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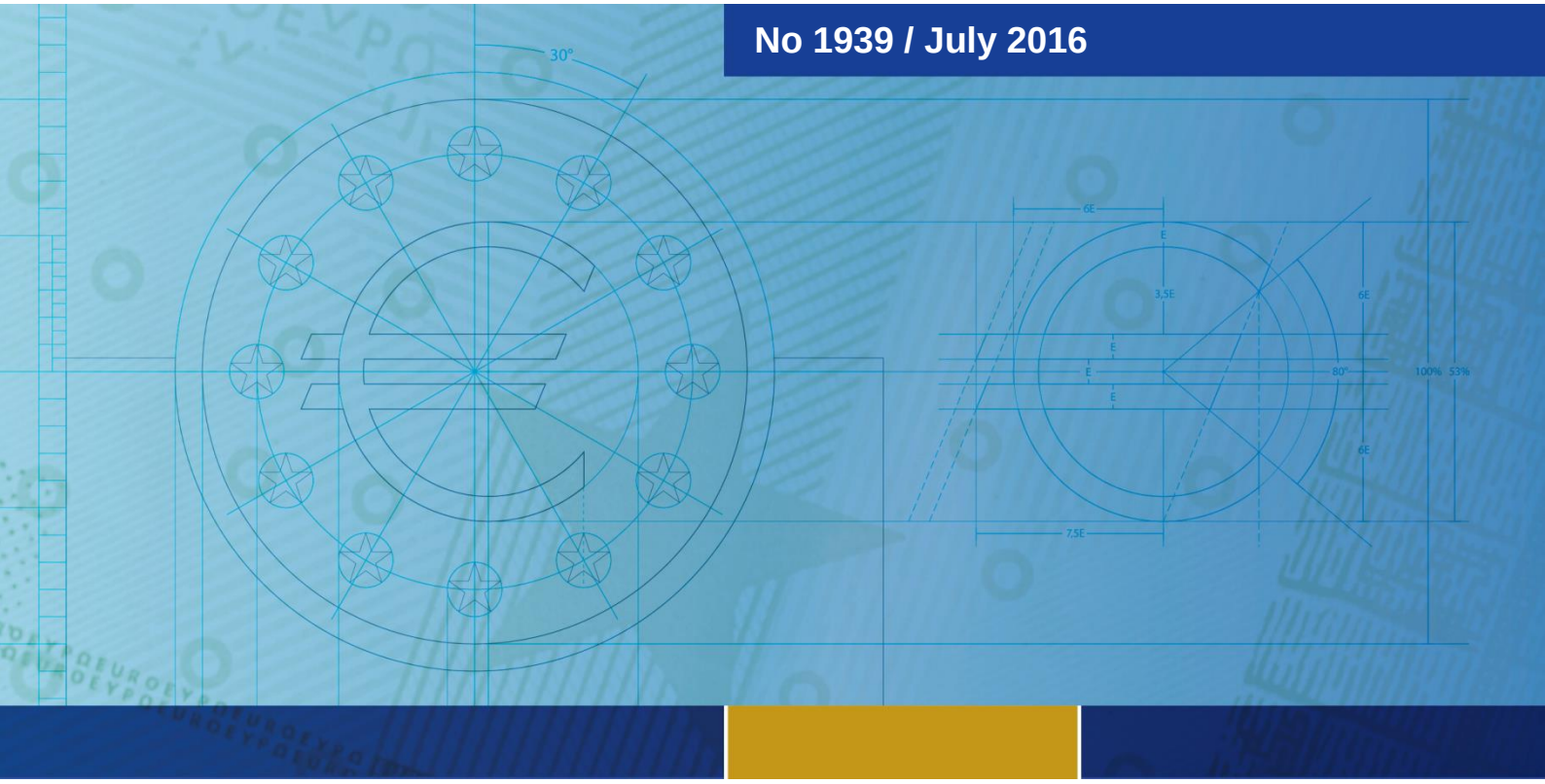
Impact of the asset purchase programme on euro area government bond yields using market news



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Abstract

Assessing the impact of the Asset Purchase Programme (APP) by the European Central Bank (ECB) on euro area sovereign yields is challenging, because the monetary policy announcement in January 2015 was already implicitly communicated to the market in the second half of 2014. Therefore, to identify the APP for the euro area, we rely upon Bloomberg news on euro area APP. The econometric results suggest that the impact of APP on euro area long-term sovereign yields is sizeable, albeit the programme was announced at a time of low financial distress. Most of the impact took place before the purchases took place with the vulnerable countries benefiting most.

Keywords: Quantitative easing, APP, Sovereign yields.

JEL classification: E43, E52, E58, G14

Non-Technical Summary

The major central banks pursuing Quantitative Easing (QE) have bought large volumes of public and private assets with purchases carried out in several stages. The overall balance of evidence from the literature on QE is that central bank asset purchases have had a material impact on the price of financial assets that have been purchased.

Studies focusing on the US government bond yields found that during the period December 2008 and March 2010, large-scale asset purchases (LSAPs) by the Fed worth 10% of GDP reduced the government long-term yields by nearly 90 basis points. Equivalent amounts of BoE purchases, through the so-called Asset Purchase Facility (APF), reduced the long-term yields by just over 50 basis points between March 2009 and January 2010. It is important to note that these average estimates are partly driven by event study estimates that relate to the early stages of the crisis in 2008 and 2009, which may be less relevant in tranquil conditions.

The identification of the impact for the euro area associated to the Asset Purchase Programme (APP) is challenging because the monetary policy announcement on 22 January 2015 was implicitly communicated to the market in the course of the second half of 2014. Therefore, the use of traditional event studies is not clear cut. In this paper, the APP for the euro area is identified using the number of references to such a programme in news stories recorded on Bloomberg, with the intuition behind this approach being that the more intense the discussion about the programme, the greater the expectation that euro area APP would be initiated.

The econometric results suggest that the ECB policy reduced the GDP-weighted 10-year euro area sovereign yields up to October 2015 by 63 basis points with the vulnerable countries benefiting most. Most of the impact occurred between September 2014 and February 2015, in line with the view that investors discounted the implications of the monetary policy, before the actual purchases even started. The results in relation to the GDP are not very dissimilar from the estimates computed for the QE programmes in the US and the UK. Most likely, markets have looked at the experience of other central banks in order to anticipate the potential impact of APP purchases. All in all, the findings suggest that APP remains an important instrument to affect financing conditions, albeit the programme was announced at a time of low financial distress.

