EUROPEAN CENTRAL BANK

EUROSYSTEM

# Working Paper Series

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## Euro area equity risk premia and monetary policy: a longer-term perspective

No 2535 / April 2021

## Abstract

*This study analyses the effects of euro area monetary policy on equity risk premia (ERP). We find that changes in equity prices during periods of accommodative monetary policy mainly reflected adjustments in the discount factor and economic activity – rather than fluctuations in investors' required risk compensation. Furthermore, the ERP appears to not have declined much since the introduction of unconventional monetary policy and stands higher than prior to the GFC. Use of identified monetary policy shocks points to insignificant effects of monetary policy on the ERP. Further breakdown of these shocks reveals that monetary policy has a significant upwards impact on the ERP if it is perceived as a negative information surprise, while the opposite prevails in the case of a genuine accommodative monetary policy surprise. Accumulating these effects over time suggests that the two might have largely offset each other since the introduction of unconventional monetary policy.*



***JEL Classification:*** *E22, E52, G12*

***Keywords:*** *monetary policy transmission; monetary policy shocks; equity risk premia*

***Non-technical summary***

Leaving aside recent COVID-19 related gyrations in equity markets, this study analyses the effects of euro area monetary policy on equity risk premia (ERP) over the last decade but prior to the global spreading of Covid-19.

We note that the euro area ERP has, according to an estimate based on a Dividend Discount Model (DDM), since 2014 fluctuated at a level of slightly above 8%, i.e. around 3-4 percentage points higher compared to pre-crisis years. Furthermore, also changes in equity prices during select individual periods of accommodative monetary policy mainly reflected adjustments in the discount factor and economic activity, rather than fluctuations in investors' required risk compensation. Especially in light of non-negligible price gains during these periods, these observations raise the question how monetary policy affects ERP.

In general, econometric analysis using identified accommodative and contractionary monetary policy shocks points to an insignificant effect of monetary policy on the ERP. However, further breakdown of these shocks reveals that monetary policy has a significant downward impact on the ERP if a policy event is predominantly perceived as a pure unexpected accommodative monetary policy surprise, while a negative information surprise has the opposite effect and thus leads to an increase in the ERP. Accumulating these effects over time suggests that the two might have largely offset each other since the introduction of unconventional monetary policy measures in 2014.

To ensure that results are not disproportionately dependent on the choice of the ERP approximation, we estimate the ERP using a number of alternative models. Although ERP estimates differ, regression results consistently suggest that identified pure accommodative monetary policy shocks entail a decline in the ERP, while negative information shocks are followed by an increase. Further, the impact of monetary policy shocks is higher for financials than for non-financials and roughly comparable across the German, French, Spanish and Italian stock markets.

# 1. Introduction

The drivers of equity price changes are of considerable interest to financial market participants, but also from a monetary policy point of view. As such, changes in equity prices might reflect fluctuations in discount rates, in earnings expectations, or in equity risk premia (ERP).

For monetary policy, the ERP and the effects of monetary policy thereon are of particular interest but cannot be directly observed. One of the reasons for importance of the ERP is that equity capital is among the main sources of funding for euro area non-financial corporations, making the cost of equity – which in turn is estimated by the sum of the ERP and the risk free rate – an important factor in the transmission of monetary policy. As a result, changes in the ERP may dampen or stimulate corporate investment. Equity price developments can, to some extent, also influence the financial wealth of households and therefore their consumption decisions.

While not the main focus of the following analysis, the ERP and cost of equity are also important from a financial stability perspective. The cost of equity relative to the cost of debt may influence decisions about corporate capital structure and leverage. Moreover, equity prices that are out of line with macroeconomic fundamentals, signalled e.g. through a very compressed ERP, might trigger disorderly equity market corrections with possible adverse spillovers to other asset classes and the real economy.

Against this backdrop, this study analyses the effects of euro area monetary policy on equity risk premia (ERP) over the last decade, but prior to the global spreading of Covid-19. We note that euro area equity prices have increased over the last years[1] (**Chart 1**), while monetary policy has been very accommodative, which has led some to argue that accommodative monetary policy may have unduly compressed risk premia in equity markets, see e.g. Hudepohl et al (2019).

# 2. Related literature

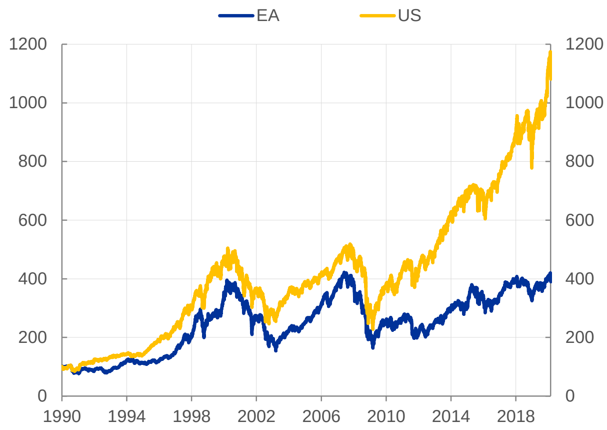
Our study relates to a rich body of research which focuses on the interaction between monetary policy and (excess) stock returns. Most of these studies can be classified into one of two strands. On the one hand, a significant share of

[1] Price increases in euro area equity markets have however been modest in comparison to the US.

research applies an event study approach around monetary policy events to find the contemporary response of stock prices to (unexpected) changes in policy rates. On the other hand, the literature applies VARs to study the dynamic interaction between monetary policy, often measured by money growth, central bank rates or short-term market rates, and stock prices. Using either of these approaches, Rigobon and Sack (2004), Ehrmann and Fratzscher (2004), Ioannidis and Kontonikas (2008), and Gospodinov and Jamali (2015), find that unexpected monetary policy loosening normally causes equity prices to increase.

**Chart 1: Euro area and US equity prices since 1990**

(1 January 1990 = 100)




Sources: Refinitiv, ECB.
Latest observation: 21 February 2020.

