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The Impact of COVID-19 and other Crises on the Responses of Swiss Bond Yields and Stock Prices to ECB Policy Surprises

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The impact of Covid-19 and other crises on the responses of Swiss bond yields and stock prices to ECB policy surprises

12 November 2021

Abstract

We analyse spillovers from ECB policy surprises to non-euro area asset markets using Switzerland as a case study. We find that spillovers are particularly strong in crisis periods. Moreover, our findings suggest that Swiss stock prices respond to non-monetary information provided with the ECB's short-term forward guidance. Policy surprises from the ECB press release were only influential at the start of the coronavirus pandemic. By contrast, policy surprises from the ECB's press conference influence both Swiss stock prices and Swiss government bond yields at all times. These surprises affect bond yields through both signalling and portfolio balance effects.

JEL: E43, E52, G15

Keywords: bond, event study, international spillovers, monetary policy, stock

1 Introduction

Monetary policy actions aim at influencing macroeconomic variables, such as inflation or employment, but the immediate effects of monetary policy are mainly visible on financial markets (Bernanke and Kuttner, 2005).

Monetary policy decisions in major economies do not only influence domestic asset prices but also international financial markets. For example, it is well documented empirically (Ammer, Vega, and Wongswan, 2010; Brusa, Savor, and Wilson, 2020; Ehrmann and Fratzscher, 2009; Miranda-Agrippino and Rey, 2020; Thorbecke, 1997; Wongswan, 2009) and theoretically, e.g., Jiang, Krishnamurthy, and Lustig (2020), that US monetary policy decisions affect asset markets worldwide.

Somewhat surprisingly, there are few research papers on the question of whether the monetary policy decisions of the European Central Bank (ECB), the central bank of the second main currency area, affect asset markets of economies outside the euro area. Notable exceptions are ter Ellen, Jansen, and Midthjell (2020), who analyse spillovers from ECB policy to asset prices in Denmark, Norway and Sweden. In addition, Falagiarda, McQuade, and Tirpák (2015) assess whether the ECB's unconventional monetary policy measures from 2007 to 2015 affect financial markets in the Czech Republic, Hungary, Poland and Romania. Furthermore, Potjagailo (2017) evaluates the real and financial spillovers of ECB policy shocks to a block of 14 non-euro area economies.

Our paper contributes to the literature analysing the impact of ECB policy on non-euro area asset markets by empirically evaluating the responses of Swiss government bond yields and stock market indices to ECB policy surprises in event study regressions. Moreover, we explicitly assess whether particular events had an outsized influence on the reaction of Swiss bond and stock prices to ECB policy surprises and thus whether ECB policy spillover is particularly pronounced in specific periods.

We view Switzerland to be an interesting case study of the international spillovers of ECB policy because the Swiss economy is tightly linked with the euro area.¹ Hence, evaluating the responses of Swiss bond and stock prices to ECB policy de-

¹For example, the weight of the euro area in the Swiss National Bank's trade-weighted Swiss franc exchange rate index varied between 40% and 60% from 2002 to 2020 (SNB Dataportal).

cisions helps to understand the channels through which euro area monetary policy transmits to economies outside the euro area.

Our analysis complements Bernhard and Ebner (2017), who assess the impact of foreign central banks' unconventional monetary policy measures, approximated by changes in futures on long-term government bond yields, on Swiss asset markets. Our assessments extend this analysis by additionally exploiting recent advances in measuring ECB policy surprises (Altavilla, Brugnolini, Gürkaynak, Motto, and Ragusa, 2019))² to assess whether specific dimensions of ECB monetary policy (policy rate, short-term and longer-term forward guidance, asset purchases) particularly affect Swiss stock and bond prices from 2002 to 2020. Moreover, we do not only look at 'raw' changes in bond yields and stock prices but also evaluate the responses of the different components of Swiss government bond yields that reflect either expectations about the future path of CHF short-term interest rates or the term premium of long-term Swiss government bond yields. This distinction is important because foreign monetary policy has a strong impact on CPI inflation and economic developments in Switzerland and thus on Swiss monetary policy (Jordan, 2016). Indeed, we provide evidence suggesting that ECB policy surprises affect the expectations about future short-term CHF interest rates, which should be closely related to expectations about the policy rate of the Swiss National Bank (SNB). Furthermore, we explicitly evaluate whether our main empirical results reflect the impact of specific events. For example, we highlight that the scheduled ECB decisions at the heights of the global financial crisis and at the beginning of the coronavirus pandemic in March 2020 were highly influential for Swiss asset markets. In contrast to Bernhard and Ebner (2017), we do not examine exchange rate reactions to ECB policy surprises because the SNB either imposed a minimum exchange rate against the euro or, if necessary from a monetary policy point of view, directly intervened in foreign exchange markets in large parts of our sample period (Swiss National Bank, 2020). These actions presumably had an impact on the sensitivity of CHF exchange rate changes to ECB policy surprises which we cannot control for.

We use event study regressions to analyse how ECB policy surprises affect Swiss government bond yields and stock prices. There are four main findings.

²We are grateful to the authors for making their replication code and the raw data to compute the policy surprises publicly available.

First, on average, Swiss stock prices primarily respond to surprise changes in the ECB policy rate and short-term forward guidance. A surprisingly lower ECB policy rate is associated with an increase in Swiss stock prices (returns). However, surprisingly accommodative short-term forward guidance leads to declining Swiss stock prices. This latter finding could be evidence of stock markets reacting to non-monetary information (Campbell, Evans, Fisher, and Justiniano, 2012; Campbell, Fisher, Justiniano, and Melosi, 2016; Cieslak and Schrimpf, 2019; Jarociński and Karadi, 2020; Kroencke, Schmeling, and Schrimpf, 2019; Nakamura and Steinsson, 2018) because the expansionary monetary news of e.g., postponing an increase in the policy rate for some months, might be viewed as bad news about the economic outlook or be related to a negative risk assessment of the ECB that affect listed Swiss firms.

Second, all types of ECB policy surprises affect Swiss government bond yields. More accommodative ECB policy than expected tends to be associated with a decline in Swiss government bond yields, which is similar to the response of euro area interest rates. However, the reaction of Swiss bond yields to the ECB's longer-term forward guidance are different. Restrictive (accommodative) forward guidance surprises lower (increase) Swiss government bond yields by influencing the expectations about average short-term CHF interest rates in the future. This finding could reflect that the SNB focuses on price stability (consumer price inflation) in the medium term and that, for instance, an overheating euro area economy could pose upside risks to medium-term inflation in Switzerland. In this case, the SNB would have to react by increasing its policy rate. Hence, ECB forward guidance suggesting that its policy rate will rise in the longer term, thus cooling the euro area economy, could lower market participant's expectations about the future path of the SNB's policy rate. In addition, the ECB's QE surprises affect both average short rates and the term premium component of Swiss government bond yields. This suggests that both signalling (expectations about monetary policy actions) and portfolio balancing (QE affects the supply of ECB government bonds which triggers flows to or from close substitutes) effects explain the responses of Swiss government bond yields to QE surprises.

Third, we use statistical tests to identify scheduled ECB policy meetings that particularly affect our regression results. This analysis reveals that ECB policy decisions during crisis periods, in which global risks are high, have an extraordinary

impact on Swiss bond and stock markets. The spillover in those periods seems to be particularly strong, but do not alter the qualitative results with the exception of the responses to surprise changes in the ECB policy rate. Our evidence suggests that the average responses of Swiss bond yields and stock prices to this type of surprise primarily reflect the impact of the ECB policy rate decision at the beginning of the coronavirus pandemic on 12 March 2020.

Fourth, we document that the average responses of Swiss bond yields and stock prices depend to some extent on the nature (expansionary or restrictive) of the surprise. For example, Swiss stock prices and bond yields only respond in a statistically significant way to expansionary short-term forward guidance surprises.

Taken together, our empirical results highlight the complex nature of spillovers from ECB policy to asset markets of non-euro economies. Spillovers are most pronounced in crisis periods and depend on the type as well as on the nature of the monetary policy surprise.

The remainder of the paper is organized as follows. Section 2 briefly describes the construction of the ECB policy surprises that we use in our empirical assessments. Section 3 introduces the empirical framework to evaluate the responses of Swiss bond yields and stock returns to ECB policy surprises. We provide details on the data in section 4. Section 5 presents the main empirical results. Section 6 concludes.

2 Measuring euro area policy surprises

We use the approach (and the replication code) of Altavilla et al. (2019) to obtain ECB policy surprises from high frequency interest rate data on days of scheduled ECB monetary policy decisions. We take the high frequency data from the Euro Area Monetary Policy Database (EA-MPD), which is publicly available. We work with data from January 2002 until June 2020.

Altavilla et al. (2019) take into account that the ECB Governing Council communicates policy decisions in two separate steps, a press release and 45 minutes later a press conference. They analyse changes in risk-free euro area interest rates of different maturities in short time windows around the press release and the press conference. The underlying assumption of this high frequency identification is that interest rate changes in those short time windows primarily reflect

ECB policy surprises and no other economic news.

