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Did the Swiss Exchange Rate Shock Shock the Market?

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Did the Swiss Exchange Rate Shock Shock the Market?*

Abstract

The Swiss National Bank abolished the exchange rate floor versus the Euro in January 2015. Based on a synthetic matching framework, we analyse the impact of this unexpected (and therefore exogenous) shock on the stock market. The results reveal a significant level shift (decline) in asset prices in Switzerland following the discontinuation of the minimum exchange rate. While adjustments in stock market returns were most pronounced directly after the news announcement, the variance was elevated for some weeks, indicating signs of increased uncertainty and potentially negative consequences for the real economy.

Keywords: exchange rate shock, stock markets, uncertainty, synthetic matching

JEL classification: C22, E50, F30, F41

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1 Motivation

Exchange rate movements have implications for a country's competitiveness and future growth options. For small open economies in particular, it is important to know in how far the changes in exchange rate policy affect the market participants' assessment of future development as reflected in stock market prices. However, tracing these effects is challenging because causality between exchange rate fluctuations and stock market movements can run in both directions (Granger, Huangb & Yang 2000, Hashimoto & Ito 2004). We exploit the unexpected removal of the exchange rate floor of the Swiss franc versus the Euro on January 15, 2015 as a clear exchange rate shock to analyze its causal effect on stock markets.

With the start of the financial crisis, and even more so during the European sovereign debt crisis, Switzerland's status as a safe haven caused an increase in demand for the Swiss franc. To stop the appreciation of the currency, the Swiss National Bank (SNB) introduced an exchange rate floor in September 2011.[1] The floor was set at a minimum exchange rate of 1.2 Swiss franc per Euro. On the one hand, this ensured no further appreciation of the Swiss franc against the Euro. On the other hand, monetary policy became less independent as it forced the SNB to accumulate high foreign currency reserves and to increase the amount of Swiss franc in the market. Following the depreciation of the Euro and in the run-up to an announcement of further monetary expansion of the European Central Bank (ECB), the SNB suddenly discontinued the minimum exchange rate on January 15, 2015.[2]

The change in the Swiss exchange rate policy was a surprise to markets (Brunnermeier & James 2015, Mirkov, Pozdeev & Söderlind 2016, Wyplosz 2015). This exogenous shock thus offers an ideal setting to evaluate reactions of stock market participants in response to the appreciation shock. The "current account channel" suggests that exchange rates affect stock prices through the effect on the profitability of firms; exporting firms will most likely lose given an appreciation, while those that (strongly) rely on imported inputs should benefit. Therefore, the overall effect depends on the composition of importing versus exporting firms in the economy and remains unclear ex ante. Bäurle & Steiner (2015) provide evidence in a structural dynamic factor model that the negative effect on exports should dominate. We thus expect to find a significantly

[1] Technically, the new policy introduced a one-sided cap on the previously free-floating exchange rate.

[2] This step was accompanied by a reduction of its benchmark rate by 75 basis points from 0% to -0.75%, in order to ease possible negative consequences of the change in exchange rate policy. As both policy decisions were taken simultaneously, we cannot distinguish between them. For abbreviation purposes, we will talk about exchange rates in the rest of the paper, always implying the combination of both policies.

negative reaction of stock markets to the exchange rate shock. Additionally, some sectors may be disproportionately hit due to their larger exposure to exchange rate fluctuations.

In this paper, we employ synthetic matching to trace the effect of the exchange rate shock on stock markets because this technique is particularly well suited to analyze the effect of an exogenous shock on single entities in a relatively heterogeneous group (like countries). The idea of synthetic matching is to build a synthetic counterfactual to Switzerland from a control group of OECD countries that have not been treated. The synthetic counterfactual should be comparable to Switzerland in terms of its general economic environment and its development of stock markets until January 14, 2015. The counterfactual is then used to construct stock market developments after January 15, 2015 that would most likely have occurred in absence of the treatment (Abadie & Gardeazabal 2003, Chamon, Garcia & Souza 2017, El-Shagi, Lindner & von Schweinitz 2016).

Synthetic matching has been used in alternative contexts. For example, Abadie & Gardeazabal (2003) construct a synthetic control group out of other Spanish regions to analyze the effects of terrorism in the Basque country. These authors find that GDP per capita declined around ten percentage points due to terrorism. Abadie, Diamond & Hainmueller (2010) extend the method to study the effects of tobacco control in California. They emphasize that synthetic matching can be a helpful tool and an alternative to case studies to analyze effects at the aggregate level where the number of observational units is limited in most cases. Recently, synthetic matching was used to study the effects of the implementation of the Euro (El-Shagi et al. 2016, Gomis-Porqueras & Puzzello 2015) and the impact of foreign exchange interventions on the exchange rate in Brazil (Chamon et al. 2017).

The results of the synthetic matching model reveal an immediate significant and permanent decline in asset prices in Switzerland as a consequence of the exchange rate shock. The increased variance of the daily returns after the shock indicates that it took a couple of days until markets fully incorporated the new information. Breaking down the price index by sectors, we find that the negative growth effect was heterogeneous.[3] Stock market declines were strongest for sectors related to the health sector and the industrial sector, followed by the energy sector, consumer staples and the financial sector. This result is likely to reflect fears about reduced competitiveness in international markets, depressed margins, and declines in demand due to an

[3] An exchange rate survey of the SNB similarly reveals that the appreciation shock affected sectors heterogeneously (Swiss National Bank (SNB) 2015a).

appreciating currency.

The literature on the recent Swiss exchange rate shock is relatively scarce. Bannert, Drechsel, Mikosch & Sarferaz (2015) focus on the pass-through to firms' costs and profits. Relying on survey-based impulse response analysis, they find that turnover ratios, costs and profits decline. Responses are thereby heterogeneous across firms depending on their export ratio and import share of intermediate goods. A study by Efing, Fahlenbrach, Herpfer & Krüger (2016) based on firm-level data confirms that effects are heterogeneous. They find that, following the currency shock, firms that are more exposed to foreign currency risk show a larger decline in profitability and sales, and thus decrease investment rates. While our main focus is on the identification of the impact of exchange rate shocks on stock markets, we contribute to this literature by breaking down stock market reactions by sector and assessing heterogeneous responses.[4]

In principle, our results—while plausible—are not the only possible outcome. A recent paper by Fauceglia, Lassmann, Shingal & Wermelinger (2015) looks at the effects of exchange rate movements on Swiss exporters. They argue that adverse effects for exporters arising from an appreciation of the Swiss franc are mitigated due to the integration of Switzerland in global value chains. Their results suggest that an appreciation has negative effects but less so for sectors that rely heavily on imported input goods. "Natural hedging" compensates for the effects of a stronger Swiss franc by simultaneously reducing the prices of inputs. Thus, Swiss exporters integrated in global value chains are not forced to strongly increase export prices as a response to a higher value of the Swiss currency to maintain profit margins (see also the theoretical model of Amiti, Itskhoki & Konings 2014).[5]

Exchange rate movements might thus have no relevant effects given the high level of international integration of the typical exporting firm in Switzerland. Efing et al. (2016) also find that financial hedging mitigates the negative effects of currency shocks. However, while there might be mitigating effects for some exporting firms, we provide graphical evidence revealing that uncertainty following the shock not only increases in stock markets but also among the general public as well as among professional forecasters. Hence, negative and longer-run implications for the Swiss economy indicated by the immediate decline in prices in the stock market seem

[4]The relation between exchange rates, monetary policy, and real effects in Switzerland has, for example, been studied by Bäurle & Menz (2008), Bäurle & Steiner (2015) and Siliverstovs (2016). While adjustments in the real economy are found to take a couple of months, Bonadio, Fischer & Sauré (2016) find a fast exchange-rate pass through into prices.

[5]The relation between exchange rates and trade is also studied by Auer & Saure (2012), Berman, Martin & Mayer (2012) and Campa (2004).

probable (Baker & Bloom 2013, Bloom, Floetotto, Jaimovich, Saporta-Eksten & Terry 2012).