Determinants of the equity price response to monetary policy appear to be firm characteristics, with the impact of monetary policy differing on a sectoral level. In this respect, Haitsma, Unalmis and de Haan (2016) find that bank equity prices are more exposed to changes in the course of monetary policy than other sectors. In addition, Neri (2004) and Li, Iscan and Xu (2010) document that the effects of monetary policy on equity prices might differ across countries. Furthermore, Poshakwale and Chandorkar (2016) and Fausch and Sigonius (2018) show that the impact of monetary policy on equity prices might have changed with the global financial crisis (GFC), and Eksi and Tas (2017) find that crossing the zero-lower bound increased the reactions of stock markets to changes in monetary policy. Finally, also the fact of being in a bull or bear market might play a role for the impact of monetary policy according to Zare, Azali and Habibullah (2013).

Furthermore, our study relates to a growing literature that concerns itself also with one of the most central channel through which central banks affect financial asset prices and premia – central bank communication. Two recent examples include Andrade and Ferroni (2020) and Kerssenfischer (2019). The former highlights the role of signalling concerning macroeconomic conditions (Delphic shocks) and news on future monetary policy shocks (Odyssean shocks). While these two shocks are found to move the yield curve in the same direction, they are likely to have opposite effects on financial conditions and macroeconomic expectations. Also the latter study, using tick-by-tick futures prices, distinguishes between policy and information shocks and finds differential effects on a wide set of financial market prices and measures of economic expectations.

Also studies such as Tsai (2014), Jarocinski and Karadi (2020) and Altavilla, Brugnolini, Gürkaynak, Motto and Ragusa (2019) distinguish between the nature of monetary policy shocks, with analysis laid out in the latter two being followed in this paper. The underlying logic of all these studies is that changes in the stance of monetary policy are usually accompanied by revelation of new information concerning the economic and risk outlook. An (unexpected) accommodative monetary policy decision can for example lead to a decrease in equity prices (despite a decline in the discount factor which should *a priori* lead to an increase), if new information released by the central bank about the future economic outlook is sufficiently negative. In terms of methodology, Altavilla, Brugnolini, Gürkaynak, Motto and Ragusa (2019) use a sign restricted VAR to identify two distinct monetary policy shocks: A pure policy shock and an information shock. Their findings confirm that an accommodative (contractionary) policy shock is usually followed by positive (negative) stock market returns, whereas a negative (positive) information shock is followed by negative (positive) returns.

While the above mentioned studies offer insight into the relationship between monetary policy action, communication, and equity prices, they largely abstain from an analysis of the underlying channel through which monetary policy affects equity prices. In his seminal paper, Bernanke (2005) argues that most of the stock price variance in the immediate aftermath of monetary policy decisions is likely to stem from changes in the ERP. As for other studies, the conclusion that ERP may be the main driver of equity price changes in the wake of monetary policy decisions is reached on the basis of a backward looking measure of the ERP and does not distinguish between the nature of monetary policy shocks.

Ideally, any assessment of the effects of monetary policy on the ERP should be reached on the basis of a forward looking ERP estimate. The reason is that any backward looking measure cannot properly take into account changes in future growth expectations induced by changes in the monetary policy stance or communication – which will instead be captured by changes in the ERP. Furthermore, as we show, it is important to use identified monetary policy shocks which discriminate between information and policy shocks, as these may have counteracting effects. To the best of our knowledge, this study is the first attempt to this end.

## 3. Euro area equity prices, risk premia, and monetary policy

In principle, monetary policy can affect equity prices through three main channels. The first is via risk-free interest rates, where equity prices increase, ceteris paribus, if – following a monetary policy easing action – the interest rate used to discount future cash-flows declines.[2] The second channel is the impact of monetary policy on companies' actual and expected earnings growth, and therefore on the level of dividends and share buy-backs. A priori, the immediate effect of monetary policy on earnings expectations is unclear. While an easing (tightening) of monetary policy should eventually have a positive (negative) impact on the macro-economy and therefore on earnings and dividends, the underlying information provided by central banks for why such easing (tightening) occurs might equally lead market participants to revise their earnings expectations downwards (upwards). Finally, monetary policy might impact equity prices via the equity risk premium (ERP) – the expected and required excess return from investing in stocks over the risk-free rate – where the sign of the impact is also a priori unclear and eventually an empirical question.[3]

[2] For long rates to decrease after a policy rate cut or after forward guidance on keeping future rates low(er), it is necessary that term premia do not increase so much that they over-compensate the policy-induced decrease in average expected short-term rates. Empirically, this condition appears to be generally satisfied.

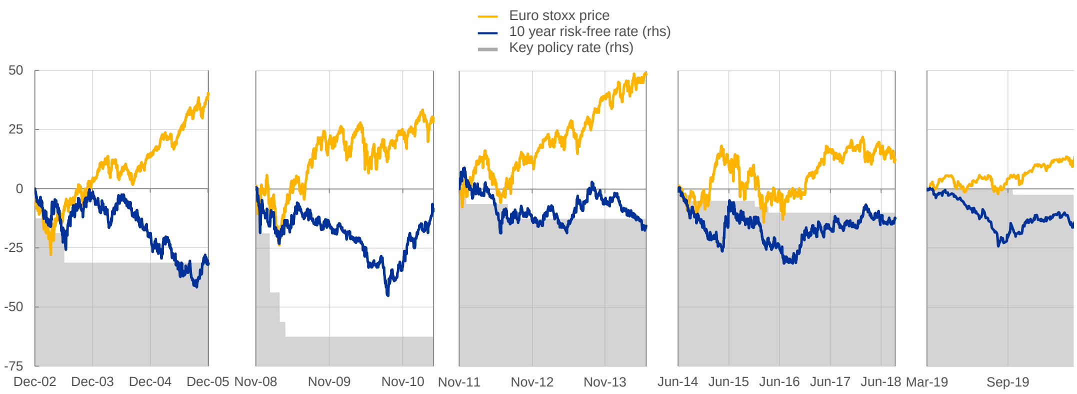
[3] See Bernanke and Kuttner (2005), Jarocinski and Karadi (2020).

