the euro-area interbank market. As to longer-dated bonds, we include the 2-year, 5-year and 10-year bond yields of the four largest economies in the euro area, to account for the heterogenous evolution in sovereign credit risk: therefore we look at the 10-year benchmarks for the German Bund, French OAT, Italian BTP and Spanish Bono.

Our sample only refers to days where there is a monetary policy announcement, scheduled or unscheduled.

3.2 Monetary policy announcement days

Monetary policy days are selected as those with scheduled and unscheduled central bank board meetings as well as those with important central bank announcements regarding monetary policy. For the ECB we follow a narrative approach and we identify not only the days of the meetings of the GC but also consider relevant speeches of the ECB President – such as the pronouncement about the intention to preserve the integrity of the single currency in July

2012, e.g. the "whatever it takes ..." speech, and the explicit introduction of the "forward guidance" in July 2013. For the US, we use the regular meetings of the FOMC, semi-annual Congress testimonies by the Fed Chairman, relevant hearings of the Fed Chairman before the Congress Joint Economic Committee, and yearly speeches taken at the Jackson Hole conference.[4] A detailed list of announcement dates starting from August 2007 is reported in Appendix for the euro area and for the US (Tables A-9 and A-10); before August 2007 we use regular monetary policy meeting announcements.

In days with monetary policy announcements interest rates display greater volatility than in the rest of the sample (see Table 2).[5] Before the financial crisis, the standard deviation of interest rates is significantly larger than on non-event days, and decreasingly along yields tenor. During the global financial and the euro-area debt crises, in the US the difference between meeting and no-meeting increases especially at longer tenors, underscoring the role of risk premia in driving yield changes. In the euro area the volatility of yields becomes increasing in tenors only since 2013, as short-term interest rates reached the zero lower bound.

4 Monetary policy surprises

Monetary policy surprises are constructed according to the spirit of Kuttner (2001), using data from the futures market to disentangle the expected and unexpected component of interest rates changes on the dates of central bank announcements.

In principle, it should be straightforward to compare the effects of a unexpected change in the central bank policy rates by 25 basis points (bp). However, when dealing with periods characterized by the zero lower bound it is not obvious what particular tenor in yields to consider as a "reference" for the central bank. Since our goal is to compare the effect of similar surprises also across periods, we need to adapt the original method of Kuttner (2001) to account for the unconventional monetary-policy phases.

Rather than choosing a specific horizon, as for instance in Hanson and Stein (2015) who look at two-year Treasury yields, we follow the more general approach in Wright (2012), who exploits the response of the entire US term structure. In his setup, monetary policy surprises are defined as a linear combination of the change in short-, medium - and long-term interest rates on central bank announcement dates.

However, since our study spans both conventional and unconventional monetary policy periods, we depart from Wright (2012) and focus only on a particular component of the monetary policy surprise, the one stemming from the communication of policy beyond immediate target changes. As already documented by Gürkaynak et al. (2005), by far the most important component of monetary policy decisions is the one which moves expectations on future policy, rather than immediate changes in the policy rate.

To this end, we consider a particular rotation of the principal component of interest

[4]We thank John Rogers for kindly sharing his dataset on announcement days as well as for high-frequency asset price changes around them.

[5]This difference is the key assumption underlying the identification of Rigobon (2003)

rate changes, so to capture movements driven only by surprises regarding the "future-path" of monetary policy, while excluding the news regarding the nearby "target" for reference rates. Following Gürkaynak et al. (2005), we assume that on T monetary policy days a two-factor model holds for N yield changes ($X_{T\times N}$, where the subscript indicates the dimension).[6] Because the two principal component factors ($F_{T\times 2}$) have no structural interpretation, one can rotate them (preserving orthonormality) in such a way to provide a structural interpretation:

$$X_{T\times N} = F_{T\times 2}\,\Lambda_{2\times N} + \upsilon_{T\times N} \quad (1)$$
$$\tilde{F}_{T\times 2} = F_{T\times 2}\,U_{2\times 2} \quad (2)$$

where U is an orthogonal matrix.

Gürkaynak et al. (2005) propose to rotate the factors in such a way that the second factor (labeled *path-factor*) does no to load the short-end of the curve. The resulting first factor (labeled *target-factor*), by construction orthogonal to the second one, hence will resemble very closely movements in the short end of the curve (see equation 10 in the Appendix).

Instead of searching for a particular rotation as in Gürkaynak et al. (2005), we consider an alternative approach where we *orthogonalize* the first principal component factor from unexpected jumps at the short end of the curve

$$X_{T\times N} = F_{T\times 2}\,\Lambda_{2\times N} + \epsilon_{T\times N} \quad (3)$$
$$\bar{F}_{T\times 1} = M_r\,F_{T\times 1} \quad (4)$$

where M_r is the residual projection matrix on the nearby future contract for the central bank reference rate (r_t).[7].

4.1 Path and target surprises before the financial crisis: an aside

In this section we show how, even before 2008, the component of monetary policy surprises pertaining to changes in the policy path was a relevant driver in yield curve changes, and how it compared to the component relating to changes in the "target" of rates. In essence, our results replicate, with daily in place of intra-daily data, the estimates in Gürkaynak et al. (2005) for the US and in Brand et al. (2010) for the euro area. The only difference is that we use a slightly modified version of the factors, as defined in equation 3, rather than the Gürkaynak et al. (2005) original definition (see equation 10 in the Appendix). For each short term futures and bond yield, we run two regressions: the first on the futures contract for the

[6]Using formal tests to determine the number of factors, the null hypothesis that two factors are sufficient to account for most of the variation in yields cannot be rejected at the 1% level of significance.

[7]The two approaches are found to give similar results: the correlation between the Gürkaynak et al. (2005) path-factor $\tilde{F}_t$ and the orthogonalized path-factor $\bar{F}_t$ is is almost 0.9 for the US and the euro area, in pre-crisis period

reference rate (r_t), and the second on r_t and our path factor $\bar{F}_t$, obtained from 4:[8]

$$\Delta y_t = \gamma + \alpha_{target}\, r_t + v_t \quad (5)$$

$$\Delta y_t = \gamma + \alpha_{target}\, r_t + \alpha_{path}\bar{F}_t + u_t \quad (6)$$

Results for the US, reported in Table 3, show that the effect of the path-factor is greater at the long-end of the yield curve and the effects remaining quite persistent at the five-year horizon. In contrast, FOMC statements that involve changes in federal funds target rate itself with the same effect at the six months horizon (scaled to be so by construction), have a monotonically decaying impact on longer maturities. Moreover, as can be seen by comparing the R^2s of the two regressions, most of the variation in long-term Treasury yields is due to communication regarding future policy rather than to target changes.

For the euro area, results,[9] reported in Table 4, are not very different from the US. The path-factor has a significant and sizable impact across all maturities and exhibits a hump-shaped response pattern. Also, similarly with what found in Brand et al. (2010), the explanatory power of the regressions is somewhat lower than for the US, more so at longer horizons. Brand et al. (2010) also exploits the institutional feature of the ECB communication, characterized by rate announcements at 13.45 GMT, followed by a press-conference, to disentangle *directly* the decision from the communication dimension of monetary policy. They show how *indirect econometric methods*, similar to that exploited in our approach, provide information that is consistent with the one obtained from a *direct* approach.

5 Measuring the impact of monetary policy

Since our analysis spans the years from 2000 to 2016, we distinguish three different periods to account for the substantial changes in monetary policy frameworks and instruments over these years. Namely, we define a **pre-crisis** period from January 2000 until November 2008, the official start of the first Quantitative Easing program in the US. The second period, which we label **crisis**, runs from November 2008 to December 2012, few months before the first "tapering" announcement by the US Fed. The last period, which we label **post-crisis**, runs from January 2013 to September 2016, the end of our sample.

Of course, our definition may not fully be consistent with the timing of the unconventional monetary policies of the ECB in the same period. In particular, in the second "crisis" period, the ECB adopted a series of measures aimed at smoothing the transmission mechanism of monetary policy as well as at removing the euro-area break-up risk related to the euro-area sovereign debt crisis. Conversely, in the same period, the Fed introduced a stream of unconventional measures, among them the LSAP and an explicit forward guidance. In the

[8] For the US, we follow Gürkaynak et al. (2005) and build the factor using the spot and the 3-month ahead federal funds futures, the 2- , 3-, and 4-quarter ahead eurodollar future rates; for the euro area, we use the 1-, 3-, 6-, 9-month and 1-year OIS.

[9] The 1-, 3-, 6- and 12-month tenors refer to the euro OISs, while the 2-, 5- and 10-year tenors refer to German Bunds. Results would have remained very similar had we used French or Italian yields, because before the euro sovereign crisis interest rates on government bonds moved in lockstep across the eurozone.

third period, which includes the more recent years, the ECB started its explicit "forward guidance" and a private and public bond purchase program – APP – while the Fed gradually unwound its unconventional measures.

To ensure that surprises have "comparable" nature across different periods we will focus on the response to path-factor shocks. Indeed, as shown in Section 4.1, even before the global financial crisis it was evident for both the US and the euro area that news stemming from the communication component of monetary policy had a more substantial and longer-lasting impact on the term structure than news stemming from decisions on policy interest rates. The relevance of the path-factor component has undoubtedly risen since the onset of the global financial crisis, when the Fed and the ECB started to progressively drive their policy rates towards zero and resorted to strategies hinging on quantitative easing and forward guidance.

Our approach will therefore use as a yard-stick the effect of monetary policy surprises shifting the 10-year by a predetermined amount point, and examines how this translates into changes in the other assets.

We compute the principal component factors from the entire term structure separately for each central bank announcement set and over the three different subperiods. We use only observations on announcement days of the Fed or the ECB. To extract the Fed factors, for the short end of the term structure we use the spot and the 3-month ahead federal funds futures current month, and the two-,three-, and four-quarter ahead eurodollar futures rates, the 2-,5- and 10-year Treasury yields. For the euro-area, in light of the cross-country heterogeneity which flared up during the sovereign crisis, we compute principal component factors from yields in the largest four economies. Therefore, we use 1-, 3-, 6 and 12-month euro OISs, the 2-,5 and 10-year yields on the benchmark German Bund, Italian BTP, French OAT and Spanish Bono.

We use the same orthogonalization described in equations 3–4, where the factor is $\bar{F}$ is the residual of the regression of the first principal component factor on the nearby futures rate on the respective central bank target – federal funds rate for the Fed, and 1-month OIS for the ECB. As to the target rate r_t we use directly the changes in nearby futures rate on the central bank target.[10]

In order to identify the causal effect of the monetary policy we estimate an ordinary least square regression of daily returns on several assets on our monetary policy surprises, defined in Section 4.1. We estimate the following equations, only on monetary policy announcement days, either by the ECB or the Fed:[11]

$$\Delta y_t^{(i)} \quad = \quad \alpha + \beta_1 \, r_t^{Fed} + \gamma_1 \, \bar{F}_t^{Fed} + \beta_2 \, r_{1,t}^{ECB} + \gamma_2 \, \bar{F}_t^{ECB} + u_t \tag{7}$$

[10] As short-term interest rates approach the zero-lower-bound the variability of the target rate variable becomes smaller, and our orthogonalized path-factor is close to the original principal component factor.

[11] This is equivalent to running two distinct regressions for Fed and ECB on their respective announcements, except for the rare joint decisions. Results for the central bank specific regressions are available upon request.

where $\Delta y_t^{(i)}$ is the change in the i-th asset under consideration, while $\bar{F}_t^{Fed}$ and r_t are the path- and target-surprise for the Fed announcements, and $\bar{F}_t^{ECB}$ and r_t^{ECB} those for the ECB – defined in Section 4.1. In our discussion of the results in Section 6, we will only report the coefficients on the path factors, for the Fed (γ_1) and the ECB (γ_2). All equations include some control variables to avoid contamination from other news relating to the macroeconomy released in the same day. These include the Citi Economic Surprise Index (CESI) for the US and the euro area, a measure of macroeconomic surprises in these areas.[12] In addition we use the VIX, to control for the overall level of financial distress in financial markets. In practice there are very few days with simultaneous ECB and Fed announcements and so estimating equation 7 may be redundant. In the robustness Section 7 we show that the estimates of

$$\Delta y_t^{(i)} \quad = \quad \alpha + \beta\, r_t^j + \gamma\, \bar{F}_t^j + v_t \tag{8}$$

for $j = ECB, Fed$, give similar coefficient estimates for β and γ.

6 Results

Before the global financial crisis: Jan. 2000 – Nov. 2008

To compare results across time frames, we scale our path-factors so that they are always associated with a predetermined 25 bp impact on the key benchmark 10-year bond yields in the US (US Treasury) and in the euro area (German Bund).

We present the results for the period before the global financial crisis in Table 5. First we analyse how a Fed path-factor surprise impacts assets returns (first column). The response of 10-year Treasury yield, by construction set to 25 bp, is associated with a slightly stronger response of shorter dated 2- and 5-year Treasury yields. This hump-shaped response across maturities is the same documented in Gürkaynak et al. (2005), which we replicate in Section 4.1.

Bond yields in the euro area respond similarly, with rates increasing in Germany, France, Italy and Spain: the intensity is hump-shaped in tenor and comparable across countries and maturities. In response to a contractionary monetary policy surprise, the US dollar exchange rate appreciates by slightly more than 1% with respect to the €, and 1.6% with respect to the Japanese Yen. The impact on equity prices is statistically significant only for the US stock market, which rises by approximately 1%. This contrasts with the original results of Bernanke and Kuttner (2003), who found that a 25 bp reduction in the federal funds target rate is associated with about a one-percent increase in broad US stock indexes. The difference can be explained by the different nature of the surprise, in their case the "target" component, in ours the "path" component of the policy, conveying information on the expected outlook for economic growth.

At the same time, term premia in the US respond at 2-, 5- and 10-year maturities, by approximately one fifth the size of the impact recorded for the corresponding Treasury yields,

[12] These indexes control for simultaneous data releases about economic indicators. For example, US weekly initial jobless claims can occur during days of ECB Governing Council meetings.

an indication that in these years long-dated yields move mostly in response to changes in expected interest rates. Spreads of US corporate bonds over their sovereign counterparts fall only modestly and only for the high-yield segment.

Considering the response to the ECB path-factor surprise on assets, four features stand out. First, the response of yields on shorter dated bonds (2- and 5-year) is much stronger than the one estimated for the 10-year tenor (by construction pinned to 25 bp for German yields). Second, across maturities, the estimated responses of yields are similar across the four euro-area countries, underscoring the homogeneous pricing of sovereign credit risk within the euro area. Third, stock markets respond positively to an ECB contractionary surprise, both in the euro area and in the US, a result that suggest that markets interpreted the path-surprise as conveying positive information regarding the state of the economy. Also, credit spreads tighten, both in the investment-grade and the high-yield segment. The spillovers of ECB path-surprises onto the US yield curve are significant. They appear to be only partly absorbed by the immediate response of the USD/EUR exchange rate, which appreciates on impact (2.3%). Fourth, the effect on euro-area term premia is large and accounts for about half of the estimated increase in nominal yields.

Crisis years: Nov. 2008 – Dec. 2012

Results for the years of the global financial crisis and the sovereign euro-area crisis are shown in Table 6.

Considering the Fed path-factor surprise we find that its impact on the US term structure has reversed compared to the pre-crisis years, becoming greater for longer tenors. This reflects the sizable impact on US term premia, which rise almost by as much as nominal long-dated yields. Also, US interest rate volatility, as measured by the MOVE index is significantly affected by these movements. Furthermore, the impact of a contractionary Fed surprise on the stock market, with an increase of approximately 1% in US equities associated to a 25 bp rise in the US 10-year Treasury yields, is even stronger than the one found for pre-crisis years. In contrast, the magnitude of the USD/EUR exchange rate response falls with respect to the one found during the pre-crisis years, while the one for the other currencies seems stronger. This result contrasts with the one presented in Glick and Leduc (2013), who document how the effect of Fed monetary surprises on the value of the US dollar before 2008 and between 2008 and 2012 remained largely unchanged.[13] Compared to the pre-crisis years, the response of euro-area yields to contractionary Fed surprises does not show widespread significance, with small increases in German and Italian longer dated yields.