The paper is structured as follows. In the following section, we describe the SNB's policy objective and the reasoning behind the introduction and the abolition of the exchange rate floor. Section 3 outlines the synthetic matching methodology and presents the data. Section 4 describes the impact of the discontinuation of the minimum exchange rate on stock markets and discusses results. The final section summarizes the paper.

2 The exchange rate floor in Switzerland

The primary objective of the SNB is the maintenance of price stability as reflected in an annual growth rate of consumer prices of less than 2%.[6] To achieve this objective, the SNB monitors changes in the national consumer price index, makes a quarterly inflation forecast that serves as a decision device, and targets the three-month Swiss franc Libor. The main policy instruments used by the SNB are repo transactions. However, since the change from a fixed to a floating exchange rate in 1973, Switzerland has experienced several periods of increased capital inflows. The consequently increased demand for the Swiss franc has often resulted into an appreciating currency and deflationary pressure, challenging the SNB's monetary policy (Baltensperger 2007, Peytrignet 1999).

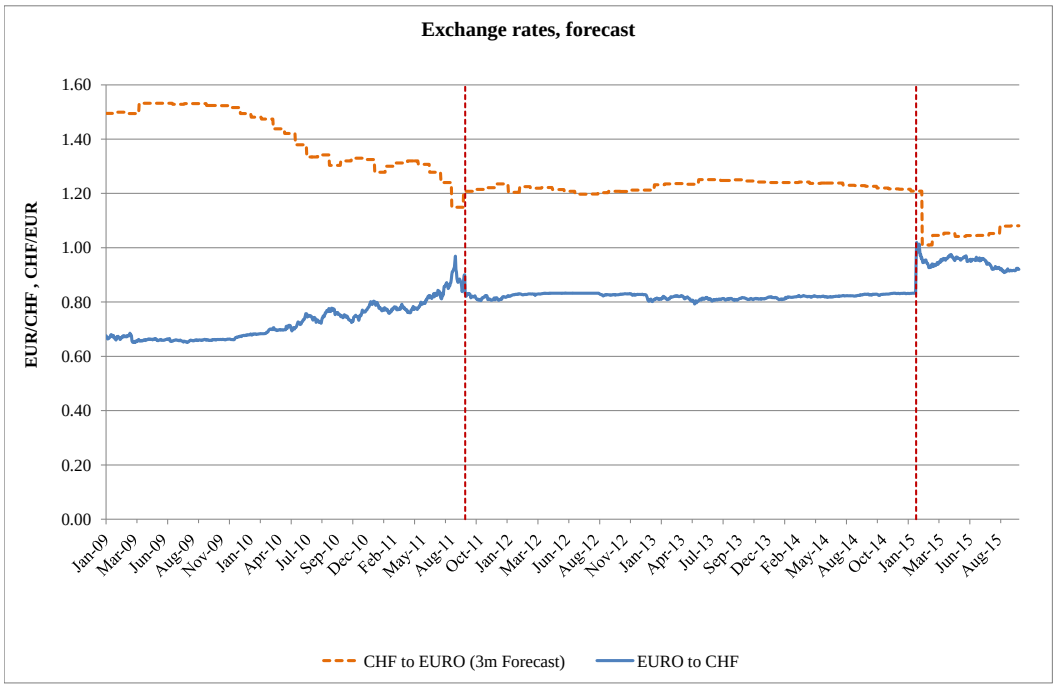
The exchange rate floor was introduced by the SNB in September 2011 with a minimum exchange rate of 1.2 Swiss francs per Euro (Swiss National Bank (SNB) 2011c).[7] Figure 1 shows the evolution of the Euro/Swiss franc exchange rate. Prior to the introduction of the exchange rate floor, the Swiss currency was considered as a safe haven. There were several reasons for this, for example, the high level of economic and political stability in Switzerland compared to other countries affected heavily by the financial and the European debt crisis. This caused increased demand for the Swiss franc by international investors and an appreciation of the currency. The appreciating currency led to increasing concerns on the side of Swiss exporters.

Moreover, Swiss inflation and output growth had been at low levels with a depressed economic outlook. The SNB had lowered its inflation forecasts in September 2011 to 0.4% for 2011, -0.3% for 2012, and 0.5% for 2013 and expected stagnating growth for the third and fourth quarter of 2011 (Swiss National Bank (SNB) 2011b), see also Figure 2. To stop the appreciation of the Swiss

[6] See the online reference: `http://www.snb.ch/en/iabout/monpol/id/monpol_strat.`

[7] Lera & Sornette (2016) analyze whether the target zone model by Krugman applies to the Euro/CHF exchange rate during the period of the exchange rate target.

Figure 1: Exchange rates and forecasts



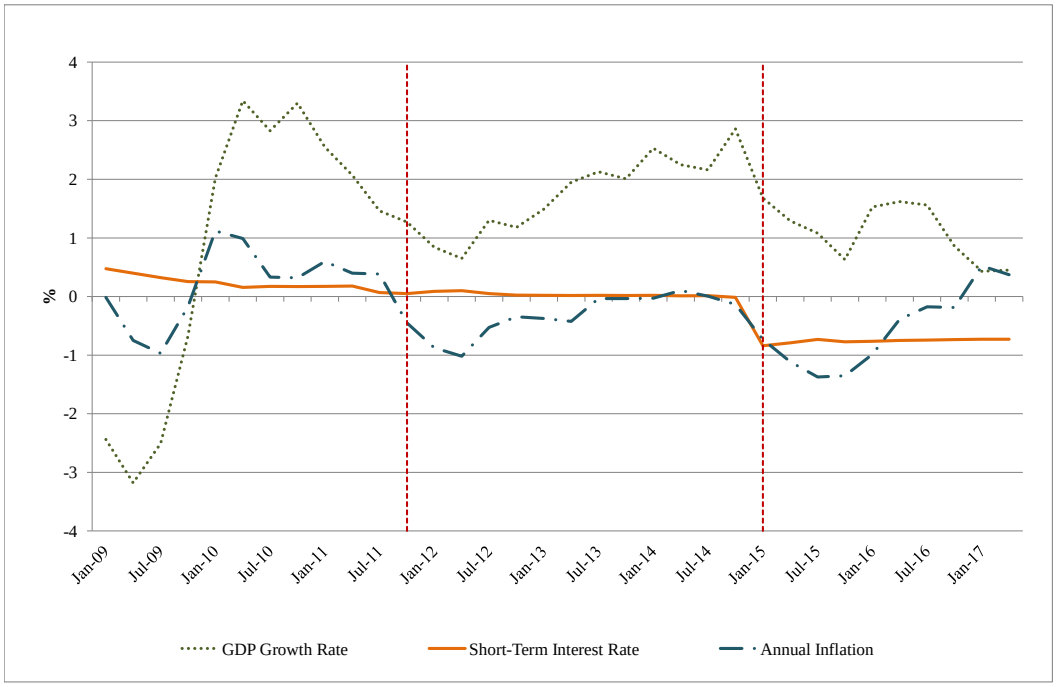
Note: This figure shows the daily exchange rate of the Euro against the Swiss franc (blue, solid line) and the monthly three-month ahead forecast for the exchange rate of the Swiss franc against the Euro (orange, dashed line) for the period from January 2009 to October 2015. The minimum exchange rate with approximately 1.2 Swiss franc per Euro was introduced on September 06, 2011 and abolished on January 15, 2015 (red, vertical lines). Source: Datastream, Consensus Economics.

franc, regain competitiveness and mitigate deflation risk, the SNB adopted the floor and the SNB stated a high commitment to maintain the floor (Swiss National Bank (SNB) 2011b, Swiss National Bank (SNB) 2011a). The maintenance of the floor was mainly executed through an increase in the number of Swiss francs used to buy Euros. Over time, this had the effect of strongly increasing the amount of foreign currency in the SNB's balance sheet to 480 billion US dollar in 2014 or 70% of GDP.[8] Figure 3 documents a strong increase in foreign reserve assets.

