Are ECB announcement days special? Evidence from QE announcements

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Abstract

Using a data set of the most liquid euro denominated corporate bonds between 2004-2020, this study shows that excess bond returns are on average significantly positive and have a one factor structure on ECB *policy* announcement days. Moreover, this pattern is there on average on *all* ECB announcement days post-2012 but not before. Beta and a Value at Risk (VaR) measure of past returns explain the same cross-sectional variation in announcement returns, but the VaR measure drives out beta. The results support the view that a central bank put explains announcement day returns. When the ECB reacts with accommodative policy to market turmoil, it particularly boosts returns of those assets that have lost the most, i.e. with a high beta and high VaR.

Keywords: ECB, Fed, QE, Announcement Returns, Bond Returns, Risk Factors, Bond Characteristics

JEL classification: E58, E52, G12

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1 Introduction

When central banks announce accommodative policies such as unexpected interest rate cuts, financial markets react–at times euphorically (Bernanke and Kuttner, 2005). Besides boosting asset returns on average, assets with a high CAPM beta experience especially high gains (Savor and Wilson, 2014). The Fed and the ECB hold scheduled meetings in a six-week cycle and announce the result of each meeting to the public in form of a monetary policy decision. The announcements after the Fed's FOMC meetings result in positive returns on average in the post-1994 period (Lucca and Moench, 2015; Savor and Wilson, 2014), the ECB, BoE or BoJ meetings' announcements do not (Brusa, Savor, and Wilson, 2020). While the US dollar is the primary reserve currency of the world and the Fed plays an important role for financial conditions globally, the euro is the primary currency in Europe. Accommodative monetary policies should therefore affect the returns in the financial conditions and therefore asset prices in Europe. One possible explanation for the findings above is that Fed policy has been more accommodative during the sample period (and policies were communicated swiftly) than other central banks' monetary policies. Indeed, evidence presented in this study shows that on ECB announcement days post-2012, bond returns are positive on average and have a strong one-factor structure as in Savor and Wilson (2014). One way to view the results is that the ECB's monetary policy has become more accommodative on average after Mario Draghi became the ECB's president in November 2011.

This paper examines the cross-section of bond returns in the euro denominated bond market on ECB announcement days, studying two-day windows around each announcement during the 16-year period December 31, 2004 - December 31, 2020. The sample includes four crises periods. The aftermath of the Lehman collapse, the European sovereign debt crisis, the period of heightened market volatility in 2015[1] and the Covid pandemic. The ECB has responded to these crises with conventional and unconventional monetary policies implemented in the bond market. "ECB announcement days" are all scheduled meeting announcements and intermeeting announcements. A subset of these days are "ECB policy announcement days" which contain all event days in Krishnamurthy, Nagel, and Vissing-Jorgensen (2018) and all announcements of large-scale asset purchase programs as listed on the website of the ECB.

First, the study focuses on excess returns of corporate bonds with three-, five- and seven-year maturity, constant maturity returns are obtained using issuer-level spot rates estimated

[1]See for example, the BIS Quarterly Review, December 2015

with the Nelson-Siegel model. Excess returns are calculated relative to the return on a maturity-matched German government bond. The excess returns on all sample bonds are aggregated to the DEF factor using weighted-averages. The DEF beta is obtained using monthly return data for each bond in a 18-month rolling window estimation of bond-level excess returns on the DEF factor.

On the 32 ECB policy announcement days, the average return on the DEF factor is 13.68 bps. The average DEF return is 3.55 bps (t-stat 3.83) on all 172 ECB announcement days post-2012 and −2.59 bps on all 138 ECB announcement days pre-2012. Turning to cross-sectional intercept and slope estimates of excess returns on the estimated DEF beta, estimates show that one factor explains the cross-section of corporate bond announcement returns. Intercept estimates are insignificant and slope estimates match the average factor return closely: On ECB policy announcement days the slope estimate is 11.57 bps, on ECB announcement days post-2012 it is 3.49 bps (t-stat 3.46) and pre-2012 it is −2.72.

If the timing of policy announcements is correlated with past market conditions, then variation in estimated beta could reflect variation in past performance. If monetary policy leads to a reversal of past market conditions, and past losers are estimated with a high beta, then high beta assets should outperform low beta assets on central bank announcement days. To test this, I calculate the Value at Risk measure (VaR) of past bond returns of Bai, Bali, and Wen (2019) who show that it explains well the cross-section of future monthly US corporate bond returns. For each bond and at each announcement, the VaR measure is the second-lowest monthly return during the 18 months preceding an announcement (multiplied by minus one so that a higher VaR indicates higher risk).

Indeed, the VaR bond characteristic explains at least as much variation as does the DEF beta on ECB announcement days. When including both the DEF beta and the VaR in the cross-sectional excess return regressions, VaR remains significant while the DEF beta loses its significance. In other words, those bonds that lost the most previously, gained the most on ECB announcement days and this relationship drives out the explanatory power of beta. When ECB monetary policy is accommodative on average in line with the Fed's monetary policy (Cieslak and Vissing-Jorgensen, 2020), announcement returns are positive on average on ECB announcement days and returns follow a one-factor structure.

Results show that the positive average returns and the one-factor structure of returns on ECB announcement days post-2012 is there too in the covered and government market. These two bond markets have each experienced stress during the sample period and subsequent targeted policy action by the ECB.

Finally, different to the stock market (Brusa et al., 2020), the documented results are economically more significant on ECB announcement days than on Fed announcement days. Post-2012, average DEF returns on ECB announcement days are, as reported above, 3.55 bps (t-stat 3.83) compared to 1.16 bps (t-stat 1.38) on Fed announcement days.

2 Announcement days

The informativeness of scheduled central bank announcements should depend on the frequency of these announcements. Figure 1 plots the number of days since the previous ECB announcement against regularly scheduled ECB announcement days. As visible in the Figure, the ECB held biweekly scheduled announcements after its inauguration, arguably limiting the incremental informativeness of each announcement compared to the six-week cycle it switched to in 2015.

(Insert Figure 1 about here)

Table 1 shows the exact dates of announcements classified as ECB policy announcement days. These announcements include all unconventional monetary policy announcements in Krishnamurthy et al. (2018) and include the announcements of the CBPP3, PSPP, the CSPP as well as the main policy intervention in 2020 in response to the Covid Pandemic. The website of the ECB is taken as a reference for these dates, the link of each policy announcement to the ECB's website is in Table 1.

(Insert Table 1 about here)

As Table 1 shows, the concentration of large scale unconventional monetary policy is higher towards the second half of the sample. The Fed, for example, has implemented large scale asset purchases in response to the Lehman collapse (Krishnamurthy and Vissing-Jorgensen, 2011), while the ECB chose a more muted policy response.

"ECB announcement days" include all ECB policy announcement days as well as the scheduled ECB announcement days and intermeeting interest rate changes. Figure 2 plots the surprise component of interest rate changes (actual rate change minus expected rate change) on ECB announcement days over time. As a reference, it also plots the same series but for the Fed. ECB interest rate surprises are taken from the database provided in Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa (2019) and Fed rate surprises are from the Website of Kenneth N. Kuttner.

(Insert Figure 2 about here)

Figure 3 shows the amount of liquidity provided by the Eurosystem through its various programs over time.

