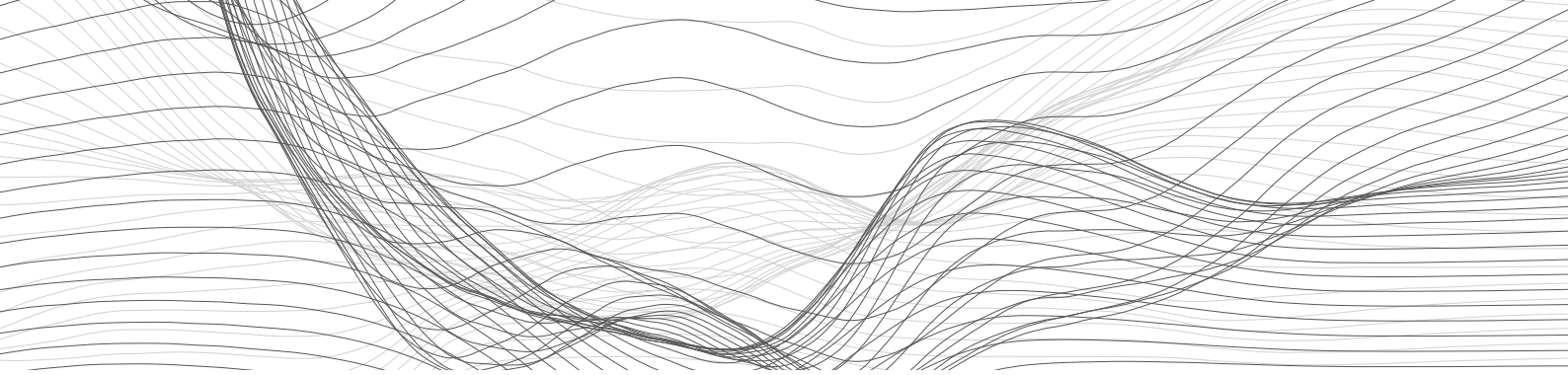

The exchange rate elasticity of the Swiss current account

Johannes Eugster, Giovanni Donato

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The Exchange Rate Elasticity of the Swiss Current Account

Johannes Eugster
Swiss National Bank

Giovanni Donato
Graduate Institute Geneva, IHEID

5 December 2022

Abstract[1]

This paper investigates the effects of Switzerland's real effective exchange rate (REER) on its current account. Using dynamic empirical methods, we focus on exchange rate movements that are unrelated to real and monetary developments, i.e., those more likely to be driven by the Swiss franc's safe-haven proprieties or unexpected exchange rate policy decisions. The paper's key result is that the Swiss headline current account has been largely inelastic to the exchange rate at the business cycle frequency. Three factors explain this somewhat counterintuitive result. A) A negative but short-lived effect on the trade balance is partly offset by a positive effect on net investment income. B) Large and often volatile net exports of nonmonetary gold blur the aggregate reaction. C) Improved terms-of-trade largely offset the negative effect on the (real) goods trade balance, as import prices tend to fall by more than export prices. The limited sensitivity of the current account, however, does not mean that the Swiss economy is insensitive to the exchange rate. Our results confirm that consumer prices, as well as corporate profits in particularly exposed sectors, decline significantly following an appreciation. These results suggest that an appreciation of the Swiss franc likely doesn't reduce Switzerland's current account quickly but rather tightens monetary conditions, reduces GDP, and hampers prospects in the longer term.

JEL Codes: E31, F31, F32, F41

Keywords: exchange rate, current account, pass-through,

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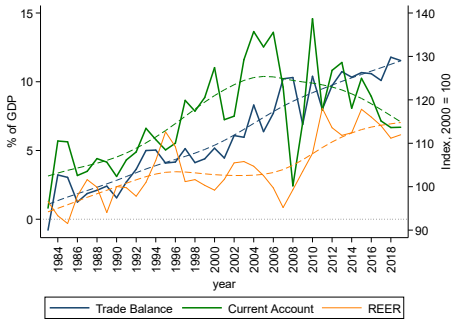
Corresponding author: Johannes Eugster: johannes.eugster@snb.ch

1. Introduction

Switzerland's current account (CA) balance has been positive for almost forty years, and it averaged levels just shy of 10% of GDP between 2000 and 2019. This recent strength of Switzerland's CA has been largely driven by the trade balance, which has followed an almost linear upward trend since the mid-1980s (**Figure 1**). What makes these developments remarkable is that they happened despite a generally appreciating real effective exchange rate (REER). Even the almost discrete jump-appreciation during and after the great financial crisis (GFC) has not led to a rapid reversal of Switzerland's trade balance. The apparent insensitivity may be perceived as an economic oddity. After all, basic economic intuition suggests that the appreciation of a country's currency reduces its external balance, as it should stimulate imports and suppress exports, which is a mechanism generally referred to as the expenditure-switching hypothesis.

Figure 1: The Swiss CA and REER



Note: Dotted series are Hodrick-Prescott (HP) filtered with smoothing parameter of 100.

Our paper tries to explain this apparent oddity. Concretely, it tries to answer how sensitive Switzerland's CA has been to the exchange rate. The question goes beyond looking at Figure 1. After all, one could rationalize a common upward movement of the CA and the REER with persistent differences in technological progress. To give justice to the importance of the underlying drivers of the exchange rate, this paper tries to identify exchange rate changes that are unrelated to domestic or foreign real and monetary developments. Equipped with such exchange rate shocks, the paper highlights that the aggregate CA has indeed been largely inelastic to the REER but that subcomponents thereof have generally reacted consistently with economic intuition. The reaction of some of the subcomponents illustrates that rapid CHF appreciation can lead to challenges for economic actors and policy-makers, even if these are not reflected in the external balance.

The current paper relies on and extends three strands of the literature. A first set of related papers looks at the sensitivity of Switzerland's export (i.e., volumes) to the exchange rate. These papers generally find that the effect of the exchange rate varies substantially across specific sectors, trade relationships and over time. Hanslin-Grossmann, Lein and Schmidt (2016), for example, find a general decline in the exchange rate elasticity of Swiss exports over time, driven by the increasing importance of relatively price-insensitive exports, such as chemicals and pharmaceuticals or precision instruments and watches. Auer and Sauré (2011) even argue that the composition of the export basket is the key reason why Switzerland's export volumes are the least sensitive (to the exchange rate) among OECD countries. In a similar vein, Thorbecke and Kato (2018) find that for the most sophisticated sectors, a CHF appreciation does not

depress export volumes[2]. For all other sectors, they find negative effects not only on export volumes but also on CHF-denominated export prices, which result in a significant squeezing of profit margins.

A second set of papers looks at the determinants of the Swiss current account more generally. Much of this literature has focused on different structural drivers[3], putting little emphasis on the joint modeling of the REER. The technical papers that provide the foundations for the IMF's *External Balance Assessment* (EBA) model are key examples. Phillips et al. (2013) and Cubeddu et al. (2018) model the current account in a cross-country panel and a multilaterally consistent way (i.e., variables are defined relative to trading partners). However, rather than including the exchange rate as an explanatory variable for the CA, Cubeddu et al. (2018) largely treat it as a separate variable of interest, driven by similar fundamentals and policy variables. More as a side note, they estimate the static CA-REER elasticities: -0.39 in the case of Switzerland and -0.26 on average for the countries in their sample. Their estimate for Switzerland is thus toward the higher end compared to that for other countries.

A third relevant stream of literature tries to identify particular types of exchange rate shocks. The existing work, both on the expenditure switching hypothesis and on the determinants of the CA, has mostly worked with annual data and estimated the reaction to an average change in the REER. However, as stressed by Bussière, Lopez, and Tille (2015), the expected effect of an appreciation depends on the underlying shock; an appreciation driven by a positive technology shock has very different implications from one driven by a monetary tightening or—in the case of a safe-haven currency—by a surge in global risk aversion. By implication, changes in the exchange rate can go hand in hand with very different outcomes, depending on the underlying drivers. One approach to overcoming this issue has been to focus on very specific events that can be interpreted as exogenous changes in the exchange rate. This is the approach taken, e.g., by Bonadio, Fischer and Sauré (2018) or Auer, Burstein and Lein (2018), who study the price-pass-through from the appreciation following the Swiss National Bank's (SNB) surprise announcement to discontinue the exchange rate floor relative to the euro (on 15 January 2015). While this seems a promising approach to study the exchange rate pass-through to prices, the focus on a single event is too narrow for the current account. As Bonadio et al. (2018) show in their paper, the external balance moved considerably before and after the exchange rate shock. We would thus struggle to differentiate the effect of an appreciation from changes in the external balance due to other drivers. A middle ground between the two extremes—focusing on one specific or all changes in the exchange rate—is to identify certain types of shocks; this is the approach chosen in this paper.

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[2] The sectors, which Thorbecke & Kato (2018) find to be affected by an appreciation, include specialized machinery, precision instruments, machine tools, and other medium-high technology goods produced using Swiss engineering; they do not, however, include the most advanced sectors such as pharmaceuticals and watches.

[3] A large set of variables has been proposed in the various cross-country studies such as those by Cheung, Fuceri & Rusticelli (2013), Phillips et al. (2013) and Cubeddu et al. (2018). Demographics and the pensions system have been shown to be particularly relevant for Switzerland, as argued by Gerigk, Rinawi & Wicht (2018) and Koomen & Wicht (2020).

We see our contribution to the literature as the first attempt to analyze the effect of the exchange rate on the Swiss CA and its detailed components. Relative to the first strand of the related literature (i.e., on determinants of export volumes), our paper is more holistic in three ways. First, it focuses on both exports (receipts) and imports (expenses), which strengthens the link to variables such as value added[4]. Second, our paper decomposes the reaction of nominal balances into a price effect and a quantity effect, allowing us to capture potentially similar effects through different channels. For example, whether a company sees a 10% decline in export quantities or can maintain the level of real exports with a 10% decline in its price may have a similar impact on revenues but a very different impact on trade quantities. Third, our paper jointly studies goods, services and investment income, providing a more complete picture, particularly if—as we argue in this paper—the different flows may be related. Relative to the literature on the link between the exchange rate and the CA, our paper is also more specific, as (i) it focuses on exogenous exchange rate shocks and (ii) disaggregates the overall CA into more detailed subcomponents. Finally, relying on a dynamic model, we can also produce a more complete picture of the CA reaction, including how it unfolds over time.

