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The impact of the ECB's conventional and unconventional monetary policies on stock markets *

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Abstract

Using an event study method, we examine how stock markets respond to the policies of the European Central Bank during 1999-2015. We use market prices of futures (government bonds) to identify surprises in (un)conventional monetary policy. Our results suggest that especially unconventional monetary policy surprises affect the EURO STOXX 50 index. We also find evidence for the credit channel, notably for unconventional monetary policy surprises. Our results also suggest that value and past loser stocks show a larger reaction to monetary policy surprises. These results are confirmed if identification of monetary policy surprises is based on the Rigobon-Sack heteroscedasticity approach.

Keywords: monetary policy surprises, stock prices, event studies approach, identification through heteroscedasticity.
JEL classifications: E43, E44, E52.

* The views expressed do not necessarily reflect the official views of the Central Bank of the Republic of Turkey or De Nederlandsche Bank.

1. Introduction

Analysts pay close attention to changes in monetary policy as such changes, particularly if they are unexpected, can influence stock market returns. The dividend discount model for equity valuation suggests two ways through which monetary policy affects stock prices. First, monetary policy can affect the discount rate for future cash flows. Second, as monetary policy can potentially affect output in the short to medium term it may affect expected cash flows themselves (Patelis, 1997; Kontonikas and Kostakis, 2013).

Most research on the stock market reactions to monetary policy (surprises) focuses on the United States (e.g. Pearce and Roley, 1984; Patelis 1997; Thorbecke, 1997; Bernanke and Kuttner, 2005; Ehrmann and Fratzscher, 2004; Chuliá et al., 2010; Kontonikas et al. 2013; Kontonikas and Kostakis, 2013; Unalmis and Unalmis, 2015).[1] Following the event study method of Bernanke and Kuttner (2005), which has been widely used also in recent research (see e.g. Kontonikas et al., 2013), we examine how stock markets respond to the policies of the European Central Bank (ECB). However, to check whether our findings are affected by the use of the event study approach, we also apply the identification through heteroscedasticity approach suggested by Rigobon and Sack (2004), which relies on much weaker assumptions than the event study approach.

Our sample period (4 January 1999 to 27 February 2015) includes the crisis period. This has two implications. First, while under normal circumstances monetary easing will increase stocks prices, in times of crisis a decrease in the policy rate may signal to investors that future economic conditions are worse than expected. If so, stock returns may decrease (Kontonikas et al. 2013; Hosono and Isobe, 2014). We therefore examine whether the impact of ECB monetary policy surprises is different in crisis and non-crisis years.[2] Second, unlike other central banks, the ECB had introduced unconventional monetary policies early in the crisis (i.e. well before it hit the so-called zero lower bound or ZLB) and for some time used conventional and unconventional policies simultaneously (Cour-Thiman and Winkler, 2014; de Haan et al., 2015). The use of unconventional instruments has implications for the identification of monetary policy surprises. Like many previous studies, we follow the approach suggested by Kuttner (2001) to identify surprises in conventional monetary policy. This approach is based on the notion that futures prices reflect market expectations of future policy rates. A monetary policy surprise can be represented by the difference between the futures rate before the policy announcement and the announced policy rate. However, with unconventional policy there is no clear measure of the central bank's policy stance and it is not straightforward

[1] Section 2 discusses research on stock market responses of ECB monetary policy in more detail and explains how our study deviates from previous studies.

[2] Kontonikas et al. (2013) report that during the crisis period, stock market investors did not react positively to unexpected Fed policy rate cuts.

to determine policy expectations (Rogers et al., 2014). To identify unconventional monetary policy surprises we follow the approach suggested by Rogers et al. (2014), which is based on changes in the yield spread between German and Italian 10-year government bonds at the day of a policy announcement. The motivation is that the ECB's unconventional monetary policies were to quite some extent aimed at reducing intra-euro area sovereign spreads.

A crucial issue in empirical research on the impact of monetary policy surprises on stock prices is endogeneity, since monetary policy can react to stock market developments. However, as pointed out by Kontonikas et al. (2013), the problem of endogeneity should be less of a concern when daily data are used within an event study framework, like in the present study. Monetary policy is unlikely to be affected by changes in asset returns on the same day, so that the likelihood that our results are contaminated by reverse causality running from stock prices to changes in monetary policy is minimal (see also Fratzscher et al., 2014).[3] Furthermore, one-day windows are unlikely to be contaminated by other pieces of news.

We not only examine the reaction of the EURO STOXX 50 index to (conventional and unconventional) monetary policy surprises but also analyse the reaction of several portfolios of stocks. Some previous studies have shown that the response to monetary policy surprises differs across sectors. For instance, Bernanke and Kuttner (2005) report that high-tech, telecom and durable goods stocks respond quite strongly to unanticipated Fed policies, whereas energy, utilities and nondurables stocks only show a mild reaction. However, this pattern may be different during a crisis period as reported by Kontonikas et al. (2013). We therefore also examine differences between the response of different portfolios to monetary policy surprises before and during the crisis.

Peersman and Smets (2005) argue that the interest rate channel of monetary policy implies that the response to monetary policy surprises should differ across sectors depending on the interest-elasticity of the demand for their products. We therefore examine the impact of monetary policy surprises on stocks for 19 sectors. Likewise, the credit channel implies that sectors will be more affected by monetary policy surprises, the stronger their dependence on bank funding (Peersman and Smets, 2005). We therefore use portfolios based on firm characteristics such as size, the free cash flow to income ratio, the financial leverage ratio, and the debt-to-equity ratio. In addition, following Kontonikas and Kostakis (2013) we explore two other stock characteristics, namely value versus growth stocks, and momentum. A value (growth) stock is defined as a stock with a relatively low (high) price when taking its

[3] As pointed out by Hosono and Isobe (2014), the use of intraday data may extract the effects of policy shocks more accurately than daily data if market participants understand the policy announcements and the policy shock is incorporated in asset returns within the intraday window set by researchers. However, it may take a considerable amount of time for an unconventional monetary policy shock to be properly reflected in stock prices due to the novelty of unconventional policies. In addition, when market functioning is impaired, as was the case in the euro area during the financial crisis, an intraday window may not be appropriate.

fundamentals into account. It can therefore be characterised by a low (high) market-to-book and price-to-earnings ratio. Value stocks are more sensitive to rising interest rates than growth stocks, since value stocks rely on high cash flows relative to their stock price. Momentum is included as past performance might reflect the stock's sensitivity to overreactions. Based on VAR estimates, Kontonikas and Kostakis (2013) report that in the US past losers are more sensitive to monetary policy shocks than past winners. Although some older studies have examined whether different portfolios of stocks respond differently to ECB policy surprises (see section 2 for further details), most recent studies only consider the reaction of some stock market index to ECB policy surprises. We also analyse whether different portfolios react differently to conventional and unconventional policy surprises.

Previewing our results, we find that especially unconventional monetary policy surprises affect the EURO STOXX 50 index. Our results provide (weak) evidence for a credit channel before the financial crisis. During the crisis, we find strong support for the presence of a credit channel for unconventional monetary policy surprises. In particular, stocks of firms that are either highly leveraged respond stronger to policy surprises. Finally, our results suggest that value and past loser stocks show a larger reaction to monetary policy surprises.

In summary, our study contributes to the literature in five ways. First, we examine the impact of ECB monetary policy surprises on stock prices since the start of the common monetary policy. Second, we distinguish between the impact of unexpected conventional and unconventional monetary policy decisions and show that both conventional and unconventional monetary policy surprises affect the EURO STOXX 50 index. Third, we examine the impact of changes in the ECB policies on returns of several portfolios sorted on firm characteristics and past performance. This provides evidence for the credit channel of monetary policy. Fourth, we show that the impact of ECB policy changes on these portfolios is not stable across time but differs across the crisis and non-crisis period. Finally, we examine whether our results are affected by the method chosen to identify the impact of monetary policy surprises on stock returns, and find out that our main conclusions remain intact when we use an alternative identification strategy.

The remainder of this paper is structured as follows. Section 2 discusses previous research. Section 3 outlines our methodology and section 4 presents our main findings. Section 5 presents the outcomes under the identification through heteroscedasticity approach. Section 6 concludes.

2. Previous studies

Several previous studies report evidence that unexpected ECB interest rate cuts (hikes) increase (decrease) stock prices (e.g. Angeloni and Ehrmann, 2003; Bohl et al., 2008; Hussain, 2011; Hayo and Niehof, 2011). However, not all studies find a positive relationship between monetary

easing and stock prices. For instance, Bredin et al. (2007) report that the German DAX index does not respond to monetary policy surprises of the German central bank and the ECB, while Hosono and Isobe (2014) report a negative relationship between ECB unconventional monetary policy surprises and stock prices.[4] Fiordelisi et al. (2014) conclude that between 2007-2012 interest rate cuts do not produce a statistically significant effect on the stock markets, but they also find that central banks' liquidity provisions are effective.