As a surprise to market participants, the SNB changed its policy on January 15, 2015 by abolishing the exchange rate floor (Swiss National Bank (SNB) 2015c). This came unexpectedly as the previous SNB's communication showed a high degree of commitment to maintain the exchange rate floor. How unexpected this policy change was can be seen by comparing the current exchange rate and expectations about the three-month ahead exchange rate. Figure 1

[8]See the online reference: `https://www.economist.com/blogs/economist-explains/2015/01/economist-explains-13`, *accessed May 3rd, 2018.*

Figure 2: Economic developments around the changes in the exchange rate regime



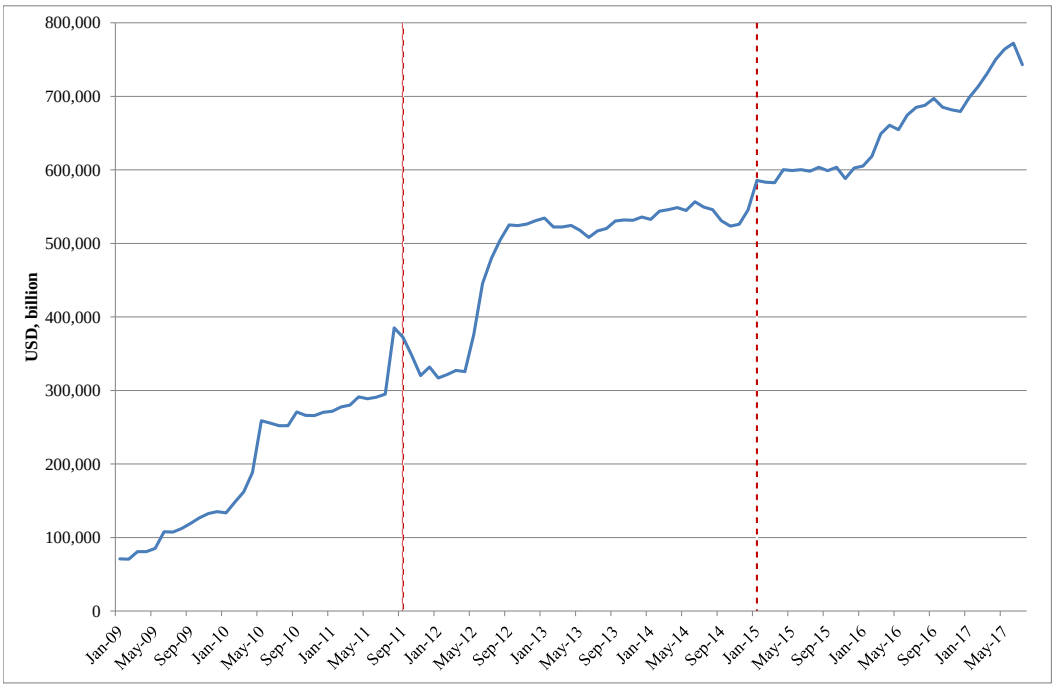
Note: This figure shows the evolution of key quarterly economic indicators in Switzerland including the percentage change in GDP, the short-term interest rate (in %) and the annual inflation rate (in %) from Q1 2009 until Q2 2017. Vertical lines indicate the introduction and abolition of the exchange rate floor. Source: Datastream.

plots the three-month ahead forecast by Consensus Economics next to the actual exchange rate. For visibility, we take the reverse of the exchange rate and plot the forecast series for the Swiss franc relative to the Euro.

The figure reveals that until the abolition of the exchange rate floor, forecasters did not expect that the SNB would change its exchange rate policy. Note that Consensus Economics collects assessments from a group of professional forecasters around the 10th of each month, that is, more or less immediately before January 15. The forecast is always close to 1.2, and the forecasters adjusted their expectations only after the abolition of the floor. This evidence is confirmed by Jermann (2017) who shows that the credibility in the exchange rate target established by the SNB was steadily increasing from 2011 onward and reached its highest value in 2014.[9] The results by Mirkov et al. (2016), who study the beliefs of market participants, point

[9]Hanke, Poulsen & Weissensteiner (2015) find that the market's confidence in the exchange rate policy has been increasing over time. Cox (2015) writes in The Economist that "the policy was reaffirmed only three days before its repeal. The doffing of the cap surprised and upset the foreign-exchange markets, hobbling several currency brokers [...]." (Source: `http://www.economist.com/node/21640231/.`, *accessed May 3rd, 2018.*)

Figure 3: Foreign reserve assets around the changes in the exchange rate regime



Note: This figure depicts the pattern of foreign reserves measured by the monthly amount of international reserve assets (in billions of USD). Vertical lines indicate the introduction and abolition of the exchange rate floor. Source: Datastream.

to the same direction. They find no evidence for shifts in expectations about the continuation of the exchange rate target by studying option and spot market data. Credibility has been enhanced by speeches given by members of the SNB's Governing Board.

There are several possible reasons for the sudden discontinuation of the minimum exchange rate. First, quantitative easing measures to mitigate the effects of the European sovereign debt crisis were expected to lead to a further depreciation of the Euro, forcing the SNB to continue to increase their supply of Swiss francs to maintain the floor. Second, by abolishing the floor, the SNB could stop the loss in value of the Swiss franc and counteract previous losses that had occurred in unison with a depreciating Euro. Third, the SNB was not forced any more to acquire euro-denominated assets (mostly sovereign bonds) carrying the risk of a Euro breakup and low returns. Thus, it could mitigate political pressure from cantons that benefit from profits of the SNB (Brunnermeier & James 2015, Wyplosz 2015). Finally, with the discontinuation of the minimum exchange rate, the SNB could again increase the independence of monetary policy.

However, the unexpected step raised concerns about the consequences for future growth in Switzerland. Consensus Economics show that the average growth expectations for the current year had been much higher with a lower standard deviation at the beginning of January 2015 (1.86% change in real GDP, st. dev. 0.316) than those after the policy change in February 2015 (0.43% change in real GDP, st. dev. 0.691). The growth expectations for 2016 had as well been lowered from 1.99% in January to 0.89% in February. Additionally, the Swiss National Bank (SNB) (2015b) states that the policy change led to a worsened economic outlook in the short-term with international trade being mostly affected. We assess to what extent the immediate reactions in the stock market mirrored these concerns and whether market participants' uncertainty about future economic developments increased following the shock.

3 Synthetic matching model and data description

To assess the impact of the exchange rate shock on stock markets, we make use of a synthetic matching model. In the following, we describe the synthetic matching model and explain the underlying data.

3.1 Synthetic matching model

Our focus is on stock market reactions, whereas we are interested in (i) whether there are significant market responses in stock markets, and (ii) whether sectoral indices are affected to the same extent. The synthetic matching model has the advantage that it allows comparing the actual development in Switzerland after the shock to a hypothetical case where the shock does not occur (Abadie & Gardeazabal 2003, El-Shagi et al. 2016). The comparison between the actual and counterfactual patterns yields insights into relevant mechanisms of exchange rate shocks.

For our identification, we exploit the fact that the removal of the exchange rate floor occurred unexpectedly (see also Section 2). Making use of this surprise, we identify effects in a synthetic matching framework, which furthermore allows estimating this effect without recourse to previous exchange rate shocks. The analysis is, hence, not limited by an otherwise necessary assumption that today's reaction is similar in all but magnitude to previous reactions to much smaller (and potentially unidentifiable) exchange rate shocks. Instead, the first main identifying assumption of synthetic matching, that is, the exogeneity of the shock under observation,

is clearly fulfilled. The second main identifying assumption is that control group countries are unaffected by the exchange rate shock. This assumption is also largely unquestionable as Switzerland is a comparably small country with negligible influence on global developments. However, we still subject our results to a robustness check in which we exclude all direct neighbors of Switzerland from the control group.