What emerges is a coherent set of results. Our key finding is that while important components react considerably, the aggregate Swiss CA is rather inelastic to the exchange rate at the business cycle frequency. Three elements help explain this result. (1) Components matter. We find that trade and investment balances partly offset each other. A CHF appreciation has a negative effect on the trade balance in the short term but a positive effect on the income balance in the medium term. (2) Swiss particularities matter. We find that nonmonetary gold (NMG) and merchanting blur the reaction of the aggregate trade balance but that a *"business cycle relevant"* trade balance (which excludes NMG and merchanting) reacts considerably and in line with the expenditure switching hypothesis. (3) Prices matter. While the business cycle trade balance declines persistently in real terms (i.e., quantities) following an appreciation, nominal values are largely inelastic. The strengthening of the terms-of-trade, driven by a larger decline in import prices than export prices, explains the difference.

The lack of a reaction of the CA does not imply that the Swiss economy is not affected by the strength of the Swiss franc. The decline in import and export prices has implications for consumer prices, as well as company profits. Consistent with other studies, we find a pass-through to consumer prices (from the nominal appreciation) that is partial but substantial and includes second-round effects on the domestic components of the CPI. This implies that an appreciation can lead to a significant tightening of monetary conditions, particularly at times when policy interest rates are close to the ELB. In addition, our results suggest that corporate profits decline in sectors that are relatively more exposed to foreign competition (e.g., manufacturing and retail). This suggests that a large appreciation is likely more disruptive to

[4] With production processes having been highly disaggregated internationally, an increase in gross export may not necessarily reflect an increase in value added.

the Swiss economy than the CA suggests and—if persistent—may for some sectors not be sustainable in the long run.[5]

A key result of our paper is that the trade and income balances react in opposite directions. While our paper is not able to investigate this aspect in greater detail, we believe the result is consistent with the characteristics of Switzerland's exporting sector. If export activity is predominantly foreign owned, which is the case for not only foreign subsidiaries but also large domestic companies, a decline in net exports and profits will reduce the amount of income transferred to the foreign owners, particularly if the investment positions have state-dependent returns. Consistent with this hypothesis, we find an overall positive effect of an exchange-rate appreciation on the income balance, driven almost exclusively by direct investment income[6]. The income balances from positions with partly fixed returns, such as portfolio and other investment income, do not react significantly. Establishing such a connection in more detail, however, goes beyond the scope of this paper, given that (i) the macro data used for this paper can mask compositional differences (e.g., between products, firm sizes, regions)[7] and (ii) the CA data at the company level that would be needed are not yet available. The investigation of the precise economic mechanisms involved thus has to be left for further research with more granular data.

We find that our results are surprisingly robust. They are largely unchanged whether we estimate the VAR in levels (our preferred specification) or in first differences; whether or not we drop the GFC from the sample, proxy for monetary conditions with policy interest rates or central bank balance sheets; or whether we focus on the pre- or post-GFC period. We also find that controlling separately for global risk aversion, which is a driver of large CHF appreciations, does not change the results. However, we do find some variations across bilateral exchange rates. Our aggregate results appear to be less driven by the USD/CHF-exchange rate than by the one relative to the euro, consistent with Switzerland's very tight economic integration with the neighboring currency union.

Our results have direct policy implications. They suggest that making inferences from the level of the CA on the appropriateness of the exchange rate can be misleading in the case of Switzerland. The limited sensitivity of the aggregate external balance implies that Switzerland's CA surpluses are likely to persist even if the exchange rate appreciates. On the other hand, substantial first- and second-round effects on consumer prices legitimize the SNB's desire to

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[5] The estimated effect on profits suggests that the REER may have an effect on the CA in the long run. If a persistent appreciation hampers international competitiveness and profits long enough for companies in the tradeable sector to fail or move away from Switzerland, this will affect the structure of the economy and eventually Switzerland's external balance.

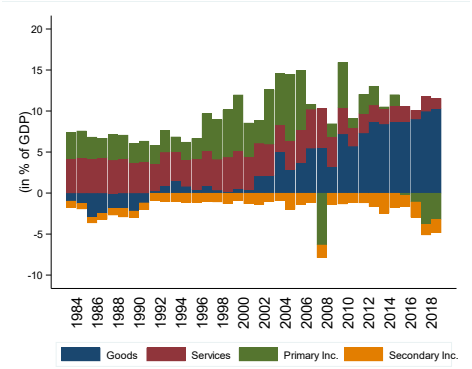
[6] The dominant role of FDI in the reaction of the overall income balance to the exchange rate (in the opposite direction as the one of the trade balance) sets Switzerland apart from countries such as Japan, which has very low FDI liabilities and for which the income balance actually reinforces the exchange rate effect on the trade balance (Colacelli et al., 2021). It could also be part of the reason why Behar and Hassan (2022) find that Switzerland has one of most negative covariance between the trade balance and income balance of all AEs.

[7] In addition, regressions based on aggregate data can be subject to a "heterogeneity bias", i.e., when larger price changes arise among inelastic goods. Imbs and Mejean (2015) highlight that higher price changes among inelastic goods is consistent with strategic price setting. The resulting goods-levels heterogeneity is pushed into the residual in a regression at the aggregate level. This can produce biased results, i.e., estimates that tend to be lower than the weighted average of the product-level coefficients.

slow appreciation pressure with FX interventions, particularly at times when the scope for conventional monetary policy easing is limited.

The rest of the paper is structured as follows. Sections 2 and 3 describe the data and the empirical methodology, respectively. Section 4 presents the results, starting with the overall CA and its main components, before disaggregating them into more detailed series. Section 5 presents a series of robustness tests related to estimation methods and time samples but also related to the role of the GFC and differences across bilateral exchange rates. Section 6 concludes.

Figure 2: The Composition of Switzerland's Current Account



Note: The graph shows the evolution of the Swiss current account and its components, scaled by GDP.

2. Data

The analysis focuses on the effect of the real effective exchange rate (REER) on Switzerland's external balances. This section briefly presents some of the main series and highlights issues of particular relevance in the empirical analysis.

Figure 2 shows the evolution and composition of the Swiss CA, scaled by GDP. The net balance has been positive since the mid-1980s and shows a pronounced upward trend up to the mid-2000s. After the GFC, the goods trade balance continued to increase, but the contributions of service trade and the primary income balance started to decline and eventually turned negative. For example, over the years 2018-19, primary income ended up reducing the CA balance by 3.5% of GDP on average.

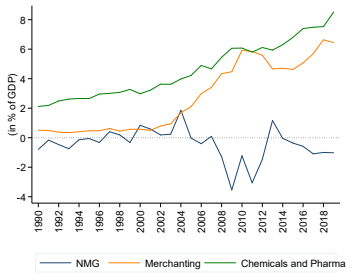
Further decomposing the positions highlights that the increase in the goods trade balance was heavily driven by nonmonetary gold (NMG) and merchanting. These positions have had an increasing influence on Switzerland's external position (see **Figure 3**, left[8]) but are believed to have a limited connection to Switzerland's real economy[9]. Net exports from merchanting have increased from approximately 0.5% of GDP in 2000 to an average of more than 5.5% since 2010. Since then, net merchanting exports have amounted to more than half of the overall trade balance, close to the contribution from chemicals and pharma. NMG, whose gross trade flows were already significant during part of the 1980s, became one of the most important export

[8] Further details on trade in NMG and merchanting are provided in **Appendix Figure 1**.

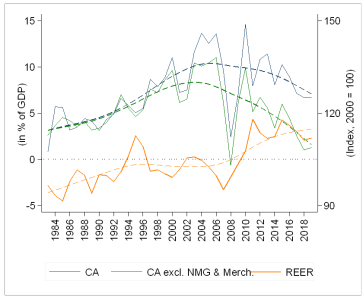
[9] By definition, merchanting involves trade, which never crosses the Swiss border and excludes any item that is used for domestic consumption or production. NMG does cross the Swiss border, but both quantities and—even more so—prices are largely unrelated to the state of the Swiss economy. Given that their inclusion can bias and blur the analysis of aggregate numbers, they are generally excluded from trade statistics, e.g., published by the Switzerland's Federal Statistical Office (FSO). Consistent with the FSO's methodology, our "business cycle trade" excludes all precious metals and gemstones, works of art and antiques, as well as "*subtractions*" and "*additions*", to capture trade without change in ownership, returns etc.

Figure 3: The Role of NMG and Merchanting

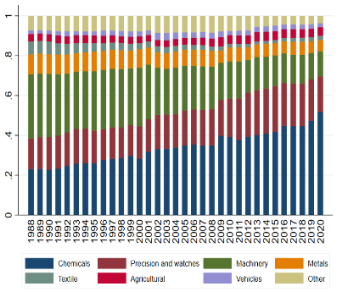
Net contribution of NMG, Merchanting and Chemicals



Dynamics excl. NMG and Merchanting



Composition of the BC Trade



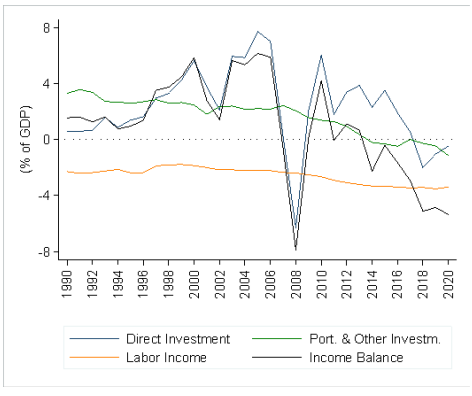
Note: The left-hand side shows the respective contribution of nonmonetary gold (NMG), merchanting and the pharma and chemical sector to the Swiss trade balance. The middle graph shows the longer-term dynamics of the CA when merchanting and NMG are excluded. Finally, the right-hand graph shows the composition of the resulting "business-cycle" goods trade balance. Dotted series are HP-filtered with smoothing parameter of 100.

products during and after the GFC. Since 2010, gross exports of NMG have exceeded 10% of GDP on average. However, as the same is true for imports, the NMG trade balance has been close to zero on average (or even slightly negative) but displayed very significant swings over short periods of time.

Accounting for these idiosyncratic developments in the net exports of NMG and merchanting produces a "*business-cycle relevant*" trade balance[10], which has declined more substantially since the jump appreciation during the GFC (see **Figure 3**, center). Its composition has also shifted as some sectors, such as chemicals or precision instruments and watches, have experienced a strong increase, while machinery and textiles have seen a gradual decline (see **Figure 3**, right). The separate treatment of merchanting and the more volatile NMG will be important going forward. Consistent with the visual impression, our results illustrate that the trade balance tends to react more persistently to an appreciation if components with little connection to the real economy are excluded.

The income balance, shown in **Figure 4**, has been dominated by income from FDI. While gross FDI positions have been neither disproportionally large

Figure 4: The dynamics of the income balance



Note: The graph shows the evolution of the Swiss income balance and its components, scaled by GDP.