1 Introduction

The major central banks pursuing Quantitative Easing (QE) have bought large volumes of public and private assets with purchases carried out in several stages (see Figure 1). In particular, the ECB on 5 March 2015 through its Asset Purchase programme (APP) announced the aim at purchasing 1.14 trillion of public and private sector securities over the period March 2015 and September 2016 representing 11% of nominal GDP, a programme further expanded in December 2015.

[Insert Figure 1, here]

The overall balance of evidence from the literature on QE is that central bank asset purchases have had a material impact on the price of financial assets that have been purchased. Most of the empirical literature on asset purchases by the Federal Reserve (FED) and Bank of England (BoE) has focused on their effects on government bond markets. Studies focusing on the US government bond yields are Doh (2010), Gagnon et al. (2011), Krishnamurthy and Vissing-Jorgenson (2011), Meaning and Zhu (2011), D'Amico et al. (2012), D'Amico and King (2013) and Li and Wei (2013). Studies focusing on the UK government bond yields are Meier (2009), Joyce et al. (2011), Joyce and Tong (2012), Meaning and Zhu (2011), Breedon et al (2012), Christensen and Rudebusch (2012) and McLaren et al (2014). Averaging over estimates in various papers, during the period December 2008 and March 2010, large-scale asset purchases (LSAPs) by the Fed worth 10% of GDP (LSAP1) reduced the government long-term yields by nearly 90 basis points. Equivalent amounts of BoE purchases, through the so-called Asset Purchase Facility (APF), reduced the long-term yields by just over 50 basis points between March 2009 and January 2010.[1]

It is important to note that these average estimates are partly driven by event study estimates that relate to the early stages of the crisis in 2008 and 2009, which may be less relevant in tranquil conditions. For example, asset purchases by the Fed worth 10% of GDP during LSAP2 reduced the long-term yields by about 65 basis points. And if we look at developments in US government bond yields after the announcement of LSAP3 in September 2012 and in UK government bond yields after the announcement of APF2 in November 2009, it is clear that

[1] The US has carried out main three rounds of quantitative easing: LSAP1 announced on 25 November 2008, LSAP2 announced on 3 November 2010 and LSAP3 announced on 13 September 2012. The Fed has also engaged in two attempts to flatten the yield curve (Maturity Extension Program - MEP) by funding long maturity Treasury purchases through the sale of shorter-term Treasury securities (i.e MEP): the MEP1 was announced on 21 September 2011and the MEP 2 was announced on 20 June 2012. The UK has carried out main two rounds of MEP: MEP1 announced on 5 March 2009 and MEP2 announced on 6 October 2011.

there was little reaction in sovereign yields. However, it could be argued that the impact of later rounds of purchases cannot be easily assessed if markets expected them (Martin and Milas, 2012; Cahill, et al., 2014).

All in all, the literature on the US and UK suggest that most of the analysis has been based on event studies, which typically assume that QE announcements are unanticipated and therefore represent news to financial markets. One disadvantage of the event study, however, is that the effect is assumed to be permanent.[2]

Moreover, to the extent that QE purchases are already expected and incorporated in market prices, these methods risk underestimating the impact of QE. These difficulties are particularly acute in assessing later rounds of purchases, which are likely to have been anticipated by markets. Second, it is possible that the impact of QE is state contingent and that the effects diminished as a result of calmer market conditions.

The identification of the APP impact for the euro area is challenging because the monetary policy announcement on 22 January 2015 was implicitly communicated to the market in the course of the second half of 2014. Therefore, using traditional event studies is not clear cut. Altavilla et al. (2015) use a traditional event study, but address this issue by considering also a series of key events associated to key ECB policy statements before the announcement. They found that the impact of the APP on the GDP-weighted 10-year euro area sovereign yields between 4 September 2014 and 5 March 2015 amounts to about 30-50 basis points. However, one disadvantage of this approach is that one could choose the most relevant dates for the analysis.

In this paper, the APP for the euro area is identified using the number of references to such a programme in news stories recorded on Bloomberg, with the intuition behind this approach being that the more intense the discussion about the programme, the greater the expectation that euro area APP would be initiated. This identification strategy is more agnostic, although there is a risk of weaker identification as the news could capture irrelevant market rumours. The results suggest that the news coverage increased sharply in September 2014 in line with the view that the Jackson Hole speech by Mr. Draghi on 22 August 2015 raised the expectations for the QE programme in the euro area. Moreover, we employ a panel error correction model for euro area countries' sovereign yields with fundamentals observed in real time, which permits

[2] Szczerbowicz (2015) has also adopted an event study methodology to assess the impact of other non-standard monetary policy measured introduced by the ECB.

at the APP effect to decay over time.

The econometric results suggest that APP is an important instrument to affect financing conditions and its effect is persistent over time. Due to APP, the GDP-weighted 10-year euro area sovereign yield declined by 56 basis points between September 2014 and February 2015 and by additional 7 basis points between March and October 2015 suggesting that the impact was discounted by bond investors before the purchases even started. Moreover, we find that the impact on vulnerable countries' sovereign yields is the largest.

Given the tapered tensions in the euro area financial markets in 2014 and 2015, the obtained results support the view that the impact of QE on government bond yields is independent from financial market conditions.

The remainder of the paper is as follows. Section 2 discusses the identification strategy. Section 3 briefly describes the econometric method and presents the empirical results. Section 4 concludes.