The matching procedure assumes that prior to the treatment in January 2015, there are no substantial differences between the treated and the control group countries used to construct the synthetic counterpart. The matching procedure creates a counterfactual country to Switzerland that (i) does not experience the appreciation shock, (ii) is similar along key economic dimensions, namely, the matching criteria mc, and (iii) has a similar development in the stock market series (MSCI index) before January 2015. The choice of countries and economic variables used for the matching is described in Section 3.2. The model that we estimate is as follows:

$$v^* = \min_v \left\{ \sum_{t=1}^{T} \left(f(MSCI_{treat,t}) - \sum_{n=1}^{N} w_n^*(v) f(MSCI_{n,t}) \right)^2 \right\} \quad (1)$$

$$\text{s.t.} \quad w^*(v) = \min_w \left\{ \sum_{m=1}^{M} v_m \left(mc_{treat,m} - \sum_{n=1}^{N} w_n mc_{n,t} \right)^2 \right\} \quad (2)$$

$MSCI_{treat,t}$ is the MSCI index of Switzerland, and $MSCI_{n,t}$ is the MSCI index of a non-treated country n in period t. In our study, we analyze different transformations of the MSCI index as indicated by a generic function $f(\cdot)$. In particular, we look at log-levels, growth rates, and sectoral subindices. The objective function in Equation (1) aims at minimizing the squared difference of the dependent variable between Switzerland, in which the policy change takes place, and the synthetic counterpart before the treatment. Stock market indices of countries in the control group are weighted by country weights $w_n^*(v)$ in order to replicate as close as possible actual stock market developments in Switzerland before the treatment. The objective function is minimized subject to the constraint in Equation (2) that the squared difference between the matching controls $mc_{treat,m}$ (or indicator variables) in the treated country and the weighted controls of the non-treated countries $w_n mc_{n,t}$ in the pretreatment period is minimized. The constraint accounts for the fact that the importance of criteria for the matching of stock market developments may not be identical for all matching criteria, using importance weights v (or v^* in the optimum).

Having estimated the synthetic counterpart, we forecast the counterfactual series for Switzerland in case the exchange rate shock would not have occurred. We then compare the effect of the exchange rate shock on the treated country, Switzerland, with the pattern of the synthetic counterparty. This difference is represented in the analysis by the "gap between treated and synthetic series". Additionally, we conduct placebo tests and repeat the matching procedure, treating any other country as if the policy change would have taken place there (Cavallo, Galiani, Noy & Pantano 2013). The treatment effects found in placebo studies should be statistically indifferent from zero, as no actual treatment took place. Thus, the distribution of observed placebo effects can be used (i) as a distribution of the null hypothesis that the treatment has no effect and (ii) to calculate whether treatment effects in Switzerland are significant.

3.2 Data used for the synthetic matching model

Our dependent variable of interest is either the log-level or the growth (return) rate of the stock market index. We base the analysis on the MSCI stock price index and exploit the high frequency of the data series as well as the availability of the index for many potential control group countries. The analysis is conducted for daily values of the MSCI index based on data from the beginning of 2014 to mid-2017.[10] The series are standard-normalized by country to make them comparable across treatment and control countries. For first visual inspection, we conduct the matching procedure for the MSCI index in log-levels. From there, we move on to an investigation of day-to-day MSCI growth rates. Finally, we make use of the granularity of the index and break it down by sector, which allows tracing heterogeneous responses across sectors. The sectors are classified in ten categories: consumer discretionary, consumer staples, energy, financials, health, industrials, information technology, materials, telecommunication services, and utilities.[11]

We use one year of data before 2015 for the daily matching procedure. This provides enough observations before the exchange rate shock to obtain accurate estimates. The synthetic counterfactual of Switzerland is a weighted average of control group countries with time-invariant

[10] In robustness tests, we use *end of month* values of the MSCI index from January 2006 to mid-2017. We do not use monthly averages or beginning of month values because the abolition of the exchange rate floor was in the middle of the month, namely, on January 15, 2015.

[11] Due to limited data availability, we exclude information technology and utilities. Moreover, we cannot use the same group of candidate countries in every estimation for two reasons. First, some MSCI subindices are not available in all countries. Second, even if they are available, the degree of time variation is sometimes insufficient. The reason for this may be that all firms in the MSCI subindex of one country are not traded for extensive periods of time. More information on the methodology and composition of the sectoral indices can be found in the appendix.

weights. Thus, more observations would raise concerns that estimates are distorted by relations that change over time. For example, the introduction of the Euro in 1999 might have had fundamental consequences to the integration of Switzerland in international trade and capital flows. Similarly, we eliminate concerns of confounding factors due to possible structural breaks as a consequence of the start of the financial crisis in 2007/08.

Next to the dependent variable, the matching is based on a set of control variables. To capture key economic developments, we include the annual growth rate of the gross domestic product (GDP), inflation (CPI), short-term interest rates, and general government gross debt (% of GDP). We also control for sectoral contributions to GDP by including the value added by the industrial sector, by the services sector, and by the banking sector (% of GDP). Given that Switzerland is a small open economy, we also include control variables that approximate competitiveness and integration in international markets, such as the current account (% of GDP), the exports of goods and services (% of GDP), the foreign reserve assets (millions USD), the unit labor costs, and the real effective exchange rate based on the consumer price index. Additionally, as we are interested in the short-run responses in stock markets, we base the matching on variables related to developments in financial markets. These include the central bank transparency index (Dincer & Eichengreen 2014), and three-month interbank rates (in percentage points).

For all control variables, we include the longest possible series. However, as usual in synthetic matching, we do not match the actual time series of the control variables but rather five-year averages (El-Shagi et al. 2016). Contrary to concerns regarding the long-run matching of the variable of interest, including five-year averages of control variables that are basically unrelated to the current values of the variable of interest is not too problematic because these controls have near-zero importance weights in the matching procedure.

A sample of reasonable matching candidates defined by the OECD countries is available to evaluate short-run stock market reactions following the removal of the exchange rate floor in Switzerland. Out of this pool, matching countries are selected according to data availability of dependent and explanatory variables. Therefore, Iceland, Luxembourg and Slovakia are excluded throughout the analysis.

4 Results of the synthetic matching model

In this section, we first evaluate whether the exchange rate shock caused significant stock market reactions. Second, we analyze the differential effects across sectors. Finally, we discuss the relevance of the shock for the broader economy.

4.1 Do financial markets respond to exchange rate shocks?

Figure 4 displays the synthetic matching results revealing the impact of the abolition of the minimum exchange rate on January 15, 2015 on the log-level of the Swiss MSCI index. In the first panel, it can be clearly seen that asset prices drop strongly in January 2015 (solid line), while the same did not happen in the synthetic counterpart (dashed line).

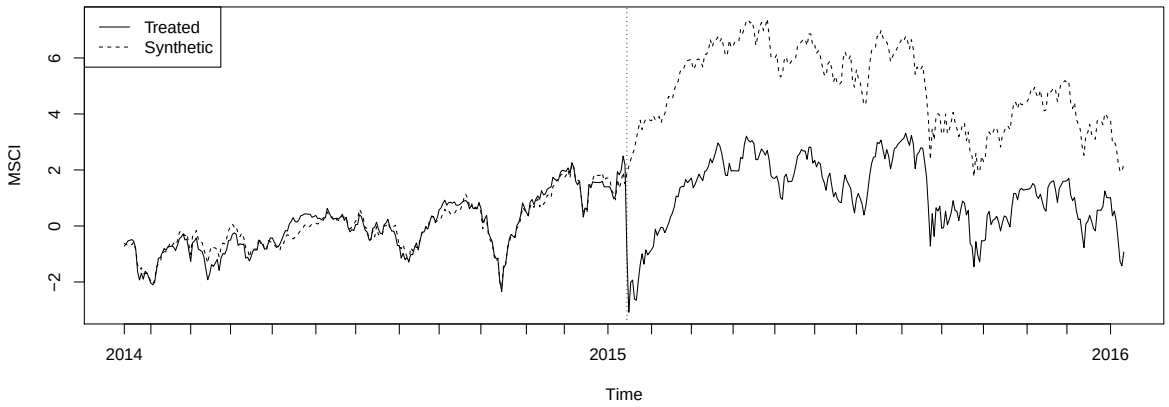
The second panel shows the gap between the treated and the synthetic counterpart of Switzerland (red, solid line). The dotted lines mark the gap for the placebo tests. Prior to treatment, the gap is zero on average (which it should be due to the matching process). Moreover, the average absolute gap is smaller than for any of the placebo tests, which implies that we match Switzerland particularly well. On the treatment day, the gap sharply increases in absolute terms and permanently remains at the new (lower) level. That is, the synthetic MSCI level in Switzerland has a parallel trend to the true MSCI development. A comparison of Switzerland to placebo studies reveals that the Swiss gap is in absolute terms the largest for a duration of six months (with the exception of eight trading days), until forecasting uncertainty starts to dominate in some placebo studies. These results suggest that the SNB's policy change caused economically and statistically significant disruptions.