(Insert Figure 3 about here)

3 Data and variables

Bond-level data on non-callable, fixed coupon bonds are from Refinitiv and mid prices from Bloomberg (price source BGN). The main focus in this paper is on corporate bonds. While bonds issued by banks are included in most corporate bond indices which would support including bank bonds into the analysis, bank bonds are different from non-bank bonds in various aspects and are therefore excluded from the sample. Compared to non-bank corporate bonds, bank bond returns might be substantially more cyclical, typically are not subject to the same bond indentures and have the distinction between senior unsecured and senior preferred due to bail-in regulations.

The study uses synthetic constant maturity bonds in the main specifications in order to cleanly place the focus on average returns and their cross-sectional variation that accrue due to risks specific to corporate bonds, i.e. returns other than term premia. To do so it estimates the Nelson-Siegel model at the issuer level to extract spot rates. The estimation follows the method outlined in Nelson and Siegel (1987). The data filters are set to accommodate the estimation of issuer-level spot rates. For each data filter, I present the percentage of initial number of observations dropped. I exclude bonds because they have no rating (average rating of Moody's, Fitch, DBRS ratings mapped to numerical scale) on any business day (28.71%), have price quotes on less than 85% of business days (5.5%) or their yield to maturity is below -2% or above 25% (0.31 %). I prune the bond-day panel to exclude 0.66% observations without a price, 2.66% without a credit rating. I drop 1.27% of observations because the Moody's rating differs from the median Moody's rating from the same issuer on a given day. Similarly, 0.17% of observations where the Fitch rating differs from the median. 13.15% of observations are dropped because an issuer has less than two bonds outstanding on a given day and 10.22% of observations because an issuer has either no bond with residual maturity below five years or no bonds with maturity above five years outstanding. Finally, I drop 3.45% of observations because their rating is below investment grade.

(Insert Table 3 about here)

Table 3 shows number of issuers and total amounts outstanding. The table displays averages and standard deviations of end-of-month series. The number of issuers is 55 with a monthly standard deviation of 16. In the first half of the sample period, the sample size grows as corporate bond issuers enter the market. In the second half of the sample, sample size shrinks as many issuers started to emit bonds with call features. As these bonds are emitted instead of non-callable bonds and only non-callable bonds enter the sample, issuers drop out towards the end of the sample.

3.1 Variable definitions and summary statistics

In what follows, for each issuer one zero coupon constant maturity bond with three, one with five and one with seven years to maturity is included, priced with the spot rates obtained from the Nelson-Siegel model.

3.1.1 Return calculations

Daily excess returns $rx_t^{(m)}$ are calculated from the spot rates data. Jones, Lamont, and Lumsdaine (1998), for example, calculate daily bond returns from constant maturity yields provided by the Fed. To derive the relationship between spot rates and bond returns, I use the same notation as in Cochrane and Piazzesi (2005) who use parentheses to distinguish maturity from exponentiation in the superscript. To keep the notation light, I drop the subscript i which would denote the respective issuer. All calculations are done at the issuer level.

$$p_t^{(m)} = \text{log price of } m\text{-day discount bond at time t} \tag{1}$$

The continuously compounded spot rate relates to the log price p_t^m through the equation

$$z_t^{(m)} = -\frac{1}{m} p_t^{(m)} \tag{2}$$

The log holding period return from buying a m period bond at time t and selling it as $m-1$ period bond at time $t+1$ is

$$r_{t+1}^{(m)} = p_{t+1}^{(m-1)} - p_t^{(m)}. \tag{3}$$

The holding period return equivalently can be written as

$$r_{t+1}^{(m)} = z_t^{(m)} - (m-1)(z_{t+1}^{(m-1)} - z_t^{(m)}), \tag{4}$$

where the first term on the right hand side represents the carry component and the second term the capital gain due to changing market conditions.

$$rx_t^{(m)} = r_t^{(m)} - rf_t^{(m)}, \tag{5}$$

where $rf_t^{(m)}$ denotes risk-free returns which are calculated using spot rates z^{rf} from German government bonds. The definition of excess log returns differs from the one in Cochrane and Piazzesi (2005) who take a short-rate to calculate excess returns and focus on risk premia in the term structure of interest rates. Fama and French (1993) and Gebhardt, Hvidkjaer, and Swaminathan (2005) study US corporate bond returns in excess of the one-month US Treasury Bill return. By defining returns in excess of the maturity-matched German Government bond, the focus is put on the return that accrues due to the compensation on a bond for the possibility of it defaulting. One can view this bond return as a duration hedged return where the hedge is done with the German government bond curve.

3.1.2 Risk factors

Fama and French (1993) and Gebhardt et al. (2005) use a default risk "DEF" and a term factor "TERM" to summarize the cross-section of US corporate bond excess returns. In the existing literature, DEF is calculated as the difference in returns of a long-term corporate bond index and a long-term government bond index (Fama and French (1993) and Gebhardt et al. (2005)). In this study, the DEF factor is the value-weighted excess return across all bonds in the sample, with excess returns defined above (bond return less a maturity-matched return on a German government bond).

(Insert Figure 4 about here)

Panel A in Figure 4 plots the cumulative two-day returns on the DEF factor for corporate bonds on ECB announcement days. The line plot represents two-day excess returns on ECB announcement days and the scatter plot shows ECB policy announcement days as selected above. The most extreme negative return on the DEF factor is on October 8 and October 9, 2008. Both the Fed and the ECB announced interest rate cuts on October 8 (the ECB also switched to its full allotment policy), with the ECB's surprise rate change amounting to -20 bps and the Fed's to -14 bps. Nonetheless, corporate bond returns suffered on the day of the policy announcements as well as the day after. The next two most negative returns are on March 12, 2020 and on May 7 2010. On March 12, 2020 the ECB announced the outcome of a scheduled meeting on that day. A substantial package of measures was announced only a bit later only, during an unscheduled announcement on March 18, 2020. The ECB announced the outcome of a scheduled meeting on May 6, 2010. Again, only days later the Securities Markets Program was announced on May 10, 2010, respectively perceived with increasing equity markets and declining bond yields (Krishnamurthy et al., 2018). The pattern of very negative returns followed by the announcement of a package of policies boosting returns is clearly visible in Figure 4. The DEF factor experienced the most positive return on June 5, 2020, May 10, 2010 and on March 11, 2016. These dates correspond to the announcement of the increase in purchase volume in the Pandemic Emergency Purchase Program (PEPP), the announcement of the Securities Markets Program (SMP) and the announcement of the Corporate Bonds Purchase Program (CSPP).

In comparison, the two highest returns on the CAPM factor (Panel B in Figure 4) accrue around Fed announcement days (March 24, 2020 and October 29, 2010). The CAPM factor is the return on the Eurostoxx 600 less the return on the OIS contract with one month maturity. Similarly, the two highest returns on the TERM factor (Panel C in Figure 4) accrue around Fed announcement days (August 10, 2011, December 17, 2008). The TERM factor is the return on the five year German government bond less the return on the OIS contract with one month maturity.

(Insert Figure 5 about here)

Figure 5 plots the cumulative two-day returns on the DEF factor against the returns on the TERM factor on ECB policy announcement days. What stands out is that the days with high returns on the DEF factor are accompanied with near zero returns on the TERM factor and vice versa. Savor and Wilson (2014) show that CAPM beta explains stock returns and US Treasuries returns on Fed announcement days. Figure 5 hints that the factors driving the returns on bonds with default risk and the returns on German government bonds are different.