Some previous studies also examine whether the response to unexpected policy changes differs between sectors (Angeloni and Ehrmann 2003; Bredin et al., 2007; Kholodilin et al., 2009). However, the results are mixed. Angeloni and Ehrmann (2003) find that stock prices of telecommunications, consumer goods, technology and finance firms seem most sensitive to policy surprises. Kholodilin et al. (2009) report similar results. In contrast, Bredin et al. (2007) find that sectoral indices do not respond significantly to an (un)expected change in policy rates of the German Bundesbank and the ECB.

Importantly, most recent studies on ECB monetary policy surprises that include the crisis either only consider broad stock market indices (e.g. Rogers et al., 2014; Hosono and Isobe, 2014; and Fratzscher et al., 2014) or only examine (parts of) the banking sector (Fiordelisi et al., 2014; Ricci, 2014; Lambert and Ueda, 2014). In addition, none of the papers examines the impact of monetary policy surprises on value and growth stocks, and momentum as Kontonikas and Kostakis (2013) do for the US.

Some papers consider whether stock market reactions to policy surprises differ between the pre-crisis and the crisis period. Again, the results are mixed. For instance, Jardet and Monks (2014) conclude that the impact of ECB monetary policy on the EURO STOXX 50 index during the crisis has not changed significantly compared to the pre-crisis period. Likewise, Hayo and Niehof (2011), who find a significant effect of ECB monetary policy on several European equity markets, conclude that the estimated coefficients from the financial crisis period are not significantly different from those estimated over the pre-crisis period. In contrast, Wang and Mayes (2012) report that instead of the negative response to a surprise policy rate increase before the crisis, during the crisis stock markets responded positively to such changes, especially when interest rates were close to the zero lower bound.

Finally, some recent studies have examined the impact of the ECB's unconventional monetary policies. The results for unconventional monetary policy surprises are also mixed. For instance, Rogers et al. (2014) find that the announcements of unconventional monetary policy of the ECB led to positive stock reactions during the crisis thereby easing financial conditions. Fratzscher et al. (2014) report similar findings. In contrast, Hosono and Isobe (2014)

[4] As will be explained below, the latter authors use a different approach to identify unconventional monetary policy surprises than the present paper.

conclude that stock markets in the euro area reacted negatively to ECB unconventional monetary policy surprises. These authors argue that expansionary policies in a crisis may lead markets to believe that economic conditions are worse than market participants realized.

A crucial issue in this line of literature is how to measure unexpected monetary policies. Some studies use survey data from professional forecasters (e.g. Ehrmann and Fratzscher (2004) for the US and Joyce et al. (2011) for the UK), while Rosa (2012) measures expectations based on newspaper articles judging whether actual Fed and Bank of England QE policy measures were more expansionary or restrictive than prior articles expected.[5] However, most studies measure policy surprises utilizing asset prices. An important issue is which asset prices should be used for measuring expected unconventional monetary policies.[6] For the case of the euro area, Hosono and Isobe (2014) use the changes in daily prices of 10-year German government bond futures traded on the Eurex Exchange. However, as pointed out by Rogers et al. (2014), several unconventional policies of the ECB during the crisis were aimed at reducing intra-euro area sovereign spreads, not at the level of German interest rates. In fact, actions that succeeded in lowering sovereign spreads in countries under stress (such as Italy and Spain) tended to drive German yields up. Thus, measuring monetary policy using German yields alone would result in the perverse conclusion that these policies represented an attempt by the ECB to tighten financial conditions. That is why Rogers et al. (2014) identify unconventional monetary policy surprises using the yield spread between German and Italian 10-year government bonds at the day of an ECB policy announcement.

Several methodologies have been applied in this line of research. Some studies employ an impulse-response analysis based on VAR models (e.g. Kontonikas and Kostakis, 2013; Chatziantoniou et al., 2013), but most studies use an event study approach. However, there are differences in the way monetary policy surprises are dealt with. Some recent studies on the impact of (unconventional) monetary policies on stock prices use a dummy that takes the value one when these measures are announced (e.g. Ricci (2014), who examines the impact of monetary policy measures on cumulative abnormal returns (CARs) for banks, or Fiordelisi et al., (2014) who examines the impact on CARS of SIFIs). However, these measures are typically discussed and partly anticipated by financial markets well before they are actually announced. For instance, the ECB's QE policy was partly anticipated by markets prior to the ECB's Governing Council meeting of 22 January 2015 when the policy was formally introduced.

[5] Rosa's measure can only take three values (-1, 0, and 1) depending on whether the announcement is deemed more restrictive, similar, or more expansionary than expected and his classification relies on a single news source. The data used by Joyce et al. are not available for the euro area and even if so would not capture the different nature of the ECB's unconventional monetary policies.

[6] Wright (2012), Glick and Leduc (2012), and Rogers et al. (2014) use intraday interest rate futures and take the first principal component of the changes in yields on two-, five-, ten-, and 30-year U.S. bond futures as the surprise component to examine the effects of large-scale asset purchases by the Fed.

Therefore, most related papers based on the event studies approach assume that the surprise part can be measured from the jumps in asset prices in a particular window around the announcement time of the policy decision. Under this method it is assumed that the monetary policy shock is fully captured by some ad hoc window size around the chosen event. If this assumption does not hold the method may be biased (Rigobon and Sack, 2004). Too narrow a window may miss part of the reactions to the monetary policy news, but too wide a window may contaminate the monetary policy surprise with other news. That is why several papers (including Bohl et al., 2008; Sondermann et al., 2009; Kholodilin et al., 2009; Hayo and Niehof, 2011; and Rogers et al., 2014) apply the identification through the heteroscedasticity-based approach of Rigobon and Sack (2004). This approach is robust to endogeneity and omitted variables problems, and therefore relies on much weaker assumptions than the event-study approach. The latter basically compares asset prices immediately after monetary policy announcements with those immediately before, and attributes the changes to monetary policy surprises. It also implicitly assumes that, in the limit, the variance of the policy shock becomes infinitely large relative to the variances of other shocks on policy dates. The Rigobon-Sack method only requires a rise in the variance of the policy shock when the monetary policy decision is announced, while the variances of other shocks remain constant (Unalmis and Unalmis, 2015). Rosa (2011) provides evidence that the event-study estimates of the response of asset prices to monetary policy contain a significant bias. But he also concludes that "this bias is fairly small and the OLS approach tends to outperform in an expected squared error sense the heteroscedasticity-based estimator for both small and large sample sizes. Hence in general the event-study methodology should be preferred" (p. 430).

3. Methodology

3.1 Model

To study the relationship between stock portfolios and monetary policy surprises, we follow a similar approach as used by Kuttner (2001), Ehrmann and Fratzscher (2004), and Bernanke and Kuttner (2005). As we are interested in differences in the response of stock prices to expected and unexpected monetary policy decisions during crisis and non-crisis years, we estimate the following model:

$$R_t^i = \alpha + \beta_1(1 - C_t)\Delta r_t^u + \gamma_1(1 - C_t)\Delta r_t^e + \beta_2 C_t \Delta r_t^u + \gamma_2 C_t \Delta r_t^e + \varphi \Delta r_t^{u,c} + \boldsymbol{\delta X_t} + \varepsilon_t, \quad (1)$$

where R_t^i represents the returns on day t of a certain stock index or portfolio i (see section 3.2), α is a constant, C_t is a dummy that takes a value of zero before the crisis and one thereafter, Δr_t^u, Δr_t^e, and $\Delta r_t^{u,c}$ are respectively the conventional monetary policy surprise, the expected

policy rate change, and the unconventional monetary policy surprise on day t (see section 3.3), $\boldsymbol{X_t}$ is a vector of control variables on day t, and ε_t is the error term on day t. β_1 represents the effects of the monetary policy surprise on stock returns pre-crisis, whereas β_2 shows the effects after the start of the crisis. Even though the efficient market hypothesis would suggest that the expected change in the policy rate should not lead to a stock market response, we control for any possible response to expected changes. The vector of control variables $\boldsymbol{X_t}$ consists of two variables: the MSCI World Index (excluding Europe) to control for general economic movements in the rest of the world and the crisis dummy.

We define the ECB's announcement of the first unconventional monetary policy on 22 August 2007 as the start of the crisis period.[7] Until the end of our sample period, the ECB conducted unconventional monetary policy.

3.2 Stock index and portfolios

All returns are calculated as:

$$R_t^i = \ln \frac{p_t^i}{p_{t-1}^i}, \tag{2}$$

where p_t^i is the closing price of stock or index i on day t. The stock market index used is the EURO STOXX 50 index (source: Datastream), which includes stocks from twelve euro-area countries.[8] For sector indices we use the nineteen 'supersectors', as defined by the International Classification Benchmark and shown in Table 2.

