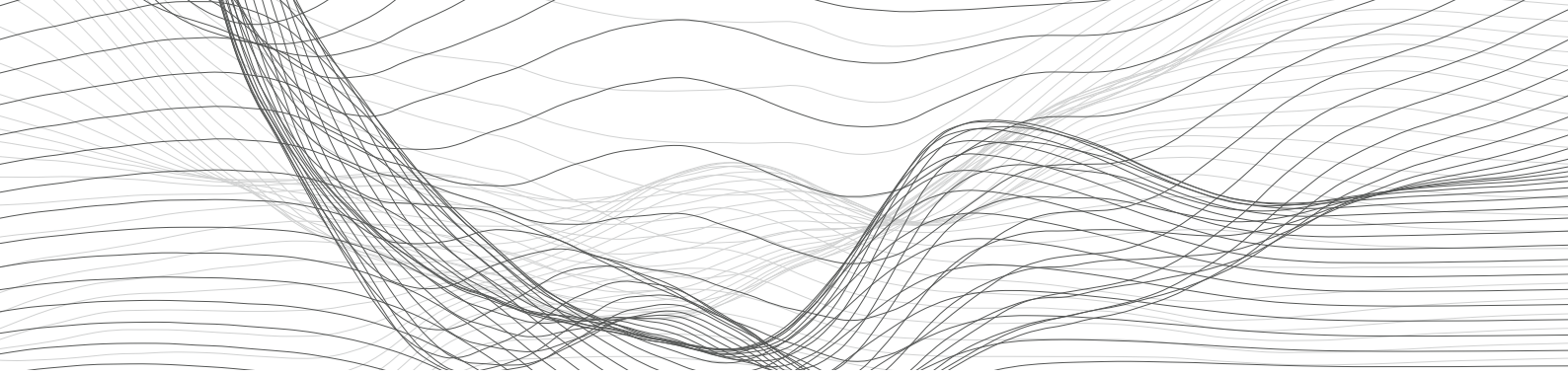


Responses of Swiss bond yields and stock prices to ECB policy surprises

Diego M. Hager, Thomas Nitschka

SNB Working Papers
8/2022

SCHWEIZERISCHE NATIONALBANK
BANQUE NATIONALE SUISSE
BANCA NAZIONALE SVIZZERA
BANCA NAZIUNALA SVIZRA
SWISS NATIONAL BANK

Legal Issues

ISSN 1660-7716 (printed version)
ISSN 1660-7724 (online version)

Responses of Swiss bond yields and stock prices to ECB policy surprises*

Diego M. Hager†, Thomas Nitschka‡

19 July 2022

Abstract

We analyse spillovers from European Central Bank (ECB) policy surprises to asset markets outside the euro area using Switzerland as a case study. Our results suggest that Swiss asset price responses to ECB policy surprises are significant. They depend on the type and nature of the surprise and change over time. Decomposing bond yields into expected short-term interest rates and the term premium reveals that both signalling and portfolio rebalancing effects explain the responses of bond yields of various maturities to surprises resulting from scheduled ECB policy decisions. ECB policy surprises are more important to Swiss government bond yields than Swiss stock prices.

JEL: E43, E52, G15
Keywords: bond, event study, international spillovers, monetary policy, stock

*We are grateful to Jens Christensen and Lucas Fuhrer for implementing decompositions of the Swiss government bond yield curve. In addition, this paper benefitted from comments of an anonymous referee of the SNB Working Paper Series, Petra Gerlach, Christian Grisse, Christian Hepenstrick, Daniel Kaufmann, Maxime Phillot, Jörn Tenhofen, Cedric Tille and of participants of the SSES Annual Meeting 2022 and of the SNB Brown Bag Seminar. Any errors and omissions are our own. The views, opinions, findings, and conclusions or recommendations expressed in this paper are strictly those of the authors and they do not necessarily reflect the views of the Swiss National Bank. The Swiss National Bank does not take responsibility for any errors or omissions in, or for the correctness of, the information presented in this paper.

†diego.hager@outlook.de, University of Zurich
‡thomas.nitschka@snb.ch, Swiss National Bank

1 Introduction

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

Monetary policy decisions in major economies influence not only domestic asset prices but also international financial markets. For example, it is well documented both 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 have been 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.

We believe Switzerland to be an interesting case study of the international spillovers of ECB policy because foreign monetary policy has a strong impact on CPI inflation and economic developments in Switzerland and thus on Swiss monetary policy (Jordan, 2016). Furthermore, the Swiss economy is tightly linked with the euro area.[1] Hence, evaluating the responses of Swiss bond and stock prices to ECB policy decisions helps to understand the channels through which changes in ECB policy transmit to economies outside the euro area.

[1]For 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).

Our analysis complements that of 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 evaluate whether specific dimensions of ECB monetary policy decisions (policy rate, short-term and longer-term forward guidance, asset purchases) particularly affect Swiss stock prices and bond yields from 2002 to 2020. 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).[3] Moreover, we focus on scheduled ECB meetings to shed light on the spillovers from regular ECB policy decisions to Swiss asset prices. Unscheduled meetings typically take place in response to extraordinary events, e.g., the outbreak of the coronavirus pandemic, making it difficult to empirically distinguish between the monetary policy effects and the impact of the extraordinary events on asset prices.

We use event study regressions to analyse how ECB policy surprises affect Swiss government bond yields and stock prices. Altavilla et al. (2019) show that one common factor describes the variation in euro area interest rates during a short time window around the ECB's press release best. This factor is interpretable as a reflection of policy rate surprises (*Target*). In the conference window, they find three types of surprises. One seems to be related to the short-term timing of future policy rate changes (*Timing*). Another surprise reflects the ECB's guidance on the future longer-term path of the policy rate (forward guidance. *FG*). The

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

[3]One cannot rule out that the exchange rate interventions of the SNB occurred at the time of ECB policy decisions. This could not only have had a direct impact on Swiss franc exchange rates but also indirectly on the sensitivities of other Swiss asset prices to ECB policy surprises, because the exchange rate might have acted as either shock absorber or shock propagator without the foreign exchange market interventions. We cannot directly control for this potential effect, so we assess whether our estimates of Swiss asset price responses to the different ECB policy surprises vary across subsample periods in our empirical analysis. The subsamples aim to distinguish between periods of different Swiss franc exchange rate flexibility and limitations for ECB policy rate changes due to the effective lower bound.

third factor reflects surprise changes in long-term euro area interest rates and is rotated in such a way that it is interpretable as reflecting surprises related to the ECB's asset purchase programmes (*QE*).

According to results presented by Altavilla et al. (2019), the impact of the different ECB policy surprises on euro area interest rates varies across maturities. Moreover, restrictive (expansionary) surprises lead to significant increases (declines) in euro area interest rates. Euro area stock market reactions to the ECB policy surprises depend on specific subsamples to a larger extent than interest rate responses. Restrictive surprises tend to lower stock prices in the euro area, but Altavilla et al. (2019) find many instances of subsamples in which stock market reactions to the ECB surprises remain insignificant.

How do Swiss bond yields and stock prices respond to ECB policy surprises? Do they move in the same direction as their counterparts in the euro area?

We find that restrictive *Target* surprises are associated with rising bond yields and falling stock prices, which are the responses one would expect from a standard monetary policy surprise. This finding is also aligned with the euro area evidence. However, decompositions into short-term Swiss franc (CHF) interest rate expectations and the term premium reveal that Swiss bond yield responses to the *Target* surprise primarily reflect movements in the term premium of Swiss government bond yields. This suggests that unanticipated changes in the ECB's policy rate transmit to Swiss bond yields because of portfolio rebalancing. Furthermore, the responses of Swiss bond yields to *Target* surprises are only statistically significantly different from zero in the most recent part of the sample period when the ECB policy rate entered negative territory in 2014. These findings suggest that the impact of ECB policy rate surprises on Swiss asset prices varies over time. Moreover, we find evidence of an asymmetry in bond yield responses. They react primarily to restrictive surprises but not to expansionary *Target* surprises.