3.1.3 Beta estimation

Fama and French (1993) and Gebhardt et al. (2005) estimate the following regression to obtain factor betas.

$$r_{i,t} - rf_t = \alpha_i + \beta_i^D DEF_t + \beta_i^T TERM_t + \epsilon_{i,t}. \tag{6}$$

The return of bond i at day t is $r_{i,t}$ and rf_t is the return on the risk-free short rate. In a two-factor model, when estimating the DEF beta (β^D) and the TERM beta (β^T) jointly, the TERM beta can vary considerably between bonds although they have the same maturity and joint estimation could lead to collinearity affecting the point estimate of β_i^D (the quantity of interest). Instead, I use excess bond returns calculated as $rx_{i,t} = r_{i,t}^{(m)} - rf_t^{(m)}$, where $rf_t^{(m)}$ is the return on the German government bond with maturity m. The DEF beta (β_i^D) of bond i is estimated with an OLS regression of excess returns on the DEF factor only, as the TERM part is removed in the calculation of excess returns.

$$rx_{i,t} = \alpha_i + \beta_i^D DEF_t + \epsilon_{i,t}. \tag{7}$$

Following much of the literature (e.g. Gebhardt et al. (2005)), I use monthly data for the beta estimation with 18-month rolling windows.

3.1.4 Value at Risk estimation

I use the Value at Risk measure (VaR) of past bond returns of Bai et al. (2019) who show that it explains well the cross-section of future monthly US corporate bond returns. The VaR in Bai et al. (2019) is the second lowest return in the preceding months inside the rolling window. I also use the second-lowest return with 18-month rolling windows, multiplied by minus one so that a higher VaR indicates higher risk.

3.1.5 Summary statistics

Table 2 presents summary statistics of the bond-level daily return series. Panel B shows daily risk factors and Panel C shows monthly risk factors. The variable "Rating" is 1 for AAA ratings, 2 for AA ratings, 3 for A ratings and 4 for BBB ratings.

(Insert Table 2 about here)

4 Main analysis

Figure 6 plots average excess returns against average DEF betas on ECB announcement days post- and pre-2012. On each date each bond is sorted into beta deciles. Excess returns and DEF betas are then averaged by date and by beta decile. The Figure shows that average excess returns were positive on average on ECB announcement days post-2012 and that the cross-section of excess returns is well explained by the DEF beta. Pre-2012 excess returns are negative, the DEF beta appears to remain the key explanatory factor of the cross-section of returns.

One interpretation for the post-2012 data is that bonds that suffered in the months previous to an ECB announcement are estimated to have a high DEF beta. As the ECB stepped in by responding to market turmoil with accommodative monetary policies, bonds that suffered previously reversed and gained more than others. Central bank announcements thus especially boost the returns of high beta assets. Evidence that the DEF beta proxies for past losses is provided below.

(Insert Figure 6 about here)

$$rx_i = \lambda_0 + \lambda_1 \hat{\beta}_i^D + u_i, \tag{8}$$

I perform cross-sectional regressions of average excess returns on the estimated beta. In the regression equation above, the subscript t was omitted. Standard errors for λ_1 are calculated using the Fama-MacBeth procedure. In the text, I refer to λ_0 as intercept estimates and λ_1 as slope estimates.

(Insert Table 4 about here)

Table 4 shows that average DEF returns are significantly positive on ECB policy announcement days. The one-factor structure of bond returns is strong as evident in cross-sectional λ_1 estimates matching closely the average DEF return (Lewellen, Nagel, and Shanken, 2010). If the analysis in Table 4 was redone with another factor, say the CAPM market factor of stock returns, the λ_1 estimates would remain positive and significant. The λ_1 estimates would not match the average factor returns any more, however. Table 4 also shows, confirming the patterns in Figure 6, that post-2012 the λ_1 are significantly positive and pre-2012 λ_1 estimates are significantly negative. In both periods, λ_1 estimates match average returns on the DEF factor.

4.1 Determinants

Monetary policy may be a response to stress in particular market segments. A high DEF beta would then capture bonds that have particularly suffered in the near past before an announcement. To test this explanation, I use the Value at Risk measure (VaR) of past bond returns of Bai et al. (2019) who show that it explains well the cross-section of future monthly US corporate bond returns. The VaR is the second-lowest return in the months preceding each announcement, defined above, multiplied by minus one so that a higher VaR indicates higher risk. Table 5 shows the results of regressions of excess returns on VaR, on DEF beta and on VaR and on the DEF beta, while controlling for other bond characteristics. The results show that first, while DEF beta explains the cross-section of excess returns, the VaR explains returns at least equally well. On ECB announcements post-2012 the R-squared estimates are 0.29 in the VaR and 0.29 in the DEF beta regression. On ECB policy announcement days the R-squared estimates are 0.35 and 0.38, respectively. When including both variables in the regression, VaR remains significant while DEF beta becomes insignificant. Similarly, on ECB policy announcement days.

(Insert Table 5 about here)

4.2 Other bond types

Covered and government bonds generally are safer than corporate bonds and term risk may be a more important contributor to bond returns than default risk. As Table 6 shows, however, DEF beta is a key explanatory variable of covered and government bond returns on ECB announcement days post-2012 as well. The DEF factor was recalculated for each of the bond types.

(Insert Table 6 about here)

4.3 Fed policy announcement days

Brusa et al. (2020) show that global stocks react on average positively to Fed announcements. Table 7 analyzes two-day bond returns around Fed FOMC announcements. The two-day window is chosen according to European market opening hours, i.e. refers to [-1,0] in FOMC announcement time, thus capturing any potential pre-announcement drift in the bond market as documented by Lucca and Moench (2015) in the stock market. The results in Table 7 and Table 5 suggest that for bond returns ECB announcement days are economically more important than Fed announcement days. Post-2012, on Fed announcement-days the λ_1 estimate is 1.16, compared to 3.49 bps on ECB announcement days. The t-stats are 1.38 and 3.46, respectively.

(Insert Table 7 about here)

5 Conclusion

As the Fed put explains stock market reactions on Fed announcement days (Cieslak and Vissing-Jorgensen, 2020), an ECB put explains the return patterns in euro denominated bonds on ECB announcement days. First, this study documents that specific ECB monetary policy announcements boosted corporate bond returns but also scheduled ECB announcements boosted bond returns on average. Second, the cross-section of bond returns followed a strong one-factor structure and is explained by one beta with respect to the DEF factor—the value-weighted average excess return of all bonds. Third, the determinant of this relationship appears to be the Value at Risk (VaR) measure of (Bai et al., 2019). Bonds that have lost the most during the months preceding an ECB announcement also gain the most on ECB announcement days.

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A Figures and tables

Figure 1: Days since previous ECB announcement over time. The data on ECB announcement days are from Altavilla et al. (2019).