[10] Trade statistics from the Swiss statistical office distinguish total imports and exports from "business cycle" imports and exports, which exclude nonmonetary gold and merchanting, as well as other precious metals, gemstones, works of art and antiques.

nor particularly volatile (relative to portfolio or other investment positions), related gross income flows have been so. They have also been correlated less with each other (e.g., relative to the correlation between receipts and expenses from trade or other investments). With net income from labor and other forms of investment having been relatively smooth, the dynamics in the overall income balance have almost entirely been driven by net FDI income.

Other variables used in the analysis will be introduced as they become relevant. All variable definitions and data sources are presented in the Appendix. Barring financial variables and unless specified differently, all variables are seasonally adjusted.

3. Empirical Framework

The bulk of the analysis is based on a VAR with quarterly data, which identifies changes in the REER that are orthogonal to the changes in domestic and international real and monetary developments. How this approach is implemented is described next. More details are provided in the Appendix[11].

The baseline model is a standard 4-variable VAR, estimated with four lags[12], two additional exogenous variables and a small-sample correction for the degrees of freedom. At the heart of the system are the REER (in logs) and different variables capturing components of the external balance (included in different specifications and generally in percent of GDP). To control for domestic real and monetary conditions, the VAR also includes 4 lags of Switzerland's real GDP (in logs), as well as the changes in the SNB's policy rate. To control for real and monetary developments in the rest of the world, we include as exogenous variables the log differences in the US Federal Funds Rate, as well as in the real GDP among Switzerland's trading partners[13].

More sensitive than the estimation of a VAR is often the identification of the shocks of interest. As already discussed in the introduction, the effect of an exchange rate movement depends on the underlying driver (see Bussière et al., 2015). Identifying meaningful exchange rate shocks is complicated by the fact that the exchange rate is a fast-moving variable that reacts quickly to the realization—or even the anticipation—of a wide range of developments both at home and abroad. The literature suggests that the drivers of the Swiss REER differ depending on the frequency. Mancini-Griffoli et al. (2015) stress the importance of relative government spending and terms-of-trade as key drivers of the REER in the longer term. At the higher frequency, more comparable to the frequency exploited in this analysis, financial variables become more relevant. A factor that has received particular attention is the Swiss franc's safe-haven

[11] See also Hamilton 1994, Lütkepohl (2005) and Stock and Watson (2001) for background information on vector autoregressions.

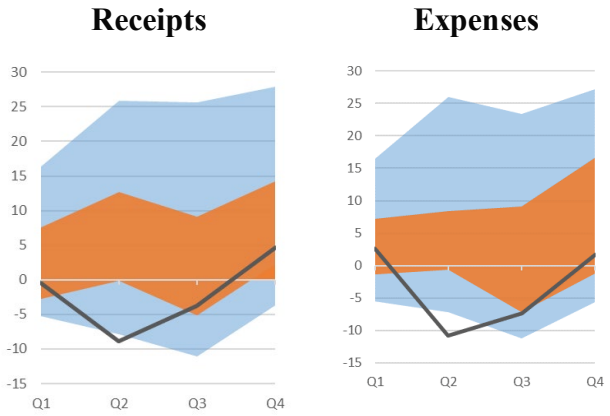
[12] See the Appendix for tests determining the lag order.

[13] The monetary stance in the world and Switzerland are captured by the US Federal Funds Rate and the policy rate of the SNB, respectively. The use of the FFR to proxy the global monetary policy stance relies on its dominant role in driving global interest rates. The results are, however, robust to including the policy rates of the ECB (and Germany prior to 1999). The fact that we use the first difference of the monetary policy rate, rather than the level, is inconsequential. The results are close to identical, although at times somewhat more volatile with the level. The results discussed in this footnote are available upon request.

proprieties. Ranaldo and Söderlind (2010), Hoffmann and Suter (2010), De Bock and de Carvalho Filho (2013), Grisse and Nitschka (2015) and Jäggi et al. (2019) have shown that the Swiss franc reacts strongly to global factors[14].

Our empirical framework tries to identify the exchange rate movements that go beyond those warranted by standard economic conditions, at least in a linear framework. We do this with a Cholesky decomposition, which lets the REER react instantaneously to the current account and real and monetary developments but assumes that all other variables react only with a one-quarter lag to changes in the REER[15]. Given the fast-moving and forward-looking character of the exchange rate, we are confident about the validity of the identification assumption for the REER shocks, i.e., that the REER reacts contemporaneously to all other variables. The assumption that the CA does not react instantaneously may, however, be less obvious. To illustrate that this a reasonable assumption, we explore the reaction of the CA around the large and unanticipated appreciation following the SNB's 15 January 2015 decision to abandon the minimum exchange rate with the euro.

Figure 5: CA expenses and receipts after the 2015 surprise appreciation



Note: The graphs compares the evolution of the 2015 CA receipts and expenses (black lines) with the other years in the sample (1984-2021). Y-axis: The change relative to the average of the preceding year, in %. X-axis: quarter of the year. Orange area: interquartile range. Light blue area: 10th/ 90th percentiles range-

Figure 5 compares the year-on-year change in the CA receipts and expenses in 2015 to the range in the other years in the sample (1984-2021). The figure suggests that the contemporaneous (Q1) reaction of both gross positions was small. For example, the Q1 CA receipts and expenses in 2015 were 0.5% lower and 2.6% higher than the average of the preceding year, respectively. Both of these numbers are comfortably within the interquartile range of the sample, as illustrated by the position of the black line relative to the orange area. In Q2, both receipts and expenses collapse, going below the 10th percentile (outside of the light blue area), before recovering during the rest of the year. The representativeness of this exercise has its limits, as many other elements were driving the external balance at the time.

[14] These various papers on the safe haven proprieties of the CHF suggest important nonlinearities (Ranaldo & Söderlind, 2010) in the relationship with risk proxies, time-variation (De Bock & de Carvalho Filho, 2013; Grisse & Nitschka, 2015; Hoffmann & Suter, 2010; Ranaldo & Söderlind, 2010) and different reactions of bilateral exchange rates (Grisse & Nitschka, 2015; Hoffmann & Suter, 2010). Despite some differences, the papers generally agree that the Swiss franc is susceptible to global shocks, including those related to investors' risk aversion.

[15] Given the limited focus of this paper, we use a partially identified system, which helps us avoid making assumptions regarding, e.g., shocks to monetary policy or value-added. This makes it impossible to meaningfully interpret the effects of growth surprises, monetary policy changes or surprise changes in the Swiss external balances.

Figure 6: REER shocks with different endogenous variables

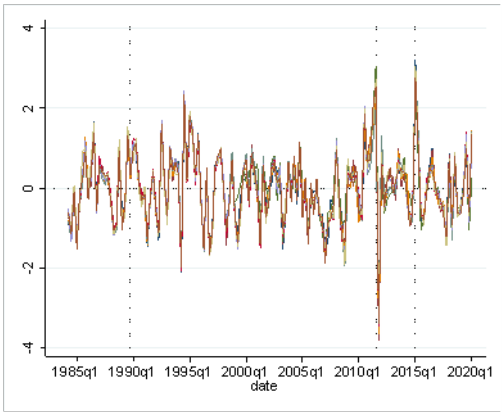
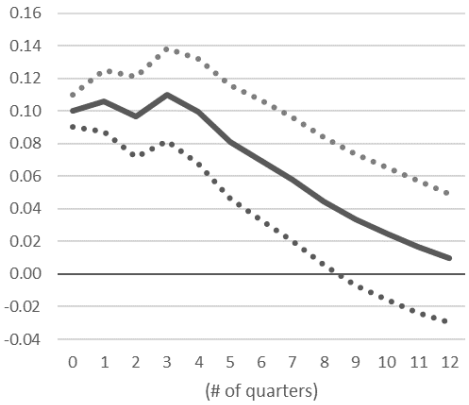


Figure 7: The Reaction of the REER to its own shock



Note: The left graphs shows the identified REER from the various VARs using the overall current account, trade balance, income balance, NMG, merchanting, the real and nominal goods trade balance, terms-of-trade and consumer prices. Vertical lines indicate 1989Q4 (fall of Berlin wall), 2011Q3 and 2015Q1, reflecting the instauration and removal of the exchange rate floor relative to the euro. The right graph shows the impulse response functions of the REER to its own shock, with 90% confidence intervals.

Nevertheless, the fact that we observe a significant decline in CA flows one quarter after the appreciation (and not contemporaneously) provides some confidence in the appropriateness of the recursive identification. However, despite the supporting evidence, we recognize that our shocks are likely not truly exogenous and that some endogeneity (e.g., by omitted common determinants) likely remains.

Figure 6 shows the resulting shocks from our baseline regressions. The different lines are the products of different specifications when the CA (scaled by GDP) or other proxies for the external balance are included as the endogenous variable. Two things stand out. First, the shocks are generally very similar across specifications. Re-estimating the VAR with different endogenous variables means that the structural shocks cannot be exactly the same. Potentially, this could make the comparison of results across variables difficult, particularly if comparing different components of a bigger aggregate (e.g., the CA). The fact that the shocks are very similar is thus reassuring. Second, shocks are reasonably well behaved and align quite nicely to major economic events. For instance, shocks were positive and persistent in the late 1980s and mid-1990s when the German reunification and speculative attacks on the European monetary system pushed up the value of the CHF (see Reynard 2008). After a period of smaller shocks around the turn of the millennia, the VAR suggests some sustained negative shocks in the run-up to the GFC, which turned significantly positive in the immediate aftermath. The time of the exchange rate floor between September 2011 and January 2015 is surrounded with significant spikes, but rather little action in between. [16] The identified REER shocks tend to be

[16] The similarity of the identified shocks across different endogenous variables likely stems from the fact that the exchange rate is often hard to predict, particularly in the short run. Accordingly, the shocks are often surprisingly similar to the simple log-difference in the REER.

reasonably consistent. As shown in **Figure 7**, after an appreciation shock, the exchange rate remains at roughly the same level for 4 quarters and then only reverts half way over the following year.

Conscious of the risk that our exchange rate shocks are not fully exogenous, we generally focus on the external balance and refrain from interpreting gross flows. The validity of our results further benefits if omitted drivers of the exchange rate have a roughly symmetric effect on gross flows (e.g., they depress imports and exports in a similar manner)[17]. While even this we cannot assume with certainty, we believe that the quantitative relevance of this issue is reasonably contained. For example, while one of our sensitivity analyses suggests that Swiss exports are indeed more susceptible to an increase in risk aversion than its imports[18] (counter to the symmetry assumption just described), we also show that the main effect of the appreciation barely changes when the VIX is included as an additional endogenous variable.