2 Identification

In the economic literature, the quantification of the impact of QE policy measures on asset prices is often based on the price changes observed over a narrow time window surrounding the policy announcement. However, the identification of the APP shock for the euro area is more challenging, because the monetary policy announcement on 22 January 2015, followed by the details of the new programme and the initial purchases in March 2015, was implicitly communicated to the market in the autumn 2014 and many believe that the Jackson Hole speech by Mr. Draghi on 22 August 2015 raised already such expectations, as worries about rising deflationary risks coupled with negative news about the real economy were communicated. This speech is relevant against the background that, previously on 24 April 2014, Mr. Draghi stated that a worsening of the medium-term inflation outlook would provide a reason for broad-based asset purchases. After the Jackson Hole speech, stocks rose, the euro fell and bond yields dropped as the comments fanned speculation the ECB was heading for further monetary stimulus.[3] This suggests that event studies based only on the official announcement on 22

[3]For example, on August 25 2014, Simon Kennedy and Alessandro Speciale in a Bloomberg article entitled "Draghi pushes ECB closer to QE as deflation risks rise" report the following: The Aug. 22 speech "was a major event and marked a turning point in ECB rhetoric," said Philippe Gudin, chief European economist at Barclays Plc in Paris. "We think the recent economic developments have increased the chance of outright QE as the next step." The article also writes the following: Citigroup Inc. economists last week predicted that the ECB will unveil a QE program in December valued at 1 trillion euros ($1.3 trillion), split between public and private assets and

January 2015 would not be satisfactory to identify the APP shock for the euro area.

In order to estimate the incremental impact of the expected monetary policy intervention, it is necessary to look at the impact of news about the ECB asset purchases that have accumulated over time. The APP for the euro area is identified using the number of references to such a programme in news stories recorded on Bloomberg, with the intuition behind this approach being that the more intense the discussion about the programme, the greater the expectation that euro area APP would be initiated. In the specific, the news variable is defined as the sum of all Bloomberg news containing jointly the following keywords: "Draghi, QE or quantitative easing, and sovereign, and euro area". Needless to say that we have tried also other alternative word combinations, such as for example the exclusion of "sovereign" or the inclusion of "ECB" together with Draghi ("Draghi "or "ECB "), but the degree of correlation between the time series is very high, even above 90 percent, and the results are not affected.

Figure 2 shows that the news as published by Bloomberg about APP in the euro area start to increase in August 2014 with 32 news coverages, in September 2014 with 108 coverages, reaching the peak in January 2015 with 226 coverages, of which 45 and 26 hits on 22 (the day of the Governing Council meeting) and 23 January 2015, respectively. The news coverage was also relatively large in March 2015, which implies that market participants treated as news the detailed announcement of the size of the programme (i.e. 20 hits on the day of the Governing Council meeting on the 5th of March), specifically the market concerns about the scarcity of bonds of 'core' government bonds,[4] and the actual purchases thereafter during the month. APP news has then declined as learning took place. After the October 2015 Governing Council meeting, there has been a renewal of news, as market participants expected – albeit timidly – the ECB to increase stimulus measures in December 2015 including APP expansion. It is very interesting to point out that APP news declined also after the Eurosystem Governing Council meeting on 05 June and 4 September 2014 (see first and second red and dotted vertical lines, when the two rate cuts were announced together with the longer-term refinancing operations (TLTROs) in June and the covered bonds (CBPP3) and asset-backed securities (ABSPP) programmes in September. This suggests that the Bloomberg variable is

aimed at reducing borrowing costs and increasing liquidity. See "http://www.bloomberg.com/news/articles/2014-08-24/draghi-pushes-ecb-closer-to-qe-as-deflation-risks-rise".

[4]The combination of the large scale of sovereign purchase programme, the decision to set a maximum price at which the Eurosystem is willing to buy bonds and the low level of the expected net sovereign bond issuances strengthens the crowding out effects of current government bond holders. It is important to notice also that on 5 March 2015 German bonds with maturities of up to three years traded below the ECB's deposit rate of -0.20% and maturities of up to seven years had negative yields.

indeed capturing the news about the APP in the euro area and no the other monetary policy measures.

[Insert Figure 2, here]

To be assured about the suggested identification, a similar series containing jointly the following keywords: "Bernanke or Yellen, and quantitative easing, and US" has been constructed. The correlation between the EA and the US APP news amounts to a statistically insignificant 12.6%.

The number of news-stories would have been very large also had the programme disappointed. This is a clear limitation to the identification method. However, on the ECB press conference days, when Mario Draghi announced the APP (22 January 2015), launched the APP (5 March 2015) and surpriced markets by signalling that he was prepared to expand the APP to stave off the risk of a renewed economic slowdown in the euro area (22 October 2015), all sovereign yields declined, the stock price increased, the exchange rate depreciated, suggesting that at least in these key days the news stories mainly identify positive surprises.

Table 1 provides the overall summary with the GDP-weighted 10-year euro area sovereign yields declining by 24 basis points on the three announcement days. The largest decline in yields were recorded in Portugal (-40 basis points), Italy (-37 basis points) and Spain (-37 basis points), while the largest increase in the stock market prices were recorded in Italy (5.4%), Germany (5.2%) and Finland (4.8%). The devaluation of EUR exchange rate vis-à-vis the US dollar amounts to 7%.

In general, if some of the counted news over the entire sample period are capturing adverse sentiment vis-à-vis the euro area quantitative easing programme, it can be argued that the estimated impact coefficients underestimate the true impact of the asset purchases.

[Insert Table 1, here]

3 Empirical results

3.1 The empirical model

During the APP period, two key forces might have driven sovereign yields. On the one hand, monetary policymakers introduced the APP aiming at improving the financing conditions for firms and households by reducing the long-term sovereign yields, as the latter are typically used

as benchmarks. On the other hand, macroeconomic forces might have moved sovereign yields towards levels suggested by economic fundamentals. These forces can be modelled jointly using the dynamic equation of an error correction model for sovereign yields adding the APP-related shock, which is the monthly count as depicted in Figure 2. Moreover, an error correction model allows the APP shocks to be transitory.

Therefore, we opt for a panel error correction model to explain sovereign yields with macro fundamentals. The advantage of this approach is that if the estimated model residuals are stationary, we can be sure to have selected and identified the key variables driving sovereign yields in the long term and the omitted variable bias is less of an issue. Moreover, the model residuals represent the deviation between actual sovereign yields and their desired values and it is generally accepted that such residuals were positive in the stressed countries during the hikes of the sovereign debt crisis in the summers of 2011 and 2012. If the model were correctly specified, this evidence should be reflected. Finally, such residuals act as an error correction mechanism. In particular, if sovereign yields were below their fair value in 2014 and 2015, the country-specific error correction mechanisms would push towards higher rates; while monetary policymakers would aim at counterweight this dynamics by means of APP.