### 3.1 Euro area equity prices in times of accommodative monetary policy

To gain some initial intuition, we dissect equity price changes during the major periods of monetary policy accommodation since the establishment of the euro. Concretely, we dissect five periods since the early 2000s during which ECB policy rates were lowered **(Chart 2 and Annex 2)**. Although these episodes were characterised by different economic conditions, and rate cuts were complemented by additional policy measures that were specific to each episode, longer-term risk free rates declined and equity prices rose in the wake of all of those periods. It thus appears likely that discount rates are one important mechanism through which monetary policy affects equity prices but more formal analysis is required to single out the potential role of macro-fundamentals and required risk compensation.

**Chart 2: Euro area equity prices, the policy rate, and the 10 year risk-free rate during episodes of monetary policy accommodation**

(lhs: percentage points; rhs: percentages per annum, cumulative change)




Sources: Refinitiv, ECB.

Latest observation: 21 February 2020. Notes: The risk free rate refers to the 10 year Bund in the first period and the 10 year euro area OIS rate in the later periods.

### 3.2 Estimating a forward looking ERP for the euro area

Since the ERP cannot be observed directly, it needs to be estimated on the basis of a model and by making a series of assumptions. Various approaches exist, ranging from the simple assumption that the ERP is the difference between the current equity yield and the yield on risk-free bonds, to regression-based approaches, and dividend discount models (DDMs).[4] Arguably, the most common and theoretically sound approaches to estimate the ERP include some forward looking notion of estimating and discounting future dividend streams – which is the foundation of DDMs.

Accordingly, we estimate the ERP using a relatively elaborate DDM building on Geis, Kapp and Kristiansen (2018). The ERP is estimated at a weekly frequency by equating the observed stock price to the value of the discounted future cash flow received by investors:

$$(1)\quad P_t = \frac{D_{t-1,0}(1+g_{t,1})}{\left(1+r^f_{t,1}+erp_t\right)^1} + \sum_{h=2}^{5} \frac{D_{t-1,h-1}(1+g_{t,2})}{\left(1+r^f_{t,h}+erp_t\right)^h} + \sum_{h=6}^{10} \frac{D_{t-1,h-1}\left(1+g_{t,2}-(g_{t,2}-g_{t,3})\frac{h-5}{5}\right)}{\left(1+r^f_{t,h}+erp_t\right)^h} + \sum_{h=11}^{\infty} \frac{D_{t-1,h-1}(1+g_{t,3})}{\left(1+r^f_{t,15}+erp_t\right)^h}$$

where all variables are observed at time *t*. *P* denotes the observed stock price and $D_{t-1,0}$ the most recent payout to shareholders, consisting of both dividends and share repurchases, aggregated on a company level at time t, as obtained from Refinitiv, and expected to grow at rates $g_{t,i}$, i.e. $D_{t,h} = D_{t,h-1}(1 + g_{t,i})$.

In order to estimate dividend growth expectations, we use analyst forecasts of earnings growth $g_{t,i}$ from IBES at different horizons (12 month to 5 year forward average y-o-y growth rates for the short and medium term), and the Consensus Economics estimate of long term nominal GDP growth to anchor the model to economic growth expectations in the long run. The full term structure of euro area OIS yields is used as a euro area risk-free rate and thus as a discount factor for future cash flows. That is, $r^f_{t,h}$ is the OIS rate with maturity *h* observed at time *t*.

A major advantage of using such model to derive the ERP compared to most other ERP estimates is not only that it incorporates forward looking components, but also that it allows for decomposition of equity price changes into their underlying drivers.[5] In spirit, it remains closely related to the Gordon growth model (Gordon, 1962) and the H-model (Fuller and Hsia, 1984), both of which also produce forward looking, albeit less time variant estimates of the ERP.

[4] For a more complete review across different classes of ERP models see Duarte and Rosa (2015).

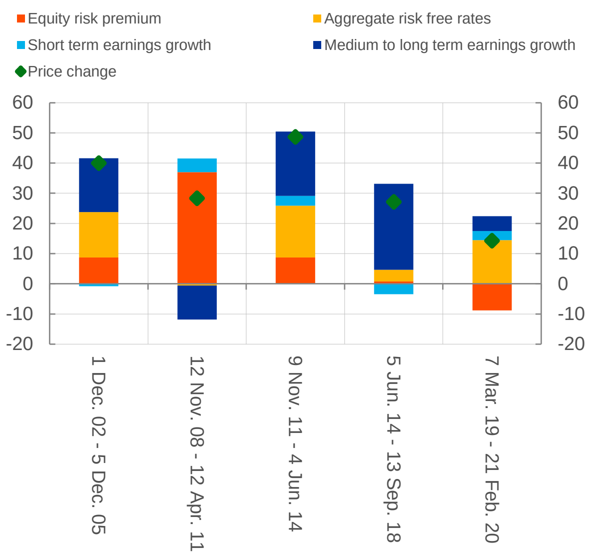
[5] Other models often cited and used to estimate ERP are described in Geis, Kapp and Kristiansen (2018).

### 3.3 Decomposing price changes into their underlying drivers

Using the above mentioned model to decompose equity price changes during the episodes shown in **Chart 2** suggests that price changes occurred mainly on account of the discount factor and gyrations in actual and expected earnings **(Chart 3)**.[6] The ERP, by contrast, played a relatively minor role. An exception is the time following the GFC, where much of the recovery in equity prices was supported by a decline in the ERP.

**Chart 3: Decomposition of changes in euro area equity prices**

(percentages, cumulative)




Sources: Bloomberg, IBES, Consensus Economics, Refinitiv, ECB. Notes: The decomposition is based on the dividend discount model (DDM) outlined in the main text. Latest observation: 21 February 2020.