Their analysis reveals that one common latent factor summarizes most of the variation of risk-free rates in the press release window. In the conference window, they find that three common factors describe the common variation of risk-free rates best.

Based on the methodologies of Gürkaynak, Sack, and Swanson (2005) and Swanson (2021), Altavilla et al. (2019) impose economically justified restrictions and rotate the latent factors to give each of them a structural interpretation. They show that the latent factor in the press release window primarily reflects surprise changes in short-term interest rates (one-month OIS) and thus should be related to the ECB target policy rate. This factor is labelled *Target*. In the conference window, the three latent interest rate factors appear to reflect two types of forward guidance surprises and surprises regarding the ECB's bond purchase programmes. Altavilla et al. (2019) label the first forward guidance factor *Timing*, because of its impact on shorter-term interest rates. This factor seems to be associated with surprises regarding the timing of changes in the policy rate. The second forward guidance factor is associated with medium-term interest rates. This factor is referred to as *Forward Guidance* (FG), but it should be noted that both *Timing* and *FG* reflect the ECB's forward guidance. The third factor in the conference window is associated with movements in long-term interest rates. Following Swanson (2021), Altavilla et al. (2019) rotate this factor in such a way that it mainly reflects surprises related to the ECB bond purchase programmes, which started 2014. Hence, the abbreviation of this factor is *QE*.

Compared with other approaches to estimate ECB policy surprises, e.g., (ter Ellen et al., 2020), the identification mechanism of Altavilla et al. (2019) has the advantage that it explicitly distinguishes between the two separate steps (press release and subsequent press conference) of the ECB's policy communication. Moreover, this distinction allows them to identify factors that help researchers to differentiate between the multiple dimensions of the ECB policy communication.

3 Empirical framework

Our empirical analysis builds on event study regressions along the lines of Altavilla et al. (2019), ter Ellen et al. (2020) and Swanson (2021) using daily data.

We estimate OLS regressions of the following form

$$\Delta X_t = \alpha + \beta Target_t + \gamma Timing_t + \delta FG_t + \zeta QE_t + \epsilon_t \quad (1)$$

in which ΔX_t denotes the $t - 1$ to t logarithmic changes of different Swiss stock indices or the $t - 1$ to t first differences of the Swiss ten-year government bond yield and its two components reflecting expectations about average short-term CHF interest rates over the lifetime of the bond and the term premium. The time index t refers to all dates at which ECB policy decisions took place.

The different ECB policy surprises (*Target*, *Timing*, *FG*, *QE*) are defined in such a way that positive values of the surprises indicate restrictive policy surprises and negative values indicate expansionary policy surprises.

We assess the statistical significance of the regression coefficients by a bootstrap procedure in which we re-sample the residuals from equation (1) to generate a new artificial data sample, run the regression again and store the estimated regression coefficients. We repeat this procedure 10000 times and assess statistical significance based on the empirical distribution of the regression coefficients from this bootstrap exercise.

4 Data

Swiss stock market data is from SIX exchange. We assess the responses of the Swiss Market Index (SMI), the Swiss Performance Index (SPI) and several SPI sector indices to ECB policy surprises. The SMI comprises the 20 largest listed Swiss firms by market capitalization. The SPI covers basically all listed Swiss firms on the SIX exchange. However, the SMI firms still make up approximately 80% of the SPI's market capitalization on average in our sample period.

The SPI sectoral indices follow the Industry Classification Benchmark (ICB) and distinguish between firms in the sectors Oil and Gas, Basic Materials, Industrials, Consumer Goods, Health Care, Consumer Services, Telecommunication, Utilities, Financials and the Technology sector.

In the case of the stock indices, ΔX_t in equation (1) represents the first difference in the log closing value of the index on the day of a scheduled ECB policy meeting, t , and the closing value of the respective index on day $t - 1$.

Swiss government bond data are from the website of the SNB. We focus on responses of ten-year Swiss government bond yields to ECB policy surprises because ten-year yields are typically used as benchmarks. In addition, we decompose the ten-year Swiss government bond yield into components reflecting expectations about average short-term CHF interest rates and the term premium (the difference between yields and the expected average short-term interest rates) to assess whether ECB policy surprises move bond yields because they affected expectations about short-term CHF interest rates (signalling effect) and/or because these surprises influence the term premium of Swiss government bond yields (portfolio balance effect).

We use two different models (Adrian, Crump, and Moench, 2013; Christensen, Diebold, and Rudebusch, 2011) to decompose the Swiss government bond yields. Both models fit Swiss government bond yields well, but use different approaches to model the future path of short-term interest rates. The bond yield components from the model of Adrian et al. (2013), ACM, are available from January 2002 to June 2020. The bond yield components from the model of Christensen et al. (2011), AFNS, are available from January 2006 to June 2020. The latter data has already been used to study the effects of the SNB's reserve expansion on the term structure of Swiss government bond yields (Christensen and Krogstrup, 2018).

The Swiss government bond yields published on the SNB's website reflect bond prices collected around 11am each day. Hence, in the case of government bond data, ΔX_t in equation (1) represents the change in Swiss government bond yields from the morning of the day of a scheduled ECB policy meeting, t , to the morning of the day after the policy meeting, $t + 1$.

5 Empirical results

This section presents our main results. The sample of the event study regressions covers scheduled ECB policy meetings between January 2002 and June 2020. All of the results presented below are robust to excluding ECB policy meetings that took place within three days before or after SNB or Fed policy meetings (results are available upon request).

5.1 Stock market

The results of our event study regressions suggest that, on average, Swiss stock prices primarily respond to surprise changes in the policy rate of the ECB (*Target*) and to surprises with respect to the timing of ECB policy rate changes (*Timing*). Neither longer-term forward guidance nor surprises related to the ECB's bond purchase programmes have a significant effect on Swiss stock returns.

Panel A of table (1) presents the results from regressions of daily log changes in the two market indices (SMI, SPI) on the four different ECB policy surprises of the full sample of scheduled ECB policy decisions. Panel B gives the corresponding results for sectoral indices of the SPI. The regression coefficients shown in panel A of table (1) suggest that only surprises related to changes in the policy rate and the timing of these changes have an impact on daily Swiss stock market returns on average. This finding holds for both the SMI, which comprises only the 20 largest listed Swiss firms, and the broader SPI. The sensitivities to the ECB policy surprises describe approximately seven percent of the variation in the daily stock market returns.

[Table (1) about here]

For the interpretation of the sign of the regression coefficients, note that the policy surprises are defined in such a way that positive values represent restrictive surprises and negative values represent expansionary surprises. Hence, the negative sign of the regression coefficient for the surprise change in the policy rate (*Target*) means that an expansionary surprise of the ECB increases Swiss stock prices and thus returns. Restrictive surprises have the opposite effects. This response looks like a textbook case in which expansionary monetary policy temporarily lowers short-term real interest rates and thus, *ceteris paribus*, lowers the discount rate applied to expected cash flows of Swiss stocks. By contrast, the responses of both the SMI and the SPI returns to *Timing* surprises exhibit a positive sign. This observation indicates that an expansionary surprise leads to a decrease in Swiss stock prices and thus returns. This response might make sense if the communication associated with the timing of euro area policy rate changes is accompanied by non-monetary information providing news about the economic outlook or the risk assessment of the ECB. For example, suppose an expansionary *Timing* surprise

takes the form of a postponed interest rate hike. If this postponement reflects a surprising deterioration in the ECB’s economic outlook, then the fall in Swiss stock prices as a reaction to the *Timing* surprise makes sense. In this case, the non-monetary news provided by the ECB in the press conference outweighs the impact of the outlook of a lower policy rate in the euro area for a few weeks or months longer (Campbell et al., 2012, 2016; Cieslak and Schrimpf, 2019; Jarociński and Karadi, 2020; Kroencke et al., 2019; Nakamura and Steinsson, 2018). Interestingly, Altavilla et al. (2019) do not find such a link between euro area stock returns and the *Timing* surprise. In the euro area, the response is either insignificant or indicating that expansionary *Timing* surprises increase stock prices.

Panel B of table (1) zooms in on the different sectors that comprise the SPI. The results for the sectoral indices show that restrictive *Target* surprises lower the stock prices of Swiss firms from a broad range of industrial sectors. However, the effects of the *Timing* surprises seem to be more concentrated. These effects pertain only to roughly half of the sectoral indices under study, namely Basic Materials, Industry, Consumer Goods, Financials and the Technology Sector. We speculate that the business prospects of these sectors are most affected by surprising short-term changes in the economic outlook of the euro area, while other sectors, such as health care or consumer services, are less affected by such short-term effects.

Moreover, with the exception of the Basic Materials sector, the results presented in panel B of table (1) confirm that longer-term forward guidance or surprises related to the ECB’s quantitative easing programmes did not have significant effects on stock prices of listed Swiss firms, which is consistent with euro area evidence provided by Altavilla et al. (2019).