We also define several portfolios based on firm characteristics to examine the credit channel. First, for size we use the Datastream portfolios for the euro area, i.e. EURO STOXX Large, Mid, and Small. Second, to capture firms' reliance on debt we use the following ratios: the interest coverage ratio, the free cash flow to income ratio, the current ratio, the financial leverage ratio, and the debt-to-equity ratio. These ratios either indicate how leveraged a firm is or they reflect the ability of the firm to pay interest (similar measures have been used by Warner and Georges, 2001 and Ehrmann and Fratzscher, 2004). The interest coverage ratio shows the extent to which a company has funds to cover its interest payments. The free cash flow to income ratio shows a company's total net income that is available as cash for investing and financing ongoing operations relative to income. The current ratio is measured by current assets over current liabilities, thereby reflecting the ability of the firm to service short-term debt. The financial leverage ratio is defined as assets over equity, thus the higher the ratio, the higher the

[7] Results using the fall of Lehman Brothers as the starting point of the crisis period are available on request.
[8] Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

dependence on debt. Finally, the debt to equity ratio measures debt over equity. Using the company characteristics, we divide the stocks into three groups: high, mid, and low and use the average of the daily returns of the sorted groups of stocks. The individual stock prices are retrieved from Datastream. Only 44 out of the 50 stocks in the EURO STOXX 50 index cover the whole sample period, hence we drop six stocks.[9] Morningstar provides the relevant statistics on firm characteristics. We also construct portfolios excluding financials, since the banks included in the EURO STOXX 50 are very similar thereby often constituting the lion's share of one of the sorted portfolios. It is therefore important to also investigate the influence excluding such stocks, as sectoral heterogeneity might otherwise drive the results.

Finally, we construct portfolios based on two other stock characteristics which might influence monetary policy transmission, namely value versus growth stocks and momentum. A value stock can be defined as a stock with a relatively low price when taking its fundamentals into account. It is characterised by a low market-to-book and price-to-earnings ratio. The opposite holds for a growth stock. Data on the market-to-book and price-to-earnings ratios are retrieved from Morningstar. We again create a high, mid, and low portfolio for each ratio. Again, we construct the portfolios with and without financials. For the momentum factor we can simply use the returns of the 44 stocks and sort them based on past performance. We use three different time-spans to determine the performance of the stocks, i.e. one month, three months, and twelve months and then sort the stocks based on their relative performance in in two equally sized groups of past winners and losers. The portfolios are updated daily, hence they constantly reflect the best or worst performing stocks of the past period. The data are obtained from Datastream.[10]

3.3 Policy surprises

If equity markets are efficient, expected policy changes are reflected in prices and only unanticipated policies will affect stock prices. We follow the approach suggested by Kuttner (2001) to measure surprises in conventional monetary policy. The basic idea is that futures prices reflect market expectations of future policy rates. So changes of futures prices in response to a monetary policy announcement imply that markets were surprised. We use continuous three-month Euribor futures rates as Bernoth and von Hagen (2004) show that these rates are a reliable predictor for the policy rates of the ECB. We follow Bredin et al. (2007) and use the discrepancy between the daily futures rates to construct our proxy for conventional monetary policy surprises:

[9] We drop AB Inbev, Inditex, GDF, Airbus, ENEL, and Deutsche Post.
[10] We drop the stock of Daimler from the six- and twelve-month momentum portfolios, since it only has data from November 1998 onwards.

$$\Delta r_t^u = f_{s,t} - f_{s,t-1}. \quad (3)$$

where Δr_t^u represents the policy surprise at day *t*, and $f_{s,t} - f_{s,t-1}$ represents the discrepancy between the futures spot rate at day *t* and the prevailing rate at the day before the announcement, *t-1*. The futures rates are calculated by subtracting the daily settlement price from 100, which provides us with an implied expectation for the policy rate. The expected part of the policy change (Δr_t^e) can be represented by the difference between the actual rate change (Δr_t) and the unexpected part calculated above:

$$\Delta r_t^e = \Delta r_t - \Delta r_t^u. \quad (4)$$

To measure unexpected unconventional policies, we follow Rogers et al. (2014) who proxy the surprise by the change in the spread between German and Italian 10-year bond yields. If the spread increases following an unconventional monetary policy announcement it implies that monetary policy is tighter than expected and vice versa. The surprise factor for the unconventional measures, $\Delta r_t^{u,c}$, can then be represented as follows:

$$\Delta r_t^{u,c} = \left(y_{s,t}^I - y_{s,t}^G\right) - \left(y_{s,t-1}^I - y_{s,t-1}^G\right), \quad (5)$$

where $y_{s,t}^I$ and $y_{s,t}^G$ are the Italian and German 10-year government bond yields at day *t* respectively.

At its press conferences the ECB announces its policy is decisions.[11] We use these dates for the conventional monetary policy decisions. The unconventional measures taken by the ECB in recent years did not always correspond to the regular announcement dates and are therefore partly extracted from other sources. Specifically, we use the dates provided by Rogers et al. (2014) for the period up to April 2014 and the database of press release of the ECB up to and including February 2015.[12] We include all the press releases also when there was no change in monetary policy.

4. Results

This section reports the estimates of equation (1). As White tests frequently reject the null hypothesis of homoscedasticity, we use White's robust standard errors. We do not report the estimated parameters for the control variables. In general, the MSCI World (excluding Europe) index is highly significant while the crisis dummy is mostly insignificant. In addition to our

[11] See: http://www.ecb.europa.eu/press/govcdec/mopo/previous/html/index.en.html.
[12] See: https://www.ecb.europa.eu/press/pr/date/2015/html/index.en.html.

regression results, we report Wald test t-statistics for the null hypothesis that coefficients for the pre-crisis conventional monetary policy surprise and the conventional monetary policy surprise during the crisis are equal.

First, Table 1 shows the results for the broad EURO STOXX 50 index. For the pre-crisis period we find a weakly significant influence of monetary policy surprises on the index. The negative sign indicates that an unexpected loosening of monetary policy leads to an increase in stock returns. To be precise: a 0.25%-point surprise cut in the policy rate leads to an increase in the index of almost 1.78%-point, which is an economically significant effect. Surprisingly, we also find that the expected change has a highly significant negative influence on the stock index. Even though the coefficient for conventional monetary policy surprises during the crisis is not significant, the null hypothesis that the pre-crisis parameter is equal to the crisis parameter cannot be rejected; both parameter estimates are about 0.71. We also find a highly significant, negative influence of the unconventional monetary policy surprise. This indicates that an announcement that causes a decrease in the yield spread between German and Italian government bonds also leads to an increase in the returns of the index. An unconventional monetary policy surprise that causes a decrease in the German-Italian yield spread of 0.06%-points (the average change on event days) on average causes an increase in the EURO STOXX 50 returns of almost 0.5%-points. These results are qualitatively in line with the findings of Rogers et al. (2014).

[Insert Table 1 here]

Next, Table 2 reports the estimated surprise parameters for the nineteen sector portfolios. The pre-crisis conventional surprise variable is significant in ten out of nineteen cases. All significant parameters have the expected negative sign, indicating that surprise monetary policy tightening leads to lower stock returns for those sectors. The largest parameter estimate is found for telecommunications, which is in line with the findings of earlier research (see e.g. Kholodilin et al., 2009; Angeloni and Ehrmann, 2003). A surprise policy rate cut of 0.25%-points by the ECB leads to an increase in telecom stock returns of 2%-points. So these effects are also economically significant. Based on the interest rate channel of monetary policy, we expect sectors that rely most on interest rates (e.g. durables and banks) to show the largest responses. Our results do not fully support this hypothesis. Although we find a significant impact of pre-crisis monetary policy surprises for some durables sectors like automobiles & parts, other sectors for which we find a significant impact cannot be classified as producing durables or being sensitive to interest rates, like food & beverage.

[Insert Table 2 here]

For the crisis period, we find that the estimated parameters for the conventional surprise variable are now positive, as was the case for the EURO STOXX 50 index. However, whereas the latter lacked significance, eleven out of nineteen coefficients are significant now, albeit only at the 5% or 10% level. The largest influence can now be observed in the utilities sector. The Wald tests suggest that the relationship between conventional monetary policy surprises and stock returns is significantly different for sixteen out of nineteen portfolios between the pre-crisis and the crisis periods.

We find that sixteen sectors are significantly influenced by unconventional monetary policy surprises. In contrast to the conventional surprise during the crisis, the coefficients are mostly negative. But there is quite some heterogeneity in the magnitude of the parameters. The highest parameter estimate is again found for the banking sector. Apparently, this sector benefited the most from announcements that eased financial conditions in the euro area. Using the average change in yield spreads on announcement days, a monetary policy announcement that caused a decrease in the German-Italian yield spread of 0.06%-points on average led to an increase in banking stock returns of almost 1%-point. Sectors producing durable goods (like construction & materials, real estate, and automobile & parts) have high coefficients while non-durable sectors like personal & household goods, travel & leisure, and media are at the lower end of the spectrum. However, the sectors mostly affected after banks are insurance and oil & gas, which are non-durables sectors. It is therefore again difficult to identify a link between monetary policy surprises and the interest rate sensitivity of the sectors discerned.