The econometric model takes the following structure:

$$Y_{it} = a_i + bX_{it} + E_{it} \tag{1}$$

$$\begin{aligned} \Delta Y_{it} = \quad & \beta_0 - \beta_1 E_{it-1} + \beta_2 News_t^{EA} + \beta_3 News_t^{US} + \beta_4 \Delta Y_{it-1} + \\ & \beta_5 \Delta X_{it} + \beta_6 \Delta X_{it-1} + \beta_7 \Delta Z_{it} + \beta_8 \Delta Z_{it-1} + e_{it}, \end{aligned} \tag{2}$$

where Y_{it} denote the 10-year benchmark sovereign yields in country i at time t, a_i the sovereign specific intercept (fixed effects), X_{it} the vector of macro factors, E_{it} the error correction mechanism, $News_t^{EA}$ the euro area APP news, $News_t^{US}$ the US QE news, Z_{it} all other exogenous variables and e_{it} are the error terms of the dynamic equation which are assumed to be white noise. Δ is the first difference operator. The validation of the econometric model requires the stationarity of E_{it} and $0 < \beta_1 < 1$.

To study the heterogeneous response of the APP shock on bond yields among countries, we

also estimate the dynamic equation by interacting the APP news with the country fixed effects:

$$\begin{aligned}\Delta Y_{it} = \quad & \beta_0 - \beta_1 E_{it-1} + \beta_{2i} News_t^{EA} + \beta_{3i} News_t^{US} + \beta_4 \Delta Y_{it-1} + \\ & \beta_5 \Delta X_{it} + \beta_6 \Delta X_{it-1} + \beta_7 \Delta Z_{it} + \beta_8 \Delta Z_{it-1} + e_{it}.\end{aligned} \tag{3}$$

3.2 The database

The macro factors should capture liquidity risk, credit risk and systematic risk. Among the selected and statistically significant X_{it} variables, 10-year bid-ask spreads are used as a measure of liquidity risk; government balance to GDP ratio, government debt to GDP ratio and its squared term are used to proxy credit risk; the 10-year break even inflation rate (BEIR), the 3-month Overnight Index Swap (OIS) rate, real GDP growth forecast 1-year ahead and the dispersion among professional forecasters of inflation 1 year ahead are used to proxy for systematic risk. Z_{it} include the inflation forecast 1-year ahead and the dispersion among professional forecasters of real GDP growth 1 year ahead.

The countries' government balances and debt to GDP ratio are the nowcast estimates on a quarterly basis by the European Central Bank. The quarterly nowcast takes the same value for each month within the quarter.

The BEIR is the yield spread between nominal and inflation-linked bonds at 10-year maturity. The underlying yield curve to estimate the BEIR and the 3-month OIS rate are provided by Bloomberg.

Macroeconomic forecasts are provided by Consensus Economics. Given that asset prices and consensus forecasts are not revised, real-time data vintages are employed to assess the determinants of sovereign yields.

The model is estimated over the sample period February 2004 – October 2015 due to data limitation to construct the BEIR and the nowcast vintages to estimate credit risk and it includes the largest 10 euro area countries: Austria, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal and Spain. The frequency is monthly and the financial variables are collected at the end of the month.

3.3 The results

The estimation of the level equation (1) for the euro area takes the parameters reported in Table 2. The coefficients have all the correct sign and are statistically significant, as deterioration in

liquidity, credit and market risks increases sovereign yields. It is important to stress that the level equation provides an equilibrium relationship between all variables and, for example, a decrease in credit and liquidity risk might not be associated with a decline in sovereign yields if the effect is counterweighted by an increase in systematic risk, such a fall in expected real GDP growth or an increase in BEIR or an increase in uncertainty about the inflation forecasts. Nevertheless to appreciate the economic significance of the factors, we can look at the partial elasticities, whose effect is valid only all other factors being equal. Hence, *ceteris paribus*, an increase in bid-ask spreads by 1 basis point implies an increase in sovereign yields by 12 basis points. An increase in government balance to GDP ratio by 1 percentage points implies a decline in sovereign yields by 15 basis points. The relationship between government debt to GDP ratio and sovereign yields is quadratic and convex. An increase in the debt to GDP ratio leads to an increase in sovereign yields after the debt to GDP ratio has reached 150%. An increase in 10-year break even inflation rate by 10 basis points implies an increase in sovereign yields by 14 basis points. An increase in the 3-month OIS rate, a proxy for conventional monetary policy, by 10 basis points implies an increase in sovereign yields by 5 basis points. An increase in expected real GDP growth by 1 percentage point implies a decrease in sovereign yields by 18 basis points. An increase in the dispersion among professional forecasters in HICP inflation forecasts by 1 percentage point implies an increase in sovereign yields by 214 basis points.

[Insert Table 2, here]

The residuals of the long run relationship are stationary based on standard panel unit root tests, regardless whether a common or individual unit root process is assumed (see Table 3). The country-specific error correction terms are plotted in Figure 3.

[Insert Table 3, here]

[Insert Figure 3, here]

In countries such as Ireland and Portugal, liquidity premia become an important issue during the sovereign debt crisis rising to unprecedented levels, most likely driven by panic and fear. Therefore, we construct also a misalignment measure by adding to the cointegrating residuals the spread between the estimated liquidity premium and its typical past value, which

is assumed to be equal to its average before the financial crisis started in August 2007: $E_{it} + b^{liq}\left(X_{it}^{liq} - \overline{X}_{it}^{liq}\right)$. This is to say that the estimation of a sovereign yield fair value should also take into consideration a fair value for liquidity premia.

Both the estimated error correction term and the misalignment are reported in Figure 3. They present similar developments except for Ireland and Portugal. The misalignment registered during the hikes of the sovereign debt crisis reached 3 percentage points for Italy and Spain and 8 and 10 percentage points for Ireland and Portugal, respectively. The liquidity premium has been an issue for smaller market and clearly in Ireland and Portugal. All other sovereigns benefited owing to flight to safety motives. All in all, these results are not inconsistent with the narrative that can be found in the academic literature and in financial letters.