The effects of the euro-area sovereign debt crisis emerge starkly when we examine the role of ECB monetary policy surprises (reported in the second column of coefficients). Given the exceptional circumstances, we scale our path-factor so to consider as "contractionary" a *reduction* in 10-year German yields of 25 bp, which in this period entailed an increase in yields of more vulnerable countries. In fact, surprises leading to a fall in 10-year German yields of 25 bp are associated to large jumps of the corresponding Italian and Spanish yields

[13] Their method is somewhat different from ours, as they compare pre- and post-crisis years to infer a scaling factor for the monetary policy surprises, and show how monetary policy has the same "bang-per-unit of surprise" on the USD exchange rate.

(over 200 bp). The response of short-dated Italian and Spanish tenors is even greater than the one for 10-year yields. Interestingly, the French yields, despite still being among the highest rated sovereign issues, also increase, albeit substantially less than those in Spain and Italy. Thus, the ECB monetary policy surprises are now akin to a shock to the spread in sovereign yields between core and vulnerable countries. This provides empirical support to the assumption made by Rogers et al. (2015), who define the ECB surprise as the spread between the 10-year Italian and German government bond yields. Similarly to Rogers et al. (2015), we find that a compression in sovereign spreads within the euro area, such as that triggered by the OMT announcement, led to a marked appreciation of the euro against the dollar, underscoring an effective reduction of default risk and risk premia.

In this period ECB contractionary monetary policy surprises impact strongly also equity markets, which fall within the euro-area countries, as well as abroad. Interestingly, also the oil price falls markedly, underscoring the systemic relevance of euro-area events on such a key global commodity. Also, in response to the ECB surprises, yields on the whole US term structure respond by *falling* suggesting a strong flight to safety effect in action. Finally, the ECB surprises strongly affect the implied volatility of interest rates as well as of exchange rates.

Post-crisis years: Jan. 2013 – Sep. 2016

In the third period, starting from January 2013 to date, the reaction of asset prices to monetary policy path-factor surprises has changed again. Results are presented in Table 7.

Fed surprises impact again the US yield curve with a more "conventional" hump-shaped pattern. However, the term-premium component still accounts for a sizable part of the increase in yields, largely as a result of the "taper-annoucements" in the first half of 2013. The impact on US interest rates volatility, measured by the MOVE index, remains significantly positive, as found during the crisis years. Spillovers to the euro-area yields are more muted, while the impact on bilateral USD exchange rates has the same sign and magnitude found before the crisis years. Similarly, US corporate credit spreads are negatively impacted by a US contractionary announcement, with approximately the same magnitudes found before the crisis. In contrast, the impact of Fed surprises turns out to be not significant for all stock market indices, including the US.

Also the effect of ECB surprises in this period becomes more conventional, as a result of the fading away of the euro-area breakup fears. While interest rates across the main economies respond in the same direction, they do so with different magnitudes, flagging the different sovereign risks perceived by investors. In response to an ECB contractionary surprise, associated to a 25 bp rise in German yields, we estimate Italian yields to increase by 43 bp, i.e. a widening of sovereign spreads by 18 bp for the 10-year tenor. These are only partly explained by the corresponding increase in the 5-year Italian CDS (12 bp), suggesting that other factors beyond perceived sovereign risk may be at play. This contrasts with the crisis years, when most of the increase in vulnerable countries' yields reflected the fears related to the sovereign crisis. The difference can be attributed to the adoption of forward guidance and quantitative measures by the ECB; our estimates show that, during this last period, changes in term premia explain most of the movements in long dated yields. The impact on

equity price indices of a contractionary ECB surprise, while still negative and statistically significant on most markets, is much smaller than during the crisis period. Euro-area inflation swaps rates, a relevant measure of inflation expectations at longer horizons, fall in response to contractionary ECB surprise, suggesting that the ECB announcements are effective in contrasting deflationary pressures. In contrast, during pre-crisis years, inflation swap rates tended to comove positively with bond-yields instead.

Event study analysis

We use our estimated coefficients to run an event study analysis on the contribution of path-surprises of monetary policy to the overall daily change in some asset prices. The contribution is calculated as the product of the daily change in estimated monetary-policy path surprises times the estimated coefficient over the period.

For the ECB, we focus here on three ECB announcements regarding the APP in 2015, wich surprised markets in differing ways. First, we look at the 1^{st} Public Sector Purchase Programme (PSPP) announcement in January 2015, which contributed the most to a reduction in long-term yields in the euro area and spilled over onto other markets. Second we look at the first announcement in September 2015 of an increase in the pool of APP eligible assets: by raising the issue share limit from 25% to 33%, it led to a further reduction in euro area long-term yields, a marked depreciation of the euro against the dollar, while US yields were not affected much. Third, present results for the 2^{nd} APP extension announcement in December 2015, which disappointed the markets despite being clearly expansionary: euro-area long-term yields as well as those in the US rose in sync, while the euro appreciated against the dollar. The contribution of path surprises to changes in 10-year German, Italian and US government bonds and on the EUR/USD exchange rate is presented in Figure 1a–1d. Daily changes in 10-year bond yields and in the EUR/USD exchange rate have been almost entirely explained by the ECB path-factor surprise.

For the Fed we focus on three announcements in 2010, which according Krishnamurthy and Vissing-Jorgensen (2011) conveyed the essence of the information relating to the QE2 program. Thus, we look at the LSAP announcements at the August 2010, September 2010 and November 2010 FOMC meetings. On August 2010, the Fed announcement about the intent to continue QE revised market expectations; moreover, the announcement indicated that QE would shift toward longer-term Treasuries, and not agencies or agency MBSs as in QE1. The September 2010 announcement reiterates this message. The following announcement in November 2010, albeit widely anticipated, was read by many market participants as indicating new stimulus by the Federal Reserve, and particularly an expansion of its purchases of long-term Treasuries. The contribution of path suriprises to changes in US 10-year Treasury, 10-year term premium, high-yield corporate spread and USD/EUR exchange rate is shown in Figure 2a–2-d. We see that upon these dates, the response of long-term yields is closely tracked by the contribution of the path-surprises, and it clearly shows how most of Fed surprises were successful in impacting the term-premia component. In contrast, the response of the US dollar exchange rate on these dates is largely unaccounted for by our measure of monetary policy surprises.

Robustness checks

Results are robust to a set of robustness checks. First, we selected different subsamples to better account the different evolution of the Fed and ECB unconventional monetary policies, as well as the unfolding of the global financial crisis and the euro area sovereign crisis –see Tables A-4-A-5. Second, for the crisis periods we run the regressions excluding the days of some of the most important non-scheduled ECB and Fed monetary policy annoucements – available on request. Third we run the regression separately for the ECB and Fed announcement dates – see Tables A-7-A-8. Results are almost identical to those shown with the joint estimation.

7 Conclusion

We investigate how the reaction of several asset prices – fixed-income instruments, exchange rates, stock indices, inflation swaps and corporate spreads, sovereign CDS, and implied volatilities – to monetary policy surprises varies during monetary policy regimes and through which channels these surprises are transmitted, in the euro area and in the United States.

We identify one dimension of monetary policy surprises, affecting more the longer-end of the yield curve – rather than the one leading to changes in nearby futures on the central bank reference rates.

To ensure that surprises have "comparable" nature across different periods we focus on the response to path-factor shocks. Indeed, even before the global financial crisis, the evidence for the US as well as for the euro area was that surprises stemming from the communication component of monetary policy had a more substantial and longer-lasting impact on the yield curve than surprises stemming from decisions on policy interest rates. The relevance of the path-factor component has undoubtedly become greater since the onset of the global financial crisis, when the Fed and the ECB progressively reached the zero-lower-bound and resorted to strategies hinging on quantitative easing and forward guidance.

We find a hump-shaped response of the yield curve to path-surprises, both in the "pre-crisis" period and since 2013. In contrast, during crisis years Fed surprises, largely through movements in term premia, account for the impact in interest rates, which is increasing in tenor.

In the euro area the path-surprises reflect the shifts in sovereign spreads, and have a large impact on the entire constellation of interest rates, exchange rates and equity markets. The adoption of forward guidance and quantitative measures by the ECB, successfully impacted euro-area term premia: most of the movements in long dated yields correspond to the term premia component. Euro-area inflation swap rates, a relevant measure of inflation expectations at longer horizons, fall in response to contractionary ECB surprise, suggesting that the ECB announcements are effective in contrasting deflationary pressures. In contrast, during pre-crisis years, inflation swap rates tended to comove positively with bond-yields instead.

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A Appendix

Factor rotation

Under the assumption of a 2-factor model holds for interest rate changes (X) on monetary policy days:

$$X_{T\times N} = F_{T\times 2}\Lambda_{2\times N} + \upsilon_{T\times N} \tag{9}$$

Let the rotated factors $\tilde{F}$ be related to the base principal component factors F through the following relationship:

$$\tilde{F} = FU \tag{10}$$

where

$$U = \begin{pmatrix} cos\,\theta & -sin\,\theta \\ sin\,\theta & cos\,\theta \end{pmatrix} \tag{11}$$

and $U(\theta)$ is an orthonormal rotation matrix, such that $U'U = I$ by construction. The identification restriction used by Gürkaynak et al. (2005) is on the second factor (the path factor), namely it requires that z_2 does not load the first element of vector of yields (Gürkaynak et al. (2005) set this to be the nearby Federal Funds futures contract), i.e. that the second factor is uncorrelated with the current monetary policy surprise. This can also be shown to be equivalent to

$$\theta^* = atan(\frac{\gamma_2}{\gamma_1}) \tag{12}$$

where γ_1 and γ_2 are the elements of the first column of the $2 \times N$ loading matrix Λ.

We replicated the analysis of Gürkaynak et al. (2005) for the US and of Brand et al. (2010) for the euro, using daily data. A path and a target factor ($\tilde{F}_1$ and $\tilde{F}_2$) were extracted by imposing the particular rotation matrix $U(\theta^*)$, and the regressions described in Tables 3-4 in the main text, were run again with these factors in place of the orthogonalized ones. As can be seen from Table A-1 and A-2 we find very similar results. In particular, the maturity response pattern to communication altering the path of policy is hump-shaped, whereas that to policy decisions is downward-sloping. That is short to medium-term maturities respond prominently to the target-factor, while the path-factor impacts the term structure at all maturities.

Monetary policy surprises: a closer look during 2015

A closer look to monetary policy surprises by the ECB can motivate our choice of relying on a daily window, as well as in the usefulness of estimating our measures of monetary policy surprises. We illustrate this, graphically, by showing asset price movements around the same ECB announcement dates in 2015 shown in Sub-Section 6, for which we collected intra-daily sampled at a 5-minute frequency.

With the exception of exchange rates traded around the clock, all other assets are not traded in a "continuous" fashion and there are extended intervals without a transaction and price being recorded. This is true for futures, whose trading hours depend on the exchange

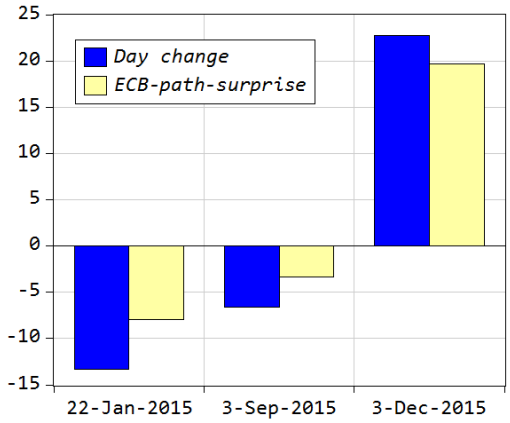
where they are negotiated, as well as for other OTC traded securities (e.g. for the less liquid inflation swaps reflected in their volatility). Furthermore, for some securities, such as corporate spreads or CDS, there is not even a reliable intra-daily price and data are only available at a daily frequency. These price data gaps may become a problem when using very narrow intra-daily windows, especially if one is interested in the international spillovers of monetary policies which span across different time zones. For example, the benchmark Italian and German government bonds are quoted between 7:00 and 17:00 London Time, while the corresponding futures are traded between 7:00 and 21:00 London Time. This implies that, following a Fed announcement, typically at 18:00 London Time, the same day reaction of asset prices may fail to reflect the full price adjustment, which spills onto the following trading day. Also, the spillovers across the Atlantic of ECB and Fed announcements have the greatest impact on yields and the exchange rate, which show an immediate response. The persistence of the interest rate response is much greater, while the exchange rate and also the stock market show in several instances some reversion of the initial impact.

The three ECB announcements in 2015 surprised markets in differing ways. The 1^{st} PSPP announcement in January 2015 contributed the most to a reduction in long-term yields in the euro area and spilled over onto other markets (Figure 3). The September 2015 announcement led to a further reduction in euro area long-term yields, a marked depreciation of the euro against the dollar, while US yields were not affected much (Figure 4). In contrast, the 2^{nd} APP extension announcement in December 2015, despite being clearly expansionary disappointed the markets: euro-area long-term yields as well as those in the US rose in sync, while the euro appreciated against the dollar. The reaction of equities was also negative both in the US and Europe (Figure 5). All in all, intra-daily changes coincided with daily changes supporting our modeling identification strategy.

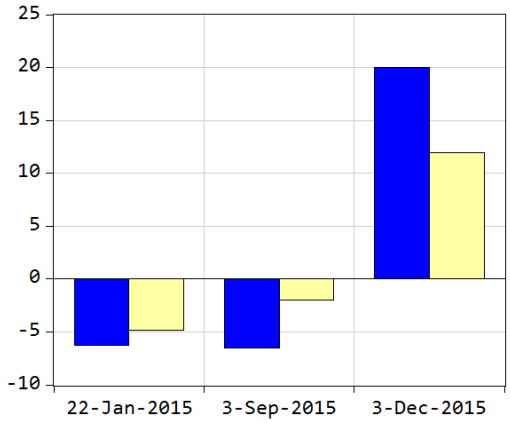
Figures

Figure 1: Asset price changes around specific ECB APP dates *(basis points)*

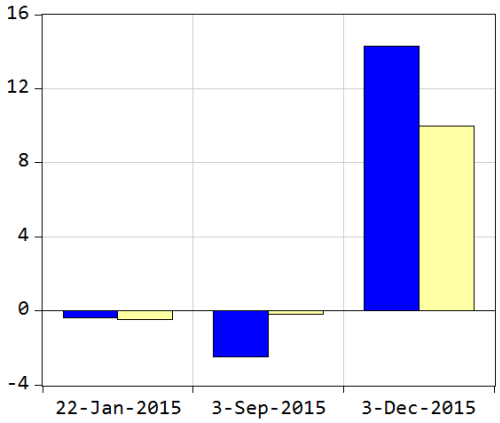
(a) Italy 10 Year BTP



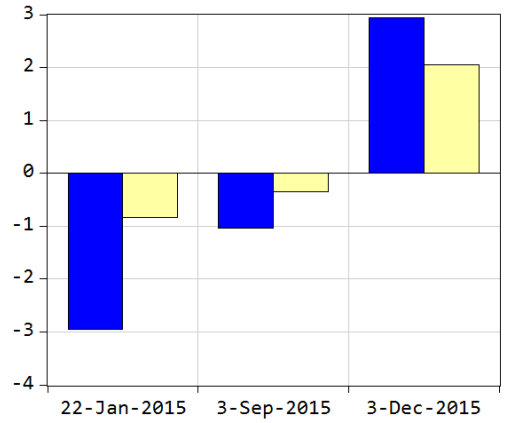
(b) Germany 10 Year Bund



(c) US 10 Year Treasury



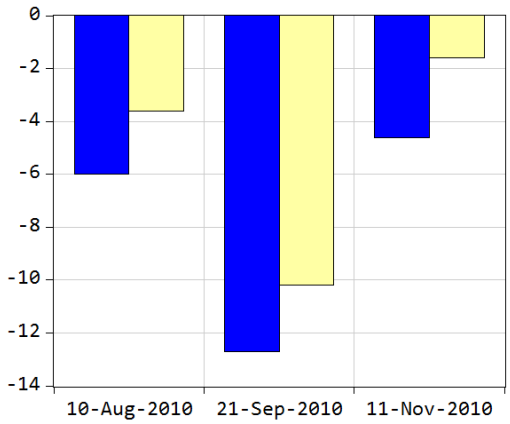
(d) USDEUR (% change)



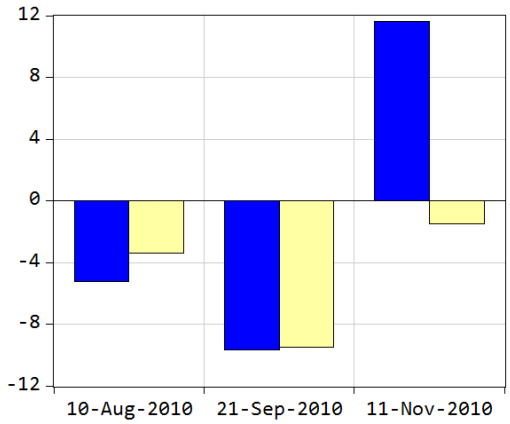
Notes: On 22-Jan-2015 the ECB officialy announced the Public Sector Purchase Program (PSPP). On 3-Sep-2015 the ECB raised the issue share limit for the purchasable assets, thereby extending the PSPP. On 3-Dec-2015 the ECB announced an extension of the PSPP horizon. of the APP.