5.2 Bond market

Apart from analysing the response of daily changes in ten-year Swiss government bond yields (y) to the ECB policy surprise, we work with two different models to estimate the yield component that reflects expectations of short-term interest rates over the lifetime of the bond. The term premium (TP) captures compensation for investing in the long-term bond instead of repeatedly investing in the short-term interest rate on the money market and is simply the difference between yields and the short rate component as highlighted in equation (2) for a bond of maturity m .

$$TP_t(m) = y_t(m) - \frac{1}{m} \int_t^{t+m} E_t(r_s) ds \quad (2)$$

These decompositions help us to better understand the economic reasons underlying the responses of Swiss government bond yields to ECB policy surprises. If ECB policy decisions affect Swiss bond yields through their impact on expectations about the future path of CHF short-term interest rates, then the ECB decision presumably altered expectations about the future SNB policy stance (signalling effect). If ECB policy decisions transmit to Swiss bond yields via the term premium, then the ECB decision affected the relative attractiveness of government bonds in the euro area compared with close substitutes (portfolio balancing effect).

We use two different term structure models to obtain the two yield components in order to assess the robustness of our results with respect to the choice of term structure model. One model is the arbitrage-free Nelson-Siegel model by Christensen et al. (2011). This model (AFNS) adds an extra term to the Nelson and Siegel (1987) model to ensure the absence of arbitrage when modelling the yield curve. Christensen and Krogstrup (2018) use this model to assess the channels through which the reserve expansion of the SNB affected Swiss government bond yields. We use their specification of the AFNS model in our study and kindly refer the reader to Christensen and Krogstrup (2018) for further details. The second model is the one proposed by Adrian et al. (2013), ACM. This model is also an affine term structure model.³ It uses a sequence of three linear regressions to obtain the short rate component of bond yields from bond excess returns.⁴

The detailed results are presented in table (2). Please note that restrictive (expansionary) surprises, irrespective of the type of surprise, increase (decrease) euro area interest rates (Altavilla et al., 2019).

We run the event study regressions with the fitted yields from the term structure models instead of the actual yields to directly link the regression coefficients of the yield changes regressions to the regressions featuring the two yield compo-

³The two models differ from each other in some dimensions. The ACM model employs five latent factors to model the yield curve. Daily decompositions of yields use model parameters optimised at the monthly frequency. The ANFS model allows for three latent factors to model the yield curve and its parameters are optimised at the daily frequency.

⁴We are grateful to Jens Christensen for implementing the Christensen et al. (2011) model with Swiss government yield data and to Lucas Fuhrer for implementing the Adrian et al. (2013) model.

nents. The two models approximate the actual yields reasonably well, such that the qualitative results for changes in the actual and fitted ten-year government bond yield are the same and the quantitative results very similar (results available upon request).

Table (2) shows the results from event study regressions of daily changes in the fitted ten-year government bond yields or of daily changes in the yield components that reflect expectations about future short-term interest rates or the term premium to ECB policy surprises.

The regression coefficients under the headings ‘10Y Yield’ suggest that Swiss ten-year government bond yields respond to all types of ECB policy surprises. All of the regression coefficients are statistically significantly different from zero. The signs of the regression coefficients highlight that restrictive *Target*, *Timing* and *QE* surprises (positive values of the surprise series) are associated with subsequent increases in Swiss ten-year government bond yields. By contrast, restrictive *FG* surprises lower Swiss bond yields.

This latter finding appears to be counterintuitive but the sensitivities of the two yield components to the policy surprises help us to better understand the economic mechanism underlying this yield response. The ACM model attributes the negative coefficient entirely to the response of the expected short rate component to the *FG* surprise. This finding might reflect that restrictive *FG* surprises increase risk-free rates with maturities of two to five years in the euro area (Altavilla et al., 2019), which suggests a cooling effect of monetary policy on the euro area economy in the medium term. This reduces medium-term inflationary pressure in Switzerland as well, because foreign economic developments strongly affect the state of the Swiss economy and inflation in Switzerland (Jordan, 2016). In addition, the SNB aims at price stability (defined as CPI inflation between zero and two percent) in the medium term. One could think about the medium-term horizon as the forecast horizon of the SNB’s conditional inflation forecast, its main communication tool, of round about three years. Against this background, a restrictive *FG* surprise in the euro area could be associated with lower inflationary pressure and a less dynamic economy in Switzerland in the medium term. It hence leads to lower expected short-term Swiss franc interest rates (signalling effect) and thus lower long-term Swiss government bond yields. However, according to the AFNS model, the ECB’s longer-term forward guidance affects both yield

components suggesting that signalling and portfolio balance effects jointly explain the responses of Swiss government bond yields to the information about the future, longer-term path of the ECB policy rate. The ACM model disagrees and relates all of the response of the Swiss government bond yield to the *FG* surprise to changes in expectations about future short-term CHF interest rates and thus a pure signalling effect. Previewing the results from the subsequent section, we note that this disagreement between the models reflects the different sample periods for which the respective yield decompositions are available. Especially one policy meeting in 2003, close to the Iraq war, influenced the sensitivity of the short rate component of the ACM model-implied bond yield. Nevertheless, the two models indicate that the expectations about future short-term CHF interest rates play an important role in explaining the overall response of Swiss ten-year government bond yields to the euro area *FG* surprise.

When we zoom in on the link between the yield components and their responses to the other ECB policy surprises, we observe that surprises related to the ECB policy rate (*Target*) in the ECB press release window affect bond yields through their impact on the term premium component. This finding pertains to the yield decomposition of both term structure models and suggests that the information contained in the ECB press release primarily influences Swiss government bond yields because it leads to portfolio rebalancing. Market participants do not seem to alter their expectations about the future Swiss monetary policy stance (expectations about future CHF short-term interest rates) based on the ECB press release.

By contrast, *Timing* surprises only affect the short rate component of Swiss bond yields. This finding is consistent with the notion that the *Timing* factor provides information about the timing of policy rate changes but no additional information about the size of the change (if any) in the ECB policy rate.

Moreover, the two models agree that surprises with respect to the ECB's asset purchase programmes (*QE*) affect ten-year Swiss government bond yields through altering expectations about future short-term CHF interest rates and the term premium. This finding suggests that both signalling (altering the short-rate expectations) and portfolio balance (altering the term premium) effects play a role in explaining the reactions of Swiss government bond yields to the ECB's bond purchase programmes. The ECB's asset purchases seem to have affected the relative

attractiveness of Swiss government bonds but also appear to signal commitment to its forward guidance about the future path of its policy rate.

[Table (2) about here]

What is the magnitude of the Swiss bond yield responses to ECB policy surprises? The regression coefficients measure the percent change of Swiss bond yields in response to a one standard deviation change of the ECB policy surprises. Since most of the policy surprises do not explain 100% of the variation of one specific euro area interest rate, this question is difficult to answer. However, according to Altavilla et al. (2019), the *Target* factor explains approximately 98% of the variation of the one-month OIS rate in the press release window and a one standard deviation of the *Target* surprise is 2.2bp. Hence, the regression coefficients of 0.009 (AFNS) and 0.007 (ACM) of the change in ten-year yields on the *Target* surprise imply that Swiss ten-year government bond yields would rise by approximately between 41bp and 32bp⁵ in response to a one percentage point surprise rise of the ECB policy rate or, more precisely, to a one percentage point surprise in the one-month OIS rate in the euro area (Altavilla et al., 2019).

5.3 Influential events: covid-19 versus other crises

So far, we have presented the average responses of Swiss stock prices and government bond yields to ECB policy surprises. However, specific events might have had an outsized influence on the estimated regression coefficients in the event study regressions (Bernanke and Kuttner, 2005).

Analysing highly influential observations is particularly interesting in the context of our paper because our sample period includes two global crises (global financial crisis, coronavirus pandemic) and one regional crisis (euro area sovereign debt crisis) which may have had strong influence on our estimates of the responses of Swiss bond yields and stock prices to ECB policy decisions and thus on the strength of the international spillover from ECB policy.

We analyse the impact of each of the ECB policy decisions in our sample on the regression coefficients of equation (1) with the DFBETA statistic (Belsley,

⁵0.009 or 0.007 times 100/2.2

Kuh, and Welsch, 1980). This statistic reveals whether specific observations have a particularly strong influence on the regression coefficients.

DFBETA for each coefficient β_l with $l \in \{Intercept, Target, Timing, FG, QE\}$ is calculated as

$$DFBETA_{l,i} = \frac{\beta_l - \beta_{l,(i)}}{SE_{(i)}(\beta_l)} \quad (3)$$

in which $\beta_{l,(i)}$ denotes a regression coefficient without observation i and $SE_{(i)}(\beta_l)$ denotes the standard error of β_l without observation i .

To differentiate between observations which are influential and those which are not, we follow the recommendation of Belsley et al. (1980) and use the threshold $|DFB| \leq \frac{2}{\sqrt{\mathcal{N}}}$ with \mathcal{N} being the number of observations. Observations associated with DFBETA higher in absolute value than the threshold are influential observations according to this metric. Positive (negative) values of DFBETA suggest that a particular observation pushed the respective regression coefficient upwards (downwards).

Figures (1) to (4) summarize the results of this analysis. Dotted blue lines mark the thresholds. The black crosses represent DFBETA for each observation, i.e., for each scheduled ECB policy decision in our sample. We provide labels (month and year) for the three most influential observations for each regression coefficient.