Surprises about the timing of future ECB policy rate changes, communicated during the ECB press conference, drive Swiss bond yields and Swiss stock prices in the same direction. This suggests that Swiss stock prices mainly react to the non-monetary information of these surprises (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 policy rate for some months, might be taken as bad news about the economic outlook or a negative risk assessment of the ECB. In this case, stock prices decline and bond yields fall at the same time. Indeed, we find evidence of Swiss bond yields and stock prices mainly reacting to expansionary *Timing* surprises. Moreover, *Timing* surprises significantly affected Swiss asset prices only from the start of the global financial crisis (GFC) until the introduction of negative policy rates in the euro area.

Surprises related to the ECB's longer-term forward guidance influence only Swiss government bond yields. The impact is strongest for short-term and medium-term maturities. At first glance, the direction of the bond yield responses to the ECB's *FG* surprises looks unusual. Restrictive (accommodative) forward guidance surprises lower (increase) Swiss government bond yields and mainly transmit to Swiss bond yields by influencing the expectations about future short-term CHF interest rates. Moreover, this observation is confined to the sample period before the introduction of negative policy rates in the euro area. These findings could reflect that surprisingly hawkish forward guidance by the ECB leads market participants to expect a slowdown in the euro area economy. In this case, the Swiss economy would cool as well and reduce inflationary pressure in Switzerland. This would give the SNB room to lower its policy rate.

Finally, Swiss asset price responses to the ECB's *QE* surprises look like reactions to conventional monetary policy. Restrictive *QE* surprises increase Swiss bond yields and lower Swiss stock prices. In addition, the ECB's *QE* surprises affect both expectations about future short-term CHF interest 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.

To summarise, our empirical results highlight the complex nature of spillovers from ECB policy to asset markets of non-euro economies. The spillovers depend on the type as well as on the nature (restrictive or expansionary) of the monetary policy surprise. In addition, the importance of the different types of ECB policy surprises varies over time. For example, the lowering of the ECB policy rate into negative territory and the advent of QE seems to have diminished the effect of the

ECB's forward guidance on Swiss asset prices.

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. The appendix provides additional results and robustness checks.

2 Measuring euro area policy surprises

We use the approach and the replication code of Altavilla et al. (2019) to measure 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 then a press conference 45 minutes later. 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 euro area 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 can be interpreted as surprise related to the ECB bond purchase programmes, which started in 2014. Hence, the abbreviation of this factor is *QE*.

Note that restrictive (expansionary) surprises, irrespective of the type of surprise, increase (decrease) euro area interest rates (Altavilla et al., 2019).

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 of explicitly distinguishing between the two separate steps (press release and subsequent press conference) of the ECB's policy communication. Moreover, this distinction allows for the identification of factors that help researchers to differentiate between the multiple dimensions of the ECB policy communication.

Figure 1 depicts the four policy surprises in our sample period from January 2002 to June 2020. 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.

A couple of observations are noteworthy. First, strong surprises related to the ECB's policy rate are rare in our sample period. Exceptions were the time of the Iraq war in 2003, the sovereign debt crisis in the euro area in 2011 and 2012 and the outbreak of the coronavirus pandemic in March 2020. Second, the two forward guidance factors (*Timing* and *FG*) spiked often during the global financial crisis and the euro area debt crisis. However, there were little pronounced surprises related to the ECB's forward guidance in the latter half of our sample period, which stands in marked contrast to the *QE* factor. This measure of surprise movements in long-term euro area interest rates became more volatile during the global financial crisis and remained volatile thereafter.

[Figure (1) about here]

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:

$$\Delta X_t = \alpha + \beta Target_t + \gamma Timing_t + \delta FG_t + \zeta QE_t + \epsilon_t \tag{1}$$

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 Swiss government bond yields or of one of the two yield 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 scheduled ECB policy decisions took place.

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) and the Swiss Performance Index (SPI) 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 appendix provides results for sectoral indices of the SPI.[4]

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 $t-1$.

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

Swiss government bond data are from the website of the SNB. We assess the responses of Swiss government bond yields of different maturities (three, five, seven, ten, fifteen and twenty years) to ECB policy surprises. In addition, we decompose the five- and ten-year Swiss government bond yields 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 affect 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 the model of Adrian, Crump, and Moench (2013) as a benchmark for decomposing the Swiss government bond yields. Robustness checks with decompositions from the model of Christensen, Diebold, and Rudebusch (2011) provide qualitatively similar results. We report this robustness check in the appendix because the available data only starts in January 2006. However, this model 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) and thus provides a good check of whether our results depend on the specific model used to decompose bond yields.

The Swiss government bond yields published on the SNB's website reflect bond prices collected around 11 each morning. 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 the exclusion of ECB policy meetings that took place within three days of SNB or Fed policy meetings (results are available upon request). Outlier analysis (Cook's distance (Cook, 1977)) suggests that no single event had an extraordinary impact on the results for bond yields. However, the scheduled March 2020 meeting at the beginning of the coronavirus pandemic

had an outsized impact on Swiss stock prices. Therefore, we report results from the stock return regressions based on samples that exclude that particular event.[5]

5.1 Overview of full sample results

This section provides the baseline results of our event study regressions from which we depart in order to analyse the responses of Swiss bond yields and stock prices to the different types of ECB policy surprises in more detail.

The regression outcomes presented in table (1) suggest that, on average, Swiss bond yields respond to all of the four different facets of ECB policy surprises. By contrast, only *Timing* surprises have a statistically significant impact on Swiss stock prices in our sample period from 2002 to 2020.

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 positive regression coefficients in regressions of daily changes in Swiss government bond yields of various maturities indicate that a restrictive ECB *Target* surprise is associated with rising Swiss government bond yields. At first glance, this response looks like a textbook case in which a restrictive policy rate surprise abroad leads to higher yields at home. Interestingly, only the bond yields with maturities of five years or more react to the *Target* surprises. This observation stands in contrast to the euro area evidence of Altavilla et al. (2019), who show that *Target* surprises mainly affect risk-free euro area interest rates with maturities below five years. Whether the response of Swiss government bond yields reflects that investors adjusted their expectations about the future path of CHF short-term rates or the term premium on Swiss government bonds will be discussed in more detail in the subsequent sections. In contrast to the Swiss government bond yields, daily Swiss stock market returns do not show any significant association with the *Target* surprises.

Restrictive *Timing* surprises also increase Swiss government bond yields. This effect is most pronounced for yields on bonds with maturities of ten years or below. At the same time, restrictive *Timing* surprises lead to higher Swiss stock prices,

[5]Including the March 2020 ECB meeting leaves most of the main results qualitatively unaffected but makes the average response of daily returns on the Swiss stock market indices to the ECB *Target* surprise statistically significant.

thus moving bond yields and stock prices in the same direction. This observation suggests that the Swiss stock prices mainly react to the nonmonetary information (economic outlook or risk assessment) in the ECB communication that triggered the *Timing* surprises as argued in Cieslak and Schrimpf (2019) based on the present value representation of stock prices. Suppose a restrictive *Timing* surprise takes the form of an indication of an interest rate hike earlier than expected. If this sign of an earlier hike reflects a surprising improvement in the ECB's economic outlook, then a rise in Swiss stock prices as a reaction to the restrictive *Timing* surprise makes sense. In this case, the nonmonetary news provided by the ECB in the press conference outweighs the impact of the outlook of a higher policy rate in the euro area in a few weeks or months earlier than expected (Campbell et al., 2012, 2016; Cieslak and Schrimpf, 2019; Jarociński and Karadi, 2020; Kroencke et al., 2019; Nakamura and Steinsson, 2018).