The estimation of the dynamic equation (2), which also controls for euro area APP news, is reported in the first two columns of Table 4. For the sake of saving space, only the coefficients on the error correction mechanism and the APP shock are shown. The results described in Panel A suggest that the error correction mechanism is strongly statistically significant at 1% level with the correct negative sign. Similarly, the adjustment required to reduce the distance between actual and fair sovereign yields is highly statistically significant (see coefficient on E_{it-1} in the misalignment column). Finally, the APP news has an impact on the dynamics of sovereign yields, which is highly statistically significant regardless of the specification adopted.

[Insert Table 4, here]

To study the country heterogeneous implications of the APP shock, we interact the APP news with the country fixed effects, namely we estimate (3). The coefficients reported in Panel B of Table 4 are all negative, highly statistically significant and highly heterogeneous with the lowest value for German and Dutch sovereign yields and the largest value for Italian and Portuguese rates, in line with the findings for the US and the UK, where the impact is found to be larger for riskier and more illiquid assets.

The economic implications of these results are summarised in Figure 4 for the euro area as a whole and in Table 5 for the individual countries.

We compute the static flow effect on sovereign yields and its dynamic effect, which takes into account the decay from the error correction mechanism and the fact that $\widehat{\beta}_4$ is not statistically different from zero. The cumulated static flow effect between $t+j$ and T is simply

$\sum_{j=0}^{T} \beta_{2i} News_{t+j}^{EA}$. The cumulated dynamic effect, which takes into account the effects of all shocks in each period and the decay after T periods given that $0 < \beta_1 < 1$, amounts to $\sum_{j=0}^{T} (1-\beta_1)^{T-j} \beta_{2i} News_{t+j}^{EA}$ (see Appendix).[5] Note that as β_1 approaches zero, the impact of the APP becomes permanent as with the event study methodology. The decay effect is estimated as

$$Decay_{it} = \sum_{j=0}^{T} (1-\beta_1)^{T-j} \beta_{2i} News_{t+j}^{EA} - \sum_{j=0}^{T} \beta_{2i} News_{t+j}^{EA}.$$

The counterfactual experiment for the euro area showing the actual level of the sovereign yield and its prevailing rate, if the APP would have not been launched, indicate that the effect occurred mostly before the bond purchases started in March 2015 and that the APP effect is persistent because $\widehat{\beta}_1$ is relatively small (see Figure 4).

[Insert Figure 4, here]

For the euro area as a whole, we compute three set of values: those labelled "EA " in Table 5 are based on the estimation of the pooled regression (2); the EA simple mean is based on the coefficients obtained interacting the APP news with the country dummies and the estimated impact is the country simple mean; the EA weighted average is based on the same coefficients obtained interacting the APP news with the country dummies, but the country affects are weighted by nominal GDP. The dynamic effect is estimated through both the error correction term and the misalignment.

[Insert Table 5, here]

Focusing on the model with misalignment, between September 2014 and October 2015, the ECB policy reduced the 10-year euro area sovereign yields by 63 basis points when looking at the weighted average and by 69 basis points when looking at the mean, with the largest impact on Portuguese yields (106 basis points) and the lowest impact on Dutch and German yields (38-43 basis points). This implies that the policy affected the term premium given that all the risk free rates declined, as well as credit risk perceived by the market, as the jurisdictions benefiting most from the monetary policy were those with a worse credit risk outlook.

Most of the impact occurred between September 2014 and February 2015, in line with the view that investors discounted the implications of the monetary policy, before the actual

[5] If ths shock would occurr only in the first period, then the cumulated dynamic effect after T periods from the shock would amount to $(1-\beta_1)^T \beta_{2i} News_{t+1}^{EA}$.

purchases even started. The actual decline in (the ten countries) GDP weighted 10-year euro area sovereign yields amounted to 77 basis points between September 2014 and February 2015, of which 56 basis points was due to APP-related shocks.

It is also useful to point out that the cumulated decay effect amounted to 23 basis points in the case of misalignment. This implies that the level of yields would have been 23 basis points higher in October 2015 without the dynamic effect (see Figure 4).

The results are not very dissimilar from the estimates computed for the QE programmes in the US and the UK, despite the APP was launched during calm financial conditions. Most likely, markets have looked at the experience of other central banks in order to anticipate the potential impact of APP purchases.

4 Conclusions

The quantification of the impact of policy measures on asset prices is often based on the price changes observed over a narrow time window surrounding the policy announcement. The identification of the APP impact for the euro area is more challenging, because the monetary policy announcement in January 2015 was already implicitly communicated to the market in 2014. Therefore, to identify the APP, Bloomberg news on euro area APP is employed.

Using a country-panel error correction model with Bloomberg news in the dynamic equation, the results suggest that up to October 2015 the ECB policy reduced the GDP-weighted 10-year euro area yields by 63 basis points with the vulnerable countries benefiting most. Most of the impact occurred between September 2014 and February 2015, in line with the view that investors discounted the implications of the monetary policy, before the actual purchases even started. The econometric results suggest that APP remains an important instrument to affect financing conditions, albeit the programme was announced at a time of low financial distress.

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APPENDIX

Using expression (3), under the hypothesis that $\beta_4 = 0$, the impact of APP shocks are calculated as follows:

Period	Shock	Cumulated impact
0	$\beta_{2i} News^{EA}_{t+0}$	$\beta_{2i} News^{EA}_{t+0}$
1	$\beta_{2i} News^{EA}_{t+1}$	$\beta_{2i} News^{EA}_{t+1} + (1-\beta_1)\,\beta_{2i} News^{EA}_{t+0}$
2	$\beta_{2i} News^{EA}_{t+2}$	$\beta_{2i} News^{EA}_{t+2} + (1-\beta_1)\,\beta_{2i} News^{EA}_{t+1} + (1-\beta_1)^2\,\beta_{2i} News^{EA}_{t+0}$
3	$\beta_{2i} News^{EA}_{t+3}$	$\beta_{2i} News^{EA}_{t+3} + (1-\beta_1)\,\beta_{2i} News^{EA}_{t+2} + (1-\beta_1)^2\,\beta_{2i} News^{EA}_{t+1} + (1-\beta_1)^3\,\beta_{2i} News^{EA}_{t+0}$
.	.	.....