Figure (1) presents the results of the analysis of influential statistics for the regressions of log daily changes in the SPI on the four ECB policy surprises. The upper left panel of figure (1) depicts DFBETA for the regression coefficient on the *Target* surprise. It shows that the three most influential observations for this coefficient occurred during the three major crisis periods in our sample period. The scheduled ECB decision on 12 March 2020, at the beginning of the coronavirus pandemic, had an outsized influence on the regression coefficient even compared with other influential observations. In this meeting, the ECB decided to leave its policy rates unchanged, which constituted a relatively strong restrictive surprise for market participants amid the financial market turmoil around the start of the pandemic. In fact, on 18 March 2020, the ECB convened for an unscheduled meeting. According to DFBETA, the next strongest influential decision took place on 6 October 2011 in the midst of the sovereign debt crisis. At this meeting, the ECB did not change its policy rates, which was also interpreted as restrictive

surprise. During the global financial crisis, on 2 April 2009, the ECB decided to lower its policy rates by 25bp. Judged by the sign of the *Target* surprise on this day, this decision was also considered to be a restrictive policy surprise.

[Figure (1) about here]

The DFBETA statistics in the upper right and lower left panels of figure (1) show that the ECB's short-term and longer-term forward guidance during the press conference window of its meetings had most influence on the Swiss stock market during the global financial and the sovereign debt crisis. The ECB policy decisions during the coronavirus pandemic did not exert a particularly high influence on these regression coefficients. By contrast, the ECB's decision to announce additional net asset purchases (an expansionary surprise) on 12 March 2020 was the most influential decision for the overall sensitivity of changes in the SPI to *QE* surprises.

These results show that the different facets of ECB policy decisions exert an outsized influence on the Swiss stock market at different times. The analysis of the DFBETA statistics of Swiss government bond yields confirm this impression.

Figure (2) gives the corresponding results for the fitted ten-year Swiss government bond yields from the two term structure models. Panel A of this figure highlights that the policy decisions on 12 March 2020 had the biggest impact on the response on Swiss government bond yields to surprise changes in the ECB policy rate. Another influential decision took place on 3 November 2011 when the ECB unexpectedly cut its main policy rates. This expansionary surprise during the sovereign debt crisis exerted a strong influence on the regression coefficient of the *Target* surprise as well.

[Figure (2) about here]

Panel B of figure (2) shows that the most influential *Timing* surprises occurred during the global financial crisis. The same is true for longer-term forward guidance (Panel C) by the ECB, although single observations during the sovereign debt crisis and at the beginning of the sample affected the coefficients from regressions of changes in Swiss ten-year government bond yields on *FG* surprises as well. Panel D highlights again the importance of the meeting on 12 March 2020 and shows that this meeting had a strong effect on the regression coefficient of yield changes

on the QE surprises. Policy decisions introducing the expansion of the ECB's asset purchase programmes in 2015 also had a strong influence on the reaction of Swiss bond yields to ECB policy decisions.

For completeness, figures (3) and (4) provide the DFBETA statistics for the coefficients from regressions of the two yield components that reflect expected short-term CHF interest rates and the term premium of the ten-year government bond yield on the four ECB policy surprises. These results largely confirm the pattern that we observed in the context of the yields. The *Target* surprise of the ECB's policy decision on 12 March 2020 strongly affected the respective regression coefficients of the short rate component and the term premium component. The most influential observations for the regression coefficients of the two forward guidance factors occurred during the global financial crisis. This finding pertains to both yield components. The sensitivity of the short-rate component of the ACM model reflects a strong influence from an ECB policy meeting in 2003, which is not part of the sample of the AFNS model. This difference in sample periods mainly explains why the two models disagree with respect to what component of the long-term bond yields is most sensitive to ECB longer-term forward guidance surprises depicted in table (2). Decisions in 2015 appear to have had the most influence on the changes in the expectations of average short-term interest rates and changes in the term premium in response to unexpected movements in the QE factor. For the term premium, the DFBETA statistic for observations before 2014 turn out to be influential for the regression coefficients. This is at odds with the interpretation of this factor as reflecting surprise changes of the ECB's asset purchase programmes. The reason why we observe this pattern in the DFBETA statistic is simply that we did not restrict the QE factor to zero before the ECB's asset purchases started and, more generally, that this factor primarily reflects surprise changes in long-term euro area interest rates. Therefore, the influential observations before 2014 could be interpreted as reflecting the influence of these observations on the link between changes in the term premium of long-term Swiss government bond yields and surprise changes in long-term euro area interest rates that happened during the press conference window of ECB monetary policy decisions.

[Figure (3) about here]

[Figure (4) about here]

We note here that subsample analyses (not shown but available upon request) confirm the impressions by the DFBETA statistics. While we observe no change in the signs of the regression coefficients across subsamples, e.g., samples distinguishing between periods in which the SNB policy rate was at or far away from the perceived effective lower bound or samples distinguishing between the flexibility of the EURCHF exchange rate, the statistical significance is most pronounced in those subsamples in which the most influential observations occurred. However, we view the analysis of the DFBETA statistic superior to the subsample analyses in the context of our paper because of the low number of observations of specific subsamples. This low number of observations makes comparisons of the size of regression coefficients across subsamples and thus an analysis of influential observations/periods difficult.

Taken together, the analysis of influential observations reveals that crises play an important role in understanding responses of Swiss bond yields and stock prices to ECB policy decisions. This observation suggests that the spillover from ECB monetary policy to foreign, in this case Swiss, asset markets is particularly pronounced during periods of crisis, i.e., in times of high global risks.

5.4 The impact of influential observations on average regression estimates

How important are the most influential observations for the full sample estimates of the sensitivities to the ECB policy surprises? For example, the DFBETA statistics for the regression coefficients on the *Target* and *QE* surprises suggest that the 12 March 2020 ECB decisions were highly influential.

To assess this question, we repeat our main regressions with samples that exclude the three most influential observations for each type of ECB policy surprise. Table (3) summarizes the results. To conserve space, it presents the baseline results for the regressions of the SPI returns and the fitted yields from the two term structure models along with the estimates obtained from the restricted sample that excludes the three most influential observations for each type of ECB policy surprise. The other regression results (SPI sectoral indices, yield components) are available upon request.

The qualitative results for *Timing*, *FG* and *QE* surprises are robust, i.e., the

average responses of Swiss stock market returns and bond yield changes to these types of policy surprises do not only reflect the impact of a few influential observations but are more general. By contrast, it seems to be the case that the full sample estimates of the sensitivities to the *Target* surprise depend primarily on the three most influential observations. This finding puts the previous results from the full sample into perspective and highlights that average effects from regression analysis can be deceiving. We highlighted in section 5.2 that, on average, a one percentage point *Target* surprise leads to a change in ten-year Swiss government bond yields of between 30bp to 40bp. As the results of this section show, this estimate does not reflect the average response but rather the response in extreme times.

[Table (3) about here]

5.5 Differences in responses to restrictive and expansionary surprises?

Does the significance or the sign of the responses of Swiss bond yields and stock prices depend on the surprises being expansionary or restrictive? This question is motivated by Glick and Leduc (2012), who find that the signs and the strength of the responses of global asset prices to surprise changes in the Fed’s asset purchase programmes vary with the sign of the monetary policy surprises. Bernhard and Ebner (2017) observe that the signs of Swiss asset price reactions to foreign monetary policy surprises (measured as changes in futures of ten-year government bond yields) depend on the sign of the surprises but not the overall strength of the spillovers from foreign monetary policy.

We revisit the question of whether the responses of Swiss bond yields and stock price to ECB policy surprises depend on the signs of the surprises, because our analysis builds on measures of policy surprises that are different from the overall measure of policy surprises used by Bernhard and Ebner (2017). The surprises that we employ capture different facets of the ECB monetary policy decisions and we cover a longer time period. Therefore, we run the event study regression in equation (1) distinguishing between restrictive and expansionary policy surprises.

The results of this assessment are summarised in table (4). The first row of table (4) gives the regression estimates on the *Target* surprise when the surprise is

restrictive (positive sign of the series) and controlling for all of the policy surprises on those dates at which *Target* surprises were restrictive. The second row gives the corresponding results when the *Target* surprise was negative, again controlling for the other policy surprises on those dates. We run the same type of regressions for the other surprises.

The first two rows of table (4) show that the responses of Swiss bond and stock prices to the *Target* surprise are mainly driven by restrictive *Target* surprises. However, as suggested by the results of the previous section, this finding is mainly driven by the ECB *Target* surprise on 12 March 2020. Against this background, the asymmetry that we document here does not reflect a general pattern in the data.

However, our estimates also suggest that the average response to the *Timing* surprise primarily reflects sensitivity of Swiss bond yields and stock prices to expansionary surprises. Restrictive *Timing* surprises do not seem to play a role in this respect. This finding is robust to excluding the most influential observations from the sample. Moreover, we do not find a link between the signs of the *FG* surprises and the responses of Swiss bond and stock prices, but there is some evidence that rather restrictive *QE* surprises than expansionary *QE* surprises drive the average responses to this type of surprise.