Surprises related to the ECB's communication of longer-term forward guidance affect Swiss government bond yields of all maturities. By contrast, Swiss stock prices do not respond to *FG* surprises in a statistically significant way. This finding might reflect that the impact of monetary and nonmonetary news cancel each other out because they constitute opposing news about future cashflows and discount rates.[6]

Moreover, the negative sign of the regression coefficients for bond yields suggests that Swiss government bond yields fall in response to a restrictive *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 approximately three years. Against this background, a restrictive *FG* surprise

[6]For example, surprisingly accommodative forward guidance about the future path of the policy rate could lower the discount rate applied to expected future cashflows of a listed firm. However, at the same time, an expansionary forward guidance surprise reflecting an adverse economic outlook could lead to downward revisions in expectations about future cashflows.

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. Section 5.3 sheds further light on this issue.

The reactions of Swiss bond yields and Swiss stock prices to *QE* surprises in the euro area appear to be standard, albeit statistically insignificant in the case of the Swiss stock prices. Nevertheless, restrictive *QE* surprises are associated with rising Swiss government bond yields of all maturities and falling stock prices.

Judged by the adjusted R^2 statistics, the effects of the ECB policy surprises on daily changes in Swiss bond yields are strongest at maturities of five years to seven years with R^2 statistics of more than 30%. This finding highlights the importance of the ECB policy decisions for the dynamics of Swiss government bond yields. By contrast, sensitivity to the ECB policy surprises only describes approximately 5% to 6% of the daily variation in Swiss stock prices.

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 0.00610 for changes in the five-year yield and 0.00702 for changes in the seven-year yield on the *Target* surprise imply that Swiss ten-year government bond yields would rise by approximately between 28bp and 32bp[7] in response to a one percentage point surprise rise of the ECB policy rate or, more precisely, to a one percentage point surprise change in the one-month OIS rate in the euro area (Altavilla et al., 2019).

[Table (1) about here]

[7] 0.00610 or 0.00702 times 100/2.2

5.2 Subsamples and assessment of asymmetric responses

In this section, we take a more detailed look on the full sample results reported in section 5.1 from two different angles. First, we examine the responses of Swiss government bond yields and stock prices to each ECB policy surprise in different subsample periods. The choice of subsamples reflects our intention to distinguish between periods in which either the SNB or the ECB faced severe shocks and constraints. Our first subsample period runs from January 2002 to June 2007, i.e., the period before the first jitters on money markets and the beginning of the global financial crisis (e.g. Aït-Sahalia, Andritzky, Jobst, Nowak, and Tamirisa (2012)). The second subsample runs from July 2007 to 5 September 2011, the day before the introduction of the minimum CHF exchange rate against the euro (Swiss National Bank, 2011). We chose the SNB's decision to impose a minimum exchange rate of the Swiss franc against the euro (EURCHF) as a cut-off date because EURCHF thus lost its potential role as shock absorber[8] which might have had an impact on the sensitivity of other Swiss asset prices to policy decisions in the euro area. The third subsample covers the period from the start of the EURCHF minimum rate period on 6 September 2011 to 10 June 2014 because ECB policy rates went into negative territory on 11 June 2014. Alternatively, one could also use the day of the discontinuation of the EURCHF minimum exchange rate and the lowering of the interest rate on reserves at the SNB to -0,75% (15 January 2015) as the cut-off date for this subsample period. The results are qualitatively similar and available upon request. However, we view the introduction of negative policy rates as the more interesting feature of the data because it shows that the perception of the lower bound of monetary policy rates in the euro area has shifted over time. Finally, we report results for the subperiod from 11 June 2014 to June 2020 as well.

Second, we assess whether the significance or the sign of the responses of Swiss bond yields and stock prices depends on whether the surprises are expansionary or restrictive. This assessment 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

[8]The Swiss franc could depreciate against the euro but was not allowed to appreciate below 1.20, the minimum rate, from 6 September 2011 to 15 January 2015.

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 on the overall strength of the spillovers from foreign monetary policy. We revisit this question, 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.

5.2.1 Responses to Target surprises

The subsample analysis presented in panel A of table 2 suggests that the average response of Swiss government bond yields to the *Target* surprises primarily reflects the sensitivity of Swiss bond yields to these surprises in the period of negative ECB policy rates. Pushing the policy rate into negative territory seems to have made a significant difference with respect to the spillover effects from surprise changes in the ECB policy rates to asset markets in non-euro economies such as Switzerland.

In addition, during this period, we also observe significant responses of Swiss stock prices to *Target* surprises. The signs of the regression coefficients for daily changes in Swiss bond yields and daily returns on the Swiss stock market indices suggest that the *Target* surprises during the negative policy rate period transmitted to Swiss asset prices as a standard monetary policy surprise. Restrictive surprises increase bond yields and lower stock prices.

Moreover, panel B of table 2 highlights that there is some evidence of asymmetries in the reactions of long-term Swiss government bond yields to the ECB *Target* surprises. Only the responses of long-term bond yields to restrictive *Target* surprises are statistically different from zero. Furthermore, the coefficients from regressions of bond yield changes on expansionary *Target* surprises are considerably smaller than the coefficients from the respective regressions on restrictive *Target* surprises.

The differences in the sensitivities to the *Target* surprises across subsample periods do not seem to be related to the size of the surprises. As shown in figure

1, the size of the *Target* surprise in the most recent subperiod was not particularly high compared with earlier events in the sample.

[Table (2) about here]

5.2.2 Responses to Timing surprises

Swiss asset prices primarily react to surprises related to the short-term timing of ECB policy rate changes in the subsamples characterised by acute crises, from July 2007 until the introduction of negative policy rates in the euro area in June 2014. Only in those subsample periods are the regression coefficients of bond yield changes and daily stock market returns on the *Timing* surprises statistically different from zero (panel A of table 3).

Figure 1 shows that the biggest *Timing* surprises occurred in the time periods mentioned above. This observation suggests that the responses of Swiss asset prices may depend on the size of the *Timing* surprises.

The signs of the regression coefficients confirm the results from the full sample regressions and suggest that Swiss asset prices mainly responded to the nonmonetary news provided with surprise changes in the timing of ECB policy rate changes (Cieslak and Schrimpf, 2019; Jarociński and Karadi, 2020). Expansionary *Timing* surprises lower both bond yields and stock prices which stands in contrast to the reactions to the *Target* surprises.

Moreover, panel B of of table 3 reveals that Swiss asset prices mainly react to expansionary *Timing* surprises. For example, news that a policy rate hike will be postponed is expansionary news and should, ceteris paribus, lead to both lower bond yields and higher stock prices. However, if the ECB communicates the reason for postponing the rate hike to be a deteriorating economic outlook or a negative risk assessment, then this adverse nonmonetary news seems to outweigh the impact of the monetary policy news provided with the *Timing* surprise on Swiss stock prices.

[Table (3) about here]

5.2.3 Responses to FG surprises

The subsample results confirm the full sample evidence that Swiss bond yields respond to the ECB's *FG* surprises but not Swiss stock prices (panel A of table

4). Interestingly, the full sample results seem to primarily reflect the sensitivities of Swiss government bond yield changes to *FG* surprises before the introduction of negative policy rates in 2014 and the advent of QE in the euro area. We also observe this pattern in the responses to the other forward guidance surprise, *Timing*, in the previous section. This suggests that negative policy rates and the introduction of QE diminished the effects of forward guidance on Swiss government bond yields. This is also visible in the time series of the *Timing* and the *FG* surprises depicted in figure 1. From the end of the euro area sovereign debt crisis onwards, pronounced forward guidance surprises appear to be relatively few compared with the earlier half of the sample period.