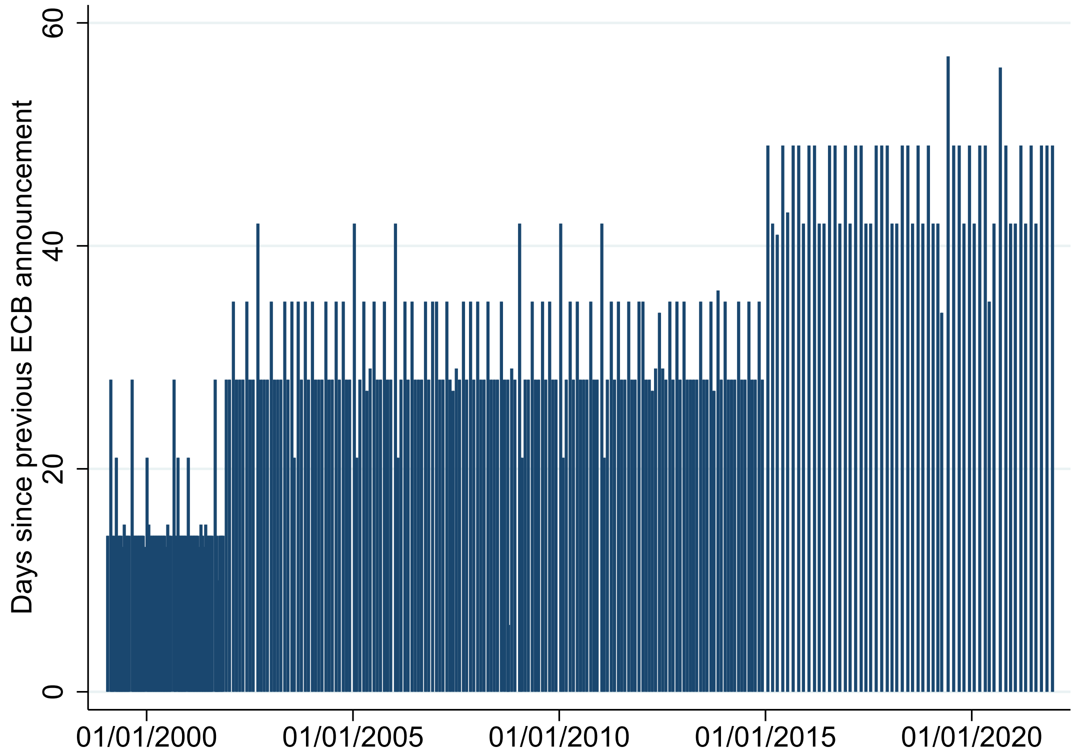


Figure 2: ECB and Fed interest rate surprise series over time. Interest rate surprises are calculated as the actual interest rate change minus the expected rate change. ECB interest rate surprises are taken from the database provided in Altavilla et al. (2019) and Fed rate surprises are from the Website of Kenneth N. Kuttner.

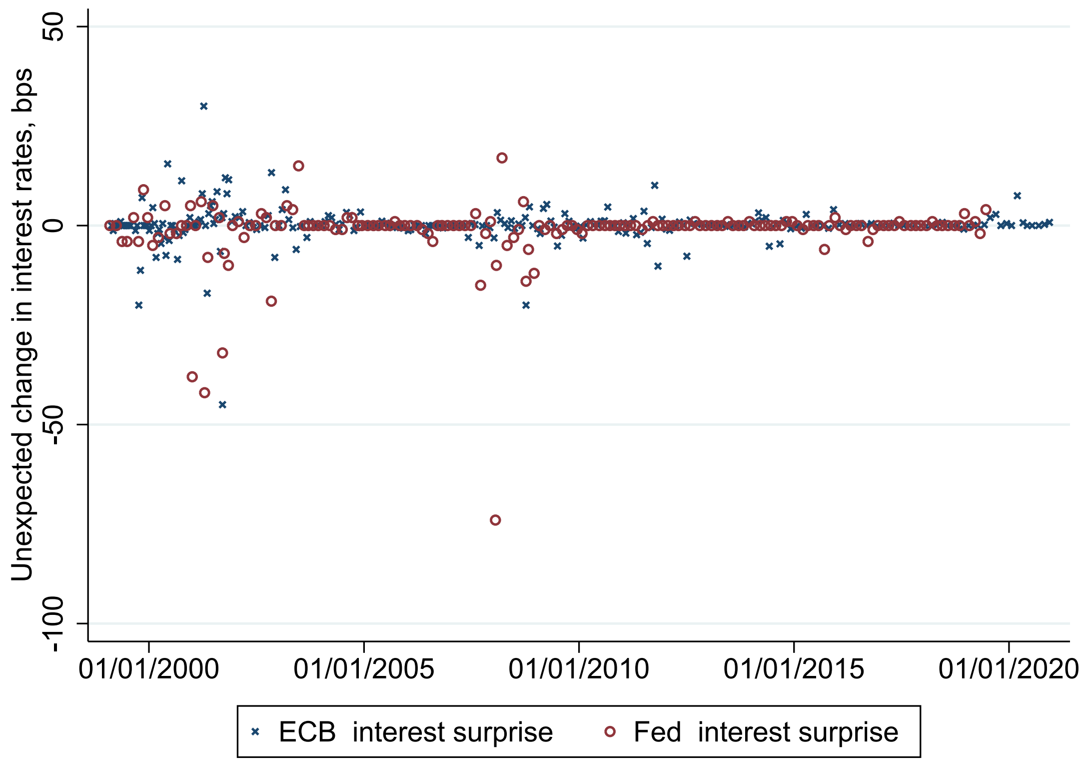


Figure 3: ECB liquidity provided through various programs over time. The data are from the website of the ECB. Displayed are various policies that each have increased the liquidity that the ECB provides to the financial system.