Figure 2: Asset price changes around specific Fed QE2 dates *(basis points)*

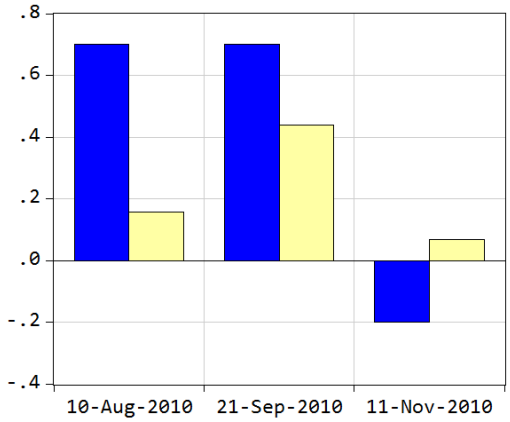
(a) US 10 Year Treasury



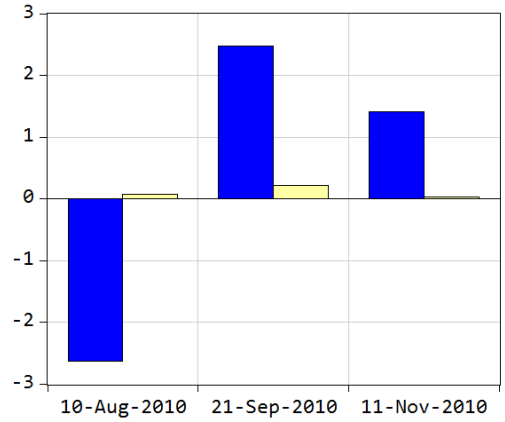
(b) US 10 Year Term-premia



(c) OAS on US High-Yield bonds

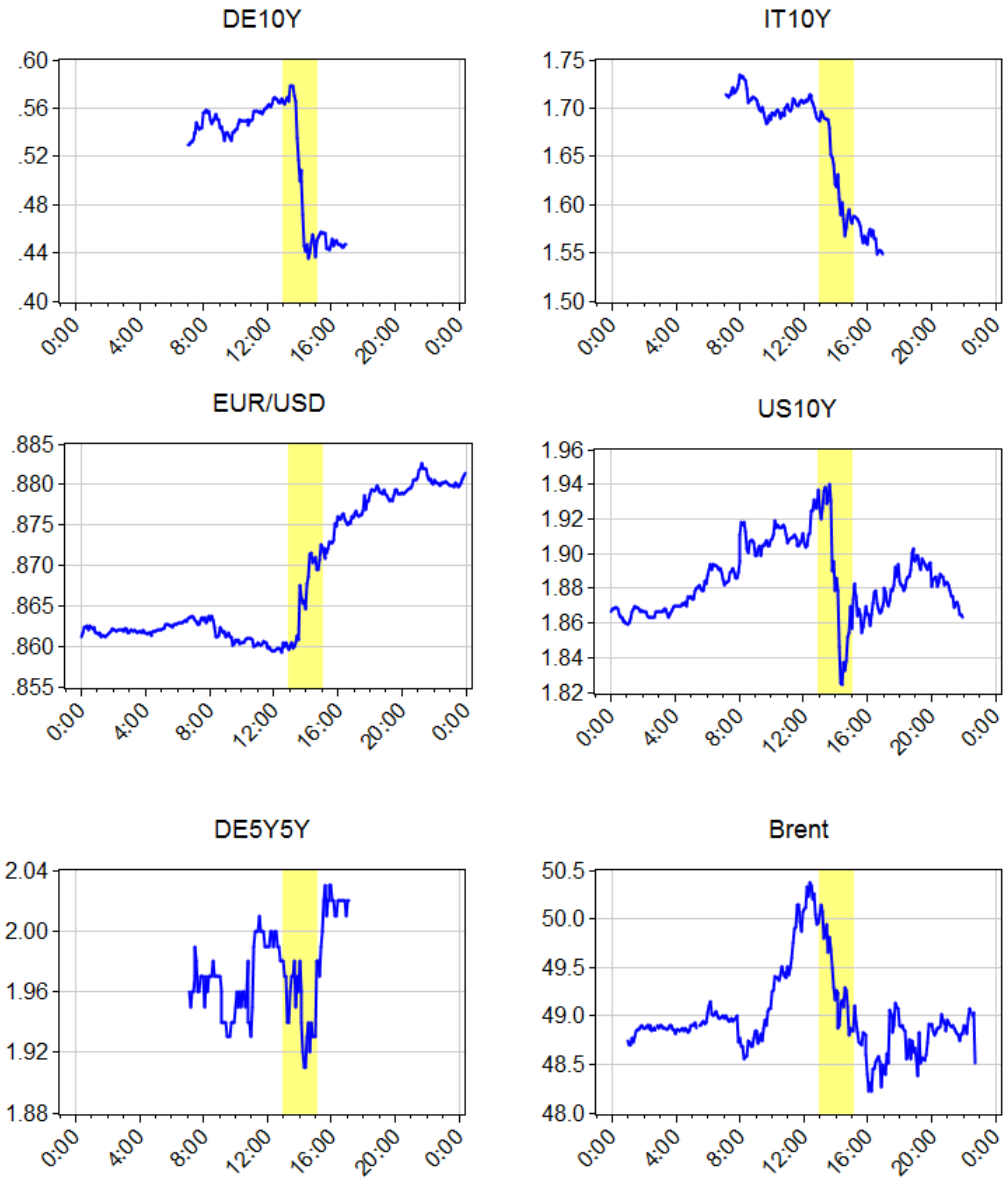


(d) USDEUR (% change)



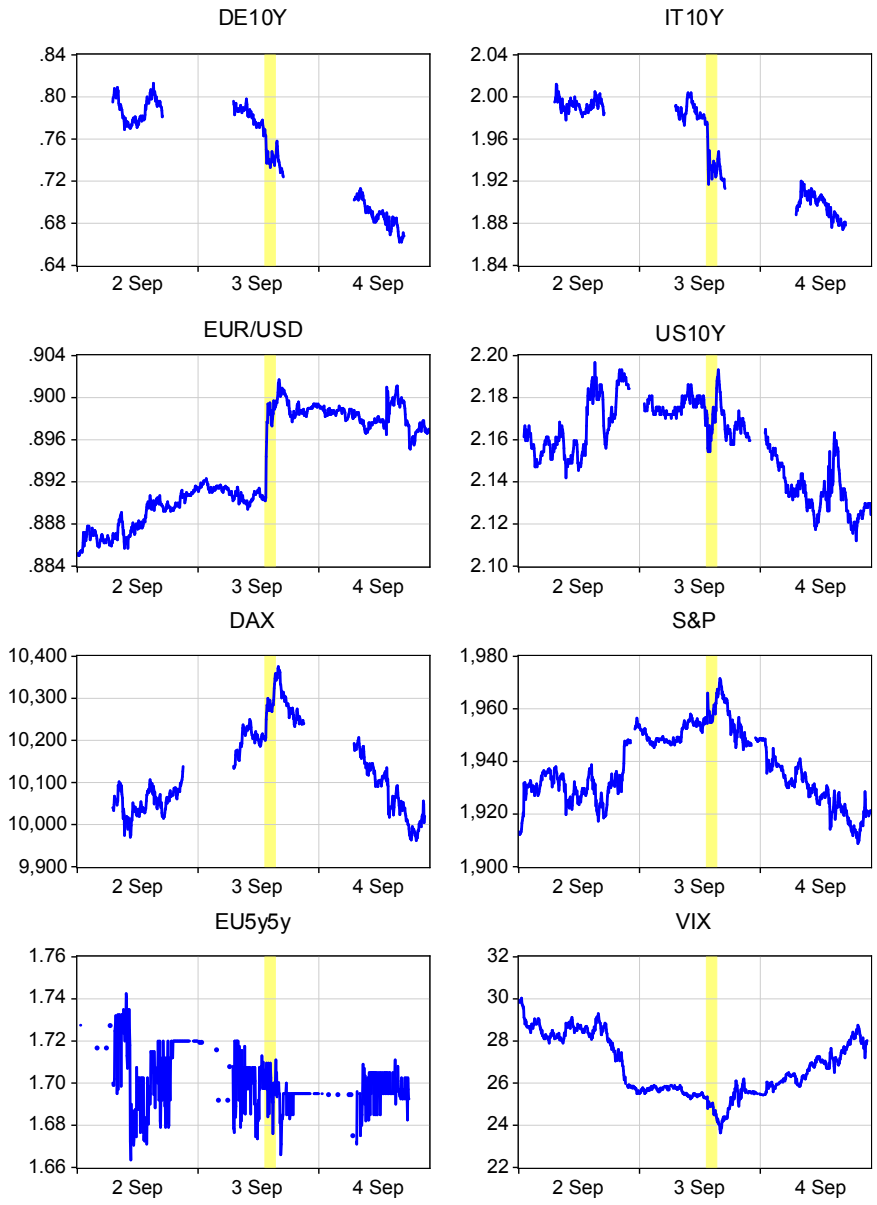
Notes: The statements accompanying the August, September and November 2010 FOMC meetings, collectively conveyed the essence of the information about the Fed QE2-program (see Krishnamurthy and Vissing-Jorgensen (2011)).

Figure 3: ECB announcement on 22 Jan 2015: introduction of the PSPP



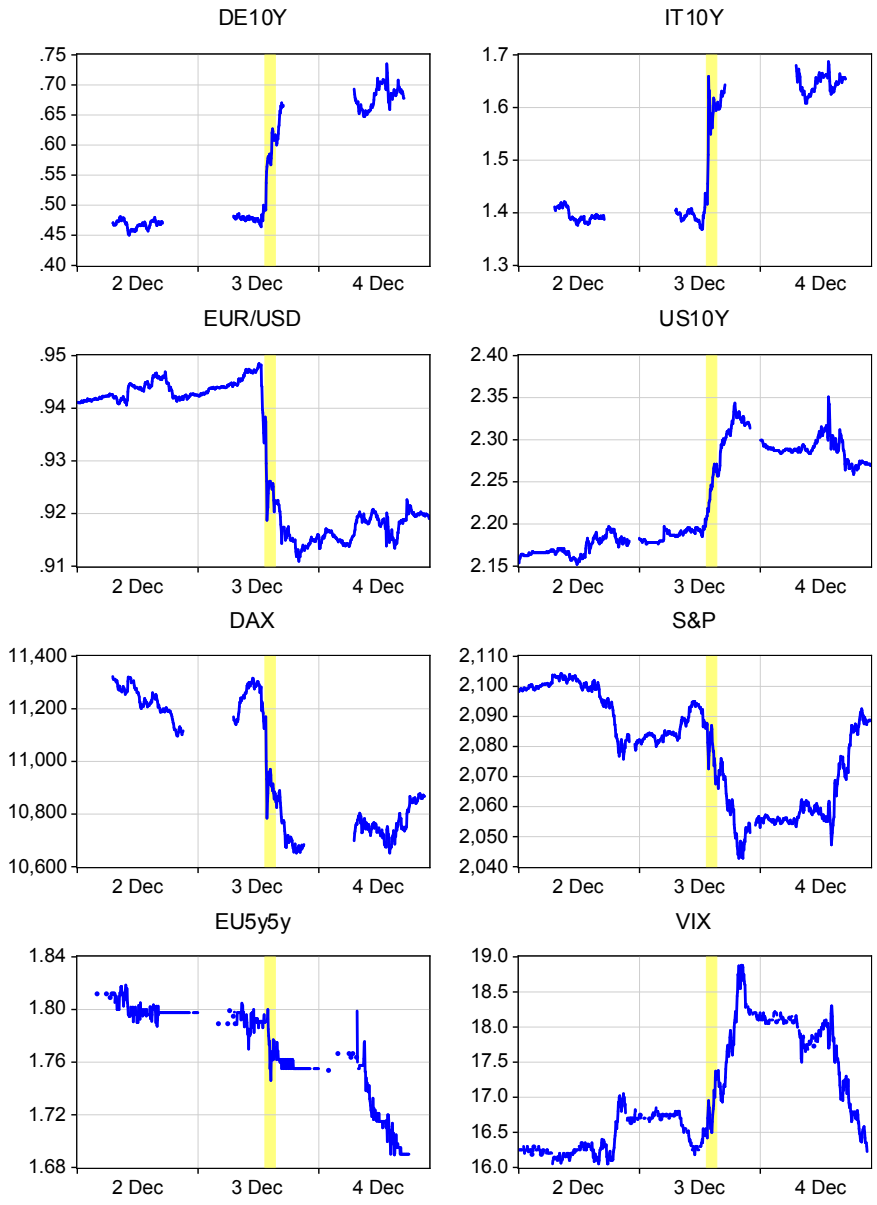
Notes: Vertical shading between 1pm and 3pm GMT on 22-Jan-2015, i.e. from the start of the ECB press conference and 2 hours aftwerward. DE10Y=yield on German 10 year benchmark Bund; IT10Y=yield on Italian 10 year benchmark BTP yield; US10=yield on 10Y US treasury benchmark; EUR/USD= euro per US dollar exchange rate; DE5y5y=German 5-year, 5-year breakeven forward inflation rate; Brent= Brent crude spot price US/bbl.

Figure 4: ECB announcement on 3 September 2015: 1^{st} PSPP extension



Notes: Vertical shading between 1pm and 3pm GMT on 3-Sep-2015, i.e. from the start of the ECB press conference and 2 hours aftwerward. DE10Y=yield on German 10 year benchmark Bund; IT10Y=yield on Italian 10 year benchmark BTP yield; US10=yield on 10 year US treasury benchmark; EUR/USD= euro per US dollar exchange rate; S&P=US Standard & Poor stock market index; DAX=German DAX stock market index; EU5y5y=euro area 5 year forward 5 year inflation swap rate; VIX=VIX index.

Figure 5: ECB announcement on 3 December 2015: 2^{nd} PSPP extension



Notes: Vertical shading between 1pm and 3pm GMT on 3-Dec-2015, i.e. from the start of the ECB press conference and 2 hours aftwerward. DE10Y=yield on German 10 year benchmark Bund; IT10Y=yield on Italian 10 year benchmark BTP yield; US10=yield on 10 year US treasury benchmark; EUR/USD= euro per US dollar exchange rate; S&P=US Standard & Poor stock market index; DAX=German DAX stock market index; EU5y5y=euro area 5 year forward 5year inflation swap rate;VIX=VIX index.