Next we examine the credit channel by analysing whether the extent to which firms rely on debt influences the relationship between monetary policy surprises and stock returns. We first discuss the results for the pre-crisis period. Rows (1)-(3) of Table 3 present the estimations for the size effect. Our results suggest that monetary policy surprises before the crisis only have a (weakly) significant influence on large and mid cap stocks. It is difficult to reconcile these results with the credit channel. For the portfolios based on free cash flow (shown in rows (4)-(6) of Table 3), we find significant negative parameters for monetary surprises for the pre-crisis period, but there is no clear pattern in the magnitude of the estimated coefficients. The results for the portfolios sorted on the basis of the current ratio (shown in rows (7)-(9) of Table 3) confirm the hypothesis that firms with fewer means to meet short-term obligations are most strongly influenced monetary policy surprises. The parameters for monetary policy surprises for portfolios consisting of firms with low and medium current ratios are negative and significant, with the former being the largest and most significant.

[Insert Table 3 here]

The parameters for monetary policy surprises for portfolios sorted on the basis of free cash flow (shown in rows (10)-(12) of Table 3, both inclusive and exclusive financials) are negative and significant, but there is no clear pattern in the magnitude of these coefficients. The parameters for monetary policy surprises for portfolios sorted on the basis of the financial leverage ratio (shown in rows (13)-(15) of Table 3, both inclusive and exclusive financials) provide some evidence for the credit channel. For the portfolios with the highest leverage we find large and highly significant coefficients, whereas the estimated coefficients for the portfolios with low financial leverage are smaller and less significant. Finally, the results for the portfolios sorted on the basis of the debt-to-equity ratio (shown in rows (16)-(18) of Table 3) offer some weak evidence for the presence of a credit channel. The coefficients for monetary policy surprises for the two portfolios with high ratios (i.e. including and excluding financials) are large and have the highest significance levels. However, the coefficients of the portfolios with stocks having low debt-to-equity ratios are almost the same, while parameter estimates for the portfolios of stocks with medium ratios are relatively low.

In conclusion, our results for the pre-crisis conventional monetary policy surprises do not provide strong evidence for the credit channel of monetary policy. Excluding financials does not lead to a different conclusion.

Next, we turn to the crisis period. We start with the Wald tests about differences in parameter estimates of conventional monetary policy surprises between the pre-crisis and the crisis period. They suggest that there is not a very clear break between the pre-crisis and crisis results for conventional monetary policy surprises. Only for 11 out of 27 portfolios constructed to examine the credit channel the null hypothesis of similar parameter estimates can be rejected.

The coefficients of our proxy for unconventional monetary policy surprise are highly significant and negative in most cases. However, our results do not suggest that the impact differs across portfolios sorted based on size. The parameter estimates are fairly close to each other, and the coefficient of the small cap index is the smallest (see rows (1)-(3) of Table 3). But the results for the portfolios sorted on the basis of the financial structure of the firms do offer support for the credit channel. The parameter estimates for unconventional monetary policy surprises for the portfolios based on the coverage ratio confirm the presence of a credit channel. The estimates are highest for the portfolio with low coverage, whereas the portfolio with high coverage yields the smallest and least significant parameter (see rows (4)-(6) of Table 3). The same holds for the current ratio (see rows (7)-(9) of Table 3). The results for portfolios constructed on the basis of free cash flow are also in line with the credit channel with the low free cash flow portfolios yielding the largest coefficients (see rows (10)-(12) of Table 3). Likewise, the results for the portfolios based on leverage (shown in rows (13)-(15) of Table 3) and the debt-to-equity ratio (shown in rows (16)-(18) of Table 3) provide support for the credit

channel. The portfolios with high leverage (i.e. a high financial leverage ratio and debt-to-equity ratio) are influenced the most by unconventional monetary policy surprises.

Next, following Kontonikas and Kostakis (2013), we explore the classification of stocks into value and growth stocks. Rows (1)-(6) in Table 4 present the results. It turns out that all parameter estimates for the pre-crisis conventional monetary policy surprise variable are (weakly) significant. The estimated coefficients for value stocks and growth stocks are very similar suggesting that value stocks do not respond stronger than growth stocks to pre-crisis monetary policy surprises. For the crisis period the coefficients of conventional monetary policy surprises become insignificant. The Wald test t-statistics indicate that the relationship has especially changed for growth stocks. In contrast, the coefficients for the unconventional monetary policy surprise are highly significant. The largest parameter estimates are found for low market-to-book and price-to-earnings stocks, that is, the value stocks. For unconventional monetary policy announcements our results therefore confirm the findings of Kontonikas and Kostakis (2013). The exclusion of financials does not change this conclusion.

[Insert Table 4 here]

Finally, we look at the effect of momentum on the relationship between ECB monetary policy surprises and European stock returns (results are shown in rows (7)-(12) in Table 4). For the pre-crisis conventional monetary policy surprise, only the coefficient for the portfolio of the past month's winners is negative and highly significant. However, if winners and losers are determined over a six- and twelve-months period, the coefficients of portfolios of losers are the largest. For these portfolios we therefore confirm the findings of Kontonikas and Kostakis (2013). During the crisis, the coefficients for conventional monetary policy surprises for all portfolios are insignificant. The Wald test indicates that the relationship between conventional monetary policy and stock returns has only significantly changed for winner portfolios. The parameter estimates for the unconventional surprise are significant and negative across the board and confirm the findings of Kontonikas and Kostakis (2013). For all time horizons, the loser portfolios turn out to have larger coefficients than the winner portfolios.

5. Sensitivity analysis

So far, our analysis is based on an events study approach. Although widely used, this approach is based on some rather restrictive assumptions. This section therefore presents the results for the heteroscedasticity-based identification approach suggested by Rigobon and Sack (2004). In this approach, the dynamics of the short-term interest rate and stock prices are assumed to be as follows:

$$\Delta i_t = \beta \Delta s_t + \gamma z_t + \varepsilon_t \quad (6)$$

$$\Delta s_t = \alpha \Delta i_t + z_t + \eta_t \quad (7)$$

where Δi_t is the change in the policy rate, Δs_t is the change in the asset price and z_t is an unobservable common factor which affect both Δi_t and Δs_t. The variable ε_t is the monetary policy shock and η_t denotes a shock in the stock market. The shocks ε_t and η_t are assumed to be serially uncorrelated and to be uncorrelated with each other and with the common shock z_t. The heteroscedasticity-based identification technique requires a rise in the variance of the policy shock when the monetary policy decision is announced, while the variances of other shocks remain constant. Following Rigobon and Sack (2004), we use the generalized method of moments (GMM) technique which requires two subsamples, namely policy days and non-policy days. Policy days are days when the policy announcements are made. Non-policy days are the days immediately preceding the policy days. As detailed in Rigobon and Sack (2004), the GMM estimation uses a comparison of the covariance matrices of the variables on policy and non-policy days. Specifically, the moment conditions in the GMM estimation are the distinct elements of the difference of the two covariance matrices, hence the number of the moment conditions are three. Assuming that the parameters of the model, α, β and γ are stable across the two subsamples, the policy shock is heteroscedastic and the other shocks are homoscedastic, most of the parameters drop off the moment conditions. Ultimately, there are two parameters to be estimated, namely: α in equation (7) and a measure of the degree of heteroscedasticity that is present in the data. As there are three moment conditions and two parameters to be estimated, the overidentification restrictions enable us to test the model as a whole. As stated above, one assumption here is that the coefficients of the common factors are stable during policy and non-policy days. Hence it is not necessary to include the common factor (in our case, MSCI World Excluding Europe) in the estimations based on the Rigobon and Sack (2004) methodology.[13] For conventional and unconventional monetary policies, we use the same surprise measures in the GMM estimations as in section 4. We again analyze the responses of the EURO STOXX 50 index and various portfolios of stocks to policy announcements. In total, we consider 246 announcements; 226 of which are for conventional monetary policy and 20 of which are for unconventional monetary policy. The Rigobon and Sack (2004) methodology outlined above measures only the effects of policy surprises. Hence, we cannot measure the effects of expectations here. We have split the dataset into subsamples to examine the impact of monetary policy surprises during the non-crisis and crisis periods,

[13] When we include the MSCI index, the results (available on request) are fairly similar.

which are defined in the same way as in section 4. Since we use the data only on days of policy announcements, this gives us 136 observations for conventional monetary policy surprises in the pre-crisis period, 90 observations for conventional monetary policy surprises during the crisis period and 20 observations for unconventional monetary policy surprises.[14]

Table 5 shows the results for the Rigobon and Sack (2004) methodology. It is reassuring that our main findings are very similar to those based on the event study approach. To be more precise, we find only limited support for the interest rate channel of conventional monetary policy, only weak evidence for the credit channel of conventional monetary policy, but strong support for the credit channel of unconventional monetary policy. Likewise, our results for unconventional monetary policy announcements confirm the findings of Kontonikas and Kostakis (2013) concerning the differences between portfolios constructed on the basis of value vs. growth stocks and those based on momentum.[15]

[Insert Table 5 here]

6. Conclusion

This paper has made five contributions. First, we examine the impact of ECB monetary policy surprises on stock prices since the start of the common monetary policy using an event-study approach. Most previous studies focus on the impact of US monetary policy on stock prices and those studies examining the impact of the ECB's policies report mixed results.