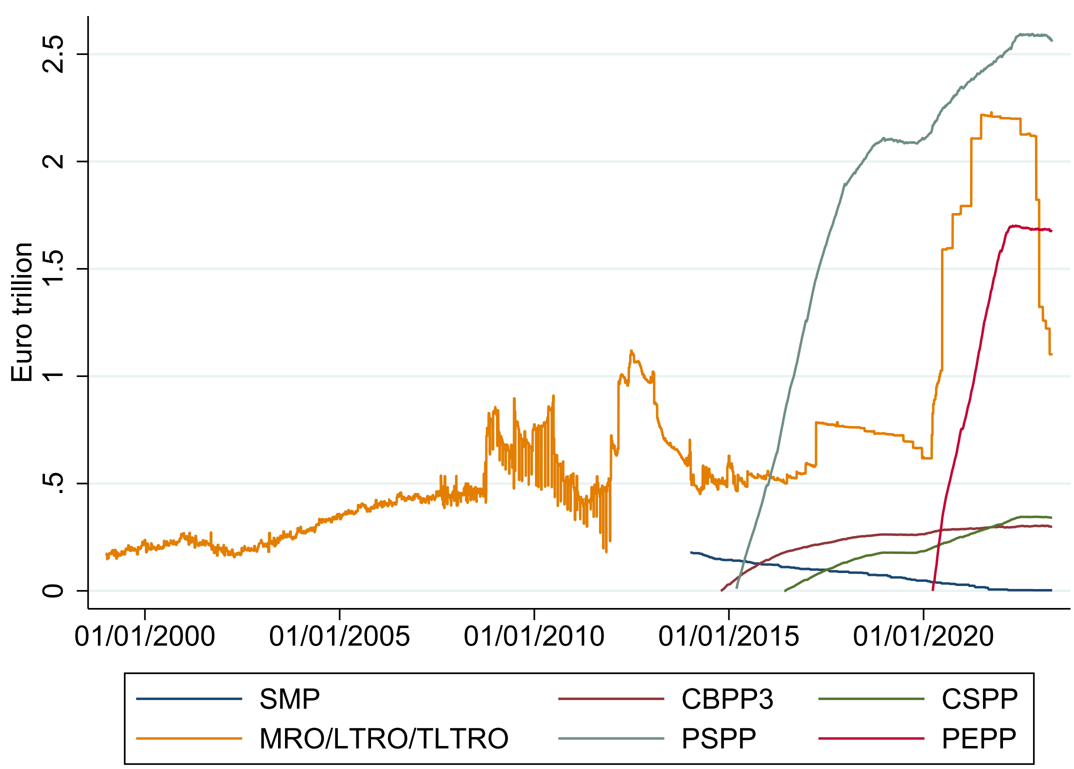


Figure 4: Factor returns on ECB announcement days. The Figure plots two-day cumulative returns on various risk factors over the [0,1] window around scheduled and unscheduled ECB monetary policy announcements. ECB policy announcements are defined in Table 1 and mark major ECB policy announcements. ECB announcement days include regularly scheduled monetary policy announcements as well as the ECB policy announcements. The DEF factor is the value-weighted daily excess return across all corporate bonds in the sample. Each bond is a synthetic constant maturity bond, obtained by estimating zero rates with the Nelson-Siegel model. For each issuer one bond with three, one with five and one with seven years to maturity is included. The excess return of bond i at time t is the holding period return less the maturity-matched return on a German government bond. The TERM factor is the daily return on the five year German government bond less the daily return on the OIS contract with one month maturity. The CAPM factor is the daily return on the Eurostoxx 600 less the daily return on the OIS contract with one month maturity.

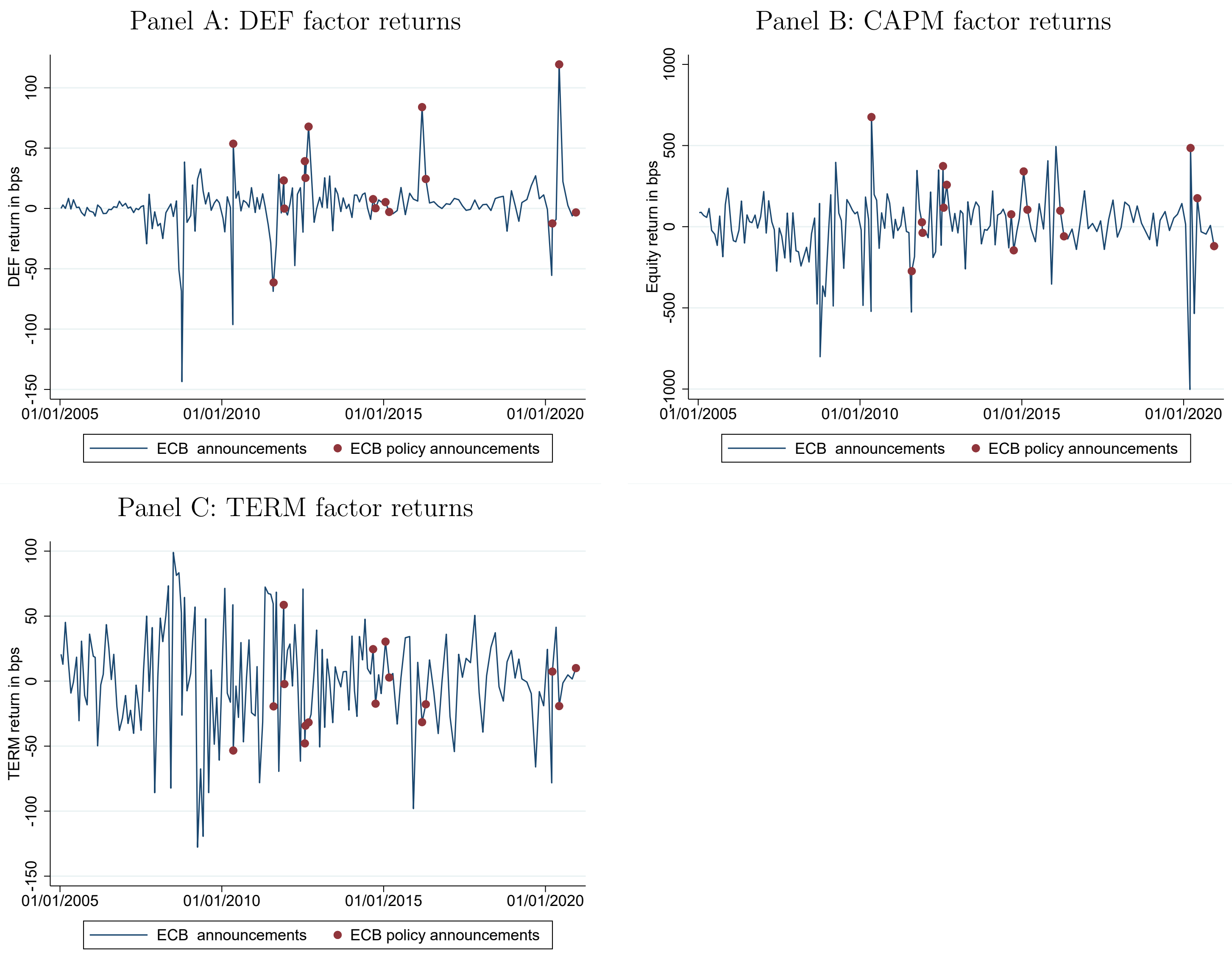
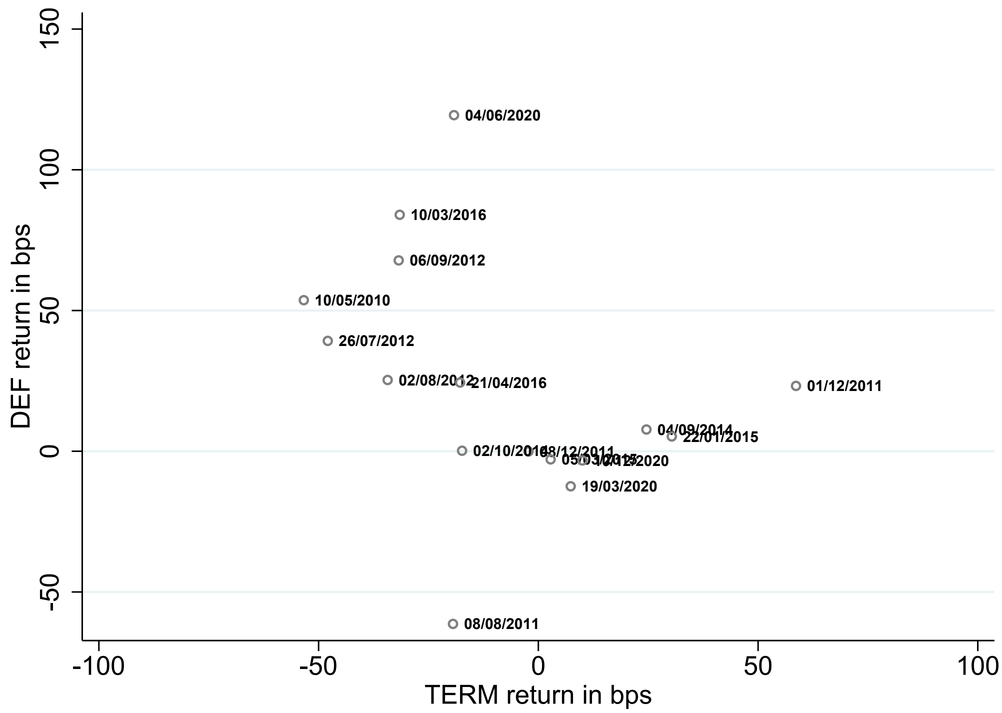