[Table(4) about here]

Taken together, this analysis highlights that spillovers of ECB policy to Swiss asset prices do not only depend on the distinction between crisis periods and rather normal times but for some types of policy surprises also depend on the nature of the surprise, i.e., whether it is expansionary or restrictive.

6 Conclusions

We have used Switzerland as a case study to analyse the channels through which ECB monetary policy surprises affect financial markets of economies outside the euro area. We have conducted event study regressions to show that ECB policy spills over to Swiss bond and stock markets and that the spillover effects are particularly strong in periods of crisis. However, policy decisions during different

crisis periods affect the responses to the different facets of ECB monetary policy differently. One policy meeting during the coronavirus pandemic had an outsized influence on Swiss asset price responses to ECB policy rate surprises. Forward guidance (short-term and longer-term) surprises had the biggest influence on Swiss asset prices during the global financial crisis and the sovereign debt crisis in the euro area. Surprises related to the ECB asset purchase programmes had their strongest effect on Swiss bond and stock prices during the coronavirus pandemic.

In addition, our results suggest that policy surprises related to the ECB's short-term forward guidance during its press conferences reveal non-monetary information (economic outlook or its risk assessment) to which Swiss stock prices react more strongly than to the monetary information provided by this guidance.

Furthermore, our analysis of bond yields suggests that ECB policy surprises during the press conference window affect both expectations about future average CHF short-term interest rates and the term premium. This finding highlights that the ECB policy decisions do not only lead to portfolio rebalancing but also affect expectations about the future monetary policy stance in Switzerland.

Finally, our empirical assessments suggest that the spillovers from ECB policy to Swiss asset markets do not only depend on the distinction between crisis periods and normal times but also depend to some extent on the sign of the surprises, i.e., whether the surprises are expansionary or restrictive.

In sum, our findings highlight the complex nature of spillovers from monetary policy in large currency areas to smaller ones. Fostering the understanding of the channels through which foreign monetary policy transmits to domestic economies is therefore vital for policymakers of small, open economies. The analysis of spillovers to domestic asset markets plays a key role in this respect because the effects of foreign monetary policy quickly transmit to asset prices.

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Tables

Table 1: Swiss stock return responses to ECB policy surprises

Panel A: Swiss main stock indices		
	SMI	SPI
(Intercept)	-.07620 (.09085)	-.04822 (.08445)
Target	-.23544* (.09103)	-.23244** (.08567)
Timing	.29068** (.09153)	.29514*** (.08586)
FG	-.04725 (.09289)	-.05870 (.08666)
QE	-.00050 (.09534)	-.01614 (.08576)
R ²	.08550	.09456
Adj. R ²	.06615	.07590
Num. obs.	194	199

Panel B: SPI sectoral indices										
	OilnGas	BasicMater	Industry	ConsGood	Health	ConsService	TeleCom	Utilities	Financials	Technology
(Intercept)	.20470 (.24150)	-.04960 (.09976)	-.00597 (.11058)	-.06885 (.08322)	-.13441 (.08469)	-.11114 (.10668)	-.05671 (.07574)	-.18464 (.10210)	-.04730 (.12912)	.01030 (.12765)
Target	.35762 (.23526)	-.19151 (.10120)	-.24287* (.11219)	-.23700** (.08443)	-.22997** (.08591)	-.41974*** (.10822)	-.12840 (.07684)	-.15212 (.10358)	-.26794* (.13099)	-.33736** (.12950)
Timing	.23284 (.22355)	.39293*** (.10142)	.41205*** (.11243)	.28018** (.08461)	.13361 (.08610)	.16967 (.10846)	.05094 (.07700)	.02741 (.10380)	.41211** (.13127)	.46161*** (.12978)
FG	.15128 (.22654)	-.21582* (.10237)	.00932 (.11348)	-.09790 (.08540)	.02353 (.08691)	-.15640 (.10947)	-.02471 (.07772)	-.18794 (.10478)	-.09854 (.13250)	-.10148 (.13100)
QE	-.34794 (.21607)	-.28010** (.10130)	-.10377 (.11230)	-.07098 (.08451)	.04427 (.08600)	.11829 (.10833)	.08180 (.07691)	-.02428 (.10369)	.03520 (.13112)	.07251 (.12963)
R ²	.04298	.13511	.09309	.09776	.05254	.09440	.02285	.02449	.07181	.09737
Adj. R ²	.01462	.11728	.07439	.07916	.03301	.07573	.00270	.00438	.05267	.07876
Num. obs.	140	199	199	199	199	199	199	199	199	199

Notes: This table presents the sensitivities of daily log returns on the Swiss stock indices to ECB policy surprises. Policy surprises take the form of surprises with respect to the ECB policy rate (*Target*), the ECB's short-term (*Timing*) and longer-term forward guidance (*FG*) as well as to ECB bond purchases (*QE*). Panel A summarizes the results for the two main Swiss stock market indices. Panel B gives the results for sectoral stock indices. The SPI sectoral indices follow the Industry Classification Benchmark (ICB) and distinguish between firms in the sectors Oil and Gas (OilnGas), Basic Materials (BasicMater), Industrials (Industry), Consumer Goods (ConsGood), Health Care (Health), Consumer Services (ConsService), Telecommunication (TeleCom), Utilities, Financials and the Technology sector. ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level based on the empirical distribution of the coefficients from 10000 bootstrap samples. The sample covers all scheduled ECB policy meetings from January 2002 to June 2020 or starts at the earliest date at which the stock index data is available. The coefficients are interpretable as percent change per standard deviation change in the respective surprise series.

Table 2: Responses of Swiss ten-year government bond yield and its components to ECB policy surprises

	AFNS			ACM		
	10Y Yield	Short rate	Term premium	10Y Yield	Short rate	Term premium
(Intercept)	-.00085 (.00253)	.00288 (.00202)	-.00373 (.00255)	.00038 (.00249)	-.00111 (.00168)	.00149 (.00194)
Target	.00911*** (.00252)	.00167 (.00202)	.00744** (.00255)	.00695** (.00251)	.00142 (.00171)	.00553** (.00195)
Timing	.00792*** (.00231)	.00495** (.00184)	.00296 (.00233)	.00744** (.00252)	.00650*** (.00171)	.00093 (.00195)
FG	-.01007*** (.00243)	-.00495* (.00195)	-.00512* (.00245)	-.01062*** (.00255)	-.00993*** (.00173)	-.00069 (.00198)
QE	.01499*** (.00231)	.00441* (.00185)	.01057*** (.00233)	.01415*** (.00253)	.00833*** (.00172)	.00582** (.00197)
R ²	.36410	.11957	.19375	.25964	.27472	.08248
Adj. R ²	.34656	.09529	.17151	.24422	.25961	.06337
Num. obs.	150	150	150	197	197	197

Notes: This table presents the sensitivities of daily changes in ten-year Swiss government bond yields (10Y Yield) or the yield components reflecting expectations about future average short-term interest rates (Short rate) or reflecting the term premium (Term premium) of the ten-year yield to ECB policy surprises. We run the regressions with fitted yields instead of actual yields and obtain the yield components from two different models proposed by Christensen et al. (2011) (AFNS) and Adrian et al. (2013) (ACM). The fitted yields of the models are close to actual yields. Policy surprises take the form of surprises with respect to the ECB policy rate (*Target*), the ECB's short-term (*Timing*) and longer-term forward guidance (*FG*) as well as to ECB bond purchases (*QE*). ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level based on the empirical distribution of the coefficients from 10000 bootstrap samples. The sample covers scheduled ECB policy meetings from January 2002 to June 2020 in the case of the ACM model or the meetings from January 2006 to June 2020 in the case of the AFNS model.

Table 3: Responses of Swiss asset prices to ECB policy surprises: excluding the three most influential observations

	Baseline			w/o three most infl. obs.		
	SPI	10Y AFNS	10Y ACM	SPI	10Y AFNS	10Y ACM
Target	-.23244** (.08445)	.00911*** (.00252)	.00695** (.00251)	-.08994 (.08417)	.00410 (.00311)	.00532 (.00305)
Timing	.29514*** (.08586)	.00792*** (.00231)	.00744** (.00252)	.21551* (.09919)	.00738** (.00256)	.00695* (.00276)
FG	-.05870 (.08666)	-.01007*** (.00243)	-.01062*** (.00255)	-.02999 (.08312)	-.00908*** (.00270)	-.00877** (.00274)
QE	-.01614 (.08576)	.01499*** (.00231)	.01415*** (.00253)	-.05365 (.07493)	.01520*** (.00236)	.01630*** (.00259)

Notes: This table presents the sensitivities of daily log returns on the Swiss Performance Index (SPI) and daily changes in fitted ten-year Swiss government bond yields (10Y Yield) from two different models proposed by Christensen et al. (2011) (AFNS) and Adrian et al. (2013) (ACM) to ECB policy surprises. The Baseline panel presents the full sample estimates. The other panel presents the regression coefficients when excluding the three most influential observations for each type of policy surprise according to the DFBETA statistic. Policy surprises take the form of surprises with respect to the ECB policy rate (*Target*), the ECB's short-term (*Timing*) and longer-term forward guidance (*FG*) as well as to ECB bond purchases (*QE*). ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level based on the empirical distribution of the coefficients from 10000 bootstrap samples. The sample covers scheduled ECB policy meetings from January 2002 to June 2020 in the case of the ACM model or the meetings from January 2006 to June 2020 in the case of the AFNS model.