We replicate the VAR exercise with a more static model, akin to the work done by Cubeddu et al. (2018). This serves mainly to make our results more directly comparable with some of the existing work. Since this so-called "*CGER-inspired approach"* does not provide significant new insights, both the methodology and the results are explained in the appendix.

4. Results

The section presents the main results. It starts by investigating the elasticity of the CA and its main components, namely, the trade and (primary) income balance. The section then illustrates the roles of NMG and merchanting and further disaggregates the trade balance into quantity and price reactions. It concludes by discussing the implications of an appreciation of consumer prices and corporate profits and how the latter can possibly explain the pronounced positive reaction of the FDI income balance.

4.1. The Current Account and Its Main Components

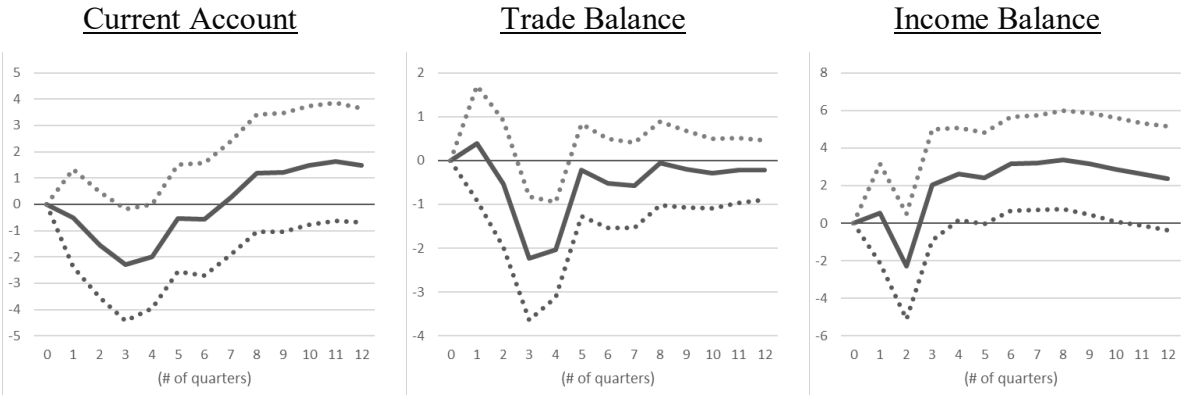
One of the key results of this paper is that the overall CA is rather inelastic to the REER. This is apparent when looking at **Figure 8**. It shows the impulse response functions (IRFs) of the aggregate CA, as well as of the trade and income balances (all scaled by GDP) to a 10% appreciation in the REER. The CA (on the left) tends to decline over the first four quarters, peaking at approximately -2%. Subsequently, the point estimate reverts quickly and then

Appendix Figure 2 compares the identified shocks with the rescaled log-difference of the exchange rate. What stands out is that the two lines overlap almost perfectly during periods of big exchange rate movements, but they differ more significantly during "calmer" periods. This suggests that most of the big swings in the exchange rates were reasonably exogenous and is likely a key reason why the VAR results are often comparable to those obtained from the CGER-inspired approach.

[17] If this is not the case, one would mistakenly attribute a change in net flows to the exchange rate when, in reality, it is due to differential reactions of receipts and expenses to the underlying shocks.

[18] As discussed in more details in Section 5, an increase in risk aversion (proxied by the VIX) is followed by a short-lived deterioration in net exports, consistent with Switzerland's large exports of investment goods and luxury products reacting more strongly than its imports.

Figure 8: The REER Reaction of the CA and its main Components



Note: The figure shows the impulse response functions of the CA and its main components (in % of GDP) to a 10% REER appreciation. Dotted lines show the 90% confidence intervals. The sample of the income balance estimation starts only in 1998Q1.

overshoots to reach a level of approximately +1.5% between quarters 8 and 12. The estimated effects are rather noisy, however, as only the trough is marginally significant at 10%.

The decomposition of the aggregate effect suggests that different drivers dominate at different horizons. Over the first 4 quarters, the effect is driven by a pronounced but short-lived reaction of the trade balance (see **Figure 8**, middle). Subsequently, the trade balance reverts to zero, and the income balance becomes the driving factor, which after an initial hiccup—driven by the disruption during the GFC (see the sensitivity analysis)—tends to be positive and statistically significant (see **Figure 8**, right). The more static CGER-inspired analysis provides very similar results (reported in the Appendix).

Our estimates for the CA elasticity are somewhat smaller and/or less precise than the ones from the literature. For example, Cubeddu et al. (2018) find a CA elasticity of -0.39 for Switzerland. This is more than twice our short-term estimate based on the dynamic analysis (and ten times our estimate for the longer-term elasticity, which we report in the Appendix). What drives the differences between our results and their results? The answer to this question is not entirely obvious. For one, the CA-REER elasticity is rather a side note in Cubeddu et al. (2018), so their paper does not provide extensive details on country-specific estimations or even confidence intervals for their estimates. It is thus not unlikely that while we use a similar model, the two specifications differ, e.g., in the lag length, precise variables used, or the length of the sample. Based on our analysis, we find that the results are qualitatively very robust to changes in the specifications or the sample[19].

[19] For example, using the same sample with only two lags rather than the four used in the baseline produces a CA elasticity of 0.005, with a p value of 0.975. Using the original specification but restricting the sample period to 2000Q1-2020Q1 produces a negative CA elasticity of -0.291, which is closer to the -0.39 found by Cubbedu et al. (2018), but still statistically indistinguishable from zero by a large margin (p value of 0.388). One choice that tends to affect the results, although in the opposite direction, is the omission of the trend. Dropping the trend, which in our model controls for the slow-moving structural dynamics, tends to produce a positive and significant reaction of the CA

Relative to Fischer et al. (2012), our estimates differ more in the degree of precision than in the estimated point estimate. They combine a static annual model (estimated in levels) with an error correction component to find estimates ranging from -0.12 to -0.23 in the short run and -0.09 to -0.27 in the longer term. The methodological differences are more substantial, which somewhat complicates the comparison with our estimates. Nevertheless, we assess their estimates in line in terms of magnitude, at least in the short run. For example, our dynamic reaction points to an average elasticity of -0.16 between quarters $t + 3$ and $t + 5$ and a peak effect of -0.21[20].

4.2. The "Business Cycle Relevant" Trade Balance

Our descriptive statistics highlight the growing importance of nonmonetary gold (NMG) and merchanting in driving both the level and the short-term dynamics of the Swiss CA. In this subsection, we look at their reaction to a real appreciation and how their sequential omission changes the reaction of the remaining "business-cycle relevant" parts of the trade balance.[21]

The left-hand chart in **Figure 9** shows the IRF of net NMG exports to a 10% appreciation shock. The point estimate is negative over the first four quarters and then peaks at approximately 1% of GDP before becoming positive and significant after approximately 2 years (left-hand graph). Unsurprisingly, given its magnitude and pronounced dynamics, accounting for the reaction of NMG changes the reaction of the trade balance. Once NMG is excluded, the effect on the trade balance (including both goods and services) decreases in magnitude but is more persistent (middle graph). The peak effect is roughly cut in half, but the effect becomes negative and statistically significant for most of the first 3 years. The effect on the current account is also smoothed (right-hand graph); the point estimates—first negative, then positive—are no longer statistically distinguishable from zero at any horizon. The three graphs in **Figure 9** illustrate that accounting for NMG strengthens the negative reaction of the TB but does not significantly alter the reaction of the CA balance.

In what follows, we further disaggregate the trade balances to distinguish the effects on different components and eventually between prices and quantities. **Figure 10** (left and middle) starts by showing the IRFs in net income from merchanting (left-hand graph) and net service exports (middle graph). Both series decline gradually after an appreciation. Even if individually they are at best marginally statistically significant, their exclusion quite substantially changes the reaction of the residual goods trade balance. The nominal goods balance, which excludes

balance to a REER appreciation. Given the counterintuitive results and obvious risks of spurious regression, specifications without a trend are not further explored.

[20] Given the absence of dynamics in the model by Fischer et al. (2012), their results do not compare easily with ours, as, e.g., it is unclear over which time horizon their estimated effect materializes. As our dynamic estimates show, the reaction appears quite sensitive to the horizon chosen.

[21] It is possible that earnings from exports of NMG and merchanting are connected to foreign ownership and are thus partially offset by expenses recorded under the income balance. In such a situation, a consistent analysis of the CA excluding NMG and merchanting would require the income balance to be adjusted as well. Given data constraints, this was not possible for this project.