Tables

Table 1: Data description

asset	start	end	source	description
US 1m, 3m	01-Jan-1999	30-Sep-2016	Thomson Reuters	federal funds futures current month and 3-months ahead
US 6m, 9m, 1y	01-Jan-1999	30-Sep-2016	Thomson Reuters	two-,three-, and four-quarter ahead eurodollar future rates
euro OIS 1m, 3m, 6m, 9m, 1y	01-Jan-1999	30-Sep-2016	Thomson Reuters	euro-denominated Overnight Index Swap
2-year, 5-year, 10-year US bond	01-Jan-1999	30-Sep-2016	Thomson Reuters	yield on benchmark Treasury/Note
2-year, 5-year, 10-year German bond	01-Jan-1999	30-Sep-2016	Thomson Reuters	yield on benchmark Bund/Schatz
2-year, 5-year, 10-year French bond	01-Jan-1999	30-Sep-2016	Thomson Reuters	yield on benchmark OAT/BTAN
2-year, 5-year, 10-year Italian bond	01-Jan-1999	30-Sep-2016	Thomson Reuters	yield on benchmark BTP
2-year, 5-year, 10-year Spanish bond	01-Jan-1999	30-Sep-2016	Thomson Reuters	yield on benchmark Bonos
USD/EUR	01-Jan-1999	30-Sep-2016	Thomson Reuters	US dollar per foreign currency
USD/GBP	01-Jan-1999	30-Sep-2016	Thomson Reuters	US dollar per foreign currency
USD/YEN	01-Jan-1999	30-Sep-2016	Thomson Reuters	US dollar per foreign currency
US stock market	01-Jan-1999	30-Sep-2016	Thomson Reuters	S&P Composite
euro-area stock market	01-Jan-1999	30-Sep-2016	Thomson Reuters	EuroSTOXX50
Japan stock market	01-Jan-1999	30-Sep-2016	Thomson Reuters	Nikkei 225
German stock market	01-Jan-1999	30-Sep-2016	Thomson Reuters	DAX
French stock market	01-Jan-1999	30-Sep-2016	Thomson Reuters	CAC40
Italian stock market	01-Jan-1999	30-Sep-2016	Thomson Reuters	FTSE Mib
2-year US bond term premium	01-Jan-1999	30-Sep-2016	estimated	Affine term structure model
5-year US bond term premium	01-Jan-1999	30-Sep-2016	estimated	Affine term structure model
10-year US bond term premium	01-Jan-1999	30-Sep-2016	estimated	Affine term structure model
2-year euro-area bond term premium	4-Sep-2004	30-Sep-2016	estimated	Affine term structure model
5-year euro-area bond term premium	4-Sep-2004	30-Sep-2016	estimated	Affine term structure model
10-year euro-area bond term premium	4-Sep-2004	30-Sep-2016	estimated	Affine term structure model
5-year US inflation swap	01-Jan-1999	30-Sep-2016	Bloomberg	derivative on the domestic CPI
5-year US 5-year ahead inflation swap	01-Jan-1999	30-Sep-2016	Bloomberg	derivative on the domestic CPI
5-year euro-area inflation swap	01-Jan-1999	30-Sep-2016	Bloomberg	derivative on the domestic CPI
5-year 5-year ahead euro-area inflation swap	01-Jan-1999	30-Sep-2016	Bloomberg	derivative on the domestic CPI
US MOVE index	01-Jan-1999	30-Sep-2016	Thomson Reuters	1-month Treasury volatility index
German bond volatility	01-Jan-1999	30-Sep-2016	Thomson Reuters	1-month Bund implied volatility
VIX	01-Jan-1999	30-Sep-2016	CBOT-CME	Volatility index of the US stock market
euro-area investment grade corporate spread	01-Jan-1999	30-Sep-2016	Moody's	spread between BAA corporate and government bonds
euro-area high-yield corporate spread	01-Jan-1999	30-Sep-2016	Moody's	spread between sub-investement corporate and government bonds
US investment grade corporate spread	01-Jan-1999	30-Sep-2016	Moody's	spread between BAA corporate and government bonds
US high-yield corporate spread	01-Jan-1999	30-Sep-2016	Moody's	spread between sub-investement corporate and government bonds
1-month risk reversal	01-Jan-1999	30-Sep-2016	Bloomberg	difference between call and put option on USD/EUR
1-month USD/EUR and USD/GBP implied vol	01-Jan-1999	30-Sep-2016	Thomson Reuters	1-month implied vol
1-year USD/EUR cross-currency basis swap	01-Jan-1999	30-Sep-2016	Thomson Reuters	cross-currency basis swap
Brent	01-Jan-1999	30-Sep-2016	Thomson Reuters	Oil price: Brent USD/brl

Table 2: Yields volatility on announcement and non-announcement days

Federal Reserve Board									
	Pre-crisis			Crisis			Post-crisis		
	σ_{Fed}	$\sigma_{Non-Fed}$		σ_{Fed}	$\sigma_{Non-Fed}$		σ_{Fed}	$\sigma_{Non-Fed}$	
US 1-mo	7.9	3.1	***	1.3	0.9	***	0.5	0.6	
US 3-mo	6.1	3.3	***	0.8	0.9		1.0	0.5	***
US 12-mo	6.8	5.1	***	2.2	1.8	**	1.3	1.3	
US 2-year	9.9	6.4	***	4.9	3.5	***	4.4	2.5	***
US 5-year	10.1	6.8	***	9.9	5.8	***	7.5	4.3	***
US 10-year	9.1	6.2	***	10.9	6.4	***	6.3	4.5	***
obs	123	2442		51	1019		43	1001	
European Central Bank									
	Pre-crisis			Crisis			Post-crisis		
	σ_{ECB}	$\sigma_{Non-ECB}$		σ_{ECB}	$\sigma_{Non-ECB}$		σ_{ECB}	$\sigma_{Non-ECB}$	
Eur OIS 1-mo	5.3	2.8	***	4.2	2.2	***	1.9	0.8	***
Eur OIS 3-mo	4.9	2.5	***	4.0	1.9	***	1.9	0.7	***
Eur OIS 12-mo	7.0	4.2	***	6.2	2.9	***	2.9	1.0	***
Ger 2-year	6.8	4.7	***	5.6	4.1	***	3.5	1.4	***
Ger 5-year	6.2	4.7	***	6.2	4.9	***	5.0	2.7	***
Ger 10-year	4.8	4.1	**	5.4	4.8	*	5.7	3.6	***
Ita 2-year	6.4	4.6	***	18.7	13.0	***	7.7	4.6	***
Ita 5-year	5.6	4.6	***	16.9	11.1	***	8.6	5.1	***
Ita 10-year	4.6	3.9	**	13.4	8.4	***	8.1	5.5	***
obs	125	2440		53	1017		41	1003	

The table reports the standard deviation of changes in interest rate futures (1 month and 3 month) and bond yields during monetary policy monetary policy announcements for the ECB or the Fed (σ_{Ecb}, σ_{Fed}), along with the standard deviation on the other non-event days ($\sigma_{Non-Ecb}$, $\sigma_{Non-Fed}$); (*), (**), (***) denote 10%, 5% and 1% significance, for the one sided variance difference F-test over the two samples. The pre-crisis, crisis and post-crisis periods are defined in the main text.

Table 3: US: Response of Yield Curve to Target and Path Factors

	α_{target}	$p-val$	R^2	α_{target}	$pval$	α_{path}	$p-val$	R^2
6m	25.00	0.00	0.26	25.00	0.00	25.00	0.00	0.70
12m	13.91	0.05	0.03	13.91	0.00	53.59	0.00	0.90
2y	15.46	0.00	0.09	15.46	0.00	28.73	0.00	0.60
5y	7.14	0.11	0.02	7.14	0.02	27.01	0.00	0.58
10y	1.85	0.61	0.00	1.85	0.48	20.68	0.00	0.50

Note: Regressions on Fed announcement days only, with orthogonalized factors. Sample is all monetary policy announcements from Jan. 2000 to November 2008. Target rate and path factor are defined in 5, and normalized to have a 25bp impact on the 6-months yield. The regression in the left panel only includes the target-rate, while the second also adds the path-factor. Standard errors computed with heteroskedasticity-consistent estimator: p-values calculated accordingly.

Table 4: Euro area: Response of Yield Curve to Target and Path Factors

	α_{target}	$p-val$	R^2	α_{target}	$pval$	α_{path}	$p-val$	R^2
6m	25.00	0.00	0.35	25.00	0.00	25.00	0.00	0.96
12m	22.59	0.00	0.20	22.59	0.00	33.07	0.00	0.96
2y	17.73	0.00	0.13	17.73	0.00	25.35	0.00	0.62
5y	10.13	0.01	0.05	10.13	0.00	19.97	0.00	0.43
10y	2.68	0.39	0.01	2.68	0.33	11.36	0.00	0.23

Note: Regressions on ECB announcement days only; orthogonalized factors (see 5). Sample is all monetary policy announcements from Jan. 2000 to November 2008, and normalized to have a 25bp impact on the 6-months yield. The regression in the left panel only includes the target-factor, while the second also adds the path-factor. Standard errors computed with heteroskedasticity-consistent estimator: p-values calculated accordingly.

Table 5: Impact of monetary policy surprises on asset prices before the global financial crisis

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	26.74 * **	[1.41]	20.18 * **	[2.88]	0.53	151
US 5-Year Treasury	30.40 * **	[1.33]	30.86 * **	[2.71]	0.50	151
US 10-Year Treasury	25.00 * **	[1.52]	21.31 * **	[3.11]	0.40	151
Ger 2-Year Bund	1.25*	[0.74]	42.90 * **	[1.51]	0.50	151
Ger 5-Year Bund	1.44*	[0.83]	40.67 * **	[1.70]	0.48	151
Ger 10-Year Bund	7.04 * **	[1.13]	25.00 * **	[2.31]	0.38	151
Ita 2-Year BTP	1.37 * *	[0.63]	43.06 * **	[1.28]	0.52	151
Ita 5-Year BTP	5.68 * **	[0.87]	38.48 * **	[1.78]	0.50	151
Ita 10-Year BTP	4.26 * **	[0.99]	26.98 * **	[2.03]	0.41	151
Fra 2-Year OAT	2.11 * **	[0.69]	44.64 * **	[1.41]	0.53	151
Fra 5-Year OAT	3.14 * **	[0.77]	39.14 * **	[1.58]	0.52	151
Fra 10-Year OAT	9.49 * **	[1.08]	26.47 * **	[2.21]	0.43	151
Spa 2-Year Bonos	3.19 * **	[0.68]	44.87 * **	[1.38]	0.54	151
Spa 5-Year Bonos	6.08 * **	[0.94]	42.43 * **	[1.91]	0.50	151
Spa 10-Year Bonos	6.40 * **	[1.09]	29.78 * **	[2.23]	0.46	151
USD/EUR	−1.14 * **	[0.34]	2.32 * **	[0.69]	0.10	151
USD/GBP	−0.11	[0.34]	1.25*	[0.69]	0.14	151
USD/YEN	−1.63 * **	[0.38]	−0.80	[0.78]	0.12	151
US stock	1.08 * **	[0.23]	5.16 * **	[0.47]	0.50	151
€ stock	0.48	[0.40]	3.61 * **	[0.82]	0.27	151
Jap stock	−0.19	[0.46]	−0.04	[0.94]	0.07	151
Ger stock	0.66	[0.48]	3.73 * **	[0.98]	0.24	151
Fra stock	0.35	[0.44]	3.98 * **	[0.90]	0.31	151
Italy stock	−0.05	[0.39]	2.87 * **	[0.80]	0.28	151
US 2-Year term-premia	5.85 * **	[1.08]	4.37 * *	[2.23]	0.18	148
US 5-Year term-premia	6.01 * **	[1.33]	6.10 * *	[2.73]	0.16	148
US 10-Year term-premia	4.70 * **	[1.67]	4.24	[3.43]	0.14	148
€ 2-Year term-premia	0.94	[1.21]	29.01 * **	[2.47]	0.24	151
€ 5-Year term-premia	3.33*	[1.71]	26.59 * **	[3.49]	0.23	151
€ 10-Year term-premia	4.72 * **	[1.73]	16.62 * **	[3.53]	0.15	151
US 5y Inflation-swap	−0.84	[2.96]	21.14 * **	[5.20]	0.06	103
US 5y-5y Inflation-swap	−0.52	[2.53]	7.51*	[4.45]	0.09	104
€ 5y Inflation-swap	−1.04	[2.44]	14.64 * **	[4.48]	0.14	114
€ 5y-5y Inflation-swap	1.74	[1.35]	7.75 * **	[2.47]	0.13	114
US rates vol	−1.48	[1.34]	−0.09	[2.73]	0.10	151
Ger rates vol	0.29 * **	[0.09]	0.75 * **	[0.19]	0.08	151
France CDS	0.31	[0.36]	0.19	[0.63]	0.02	87
Italy CDS	−0.05	[0.21]	−0.13	[0.40]	0.03	123
€ OAS Inv. grade	−0.00	[0.05]	−0.76 * **	[0.10]	0.20	151
€ OAS HY	−0.34	[0.28]	−3.16 * **	[0.58]	0.13	151
US OAS Inv. grade	−0.13 * **	[0.04]	−0.11	[0.08]	0.05	151
US OAS HY	−2.15 * **	[0.26]	−2.99 * **	[0.54]	0.26	151
EUR 1-mo implied vol	−0.05	[0.14]	0.11	[0.29]	0.05	151
GBP 1-mo implied vol	0.07	[0.13]	−0.35	[0.26]	0.03	151
JPY 1-mo implied vol	−0.49 * *	[0.24]	−1.10 * *	[0.49]	0.11	151
USD/EUR 25δ risk-rev.	0.04	[0.03]	0.16 * **	[0.06]	0.06	148
USD/EUR 1y crosscurr basis	−0.83	[3.68]	0.02	[7.09]	0.18	41
Brent	0.72	[0.90]	−0.06	[1.83]	0.07	151

Note: Regressions of daily change of the asset price shown in each row (basis points or % points) on changes in the monetary policy suprise factors (see equation 7) for the Federal Reserve and the ECB, on announcement days only.
(*), (**), (***) denote 10%, 5% and 1% significance, based on robust standard errors shown in brackets.
Fed and ECB path factors are scaled so to have a 25bp impact on the 10-Year US-Treasury and 10-Year German-Bund yield, respectively. Sample are announcement days in pre-crisis period: Jan-2000 to Oct-2008.