Overall, the decompositions suggest that monetary policy easing over the respective periods is unlikely to have contributed to an ERP compression that has led to stretched levels of stock price valuations. An exceptional period is the marked recovery after the GFC peak, where the strong improvement in risk sentiment contributed to bringing down the ERP from unprecedentedly high levels. While accommodative monetary policy certainly supported the improvement in risk-sentiment, the recovery in the ERP can also be attributed to other targeted central bank and government interventions in the financial sector,

[6] For a continuous decomposition of the full time horizon please see Chart A in the background.

such as large liquidity injections and the bail-out of a number of major global financial institutions.

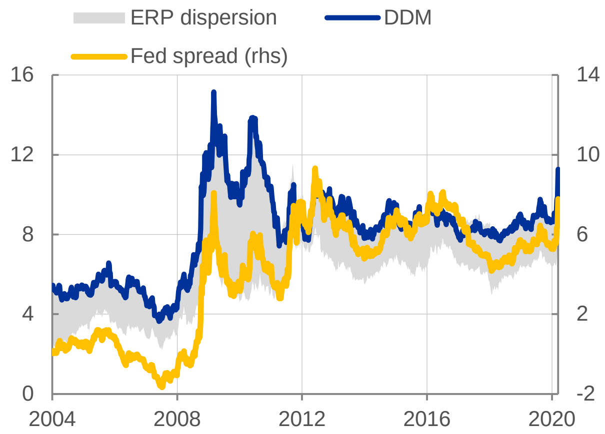
Naturally, while those developments followed monetary policy action, the above does not establish a causal link between these factors nor does it prove that monetary policy – accommodative or contractionary – does generally not have an effect on the ERP.

## 4. A persistently elevated ERP in the euro area

Since 2014, the euro area ERP has been relatively stable at slightly above 8 percent, i.e. 3-4 percentage points above its pre-GFC level **(Chart 4**). That is, compared to pre-financial crisis averages ranging between 4% and 6%, investors demanded a relatively high compensation for investing in equities instead of risk-free assets. Importantly, this result is not specific to the dividend discount model underlying the ERP estimate in **Chart 4**, but rather a common finding in the academic literature (see Duarte and Rosa, 2015) and across different gauges, as can be seen in the range of model estimates shown in **Chart 4**.

**Chart 4: Estimates of the euro area equity risk premium**

(percentages per annum)




Sources: Bloomberg, IBES, Consensus Economics, Refinitiv, ECB. Estimates of the euro area equity risk premium are based on the Gordon Growth model, the H-model, a Goldman Sachs estimate, the Fed spread and the DDM outlined in the paper. Latest observation: 13 March 2020.

The persistently elevated level of the equity risk premium, that is the additional risk remuneration required by investors to hold equities instead of risk-free bonds, relative to times prior to the GFC has been related to both market-specific factors and macroeconomic trends. On the one hand, the literature points to a shift in risk aversion (as a persistent legacy of the financial crisis), and to concerns about increased downside economic risks.[7] These explanations help to explain why risk premia have risen and risk-free interest rates have declined at the same time.[8] In addition, a number of structural factors are argued to have increased the demand for safe assets over and beyond the demand for risky assets. These factors include changes in regulation, the savings glut, secular stagnation and the rise in global central bank reserves. Moreover, market segmentation and frictions that prevent the stock market engagement of certain investor groups (e.g. pension funds), a limited participation in equity markets (e.g. due to country-specific investment habits), as well as continued net issuance of equity – at least in the euro area - throughout the post-GFC period might have played a role. Finally, studies suggest that, while market participants rebalanced from shorter- to longer-term maturities in response to unconventional monetary policy easing, there is little evidence of strong portfolio rebalancing towards equities.[9]

## 5. Gauging the effects of euro area monetary policy on the ERP

In order to examine the impact of monetary policy on the ERP more generally – for both accommodative and contractionary monetary policy actions – we first follow Gürkaynak, Sack and Swanson (2004), Jarocinski and Karadi (2020) and Altavilla, Brugnolini, Gürkaynak, Motto and Ragusa (2019) for the identification of monetary policy shocks. In this first step we calculate a monetary policy shock (MPS) series in line with Gürkaynak, Sack and Swanson (2004), where monetary policy shocks are estimated by calculating principal components from the change in yields around monetary policy announcements, i.e. the change in the first principal component.

Concretely, the change in yields around a policy event elicits the sign of the surprise: a positive monetary policy shock (an increase in yields) is interpreted as an unexpected monetary policy tightening and vice versa. Whereas Gürkaynak, Sack and Swanson (2004) use a 30 minute window around monetary policy

[7] See also Bernanke (2005), Lane and Schmukler (2007), Caballero, Farhi, and Gourinchas (2008, 2016), Gordon (2015), Lane (2019), Summers (2014), Summers and Rachel (2019), Norton and Philippon (2019), Blanchard, Giavazzi and Sa (2005), Daly (2016), and Kedan and Ventula Veghazy (2018).

[8] See Broadbent (2014, 2019).

[9] See Bua and Dunne (2017), who find that, in response to the PSPP, investment funds do rebalance into longer-term maturities, but not towards equities.

announcements we opt to use end-of day values. Although this potentially allows for other factors, such as macroeconomic data releases or news, to contaminate the shock, the resulting extended shock series is very similar – suggesting that monetary policy decisions are often the dominant factor on those particular days.

Subsequently, we follow Jarocinski and Karadi (2020) and Altavilla, Brugnolini, Gürkaynak, Motto and Ragusa (2019) and partition monetary policy shocks into central bank information shocks and 'pure' monetary policy shocks by applying a sign restricted BVAR to the shock series derived under step one, and adding daily changes in euro area Inflation Linked Swaps (ILS) rates[10] to the model.