After T periods, the cumulated impact can be written as $\beta_{2i} News^{EA}_{t+T} + (1-\beta_1)\,\beta_{2i} News^{EA}_{t+T-1} + (1-\beta_1)^2\,\beta_{2i} News^{EA}_{t+T-2} + \cdots + (1-\beta_1)^T\,\beta_{2i} News^{EA}_{t} = \sum_{j=0}^{T} (1-\beta_1)^{T-j}\,\beta_{2i} News^{EA}_{t+j}$.

Table 1. Reaction of Market prices to Governing Council meetings in January, March and October 2015

(basis points and percentage growth)

	PT	IT	ES	IE	FR	AT	FI	BE	NL	DE	EA	USD/EUR
				10-year sovereign yields (basis points)								
22/01/2015	-16	-14	-14	-9	-8	-8	-7	-8	-7	-7	-10	
05/03/2015	-11	-8	-8	-3	-3	-4	-5	-3	-3	-4	-5	
22/10/2015	-13	-15	-15	-9	-9	-8	-8	-8	-8	-7	-9	
Overall	-40	-37	-37	-21	-20	-20	-20	-19	-18	-18	-24	
				Stock market prices and USD/EUR (%)								
22/01/2015	1.5	2.3	1.6	1.4	1.4	1.5	2.0	1.1	1.2	1.7	0.1	-3.6
05/03/2015	1.7	1.3	0.7	0.9	1.0	1.1	1.1	1.0	1.3	1.0	0.7	-1.1
22/10/2015	0.6	1.8	1.9	0.6	2.0	1.8	1.7	1.7	1.6	2.6	0.3	-2.3
Overall	3.8	5.4	4.2	3.0	4.4	4.4	4.8	3.8	4.1	5.2	1.0	-7.0

Source: ECB and Reuters DataStream.

Note (*) EA sovereign yields are weighted by nominal GDP. On 22 January 2015, Mario Draghi at ECB press conferences announced the APP on 22 January 2015, the launch of the APP on 5 March 2015 and the signalling of forthcoming higher degree of monetary policy accommodation including through the APP on 22 October 2015.

Table 2: Estimation of the sovereign yield level equation

	Coefficient	Std. Error
10-yr Bid-ask spreads	0.1162	0.0027
Government balance / GDP	-0.1497	0.0100
Government Debt / GDP	-0.0618	0.0061
(Government Debt / GDP)^2	0.0004	0.0000
10-yr BEIR	1.4436	0.0767
3-m OIS	0.4926	0.0220
Real GDP growth forecast 1yr ahead	-0.1827	0.0183
Standard dev. of inflation forecast 1-yr ahead	2.1365	0.3261

Note: Sample period February 2004-September 2015. Panel with country fixed effects.

Table 3: Unit Root Test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.2316	0.0128	10	1375
Breitung t-stat	-5.1811	0.0000	10	1362
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.1460	0.0000	10	1375
ADF - Fisher Chi-square	79.3750	0.0000	10	1375
Phillips-Perron - Fisher Chi-square	89.9978	0.0000	10	1390

*** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. Automatic selection of maximum lags. Automatic lag length selection based on AIC. Newey-West automatic bandwidth selection and Bartlett kernel.*

Table 4: Estimation of the sovereign yield dynamic equation

	Panel A		Panel B	
	ECT	Misalignment	ECT	Misalignment
E_{it-1}	-0.067***	-0.0336**	-0.068***	-0.023**
	(0.014)	(0.013)	(0.015)	(0.011)
$News_{Eat}$	-0.094***	-0.086***		
	(0.014)	(0.014)		
$News_{EAt}$ -ES			-0.106***	-0.095***
			(0.016)	(0.009)
$News_{EAt}$ -IT			-0.122***	-0.101***
			(0.026)	(0.010)
$News_{EAt}$ -PT			-0.146***	-0.135***
			(0.022)	(0.020)
$News_{EAt}$ -FR			-0.098***	-0.089***
			(0.012)	(0.005)
$News_{EAt}$ -NL			-0.052***	-0.048***
			(0.014)	(0.010)
$News_{EAt}$ -BE			-0.110***	-0.091***
			(0.013)	(0.009)
$News_{EAt}$ -IE			-0.086***	-0.076***
			(0.020)	(0.024)
$News_{EAt}$ -AT			-0.092***	-0.085***
			(0.007)	(0.005)
$News_{EAt}$ –FI			-0.124***	-0.107***
			(0.014)	(0.004)
$News_{EAt}$ –DE			-0.052***	-0.054***
			(0.008)	(0.007)
…..	…..	…..	…..	…..
Adj. R^2	0.268	0.265	0.264	0.262
N. of Obs.	1380	1380	1380	1380

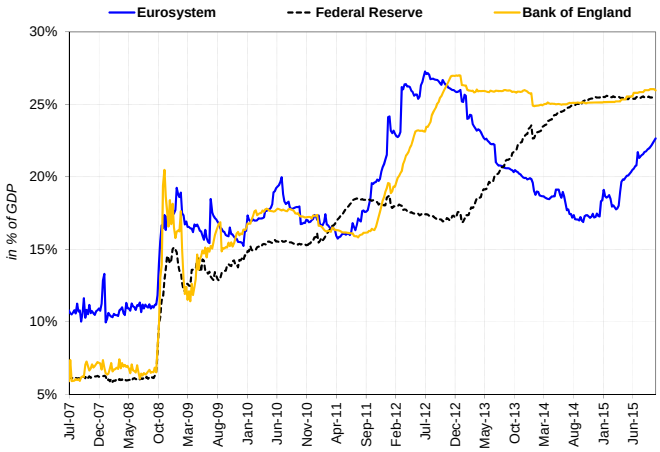
*Note: Sample period April 2004-October 2015. Pooled least squares. Standard errors are robust to arbitrary within cross-section residual correlation. The APP coefficients are multiplied by 100. ECT is the error correction term from the panel cointegration specification. Misalignment is the error correction term adjusted for the deviation between the actual liquidity premium and its average value before the financial crisis over the period April 2004 – July 2007. Coefficients that are statistically significant at 1% and 5% are denoted with *** and **, respectively.*