Figure 9: The Role of Nonmonetary Gold

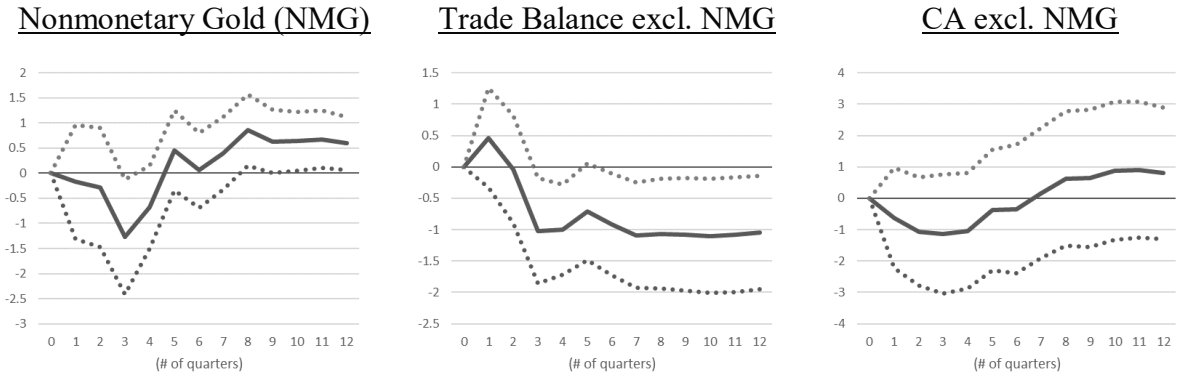


Figure 10: Business Cycle Goods vs. Service Trade

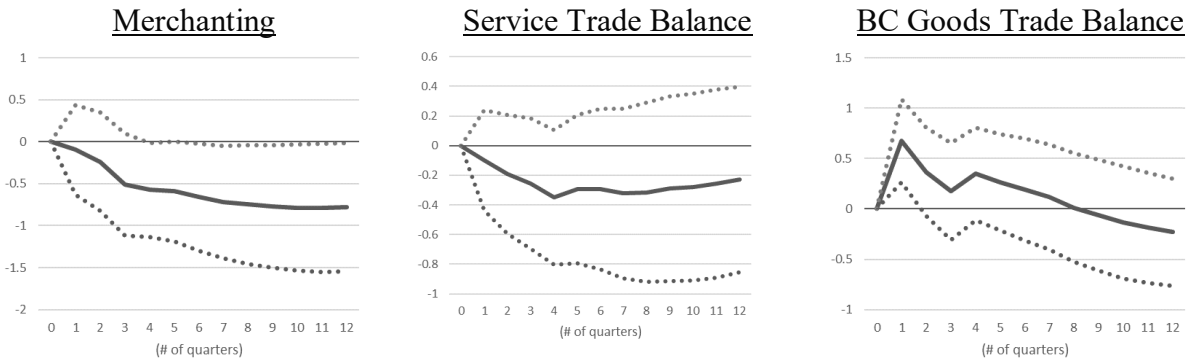
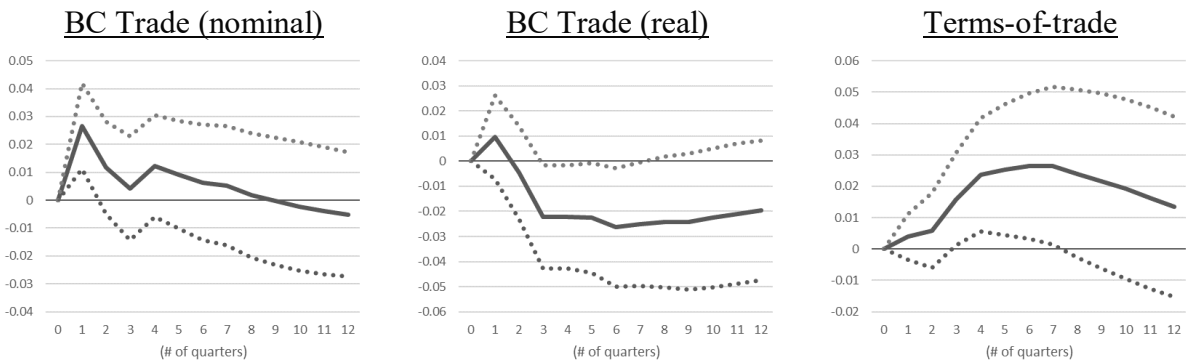


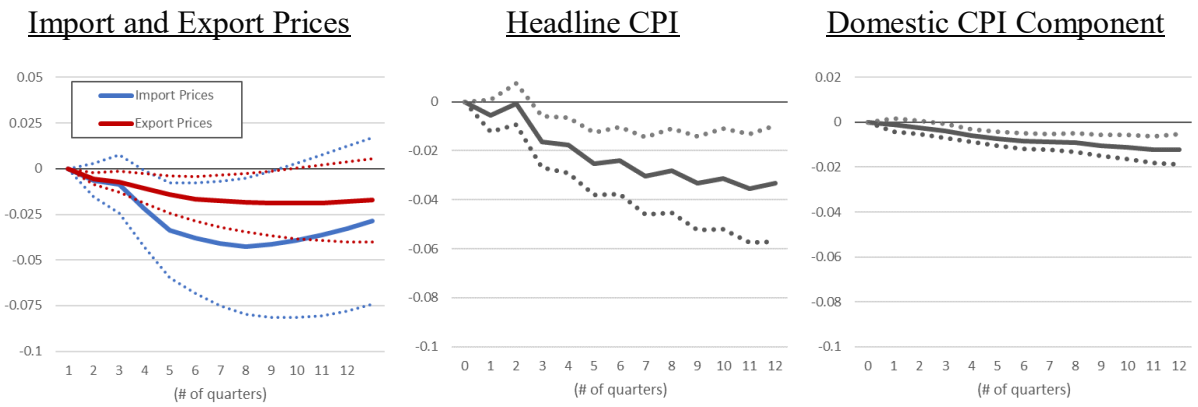
Figure 11: Nominal vs. Real and the Terms-of-trade



Note: The figure shows the impulse response functions of goods and service trade balances, exports and imports, all in % of GDP to a 10% REER appreciation. Dotted lines show the 90% confidence intervals. Trade balances are defined as $\ln(X/M)$, consistent with the definition of the terms-of-trade as $\ln(P_x/P_m)$. Dotted lines show the 90% confidence intervals.

services, NMG and merchanting—what we call the "*business-cycle relevant*" (BC) goods trade balance—actually increases at first and then only gradually returns to zero (**Figure 10**, right).

Figure 12: Pass-Through on Consumer Prices



Note: The figure shows the impulse response functions of the terms-of-trade, as well as the foreign and domestic components of the consumer price indices (all in logs), to a 10% NEER appreciation. Dotted lines show the 90% confidence intervals.

This rather surprising pattern of the "business-cycle relevant" goods trade balance can be explained by further disaggregating the reaction of the nominal BC goods balance into the price and quantity components[22]. Doing so shows that the shift in relative prices is sufficiently large to fully offset a negative effect on the quantities. Concretely, **Figure 11** illustrates that the positive reaction of the trade balance in nominal terms (left) hides a negative reaction in real terms (i.e., quantities, middle), which is, however, smaller than the strengthening of the terms-of-trade (right). The reaction of the real goods trade balance is broadly consistent with the expenditure switching hypothesis and a negative reaction of overall real GDP.

4.3. Implications for Consumer Prices and Corporate Profits

In what follows, the paper shows that while the exchange rate does not appear to affect the external balance, it can have profound implications for the Swiss economy both in terms of consumer prices and corporate profits. We investigate these effects by including the two variables in the VAR instead of the proxies for the external balance (e.g., the CA).

The left-hand side of **Figure 12** shows that the strengthening of the terms-of-trade is due to a particularly pronounced decline in import prices[23]. Import and export prices both decline, but

[22] We define the BC trade balances as $\ln(X/M)$, where X and M are either nominal or price deflated exports and imports. This definition is used to be consistent with the definition of the terms-of-trade as $\ln(P_x/P_m)$. While the import price index P_m is available from the early 1960s, no proper export index is produced by the Swiss Federal Statistical Office. Due to data limitations, the aggregate producer price index are used to proxy for export prices P_x. Comparing the series with a manually constructed alternative that uses more detailed export weights for a sample starting 2003Q2 suggests that the approximation is very good, with a correlation between the two series of 97%.

[23] The regressions for **Figure 12** use the NEER instead of the REER as the source of shocks. Import and export price indices rely are measured in local currency. See the Appendix for further detail on the data series.

import prices do so in a more pronounced manner[24]. A 10% appreciation in the nominal effective exchange rate (NEER) depresses import prices by approximately 4 percent over the first three years and export prices by only 2 percent. The pass-through to import prices is thus incomplete, consistent with the evidence from Stulz (2007) for Switzerland.

The fact that terms of trade react to the exchange rate, although in a partial manner, is consistent with historical evidence. For example, Campa & Goldberg (2005) find an incomplete pass-through in an international sample between 1975 and 2003. More recent evidence has, however, emphasized that trade is often invoiced neither in the consumer nor the producer currency but in a dominant third currency (most often the USD or the euro). In such a "dominant currency paradigm", the terms-of-trade no longer react to the exchange rate (e.g., Gopinath et al., 2020, Bruno and Shin, 2020). Our results are, however, consistent with a situation where particularly invoicing in producer prices is still common. Only 25% of imports but more than 50% of exports are invoiced in Swiss francs (see **Figure 16** and the related discussion below). In addition, differences in market power may affect the exchange rate pass-through. Bonadio, Fischer and Saure (2018) suggest that market shares matter for the exchange rate pass-through in the case of Switzerland, consistent with an abundant international literature[25].

Compared to Stulz (2007), who finds a CPI pass-through of only -0.18, our CPI pass-through estimate is somewhat larger, at roughly -0.35 after three years. This gap is likely related to differences in methodology and/or the types of events investigated. While Stulz (2007) also uses a recursive VAR with real and monetary domestic variables, his setup does not control for global variables. Thus, the exchange rate shocks he identifies likely include some that are due to monetary policy easing in partner countries. As during his sample period, the SNB still had ample space to react with traditional monetary easing[26], such appreciation shocks may have been expected to be more temporary[27] in nature, provoking more moderate price reactions by economic agents.

It is noteworthy that the effect on consumer prices is also larger than the direct impact from cheaper imports, that is, the effect on import prices multiplied by the weight of the foreign component in consumption (roughly 25 on average). While the decline in the foreign components (see also **Appendix Figure 3**) is the key driver of lower consumer prices, it is

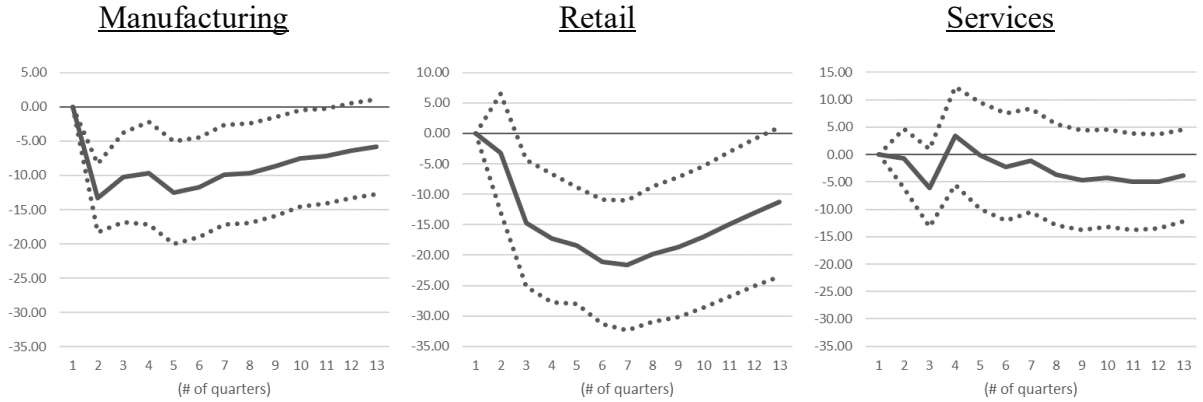
[24] We are deviating here from the approach used thus far of focusing on net variables only (in this case, the terms of trade). This approach likely increases the risk that common determinants of the exchange rate and prices blur the picture.

[25] See, e.g., Fischer (1989), Feenstra et al. (1996), Kadiyali (1997), Bernhofen & Xu (2000), or Auer and Schoenle (2016) for further evidence of the role of market power on the exchange rate pass-through.

[26] With the SNB close to the ELB during much of the post-GFC period, appreciation shocks became more persistent, increasing the scope for higher pass-through to import prices. Dividing the sample into pre-2008 and post-2007 periods produces results consistent with such a hypothesis. The persistence of the real appreciation shock, as well as the pass-through from the nominal appreciation to import prices, increased after the GFC (shown in Appendix Figure 12.).