Figure 5: Returns on DEF and TERM on ECB policy announcement days. The Figure plots in Panel A two-day cumulative DEF returns against TERM returns over the [0,1] window on ECB policy announcement days. In Panel B, the Figure plots CAPM returns against TERM returns. ECB policy announcements are defined in Table 1 and mark major ECB policy announcements. The DEF factor is the value-weighted daily excess return across all corporate bonds in the sample. Each bond is a synthetic constant maturity bond, obtained by estimating zero rates with the Nelson-Siegel model. For each issuer one bond with three, one with five and one with seven years to maturity is included. The excess return of bond i at time t is the holding period return less the maturity-matched return on a German government bond. The TERM factor is the daily return on the five year German government bond less the daily return on the OIS contract with one month maturity. The CAPM factor is the daily return on the Eurostoxx 600 less the daily return on the OIS contract with one month maturity.

Panel A: DEF returns against TERM returns over the [0,1] window on ECB policy announcement days.



Panel B: CAPM returns against TERM returns over the [0,1] window on ECB policy announcement days.

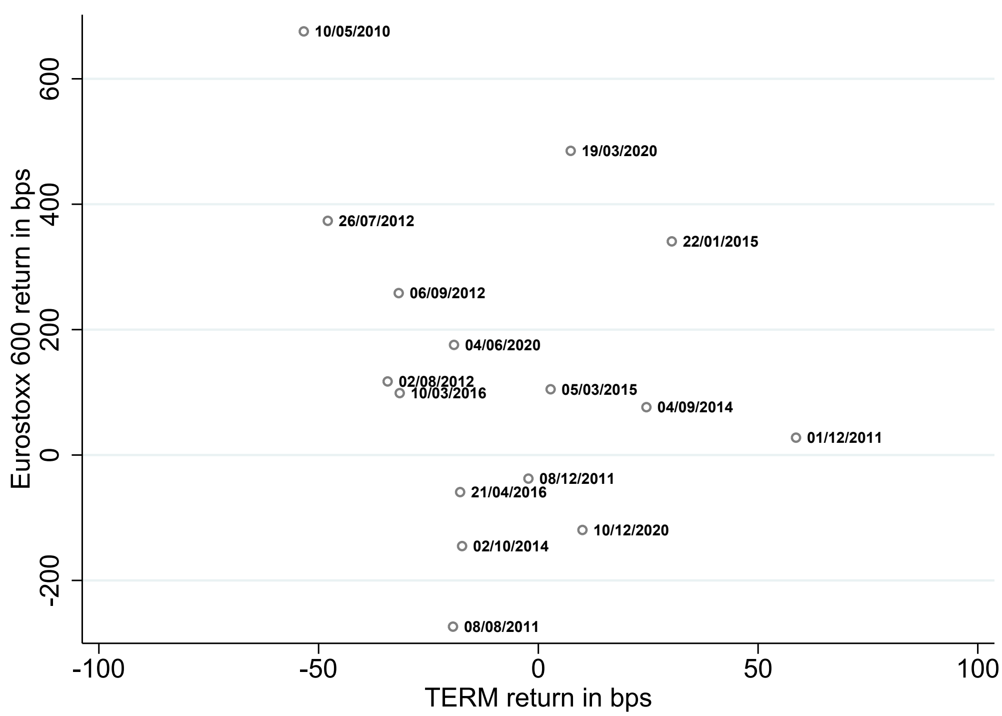


Figure 6: Average excess corporate returns and DEF beta on ECB announcement days. This Figure plots average excess returns against average DEF betas on ECB announcement days post- and pre-2012. On each date, each bond is sorted into beta deciles. Excess returns and DEF betas are then averaged by date and by beta decile.

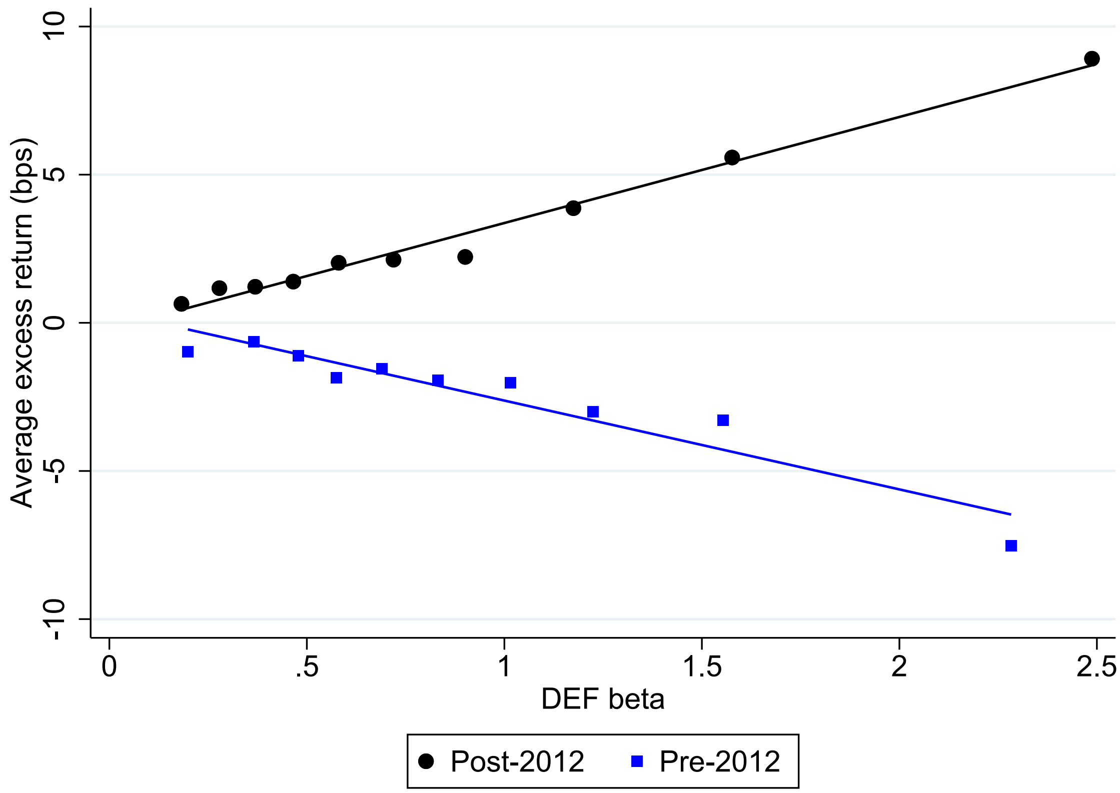


Figure 7: Factor returns on Fed announcement days. The Figure plots two-day cumulative returns on various risk factors over the [0,1] window around scheduled and unscheduled Fed monetary policy announcements. The [0,1] window is over European trading hours, i.e. the 0-day includes the trading day that lies entirely before the Fed announcement and the 1-day is entirely after the Fed's announcement. Fed announcement day data are taken from the website of Kenneth N. Kuttner. The DEF factor is the value-weighted daily excess return across all corporate bonds in the sample. Each bond is a synthetic constant maturity bond, obtained by estimating zero rates with the Nelson-Siegel model. For each issuer one bond with three, one with five and one with seven years to maturity is included. The excess return of bond i at time t is the holding period return less the maturity-matched return on a German government bond. The TERM factor is the daily return on the five year German government bond less the daily return on the OIS contract with one month maturity. The CAPM factor is the daily return on the Eurostoxx 600 less the daily return on the OIS contract with one month maturity.