We proceed by evaluating the effects on daily asset price growth rates. The result in the first panel of Figure 5 shows that asset price growth in Switzerland drops strongly on January 15, 2015 (solid line). However, this is not observed for the synthetic counterpart (dashed line). The corresponding treatment effect on impact (i.e., the difference between the Swiss and the synthetic MSCI index in January 2015) is not only large but also highly statistically significant, as seen in the second panel, which again displays the difference between the treated and the synthetic series with Switzerland as the treated country (red, solid line) in comparison to placebo studies (black, dotted lines). It can be seen that the gap in the case in which Switzerland is the treated country is a strong outlier after the treatment.[12]

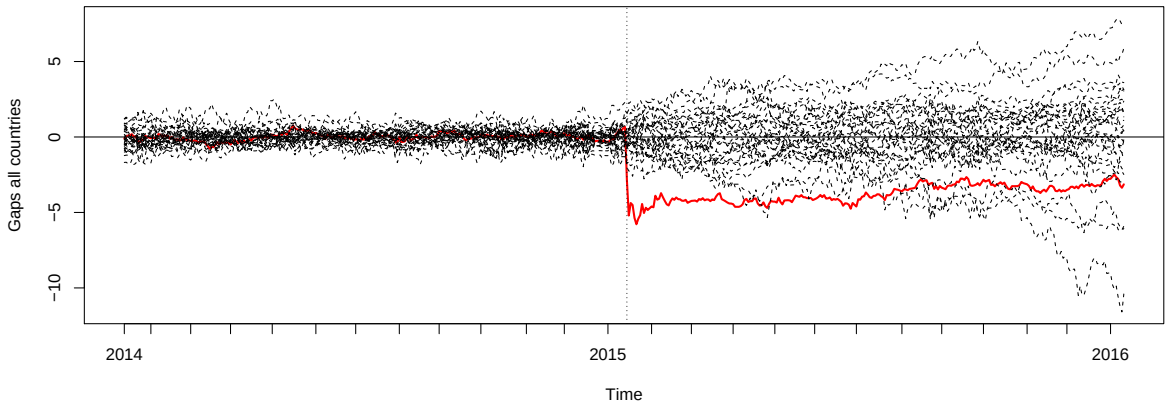
[12]Results remain robust when excluding neighboring countries of Switzerland from the control group and are available upon request. This is not totally surprising, as neighboring countries have very low weights in the

Figure 4: Synthetic matching result for Swiss MSCI index – Levels

(a) Treated and synthetic control series



(b) Gaps



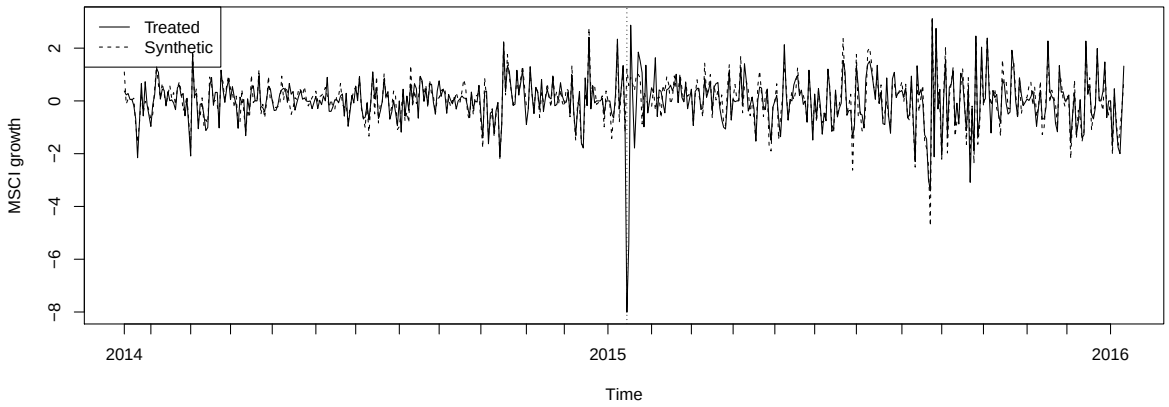
Note: The first panel shows the effect of the abolition of the minimum exchange rate on the MSCI index in Switzerland and in its counterfactual (in levels, standard-normalized by country). The second panel displays the gap (treated-synthetic) between the two series with Switzerland as the treated country (red, solid line) and the gap between treated and synthetic country if any of the other control group countries would have been the treated country (black, dotted lines). The dotted vertical line marks the treatment, that is the abolition of the minimum exchange rate in January 2015. The set of variables and control countries used for the matching procedure is described in Section 3.2 and in the data appendix.

Table 1 shows statistics of the gap series. The first row confirms the finding of a significant disruption in Swiss stock price growth compared to that of its counterfactual. Switzerland

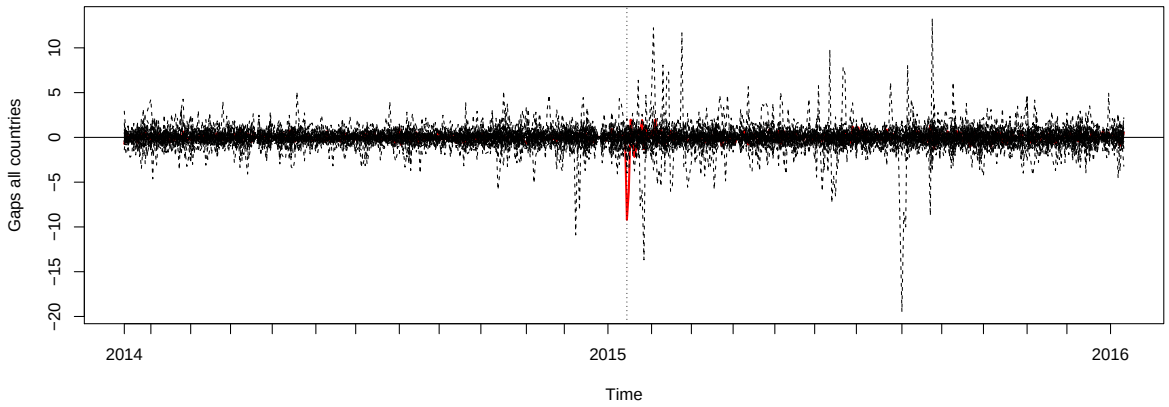
counterfactual Switzerland in the baseline estimation. Information on all weights (of control group countries and matching indicators) can be obtained upon request. It turns out that the Nordic and Benelux countries have the largest weights, meaning that European small open economies are most useful for generating a synthetic counterpart. Nearly all matching variables receive some positive weights, but there is no single indicator that receives a large weight. Hence, changing the set of matching variables should not have huge effects on the results. If at all, variables reflecting competitiveness and future growth patterns, such as (recent) exports and the real effective exchange rate, receive more weight in matching stock market data.

Figure 5: Synthetic matching result for Swiss MSCI index – Growth rates

(a) Treated and synthetic control series



(b) Gaps



Note: The first panel shows the effect of the abolition of the minimum exchange rate on the MSCI index in Switzerland and in its counterfactual (in growth rates, standard-normalized by country). The second panel displays the gap (treated-synthetic) between the two series with Switzerland as the treated country (red, solid line) and the gap between treated and synthetic country if any of the other control group countries would have been the treated country (black, dotted lines). The dotted vertical line marks the treatment, that is the abolition of the minimum exchange rate in January 2015. The set of variables and control countries used for the matching procedure is described in Section 3.2 and in the data appendix.

shows the largest gap for the aggregate index both in absolute terms and relative to all other countries used for the placebo test (third column). The aggregate MSCI index of Switzerland receives an extremely strong shock, leading to a gap of almost ten standard deviations in size (first column). In contrast, the placebo studies have a gap between observed and synthetic series that is comparable to pretreatment gaps, as indicated by a standard deviation of 0.939 (second column). In line with the parallel development of log-level asset prices, we cannot find

systematically positive or negative gaps after January 15, 2015. In total, the results confirm that there was a relevant one-time shock due to the abolition of the minimum exchange rate with significant declines in asset price growth on impact.