[27] More temporary shocks likely reduce the incentives for importers and producers to adjust prices and thus the pass-through to import and consumer prices.

Figure 13: Perceived Company Profits



Note: The figure shows the impulse response functions of perceived profits in the manufacturing, retail and service sectors to a 10% REER appreciation. Shaded lines show the 90% confidence intervals. The sample of manufacturing and retail starts in 1994, the one for services only in 2006Q4. Aligning the samples does not alter the reaction of manufacturing and retail substantially.

complemented by a smaller although still statistically significant decline in the domestic CPI component (**Figure 12**), which is suggestive of a second-round effect, including on services.

The second significant implication of the reaction of the terms-of-trade relates to the resulting decline in company profits. A high pass-through to the import and export prices, as well as to the prices charged to the eventual consumer, squeezes company profits if some of the production costs (e.g., wages and rents) are sticky and denominated in Swiss francs. Swiss data on company profits by sector are scarce. To support this hypothesis, we thus rely on the profit-relevant question of the KOF business cycle survey ("KOF/ETH Konjunkturumfrage"). We include in our VAR (instead of the variable capturing the external balance) the balance of respondents to the question of whether company profits improved or deteriorated during the preceding 3 months. The results, shown in **Figure 13**, suggest that following an appreciation, profits deteriorate significantly in the retail and manufacturing sectors. However, the same outcome is not found in the case in the service sector, where the largely nontradeable character mutes international price competition.

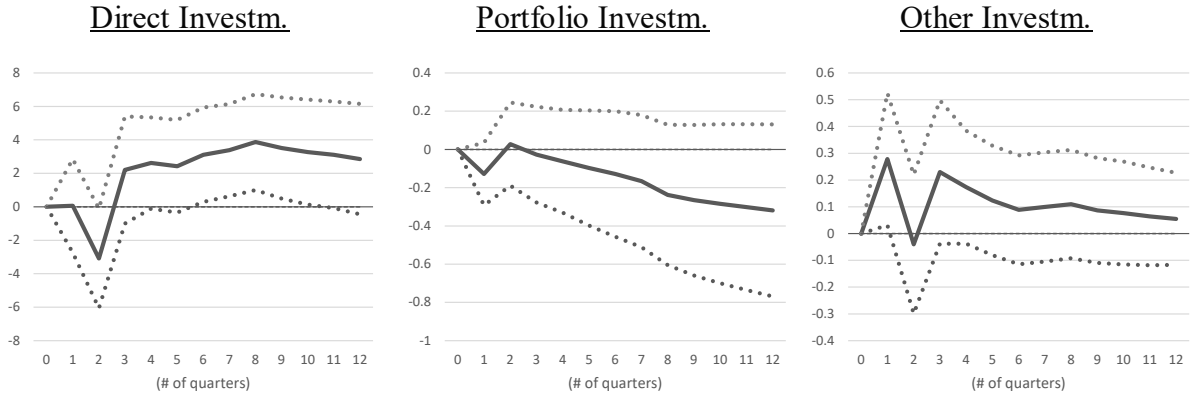
4.4. FDI and the Income Balance

The finding that an appreciation of the exchange rate depresses profits in exposed sectors helps explain the positive reaction in the income balance. How this can more than offset a potential mechanical effect of the exchange rate on the income balance is explained next.

In many countries, trade is dominated by multinational enterprises[28], which implies that export activity tends to be more concentrated among foreign-owned firms. Higher trade intensity

[28] See, e.g., Helpman, Melitz, and Yeaple (2004), Bernard, Jensen & Schott (2009),

Figure 14: Investment Income Balances



Note: The figure shows the impulse response functions of the net income balances relative to direct, portfolio and other investment (in % of GDP) to a 10% REER appreciation. Dotted lines show the 90% confidence intervals.

(exports and imports) among foreign-owned firms has generally been found in the case of Germany (Raff & Wagner, 2013; Weche Gelübcke, 2013), the US (Fetzer and Strassner, 2015), China (Ma, Wang, and Zhu, 2015) and a panel of different OECD countries (Piacentini and Fortanier, 2015). While we are not aware of a study specific to Switzerland, it seems plausible that this is also the case for Switzerland, as many of the biggest exporters are largely foreign owned (obviously true for subsidiaries of foreign companies but also for the large, publicly traded Swiss companies).

A high concentration of FDI in the export sector creates a possible link between the reaction of the trade balance and the one of the income balance. To the extent that income flows are tied to profits rather than a fixed interest rate, falling profits among Swiss corporations can imply falling FDI income expenses and hence an improvement in the net FDI income balance. Depending on the importance of FDI and the denomination of both assets and liabilities, the fall in domestic profits could more than offset the mechanical decline in the CHF value of often foreign currency-denominated income receipts.

Based on our results, this is precisely the case in Switzerland. **Figure 14** presents the results for the different investment balances, expressed in % of GDP. It shows a positive and highly statistically significant effect of an exchange-rate shock on the FDI income balance, driven by a larger decline in expenses than receipts. A similar reaction can, however, not be observed in net income from portfolio or other investments, where reactions are close to zero[29]. Given the

[29] It is possible that measurement issues affect the IRF of portfolio investment. The retained earnings of portfolio equity positions are not included into the statistical concept and can thus distort portfolio income. Given that the reaction of FDI income is larger by an order of magnitude, this effect is unlikely to qualitatively change the results. However, investigating the precise quantitative relevance goes beyond the scope of this paper.

dominant size of FDI income, relative to other foreign income types (including from labor), the reaction of direct investment translates very directly into a positive reaction of the investment income balance, as well as the income balance overall (see **Appendix Figure 4**).

This section has presented the main results, painting a coherent picture that is consistent with economic intuition. It has shown that the overall CA is largely insensitive to the exchange rate, as the short-lived reaction of the trade balance is partly offset by a positive reaction of the income balance. It has further shown that Swiss-specific factors such as net exports of NMG and merchanting have played an increasingly important role. Abstracting from these positions produces a "*business-cycle relevant*" goods trade balance in which a strengthening of the terms-of-trade fully offsets a significant and persistent reduction in quantities. While the relative decline in import prices reduces the negative effect on the current account, their absolute decline depresses both consumer prices and companies' bottom line. The pronounced decline in corporate profits in the more exposed sectors such as manufacturing or retail suggests a negative link between trade and income balance and provides a possible explanation for the positive reaction in the FDI income balance.

5. Sensitivity Analysis

In what follows, we will show that the conclusions from the previous section are qualitatively insensitive to (i) different specifications (including estimating the VAR in differences or adding the VIX), (ii) different samples (including the omission of the great financial crisis (GFC) or specific subperiods) or (iii) different proxies (such as central bank balance sheets for monetary policy stances). However, the results do vary somewhat across bilateral exchange rates, as they appear more driven by the euro exchange rate than, e.g., the one relative to the USD. In the interest of readability, the relevant figures and tables are reported in the appendix.

5.1. A VAR in Differences

We have explained in Section 3. that our preferred specification is a VAR in levels, as statistical tests (reported in the Appendix) reject the null of nonstationarity. In addition, from an economic point of view, it is hard to argue that external balances, such as the current account, can be nonstationary when scaled by GDP. Despite this, given that other papers[30] have decided against using a model in levels when investigating similar questions, we nevertheless investigate whether this choice is consequential for our main results.

Appendix Figure 5 shows that this is not the case. The IRFs based on a VAR in first difference are very close in terms of shape, magnitude and statistical significance for the current account, as well as the trade balance. For the income balance, the result weakens slightly in terms of magnitude but remains positive and statistically significant.

[30] E.g. Fischer et a. (2012), Grossman et al. (2016) or Thorbecke and Kato (2017) all use some type of error-correction model.

5.2. The role of the GFC

A second possible concern is that our results are largely driven by the gGreat Financial Crisis (GFC), a once-in-a-lifetime event that was hugely disruptive both for trade and investment flows. If this were the case, the results could still be interesting from an academic point of view, but the policy relevance would be much reduced. To investigate this possibility, we simply drop the period from 2008Q1 to 2009Q4 from the sample.

Appendix Figure 6 shows that the GFC does not have a material impact on the main results. The results for the current account and trade balance are almost identical. The reaction of the income balance is also similar, but the initial drop (observed in quarter 2) weakens, producing an overall smoother IRF. This suggests that while the GFC has some influence on the very short-term reaction of the income balance, omitting it rather strengthens the conclusion that its reaction tends to be positive.

5.3. Sensitivity to Time Sample

A related concern could be that the GFC may be driving the results less in the short run but more by inducing a structural break in the relationship between the REER and the variables reflecting the external balance. To investigate this possibility, we split the sample into a pre-2008 and a post-2007 period.

Appendix Figure 7 shows that the results are broadly comparable in the two subsamples. The most notable differences are the more rapid reversal of the trade balance in the post-GFC sample and the overall reduction in precision. Such differences, however, need to be expected, as the sample sizes shrink dramatically from 144 observations in the baseline to 95 and 49. Accordingly, we conclude that the results are broadly robust to different subsamples and that there is little evidence that the GFC has significantly changed the relationships between the REER and Switzerland's external balances.

5.4. Central Bank Balance Sheets as a Proxy for Monetary Policy

One key characteristic of much of the post-GFC period is the low level of policy interest rates. With interest rates converging to a—although unknown—effective lower bound, central banks in advanced economies reverted to quantitative easing (QE), FX interventions, forward guidance and other tools to influence monetary and financial conditions. Empirically characterizing monetary policy has thus become more complex, and this paper cannot fully address this issue.

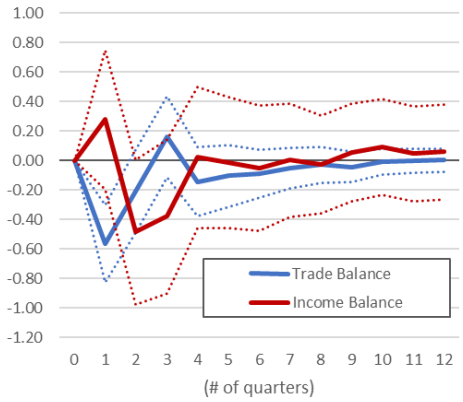
To illustrate that the use of a richer set of monetary policy tools does not drive our results, we use central bank balance sheets as an alternative proxy for the monetary policy stance. This is done by including the balance sheet of the SNB (scaled by GDP) as an endogenous variable

and that of the US Fed as an exogenous one[31]. **Appendix Figure 8** shows that the main results do not change with these alternative proxies for the monetary policy stance. The IRF of the current account is slightly tilted upward. The negative reaction in the short term is thus slightly more muted, and the positive reaction in the medium term is more pronounced, reflecting differences in the reaction of trade and investment income balances. While we recognize that our alternative proxy is imperfect, the results still suggest that the presence of the lower bound or the use of alternative tools does not drive the overall results.