Subsample analysis also shows that the negative sign of the regression coefficients in the regressions of bond yield changes on *FG* surprises persists across subsample periods. This observation leaves the impression that the finding of restrictive *FG* surprises being associated with lower Swiss government bond yields is a consistent feature of the data and not the product of single events.

Moreover, panel A of table 4 shows that there is again some mild evidence of asymmetries in the responses of long-term government bond yields to *FG* surprises. In contrast to the evidence for the *Timing* surprises, long-term Swiss government bond yields mainly respond to the restrictive *FG* surprises.

[Table (4) about here]

5.2.4 Responses to QE surprises

The *QE* surprise mainly reflects the impact of ECB policy decisions on long-term interest rates in the euro area during the ECB's press conference (Altavilla et al., 2019). Since the ECB introduced QE (ABSPP,CBPP-3) only in 2014, the *QE* surprise can only reflect QE from 2014 onwards.

Therefore, we focus our discussion of the main results presented in table 5 on the subsample period from June 2014 to June 2020. However, we observe significant responses of Swiss government bond yields with five-year and seven-year maturity in the 2007–2011 subsample period as well as of the narrow Swiss stock market index, SMI, in the 2011–2014 subsample period. These regression outcomes seem to reflect that whatever affected long-term interest rates in the euro area had at least some impact on Swiss asset prices as well.

The signs of the sensitivities of the bond yield changes and stock returns to *QE* surprises suggest that the ECB's QE transmitted to Swiss asset prices as a standard monetary policy surprise. This finding confirms Swanson (2021) in the sense that QE in the euro area appears to have been a substitute to changes in policy rates when they reached the effective lower bound.

Expansionary *QE* surprises are associated with significantly lower Swiss government bond yields and tend to increase stock prices, albeit not in a statistically significant way. *QE* surprises affect Swiss government bond yields of short as well as long maturities, which immediately raises the question of whether the ECB's QE affected financial market participants' expectations about future CHF short-term interest rates, and thus expectations about the future Swiss monetary stance (signalling effect), or the term premium (portfolio rebalancing) or both. We address this question in the subsequent section.

[Table (5) about here]

5.3 Bond yield decompositions

Swiss bond yields respond to ECB policy surprises, but what is the underlying economic reason? Do the policy decisions of the ECB influence market participants' views on future SNB policy rate decisions and thus have a signalling effect? Or do the policy decisions simply affect the pricing of government bonds in the euro area, which triggers portfolio rebalancing and thus influences Swiss government bond yields?

This section aims to shed light on this question by decomposing Swiss government bond yields (y) into the yield component that reflects expectations of short-term interest rates (r) over the lifetime of the bond. The term premium (TP) captures compensation for investing in a long-term bond instead of repeatedly investing in the short-term interest rate on the money market and is simply the difference between the yield and the short-rate component as highlighted in equation (2) for a bond of maturity m.

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

We use the model proposed by Adrian et al. (2013), ACM, as our benchmark

model and the model by Christensen et al. (2011), AFNS, as robustness check (appendix B presents the corresponding results) because the ACM-decomposition is available for the entire sample period. The data from the AFNS-decomposition is only available from January 2006 to the end of the sample period. Both models are affine term structure models but differ in some dimensions. The ACM model employs five latent factors to model the yield curve. The daily decompositions of yields use model parameters optimised at the monthly frequency. It uses a sequence of three linear regressions to obtain the short rate component of bond yields from bond excess returns.[9] The ANFS model allows for three latent factors to model the yield curve and its parameters are optimised at the daily frequency.

The detailed results are presented in table (6). To save space, we only report the results for the yield components of the five-year and the ten-year Swiss government bonds because the results for the five-year bond are representative for bonds with three-year and seven-year maturities.

When we zoom in on the link between the yield components and their responses to the ECB policy surprises, we observe that surprises related to the ECB policy rate (*Target*) in the ECB press release window affect Swiss government bond yields through their impact on the term premium component. This finding pertains to both five-year and ten-year bond yields 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 primarily affect the short-rate component of Swiss government 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. This result is most pronounced for the ten-year government bond yield. However, the *Timing* surprise also partly affects the term premium of shorter-term Swiss government bonds suggesting that portfolio balancing effects also play some role in explaining the reaction of Swiss government bonds with rather short maturities

[9]We are grateful to Jens Christensen for implementing the Christensen et al. (2011) model for Swiss government bond yields and to Lucas Fuhrer for implementing the Adrian et al. (2013) model.

to the *Timing* surprise.

The results from the yield decompositions confirm that a restrictive *FG* surprise lowers Swiss government bond yields of all maturities. According to the yield decompositions, this response appears to be mainly attributable to the reaction of the expected short-rate component to the *FG* surprise.

Does this response make sense? *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. As argued earlier, this increase in euro area interest rates 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) within the forecast horizon of its conditional inflation forecast, which is approximately 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. Hence, it leads to lower expected short-term Swiss franc interest rates (signalling effect) and thus lower long-term Swiss government bond yields. However, the ECB's longer-term forward guidance affects both yield components of the five-year bond suggesting that signalling and portfolio balance effects jointly explain the responses of five-year Swiss government bond yields to the information about the future, longer-term path of the ECB policy rate.

Finally, the yield decomposition reveals that surprises with respect to the ECB's asset purchase programmes (*QE*) affect Swiss government bond yields through altering expectations about future short-term CHF interest rates and the term premium. 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, which influences market participants' expectations about the future path of the SNB's policy rate.

[Table (6) about here]

6 Conclusions

We used Switzerland as a case study to analyse the channels through which different types of ECB monetary policy surprises (policy rate, short-term forward guidance, long-term forward guidance, QE) affect financial markets of economies outside the euro area. We conducted event study regressions to show that ECB policy surprises spill over to Swiss bond and stock markets in a statistically significant way.

While all types of ECB policy surprises affect Swiss government bond yields, only the nonmonetary information provided with the communication of the short-term timing of ECB policy rate changes influenced Swiss stock prices. Swiss bond yields seem to be more sensitive to ECB policy decisions than the Swiss stock market, which may reflect that listed Swiss firms tend to be globally active and thus their business activities are to some extent globally diversified.

Furthermore, our analyses highlight that the sensitivities of bond yields and stock prices to the different types of ECB policy surprises vary over time. For example, forward guidance surprises had significant effects on Swiss bond yields and stock prices until the advent of QE and the lowering of the ECB policy rate into negative territory in 2014 but not thereafter. At the same time, the ECB policy rate only started to matter for Swiss asset prices when it turned negative.

Finally, our empirical assessments suggest that the spillovers from ECB policy to Swiss asset markets do not only depend on the type of monetary policy surprise and the particular time period. To some extent, they also depend on the sign of the surprises, i.e., whether the surprises are expansionary or restrictive.

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.

References

T. Adrian, R. K. Crump, and E. Moench. Pricing the term structure with linear regressions. *Journal of Financial Economics*, 110(1):110–138, 2013.

Y. Aït-Sahalia, J. Andritzky, A. Jobst, S. Nowak, and N. Tamirisa. Market response to policy initiatives during the global financial crisis. *Journal of International Economics*, 87(1):162–177, 2012.

C. Altavilla, L. Brugnolini, R. S. Gürkaynak, R. Motto, and G. Ragusa. Measuring euro area monetary policy. *Journal of Monetary Economics*, 108:162–179, 2019.