Second, we distinguish between the impact of unexpected conventional and unconventional monetary policy decisions and show that both conventional and unconventional monetary policy surprises affect the EURO STOXX 50 index. The strongest effects are found for unconventional monetary policy surprises. To measure conventional monetary policy surprises we follow the approach suggested by Kuttner (2001) which is based on the notion that futures prices reflect market expectations of future policy rates. A monetary policy surprise can be represented by the discrepancy between the futures rate and the announced policy rate. To measure unconventional monetary policy surprises we follow the approach suggested by Rogers et al. (2014), which is based on changes in the yield spread between German and Italian

[14] Since the number of policy announcements for the unconventional monetary policy period is limited, many studies have to carry out regressions with limited sample sizes. For example, the estimations in Table 4 in Wright (2012) are carried out with 21 observations. Similarly, Rogers et al. (2014) estimate the impact of Fed's announcements regarding the large-scale asset purchases with 17 observations in Table 7 in their study. Here, we use 20 unconventional policy announcements, but even though the sample is small, the responses are highly statistically significant.

[15] We also carry out the diagnostic tests suggested by Rigobon and Sack (2004) for the heteroscedasticity-based estimation. Our diagnostic tests (not reported here, but available on request) show that, for all the cases, the change in the volatility in monetary policy shocks is satisfactory for the heteroscedasticity-based estimation. Besides, for all the cases, the over-identification test results do not indicate any over-identification problem. These findings imply that our heteroscedasticity-based estimation results are quite robust.

10-year government bonds at the day of a policy announcement. This reflects that the ECB's unconventional monetary policies were to quite some extent aimed at reducing intra-euro area sovereign spreads.

Third, we examine the impact of changes in the ECB policies on returns of several portfolios sorted on firm characteristics and past performance. This provides evidence for the credit channel of monetary policy, notably for unconventional monetary policy surprises. Our results do not provide strong evidence for the interest rate channel. Although stocks of different sectors respond differently to monetary policy surprises, these differences are hardly linked to differences with respect to their sensitivity to interest rates. Our results also suggest that value stocks are affected more by unconventional monetary policy surprises than growth stocks. The effects on value and growth stocks are fairly similar for conventional policy surprises. For portfolios constructed on the basis of momentum, we find that loser stocks react more strongly to unconventional monetary policy surprises which is in line with the findings of Kontonikas and Kostakis (2013) for the US.

Fourth, we show that the impact of ECB policy changes on these portfolios is not stable across time but differs across the crisis and non-crisis period. During the crisis, unexpected conventional monetary policy tightening is frequently associated with higher stock prices although the coefficients are insignificant in most cases. In addition, Wald tests frequently suggest a change in the effects of conventional monetary policy before and after the crisis. This finding is in line with the view of Hosono and Isobe (2014) that the loosening of monetary policy during times of crises might signal worsening economic conditions to investors. If the lowering of conventional policy rates is no longer considered a fruitful venture by investors, but a mere indicator of economic problems, it could lead to lower stock returns.

Finally, we examine whether our results are affected by the method chosen to identify the impact of monetary policy surprises on stock returns. It turns out that our main conclusions are similar for the events-study approach and the Rigobon and Sack (2004) methodology. The latter approach is robust to endogeneity and omitted variables problems and relies on much weaker assumptions than the event-study approach.

Appendix

Table A1.
Descriptive statistics. The statistics for monetary policy are measured only on event days. The stock return statistics are in percentages. The statistics for the 44 stocks of the EURO STOXX 50 are available from the author upon request.

	Mean	Standard Error	Minimum	Maximum
Monetary Policy				
Conventional Surprise	0.000	0.060	-0.270	0.300
Unconventional Surprise	-0.060	0.110	-0.340	0.150
Expected Changes	0.000	0.040	-0.200	0.280
General Indices				
EURO STOXX 50	0.002	1.495	-8.208	10.438
MSCI World Ex Europe	0.010	1.140	-7.070	8.240
Interest-Rate Channel Portfolios				
Automobiles & Parts	0.006	1.773	-13.523	9.905
Banks	-0.016	1.919	-10.781	17.583
Basic Resources	0.016	1.925	-15.667	15.687
Chemicals	0.030	1.526	-9.299	12.928
Construction & Materials	0.013	1.552	-10.372	11.474
Financial Services	0.019	1.101	-8.058	8.559
Food & Beverage	0.025	1.159	-8.494	7.428
Health Care	0.018	1.178	-8.965	10.356
Industrial Goods & Services	0.020	1.438	-9.809	10.124
Insurance	-0.006	1.810	-12.384	12.710
Media	0.001	1.473	-9.740	10.206
Oil & Gas	0.009	1.634	-11.519	14.528
Personal & Household Goods	0.025	1.377	-9.458	10.889
Real Estate	0.013	1.141	-7.760	7.668
Retail	0.018	1.178	-8.965	10.356
Technology	0.001	1.999	-12.860	10.310
Telecommunications	-0.007	1.654	-10.637	11.705
Travel & Leisure	0.005	1.450	-10.805	8.600
Utilities	-0.001	1.362	-9.798	14.817

Table A1 - Continued

	Mean	Standard Error	Minimum	Maximum
Credit Channel Portfolios				
EURO STOXX 50 Large	0.017	1.164	-7.890	8.132
EURO STOXX 50 Mid	0.014	1.163	-8.238	9.186
EURO STOXX 50 Small	0.003	1.426	-8.273	10.184
Interest Coverage High	0.018	1.410	-8.909	10.204
Interest Coverage Mid	0.019	1.362	-9.519	12.136
Interest Coverage Low	0.008	1.485	-7.656	9.448
Current Ratio High	0.025	1.525	-8.060	9.590
Current Ratio Mid	0.013	1.425	-8.471	12.081
Current Ratio Low	0.009	1.281	-7.983	10.365
Free Cash Flow High	0.013	1.396	-7.859	9.117
Excluding Financials	0.012	1.422	-8.052	9.733
Free Cash Flow Mid	0.020	1.375	-7.816	10.964
Excluding Financials	0.024	1.384	-7.825	10.909
Free Cash Flow Low	0.002	1.769	-10.688	13.051
Excluding Financials	0.013	1.400	-8.439	11.164
Financial Leverage High	-0.007	1.832	-10.917	14.577
Excluding Financials	0.005	1.526	-8.686	11.456
Financial Leverage Mid	0.013	1.397	-7.637	10.295
Excluding Financials	0.005	1.405	-7.600	9.788
Financial Leverage Low	0.024	1.353	-8.717	9.208
Excluding Financials	0.030	1.354	-8.794	9.409
Debt-to-equity High	0.005	1.522	-9.138	11.205
Excluding Financials	0.010	1.348	-7.487	10.129
Debt-to-equity Mid	0.012	1.482	-8.800	11.527
Excluding Financials	0.020	1.380	-9.695	13.175
Debt-to-equity Low	0.014	1.505	-8.839	10.165
Excluding Financials	0.014	1.572	-10.235	9.660
Value and Growth Stock Portfolios				
Market-to-book High	0.021	1.350	-7.819	9.358
Excluding Financials	0.022	1.326	-7.586	8.192
Market-to-book Mid	0.005	1.466	-8.470	11.960
Excluding Financials	0.013	1.429	-8.447	11.628
Market-to-book Low	0.003	1.792	-9.938	14.395
Excluding Financials	0.006	1.510	-9.054	11.447
Price-to-earnings High	0.016	1.293	-7.923	9.122
Excluding Financials	0.017	1.355	-8.120	8.989

Table A1 - Continued

	Mean	Standard Error	Minimum	Maximum
Price-to-earnings Mid	0.006	1.635	-7.965	10.582
Excluding Financials	0.015	1.479	-7.895	10.101
Price-to-earnings Low	0.008	1.631	-10.214	12.602
Excluding Financials	0.011	1.442	-8.664	11.566
Momentum Portfolios				
Winners (1 Month)	0.250	1.422	-7.590	10.598
Losers (1 Month)	-0.230	1.613	-10.110	11.428
Winners (6 Months)	0.104	1.317	-7.482	9.478
Losers (6 Months)	-0.084	1.727	-9.622	12.096
Winners (12 Months)	0.081	1.304	-6.929	9.351
Losers (12 Months)	-0.061	1.744	-9.912	11.978

Table A2.

Correlation table for the independent variables.