5.5. Risk Aversion as an Independent Driver of the CA

A key concern already discussed in detail in Section 3 is that the effects we attribute to the appreciation could actually be due to omitted underlying drivers thereof. This could notably be the case if an increase in risk aversion weakens the Swiss CA but also leads to an appreciation of its exchange rate. We test this hypothesis by including the VIX as an additional endogenous variable in our VAR. Reflecting the expected price change of the S&P500 during the 30 days ahead, the VIX has both a US and an equity focus.[32] Nevertheless, its reasonably long time series and its visibility in the eyes of the public make it, to the best of our knowledge, the best available proxy for changing risk aversion in this context.[33]

Figure 15: VIX and Swiss External Balances



Note: The figure shows the IRF of the nominal trade and investment balances to a positive one-standard deviation VIX shock. Dotted lines show the 90% confidence intervals.

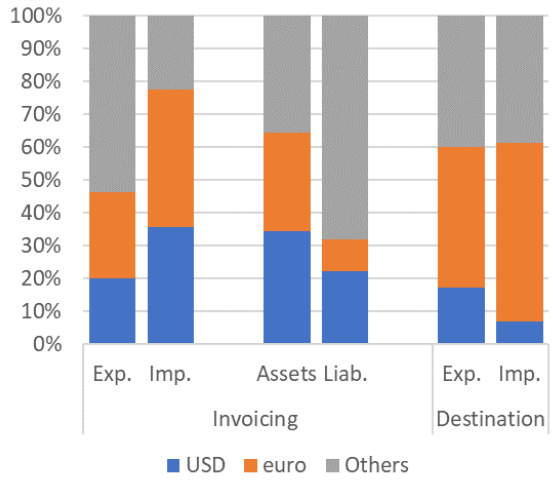
The results suggest that an increase in the VIX is indeed followed by a temporary deterioration of both the trade and the income balance (**Figure 15**). Both series tend to deteriorate significantly after an increase in risk aversion for one or two quarters but revert to zero quickly. **Appendix Figure 9** also shows that the effect of the exchange rate on the external balances is

[31] For the period when the Fed balance sheet is not publicly available in the early part of our sample, we assume that it stayed constant in terms of GDP going backward from the last observation, which is an assumption that seems plausible based on the available balance sheet of the SNB at the time.

[32] In addition, the VIX's high volatility and low persistency sets it apart from more precise measures of economic uncertainty (rather than measures of risk aversion) such as the ones proposed by Jurado, Ludvigson, and Ng (2015) or Orlik & Veldkamp (2015).

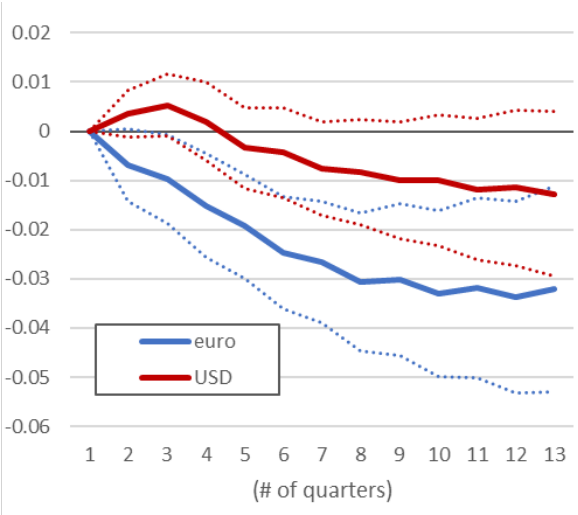
[33] To be consistent with all other variables, we use the quarterly average and include it as the fastest moving variable in the system. Aware that the level of the VIX can be extremely volatile, we have experimented with the first or the highest value of the quarter. The results, which are available on request, vary very little. The same is true when using the natural logarithm of the VIX or when switching the order of REER and the VIX in the identification. We also experience with related alternatives, such as the VSTOXX index, which measures the volatility index of the EURO STOXX 50 index. Despite the short time series (starting in 1999), its inclusion does not alter the results.

Figure 16: Invoicing and Trade with the US and the Euro Area



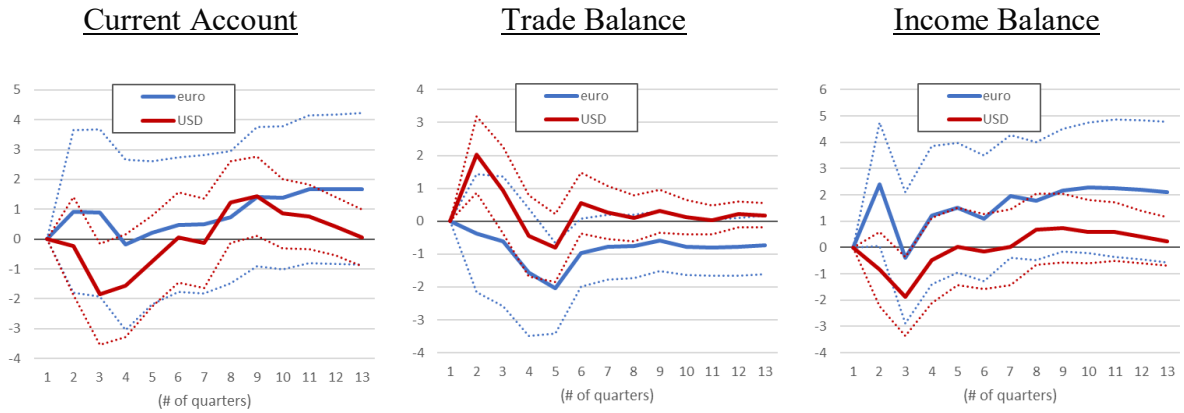
Note: The figure shows the currency composition of exports and imports as well as foreign assets and liabilities. Destination refers to the USA and the euro area. Sources: Boz et al. 2020, SNB, Federal Customs Administration.

Figure 17: Differential Effect on CPI



Note: The figure shows the IRF of the Swiss CPI to a 10% appreciation of the CHF, respectively vis a vis the euro and the USD. Dotted lines show the 90% confidence intervals.

Figure 18: CA Reaction Across Exchange Rates



Note: The figure shows the IRF of the business cycle trade balance (in % of GDP) to a 10% appreciation, respectively in the NEER, the bilateral exchange rate with the euro or the bilateral exchange rate with the USD. The euro exchange rate is only available starting 1999Q1. Confidence intervals: 90%.

virtually unchanged. This suggests that while increases in risk aversion can affect Switzerland's external balances, they did not seem to have driven our estimated effect of the exchange rate.

5.6. Sensitivity to Bilateral Exchange Rates

The last sensitivity analysis compares the reaction of the Swiss external balances to Switzerland's two most important bilateral exchange rates, namely, the ones relative to the USD and the euro. It is plausible that the two bilateral exchange rates have different impacts, as the roles of the two currencies differ somewhat. For example, while for trade, a slightly larger share is invoiced in euros compared to USDs, the opposite is true for foreign investment positions, where particularly for liabilities, the role of the USD is substantially larger. Invoicing, however, does not reflect a direct trade relationship, as, e.g., particularly imports from (but also exports to) the euro area exceed trade with the US by large margins (see **Figure 16**). To investigate the differences in the reaction, we replace the real effective exchange rate with the bilateral nominal exchange rate. The USD sample is adjusted to the euro sample, starting in 1999, to improve comparability.

Figure 18 shows that while the current account reactions are reasonably comparable across the two currencies, particularly for the euro they are very imprecise (partly related to the much smaller sample). Regarding the major components, both the negative reaction of the trade balance and the positive reaction of the income balances tend to be more pronounced if the appreciation is relative to the euro rather than against the USD. By implication, the euro exchange rate also has a substantially more pronounced effect on domestic consumer prices (see **Figure 17**). Differentiating across bilateral exchange rates thus suggests that the euro exchange rate is the more important driver of the aggregate results, consistent with Switzerland's very tight economic integration with the neighboring currency area.[34]

6. Conclusion

This paper shows that the Swiss CA has historically been rather inelastic to the exchange rate. While this finding seems counter to common economic intuition, the paper identifies a combination of explanations. First, it shows that the negative reaction of the nominal trade balance is partly offset by a positive reaction of net investment income. Second, the reaction of the trade balance is driven by Swiss particularities, in particular the reactions of nonmonetary gold (NMG) and merchanting. Third, the negative reaction of the real (business-cycle relevant) goods trade (i.e., quantities) is fully offset by a significant appreciation of the terms-of-trade.

However, the paper also highlights that the lack of an aggregate reaction of the CA to exchange-rate shocks does not mean that these shocks are irrelevant for the Swiss economy. We show that an appreciation has significant negative effects on consumer prices, which have the potential to threaten the SNB price stability goal. In addition, the appreciation depresses corporate profits, suggesting that the stress in the real economy is likely more intense than implied by the reaction of the overall CA. The negative effect on profits implies that over the

[34] Respectively including the euro or USD exchange rate on top of the NEER produces results for the NEER that are qualitatively similar, but smaller in magnitude.

longer term, a persistently strong CHF may have contributed (and might continue to do so) to the observed compositional changes in the economy—e.g., away from machinery and textile toward merchanting, chemicals, watches and other luxury products—and thus to changes in the external balance.

The paper is also relevant from a more academic point of view. It illustrates the importance of studying the overall transfer of income by looking at net flows (rather than just exports) of nominal variables (rather than just quantities) and at different components of the current account (rather than just good exports). For some countries, terms-of-trade still fluctuate with the exchange rate, but different positions of the CA may partly offset each other. This appears particularly relevant for countries where a large part of the exporting sector is foreign owned. While Switzerland is likely an extreme case, given its trade and financial openness, the highlighted patterns may also be relevant for other countries to varying degrees.

The paper opens two avenues for further research. First, the negative effect of an appreciation on corporate profits in particularly exposed sectors provides suggestive evidence of a negative connection between the trade balance and the income balance. Depending on foreign ownership and the extent to which investment income expenses are state-contingent (i.e., they fall with profits), a decline in the trade balance could thus be partially offset by an increase in the income balance. At least in the short run, foreign ownership in the exporting sector could thus attenuate the CA reaction to the exchange rate[35]. While our macro level results are consistent with such a hypothesis, they cannot robustly support it. Further research at the company level will be needed to test whether such a mechanism is indeed at play within individual companies. Such research could provide an additional argument for why the expenditure switching effect may have weakened.