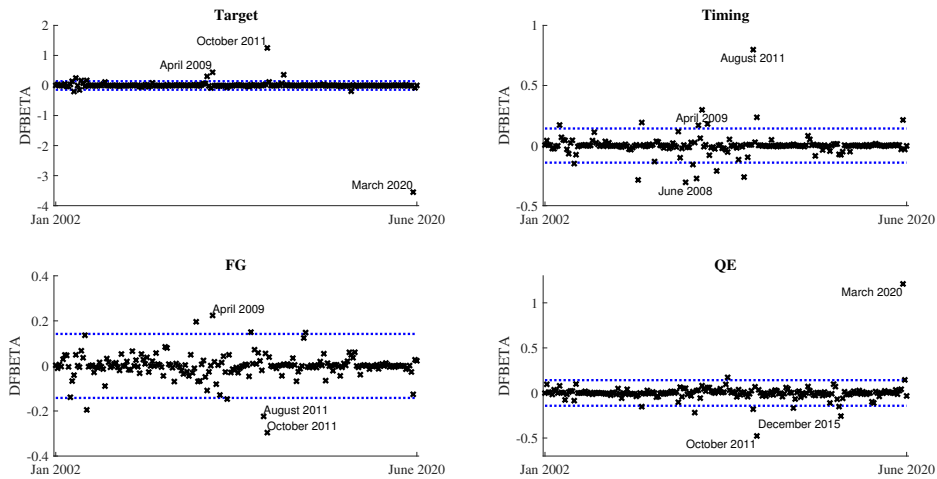
Table 4: Asymmetries in the responses to ECB policy surprises?

SPI			AFNS				ACM				
No. obs			No. obs	10Y Yield	Yield	Short rate	Term premium	No. obs	10Y Yield	Short rate	Term premium
67	Target (>0)	-.46966** (.17626)	49	.01708** (.00493)	.00824** (.00293)	.00884* (.00407)		66	.01076* (.00480)	.00421 (.00358)	.00655* (.00307)
132	Target (<0)	-.01481 (.11159)	101	.00139 (.00328)	-.00055 (.00322)	.00194 (.00378)		131	.00196 (.00349)	.00042 (.00229)	.00154 (.00300)
113	Timing (>0)	.16082 (.12812)	86	.00239 (.00384)	.00551 (.00321)	-.00311 (.00373)		113	.00176 (.00440)	.00657* (.00289)	-.00480 (.00362)
86	Timing (<0)	.31011* (.14442)	64	.01192** (.00405)	.00170 (.00320)	.01023* (.00427)		84	.01100* (.00428)	.00713* (.00304)	.00387 (.00321)
101	FG (>0)	-.12564 (.11951)	71	-.01171*** (.00323)	-.00566* (.00275)	-.00605 (.00345)		93	-.01373*** (.00369)	-.01082*** (.00227)	-.00291 (.00298)
98	FG (<0)	-.23721 (.20503)	79	-.01146 (.00576)	-.00972* (.00447)	-.00173 (.00562)		104	-.00646 (.00570)	-.01111* (.00429)	.00465 (.00432)
96	QE (>0)	-.24103 (.14722)	75	.02034*** (.00502)	.00525 (.00464)	.01508** (.00525)		95	.01962*** (.00542)	.00915* (.00357)	.01047* (.00414)
103	QE (<0)	.02061 (.18612)	75	.00987* (.00474)	.00087 (.00309)	.00900* (.00450)		102	.00664 (.00473)	.00961** (.00337)	-.00297 (.00359)

Notes: This table presents the sensitivities of daily log returns on the Swiss Performance Index (SPI) and the sensitivities of daily changes in ten-year Swiss government bond yields (10Y Yield) or the yield components reflecting expectations about future average short-term interest rates (Short rate) or reflecting the term premium (Term premium) of the ten-year yield to ECB policy surprises. We obtain the two yield components from two different models proposed by Christensen et al. (2011) (AFNS) and Adrian et al. (2013) (ACM). Policy surprises take the form of surprises with respect to the ECB policy rate (*Target*), the ECB's short-term (*Timing*) and longer-term forward guidance (*FG*) as well as to ECB bond purchases (*QE*). This table distinguishes between positive surprise values (restrictive policy surprises) and negative surprise values (expansionary policy surprises) to assess whether the responses of Swiss asset prices depend on the sign of the surprise. ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level based on the empirical distribution of the coefficients from 10000 bootstrap samples. The sample covers scheduled ECB policy meetings from January 2002 to June 2020 in the case of the SPI and ACM term structure model or the scheduled meetings from January 2006 to June 2020 in the case of the AFNS term structure model.

Figures

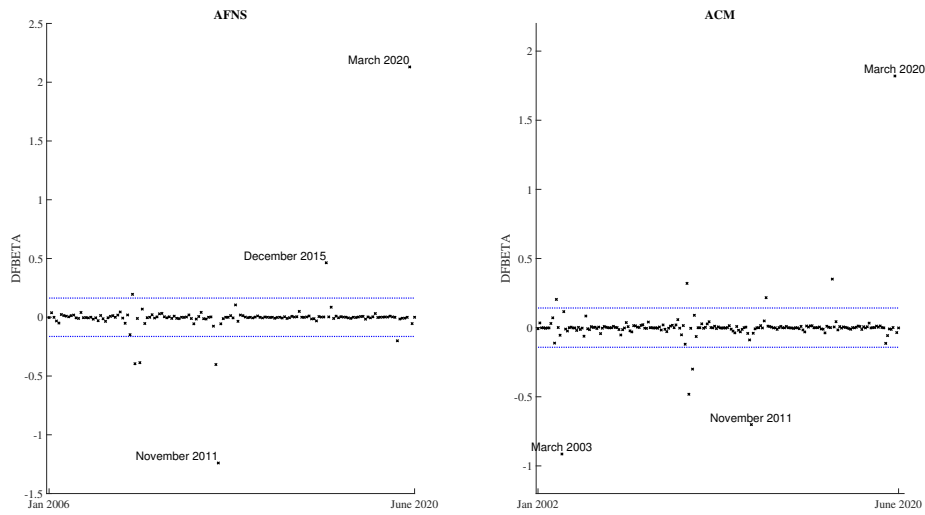
Figure 1: Influential observations: SPI and ECB policy surprises



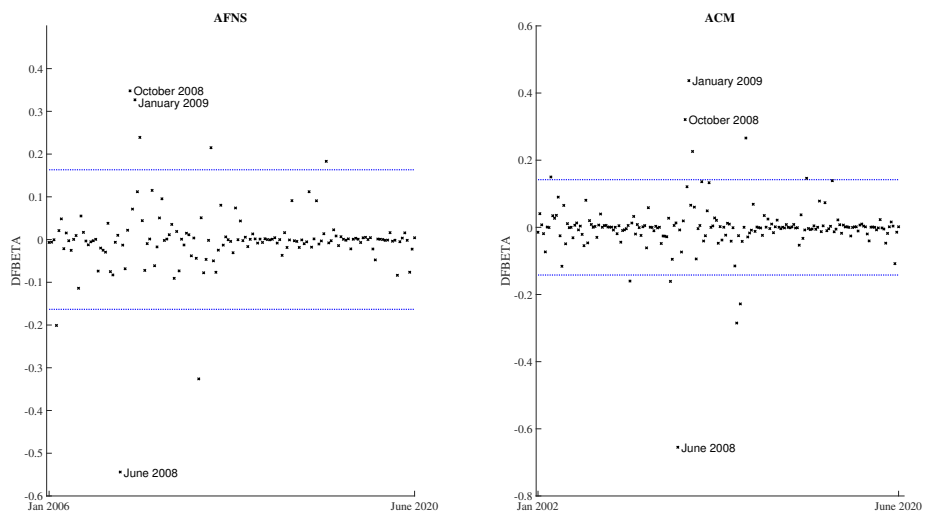
Notes: This figure depicts the DFBETA statistic from the event study regression of daily log returns on the Swiss Performance Index (SPI) on ECB policy surprises. Policy surprises take the form of surprises with respect to ECB policy rate (*Target*), the ECB's short-term (*Timing*) and longer-term forward guidance (*FG*) as well as to ECB bond purchases (*QE*). The DFBETA statistic measures whether specific observations have an outsized influence (DFBETA higher or lower than the critical values) on the regression coefficient. Positive (negative) values indicate that an observation pushed the regression coefficient upwards (downwards). The graph shows the months of the three most influential observations for each regression coefficient.