Table 6: Impact of monetary policy surprises on asset prices during the crisis

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	10.07 ∗ ∗∗	[0.85]	−6.03	[6.55]	0.38	104
US 5-Year Treasury	22.03 ∗ ∗∗	[1.44]	−21.52∗	[11.13]	0.51	104
US 10-Year Treasury	25.00 ∗ ∗∗	[1.54]	−27.10 ∗ ∗	[11.90]	0.50	104
Ger 2-Year Bund	1.64	[1.16]	−10.51	[8.96]	0.18	104
Ger 5-Year Bund	3.77 ∗ ∗	[1.49]	−30.68 ∗ ∗∗	[11.46]	0.22	104
Ger 10-Year Bund	4.64 ∗ ∗∗	[1.41]	−25.00 ∗ ∗	[10.89]	0.21	104
Ita 2-Year BTP	0.46	[1.98]	335.01 ∗ ∗∗	[15.25]	0.43	104
Ita 5-Year BTP	3.76 ∗ ∗∗	[1.33]	279.40 ∗ ∗∗	[10.27]	0.49	104
Ita 10-Year BTP	−0.88	[1.70]	218.31 ∗ ∗∗	[13.13]	0.44	104
Fra 2-Year OAT	1.64	[1.18]	32.70 ∗ ∗∗	[9.10]	0.22	104
Fra 5-Year OAT	1.69	[1.65]	29.97 ∗ ∗	[12.72]	0.17	104
Fra 10-Year OAT	1.41	[1.61]	42.24 ∗ ∗∗	[12.42]	0.19	104
Spa 2-Year Bonos	1.32	[2.33]	325.44 ∗ ∗∗	[18.00]	0.31	104
Spa 5-Year Bonos	2.00	[2.02]	245.02 ∗ ∗∗	[15.57]	0.45	104
Spa 10-Year Bonos	0.92	[1.77]	198.36 ∗ ∗∗	[13.66]	0.41	104
USD/EUR	−0.54 ∗ ∗	[0.17]	−8.57 ∗ ∗∗	[2.84]	0.21	104
USD/GBP	−0.79 ∗ ∗	[0.34]	−6.43 ∗ ∗	[2.65]	0.17	104
USD/YEN	−2.06 ∗ ∗∗	[0.30]	0.47	[2.33]	0.22	104
US stock	1.65 ∗ ∗∗	[0.28]	−9.47 ∗ ∗∗	[2.17]	0.55	104
€ stock	0.95 ∗ ∗	[0.42]	−16.47 ∗ ∗∗	[3.20]	0.30	104
Jap stock	0.44	[0.47]	−5.61	[3.61]	0.05	104
Ger stock	0.72∗	[0.41]	−13.11 ∗ ∗∗	[3.19]	0.21	104
Fra stock	1.08 ∗ ∗	[0.44]	−16.94 ∗ ∗∗	[3.36]	0.31	104
Italy stock	0.35	[0.48]	−26.07 ∗ ∗∗	[3.72]	0.35	104
US 2-Year term-premia	11.15 ∗ ∗∗	[1.08]	−14.61∗	[8.67]	0.37	103
US 5-Year term-premia	19.50 ∗ ∗∗	[1.70]	−25.68∗	[13.64]	0.44	103
US 10-Year term-premia	23.23 ∗ ∗∗	[2.20]	−33.98∗	[17.60]	0.37	103
€ 2-Year term-premia	−0.25	[1.24]	101.55 ∗ ∗∗	[9.54]	0.23	104
€ 5-Year term-premia	1.90	[2.19]	115.66 ∗ ∗∗	[16.87]	0.17	104
€ 10-Year term-premia	2.32	[1.79]	95.07 ∗ ∗∗	[13.77]	0.29	104
US 5y Inflation-swap	0.80	[2.34]	−21.65	[18.02]	0.08	104
US 5y-5y Inflation-swap	−1.94	[1.61]	−25.35 ∗ ∗	[12.41]	0.14	104
€ 5y Inflation-swap	−6.00 ∗ ∗	[2.94]	40.65∗	[22.66]	0.09	101
€ 5y-5y Inflation-swap	3.11 ∗ ∗	[1.45]	−31.50 ∗ ∗∗	[11.20]	0.12	103
US rates vol	6.67 ∗ ∗∗	[1.10]	6.68	[8.49]	0.16	104
Ger rates vol	−0.14	[0.10]	−0.15	[0.76]	0.03	104
France CDS	−0.54	[0.99]	50.75 ∗ ∗∗	[7.60]	0.22	104
Italy CDS	−6.62 ∗ ∗∗	[2.42]	189.35 ∗ ∗∗	[18.68]	0.31	104
€ OAS Inv. grade	−0.06	[0.07]	0.52	[0.57]	0.10	104
€ OAS HY	−0.24	[0.27]	5.11 ∗ ∗	[2.11]	0.23	104
US OAS Inv. grade	−0.08∗	[0.05]	1.05 ∗ ∗∗	[0.35]	0.12	104
US OAS HY	−1.60 ∗ ∗∗	[0.25]	4.16 ∗ ∗	[1.91]	0.27	104
EUR 1-mo implied vol	−0.75 ∗ ∗∗	[0.25]	3.82 ∗ ∗	[1.93]	0.16	104
GBP 1-mo implied vol	−0.09	[0.22]	2.33	[1.69]	0.07	104
JPY 1-mo implied vol	−1.20 ∗ ∗∗	[0.23]	0.36	[1.78]	0.09	104
USD/EUR 25δ risk-rev.	−0.13 ∗ ∗	[0.06]	−1.07 ∗ ∗	[0.45]	0.16	104
USD/EUR 1y crosscurr basis	−2.63 ∗ ∗∗	[0.68]	−20.01 ∗ ∗∗	[5.26]	0.18	104
Brent	1.52 ∗ ∗	[0.65]	−8.84∗	[5.00]	0.20	104

Note: Regressions of daily change of the asset price shown in each row (basis points or % points) on changes in the monetary policy suprise factors (see equation 7) for the Federal Reserve and the ECB, on announcement days only.
(*), (**), (***) denote 10%, 5% and 1% significance, based on robust standard errors shown in brackets.
Fed and ECB path factors are scaled so to have a 25bp impact on the 10-Year US-Treasury and 10-Year German-Bund yield, respectively. Sample are central bank announcement days during the global financial and sovereign crisis years, between Nov-2008 to Dec-2012.

Table 7: Impact of monetary policy surprises on asset prices after the sovereign crisis

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	16.10 * **	[1.18]	1.67	[1.51]	0.47	84
US 5-Year Treasury	31.71 * **	[1.46]	0.66	[1.88]	0.61	84
US 10-Year Treasury	25.00 * **	[2.21]	1.75	[2.84]	0.50	84
Ger 2-Year Bund	0.52	[0.97]	14.66 * **	[1.25]	0.29	84
Ger 5-Year Bund	2.77*	[1.64]	26.93 * **	[2.11]	0.40	84
Ger 10-Year Bund	3.96*	[2.21]	25.00 * **	[2.84]	0.21	84
Ita 2-Year BTP	−0.89	[2.54]	32.14 * **	[3.27]	0.33	84
Ita 5-Year BTP	0.90	[2.07]	45.06 * **	[2.67]	0.52	84
Ita 10-Year BTP	0.10	[2.30]	42.56 * **	[2.96]	0.56	84
Fra 2-Year OAT	1.18	[0.93]	16.75 * **	[1.20]	0.38	84
Fra 5-Year OAT	0.67	[1.57]	27.20 * **	[2.02]	0.39	84
Fra 10-Year OAT	3.01	[2.14]	24.58 * **	[2.76]	0.31	84
Spa 2-Year Bonos	−0.40	[2.10]	28.23 * **	[2.70]	0.41	84
Spa 5-Year Bonos	5.50 * **	[2.00]	36.30 * **	[2.57]	0.48	84
Spa 10-Year Bonos	−0.81	[2.53]	41.91 * **	[3.26]	0.47	84
USD/EUR	−1.66 * **	[0.58]	4.30 * **	[0.74]	0.35	84
USD/GBP	−0.47	[0.47]	1.50 * *	[0.60]	0.23	84
USD/YEN	−1.32 * *	[0.65]	1.85 * *	[0.84]	0.17	84
US stock	−0.01	[0.25]	−1.39 * **	[0.32]	0.61	84
€ stock	−0.27	[0.63]	−4.21 * **	[0.81]	0.25	84
Jap stock	0.61	[0.92]	0.09	[1.18]	0.08	84
Ger stock	−0.14	[0.64]	−4.38 * **	[0.83]	0.20	84
Fra stock	−0.32	[0.71]	−4.53 * **	[0.92]	0.25	84
Italy stock	−0.44	[0.99]	−5.55 * **	[1.27]	0.22	84
US 2-Year term-premia	1.12	[1.96]	2.21	[2.56]	0.16	83
US 5-Year term-premia	10.53 * **	[2.58]	3.87	[3.37]	0.29	83
US 10-Year term-premia	6.10*	[3.54]	1.53	[4.62]	0.14	83
€ 2-Year term-premia	−2.17	[1.41]	17.90 * **	[1.82]	0.43	84
€ 5-Year term-premia	−3.79	[2.73]	29.32 * **	[3.52]	0.34	84
€ 10-Year term-premia	−4.38	[2.84]	27.17 * **	[3.65]	0.28	84
US 5y Inflation-swap	−4.93 * *	[2.15]	−0.93	[2.76]	0.07	84
US 5y-5y Inflation-swap	0.25	[2.16]	−0.69	[2.78]	0.03	84
€ 5y Inflation-swap	2.44 * **	[0.95]	−3.01 * *	[1.22]	0.17	84
€ 5y-5y Inflation-swap	0.33	[1.20]	−4.09 * **	[1.55]	0.07	84
US rates vol	5.56 * **	[1.75]	3.05	[2.25]	0.20	84
Ger rates vol	−0.09	[0.19]	0.35	[0.24]	0.02	84
France CDS	0.29	[0.40]	0.73	[0.52]	0.03	84
Italy CDS	−2.57	[2.50]	12.44 * **	[3.22]	0.13	84
€ OAS Inv. grade	−0.14	[0.09]	0.05	[0.11]	0.09	84
€ OAS HY	−0.39	[0.33]	−0.42	[0.42]	0.09	84
US OAS Inv. grade	−0.21 * **	[0.06]	0.14*	[0.08]	0.21	84
US OAS HY	−2.19 * **	[0.30]	0.27	[0.38]	0.38	84
EUR 1-mo implied vol	1.13 * **	[0.42]	−0.48	[0.55]	0.12	84
GBP 1-mo implied vol	0.38	[0.27]	−1.01 * **	[0.35]	0.16	84
JPY 1-mo implied vol	0.41	[0.47]	−2.09 * **	[0.60]	0.16	84
USD/EUR 25δ risk-rev.	−0.20 * *	[0.08]	0.04	[0.10]	0.07	84
USD/EUR 1y crosscurr basis	−0.54	[0.78]	2.22 * *	[1.00]	0.13	84
Brent	−1.11	[1.07]	−0.74	[1.37]	0.02	84

Note: Regressions of daily change of the asset price shown in each row (basis points or % points) on changes in the monetary policy suprise factors (see equation 7) for the Federal Reserve and the ECB, on announcement days only.
(*), (**), (***) denote 10%, 5% and 1% significance, based on robust standard errors shown in brackets.
Fed and ECB path factors are scaled so to have a 25bp impact on the 10-Year US-Treasury and 10-Year German-Bund yield, respectively. Sample are central bank announcement days between Jan-2013 and Sep-2016.

Table A-1: US: Response of Yield Curve to Target and Path Factors

	α_{target}	$p-val$	R^2	α_{target}	$pval$	α_{path}	$p-val$	R^2
06m	25.00	0.00	0.67	25.00	0.00	25.00	0.00	0.85
12m	20.25	0.00	0.19	20.25	0.00	74.77	0.00	0.90
02y	20.25	0.00	0.39	20.25	0.00	33.32	0.00	0.68
05y	13.53	0.00	0.21	13.53	0.00	34.98	0.00	0.61
10y	7.42	0.00	0.10	7.42	0.00	28.81	0.00	0.51

Note: Regressions on Fed announcement days only; orthogonalized factors. Sample is all monetary policy announcements from Jan. 2001 to November 2008. Target factor and path factor are defined in equation 10, and normalized to have a 25bp impact on the 6-months yield. The regression in the left panel only includes the target-factor, while the second also adds the path-factor. Standard errors computed with heteroskedasticity-consistent estimator: p-values calculated accordingly.

Table A-2: Euro area: Response of Yield Curve to Target and Path Factors

	α_{target}	$p-val$	R^2	α_{target}	$pval$	α_{path}	$p-val$	R^2
6m	25.00	0.00	0.32	25.00	0.00	25.00	0.00	0.96
12m	20.43	0.00	0.15	20.43	0.00	33.69	0.00	0.97
02y	15.58	0.00	0.10	15.58	0.00	26.12	0.00	0.63
05y	7.11	0.10	0.02	7.11	0.03	21.10	0.00	0.46
10y	0.03	0.99	0.00	0.03	0.99	12.35	0.00	0.27

Note: Regressions on ECB announcement days only; orthogonalized factors. Sample is all monetary policy announcements from Jan. 2001 to November 2008. Target factor and path factor are defined in equation 10, and normalized to have a 25bp impact on the 6-months yield. The regression in the left panel only includes the target-factor, while the second also adds the path-factor. Standard errors computed with heteroskedasticity-consistent estimator: p-values calculated accordingly.

Table A-3: Impact of monetary policy surprises on asset prices before the global financial crisis: alternative sample

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	33.29 * **	[1.65]	19.27 * **	[2.95]	0.52	140
US 5-Year Treasury	34.01 * **	[1.59]	24.42 * **	[2.83]	0.55	140
US 10-Year Treasury	25.00 * **	[1.81]	18.51 * **	[3.24]	0.46	140
Ger 2-Year Bund	3.48 * **	[0.87]	41.25 * **	[1.56]	0.50	140
Ger 5-Year Bund	2.97 * **	[1.00]	43.65 * **	[1.78]	0.47	140
Ger 10-Year Bund	6.77 * **	[1.43]	25.00 * **	[2.55]	0.42	140
Ita 2-Year BTP	1.17	[0.78]	44.26 * **	[1.39]	0.52	140
Ita 5-Year BTP	2.92 * **	[0.93]	40.94 * **	[1.67]	0.48	140
Ita 10-Year BTP	5.53 * **	[1.31]	25.66 * **	[2.34]	0.44	140
Fra 2-Year OAT	2.47 * **	[0.75]	45.36 * **	[1.34]	0.53	140
Fra 5-Year OAT	4.79 * **	[0.98]	39.76 * **	[1.75]	0.50	140
Fra 10-Year OAT	7.01 * **	[1.41]	26.16 * **	[2.52]	0.44	140
Spa 2-Year Bonos	2.06 * **	[0.78]	46.13 * **	[1.40]	0.55	140
Spa 5-Year Bonos	3.00 * **	[0.81]	43.54 * **	[1.45]	0.52	140
Spa 10-Year Bonos	7.21 * **	[1.36]	27.01 * **	[2.43]	0.46	140
USD/EUR	−1.41 * **	[0.46]	1.90 * *	[0.82]	0.11	140
USD/GBP	−0.80*	[0.43]	1.20	[0.77]	0.06	140
USD/YEN	−1.39 * **	[0.45]	0.02	[0.81]	0.13	140
US stock	0.09	[0.25]	3.25 * **	[0.45]	0.56	140
€ stock	0.07	[0.47]	2.07 * *	[0.84]	0.26	140
Jap stock	−0.48	[0.60]	−0.26	[1.07]	0.09	140
Ger stock	0.49	[0.56]	1.53	[1.01]	0.21	140
Fra stock	−0.06	[0.52]	1.88 * *	[0.93]	0.25	140
Italy stock	−0.17	[0.45]	1.81 * *	[0.80]	0.24	140
US 2-Year term-premia	5.88 * **	[1.30]	5.04 * *	[2.32]	0.17	138
US 5-Year term-premia	5.38 * **	[1.51]	6.51 * *	[2.69]	0.15	138
US 10-Year term-premia	4.09 * *	[1.89]	6.71 * *	[3.38]	0.11	138
€ 2-Year term-premia	2.38	[1.72]	26.43 * **	[3.07]	0.21	140
€ 5-Year term-premia	5.74 * **	[2.20]	21.49 * **	[3.92]	0.21	140
€ 10-Year term-premia	6.23 * **	[2.11]	15.36 * **	[3.76]	0.16	140
US 5y Inflation-swap	−7.25*	[3.72]	17.41 * **	[4.73]	0.12	92
US 5y-5y Inflation-swap	7.25 * *	[3.18]	3.74	[4.04]	0.12	93
€ 5y Inflation-swap	−0.12	[3.43]	2.83	[4.75]	0.04	103
€ 5y-5y Inflation-swa	0.65	[1.76]	5.77 * *	[2.43]	0.07	103
US rates vol	−0.78	[1.58]	2.42	[2.82]	0.11	140
Ger rates vol	0.34 * **	[0.11]	0.57 * **	[0.20]	0.11	140
France CDS	0.36	[0.38]	−0.05	[0.47]	0.02	76
Italy CDS	0.03	[0.27]	0.24	[0.41]	0.01	112
€ OAS Inv. grade	−0.00	[0.05]	−0.68 * **	[0.10]	0.29	140
€ OAS HY	−0.27	[0.31]	−3.75 * **	[0.56]	0.22	140
US OAS Inv. grade	−0.13 * **	[0.05]	−0.18 * *	[0.08]	0.07	140
US OAS HY	−2.31 * **	[0.29]	−3.11 * **	[0.51]	0.39	140
EUR 1-mo implied vol	0.05	[0.16]	−0.07	[0.29]	0.09	140
GBP 1-mo implied vol	0.25*	[0.15]	−0.51*	[0.27]	0.09	140
JPY 1-mo implied vol	0.54*	[0.29]	−0.45	[0.51]	0.08	140
USD/EUR 25δ risk-rev.	0.07*	[0.04]	0.13 * *	[0.06]	0.07	113
Brent	−0.05	[1.07]	−3.20*	[1.91]	0.06	140

Note: Regressions of daily change of the asset price shown in each row (basis points or % points) on changes in the monetary policy suprise factors (see equation 7) for the Federal Reserve and the ECB, on announcement days only.
(*), (**), (***) denote 10%, 5% and 1% significance, based on robust standard errors shown in brackets.
Fed and ECB path factors are scaled so to have a 25bp impact on the 10-Year US-Treasury and 10-Year German-Bund yield, respectively. Sample are announcement days in pre-crisis period defined as: Jan-2000 to Aug-2008.