We estimate the reduced form VAR as described in equation (2), where $Y_t$ is a vector consisting of the monetary policy shocks derived from the principle components analysis of yields as described above, and the change in the 1-year in 1-year inflation linked swap rate.

$$Y_t = c + \sum_{j=1}^{P} B_j Y_{t-j} + A_0 u_t \quad (2)$$

The model is estimated using sign restrictions: If a positive monetary policy shock is accompanied by a simultaneous increase in inflation expectations, this is defined as a positive information shock. On the other hand, if inflation expectations decrease while rates increase, a 'pure' contractionary policy shock is identified. That is, in case of an unexpected monetary policy tightening, inflation expectations should decline in line with the notion of a slowing economy due to higher interest rates, and vice versa. For ease of reference we label these shocks "policy shock" and "information shock", respectively, see **Chart B** in the appendix.[11]

It is at this point where we can, using the monetary policy shocks just defined, more formally assess how monetary policy shocks may affect the ERP (alongside earnings and expectations thereof, as well as interest rates). Evidence in favour of a causal relation is provided in **Table 1**, where changes in the ERP, earnings growth expectations, and longer-term risk free rates are regressed on both types of monetary policy shocks established above.

[10] In line with the notion of some lag in transmission, inflation expectations are gauged for the horizon of 1 year in 1 year time (the so-called 1y1y ILS rate).

[11] See Altavilla, Brugnolini, Gürkaynak, Motto and Ragusa (2019) and Jarocinski and Karadi (2020) for a decomposition of asset price changes into monetary policy shocks and information shocks. In particular, Altavilla, Brugnolini, Gürkaynak, Motto and Ragusa (2019) follow a similar identification strategy based on inflation-linked swap rates and yields as the one employed here, but their subsequent regression analysis focuses on changes in equity prices rather than changes in equity risk premia.

Assuming that policy shocks are properly identified, those regressions provide some evidence that accommodative policy, identified only through rate developments (therefore not discriminating between 'pure' policy shocks and information shocks), raises dividend expectations and compresses risk-free rates.

In practice, and against the background of the central banks' mandate, central bank decisions are typically motivated by changes to the economic and inflation outlook. This means that a priori, the reaction of ERP to an accommodative monetary policy decision might be positive or negative, depending on the magnitude of the monetary policy surprise, and the information revealed by the central bank being news to the market or not.[12] In this respect, Cieslak & Schrimpf (2019) argue and confirm that central bank announcements, mainly in the form of information shocks, can directly affect market participants' risk sentiment.

**Table 1: Reaction of selected variables to MPS, information and policy shocks**

| | MPS | Information shock | Policy shock |
|---|---|---|---|
| *ERP* | 0.023 | -0.180 *** | 0.104 ** |
| | (.028) | (0.037) | (0.052) |
| *12M forward earnings growth* | -0.083 *** | 0.019 | -0.051 |
| | (0.025) | (0.094) | (0.066) |
| *5Y forward earnings growth* | -0.100 ** | -0.139 | -0.113 |
| | (0.040) | (0.099) | (0.112) |
| *10Y OIS* | 0.009 *** | 0.038 *** | 0.019 * |
| | (0.003) | (0.007) | (0.011) |
| *N* | 87 | 87 | 87 |

Notes: *p<0.1;**p<0.05:***p<0.01. Robust standard errors in brackets. Regression results for an OLS regression covering the period 2012 to end-2019 so as to exclude the period of the financial crisis.

[12] This is in line with the intuition outlined in Daly (2016) and Broadbent (2019), and consistent with the empirical results on equity prices in Altavilla, Brugnolini, Gürkaynak, Motto and Ragusa (2019).

To gauge the impact of monetary policy shocks on the ERP, we regress the weekly change in the ERP (around monetary policy meetings) on the estimated information and ‘pure’ policy shocks:[13]

$$\Delta ERP_t = \alpha + \beta_1 \cdot Information\ shock_t + \beta_2 \cdot Policy\ shock_t + \varepsilon_t$$

where $\varepsilon$ denotes the residual error term.

Results show that monetary policy is likely to have an impact on the ERP, yet with opposite effects following genuine accommodative policy surprises and negative information shocks (**Chart 5** and **Table 2**).[14]

**Table 2: OLS regression results**

| | All | NFCs | Financials |
|---|---|---|---|
| *information shock* | -0.166 *** | -0.129 *** | -0.322 *** |
| | (0.048) | (0.046) | (0.091) |
| *policy shock* | 0.143 * | 0.123 * | 0.230 * |
| | (0.074) | (0.066) | (0.124) |
| *constant* | 0.013 | 0.017 | -0.018 |
| | (0.028) | (0.023) | (0.075) |
| *N* | 63 | 63 | 63 |

Notes: *p<0.1;**p<0.05:***p<0.01. Robust standard errors in brackets. Regression results for an OLS regression covering the period 2014 to end-2019, focusing on the time of euro area unconventional monetary policy measures.

The regression furthermore confirms the intuition that the distinction between pure policy shocks and information shocks is crucial when assessing the effects of policy on the ERP. While the information and policy shocks have opposite signs and are both significant, the crude policy shock remains insignificant.

Accumulating the effects of genuine accommodative policy surprises and negative information effects over time suggests that the two effects might have largely offset each other since 2014 (**Chart 6**).

[13] Monetary policy shocks are estimated using daily data and then related to weekly changes in the ERP.

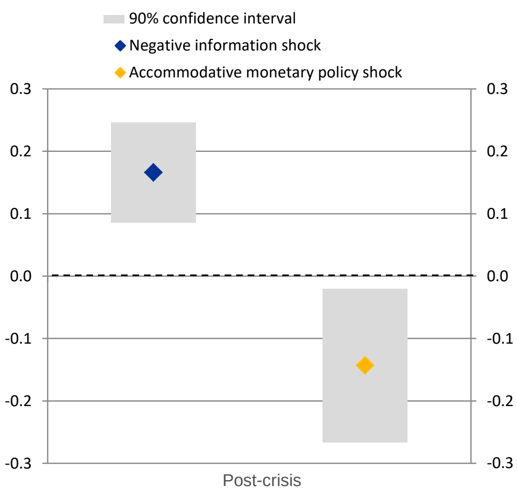
[14] Since both shock series, as well as the equity risk premium, are estimated and not directly observed, the problem of a “generated regressor” may exist. This may lead to an underestimation of the reported standard errors. Robust results for a number of alternative ERP estimates alleviate some of these concerns.