Table 1: Statistics on gap (treated-synthetic) series

	(1) gap (#sd)	(2) sd(gap, placebo)	(3) ranking(gap)	(4) #obs
MSCI aggregate index	-9.199	1.295	1	31
consumer discretionary	-2.948	0.182	1	30
consumer staples	-7.272	1.247	1	30
energy	-7.413	1.399	1	29
financials	-6.678	1.182	1	30
health	-8.611	1.318	1	28
industrials	-9.687	0.785	1	30
materials	-5.755	1.048	1	30
telecommunication	0.592	0.853	13	30

Note: This table provides information on the difference between the MSCI index in Switzerland and in its counterfactual (in growth rates, standard-normalized by country). Column (1) gives the gap (treated-synthetic) expressed in standard deviations. Column (2) shows the number of standard deviations of the change in the gap of the placebo studies relative to pre-treatment gaps. Column (3) indicates the ranking of the Swiss gap (in absolute terms) compared to the placebo gaps. A ranking of 1 implies that Switzerland is the country with the largest gap (treated-synthetic). Column (4) contains the number of countries (plus Switzerland) used in the matching analysis for the respective index.

For robustness, we repeat the analysis for the MSCI index at a monthly frequency. Even when we eliminate short-run noise out of the data by aggregating to the monthly frequency, the large and significant decline in asset price growth can be confirmed (Figure 6).[13]

4.2 Are responses heterogeneous across sectors?

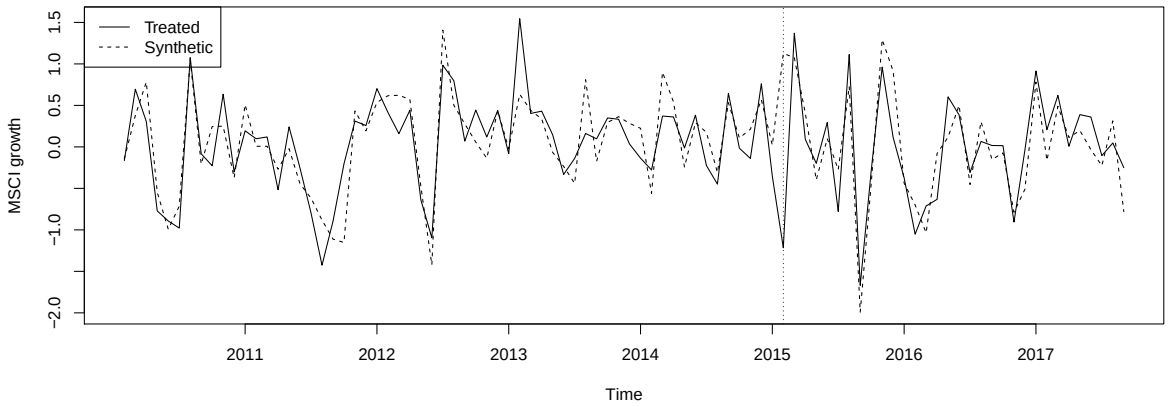
We repeat the analysis for sectoral subcategories of the MSCI index. Sectors might respond differently to the shock (Bäurle & Steiner 2015, Fauceglia et al. 2015), as investors might judge policy changes to be of different relevance for individual firms and distinct sectors. Nonetheless, a significant decline in asset growth in some sectors would support the drop in the aggregate index. The MSCI index of Switzerland consists of approximately 40 constituents. It covers more than 80% of market capitalization.[14] Among the largest firms in the index are Nestle (consumer staples), Roche Holding Genuss (health), Novartis (health), UBS Group (financials), and the

[13] Among 30 placebo studies, there is only one with a larger gap than the Swiss treatment effect.

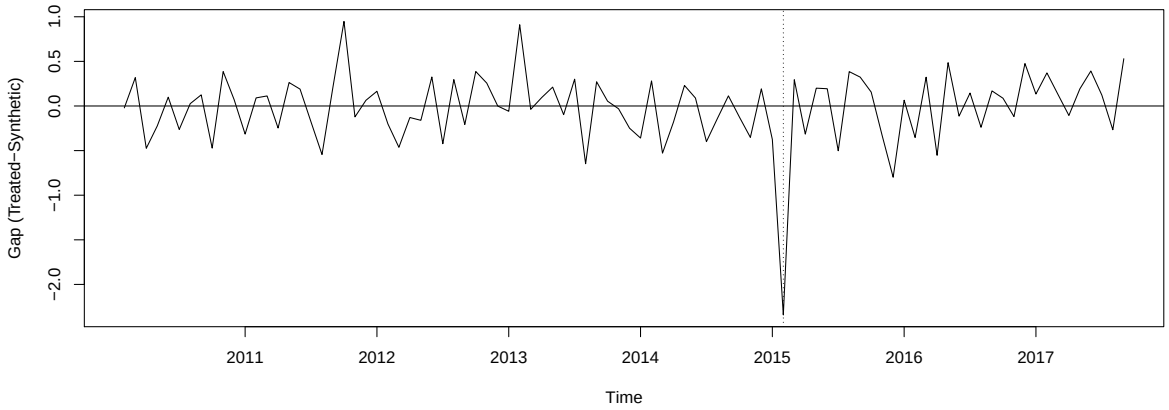
[14] See the document on the "MSCI Switzerland Index" provided by MSCI INC that can be found here: `https://www.msci.com/documents/10199/f0f13c98-d5fd-43f3-8908-9f12c2fb3a4a`

Figure 6: Synthetic matching result for Swiss MSCI index – Monthly data

(a) Treated and synthetic control series



(b) Gaps



Note: This graph shows in the upper panel the effect of the abolition of the minimum exchange rate on the MSCI index (aggregated to the monthly level) in Switzerland and in its counterfactual (in growth rates, standard-normalized by country). The lower panel shows the gap between the treated and the synthetic series. The dotted vertical line marks the treatment, that is the abolition of the minimum exchange rate in January 2015. The set of variables and control countries used for the matching procedure is described in Section 3.2 and in the data appendix.

ABB Group (industrials). In 2016, the sectors with the largest weights in the MSCI index are health, financials, and consumer staples.

Table 1 reveals the magnitude of the gap between the growth rate of the MSCI series for the treated country (Switzerland) and the synthetic counterpart for the subindices. Except for the *telecommunications* sector, all sectors show negative gap values that are also largest compared to placebo tests (Table 1, columns 1 and 3). The second column reveals that, similar to the results for the aggregate index, the placebo studies have a gap between the observed and synthetic

series that is comparable to pretreatment gaps, with standard deviations close to one.

We observe the largest drops in asset price growth for the series of the treated compared to the counterfactual country for the *industrials* and *health* sectors (Column 1). The strong negative response in asset price growth in these two sectors might be driven by fears about the reduced competitiveness of exporting goods in the course of an appreciating Swiss franc following the abolition of the floor. The biggest players in these indices are highly active in international markets and include health care companies such as Roche Holding Genuss and Novartis, as well as ABB, an industrial company that specializes in power and automation technologies. Additionally, the *energy* sector shows large values for the gap (in absolute terms), while the *materials* sector seems to be more shielded from negative responses.

Both *consumer* related sectors show a negative gap if we take the difference between the series for the treated country and the one for the synthetic counterfactual. This result might be due to the negative effects on competitive power due to a stronger Swiss franc. For example, before the introduction of the exchange rate floor, the Swiss National Bank (SNB) (2011b) stated that internationally active firms suffered from declines in margins due to the appreciating Swiss franc. Compared to the consumer staples sector, the gap for the consumer discretionary sector, which includes luxury goods such as watches or jewellery (the largest constituent in the sectoral index is Richemont, a company that encompasses various brands of luxury goods), is relatively small in absolute terms. This finding suggests that despite an appreciation of the currency and potentially more expensive import prices in counterparty countries, market participants do not judge the sector to be as affected as the sector consumer staples. One potential reason is that the demand elasticity for luxury goods is not that high.