Table 5: The impact of APP on 10-yr sovereign yields between September 2014 and October 2015 *(basis points)*

	APP static impact				APP dynamic impact				Actual changes	
	misalignment	misalignment	ECT	ECT	misalignment	misalignment	ECT	ECT		
	Sep 14 - Feb 15	Sep 14 - Oct 15	Sep 14 - Feb 15	Sep 14 - Oct 15	Sep 14 - Feb 15	Sep 14 - Oct 15	Sep 14 - Feb 15	Sep 14 - Oct 15	Sep 14 - Feb 15	Sep 14 - Oct 15
ES	-73	-101	-81	-112	-67	-75	-69	-61	-96	-57
IT	-77	-107	-93	-129	-71	-80	-79	-70	-108	-96
PT	-102	-142	-111	-155	-95	-106	-95	-84	-138	-68
FR	-68	-94	-74	-103	-63	-70	-63	-56	-71	-39
NL	-37	-51	-40	-55	-34	-38	-34	-30	-68	-37
BE	-70	-97	-84	-116	-64	-72	-71	-63	-66	-42
IE	-58	-80	-65	-90	-53	-60	-56	-49	-91	-64
AT	-65	-90	-70	-97	-60	-67	-60	-53	-74	-35
FI	-81	-113	-95	-131	-75	-84	-81	-72	-58	-27
DE	-41	-57	-40	-55	-38	-43	-34	-30	-56	-37
EA	-65	-90	-72	-99	-60	-68	-61	-55	-	-
EA simple mean	-67	-93	-75	-104	-62	-69	-64	-57	-83	-50
EA weighted average(*)	-61	-84	-67	-93	-56	-63	-57	-51	-77	-50

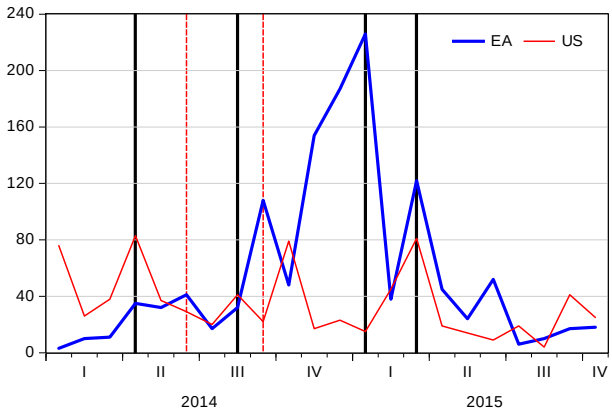
Note: (*) weighted by nominal GDP. ECT is the error correction term of the panel cointegration specification. Misalignment is the error correction term adjusted for the deviation between the actual liquidity premium and its average value before the financial crisis over the period April 2004 – July 2007.

Figure 1: Central bank balance sheet size (% of GDP)



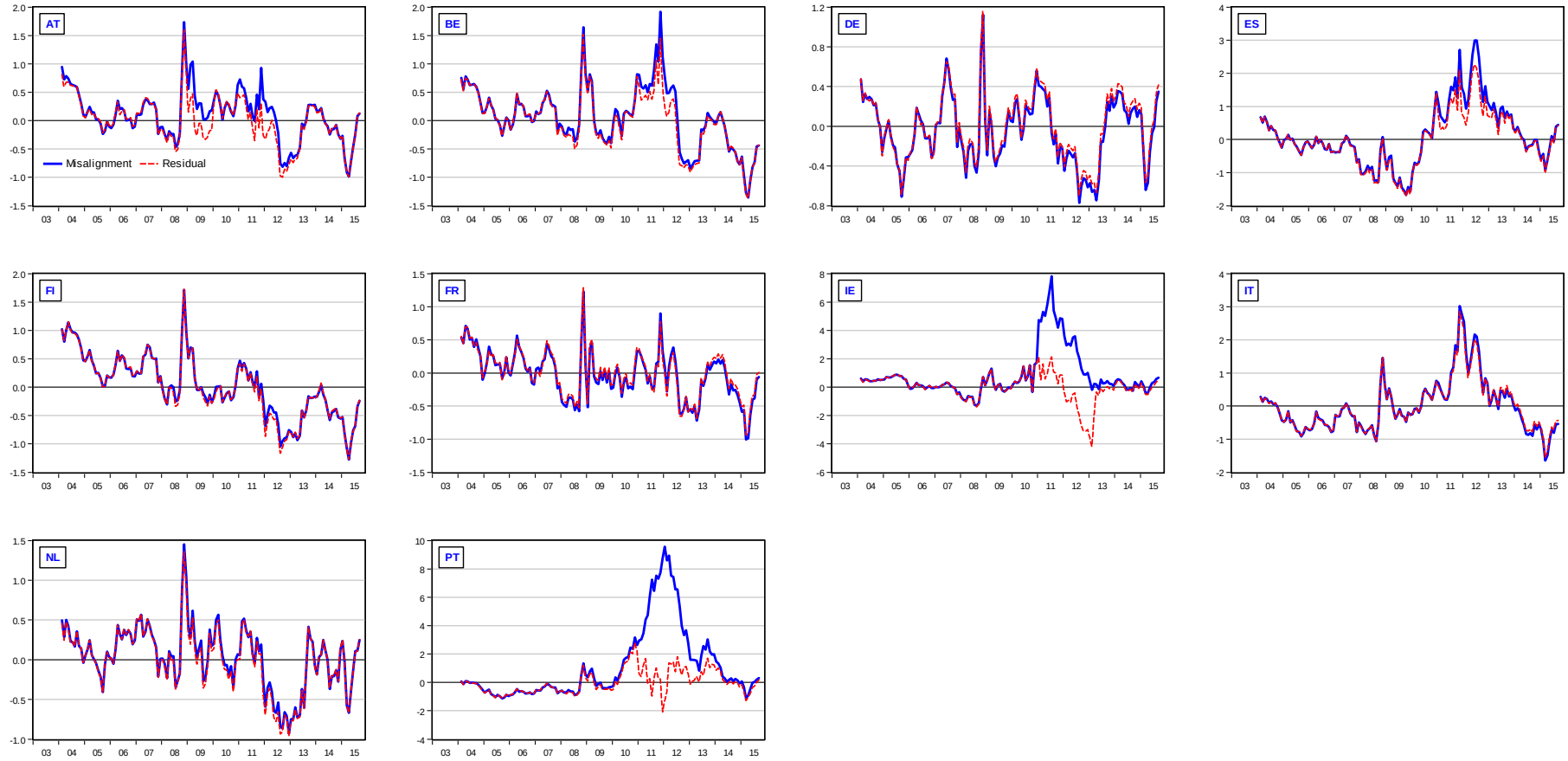
Source: BoE, Fed, ECB and author' calculations
Note: Last observation 25 Sep 2015.