	Surprise Conventional	Surprise Unconventional	Unexpected Change	MSCI World Ex Europe	Crisis
Surprise Conventional	1	-0.027	-0.662	0.044	0.003
Surprise Unconventional	-0.027	1	0.022	-0.024	-0.038
Unexpected Change	-0.662	0.022	1	-0.005	-0.009
MSCI World Ex Europe	0.044	-0.024	-0.005	1	0.008
Crisis	0.003	-0.038	-0.009	0.008	1

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Tables

Table 1

Regression output for the EURO STOXX 50. The regression model is given by Equation (1). The MSCI World Ex Europe index and the crisis dummy are included as control variables. All regressions are estimated with White's consistent standard errors. Number of observations: 4215. T-statistics are provided in parentheses. * Denotes significance at the 10%, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

	EURO STOXX 50
Conventional Surprise Pre-Crisis	-0.071*
	(-1.913)
Expected Change Pre-Crisis	-0.146***
	(-2.690)
Surprise Conventional Crisis	0.071
	(0.880)
Expected Change Crisis	0.042
	(0.441)
Surprise Unconventional	-0.069***
	(-2.961)
Constant	0.000
	(0.195)
R^2	0.283
Wald Test t-Statistic	-1.560

Table 2

Regression output for the interest-rate channel. The regression model is given by Equation (1). The MSCI World Ex Europe index and the crisis dummy are included as control variables. All regressions are estimated with White's consistent standard errors. Number of observations per regression: 4215, except automobiles & parts: 4212. The t-statistics are provided in parentheses. * Denotes significance at the 10%, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

	Conventional Surprise	Expected Change	Conventional Surprise Crisis	Expected Change Crisis	Unconventional Surprise	Constant	R^2	Wald Test t-Statistic
Automobiles & Parts	-0.068***	-0.078***	0.099	-0.040	-0.073***	0.000	0.079	-1.568
	(-3.331)	*(-2.454)*	*(0.946)*	*(-0.354)*	*(-3.081)*	*(0.689)*		
Banks	-0.043**	-0.062***	0.170	0.131	-0.146***	0.000	0.071	-1.737*
	(-2.056)	*(-2.764)*	*(1.408)*	*(0.892)*	*(-3.029)*	*(0.904)*		
Basic Resources	0.013	0.040	0.322	0.183	-0.089***	0.001**	0.058	-1.405
	(0.477)	*(1.144)*	*(1.478)*	*(0.723)*	*(-3.387)*	*(2.437)*		
Chemicals	-0.039*	-0.027	0.233*	0.131	-0.075***	0.000	0.063	-2.198**
	(-1.928)	*(-0.958)*	*(-1.908)*	*(0.917)*	*(-2.942)*	*(1.385)*		
Construction & Materials	-0.031**	0.004	0.228*	0.135	-0.095***	0.000**	0.050	-1.913*
	(-1.991)	*(0.266)*	*(1.697)*	*(0.894)*	*(-3.186)*	*(2.110)*		
Financial Services	-0.007	0.004	0.150*	0.092	-0.044**	0.000**	0.020	-1.709*
	(-0.541)	*(0.252)*	*(1.651)*	*(0.934)*	*(-2.200)*	*(2.105)*		
Food & Beverage	-0.036*	-0.033*	0.141*	0.039	-0.060**	0.000	0.017	-2.046**
	(-1.696)	*(-1.787)*	*(1.679)*	*(0.400)*	*(-1.992)*	*(1.116)*		
Health Care	-0.044***	-0.039**	0.141**	0.071	-0.043	0.000	0.031	-2.634***
	(-2.574)	*(-1.962)*	*(2.072)*	*(0.977)*	*(-1.394)*	*(0.857)*		
Industrial Goods & Services	-0.028	-0.061**	0.191	0.115	-0.057**	0.000	0.089	-1.823*
	(-1.378)	*(-2.169)*	*(1.613)*	*(0.891)*	*(-2.338)*	*(1.372)*		

Table 2 - Continued

	Conventional Surprise	Expected Change	Conventional Surprise Crisis	Expected Change Crisis	Unconventional Surprise	Constant	R^2	Wald Test t-Statistic
Insurance	-0.069***	-0.128***	0.190	0.114	-0.103***	-0.000	0.084	-2.032**
	(-2.678)	*(-3.200)*	*(1.522)*	*(0.731)*	*(-2.692)*	*(-0.026)*		
Media	-0.042	-0.074**	0.172*	0.116	-0.047	0.000	0.056	-2.052**
	(-1.522)	*(-2.098)*	*(1.712)*	*(1.057)*	*(-1.469)*	*(0.127)*		
Oil & Gas	-0.028	-0.050	0.232*	0.146	-0.102***	0.000	0.050	-2.060**
	(-1.048)	*(-1.502)*	*(1.880)*	*(1.024)*	*(-3.154)*	*(1.332)*		
Personal & Household Goods	-0.044***	-0.046**	0.194**	0.115	-0.053*	0.000	0.053	-2.588***
	(-2.724)	*(-2.247)*	*(2.141)*	*(1.139)*	*(-1.663)*	*(1.149)*		
Real Estate	0.001	0.025**	0.165**	0.089	-0.079***	0.000**	0.012	-2.390**
	(0.048)	*(1.983)*	*(2.435)*	*(1.165)*	*(-2.972)*	*(2.363)*		
Retail	-0.032*	-0.035	0.181**	0.129	-0.067**	0.000	0.037	-2.496**
	(-1.864)	*(-1.371)*	*(2.167)*	*(1.430)*	*(-2.482)*	*(0.506)*		
Technology	-0.026	-0.124*	0.137	0.050	-0.037	0.000	0.127	-1.108
	(-0.473)	*(-1.833)*	*(1.005)*	*(0.340)*	*(-1.305)*	*(0.060)*		
Telecommunications	-0.080**	-0.136***	0.147*	0.118	-0.073**	-0.000	0.059	-2.491**
	(-2.570)	*(-3.313)*	*(1.714)*	*(1.237)*	*(-2.409)*	*(-0.047)*		
Travel & Leisure	-0.023	-0.040*	0.158	0.099	-0.059**	0.000	0.052	-1.758*
	(-1.265)	*(-1.879)*	*(1.561)*	*(0.790)*	*(-2.315)*	*(0.761)*		
Utilities	-0.025*	-0.015	0.238**	0.187*	-0.081**	0.000	0.030	-2.491**
	(-1.770)	*(-0.964)*	*(2.278)*	*(1.750)*	*(-2.472)*	*(1.430)*		

Table 3

Regression output for the credit channel. The regression model is given by Equation (1). The MSCI World Ex Europe index and the crisis dummy are included as control variables. All regressions are estimated with White's consistent standard errors. Number of observations per regression: 4215. The t-statistics are provided in parentheses. * Denotes significance at the 10%, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

	Conventional Surprise	Expected Change	Conventional Surprise Crisis	Expected Change Crisis	Unconventional Surprise	Constant	R^2	Wald Test
(1) EURO STOXX 50 Large	-0.061*	-0.128***	0.075	0.046	-0.064***	0.000	0.292	-1.565
	(-1.843)	*(-2.700)*	*(0.934)*	*(0.480)*	*(-2.991)*	*(0.225)*		
(2) EURO STOXX 50 Mid	-0.020*	-0.058***	0.075	0.060	-0.068***	0.000	0.268	-1.284
	(-1.679)	*(-3.876)*	*(1.025)*	*(0.701)*	*(-4.013)*	*(1.186)*		
(3) EURO STOXX 50 Small	-0.005	-0.021*	0.090	0.061	-0.059***	0.000*	0.228	-1.309
	(-0.401)	*(-1.731)*	*(1.262)*	*(0.717)*	*(-2.924)*	*(1.651)*		
(4) Interest Coverage High	-0.083**	-0.175***	0.073	0.040	-0.044*	0.000	0.281	-2.065**
	(-2.399)	*(-3.543)*	*(1.086)*	*(0.501)*	*(-1.763)*	*(0.308)*		
(5) Interest Coverage Mid	-0.044**	-0.080***	0.137	0.102	-0.066***	0.000	0.243	-1.796*
	(-2.004)	*(-2.686)*	*(1.392)*	*(0.902)*	*(-3.135)*	*(1.346)*		
(6) Interest Coverage Low	-0.073**	-0.137**	0.042	0.020	-0.071***	0.000	0.268	-1.235
	(-2.031)	*(-2.490)*	*(0.491)*	*(0.197)*	*(-3.047)*	*(0.531)*		
(7) Current Ratio High	-0.053	-0.151***	0.075	0.032	-0.043*	0.000	0.287	-1.387
	(-1.417)	*(-2.970)*	*(0.890)*	*(0.327)*	*(-1.778)*	*(0.738)*		
(8) Current Ratio Mid	-0.070**	-0.100**	0.089	0.046	-0.069***	0.000	0.247	-1.619
	(-2.462)	*(-2.229)*	*(0.948)*	*(0.415)*	*(-3.571)*	*(1.023)*		
(9) Current Ratio Low	-0.075***	-0.133***	0.076	0.078	-0.067***	0.000	0.242	-1.966**
	(-2.822)	*(-3.529)*	*(1.056)*	*(0.965)*	*(-2.838)*	*(0.311)*		