The *financial* sector shows a negative gap, similar to and consistent with the previously discussed sectors, representing fears about reduced growth in Switzerland and a worsening of economic conditions. This is despite the fact that financial firms may have better diversification and hedging possibilities due to their integration in international capital markets and that they should profit more from capital inflows due to a stronger Swiss franc.

In summary, our results suggest that the sudden change in the exchange rate policy of the SNB caused significant reactions in stock markets. Based on the overall MSCI index, we find that the abolition of the floor had a negative effect on asset price growth for the treated compared to the counterfactual series. However, heterogeneities arise across sectors: particularly, export-oriented sectors with higher demand elasticities seem to have been affected most (indus-

trials, health). This might be due to fears about reduced competitiveness given an appreciating domestic currency. In contrast, a sector with mostly national relevancy, such as the telecommunications sector, showed no significant downward response.

4.3 Does the shock increase uncertainty in stock markets and beyond?

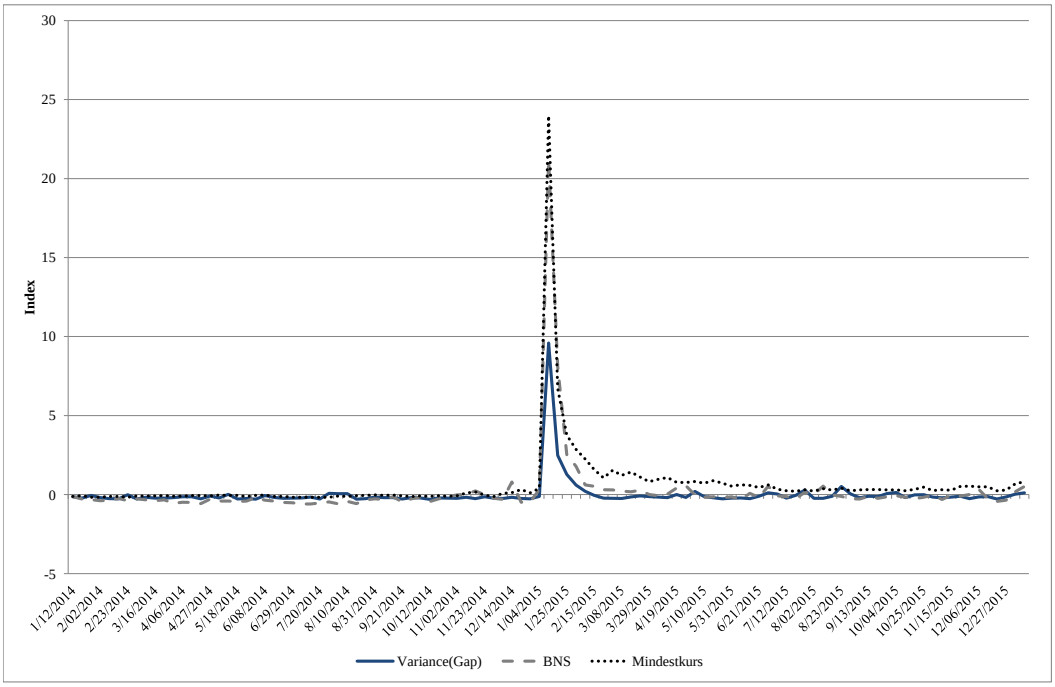
Previous results have established that stock markets in Switzerland responded significantly to the abolition of the exchange rate floor. The negative response of stock market participants may be due to three elements. First, a reduction in the value of the firms' foreign assets (as measured in Swiss franc) implies a one-to-one reduction of asset prices. Second, worsened expectations about the future economic outlook should also imply a one-off drop in asset prices. Third, and interacting with economic outlooks, increased uncertainty about future economic activity implies a decrease in asset prices but would also be reflected in a temporarily larger variation of asset prices. We find this to be the case for around three weeks both in the development of Swiss asset prices and in the gap between observed and synthetic series. Uncertainty by itself could already have more widespread economic implications by hampering investment, as shown by Bloom, Bond & Van Reenen (2007). For example, Baker & Bloom (2013) instrument stock market volatility with natural disasters and terrorist attacks but also with unexpected political shocks and show that stock market volatility explains a high degree of variation in GDP growth. We provide two pieces of evidence to show that the policy induced shock did not only raise uncertainty in stock markets but also affected other segments of the economy.

For our first piece of evidence, we link stock market volatility to public uncertainty as measured by Google search queries. We start by calculating the weekly variance of the daily gap series between the treated and synthetic group (excluding January 15th, 2015 in the calculation of the variance of that week). The variance of the daily gap series prior to the exchange rate shock (where it was negligible) can be interpreted as the volatility of Swiss stock markets that cannot be explained by international comovement. Figure 7 reveals that the variance of the gap series clearly has a peak around the abolition date of the exchange rate floor and only returns to lower values after approximately three weeks.[15] The much larger variance after the treatment is induced by the exchange rate shock and reflects a higher degree of uncertainty in stock markets.[16]

[15] Note that the variance in the gap series cannot be driven by global developments, as all shocks affecting treated and control countries alike are extracted when taking the difference between the treated and the synthetic series.

[16] We have also conducted tests for equality of means in the series before the treatment (where they are zero by construction) and after the treatment to see whether stock markets have reacted efficiently. However, only after

Figure 7: Uncertainty in gap series and among general public



Note: This graph shows an index of google search entries for the items that best match the pattern of the weekly variance of the daily gap series (blue, solid line). January 15th is excluded in the calculation of the variance of that week. Google transforms the variance series of the gaps to an index and then compares it to search indices of other terms. Best matches include "BNS" (Banque Nationale Suisse) (gray, dashed line) and "Mindestkurs" (black, dotted line). Source: Google Correlate (`http://correlate.googlelabs.com/`).

We then make use of Google Correlate, restricted to queries from Switzerland, to assess to which search items the variance of the gap series matches best. Figure 7 shows that correlations of the variance of the gap series and the most frequent search items used over the time period are highest for the terms "BNS" (Banque Nationale Suisse) as well as "Mindestkurs" (floor). In fact, the overwhelming majority of search items with a correlation coefficient above 0.95 can be linked to exchange rate (policy) or the Swiss National Bank. This reveals that not only was stock market uncertainty elevated (as indicated by uncharacteristically large variations of gaps) but also public uncertainty about the central bank's policy had increased as implied by the strongly elevated need to collect relevant information.

Our second piece of evidence on potential real effects is related to GDP forecasts around January 2015, which would incorporate all potential channels from the exchange rate shock

three trading weeks, we consistently failed to reject that gaps had a significantly different mean than they had prior to the treatment. Hence, it took a couple of days until the stock markets incorporated the new information.