Figure 2: Bloomberg news on euro area and US APP



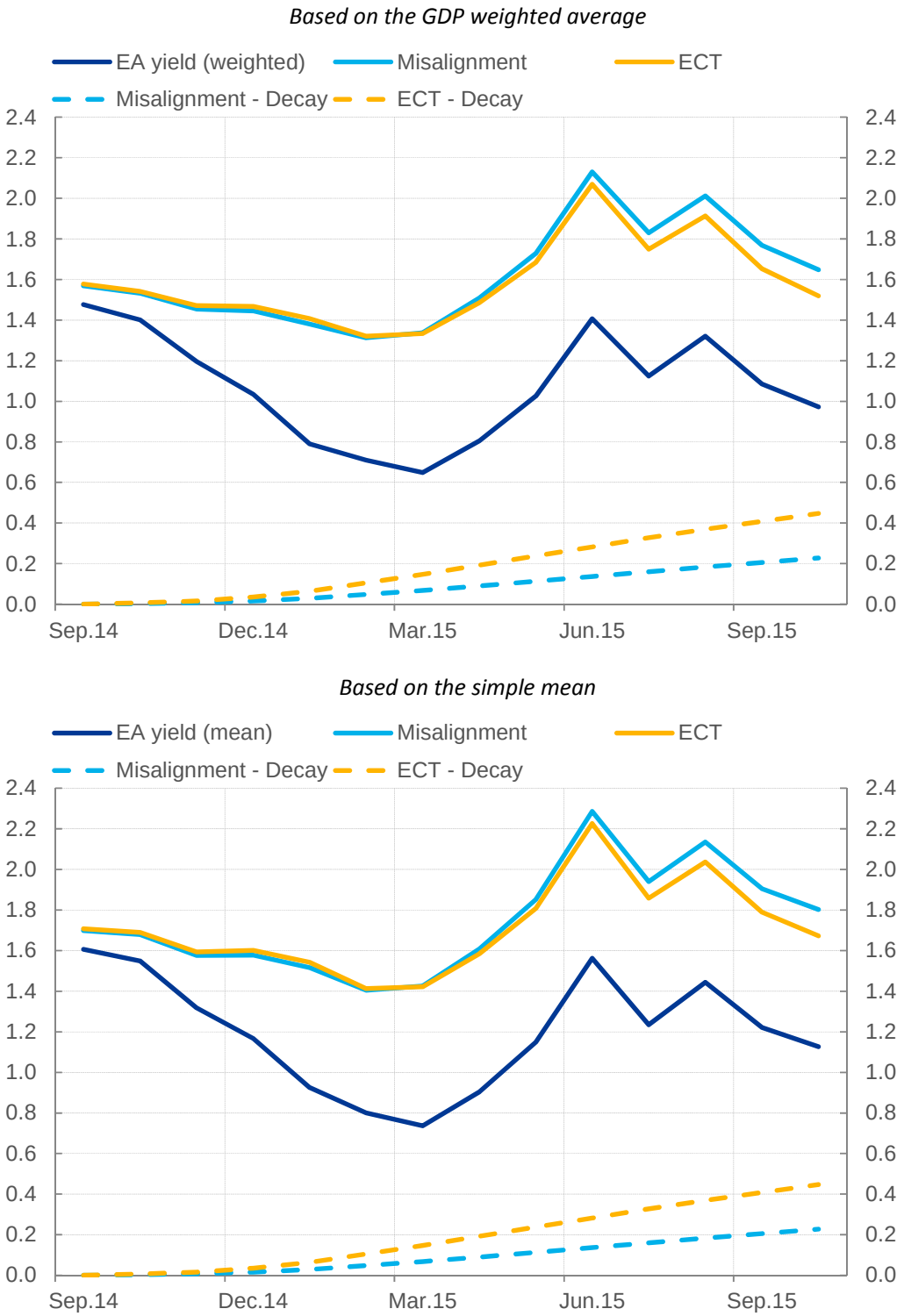
Source: Bloomberg.
Note: Last observation 30 October 2015. Euro area: Bloomberg news containing jointly the following keywords "Draghi, QE or quantitative easing, sovereign, euro area". US: Bloomberg news containing jointly the following keywords "Bernanke or Yellen, quantitative easing and US". The first black vertical line denotes the Draghi's speech on 24 April 2014. The second black vertical line denotes the Draghi's speech on 22 August 2014 at Jackson Hole. The third black vertical line denotes the Eurosystem GC meeting on 22 January 2015, when APP was officially announced. The fourth black vertical line denotes the Eurosystem GC meeting on 5 March 2015, when APP was officially launched. The first and second red and dotted vertical lines denote the Eurosystem GC meeting on 05 June and 4 September 2014, when the two rate cuts were announced together with the TLTROs in June and the ABS programmes in September.

Figure 3. Misalignment and residuals of the panel vector error correction model



Note: Residual is the error correction term from the panel cointegration specification. Misalignment is the error correction term adjusted for the deviation between the actual liquidity premium and its average value before the financial crisis over the period April 2004 – July 2007.

Figure 4: The dynamic impact of APP on 10-yr sovereign yields: A counterfactual analysis
(percentage points)



Note: ECT is the level of the euro area sovereign yield prevailing in absence of APP estimated using the error correction term from the panel cointegration specification. Misalignment is the level of the euro area sovereign yield prevailing in absence of APP estimated using the error correction term adjusted for the deviation between the actual liquidity premium and its average value before the financial crisis over the period April 2004 – July 2007.

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