J. Ammer, C. Vega, and J. Wongswan. International Transmission of US Monetary Policy Shocks: Evidence from Stock Prices. *Journal of Money, Credit and Banking*, 42:179–198, 2010.

B. S. Bernanke and K. N. Kuttner. What Explains the Stock Market's Reaction to Federal Reserve Policy? *Journal of Finance*, 60:1221–1257, 2005.

S. Bernhard and T. Ebner. Cross-border spillover effects of unconventional monetary policies on Swiss asset prices. *Journal of International Money and Finance*, 75:109–127, 2017.

F. Brusa, P. Savor, and M. Wilson. One Central Bank to Rule Them All. *Review of Finance*, 24(2):263–304, 03 2020.

J. R. Campbell, C. L. Evans, J. D. M. Fisher, and A. Justiniano. Macroeconomic Effects of Federal Reserve Forward Guidance. *Brookings Papers on Economic Activity*, Spring, 2012.

J. R. Campbell, J. D. M. Fisher, A. Justiniano, and L. Melosi. *Forward Guidance and Macroeconomic Outcomes Since the Financial Crisis*, pages 283–357. University of Chicago Press, October 2016.

J. H. Christensen, F. X. Diebold, and G. D. Rudebusch. The affine arbitrage-free class of Nelson–Siegel term structure models. *Journal of Econometrics*, 164(1): 4–20, 2011. Annals Issue on Forecasting.

J. H. E. Christensen and S. Krogstrup. Transmission of Quantitative Easing: The Role of Central Bank Reserves. *The Economic Journal*, 129(617):249–272, 12 2018.

A. Cieslak and A. Schrimpf. Non-Monetary News in Central Bank Communication. *Journal of International Economics*, 118:293–315, 2019.

R. D. Cook. Detection of influential observation in linear regression. *Technometrics*, 19(1):15–18, 1977.

M. Ehrmann and M. Fratzscher. Global financial transmission of monetary policy shocks. *Oxford Bulletin of Economics and Statistics*, 71:739–759, 2009.

M. Falagiarda, P. McQuade, and M. Tirpák. Spillovers from the ECB's non-standard monetary policies on non-euro area EU countries: evidence from an event-study analysis. ECB Working Paper 1869, 2015.

R. Glick and S. Leduc. Central bank announcements of asset purchases and the impact on global financial and commodity markets. *Journal of International Money and Finance*, 31(8):2078–2101, 2012.

R. S. Gürkaynak, B. P. Sack, and E. T. Swanson. Do Actions Speak Louder than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. *International Journal of Central Banking*, 1:55–93, 2005.

M. Jarociński and P. Karadi. Deconstructing monetary policy surprise: the role of information shocks. *American Economic Journal: Macroeconomics*, 12:1–43, 2020.

Z. Jiang, A. Krishnamurthy, and H. Lustig. Dollar Safety and the Global Financial Cycle. NBER Working Paper 27682, 2020.

T. J. Jordan. The impact of international spillovers on Swiss inflation and the exchange rate. *Journal of International Money and Finance*, 68:262–265, 2016.

T. A. Kroencke, M. Schmeling, and A. Schrimpf. The FOMC Risk Shift. Unpublished Working Paper, 2019.

S. Miranda-Agrippino and H. Rey. U.S. Monetary Policy and the Global Financial Cycle. *The Review of Economic Studies*, 87(6):2754–2776, 05 2020.

E. Nakamura and J. Steinsson. High-Frequency Identification of Monetary Non-Neutrality: The Information Effect. *Quarterly Journal of Economics*, 133:1283–1330, 2018.

C. Nelson and A. F. Siegel. Parsimonious Modelling of Yield Curves. *Journal of Business*, 60:473–489, 1987.

G. Potjagailo. Spillover effects from Euro area monetary policy across europe: A factor-augmented VAR approach. *Journal of International Money and Finance*, 72:127–147, 2017.

E. T. Swanson. Measuring the effects of federal reserve forward guidance and asset purchases on financial markets. *Journal of Monetary Economics*, 118: 32–53, 2021.

Swiss National Bank. Swiss National Bank sets minimum exchange rate at CHF 1.20 per euro. Press release, 2011.

Swiss National Bank. 113th annual report, 2020.

S. ter Ellen, E. Jansen, and N. L. Midthjell. ECB Spillovers and domestic monetary policy effectiveness in small open economies. *European Economic Review*, 121: 103338, 2020.

W. Thorbecke. On stock market returns and monetary policy. *Journal of Finance*, 52:635–654, 1997.

J. Wongswan. The response of global equity indexes to U.S. monetary policy announcements. *Journal of International Money and Finance*, 28:344–365, 2009.

Tables

Table 1: Swiss asset price responses to ECB policy surprises

	3Y	5Y	7Y	10Y	15Y	20Y	SMI	SPI
(Intercept)	−.00102	−.00138	−.00063	.00038	.00069	−.00009	−.02174	.00074
	(.00287)	(.00267)	(.00256)	(.00252)	(.00266)	(.00270)	(.07658)	(.07157)
Target	.00285	.00610*	.00702**	.00699**	.00678*	.00699*	.03891	.02483
	(.00290)	(.00269)	(.00258)	(.00254)	(.00268)	(.00273)	(.08242)	(.07799)
Timing	.01016***	.01124***	.01005***	.00709**	.00385	.00345	.27512***	.27967***
	(.00291)	(.00270)	(.00258)	(.00255)	(.00269)	(.00273)	(.07692)	(.07257)
FG	−.01643***	−.01531***	−.01319***	−.01023***	−.00725**	−.00632*	−.03695	−.04944
	(.00295)	(.00273)	(.00262)	(.00258)	(.00272)	(.00277)	(.07805)	(.07324)
QE	.01504***	.01667***	.01605***	.01440***	.01255***	.01165***	−.10460	−.10391
	(.00293)	(.00272)	(.00260)	(.00257)	(.00270)	(.00275)	(.08094)	(.07314)
R^2	.27290	.32926	.31618	.25208	.16701	.14466	.07314	.08293
Adj. R^2	.25775	.31528	.30194	.23650	.14966	.12684	.05342	.06392
Num. obs.	197	197	197	197	197	197	193	198

Notes: This table presents the sensitivities of daily changes in Swiss government bond yields of different maturities (three, five, seven, ten, fifteen and twenty years) and of daily log returns on the Swiss stock indices SMI and SPI 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*) and the ECB bond purchases (*QE*). ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level, respectively, 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 the percent change per standard deviation change in the respective surprise series.

Table 2: Swiss asset price responses to Target surprise

Panel A: Responses to Target surprise in subsample periods								
	3Y	5Y	7Y	10Y	15Y	20Y	SMI	SPI
2002 - 2007	−.00911	−.00421	−.00155	.00059	.00104	.00050	−.01468	−.02585
	(.00594)	(.00564)	(.00522)	(.00464)	(.00418)	(.00410)	(.17631)	(.16370)
2007 - 2011	.00599	−.00304	−.00530	−.00682	−.00719	−.00301	.31122	.30667
	(.01042)	(.00906)	(.00884)	(.00964)	(.01160)	(.01198)	(.24706)	(.23610)
2011 - 2014	−.00099	.00238	.00373	.00394	.00385	.00375	.08514	.06739
	(.00276)	(.00266)	(.00249)	(.00235)	(.00237)	(.00249)	(.10267)	(.10229)
2014 - 2020	.02492***	.03200***	.03142***	.02892***	.02716***	.02634***	−.00728***	−.00702***
	(.00624)	(.00549)	(.00559)	(.00584)	(.00595)	(.00603)	(.00075)	(.00071)
Panel B: Asymmetries in the responses to the Target surprise?								
	No. obs	5Y	No. obs	10Y	No. obs	15Y	No. obs	SPI
Target (>0)	66	.00932	66	.01038*	66	.01128*	66	.10869
		(.00565)		(.00481)		(.00491)		(.14972)
Target (<0)	131	.00289	131	.00221	131	.00068	132	−.01481
		(.00354)		(.00356)		(.00384)		(.11159)

Notes: This table presents the sensitivities of daily changes in Swiss government bond yields of different maturities (three, five, seven, ten, fifteen and twenty years) and of daily log returns on the Swiss stock indices to ECB *Target* surprises in four different subsample periods in Panel A. The subsamples cover 1 January 2002 to 30 June 2007, 1 July 2007 to 5 September 2011, 6 September 2011 to 10 June 2014 and from 11 June 2014 to 30 June 2020. Panel B assesses whether the responses to the *Target* surprises depend on the nature of the surprise. Surprises >0 are restrictive. Surprises <0 are expansionary. ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level, respectively, 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 the percent change per standard deviation change in the respective surprise series.