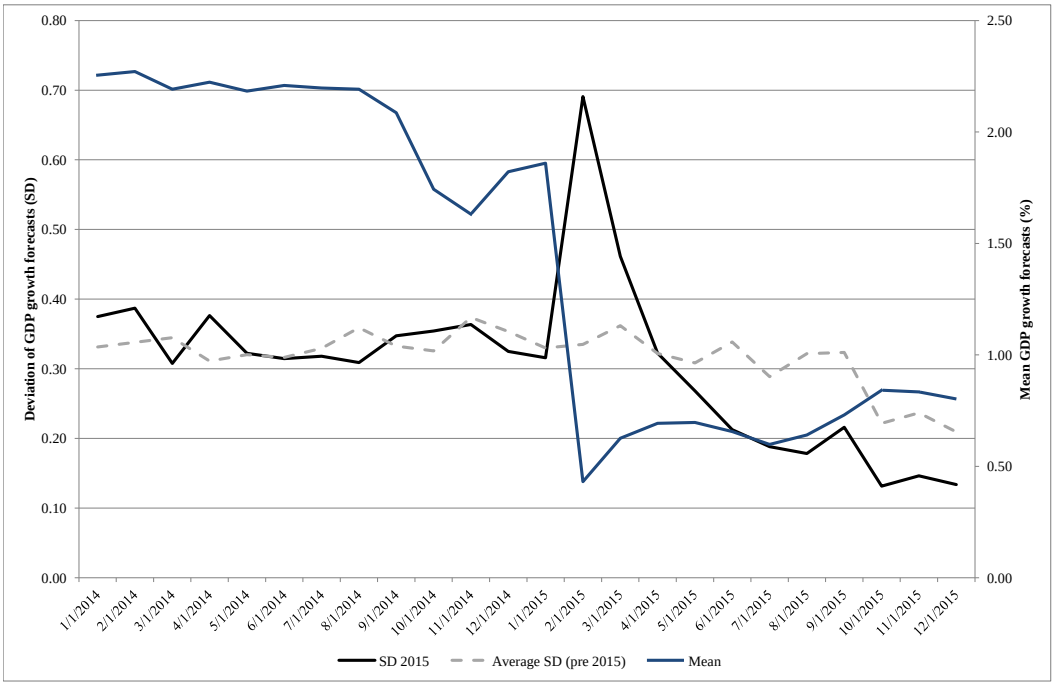
to GDP growth. Here, we look at Swiss GDP forecasts as provided by Consensus Economics. Consensus Economics collects current- and next-year forecasts from a large group of professional forecasters on a monthly basis. The forecasts are always collected around the 10th day of the month. That is, the abolition of the exchange rate floor was unknown when the forecasts were collected in January 2015 but known a month later in February. We mainly employ the mean and standard deviation of these forecasts for GDP growth in 2015. The standard deviation of forecasts can be seen as a measure of disagreement between forecasters.

Figure 8 shows these series. The horizontal axis refers to the forecast waves from January 2014 to December 2015. The mean forecast for GDP growth in 2015 (blue, dashed line) drops from close to 2% (forecast made in January 2015, prior to the exchange rate shock) to 0.5% (February 2015) and remains permanently at a much lower level afterwards. Looking at historical forecast developments, this adjustment is far from normal. In other words, forecasters strongly revised their belief about 2015 growth downward around the time of the exchange rate shock.

The standard deviation across forecasts (black, solid line) was relatively constant and nearly identical to the average standard deviations for other forecast years until January 2015. In the wave following the exchange rate shock, there is a strong outlier. The increased disagreement among professional forecasters about the real economic outlook corroborates earlier results. Moreover, the effect of the policy shock on the standard deviation of forecasts was comparable to the effect of the largest economic shocks between 2000 and 2014. To visualize this, Figure 8 also provides the average standard deviation of growth forecasts from forecasts related to GDP growth in the years from 2000 to 2015. Consistent with stock market and public uncertainty, disagreement abates from March 2015 onwards. Forecasters begin to have a more uniform opinion on low growth rates. In fact, the decrease in disagreement was relatively strong when comparing it to the average standard deviations of GDP forecasts made over the years 2000-2014 (gray, dashed line).

In summary, these results show that the exchange rate shock was not limited to stock markets. It was accompanied by a deteriorating and (at least in the short run) more uncertain outlook for future economic development.

Figure 8: Uncertainty about future GDP growth among professional forecasters



Note: This graph shows the mean GDP growth forecasts made in 2014 and 2015 for the year 2015 by professional forecasters (in %; blue, dashed line, right axis) as well as the standard deviation of the GDP growth forecasts made in 2014 and 2015 for the year 2015 (SD; black, solid line). The gray, dashed line shows the average across the standard deviations of GDP growth forecasts made in year t-1 and year t for year t. The average is taken across standard deviations of forecasts made in 1999 and 2000 for the year 2000 until those made in 2013 and 2014 for the year 2014. Source: Consensus Economics, own calculations.

5 Conclusion

During the financial and sovereign debt crisis, international capital has flown to safe havens such as Switzerland, exposing these countries to substantial exchange rate pressure. As a response, Switzerland introduced a minimum exchange rate of the Swiss franc with the Euro, which was suddenly discontinued in January 2015. The following appreciation of the Swiss currency has raised uncertainty about the future growth pattern. We exploit the change in the SNB's policy to analyze the impact of (policy-induced) appreciation shocks on stock market reactions.

We make use of a synthetic matching model and the unexpected character of the policy change to identify treatment effects. Our results show that the abolition of the exchange rate floor caused significant declines in asset price growth in Switzerland compared to the synthetic counterpart. After a few days, the stock market indices stabilized at a lower level and standard-

normalized growth rates returned to zero. Comparing the results across sectors reveals that the negative impact on asset prices was heterogeneous. The industrial sector and the health sector showed the strongest declines. This might be due to fears about reduced competitiveness in international markets due to a stronger Swiss franc.

While the unanticipated policy change offers an ideal setting for identification, it also has its limitations as concerns the analysis of the underlying channels and the possible long-term consequences in the real sector. However, graphical evidence shows that the negative effect of the exchange rate shock also raised uncertainty within stock markets as well as about future developments of the real economy. Determining channels and implications for sectoral competitiveness and economic growth would thus be an interesting avenue for future research.

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Data appendix – Synthetic matching model

Countries included

The control group includes all OECD countries excluding some with low data availability. Specifically, we include Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovenia, South Korea, Spain, Sweden, Turkey, the United Kingdom, the United States.

Dependent variable

MSCI country index: The MSCI country indices at the daily frequency are obtained from Datastream. For robustness test, we use end of month values to aggregate the index to the monthly level. The design of the MSCI country indices implies that they capture the performance of the larger segments of the respective country's market. The individual constituents come from different sectors, like industrials or financials, and in sum capture a large share of the country's equity market. The index is constructed based on the "MSCI Global Investable Market Indexes (GIMI) Methodology". Information on the classification of the sectors and the calculation method can be found here: `https://www.msci.com/index-methodology;https://www.msci.com/gics`.

MSCI country-sector index: We make use of the sectoral indices at the daily frequency for each country that can also be obtained from Datastream. The composition of the ten sectors is determined by the "Global Industry Classification Standard (GICS)" and allows a comparison across sectors. The classification has a hierarchical structure including 10 sectors, 24 industry groups, 67 industries, and 156 sub-industries. The sectors are classified and composed of the following industry groups as follows:[17]

- consumer discretionary: automobiles & components; consumer durables & apparel; consumer services; media; retailing
- consumer staples: food & staples retailing; food, beverage & tobacco; household & personal products
- energy: energy
- financials: banks; diversified financials; insurance; real estate
- health: health care equipment & services; pharmaceuticals, biotechnology & life science
- industrials: capital goods; commercial & professional services; transportation
- information technology: software & services; technology hardware & equipment; semiconductors & semiconductor equipment
- materials: materials
- telecommunication: telecommunication services

[17] For a detailed breakdown into industry groups, industries, and sub-industries, see MSCI (2016). Our analysis excludes the sectors information technology and utilities due to data availability.

- utilities: utilities

Matching variables

GDP growth: Quarterly data on the annual growth rate of the gross domestic product, seasonally adjusted (Datastream).

Inflation: Monthly data on consumer price index (2010=100) (Datastream).

Interest rates: Quarterly data on short-term interest rates in % (Datastream).

Public debt: Annual data on general government gross debt in % of GDP (Datastream).

Sectoral share (Industry): Annual data on value added by the industrial sector in % of GDP (Datastream).

Sectoral share (Services): Annual data on value added by the services sector in % of GDP (Datastream).

Current account: Quarterly data on the current account balance in % of GDP, seasonally adjusted (Datastream).

Exports: Annual data on exports of goods and services in % of GDP (Datastream).

Foreign reserves: Monthly international reserve assets in millions USD (Datastream).

ULC: Quarterly data on unit labor costs (2010=100), seasonally adjusted (Datastream).

REER: Monthly data on real effective exchange rate based on the consumer price index (2010=100) (Datastream).

Domestic credit: Annual data on domestic credit provided by the financial sector in % of GDP (Datastream).

CBT: Annual data on central bank transparency index with range 0-15 (Dincer and Eichengreen 2014).

Interbank rate: Monthly data on three-month interbank rates in percentage points (Datastream).

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