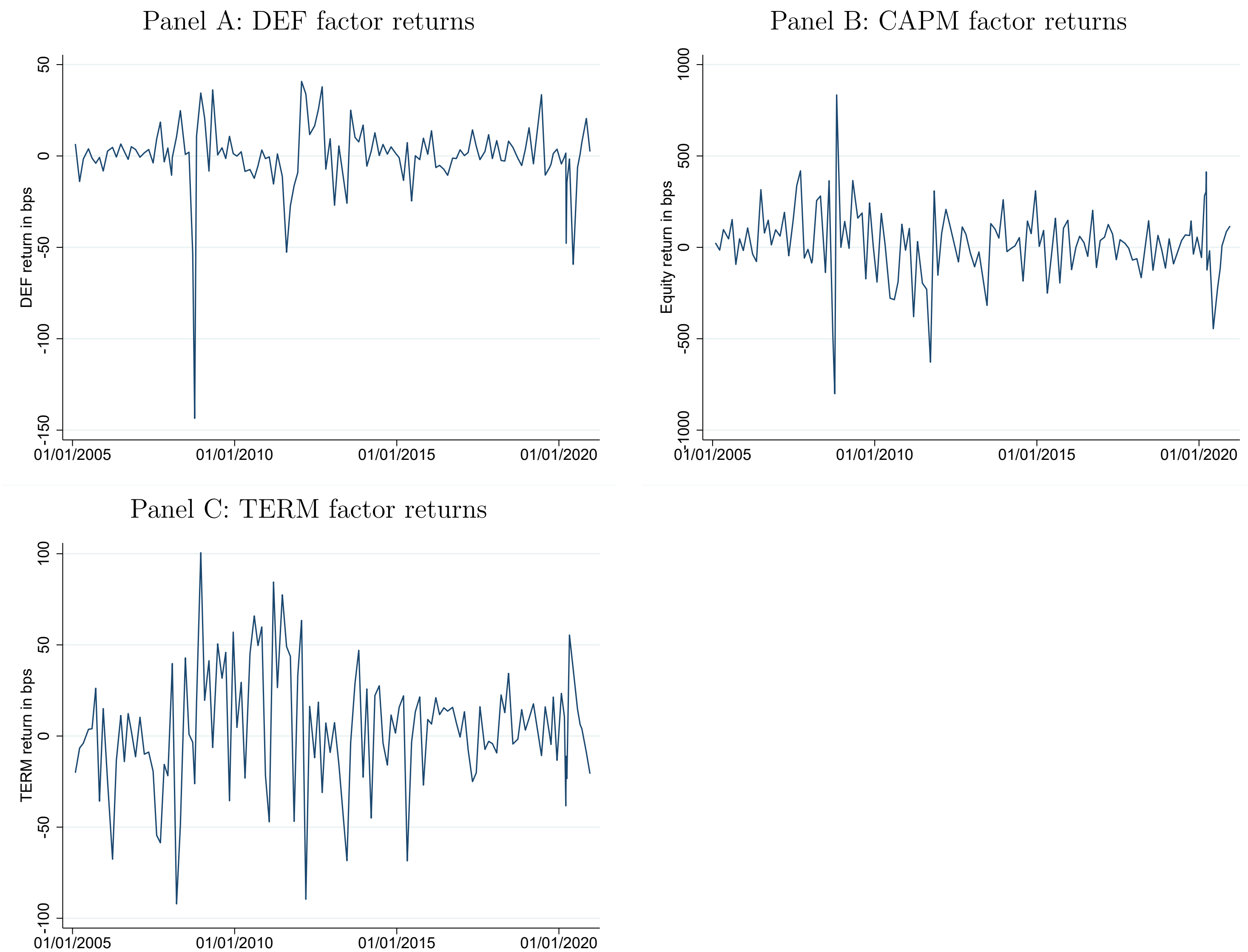


Table 1: ECB policy announcement days. ECB policy announcement days include all event days in Krishnamurthy et al. (2018) as well as all large-scale purchase program announcements listed on the website of the ECB.

May 10, 2010	Unscheduled, SMP, Krishnamurthy et al. (2018)
August 7, 2011	Unscheduled (Sunday), SMP, Krishnamurthy et al. (2018)
December 1, 2011	Unscheduled, LTROs, Krishnamurthy et al. (2018)
December 8, 2011	Scheduled, LTROs, Krishnamurthy et al. (2018)
July 26, 2012	Unscheduled, OMT, Krishnamurthy et al. (2018)
August 2, 2012	Scheduled, OMT, Krishnamurthy et al. (2018)
September 6, 2012	Scheduled, OMT, Krishnamurthy et al. (2018)
September 4, 2014	Scheduled, CBPP3 (link)
October 2, 2014	Scheduled, CBPP3 (link)
January 22, 2015	Scheduled, PSPP (link)
March 5, 2015	Scheduled, PSPP (link)
March 10, 2016	Scheduled, CSPP (link)
April 21, 2016	Scheduled, CSPP (link)
Mar 18, 2020	Unscheduled announced after market close, PEPP (link)
June 4, 2020	Scheduled, PEPP (link)
Dec 10, 2020	Scheduled, PEPP (link)

Table 2: Summary statistics. The excess return of bond i at time t is the holding period return less the maturity-matched return on a German government bond. Each bond is a synthetic constant maturity bond, obtained by estimating zero rates with the Nelson-Siegel model. For each issuer one bond with three, one with five and one with seven years to maturity is included. The DEF beta is the slope coefficient in the OLS regression of excess returns on the DEF factor. Value at Risk measure (VaR) of past bond returns of Bai et al. (2019) is calculated as the second-lowest bond return in the 18-month window preceding an announcement, multiplied by minus one. The variable "Rating" is 1 for AAA ratings, 2 for AA ratings, 3 for A ratings and 4 for BBB ratings. The DEF factor is the value-weighted daily excess return across all corporate bonds in the sample. The TERM factor is the daily return on the five year German government bond less the daily return on the OIS contract with one month maturity. The CAPM factor is the daily return on the Eurostoxx 600 less the daily return on the OIS contract with one month maturity.