Table 3: Swiss asset price responses to Timing surprise

Panel A: Responses to Timing surprise in subsample periods								
	3Y	5Y	7Y	10Y	15Y	20Y	SMI	SPI
2002 - 2007	.00637	.00972	.00963	.00704	.00210	−.00115	.31742	.28914
	(.00713)	(.00677)	(.00626)	(.00557)	(.00501)	(.00492)	(.21663)	(.19656)
2007 - 2011	.01033*	.01025**	.00876*	.00544	.00218	.00267	.30952**	.32343**
	(.00424)	(.00369)	(.00360)	(.00392)	(.00472)	(.00488)	(.10048)	(.09610)
2011 - 2014	.01498*	.01790*	.01819**	.01735**	.01593*	.01512*	.59276*	.56030*
	(.00726)	(.00699)	(.00656)	(.00619)	(.00623)	(.00656)	(.27751)	(.26872)
2014 - 2020	.01245	.00407	−.00180	−.00977	−.01553	−.01642	−.00006	−.00049
	(.01796)	(.01578)	(.01608)	(.01681)	(.01710)	(.01734)	(.00213)	(.00201)
Panel B: Asymmetries in the responses to the Timing surprise?								
	No. obs	5Y	No. obs	10Y	No. obs	15Y	No. obs	SPI
Timing (>0)	113	.00583	113	.00062	113	−.00195	113	.16082
		(.00467)		(.00446)		(.00471)		(.12812)
Timing (<0)	84	.01550**	84	.01144*	84	.00854	86	.35620**
		(.00463)		(.00435)		(.00464)		(.12548)

Notes: This table presents the sensitivities of daily changes in Swiss government bond yields of different maturities (three, five, seven, ten, fifteen and twenty years) and of daily log returns on the Swiss stock indices to ECB *Timing* surprises in four different subsample periods in Panel A. The subsamples cover 1 January 2002 to 30 June 2007, 1 July 2007 to 5 September 2011, 6 September 2011 to 10 June 2014 and from 11 June 2014 to 30 June 2020. Panel B assesses whether the responses to the *Timing* surprises depend on the nature of the surprise. Surprises >0 are restrictive. Surprises <0 are expansionary. ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level, respectively, 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 the percent change per standard deviation change in the respective surprise series.

Table 4: Swiss asset price responses to FG surprise

Panel A: Responses to FG surprise in subsample periods								
	3Y	5Y	7Y	10Y	15Y	20Y	SMI	SPI
2002 - 2007	−.02228**	−.02353**	−.02291***	−.01972**	−.01496**	−.01283*	−.05268	−.04248
	(.00736)	(.00699)	(.00647)	(.00575)	(.00517)	(.00508)	(.22143)	(.20299)
2007 - 2011	−.01557**	−.01390***	−.01125**	−.00809	−.00518	−.00403	−.06113	−.06764
	(.00445)	(.00387)	(.00377)	(.00411)	(.00495)	(.00511)	(.10531)	(.10069)
2011 - 2014	−.00947	−.01265	−.01303*	−.01202*	−.00976	−.00813	−.10896	−.16931
	(.00644)	(.00620)	(.00581)	(.00548)	(.00552)	(.00582)	(.24185)	(.23096)
2014 - 2020	−.01519	−.00943	−.00510	−.00019	.00043	−.00254	.00013	.00048
	(.01470)	(.01292)	(.01316)	(.01376)	(.01400)	(.01419)	(.00114)	(.00107)
Panel B: Asymmetries in the responses to the FG surprise?								
	No. obs	5Y	No. obs	10Y	No. obs	15Y	No. obs	SPI
FG (>0)	93	−.01741***	93	−.01316***	93	−.01038*	93	−.12564
		(.00375)		(.00371)		(.00397)		(.11951)
FG (<0)	104	−.01316*	104	−.00544	104	−.00206	105	−.17328
		(.00655)		(.00580)		(.00600)		(.15536)

Notes: This table presents the sensitivities of daily changes in Swiss government bond yields of different maturities (three, five, seven, ten, fifteen and twenty years) and of daily log returns on the Swiss stock indices to ECB *FG* surprises in four different subsample periods in Panel A. The subsamples cover 1 January 2002 to 30 June 2007, 1 July 2007 to 5 September 2011, 6 September 2011 to 10 June 2014 and from 11 June 2014 to 30 June 2020. Panel B assesses whether the responses to the *FG* surprises depend on the nature of the surprise. Surprises >0 are restrictive. Surprises <0 are expansionary. ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level, respectively, 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 the percent change per standard deviation change in the respective surprise series.

Table 5: Swiss asset price responses to QE surprise

Panel A: Responses to QE surprise in subsample periods								
	3Y	5Y	7Y	10Y	15Y	20Y	SMI	SPI
2002 - 2007	.00310	.00407	.00502	.00638	.00690	.00616	−.00069	−.00081
	(.01019)	(.00967)	(.00895)	(.00796)	(.00716)	(.00703)	(.00151)	(.00140)
2007 - 2011	.01321	.01698**	.01615**	.01186	.00649	.00409	.13129	.12243
	(.00692)	(.00602)	(.00587)	(.00640)	(.00771)	(.00796)	(.16396)	(.15680)
2011 - 2014	.00340	.00442	.00497	.00560	.00605	.00599	−.42873*	−.20812
	(.00421)	(.00405)	(.00380)	(.00359)	(.00361)	(.00380)	(.19352)	(.14783)
2014 - 2020	.02314***	.02475***	.02349***	.02206***	.02107***	.02100***	−.13728	−.16268
	(.00501)	(.00441)	(.00449)	(.00469)	(.00477)	(.00484)	(.30346)	(.28083)
Panel B: Asymmetries in the responses to the QE surprise?								
	No. obs	5Y	No. obs	10Y	No. obs	15Y	No. obs	SPI
QE (>0)	95	.02061***	95	.02011***	95	.02006***	96	−.24103
		(.00577)		(.00550)		(.00560)		(.14722)
QE (<0)	102	.01661**	102	.00677	102	−.00009	102	−.12828
		(.00523)		(.00477)		(.00505)		(.14487)

Notes: This table presents the sensitivities of daily changes in Swiss government bond yields of different maturities (three, five, seven, ten, fifteen and twenty years) and of daily log returns on the Swiss stock indices to ECB *QE* surprises in four different subsample periods in Panel A. The subsamples cover 1 January 2002 to 30 June 2007, 1 July 2007 to 5 September 2011, 6 September 2011 to 10 June 2014 and from 11 June 2014 to 30 June 2020. Panel B assesses whether the responses to the *QE* surprises depend on the nature of the surprise. Surprises >0 are restrictive. Surprises <0 are expansionary. ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level, respectively, 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 the percent change per standard deviation change in the respective surprise series.