Table 3 - Continued

	Conventional Surprise	Expected Change	Conventional Surprise Crisis	Expected Change Crisis	Unconventional Surprise	Constant	R^2	Wald Test
(10) Free Cash Flow High	-0.069**	-0.147***	0.052	0.030	-0.047**	0.000	0.273	-1.391
	(-1.967)	*(-2.898)*	*(0.654)*	*(0.331)*	*(-2.081)*	*(0.444)*		
Excluding Financials	-0.074**	-0.158***	0.047	0.033	-0.045**	0.000	0.264	-1.486
	(-2.065)	*(-3.097)*	*(0.642)*	*(0.397)*	*(-2.406)*	*(0.269)*		
(11) Free Cash Flow Mid	-0.064**	-0.106***	0.110	0.079	-0.078***	0.000	0.253	-1.892*
	(-2.477)	*(-2.789)*	*(1.248)*	*(0.778)*	*(-2.800)*	*(1.224)*		
Excluding Financials	-0.059**	-0.107***	0.091	0.052	-0.067**	0.000	0.265	-1.542
	(-2.296)	*(-2.817)*	*(0.970)*	*(0.475)*	*(-2.525)*	*(1.205)*		
(12) Free Cash Flow Low	-0.064*	-0.127***	0.079	0.067	-0.107***	0.000	0.237	-1.342
	(-1.783)	*(-2.716)*	*(0.787)*	*(0.529)*	*(-3.526)*	*(0.634)*		
Excluding Financials	-0.061**	-0.113**	0.095	0.063	-0.061***	0.000	0.259	-1.794*
	(-2.001)	*(-2.497)*	*(1.169)*	*(0.664)*	*(-3.234)*	*(0.911)*		
(13) Financial Leverage High	-0.080**	-0.159***	0.084	0.080	-0.114***	0.000	0.219	-1.521
	(-2.110)	*(-3.025)*	*(0.834)*	*(0.614)*	*(-3.041)*	*(0.198)*		
Excluding Financials	-0.085***	-0.158***	0.081	0.048	-0.073***	0.000	0.252	-1.618
	(-2.822)	*(-3.333)*	*(0.826)*	*(0.407)*	*(-2.977)*	*(0.290)*		
(14) Financial Leverage Mid	-0.067**	-0.120**	0.062	0.029	-0.062***	0.000	0.275	-1.297
	(-2.069)	*(-2.495)*	*(0.660)*	*(0.274)*	*(-2.820)*	*(0.652)*		
Excluding Financials	-0.071**	-0.126**	0.070	0.053	-0.066**	0.000	0.258	-1.552
	(-1.982)	*(-2.390)*	*(0.840)*	*(0.562)*	*(-2.478)*	*(0.217)*		

Table 3 - Continued

	Conventional Surprise	Expected Change	Conventional Surprise Crisis	Expected Change Crisis	Unconventional Surprise	Constant	R^2	Wald Test
(15) Financial Leverage Low	-0.057**	-0.123***	0.104	0.073	-0.056**	0.000	0.278	-1.983**
	(-2.130)	*(-3.323)*	*(1.358)*	*(0.808)*	*(-2.567)*	*(1.022)*		
Excluding Financials	-0.048*	-0.116***	0.101	0.064	-0.052***	0.000	0.282	-1.891*
	(-1.905)	*(-3.327)*	*(1.352)*	*(0.731)*	*(-2.642)*	*(1.290)*		
(16) Debt-to-equity High	-0.080**	-0.143***	0.062	0.055	-0.086***	0.000	0.263	-1.354
	(-2.551)	*(-3.233)*	*(0.619)*	*(0.445)*	*(-3.487)*	*(0.441)*		
Excluding Financials	-0.078***	-0.129***	0.061	0.051	-0.067***	0.000	0.261	-1.532
	(-2.741)	*(-3.122)*	*(0.705)*	*(0.516)*	*(-3.169)*	*(0.449)*		
(17) Debt-to-equity Mid	-0.050	-0.095**	0.110	0.080	-0.088***	0.000	0.236	-1.700*
	(-1.611)	*(-2.163)*	*(1.238)*	*(0.769)*	*(-3.062)*	*(0.974)*		
Excluding Financials	-0.040*	-0.070**	0.127	0.079	-0.081***	0.000	0.233	-1.733*
	(-1.745)	*(-2.148)*	*(1.361)*	*(0.728)*	*(-3.922)*	*(1.438)*		
(18) Debt-to-equity Low	-0.073**	-0.167***	0.077	0.040	-0.054**	0.000	0.284	-1.723*
	(-2.070)	*(-3.244)*	*(0.969)*	*(0.415)*	*(-1.985)*	*(0.458)*		
Excluding Financials	-0.077**	-0.186***	0.070	0.034	-0.048*	0.000	0.284	-1.693*
	(-2.037)	*(-3.404)*	*(0.896)*	*(0.364)*	*(-1.722)*	*(0.294)*		

Table 4

Regression output for the value versus growth and momentum portfolios. The regression model is given by Equation (1). The MSCI World Ex Europe index and the crisis dummy are included as control variables. All regressions are estimated with White's consistent standard errors. Number of observations per regression: 4215. The t-statistics are provided in parentheses. * Denotes significance at the 10%, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

	Conventional Surprise	Expected Change	Conventional Surprise Crisis	Expected Change Crisis	Unconventional Surprise	Constant	R^2	Wald Test
(1) Market-to-book High	-0.068**	-0.139***	0.074	0.040	-0.042*	0.000	0.286	-1.697*
	(-2.122)	*(-2.934)*	*(0.958)*	*(0.459)*	*(-1.869)*	*(0.881)*		
Excluding Financials	-0.070**	-0.144***	0.068	0.034	-0.042*	0.000	0.277	-1.754*
	(-2.094)	*(-2.885)*	*(0.950)*	*(0.419)*	*(-1.683)*	*(0.850)*		
(2) Market-to-book Mid	-0.076**	-0.133***	0.072	0.049	-0.079***	0.000	0.261	-1.665*
	(-2.443)	*(-2.939)*	*(0.864)*	*(0.512)*	*(-2.963)*	*(0.319)*		
Excluding Financials	-0.055**	-0.119***	0.070	0.043	-0.069***	0.000	0.270	-1.427
	(-2.304)	*(-3.439)*	*(0.831)*	*(0.453)*	*(-3.041)*	*(0.776)*		
(3) Market-to-book Low	-0.060*	-0.130***	0.104	0.094	-0.115***	0.000	0.221	-1.418
	(-1.753)	*(-2.886)*	*(0.945)*	*(0.648)*	*(-3.444)*	*(0.584)*		
Excluding Financials	-0.079**	-0.138***	0.114	0.088	-0.079***	0.000	0.251	-1.820*
	(-2.380)	*(-2.807)*	*(1.135)*	*(0.707)*	*(-3.473)*	*(0.166)*		
(4) Price-to-earnings High	-0.069**	-0.132***	0.070	0.044	-0.050**	0.000	0.279	-2.224**
	(-2.464)	*(-3.229)*	*(1.251)*	*(0.698)*	*(-2.198)*	*(0.576)*		
Excluding Financials	-0.069***	-0.136***	0.075	0.051	-0.049**	0.000	0.282	-2.266**
	(-2.667)	*(-3.397)*	*(1.286)*	*(0.767)*	*(-2.189)*	*(0.520)*		

Table 4 - Continued

	Conventional Surprise	Expected Change	Conventional Surprise Crisis	Expected Change Crisis	Unconventional Surprise	Constant	R^2	Wald Test
(5) Price-to-earnings Mid	-0.071*	-0.140***	0.072	0.053	-0.092***	0.000	0.257	-1.340
	(-1.906)	*(-2.744)*	*(0.720)*	*(0.464)*	*(-2.902)*	*(0.618)*		
Excluding Financials	-0.064*	-0.129**	0.065	0.018	-0.061***	0.000	0.273	-1.211
	(-1.717)	*(-2.452)*	*(0.652)*	*(0.159)*	*(-2.707)*	*(0.830)*		
(6) Price-to-earnings Low	-0.064**	-0.130***	0.109	0.085	-0.093***	0.000	0.238	-1.475
	(-2.034)	*(-2.882)*	*(0.965)*	*(0.584)*	*(-3.177)*	*(0.597)*		
Excluding Financials	-0.065**	-0.122***	0.124	0.096	-0.081***	0.000	0.237	-1.804*
	(-2.345)	*(-2.908)*	*(1.231)*	*(0.773)*	*(-3.126)*	*(0.689)*		
(7) Winners (1 Month)	-0.078***	-0.119***	0.085	0.032	-0.075***	0.003***	0.261	-1.841*
	(-3.097)	*(-3.358)*	*(1.000)*	*(0.320)*	*(-3.729)*	*(11.557)*		
(8) Losers (1 Month)	-0.058	-0.150***	0.081	0.088	-0.081**	-0.002***	0.253	-1.366
	(-1.449)	*(-2.603)*	*(0.867)*	*(0.762)*	*(-1.965)*	*(-9.258)*		
(9) Winners (6 Months)	-0.053**	-0.096***	0.066	0.028	-0.048**	0.001***	0.255	-1.800*
	(-2.157)	*(-2.695)*	*(1.076)*	*(0.386)*	*(-2.146)*	*(5.466)*		
(10) Losers (6 Months)	-0.083**	-0.172***	0.100	0.093	-0.108***	-0.001***	0.256	-1.482
	(-2.038)	*(-3.002)*	*(0.858)*	*(0.653)*	*(-3.357)*	*(-3.192)*		
(11) Winners (12 Months)	-0.050**	-0.098***	0.065	0.044	-0.065***	0.001***	0.252	-1.685*
	(-2.166)	*(-2.806)*	*(1.015)*	*(0.589)*	*(-3.679)*	*(4.196)*		
(12) Losers (12 Months)	-0.086**	-0.170***	0.100	0.076	-0.091**	-0.001**	0.256	-1.541
	(-2.037)	*(-2.937)*	*(0.886)*	*(0.549)*	*(-2.446)*	*(-2.213)*		

Table 5

Estimation output with identification through heteroscedasticity (methodology suggested in Rigobon and Sack, 2004). The regression model is given by Equation (7). * Denotes significance at the 10%, ** denotes significance at the 5% level, and *** denotes significance at the 1% level.