Table A-4: Impact of monetary policy surprises on asset prices during the global financial crisis: alternative sample definition

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	10.57 ∗ ∗∗	[0.74]	−0.67	[7.57]	0.42	123
US 5-Year Treasury	23.05 ∗ ∗∗	[1.17]	−28.63 ∗ ∗	[11.93]	0.45	123
US 10-Year Treasury	25.00 ∗ ∗∗	[1.38]	−32.18 ∗ ∗	[14.06]	0.42	123
Ger 2-Year Bund	2.93 ∗ ∗∗	[1.04]	−7.82	[10.64]	0.24	123
Ger 5-Year Bund	4.33 ∗ ∗∗	[1.30]	−26.93 ∗ ∗	[13.22]	0.23	123
Ger 10-Year Bund	6.51 ∗ ∗∗	[1.24]	−25.00 ∗ ∗	[12.61]	0.17	123
Ita 2-Year BTP	2.09	[1.68]	376.35 ∗ ∗∗	[17.10]	0.43	123
Ita 5-Year BTP	4.56 ∗ ∗∗	[1.17]	320.00 ∗ ∗∗	[11.95]	0.52	123
Ita 10-Year BTP	1.20	[1.45]	245.67 ∗ ∗∗	[14.82]	0.43	123
Fra 2-Year OAT	2.88 ∗ ∗	[1.15]	36.42 ∗ ∗∗	[11.74]	0.26	123
Fra 5-Year OAT	3.16 ∗ ∗	[1.40]	39.21 ∗ ∗∗	[14.29]	0.22	123
Fra 10-Year OAT	3.08 ∗ ∗	[1.44]	50.48 ∗ ∗∗	[14.72]	0.18	123
Spa 2-Year Bonos	2.49	[1.71]	384.01 ∗ ∗∗	[17.39]	0.37	123
Spa 5-Year Bonos	2.69	[1.64]	291.54 ∗ ∗∗	[16.72]	0.48	123
Spa 10-Year Bonos	3.47 ∗ ∗	[1.41]	232.56 ∗ ∗∗	[14.39]	0.43	123
USD/EUR	0.20	[0.33]	−9.24 ∗ ∗∗	[3.38]	0.13	123
USD/GBP	0.14	[0.29]	−5.46∗	[2.92]	0.20	123
USD/YEN	−1.85 ∗ ∗∗	[0.30]	−0.38	[3.07]	0.09	123
US stock	2.02 ∗ ∗∗	[0.22]	−4.49 ∗ ∗	[2.27]	0.52	123
€ stock	0.86 ∗ ∗	[0.35]	−12.40 ∗ ∗∗	[3.57]	0.29	123
Jap stock	0.37	[0.43]	−6.73	[4.37]	0.05	123
Ger stock	0.32	[0.39]	−6.90∗	[3.96]	0.23	123
Fra stock	0.82∗	[0.42]	−11.17 ∗ ∗∗	[4.29]	0.32	123
Italy stock	−0.01	[0.42]	−22.49 ∗ ∗∗	[4.26]	0.36	123
US 2-Year term-premia	9.90 ∗ ∗∗	[1.13]	−18.68	[12.10]	0.21	121
US 5-Year term-premia	19.76 ∗ ∗∗	[1.57]	−32.74∗	[16.81]	0.29	121
US 10-Year term-premia	22.59 ∗ ∗∗	[2.01]	−44.05 ∗ ∗	[21.50]	0.26	121
€ 2-Year term-premia	−1.71	[1.09]	123.60 ∗ ∗∗	[11.07]	0.22	123
€ 5-Year term-premia	1.15	[1.92]	147.62 ∗ ∗∗	[19.63]	0.17	123
€ 10-Year term-premia	1.62	[1.55]	113.06 ∗ ∗∗	[15.78]	0.24	123
US 5y Inflation-swap	5.23 ∗ ∗	[2.11]	−19.27	[21.56]	0.08	123
US 5y-5y Inflation-swap	−2.00	[1.53]	−19.34	[15.56]	0.15	123
€ 5y Inflation-swap	−2.07	[2.58]	31.88	[26.17]	0.11	120
€ 5y-5y Inflation-sw a	0.86	[1.24]	−29.43 ∗ ∗	[12.69]	0.19	122
US rates vol	3.92 ∗ ∗∗	[1.06]	4.78	[10.77]	0.14	123
Ger rates vol	−0.31 ∗ ∗∗	[0.09]	−0.38	[0.94]	0.05	123
France CDS	−0.40	[0.78]	53.22 ∗ ∗∗	[7.92]	0.17	123
Italy CDS	−6.59 ∗ ∗∗	[2.07]	217.87 ∗ ∗∗	[21.12]	0.26	123
€ OAS Inv. grade	−0.06	[0.07]	0.56	[0.68]	0.12	123
€ OAS HY	−0.38	[0.27]	3.83	[2.72]	0.20	123
US OAS Inv. grade	−0.09∗	[0.05]	1.05 ∗ ∗	[0.49]	0.07	123
US OAS HY	−1.36 ∗ ∗∗	[0.23]	2.08	[2.36]	0.23	123
EUR 1-mo implied vol	−1.07 ∗ ∗∗	[0.20]	2.60	[2.03]	0.16	123
GBP 1-mo implied vol	−0.84 ∗ ∗∗	[0.19]	2.02	[1.99]	0.05	123
JPY 1-mo implied vol	−1.25 ∗ ∗∗	[0.18]	−2.02	[1.85]	0.21	123
USD/EUR 25δ risk-rev.	−0.01	[0.05]	−1.04∗	[0.54]	0.10	123
Brent	1.38 ∗ ∗	[0.57]	−9.37	[5.85]	0.17	123

Note: Regressions of daily change of the asset price shown in each row (basis points or % points) on changes in the monetary policy suprise factors (see equation 7) for the Federal Reserve and the ECB, on announcement days only.
(*), (**), (***) denote 10%, 5% and 1% significance, based on robust standard errors shown in brackets.
Fed and ECB path factors are scaled so to have a 25bp impact on the 10-Year US-Treasury and 10-Year German-Bund yield, respectively. Sample are announcement days in pre-crisis period: Sep-2008 to Apr-2013.

Table A-5: Impact of monetary policy surprises on asset prices after the sovereign crisis: alternative sample definition

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2	obs
US 2-Year Treasury	16.29 ∗ ∗∗	[1.27]	2.79	[2.07]	0.52	76
US 5-Year Treasury	31.98 ∗ ∗∗	[1.50]	3.60	[2.45]	0.63	76
US 10-Year Treasury	25.00 ∗ ∗∗	[2.17]	4.30	[3.53]	0.54	76
Ger 2-Year Bund	0.39	[0.92]	18.35 ∗ ∗∗	[1.50]	0.37	76
Ger 5-Year Bund	2.59	[1.63]	32.48 ∗ ∗∗	[2.67]	0.48	76
Ger 10-Year Bund	3.77∗	[2.18]	25.00 ∗ ∗∗	[3.56]	0.27	76
Ita 2-Year BTP	−1.09	[2.25]	32.70 ∗ ∗∗	[3.67]	0.36	76
Ita 5-Year BTP	0.47	[2.26]	54.45 ∗ ∗∗	[3.69]	0.54	76
Ita 10-Year BTP	0.05	[2.13]	52.41 ∗ ∗∗	[3.47]	0.6	76
Fra 2-Year OAT	1.08	[0.83]	18.78 ∗ ∗∗	[1.36]	0.46	76
Fra 5-Year OAT	0.23	[1.35]	32.71 ∗ ∗∗	[2.20]	0.45	76
Fra 10-Year OAT	2.64	[1.99]	30.42 ∗ ∗∗	[3.24]	0.38	76
Spa 2-Year Bonos	−0.50	[2.12]	32.98 ∗ ∗∗	[3.46]	0.45	76
Spa 5-Year Bonos	5.67 ∗ ∗∗	[1.94]	43.13 ∗ ∗∗	[3.17]	0.51	76
Spa 10-Year Bonos	−0.94	[2.57]	49.64 ∗ ∗∗	[4.19]	0.48	76
USD/EUR	−1.75 ∗ ∗∗	[0.57]	5.54 ∗ ∗∗	[0.93]	0.41	76
USD/GBP	−0.50	[0.44]	2.13 ∗ ∗∗	[0.73]	0.28	76
USD/YEN	−1.28 ∗ ∗	[0.62]	1.83∗	[1.01]	0.18	76
US stock	−0.03	[0.25]	−1.60 ∗ ∗∗	[0.41]	0.63	76
€ stock	−0.25	[0.63]	−5.89 ∗ ∗∗	[1.03]	0.28	76
Jap stock	0.54	[0.93]	0.48	[1.51]	0.04	76
Ger stock	−0.14	[0.64]	−6.08 ∗ ∗∗	[1.05]	0.26	76
Fra stock	−0.33	[0.69]	−6.31 ∗ ∗∗	[1.13]	0.3	76
Italy stock	−0.38	[0.97]	−7.56 ∗ ∗∗	[1.58]	0.24	76
US 2-Year term-premia	1.05	[1.97]	4.10	[3.28]	0.18	75
US 5-Year term-premia	10.31 ∗ ∗∗	[2.53]	5.57	[4.20]	0.33	75
US 10-Year term-premia	5.84∗	[3.50]	1.94	[5.82]	0.16	75
€ 2-Year term-premia	−2.83 ∗ ∗	[1.32]	21.98 ∗ ∗∗	[2.15]	0.43	76
€ 5-Year term-premia	−4.03	[2.53]	36.00 ∗ ∗∗	[4.13]	0.39	76
€ 10-Year term-premia	−5.18 ∗ ∗	[2.53]	35.82 ∗ ∗∗	[4.12]	0.34	76
US 5y Inflation-swap	−4.69 ∗ ∗	[2.11]	1.50	[3.44]	0.08	76
US 5y-5y Inflation-swap	−0.91	[2.31]	−1.02	[3.76]	0.06	76
€ 5y Inflation-swap	2.45 ∗ ∗	[0.99]	−3.55 ∗ ∗	[1.62]	0.18	76
€ 5y-5y Inflation-swap	0.32	[1.20]	−4.77 ∗ ∗	[1.96]	0.07	76
US rates vol	3.61 ∗ ∗	[1.64]	5.15∗	[2.67]	0.24	76
Ger rates vol	−0.09	[0.19]	0.47	[0.31]	0.03	76
France CDS	0.18	[0.42]	−0.99	[0.68]	0.05	76
Italy CDS	−2.76	[2.56]	12.71 ∗ ∗∗	[4.18]	0.11	76
€ OAS Inv. grade	−0.14∗	[0.08]	−0.10	[0.13]	0.1	76
€ OAS HY	−0.39	[0.31]	−1.01 ∗ ∗	[0.51]	0.12	76
US OAS Inv. grade	−0.21 ∗ ∗∗	[0.06]	0.13	[0.09]	0.23	76
US OAS HY	−2.23 ∗ ∗∗	[0.29]	0.12	[0.47]	0.41	76
EUR 1-mo implied vol	1.16 ∗ ∗	[0.45]	−0.22	[0.74]	0.11	76
GBP 1-mo implied vol	0.39	[0.27]	−1.24 ∗ ∗∗	[0.45]	0.18	76
JPY 1-mo implied vol	0.41	[0.47]	−2.03 ∗ ∗∗	[0.76]	0.15	76
USD/EUR 25δ risk-rev.	−0.20 ∗ ∗	[0.08]	0.14	[0.13]	0.08	76
Brent	−1.08	[1.14]	−1.36	[1.86]	0.03	76

Note: Regressions of daily change of the asset price shown in each row (basis points or % points) on changes in the monetary policy suprise factors (see equation 7) for the Federal Reserve and the ECB, on announcement days only.
(*), (**), (***) denote 10%, 5% and 1% significance, based on robust standard errors shown in brackets.
Fed and ECB path factors are scaled so to have a 25bp impact on the 10-Year US-Treasury and 10-Year German-Bund yield, respectively. Sample are central bank announcement days between May-2013 and Sep-2016.

Table A-6: Impact of monetary policy surprises on asset prices before the global financial crisis: separate regressions

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2_{Fed}/R^2_{ECB}	obs_{Fed}/obs_{Fed}
US 2-Year Treasury	31.17 * **	[0.87]	23.51 * **	[4.55]	0.70/0.31	75/78
US 5-Year Treasury	30.76 * **	[0.93]	26.46 * **	[4.51]	0.66/0.29	75/78
US 10-Year Treasury	25.00 * **	[1.22]	22.23 * **	[4.06]	0.60/0.22	75/78
Ger 2-Year Bund	2.11	[1.43]	40.28 * **	[0.98]	0.06/0.69	75/78
Ger 5-Year Bund	6.78 * **	[1.84]	44.14 * **	[0.80]	0.16/0.71	75/78
Ger 10-Year Bund	5.19 * **	[1.50]	25.00 * **	[1.80]	0.15/0.61	75/78
Ita 2-Year BTP	5.48 * **	[1.50]	43.37 * **	[0.84]	0.13/0.76	75/78
Ita 5-Year BTP	6.24 * **	[1.60]	42.54 * **	[1.16]	0.20/0.72	75/78
Ita 10-Year BTP	4.73 * **	[1.32]	28.86 * **	[1.69]	0.17/0.67	75/78
Fra 2-Year OAT	7.22 * **	[1.63]	43.24 * **	[0.71]	0.11/0.70	75/78
Fra 5-Year OAT	5.88 * **	[1.62]	43.74 * **	[0.74]	0.19/0.66	75/78
Fra 10-Year OAT	6.87 * **	[1.55]	27.65 * **	[1.95]	0.19/0.64	75/78
Spa 2-Year Bonos	7.59 * **	[1.43]	45.16 * **	[0.90]	0.09/0.72	75/78
Spa 5-Year Bonos	6.32 * **	[1.67]	47.46 * **	[0.73]	0.19/0.74	75/78
Spa 10-Year Bonos	6.42 * **	[1.38]	28.32 * **	[1.95]	0.29/0.67	75/78
USD/EUR	−1.13 * **	[0.36]	2.77 * **	[0.85]	0.12/0.18	75/78
USD/GBP	−0.80 * *	[0.35]	1.79 * *	[0.78]	0.06/0.20	75/78
USD/YEN	−0.82*	[0.48]	−0.23	[0.67]	0.08/0.30	75/78
US stock	0.82 * **	[0.23]	5.92 * **	[0.45]	0.55/0.55	75/78
€ stock	0.48	[0.38]	3.72 * **	[0.89]	0.24/0.38	75/78
Jap stock	−0.52	[0.53]	−1.02	[1.25]	0.14/-0.09	75/78
Ger stock	0.72	[0.44]	3.61 * **	[1.06]	0.20/0.35	75/78
Fra stock	0.28	[0.46]	4.01 * **	[0.92]	0.22/0.41	75/78
Italy stock	0.41	[0.32]	3.19 * **	[0.89]	0.24/0.35	75/78
US 2-Year term-premia	5.54 * **	[1.06]	2.65	[2.22]	0.34/0.18	74/76
US 5-Year term-premia	5.79 * **	[1.43]	3.08	[2.55]	0.26/0.22	74/76
US 10-Year term-premia	4.33 * *	[1.80]	1.78	[3.09]	0.26/0.18	74/76
€ 2-Year term-premia	1.24	[1.60]	32.09 * **	[3.15]	0.13/0.31	75/78
€ 5-Year term-premia	3.77*	[2.05]	22.41 * **	[3.81]	0.13/0.27	75/78
€ 10-Year term-premia	3.54*	[1.94]	13.33 * **	[3.36]	0.13/0.18	75/78
US 5y Inflation-swap	−3.13	[3.31]	13.62 * **	[4.35]	0.16/-0.01	50/55
US 5y-5y Inflation-swap	7.57 * **	[2.74]	9.96 * **	[3.62]	0.14/0.19	51/55
€ 5y Inflation-swap	−0.05	[2.70]	14.67 * **	[4.05]	0.13/0.15	56/60
€ 5y-5y Inflation-swa	−3.30*	[1.88]	5.73 * **	[1.91]	0.18/0.21	56/60
US rates vol	−1.83	[1.37]	−3.94	[2.82]	0.16/0.11	75/78
Ger rates vol	0.32 * **	[0.10]	0.82 * **	[0.18]	0.11/0.16	75/78
France CDS	0.06	[0.23]	−0.53	[0.60]	0.02/0.08	43/46
Italy CDS	−0.24	[0.23]	−1.63 * **	[0.44]	0.03/0.13	60/65
€ OAS Inv. grade	−0.09	[0.06]	−0.81 * **	[0.10]	0.14/0.38	75/78
€ OAS HY	−0.30	[0.31]	−3.06 * **	[0.60]	0.10/0.24	75/78
US OAS Inv. grade	−0.10 * *	[0.04]	−0.22 * *	[0.10]	0.09/-0.04	75/78
US OAS HY	−2.39 * **	[0.25]	−3.31 * **	[0.53]	0.41/0.29	75/78
EUR 1-mo implied vol	−0.10	[0.14]	−0.31	[0.32]	0.03/0.05	75/78
GBP 1-mo implied vol	0.13	[0.12]	−0.54 * *	[0.27]	0.06/0.04	75/78
JPY 1-mo implied vol	−0.30	[0.31]	−0.37	[0.40]	0.18/0.16	75/78
USD/EUR 25δ risk-rev.	0.11 * **	[0.03]	0.34 * **	[0.06]	0.10/0.23	60/66
Brent	0.06	[0.94]	−0.62	[1.74]	0.09/0.04	75/78

Note: Regressions of daily change of the asset price shown in each row (basis points or % points) on changes in the monetary policy suprise factors (see equation 7) for the Federal Reserve and the ECB, on announcement days only.
(*), (**), (***) denote 10%, 5% and 1% significance, based on robust standard errors shown in brackets.
Fed and ECB path factors are scaled so to have a 25bp impact on the 10-Year US-Treasury and 10-Year German-Bund yield, respectively. Sample are announcement days in pre-crisis period defined as: Jan-2000 to Aug-2008.