## 6. The choice of ERP estimates and cross-country variation

As depicted in Chart 4, different ERP gauges yield different point estimates (and at times even different dynamics). To ensure that results are not disproportionately dependent on the choice of ERP estimate, we estimate a number of alternative models and investigate the robustness of the earlier regressions to these alternative ERP estimates.

**Chart 5: Transmission of euro area monetary policy surprises to ERP**

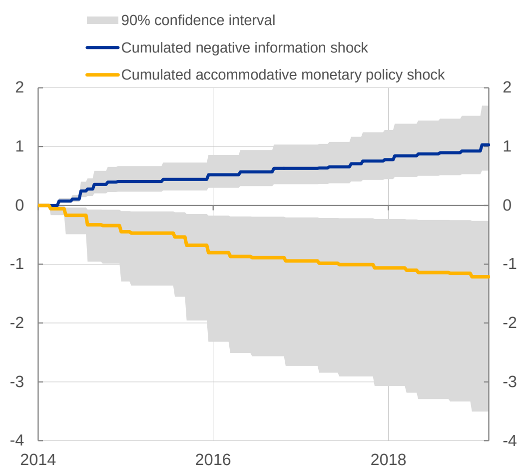
(percentage points)




Sources: Bloomberg, IBES, Consensus Economics, Refinitiv, ECB.

**Chart 6: Cumulative impact of accommodative policy shocks and negative information shocks on the ERP**

(percentage points)




Sources: Bloomberg, IBES, Consensus Economics, Refinitiv, ECB.

The Gordon growth model, following Gordon (1962), is a simple version of the DDM where dividends are assumed to grow at a constant rate, allowing the calculation of the ERP to be quite simple:

$$ERP_t = \frac{D_t(1+g_t)}{P_t} + g_t - r_t^f$$

where *D* is the latest dividend, *P the* price, $r^f$ the 10 year OIS and *g* the expected perpetual growth rate (10 year expected GDP growth from Consensus Economics).

The H-model, following Fuller & Hsia (1984), goes one step further and assumes that dividends grow in three phases. Whereas growth is initially high and gauged through analyst expectations, in the long term it converges to the expected steady state growth rate, with a step function as transitioning between these two phases.

$$ERP_t = \left(\frac{D}{P}\right)_t \left((1 + g_t^b) + \frac{A + B}{2}(g_t^a - g_t^b)\right) + g_t^b - r_t^f$$

where *D/P* is the dividend yield, $r^f$ the 10 year OIS, $g^a$ expected growth rate until time A (5 year expected earnings growth from IBES), $g^b$ expected growth rate from time B (expected long-term GDP growth from Consensus Economics).

Using the spread between the earnings yield and the risk free rate results in one version of the so-called “Fed spread”, which is thought to provide a rather good estimate of the *dynamics* of the ERP, whereas the level appears less realistic:

$$Fed\ spread_t = \frac{1}{CAPE_t} - r_t^f$$

where *CAPE* is the 10 year cyclically adjusted price-earnings ratio and $r^f$ the 10 year OIS.

In a similar vein, an alternative estimate for the ERP[15] is given by:

$$ERP_t = \frac{E_t}{P_t} - r_t^f + g_t + \pi_t$$

where *E* is the earnings, *P* price, $r^f$ the 10 year OIS, *g* expected growth rate (10 year average industrial production growth), $\pi$ expected inflation (10 year average CPI).

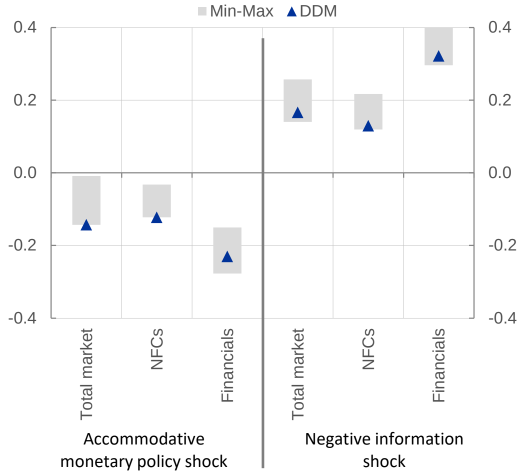
Although ERP estimates show broadly similar dynamics over the longer-run, significant differences exist especially in the implied level of the ERP (see Geis, Kapp, and Kristiansen (2018) for more detail on these models). Despite this, regression results are consistent across estimates in terms of accommodative (contractionary) ‘pure’ monetary policy shocks being followed by a decline (increase) in ERP, while negative (positive) information shocks lead to an increase (decrease) (**Chart 7**).

[15] See Wright, Mueller-Glissmann, Oppenheimer and Rizzi (2017) and Himmelberg and Weldon (2017).

We investigate two additional research questions, the first being whether financials are more exposed to monetary policy action and communication compared with other sectors, as found by Haitsma, Unalmis and de Haan (2016). Our results confirm that the impact of monetary policy innovations on the ERP is significantly larger for financials than for non-financials, for both information and 'pure' monetary policy shocks (see **Chart 7** and **Chart C** in the appendix).