Figure 2: Influential observations: Ten-year bond yields and ECB policy surprises

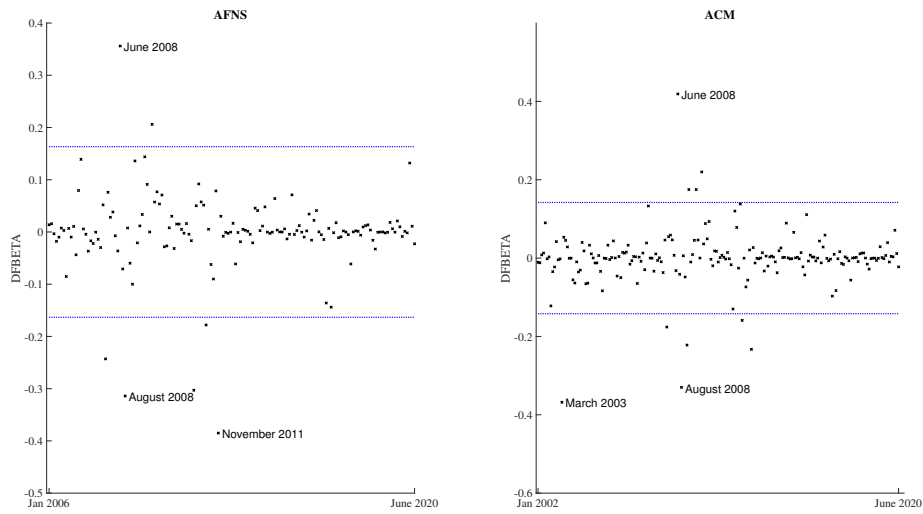
(a) *Target*



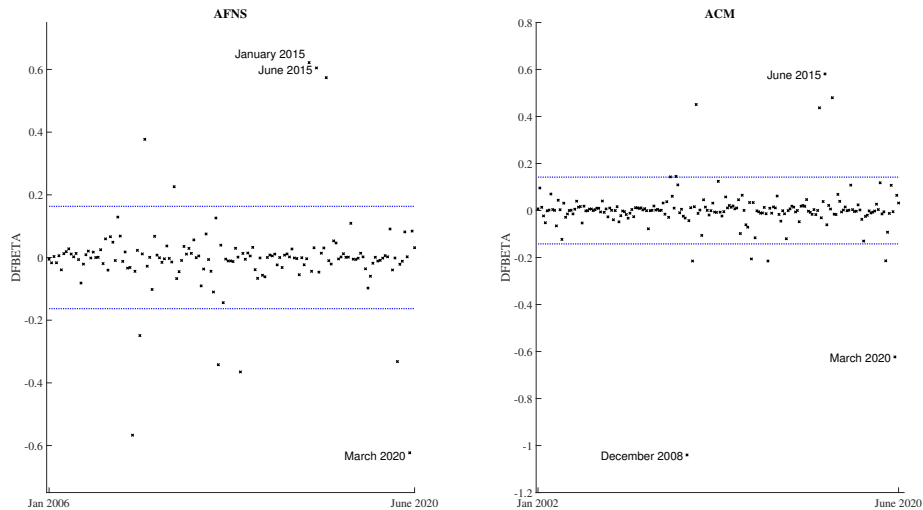
(b) *Timing*



(c) *FG*



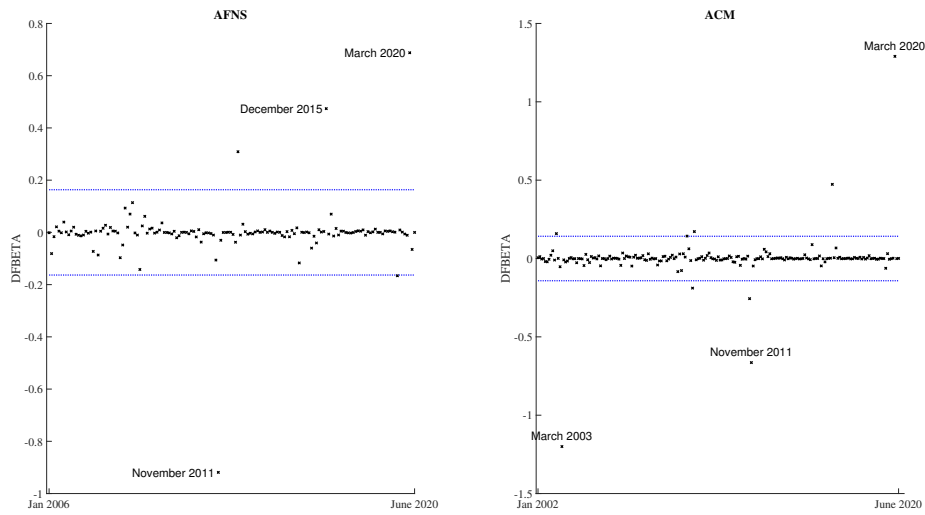
(d) *QE*



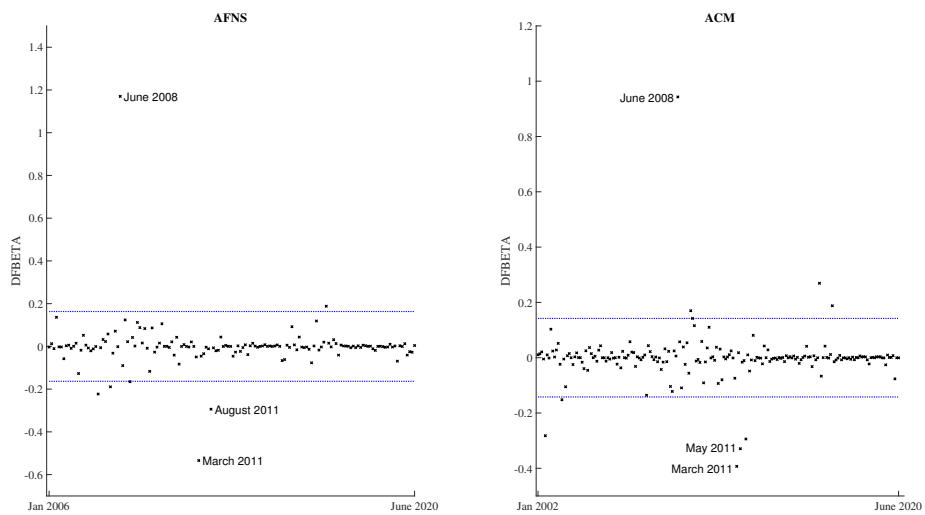
Notes: Figure (2) depicts the DFBETA statistic from the event study regression of daily changes in (fitted) yields on ten-year Swiss government bonds on ECB policy surprises. The DFBETA statistic measures whether specific observations have an outsized influence (DFBETA higher or lower than the critical values) on the regression coefficient. Positive (negative) values indicate that an observation pushed the regression coefficient upwards (downwards). The graph explicitly labels the months of the three most influential observations for each regression coefficient. Policy surprises take the form of surprises with respect to the ECB policy rate (*Target*), the ECB's short-term (*Timing*) and longer-term forward guidance (*FG*) as well as to ECB bond purchases (*QE*).

Figure 3: Influential observations: Average short rate component of ten-year bond yields