Table A-7: Impact of monetary policy surprises on asset prices during the global financial crisis: separate Fed and ECB regressions

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2_{Fed}/R^2_{ECB}	obs_{Fed}/obs_{ECB}
US 2-Year Treasury	9.89 * **	[0.64]	−4.45	[7.49]	0.61/0.39	51/53
US 5-Year Treasury	23.30 * **	[0.66]	−17.73	[14.17]	0.73/0.42	51/53
US 10-Year Treasury	25.00 * **	[0.84]	−24.08*	[13.73]	0.72/0.43	51/53
Ger 2-Year Bund	1.93*	[1.13]	−11.27	[9.35]	0.06/0.23	51/53
Ger 5-Year Bund	4.60 * **	[1.43]	−29.69 * *	[13.15]	0.13/0.29	51/53
Ger 10-Year Bund	5.72 * **	[1.39]	−25.00 * *	[10.78]	0.15/0.32	51/53
Ita 2-Year BTP	0.46	[2.42]	348.17 * **	[12.82]	0.01/0.66	51/53
Ita 5-Year BTP	1.35	[2.51]	280.00 * **	[7.18]	0.05/0.70	51/53
Ita 10-Year BTP	−1.03	[2.05]	210.59 * **	[10.61]	0.14/0.60	51/53
Fra 2-Year OAT	2.57 * **	[0.98]	35.48 * **	[12.39]	0.17/0.23	51/53
Fra 5-Year OAT	1.40	[1.57]	30.40 * *	[15.12]	0.12/0.20	51/53
Fra 10-Year OAT	1.27	[1.63]	44.19 * **	[12.86]	0.12/0.29	51/53
Spa 2-Year Bonos	1.89	[2.97]	344.11 * **	[12.90]	0.02/0.51	51/53
Spa 5-Year Bonos	2.37	[2.75]	250.50 * **	[9.14]	0.04/0.65	51/53
Spa 10-Year Bonos	2.55	[2.20]	203.83 * **	[10.84]	0.05/0.64	51/53
USD/EUR	−0.65*	[0.36]	−8.66 * **	[2.83]	0.21/0.25	51/53
USD/GBP	−0.56	[0.46]	−6.62 * **	[2.24]	0.10/0.28	51/53
USD/YEN	−2.03 * **	[0.24]	1.92	[2.77]	0.40/0.12	51/53
US stock	1.74 * **	[0.27]	−10.55 * **	[1.16]	0.55/0.58	51/53
€ stock	0.92*	[0.50]	−16.75 * **	[2.53]	0.16/0.48	51/53
Jap stock	0.34	[0.45]	−4.51	[3.84]	0.02/0.21	51/53
Ger stock	1.08 * *	[0.53]	−13.12 * **	[2.87]	0.12/0.34	51/53
Fra stock	1.00 * *	[0.50]	−17.20 * **	[2.90]	0.20/0.47	51/53
Italy stock	0.83	[0.64]	−26.69 * **	[2.57]	0.11/0.57	51/53
US 2-Year term-premia	10.47 * **	[1.11]	−12.68	[8.53]	0.47/0.36	51/52
US 5-Year term-premia	19.75 * **	[1.34]	−21.74*	[11.90]	0.56/0.41	51/52
US 10-Year term-premia	22.62 * **	[1.88]	−30.26*	[15.96]	0.52/0.35	51/52
€ 2-Year term-premia	0.21	[1.45]	103.55 * **	[8.24]	0.02/0.43	51/53
€ 5-Year term-premia	2.67	[2.26]	117.50 * **	[17.38]	0.08/0.30	51/53
€ 10-Year term-premia	2.87	[1.92]	95.00 * **	[13.27]	0.14/0.45	51/53
US 5y Inflation-swap	−3.47	[2.54]	−16.53	[22.72]	0.07/0.20	51/53
US 5y-5y Inflation-swap	−2.60	[1.71]	−27.36 * *	[10.99]	0.10/0.27	51/53
€ 5y Inflation-swap	−5.73 * *	[2.62]	30.76	[24.55]	0.21/0.06	49/52
€ 5y-5y Inflation-swap	1.08	[1.66]	−32.04 * **	[11.63]	0.07/0.19	50/53
US rates vol	6.84 * **	[1.17]	5.22	[8.22]	0.23/0.07	51/53
Ger rates vol	0.05	[0.15]	−0.63	[0.55]	0.14/0.06	51/53
France CDS	−0.45	[0.88]	57.03 * **	[8.43]	0.01/0.44	51/53
Italy CDS	−5.53 * *	[2.57]	199.15 * **	[15.91]	0.07/0.54	51/53
€ OAS Inv. grade	−0.06	[0.07]	0.56	[0.58]	0.07/0.20	51/53
€ OAS HY	0.10	[0.32]	5.29 * **	[1.93]	0.03/0.38	51/53
US OAS Inv. grade	−0.14 * **	[0.05]	1.03 * **	[0.32]	0.07/0.27	51/53
US OAS HY	−2.38 * **	[0.21]	4.38 * **	[1.52]	0.36/0.39	51/53
EUR 1-mo implied vol	−0.78 * **	[0.23]	4.25 * *	[2.09]	0.23/0.22	51/53
GBP 1-mo implied vol	−0.09	[0.21]	2.83	[1.86]	0.08/0.09	51/53
JPY 1-mo implied vol	−1.34 * **	[0.29]	0.42	[1.51]	0.14/0.13	51/53
USD/EUR 25δ risk-rev.	0.08	[0.07]	−1.12 * *	[0.45]	0.06/0.25	51/53
Brent	1.40 * *	[0.68]	−9.13*	[4.88]	0.22/0.27	51/53

Note: Regressions of daily change of the asset price shown in each row (basis points or % points) on changes in the monetary policy suprise factors (see equation 7) for the Federal Reserve and the ECB, on announcement days only.
(*), (**), (***) denote 10%, 5% and 1% significance, based on robust standard errors shown in brackets.
Fed and ECB path factors are scaled so to have a 25bp impact on the 10-Year US-Treasury and 10-Year German-Bund yield, respectively. Sample are announcement days in pre-crisis period: Sep-2008 to Apr-2013.

Table A-8: Impact of monetary policy surprises on asset prices after the sovereign crisis: separate Fed and ECB regressions

	Fed (γ_1)	s.e.	ECB (γ_2)	s.e.	R^2_{Fed}/R^2_{ECB}	obs_{Fed}/obs_{ECB}
US 2-Year Treasury	16.34 * **	[0.81]	1.83	[1.52]	0.54/0.35	43/41
US 5-Year Treasury	30.87 * **	[0.77]	5.78*	[3.25]	0.82/0.23	43/41
US 10-Year Treasury	25.00 * **	[1.88]	0.81	[3.38]	0.70/0.19	43/41
Ger 2-Year Bund	0.70	[0.95]	14.21 * **	[1.23]	0.07/0.39	43/41
Ger 5-Year Bund	3.75 * *	[1.63]	27.37 * **	[2.04]	0.15/0.56	43/41
Ger 10-Year Bund	4.96 * *	[2.11]	25.00 * **	[3.00]	0.12/0.30	43/41
Ita 2-Year BTP	−0.48	[2.03]	35.83 * **	[3.43]	0.08/0.67	43/41
Ita 5-Year BTP	−4.08	[2.95]	44.49 * **	[1.90]	0.11/0.77	43/41
Ita 10-Year BTP	−2.53	[3.22]	42.06 * **	[2.02]	0.05/0.75	43/41
Fra 2-Year OAT	1.41	[0.97]	15.96 * **	[1.05]	0.09/0.50	43/41
Fra 5-Year OAT	2.08	[1.42]	28.00 * **	[2.10]	0.07/0.61	43/41
Fra 10-Year OAT	3.69 * *	[1.86]	23.93 * **	[3.32]	0.09/0.42	43/41
Spa 2-Year Bonos	−0.72	[2.04]	27.82 * **	[2.46]	0.05/0.60	43/41
Spa 5-Year Bonos	−0.47	[2.96]	34.01 * **	[1.74]	0.12/0.62	43/41
Spa 10-Year Bonos	−3.77	[2.77]	39.47 * **	[1.96]	0.06/0.59	43/41
USD/EUR	−1.33 * *	[0.52]	4.32 * **	[0.82]	0.35/0.38	43/41
USD/GBP	−0.19	[0.36]	1.41*	[0.72]	0.33/0.15	43/41
USD/YEN	−1.04 * *	[0.50]	1.91 * *	[0.92]	0.23/0.09	43/41
US stock	−0.07	[0.28]	−1.42 * **	[0.28]	0.68/0.59	43/41
€ stock	−0.24	[0.51]	−4.17 * **	[0.84]	0.06/0.45	43/41
Jap stock	0.55	[0.77]	0.09	[1.31]	0.14/0.01	43/41
Ger stock	−0.38	[0.48]	−4.40 * **	[0.82]	0.02/0.44	43/41
Fra stock	−0.30	[0.58]	−4.53 * **	[0.96]	0.06/0.44	43/41
Italy stock	−0.38	[0.88]	−5.42 * **	[1.39]	0.10/0.33	43/41
US 2-Year term-premia	1.96	[2.03]	2.18	[2.54]	0.19/0.18	43/40
US 5-Year term-premia	11.12 * **	[2.54]	3.73	[3.52]	0.41/0.14	43/40
US 10-Year term-premia	6.97*	[3.73]	2.28	[4.44]	0.17/0.11	43/40
€ 2-Year term-premia	−2.48 * *	[1.02]	17.80 * **	[1.67]	0.15/0.65	43/41
€ 5-Year term-premia	−3.30	[2.12]	28.64 * **	[3.96]	0.15/0.55	43/41
€ 10-Year term-premia	−4.42 * *	[1.99]	26.83 * **	[4.39]	0.12/0.46	43/41
US 5y Inflation-swap	−3.35	[2.19]	−0.28	[2.77]	0.10/0.07	43/41
US 5y-5y Inflation-swap	0.30	[2.54]	−4.19*	[2.32]	0.04/0.10	43/41
€ 5y Inflation-swap	2.04 * **	[0.68]	−2.26	[1.63]	0.21/0.19	43/41
€ 5y-5y Inflation-swap	0.37	[1.03]	−4.60 * *	[1.80]	0.02/0.15	43/41
US rates vol	6.40 * **	[2.09]	2.95	[1.95]	0.27/0.12	43/41
Ger rates vol	−0.07	[0.19]	0.19	[0.19]	0.03/0.04	43/41
France CDS	0.33	[0.30]	0.67	[0.80]	0.02/0.11	43/41
Italy CDS	−3.35*	[1.97]	12.30 * **	[3.83]	0.08/0.21	43/41
€ OAS Inv. grade	−0.16 * *	[0.07]	0.01	[0.12]	0.23/0.07	43/41
€ OAS HY	−0.48	[0.33]	−0.62	[0.43]	0.10/0.09	43/41
US OAS Inv. grade	−0.20 * **	[0.06]	0.11	[0.08]	0.37/0.06	43/41
US OAS HY	−2.16 * **	[0.30]	0.36	[0.36]	0.51/0.19	43/41
EUR 1-mo implied vol	0.90 * *	[0.42]	−1.68 * *	[0.70]	0.21/0.05	43/41
GBP 1-mo implied vol	0.33	[0.31]	−1.02 * **	[0.28]	0.16/0.26	43/41
JPY 1-mo implied vol	0.24	[0.46]	−1.90 * **	[0.58]	0.22/0.21	43/41
USD/EUR 25δ risk-rev.	−0.16 * *	[0.08]	0.04	[0.12]	0.14/0.01	43/41
Brent	−1.21	[0.93]	−0.34	[1.48]	0.06/0.03	43/41

Note: Regressions of daily change of the asset price shown in each row (basis points or % points) on changes in the monetary policy suprise factors (see equation 7) for the Federal Reserve and the ECB, on announcement days only.
(*), (**), (***) denote 10%, 5% and 1% significance, based on robust standard errors shown in brackets.
Fed and ECB path factors are scaled so to have a 25bp impact on the 10-Year US-Treasury and 10-Year German-Bund yield, respectively. Sample are central bank announcement days between May-2013 and Sep-2016.