Bond-level daily return series

	N	Mean	SD	min	P25	P50	P75	max
Excess return (bps)	36,591	1.11	22.80	-732.37	-1.68	0.90	4.32	482.71
DEF beta	36,591	0.89	0.70	-0.20	0.39	0.68	1.19	6.35
VaR (bps)	36,591	79.66	103.12	-67.04	17.53	45.21	98.90	890.67
Rating (categorical)	36,591	3.33	0.64	2.00	3.00	3.00	4.00	4.00
Maturity (bps)	36,591	5.00	1.63	3.00	3.00	5.00	7.00	7.00
Zero rate (bps)	36,591	201.09	169.38	-52.90	64.03	151.83	318.41	1141.14

Risk factors, daily series

	N	Mean	SD	min	P25	P50	P75	max
DEF (bps)	596	0.59	11.55	-72.38	-2.10	0.94	4.04	72.60
TERM (bps)	596	1.43	25.56	-94.66	-11.56	1.76	16.56	100.26
CAPM (bps)	596	4.82	143.39	-1146.33	-51.29	13.07	72.96	842.01

Risk factors, monthly series

	N	Mean	SD	min	P25	P50	P75	max
DEF (bps)	191	9.99	101.12	-583.32	-15.18	17.05	53.24	267.74
TERM (bps)	191	19.26	90.20	-186.60	-43.62	25.62	72.02	274.59
CAPM (bps)	191	55.35	453.41	-1873.37	-116.68	106.70	312.61	1458.86

Table 3: Issuer distribution across bond types. Means and standard deviations are presented for end-of-month data on the number of issuers ("Nr issuers") and on total amounts outstanding ("Amounts outstanding") in the corporate bond market. Results are rounded to integer values.

	mean/sd
Nr Issuers	55
	16
Amounts outstanding (bn EUR)	220,646
	78,530

Table 4: Average excess returns and the one-factor structure of ECB announcement returns. This table reports estimates of regressions of daily excess returns on the DEF beta on specific days. "ECB policy a-days" are all announcements listed in Table 1. "All ECB a-days" are ECB announcement days including scheduled and intermeeting policy announcements. "All ECB a-days, post-2012" are ECB announcement days starting from January 1, 2012. For each announcement, the day zero and day one return is included. The excess return of bond i at time t is the holding period return less the maturity-matched return on a German government bond. Each bond is a synthetic constant maturity bond, obtained by estimating zero rates with the Nelson-Siegel model. The DEF factor is the value-weighted excess return across all bonds. Point estimates and standard errors are obtained using the Fama-MacBeth methodology. The sample runs between January 1, 2005 and December 31, 2020.

	Intercept	DEF beta	Avg. R2	N obs	Avg. DEF
ECB policy a-days	-2.19	13.68***	0.28	32.00	11.57***
	(-1.39)	(3.12)			(2.72)
All ECB a-days	-0.03	0.73	0.20	310.00	0.82
	(-0.08)	(0.83)			(1.03)
All ECB a-days, post-2012	-0.10	3.49***	0.24	172.00	3.55***
	(-0.26)	(3.46)			(3.93)
All ECB a-days, pre-2012	0.05	-2.72*	0.15	138.00	-2.59*
	(0.07)	(-1.86)			(-1.95)

Table 5: The one-factor structure of ECB announcement returns and downside risk. This table reports estimates of regressions of daily excess returns on the DEF beta, on the VaR measure or on both, on specific days. VaR is downside risk as calculated in (Bai et al., 2019), i.e. the second lowest return during the estimation window (18-month preceding an announcement), multiplied by minus one. "ECB policy a-days" are all announcements listed in Table 1. "All ECB a-days" are ECB announcement days including scheduled and intermeeting policy announcements. For each announcement, the day zero and day one return is included. The excess return of bond i at time t is the holding period return less the maturity-matched return on a German government bond. Each bond is a synthetic constant maturity bond, obtained by estimating zero rates with the Nelson-Siegel model. The DEF factor is the value-weighted excess return across all bonds. Point estimates and standard errors are obtained using the Fama-MacBeth methodology. The sample runs between January 1, 2005 and December 31, 2020.

	Intercept	DEF beta	VaR	Maturity	Rating	Avg. R2
All ECB a-days, post-2012	-1.39**	3.20***		0.03	0.42***	0.29
	(-2.57)	(3.09)		(0.27)	(2.99)	
All ECB a-days, post-2012	-0.92		0.03***	-0.01	0.45***	0.29
	(-1.52)		(3.31)	(-0.06)	(2.97)	
All ECB a-days, post-2012	-0.53	-0.24	0.03***	-0.07	0.37***	0.34
	(-0.94)	(-0.25)	(2.99)	(-0.49)	(2.66)	
ECB policy a-days	0.56	13.89***		-0.33	-0.44	0.35
	(0.26)	(3.22)		(-0.60)	(-0.62)	
ECB policy a-days	2.84		0.16***	-0.60	-0.21	0.38
	(0.94)		(2.80)	(-0.98)	(-0.23)	
ECB policy a-days	1.81	0.01	0.14***	-0.64	0.23	0.43
	(0.83)	(0.00)	(2.64)	(-1.29)	(0.40)	
All ECB a-days, pre-2012	2.01	-2.41		-0.04	-0.65	0.21
	(0.75)	(-1.18)		(-0.08)	(-1.08)	
All ECB a-days, pre-2012	3.43*		-0.01	-0.35	-0.97*	0.22
	(1.67)		(-0.68)	(-1.03)	(-1.65)	
All ECB a-days, pre-2012	2.13	-2.06	0.00	-0.13	-0.68	0.28
	(0.89)	(-0.87)	(0.19)	(-0.31)	(-1.14)	

Table 6: The one-factor structure of ECB announcement returns and different bond types. This table reports estimates of regressions of daily excess returns on the DEF beta on specific days. "All ECB a-days, post-2012" are ECB announcement days starting from January 1, 2012 and included scheduled and intermeeting policy announcements. For each announcement, the day zero and day one return is included. The excess return of bond i at time t is the holding period return less the maturity-matched return on a German government bond. Each bond is a synthetic constant maturity bond, obtained by estimating zero rates with the Nelson-Siegel model. The DEF factor is the value-weighted excess return across all bonds. Point estimates and standard errors are obtained using the Fama-MacBeth methodology. The sample runs between January 1, 2005 and December 31, 2020.

	Intercept	DEF beta	Avg. R2	N obs	Avg. DEF
Covered bonds	-0.34	1.57**	0.26	172.00	1.15**
	(-0.76)	(2.29)			(1.99)
Government bonds	0.62	4.74***	0.47	172.00	5.75***
	(1.13)	(3.02)			(3.05)

Table 7: Robustness check: Fed announcements. This table reports estimates of regressions of daily excess returns on the DEF beta on specific dates. "All Fed a-days" are Fed announcement days including scheduled and intermeeting policy announcements as listed in the database on the website of Kenneth Kuttner. For each announcement, the day zero and day one return is included. The event window is over European trading hours, i.e. the 0-day includes the trading day that lies entirely before the Fed announcement and the 1-day is entirely after the Fed's announcement. The excess return of bond i at time t is the holding period return less the maturity-matched return on a German government bond. Each bond is a synthetic constant maturity bond, obtained by estimating zero rates with the Nelson-Siegel model. The DEF factor is the value-weighted excess return across all bonds. Point estimates and standard errors are obtained using the Fama-MacBeth methodology. The sample runs between January 1, 2005 and December 31, 2020.

	Intercept	DEF beta	Avg. R2	N obs	Avg. RM
Fed a-days	0.18	-0.20	0.17	240.00	-0.17
	(0.54)	(-0.24)			(-0.24)
Fed a-days, post-2012	-0.08	1.16	0.21	149.00	0.94
	(-0.25)	(1.38)			(1.28)
Fed a-days, pre-2012	0.61	-2.43	0.12	91.00	-2.00
	(0.81)	(-1.44)			(-1.36)