**Chart 7: Transmission of euro area monetary policy surprises across models and market segments**

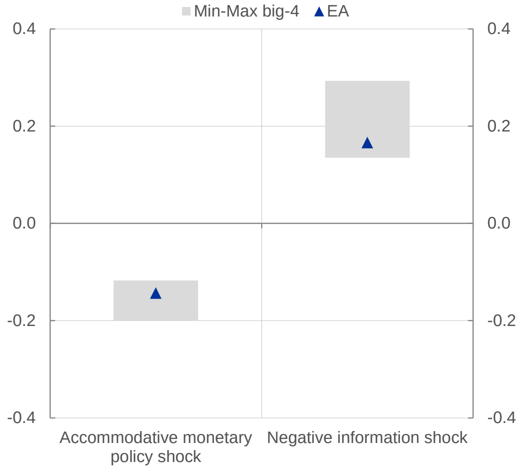
(percentage points)




Sources: Bloomberg, IBES, Consensus Economics, Refinitiv, ECB. Note: Blue diamonds denote the DDM outlined in the main text, while grey ranges depict the impact of monetary policy and information shocks on different equity market segments, with the ERP estimated from a Gordon Growth model, a H-model, a Goldman Sachs estimate and the Fed-spread.

**Chart 8: Transmission of euro area monetary policy surprises across countries**

(percentage points)




Sources: Bloomberg, IBES, Consensus Economics, Refinitiv, ECB. Note: Blue diamonds denotes the impact of monetary policy and information shocks on the total euro area equity index, while the grey range contains estimates for IT, DE, ES, FR. The ERP is estimated via the DDM laid out in the paper.

Furthermore, in a currency union, the impact of monetary policy on the ERP might differ across countries. To investigate if this is the case, we construct our DDM model for the German, French, Spanish and Italian stock markets, infer the ERP, and estimate the impact of monetary policy shocks as before. **Chart 8** shows the regression coefficients. While the estimates for the information shock are somewhat more disperse than those of the policy shock, individual country results do not differ by much overall, suggesting that central bank information shocks are transmitted to ERP in broadly similar fashion across the four countries considered.

## 7. Conclusion

We departed from the observation that past changes in equity prices during periods of accommodative euro area monetary policy mainly reflected adjustments in the discount factor and economic activity, rather than fluctuations in investors' required risk compensation, and that the ERP appears to not have declined since the introduction of unconventional monetary policy.

To shed more light on the general effects of monetary policy shocks on ERP, we note that identified accommodative and contractionary monetary policy shocks point to an insignificant effect of monetary policy on the ERP. However, further breakdown of these shocks into 'pure' monetary policy shocks and information shocks revealed that monetary policy is likely to affect the ERP, albeit through at least two distinct channels. While a significant upward impact on the ERP is observed if a policy event is predominantly perceived as a negative information surprise, the opposite prevails in the case of a genuine accommodative monetary policy surprise. Accumulating these effects over time suggests that the two might have largely offset each other since the introduction of unconventional monetary policy measures in 2014.

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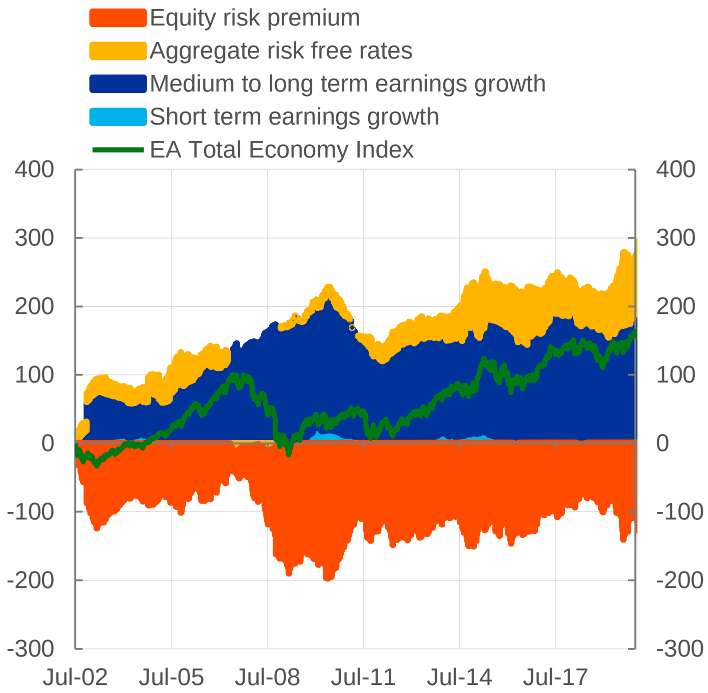
## Annex 1:

### Chart A: Cumulative decomposition of changes in euro area equity prices

(percentages, cumulative)

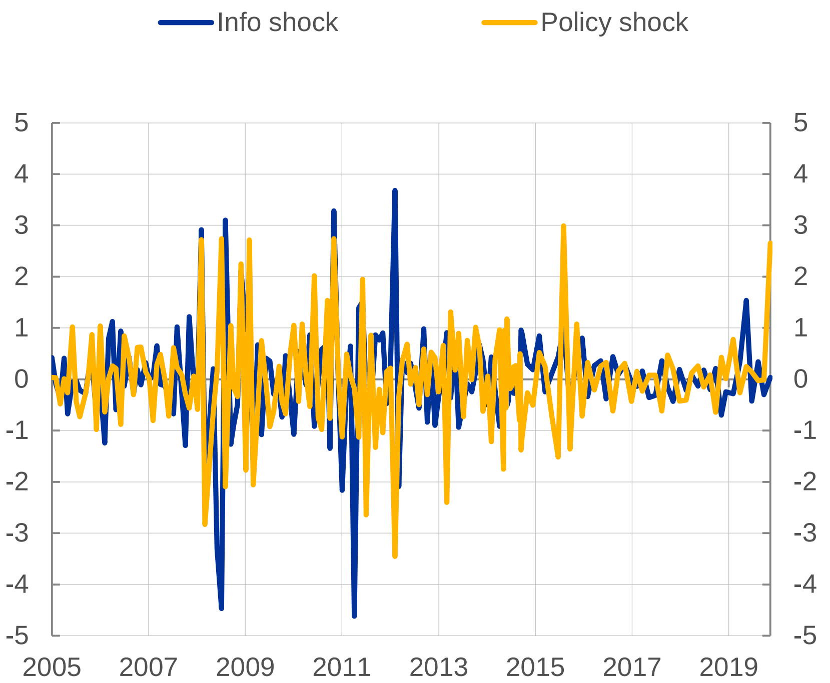



Sources: Bloomberg, IBES, Consensus Economics, Refinitiv, ECB.