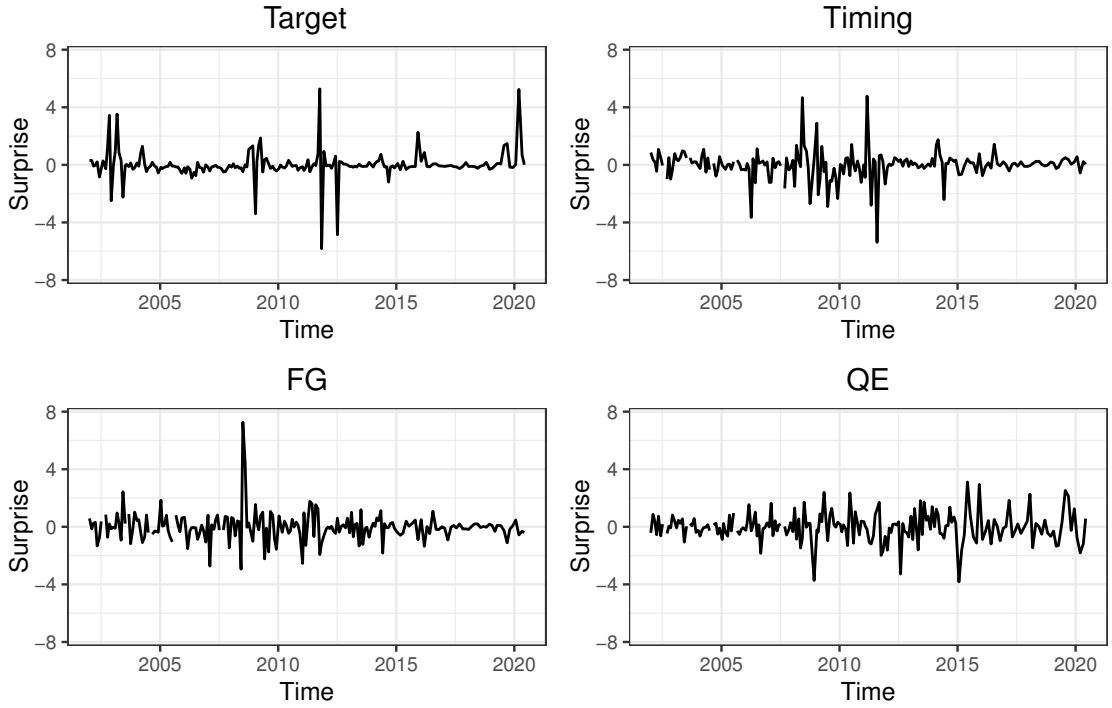
Table 6: Responses of Swiss five-year and ten-year government bond yields and its components to ECB policy surprises

	5Y		10Y	
	Short rate	Term premium	Short rate	Term premium
(Intercept)	−.00158	.00013	−.00125	.00165
	(.00199)	(.00156)	(.00160)	(.00202)
Target	.00060	.00554***	.00135	.00558**
	(.00201)	(.00158)	(.00161)	(.00204)
Timing	.00736***	.00403*	.00642***	.00095
	(.00201)	(.00158)	(.00162)	(.00204)
FG	−.01129***	−.00383*	−.00947***	−.00109
	(.00204)	(.00160)	(.00164)	(.00207)
QE	.00870***	.00787***	.00776***	.00636**
	(.00202)	(.00159)	(.00163)	(.00205)
R^2	.24789	.20814	.27790	.08510
Adj. R^2	.23222	.19164	.26285	.06604
Num. obs.	197	197	197	197

Notes: This table presents the sensitivities of daily changes in the two components of five-year (5Y) and ten-year (10Y) Swiss government bond yields to ECB policy surprises. One component reflects expectations about future average short-term interest rates (Short rate). The other component reflects the term premium (Term premium). The decompositions are based on the Adrian et al. (2013) model. 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*) and the ECB bond purchases (*QE*). ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level, respectively, 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.

Figures

Figure 1: ECB policy surprises



Notes: This figure depicts the four ECB policy surprises from January 2002 to June 2020. 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*) and asset purchases by the ECB (*QE*). Positive (negative) values indicate a restrictive (expansionary) surprise.

A Responses of sectoral stock indices to ECB policy surprises

This section takes a detailed look at different sectors that comprise the broad Swiss Performance Index (SPI) and assesses whether the findings from the main text depend on specific sectors of the Swiss stock market.

The results for the sectoral indices are presented in table (7). These results show that the effects of the *Timing* surprises on the market indices SMI and SPI seem to be driven by specific sectors, 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. For example, the sectoral indices "Industry" or "Consumer Goods" are dominated by few, international active companies such as ABB or Nestlé, whose business prospects largely depend on business cycle prospects abroad. The stock prices of companies in other sectors, such as "Health" (Novartis, Roche), are less dependent on the business cycle in general.

Moreover, with the exception of the Basic Materials sector, the results presented in table (7) 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 evidence at the market level.

Table 7: Swiss sectoral stock index responses to ECB policy surprises

	OilnGas	BasicMater	Indust	ConsGood	Health	ConsService	TeleCom	Utilities	Financials	Technology
(Intercept)	.22659	−.00460	.04784	−.03317	−.08820	−.04405	−.01710	−.14900	.02317	.06386
	(.24257)	(.09110)	(.09921)	(.07677)	(.07343)	(.08710)	(.06658)	(.09713)	(.11195)	(.11823)
Target	.46541	.04492	.03987	−.04952	.01286	−.06720	.07978	.03518	.10236	−.05590
	(.25983)	(.09926)	(.10811)	(.08365)	(.08001)	(.09491)	(.07255)	(.10584)	(.12198)	(.12883)
Timing	.22913	.37872***	.39505***	.26890***	.11901	.14847	.03842	.01615	.38985***	.44468***
	(.22362)	(.09237)	(.10060)	(.07784)	(.07445)	(.08831)	(.06751)	(.09848)	(.11351)	(.11988)
FG	.15779	−.20732*	.01949	−.09115	.03227	−.14372	−.01722	−.18120	−.08522	−.09135
	(.22667)	(.09322)	(.10152)	(.07856)	(.07513)	(.08912)	(.06813)	(.09939)	(.11455)	(.12098)
QE	−.37723	−.36076***	−.20023*	−.13494	−.03857	−.00199	.01078	−.08819	−.09114	−.02352
	(.21817)	(.09309)	(.10139)	(.07845)	(.07504)	(.08901)	(.06804)	(.09926)	(.11440)	(.12082)
R^2	.04973	.16178	.09145	.07979	.01532	.02903	.00872	.02254	.06617	.07051
Adj. R^2	.02136	.14441	.07262	.06072	−.00509	.00890	−.01183	.00229	.04682	.05124
Num. obs.	139	198	198	198	198	198	198	198	198	198

Notes: This table presents the sensitivities of the daily log returns on Swiss sectoral 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*) and ECB bond purchases (*QE*). The sectoral indices follow the Industry Classification Benchmark (ICB) and distinguish between firms in the 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 sectors. ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level, respectively, 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 the percent change per standard deviation change in the respective surprise series.

B Results of alternative bond yield decomposition

In this section, we check whether the regression results reported in section 5.3 depend on the specific model to decompose bond yields into components reflecting expected, average short-term interest rates over the lifetime of the bond or the term premium.