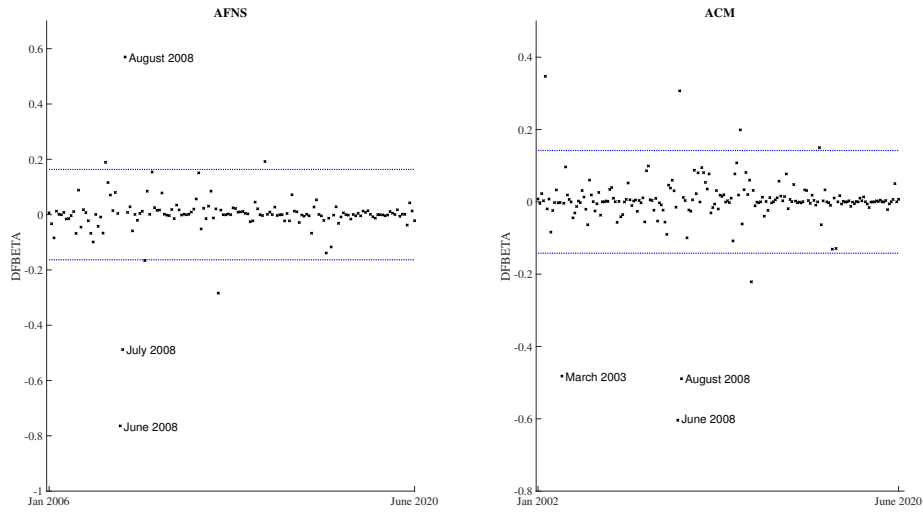
(a) *Target*



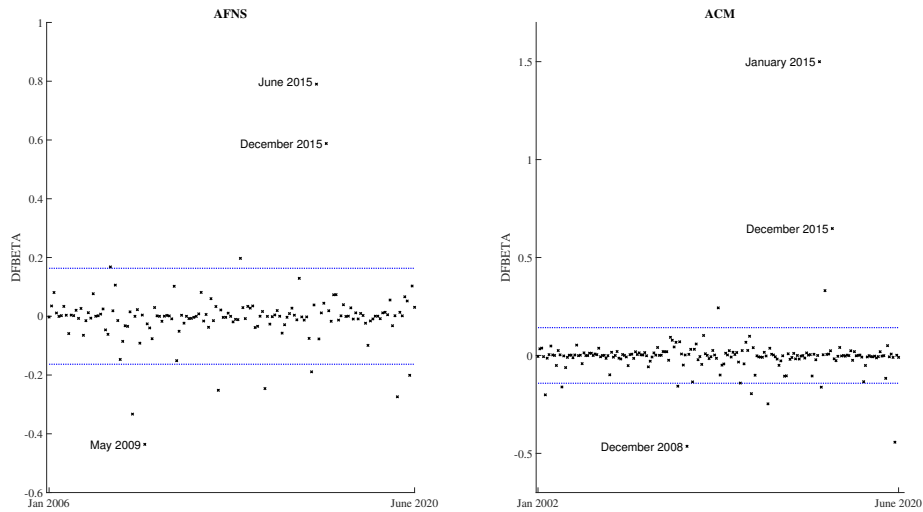
(b) *Timing*



(c) *FG*



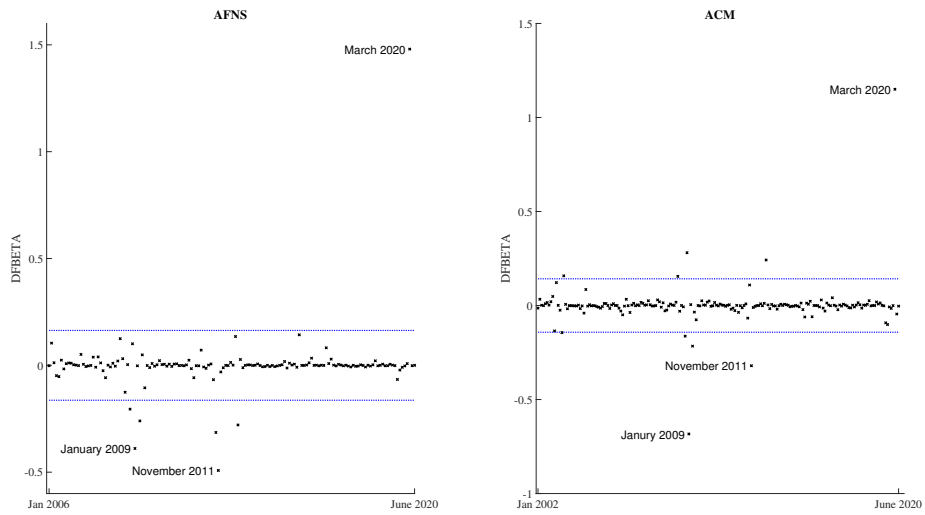
(d) *QE*



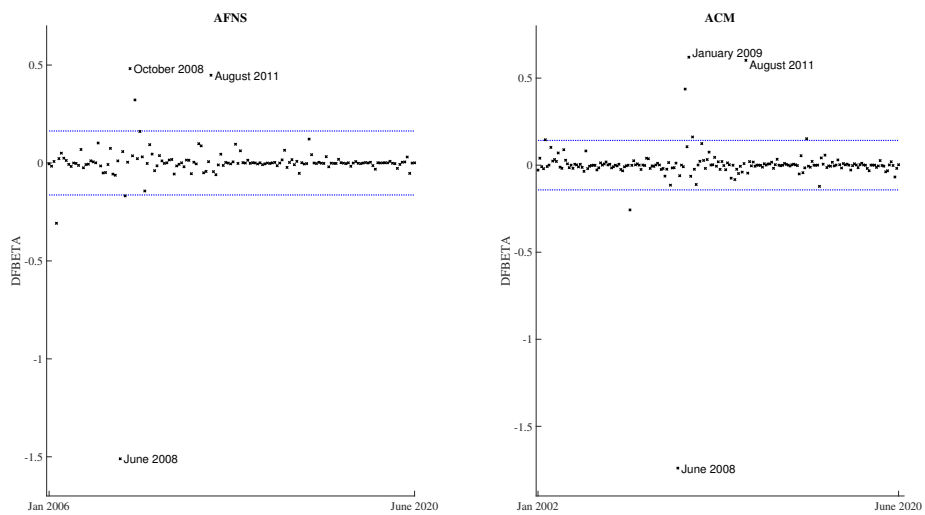
Notes: Figure (3) depicts the DFBETA statistic from the event study regression of daily changes in the average short rate component of yields on ten-year Swiss government bonds on ECB policy surprises. The DFBETA statistic measures whether specific observations have an outsized influence (DFBETA higher or lower than the critical values) on the regression coefficient. Positive (negative) values indicate that an observation pushed the regression coefficient upwards (downwards). The graph explicitly labels the months of the three most influential observations for each regression coefficient. Policy surprises take the form of surprises with respect to the ECB policy rate (*Target*), the ECB's short-term (*Timing*) and longer-term forward guidance (*FG*) as well as to ECB bond purchases (*QE*). The short rate components are extracted from two different term structure models proposed by Christensen et al. (2011) (AFNS) and Adrian et al. (2013) (ACM).

Figure 4: Influential observations: Term premium component of ten-year bond yields

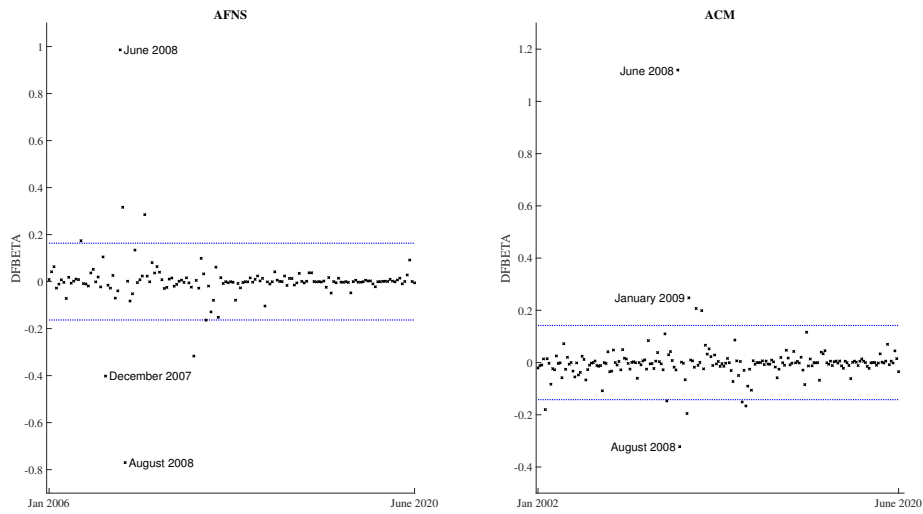
(a) *Target*



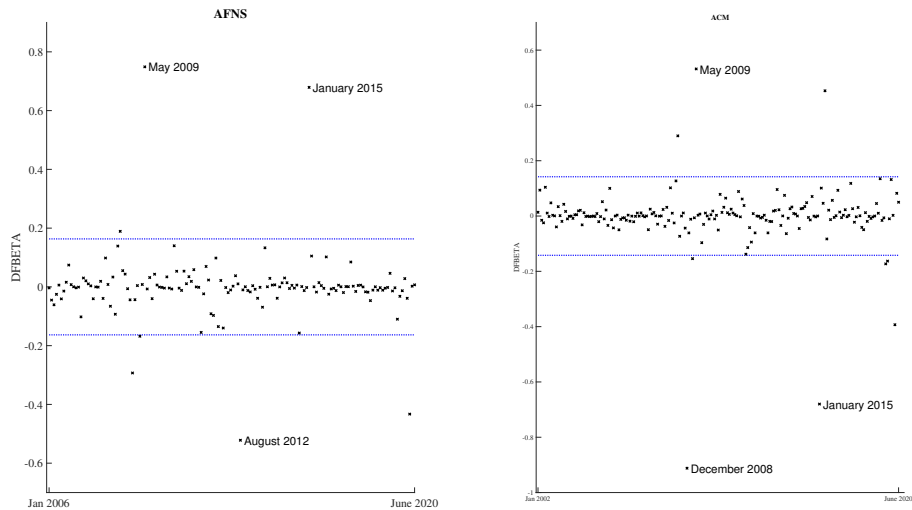
(b) *Timing*



(c) *FG*



(d) *QE*



Notes: Figure (4) depicts the DFBETA statistic from the event study regression of daily changes in the term premium component of yields on ten-year Swiss government bonds on ECB policy surprises. The DFBETA statistic measures whether specific observations have an outsized influence (DFBETA higher or lower than the critical values) on the regression coefficient. Positive (negative) values indicate that an observation pushed the regression coefficient upwards (downwards). The graph explicitly labels the months of the three most influential observations for each regression coefficient. Policy surprises take the form of surprises with respect to the ECB policy rate (*Target*), the ECB's short-term (*Timing*) and longer-term forward guidance (*FG*) as well as to ECB bond purchases (*QE*). The term premium is the difference between fitted yields and the average short rate components of ten-year government bond yields that are extracted from two different term structure models proposed by Christensen et al. (2011) (AFNS) and Adrian et al. (2013) (ACM).