Table A-9: ECB Monetary Policy: August 2007 - September 2016

date	conv. mon. policy	forward guidance (FG)	quantitative easing
2-Aug-07	GC meeting		
09-ago-07	Special fine tuning operations		
22-Aug-07			Supplementary LTRO (announcement)
23-Aug-07			Supplementary LTRO (allotment)
6-Sep-07	GC meeting		
4-Oct-07	GC meeting		
8-Nov-07	GC meeting		
6-Dec-07	GC meeting		
10-Jan-08	GC meeting		
7-Feb-08	GC meeting		
6-Mar-08	GC meeting		
28-Mar-08	introduce 6-m LTROs		
10-Apr-08	GC meeting		
8-May-08	GC meeting		
5-Jun-08	GC meeting		
3-Jul-08	GC meeting, MRO increased to 4.25%		
7-Aug-08	GC meeting		
4-Sep-08	GC meeting		
2-Oct-08	GC meeting		
8-Oct-08	unscheduled GC meeting, MRO decreased to 3.75%, coordinated action with BoC, BoE, Fed, Sveriges Riksbank, SNB, BoJ		
13-Oct-08	FX swap arrangements announced joint with BoC, BoE, Fed, SNB, BoJ – tenders of U.S. dollar funding at 7-day, 28-day, and 84-day maturities at fixed interest rates for full allotment		
15-Oct-08	Fixed-rate full allotment (FRFA) on MRO		
6-Nov-08	GC meeting, MRO decreased to 3.25%		
4-Dec-08	GC meeting, MRO decreased to 2.50%		
15-Jan-09	GC meeting, MRO decreased to 2.00%		
5-Feb-09	GC meeting		
5-Mar-09	GC meeting, MRO decreased to 1.50%		
2-Apr-09	GC meeting, MRO decreased to 1.25%		
7-May-09	GC meeting, MRO decreased to 1.00%,		1-year LTRO, CBPP
4-Jun-09	GC meeting,		CBPP details announced
2-Jul-09	GC meeting		
6-Aug-09	GC meeting		
3-Sep-09	GC meeting		
8-Oct-09	GC meeting		
5-Nov-09	GC meeting		
3-Dec-09	GC meeting,		Phasing out of 6m LTROs, indexation of 1y LTROs
14-Jan-10	GC meeting		
4-Feb-10	GC meeting		
4-Mar-10	GC meeting,		Phasing out of 3m LTROs, indexation of 6m LTROs

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Table A-9 – continued from previous page

date	conv. monetary policy	forward guidance	quantitative easing
8-Apr-10	GC meeting		
6-May-10	GC meeting		
9-May-10	GC meeting,		Securities Market Programme (SMP)
10-Jun-10	GC meeting		
8-Jul-10	GC meeting		
28-Jul-10			Collateral rules tightened, revised haircuts
5-Aug-10	GC meeting		
2-Sep-10	GC meeting		
7-Oct-10	GC meeting		
4-Nov-10	GC meeting		
2-Dec-10	GC meeting		
13-Jan-11	GC meeting		
3-Feb-11	GC meeting		
3-Mar-11	GC meeting,		FRFA extended to July 2011
7-Apr-11	GC meeting, MRO increased to 1.25%		
5-May-11	GC meeting		
9-Jun-11	GC meeting		
7-Jul-11	GC meeting, MRO increased to 1.50%		
4-Aug-11	GC meeting,		SMP covers Spain and Italy
7-Aug-11			SMP on Italy and Spain acknowledged by ECB
8-Sep-11	GC meeting		
6-Oct-11	GC meeting,		CBPP2 launched
3-Nov-11	GC meeting, MRO decreased to 1.25%		
8-Dec-11	GC meeting, MRO rate decreased to 1%		Two 3-year LTROs, reserve ratio to 1%,
21-Dec-11			Results of first 3-year LTRO
12-Jan-12	GC meeting		
9-Feb-12	GC meeting,		ECB approved criteria for credit claims for 7 NCBs
28-Feb-12			Results of second 3-year LTRO
8-Mar-12	GC meeting		
4-Apr-12	GC meeting		
3-May-12	GC meeting		
6-Jun-12	GC meeting		
5-Jul-12	GC meeting, MRO rate decreased to 0.75%, deposit facility rate to 0		
26-Jul-12			"Whatever it takes" London speech of Draghi
2-Aug-12	GC meeting		OMT
6-Sep-12	GC meeting		OMT details
4-Oct-12	GC meeting		
8-Nov-12	GC meeting		
6-Dec-12	GC meeting		
10-Jan-13	GC meeting		
7-Feb-13	GC meeting		
7-Mar-13	GC meeting		
22-Mar-13			Collateral rule changes for some uncovered gov-guaranteed bank bonds
4-Apr-13	GC meeting		
2-May-13	GC meeting, MRO rate decreased to 0.5%,		FRFA extended to July 2014
6-Jun-13	GC meeting		
4-Jul-13	GC meeting,	expects the key ECB interest rates to remain at present or lower levels for an extended period of time	
1-Aug-13	GC meeting	Same as previous	
5-Sep-13	GC meeting	Same as previous	

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Table A-9 – continued from previous page

date	conv. monetary policy	forward guidance	quantitative easing
2-Oct-13	GC meeting	Same as previous	
7-Nov-13	GC meeting, MRO rate decreased to 0.25%	Same as previous	MROs at FRFA until July 2015...we decided to conduct the three-month LTROs to be allotted until the end of the second quarter of 2015 as FRFA
5-Dec-13	GC meeting	Same as previous	
9-Jan-14	GC meeting	Same as previous	
6-Feb-14	GC meeting	Same as previous	
6-Mar-14	GC meeting	Same as previous	
25-Mar-14			QE announcement Draghi (Science Po - Paris): A consistent strategy for a sustained recovery
3-Apr-14	GC meeting	Same as previous	The Governing Council is unanimous in its commitment to using also unconventional instruments within its mandate in order to cope effectively with risks of a too prolonged period of low inflation.
24-Apr-14			QE announcement Draghi (NDL Conf - Amsterdam): Monetary policy communication in turbulent times
8-May-14	GC meeting	Same as previous	Same as previous
5-Jun-14	GC meeting, MRO rate decreased to 0.15%,	conditional FG: the key ECB interest rates will remain at present levels for an extended period of time in view of the current outlook for inflation	announcement of TLTROs - The Governing Council is unanimous in its commitment to using also unconventional instruments within its mandate should it become necessary to further address risks of too prolonged a period of low inflation
3-Jul-14	GC meeting,	Same as previous	Same a previous + details of TLTROs a period of low inflation
7-Aug-14	GC meeting	Same as previous	Same as previous
4-Sep-14	GC meeting, MRO rate decreased to 0.05%	ABSPP and CBPP3 "should also strengthen our forward guidance on the key ECB interest rates and reinforce the fact that there are significant and increasing differences in the monetary policy cycle between major advanced economies"	Same a sprevious + announcement of CCBP3 & ABSPP
2-Oct-14	GC meeting,	Same as previous	Same a previous + details of ABSPP CBPP3
6-Nov-14	GC meeting	Same as previous	Same as previous
4-Dec-14	GC meeting,	Same as previous	Same a previous + introduction of the QE-PSPP - Draghi: 'More stimulus is likely on the way, but the final decision wont be taken until early next year'
22-Jan-15	GC meeting,	Same as previous	announcement of PSPP
9-Mar-15			start of the PSPP purchases
5-Mar-15	GC meeting	Based on our regular economic and monetary analysis, and in line with our forward guidance, we decided to keep the key ECB interest rates unchanged	
15-Apr-15	GC meeting	Same as previous	
3-Jun-15	GC meeting	Same as previous	Same as previous
16-Jul-15	GC meeting	Same as previous	Same as previous
3-Sep-15	GC meeting,	Same as previous	possible extension of QE program (Draghi) - the Governing Council decided to increase the issue share limit from the initial limit of 25% to 33%
22-Oct-15	GC meeting		The Governing Council is willing and able to act by using all the instruments available within its mandate if warranted in order to maintain an appropriate degree of monetary accommodation

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Table A-9 – continued from previous page

date	conv. monetary policy	forward guidance	quantitative easing
03-Dec-15	GC meeting		new period for PSPP - to extend the APP. The monthly purchases of 60 billion under the APP are now intended to run until the end of March 2017, or beyond, if necessary
21-Jan-16	GC meeting	Based on our regular economic and monetary analyses, and after the recalibration of our monetary policy measures last month, we decided to keep the key ECB interest rates unchanged and we expect them to remain at present or lower levels for an extended period of time.	The decisions taken in early December to extend our monthly net asset purchases of 60 billion to at least the end of March 2017, and to reinvest the principal payments on maturing securities for as long as necessary, were fully appropriate.
10-Mar-16	GC meeting, MRO rate decreased to 0.00%, the deposit facility to -0.40%		CSPP, APP expanded the from 60 to 80 billion, 4-year TLTRO II starting in June 2016
21-Apr-16	GC meeting	key ECB interest rates unchanged	asset purchases of 80 billion are intended to run until the end of March 2017, or beyond, if necessary, and in any case until the Governing Council sees a sustained adjustment in the path of inflation consistent with its inflation aim.
02-Jun-16	GC meeting	Same as previous	Same as previous
21-Jul-16	GC meeting	Same as previous	Same as previous
08-Sep-16	GC meeting	Same as previous	Same as previous

Source: ECB. https://www.ecb.europa.eu/press/pressconf/ .

Table A-10: Fed Monetary Policy Decision: October 2008 - September 2016

date	conv. mon. policy	forward guidance (FG)	quantitative easing
8-Oct-08	unscheduled FOMC meeting, fed funds rate decreased by 0.5 pp to 1.50%, coordinated action with BoC, BoE, Fed, Sveriges Riksbank, SNB, BoJ		
13-Oct-08	FX swap arrangements announced jpoint with BoC, BoE, Fed, SNB, BoJ – tenders of U.S. dollar funding at 7-day, 28-day, and 84-day maturities at fixed interest rates for full allotment		
20-Oct-08			Federal Reserve offers $150 billion in 28-day credit through its Term Auction Facility
29-Oct-08	FOMC meeting, FOMC decreases fed funds rate by 0.5 pp to 1.00%		
25-Nov-08	Fed announces results of auction of $150 billion in 13-day credit		QE1 starts
1-Dec-08	Federal Reserve announces results of auction of $150 billion in 84-day credit		
16-Dec-08	FOMC meeting, FOMC decrease fed funds rate by 0.25 pp to the range 0-0.25%	economic conditions are likely to warrants exceptionally low levels of the fed funds rate for extended period	-
28-Jan-09	FOMC meeting	Same as previous	-
18-Mar-09	FOMC meeting	Same as previous	-
29-Apr-09	FOMC meeting	Same as previous	-
24-Jun-09	FOMC meeting	Same as previous	-
12-Aug-09	FOMC meeting	Same as previous	-
23-Sep-09	FOMC meeting	Same as previous	extend asset purchase program by an additional 3 months, through 2010Q1 rather than 2009Q4
4-Nov-09	FOMC meeting	Same as previous	-
16-Dec-09	FOMC meeting	Same as previous	-
27-Jan-10	FOMC meeting	Same as previous	-
16-Mar-10	FOMC meeting	Same as previous	QE1 ends
28-Apr-10	FOMC meeting	Same as previous	-
9-May-10	unscheduled FOMC meeting	Same as previous	-
23-Jun-10	FOMC meeting	Same as previous	-
10-Aug-10	FOMC meeting	Same as previous	the Committee will keep constant the Federal Reserves holdings of securities at their current level by reinvesting principal payments from agency debt and agency [MBSs] in longer-term Treasury securities.
27-Aug-10	Bernanke Jackson Hole speech		
21-Sep-10	FOMC meeting	Same as previous	The Committee also will maintain its existing policy of reinvesting principal payments from its securities holdings
15-Oct-10	unscheduled FOMC meeting		

Continued on next page

Table A-10 – continued from previous page

date	conv. mon. policy	forward guidance (FG)	quantitative easing
3-Nov-10	FOMC meeting	Same as previous	QE2 starts - In addition, the Committee intends to purchase a further $600 billion of longer term Treasury securities by the end of the second quarter of 2011
14-Dec-10	FOMC meeting	Same as previous	-
26-Jan-11	FOMC meeting	Same as previous	-
15-Mar-11	FOMC meeting	Same as previous	-
27-Apr-11	FOMC meeting	Same as previous	announcement of QE2 end by June 2011
22-Jun-11	FOMC meeting	Same as previous	
1-Aug-11	unscheduled FOMC meeting		-
9-Aug-11	FOMC meeting	economic conditions . . . are likely to warrant exceptionally low levels of the federal funds rate at least through mid-2013.	-
26-Aug-11	Bernanke Jackson Hole speech		-
21-Sep-11	FOMC meeting	Same as previous	Maturity Extension Programme ("Operation Twist") - The Committee intends to purchase, by the end of June 2012, $400 billion of Treasury securities with remaining maturities of 6 years to 30 years and to sell an equal amount of Treasury securities with remaining maturities of 3 years or less.
2-Nov-11	FOMC meeting	Same as previous	-
28-Nov-11	unscheduled FOMC meeting	Same as previous	-
13-Dec-11	FOMC meeting	Same as previous	-
25-Jan-12	FOMC meeting	Calendar FG: exceptionally low levels for the federal funds rate at least through late 2014.	-
13-Mar-12	FOMC meeting	Same as previous	
25-Apr-12	FOMC meeting	Same as previous	
20-Jun-12	FOMC meeting	Same as previous	Maturity Extension Programme - The Committee intends to purchase, by the end of June 2012, $400 billion of Treasury securities with remaining maturities of 6 years to 30 years and to sell an equal amount of Treasury securities with remaining maturities of 3 years or less.
1-Aug-12	FOMC meeting	Same as previous	
31-Aug-12	Bernanke Jackson Hole speech		
13-Sep-12	FOMC meeting	Calendar FG: that exceptionally low levels for the federal funds rate are likely to be warranted at least through mid-2015	QE3 starts
24-Oct-12	FOMC meeting	Same as previous	
12-Dec-12	FOMC meeting	Conditional FG: exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6.5%, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committees 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored.percentage point above the Committee's 2% longer-run goal, and longer-term inflation expectations continue to be well anchored	
30-Jan-13	FOMC meeting	Same as previous	

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Table A-10 – continued from previous page

date	conv. mon. policy	forward guidance (FG)	quantitative easing
20-Mar-13	FOMC meeting	Same as previous	Bernanke warns of 'premature tightening' in monetary policy (taper tantrum) - In determining the size, pace, and composition of its asset purchases, the Committee will continue to take appropriate account of the likely efficacy and costs of such purchases as well as the extent of progress toward its economic objectives
1-May-13	FOMC meeting	Same as previous	Same as previous
22-May-13	The Economic Outlook. Before the Joint Economic Committee, U.S. Congress		Bernanke warns of 'premature tightening' in monetary policy (taper tantrum)
19-Jun-13	FOMC meeting	Same as previous	Bernanke warns of 'premature tightening' in monetary policy (taper tantrum). The Committee is prepared to increase or reduce the pace of its purchases to maintain appropriate policy accommodation as the outlook for the labor market or inflation changes.
31-Jul-13	FOMC meeting	Same as previous	Same as previous
18-Sep-13	FOMC meeting	Same as previous	the Committee decided to await more evidence that progress will be sustained before adjusting the pace of its purchases
16-Oct-13	unscheduled FOMC meeting		Same as previous
30-Oct-13	FOMC meeting	Same as previous	Same as previous
18-Dec-13	FOMC meeting	Same as previous	the Committee will likely reduce the pace of asset purchases in further measured steps at future meetings. However, asset purchases are not on a preset course, and the Committee's decisions about their pace will remain contingent on the Committee's outlook for the labor market and inflation as well as its assessment of the likely efficacy and costs of such purchases.
29-Jan-14	FOMC meeting	Same as previous	Same as previous
4-Mar-14	unscheduled FOMC meeting		
19-Mar-14	FOMC meeting	Same as previous	Same as previous
30-Apr-14	FOMC meeting	In determining how long to maintain the current 0 to 1/4 percent target range for the federal funds rate, the Committee will assess progress–both realized and expected–toward its objectives of maximum employment and 2 percent inflation.	Same as previous
18-Jun-14	FOMC meeting	Same as previous	Same as previous
15-Jul-14	Semiannual Monetary Policy Report to the Congress		
30-Jul-14	FOMC meeting	Same as previous	Same as previous
22-Aug-14	Yellen Jackson Hole speech		
17-Sep-14	FOMC meeting	the Committee today reaffirmed its view that the current 0 to 1/4 percent target range for the federal funds rate remains appropriate.	Same as previous
29-Oct-14	FOMC meeting	Same as previous	
17-Dec-14	FOMC meeting	Same as previous	
28-Jan-15	FOMC meeting	Same as previous	
24-Feb-15	Semiannual Monetary Policy Report to the Congress		
18-Mar-15	FOMC meeting	Same as previous	
29-Apr-15	FOMC meeting	Same as previous	

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Table A-10 – continued from previous page

date	conv. mon. policy	forward guidance (FG)	quantitative easing
17-Jun-15	FOMC meeting	Same as previous	
15-Jul-15	Semiannual Monetary Policy Report to the Congress		
29-Jul-15	FOMC meeting	Same as previous	
17-Sep-15	FOMC meeting	Same as previous	
28-Oct-15	FOMC meeting	Same as previous	
16-Dec-15	FOMC meeting, FOMC increases fed funds rate by 0.25% pp to the range 0.25-0.50%		
27-Jan-16	FOMC meeting, the Committee decided to maintain the target range for the federal funds rate at 1/4 to 1/2 percent		
10-Feb-16	Semiannual Monetary Policy Report to the Congress		
16-Mar-16	FOMC meeting - same as previous		
27-Apr-16	FOMC meeting - same as previous		
15-Jun-16	FOMC meeting - same as previous		
21-Jun-16	Semiannual Monetary Policy Report to the Congress		
27-Jul-16	FOMC meeting - same as previous		
26-Aug-16	Yellen Jackson Hole speech		
21-Sep-16	FOMC meeting - the Committee decided to maintain the target range for the federal funds rate at 1/4 to 1/2 percent.	The Committee judges that the case for an increase in the federal funds rate has strengthened but decided, for the time being, to wait for further evidence of continued progress toward its objectives.	

Source: Federal Reserve Board. http://www.federalreserve.gov/newsevents/press/monetary/ .

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