We employ the arbitrage-free Nelson-Siegel (AFNS) model by Christensen et al. (2011) for this robustness check. This model adds an extra term to the Nelson and Siegel (1987) model to ensure the absence of arbitrage when modelling the yield curve.[10]

Christensen and Krogstrup (2018) use this model to assess the channels through

[10]We are grateful to Jens Christensen for implementing the Christensen et al. (2011) model with Swiss government yield data.

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 data from the AFNS decomposition is only available from 2006 onwards.

The results from the AFNS model confirm that the evidence presented in the main text does not depend on the particular type of term structure model to decompose yields.

Table 8 shows that *Target* surprises primarily influence the term premium component of Swiss government bond yields, while *Timing* surprises mainly affect the average short-term interest rate component. The AFNS model suggests that changes in both average short-term interest rate expectations and term premia react to the ECB's *FG* surprises. The term premium evidence is more pronounced than for our benchmark model in section 5.3, which can be entirely attributed to limited sample period of the AFNS model. The ACM model produces the same result when we restrict the sample period (results available upon request). Finally, our robustness checks confirm that *QE* surprises influence Swiss government bond yields through both average short-term interest rates and the term premium, i.e., through signalling and portfolio rebalancing effects.

Table 8: Responses of Swiss five-year and ten-year government bond yields and its components to ECB policy surprises

	5Y		10Y	
	Short rate	Term premium	Short rate	Term premium
(Intercept)	.00251	−.00339	.00288	−.00373
	(.00226)	(.00287)	(.00202)	(.00255)
Target	−.00050	.01021***	.00167	.00744**
	(.00225)	(.00287)	(.00202)	(.00255)
Timing	.00629**	.00464	.00495**	.00296
	(.00206)	(.00262)	(.00184)	(.00233)
FG	−.00607**	−.00714*	−.00495*	−.00512*
	(.00217)	(.00277)	(.00195)	(.00245)
QE	.00509*	.01213***	.00441*	.01057***
	(.00206)	(.00262)	(.00185)	(.00233)
R^2	.13407	.23192	.11957	.19375
Adj. R^2	.11018	.21073	.09529	.17151
Num. obs.	150	150	150	150

Notes: This table presents the sensitivities of daily changes in the two components of five-year (5Y) and ten-year (10Y) Swiss government bond yields to ECB policy surprises. One component reflects expectations about future average short-term interest rates (Short rate). The other component reflects the term premium (Term premium). The decompositions are based on the Christensen et al. (2011) model. 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*) and ECB bond purchases (*QE*). ***, ** and * denote significance of the regression coefficients at the 0.1%, 1% and 5% level, respectively, 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

Recent SNB Working Papers

2022-08 Diego M. Hager, Thomas Nitschka:
Responses of Swiss bond yields and stock prices to ECB policy surprises

2022-07 Gregor Bäurle, Sarah M. Lein, Elizabeth Steiner:
Firm net worth, external finance premia and monitoring cost – estimates based on firm-level data

2022-06 Alexander Dentler und Enzo Rossi:
Public debt management announcements under "beat-the-market" opportunities

2022-05 Jason Blunier, Christian Hepenstrick:
What were they thinking? Estimating the quarterly forecasts underlying annual growth projections

2022-04 Lena Lee Andresen:
The influence of financial corporations on IMF lending: Has it changed with the global financial crisis?

2022-03 Alain Galli, Rina Rosenblatt-Wisch:
Analysing households' consumption and saving patterns using tax data

2022-02 Martin Indergand, Eric Jondeau, Andreas Fuster:
Measuring and stress-testing market-implied bank capital

2022-01 Enrique Alberola, Carlos Cantú, Paolo Cavallino, Nikola Mirkov:
Fiscal regimes and the exchange rate

2021-20 Alexander Dentler, Enzo Rossi:
Shooting up liquidity: the effect of crime on real estate

2021-19 Romain Baeriswyl, Samuel Reynard, Alexandre Swoboda:
Retail CBDC purposes and risk transfers to the central bank

2021-18 Nicole Allenspach, Oleg Reichmann, Javier Rodriguez-Martin:
Are banks still 'too big to fail'? – A market perspective

2021-17 Lucas Marc Fuhrer, Matthias Jüttner, Jan Wrampelmeyer, Matthias Zwicker:
Reserve tiering and the interbank market

2021-16 Matthias Burgert, Philipp Pfeiffer, Werner Roeger:
Fiscal policy in a monetary union with downward nominal wage rigidity

2021-15 Marc Blatter, Andreas Fuster:
Scale effects on efficiency and profitability in the Swiss banking sector

2021-14 Maxime Phillot, Samuel Reynard:
Monetary Policy Financial Transmission and Treasury Liquidity Premia

2021-13 Martin Indergand, Gabriela Hrasko:
Does the market believe in loss-absorbing bank debt?

2021-12 Philipp F. M. Baumann, Enzo Rossi, Alexander Volkmann:
What drives inflation and how? Evidence from additive mixed models selected by cAIC

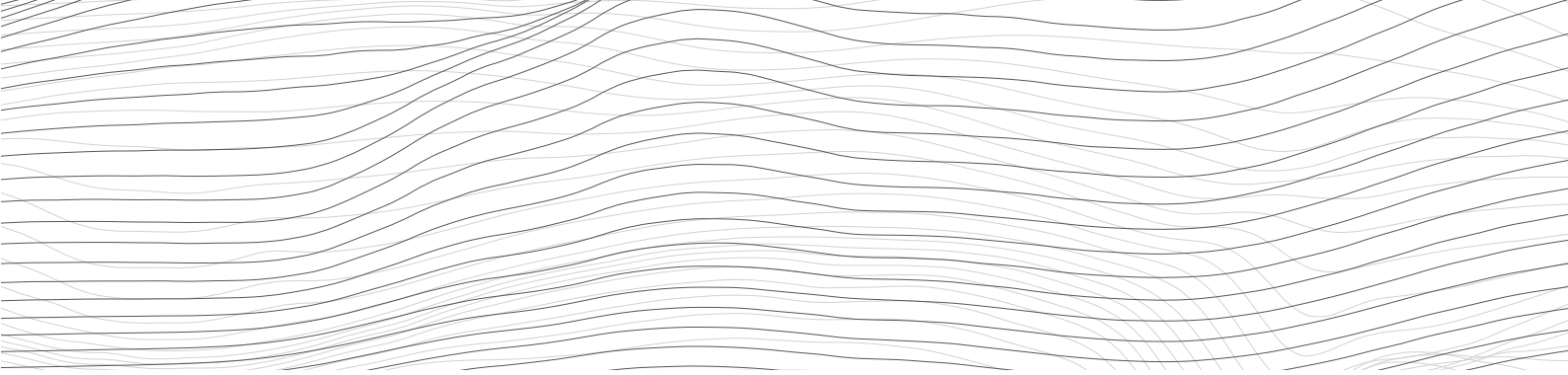
2021-11 Philippe Bacchetta, Rachel Cordonier, Ouarda Merrouche:
The rise in foreign currency bonds: the role of US monetary policy and capital controls

2021-10 Andreas Fuster, Tan Schelling, Pascal Towbin:
Tiers of joy? Reserve tiering and bank behavior in a negative-rate environment

2021-09 Angela Abbate, Dominik Thaler:
Optimal monetary policy with the risk-taking channel

2021-08 Thomas Nitschka, Shajivan Satkurunathan:
Habits die hard: implications for bond and stock markets internationally

2021-07 Lucas Fuhrer, Nils Herger:
Real interest rates and demographic developments across generations: A panel-data analysis over two centuries



SCHWEIZERISCHE NATIONALBANK
BANQUE NATIONALE SUISSE
BANCA NAZIONALE SVIZZERA
BANCA NAZIUNALA SVIZRA
SWISS NATIONAL BANK