	Conventional Surprise		Conventional Surprise Crisis		Unconventional Surprise	
	GMM est	*t stat*	GMM est	*t stat*	GMM est	*t stat*
EURO STOXX 50	-0.066**	*-2.233*	0.040	*0.903*	-0.185***	*-4.137*
Auto & Parts	-0.075***	*-2.606*	0.063	*0.977*	-0.147	*-1.445*
Banks	-0.049**	*-2.078*	0.023	*0.324*	-0.390***	*-4.798*
Basic Resources	0.023	*0.696*	0.174**	*2.125*	-0.200**	*-2.219*
Chemicals	-0.053*	*-1.797*	0.049	*0.838*	-0.242***	*-4.518*
Construction & Materials	-0.073***	*-3.079*	0.109*	*1.756*	-0.271***	*-4.470*
Financial Services	-0.028	*-1.616*	0.029	*0.899*	-0.138***	*-3.356*
Food & Beverages	-0.060**	*-2.097*	0.188***	*3.601*	-0.207***	*-6.668*
Health Care	-0.080**	*-2.544*	0.102**	*2.552*	-0.188***	*-4.643*
Industrial Goods & Services	-0.042*	*-1.744*	0.089*	*1.710*	-0.209***	*-3.493*
Insurance	-0.083***	*-2.621*	0.164	*1.208*	-0.287***	*-4.937*
Media	-0.022	*-0.639*	0.029	*0.636*	-0.196***	*-3.275*
Oil & Gas	-0.025	*-0.864*	0.103*	*1.673*	-0.236***	*-3.934*
Personal & Household Goods	-0.046*	*-1.812*	0.143***	*2.919*	-0.192***	*-4.040*
Real Estate	-0.015	*-0.774*	0.079	*1.340*	-0.213***	*-5.372*
Retail	-0.045**	*-1.979*	0.137***	*3.074*	-0.186***	*-3.620*
Technology	-0.093	*-1.276*	0.060	*1.263*	-0.194***	*-3.556*
Telecom	-0.117**	*-2.119*	0.055	*1.460*	-0.237***	*-4.424*
Travel & Leisure	-0.036	*-1.420*	0.057	*1.205*	-0.210***	*-4.366*
Utilities	-0.055***	*-2.940*	0.089*	*1.833*	-0.262***	*-5.210*

Table 5 - Continued

	Conventional Surprise		Conventional Surprise Crisis		Unconventional Surprise	
	GMM est	*t stat*	GMM est	*t stat*	GMM est	*t stat*
EURO STOXX 50 Large	-0.050*	*-1.793*	0.039	*0.906*	-0.176***	*-4.117*
EURO STOXX 50 Mid	0.011	*0.513*	-0.003	*-0.069*	-0.166***	*-4.078*
EURO STOXX 50 Small	0.008	*0.410*	0.008	*0.213*	-0.183***	*-4.433*
Interest Coverage High	-0.039	*-1.079*	0.076**	*1.997*	-0.133***	*-3.422*
Interest Coverage Mid	-0.014	*-0.558*	0.081*	*1.887*	-0.186***	*-4.114*
Interest Coverage Low	-0.073**	*-2.454*	0.017	*0.353*	-0.189***	*-3.885*
Current Ratio High	-0.026	*-0.675*	0.066	*1.516*	-0.155***	*-3.864*
Current Ratio Mid	-0.060**	*-2.371*	0.064	*1.503*	-0.156***	*-3.060*
Current Ratio Low	-0.056**	*-1.994*	0.031	*0.819*	-0.195***	*-4.401*
Free Cash Flow High	-0.057*	*-1.711*	0.034	*0.892*	-0.161***	*-3.988*
Free Cash Flow High - Excluding Financials	-0.049	*-1.339*	0.025	*0.728*	-0.155***	*-4.176*
Free Cash Flow Mid	-0.035	*-1.554*	0.069	*1.648*	-0.208***	*-4.460*
Free Cash Flow Mid - Excluding Financials	-0.031	*-1.230*	0.081	*1.808*	-0.174***	*-3.754*
Free Cash Flow Low	-0.041	*-1.327*	0.023	*0.349*	-0.264***	*-3.861*
Free Cash Flow Low - Excluding Financials	-0.032	*-1.233*	0.062	*1.495*	-0.151***	*-2.964*
Financial Leverage High	-0.074**	*-2.377*	0.056	*0.817*	-0.301***	*-4.412*
Financial Leverage High - Excluding Financials	-0.051	*-1.609*	0.031	*0.581*	-0.179***	*-3.061*
Financial Leverage Mid	-0.055**	*-2.082*	0.033	*0.784*	-0.175***	*-3.885*
Financial Leverage Mid - Excluding Financials	-0.077***	*-2.752*	0.036	*0.905*	-0.204***	*-4.745*
Financial Leverage Low	-0.012	*-0.409*	0.070	*1.804*	-0.162***	*-4.031*
Financial Leverage Low - Excluding Financials	-0.006	*-0.213*	0.084**	*2.193*	-0.141***	*-3.706*
Debt to Equity High	-0.051*	*-1.815*	-0.002	*-0.037*	-0.209***	*-3.551*
Debt to Equity High - Excluding Financials	-0.054**	*-1.986*	0.021	*0.514*	-0.185***	*-3.669*
Debt to Equity Mid	-0.041	*-1.608*	0.068	*1.329*	-0.245***	*-5.101*
Debt to Equity Mid - Excluding Financials	-0.030	*-1.267*	0.086*	*1.889*	-0.169***	*-3.981*
Debt to Equity Low	-0.043	*-1.262*	0.065	*1.437*	-0.165***	*-3.822*
Debt to Equity Low - Excluding Financials	-0.047	*-1.214*	0.065	*1.390*	-0.173***	*-4.107*

Table 5 - Continued

	Conventional Surprise		Conventional Surprise Crisis		Unconventional Surprise	
	GMM est	*t stat*	GMM est	*t stat*	GMM est	*t stat*
Market to Book High	-0.030	*-1.017*	0.077**	*2.166*	-0.155***	*-4.424*
Market to Book High - Excluding Financials	-0.036	*-1.209*	0.069**	*2.017*	-0.166***	*-4.682*
Market to Book Mid	-0.061**	*-2.336*	0.020	*0.456*	-0.201***	*-3.837*
Market to Book Mid - Excluding Financials	-0.012	*-0.422*	0.058	*1.317*	-0.186***	*-4.109*
Market to Book Low	-0.043	*-1.502*	0.041	*0.562*	-0.290***	*-4.481*
Market to Book Low - Excluding Financials	-0.069***	*-2.758*	0.035	*0.647*	-0.175***	*-3.223*
Price to Earnings High	-0.033	*-1.117*	0.074**	*2.358*	-0.156***	*-4.531*
Price to Earnings High - Excluding Financials	-0.027	*-0.907*	0.078**	*2.389*	-0.164***	*-4.626*
Price to Earnings Mid	-0.069**	*-2.113*	0.020	*0.335*	-0.268***	*-4.505*
Price to Earnings Mid - Excluding Financials	-0.050*	*-1.782*	0.054	*1.183*	-0.137***	*-2.726*
Price to Earnings Low	-0.040	*-1.577*	0.012	*0.200*	-0.216***	*-3.595*
Price to Earnings Low - Excluding Financials	-0.031	*-1.296*	0.029	*0.568*	-0.214***	*-4.099*
Winners - 1 Month	-0.068**	*-2.332*	0.033	*0.774*	-0.152***	*-2.622*
Losers - 1 Month	-0.029	*-1.020*	0.037	*0.781*	-0.275***	*-4.596*
Winners - 6 Month	-0.021	*-0.874*	0.038	*0.999*	-0.162***	*-4.114*
Losers - 6 Month	-0.079**	*-2.266*	0.055	*0.921*	-0.270***	*-4.190*
Winners - 12 Month	-0.021	*-0.836*	0.042	*1.040*	-0.164***	*-4.161*
Losers - 12 Month	-0.074**	*-2.079*	0.046	*0.764*	-0.268***	*-4.027*

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