Notes: The decomposition is based on the dividend discount model (DDM) outlined in the main text. Latest observation: 30.12.2019.

**Chart B: Monetary policy shocks**

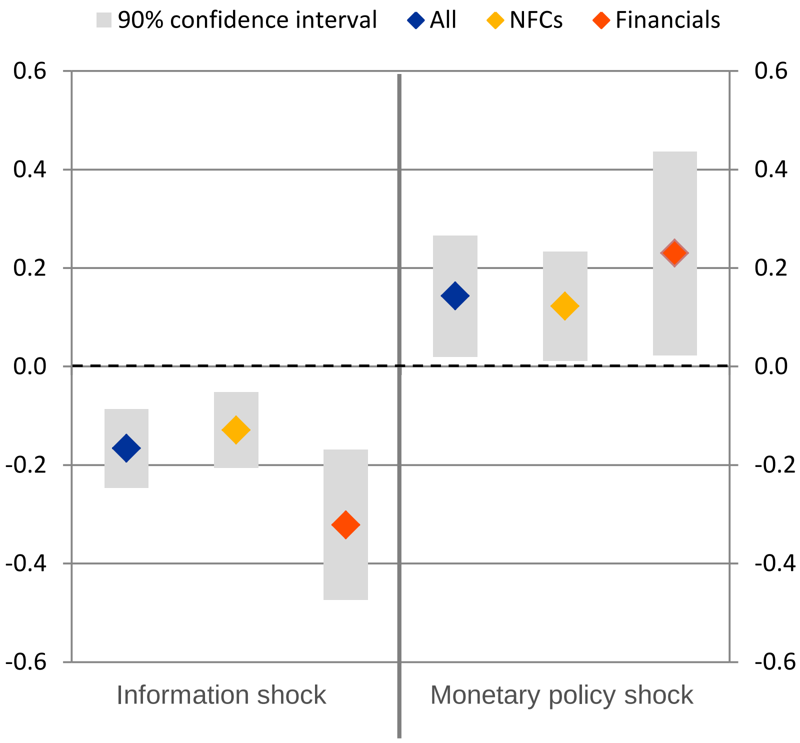
(standardised shocks)




Sources: Bloomberg, Refinitiv, ECB. Notes: The split of monetary policy changes into information and policy shocks follows Altavilla, Brugnolini, Gürkaynak, Motto and Ragusa (2019). Latest observation: 12 March 2020.

**Chart C: Transmission of euro area monetary policy surprises to ERP**

(percentage points)




Sources: Bloomberg, IBES, Consensus Economics, Refinitiv, ECB. Notes: The ERP is calculated with the DDM outlined in this paper.

## Annex 2: Periods of euro area monetary policy accommodation in Chart 2

More in detail, the first period covers the time from early December 2002 to early December 2005. It marks the round of rate cuts following the dot-com bubble and is judged to end on the day prior to the first rate hike. A second period spans from November 2008 to April 2011, and includes major monetary policy accommodation in the wake of the financial crisis. During this time, several rate cuts were conducted, the 1-year (May 2009) and 3-month (June 2010) LTROs were introduced, the CBPP1 was launched (July 2009), and finally, SMP was introduced (May 2010).[16] Again, the period is set to conclude just before the first subsequent policy rate hike.

The third period starts in early November 2011 and finishes in June 2014. As such, it commences during the peak of the sovereign debt crisis, with the first rate

[16] For more information on individual monetary policy measures taken and their effects on inflation and growth, see Rostagno, Altavilla, Carboni, Lemke, Motto, Saint Guilhem, and Yiangou (2019).

cut and the introduction of CBPP2. It also captures the introduction of the 3-year LTRO, the Additional Credit Claims (ACC) program (December 2011), which increased the availability of collateral, the London speech and Draghi's "Whatever it takes" (July 2012), the announcement of OMT (September 2012), and the start of forward guidance (July 2013, "expect rates to remain at present or lower levels for an extended period of time", after the DFR reached 0% in July 2012). Fourth, the period from June 2014 to September 2018 includes the start of, and significant additions to, the APP and, more broadly, the extensive use of further (non-)conventional monetary policy measures. It starts with the first cut of the DFR to a negative territory and the introduction of TLTRO I. It furthermore captures the announcement and implementation of ABSPP (September 2014), CBPP3 (September 2014), PSPP (January 2015), TLTRO II (March 2016), and the more prominent use of forward guidance. The period finishes with the announced end of net purchases under the APP.

Finally, the period from March 2019 to January 2020 is the latest period of monetary policy accommodation prior to the global spreading of COVID-19 and the entailing economic crisis. The period starts in March 2019 when the first signs of a slowdown in the euro area recovery appeared and financial markets were starting to consider and price in further policy rate cuts. In addition, the March meeting also marks the beginning of TLTRO III and the introduction of extended forward guidance that interest rates will remain ([…] "at present levels at least through the end of 2019, and in any case for as long as necessary" […]). The period also captures the September 2019 meeting, with the announcement of a new comprehensive policy package – including a rate cut, the re-start of net purchases under the APP, the introduction of the two-tier system and the revision of the forward guidance.

**Acknowledgements**

We are grateful to Desislava Tartova and Gregory Kidd for substantial contributions to this project. We are also thankful for helpful comments and suggestions from Ursel Baumann, Wolfgang Lemke, Thomas Werner, Carlo Altavilla, Federic Holm-Hadulla, Massimo Rostagno, as well as seminar participants at the ECB and the Danish Central Bank and one anonymous referee at the ECB. Raphaela Hotten provided excellent research assistance.

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PDF ISBN 978-92-899-4535-6 ISSN 1725-2806 doi:10.2866/899493 QB-AR-21-026-EN-N