Further research is also needed to understand the role of the exchange rate in accelerating the sectoral reallocation in the trade balance. For Switzerland, a concrete question is whether the success of the exchange-rate insensitive sectors has contributed to the CHF strength and thus a "Dutch disease" for the more exposed "losers". The extent to which the success of the "winners" has contributed to the difficulties of the "losers" could have a sociopolitical dimension if the jobs gained are either fewer or substantially different from the ones lost. How the CHF appreciation has affected employment could thus be a related question with a need for further research.

[35] In a situation in which the same exporting production capacities are owned by domestic rather than foreign investors, there is no offsetting change in the investment income in the short-run. In the longer term however the REER would plausibly revert to the same equilibrium, e.g., as changes in domestic demand would affect relative inflation.

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Appendix

6.1. Variable Description

Appendix Table 1: Variable and Sources

VARIABLE	NAME	DESCRIPTION	SOURCE
Real Effective Exchange Rate	REER	Official SNB's REER Index, obtained with IMF weighting, CPI adjusted using a "chained" Törnqvist Index	SNB
Nominal Effective Exchange Rate	NEER	Official SNB's NEER Index	SNB
Current Account	CA	The Current Account Balance is given by the sum of the Trade Balance and the Income Balance	SNB
Trade Balance	TB	Consists of the sum of net positions of Service and Services trade	SNB
Income Balance	IB	Consists of the Sum of the Primary Income (Direct Investment, Portfolio Investment and Other Investment Income) and Secondary Income	SNB
Goods	G	Goods trade comprises foreign trade, supplements to foreign trade (additions and subtractions) and merchanting	SNB/FCA
Nonmonetary Gold	NMG	Part of foreign trade, covers the cross-border trade in nonmonetary gold under tariff number 7108.1200 according to the FCA.	FCA
Merchanting	Merch	Purchase of goods in other economies and the subsequent resale of the same goods to another economy, without the goods being imported into or exported from Switzerland/Liechtenstein	SNB
Business Cycle Goods Trade	BC Goods	Goods - NMG - Merchanting	SNB
Real Business Cycle Goods Trade	Real BC Goods	BC Goods exports adjusted for producer prices, whereas imports adjusted for importer prices	SNB/SFSO
Services	S	Include transport, tourism, insurance and pension, financial, license fees, telecommunications, manufacturing, maintenance, construction, R&D, business and other services	SFSO/FCA/SECO/SNB

Primary Income	PI	Labor Income + Investment Income	SFSO/FFA/SNB
Investment Income	InvInc	Direct Investment + Portfolio Investment + Other Investment + Reserve Assets	SFSO/FFA/SNB
Direct Investment Income	FDI	Income on equity in the form of dividends, reinvested earnings and interest	SNB
Portfolio Investment Income	Portf	Income on stocks of equity and debt securities	SNB
Secondary Income	SI	Current transfers between residents and nonresidents (public and private sector)	SFSO/SFTA/FCA/SNB
Term of Trade	TOT	Producer prices/importer prices	SFSO
Import Prices	P^X	Import prices index, in CHF, norm 100=2000-01	SFSO
Export Prices	P^M	Export prices index, in CHF, norm 100=2000-01	SFSO
Perceived company profits	Profits	Profit situation, change over the past 3 months (qualitative question with 3-point scale), balance (in %), seasonally adjusted series	KOF
Consumer Price Index	CPI	Index that measures the average change in the prices of goods and services (foreign and domestic, private and public) consumed by private households over a given period (monthly)	SFSO
Foreign Demand	ForeignD_Index	Index based upon real GDP growth quarter on quarter, seasonally adjusted of Switzerland's main trade partners, weighted for their share of trade	OECD/Swiss Impex
Domestic Demand	CH_RGDP_Index	Index based upon Switzerland's real GDP growth quarter on quarter, seasonally adjusted	OECD

6.2. The VAR model

The VAR is estimated using the following equation:

$$X_t = a + A_1 X_{t-1} + A_2 X_{t-2} + A_3 X_{t-3} + A_4 X_{t-4} + M Z_t + u_t$$

where X_t is a 4 x 1 column vector containing the proxy for the external balance (e.g., CA in % of GDP), the change in the SNB policy rate, the log the real GDP index and the log of the REER. The column vector Z_t is of dimension 2 x 1 and contains in the baseline the change in the foreign demand index and the change in the US federal funds rate. In sensitivity tests, the specification is altered slightly, depending on how, e.g., we proxy for domestic and foreign monetary policy and which aspect of the external balance we focus on. The residual u_t is assumed to have a variance-covariance structure of $\Sigma = E\, u_t u_t'$.

The identification relies on the Cholesky decomposition of the variance-covariance matrix Σ, which regulates the contemporaneous relationship between the variables. Premultiplying both sides of the equation with the inverse of B_0, which is the lower triangular matrix such that $\Sigma = B_0 B_0'$, we obtain the following structural VAR equation:

$$B_0^{-1} X_t = B_0^{-1} a + B_0^{-1} A_1 X_{t-1} + B_0^{-1} A_2 X_{t-2} + B_0^{-1} A_3 X_{t-3} + B_0^{-1} A_4 X_{t-4} + B_0^{-1} M Z_t + w_t$$

where $w_t = B_0^{-1} u_t$ has a variance-covariance matrix of $\Omega = I$.

Given the ordering of the variables and the fact that B_0^{-1} is lower triangular, all variables in the system appear contemporaneously in the structural equation of the exchange rate, but none appear in the equation of the external balance.

6.3. Statistical Tests

Lag order: The information criteria analysis with foreign and domestic demands treated as exogenous suggests a 4-lag structure for the current account balance. Appendix Table 2 reports the results of the analysis performed with a maximum lag structure of 8 quarters. The LR, FPE and AIC criteria suggest 4 lags, whereas the HQIC and SBIC suggest 2 lags. However, the former are more reliable when the sample is "large" in size (more than 120 observations), as they are found to produce the lowest probability of underestimation among all the other criteria (Liew, 2004).

Stationarity: To avoid the risk of a spurious regression, we perform confirmatory analysis using the augmented Dickey Fuller test for unit root alongside the stationarity test KPSS. Appendix Table 3 reports the results of this analysis. The unit root test rejects the presence of a unit root with a p value of 1.63%, whereas the KPSS fails to reject the null of trend stationarity, even at the 1% level for all lags. We can therefore conclude that the process is I(0). The same is true for the other variables used in the regressions.

Appendix Table 2: Information Criteria – max lag 8

Selection-order criteria

Sample: **1985Q1–2020Q1** Number of obs = 141

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	475.580				4.39E-06	-6.66071	-6.60972	-6.53523
1	628.500	305.839	4	0.000	5.31E-07	-8.77304	-8.68806*	-8.56391*
2	634.412	11.824	4	0.019	5.17E-07	-8.80017	-8.68119	-8.50738
3	634.549	0.275	4	0.991	5.46E-07	-8.74538	-8.59241	-8.36894
4	643.562	18.026*	4	0.001	5.1E-07*	-8.81649*	-8.62952	-8.35640
5	645.354	3.584	4	0.465	5.25E-07	-8.78517	-8.56421	-8.24143
6	646.622	2.536	4	0.638	5.46E-07	-8.74641	-8.49146	-8.11902
7	648.302	3.359	4	0.500	5.65E-07	-8.71350	-8.42455	-8.00245
8	650.995	5.387	4	0.250	5.76E-07	-8.69497	-8.37203	-7.90027

Endogenous: Current Account balance

Exogenous: Foreign Demand Index, Domestic Demand Index and constant

Note: The same results are obtained when using Lütkepohl (2005) versions of the information criteria

Appendix Table 3: Confirmatory Analysis

Augmented Dickey-Fuller test for unit root — Number of obs = 146 — Interpolated Dickey-Fuller

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	**-3.805**	**-4.025**	**-3.444**	**-3.144**

MacKinnon approximate p value for Z(t) = 0.0163

KPSS test for Current Account Balance

Maxlag = 4; Autocovariances weighted by Bartlett kernel

Critical values for H0: Current Account Balance is trend stationary

10% : 0.119 5% : 0.146 2.5% : 0.176 1% : 0.216

Lag order	Test statistic
0	1.28
1	.762
2	.559
3	.451
4	.387

Note: Both tests are performed on a model with 4 lags and a trend

6.4. A CGER-Inspired Approach:

As a complement for the VAR, which we use for the bulk of the paper, we replicate the exercise with the CGER-inspired model of Cubeddu et al. (2018). However, we deviate from Cubeddu et al. (2018) slightly, as we estimate the elasticity of the net balances in a simplified procedure (by including them directly as dependent variables) rather than calculating them as the difference in the elasticities of the gross series. This significantly facilitates the estimation of confidence intervals, an issue of particular relevance in this paper but not addressed by Cubeddu et al. (2018).

We start with the specification by Cubeddu et al. (2018) of exports/receipts and imports/expenses, modeled as a function of their lags, of the contemporaneous and lagged values of the REER, and of domestic or foreign demand, respectively.

$$ln(X_{i,t}) = \sum_{j=1}^{n} \delta_j^X \ln(X_{i,t-j}) + \sum_{j=0}^{m} \beta_j^X \ln(REER_{i,t-j}) + \sum_{j=0}^{k} \gamma_j^X \ln(RGDP_{i,t-j}^{TP}) + \epsilon_{i,t}$$

$$ln(M_{i,t}) = \sum_{j=1}^{n} \delta_j^M \ln(M_{i,t-j}) + \sum_{j=0}^{m} \beta_j^M \ln(REER_{i,t-j}) + \sum_{j=0}^{k} \gamma_j^M \ln(RGDP_{i,t-j}) + \epsilon_{i,t}$$

We assume that $\delta_X = \delta_M = \delta_N$ and $\beta_N = \beta_X - \beta_M$ and define $\frac{X_t}{M_t} = N_t$. Deducting the previous two equations from each other yields the following definition of the trade balance:

$$ln\left(\frac{X_t}{M_t}\right) = \delta^N \ln\left(\frac{X_{t-1}}{M_{t-1}}\right) + \beta^N \ln(REER_{i,t-j}) + \gamma^X \ln(RGDP_{t-j}^{TP}) - \gamma^M \ln(RGDP_{t-j}) + \epsilon_{i,t}$$

Furthermore, including a trend to capture structural determinants of the CA and allowing for a flexible lag structure consistent with information criteria tests, we obtain the following empirical model:

$$ln(N_t) = a_t + \sum_{j=1}^{4} \delta_j^N \ln(N_{t-j}) + \sum_{j=0}^{4} \beta_j^N \ln(REER_{t-j}) + \sum_{j=0}^{1} \gamma_j^X \ln(RGDP_{t-j}^{TP}) - \sum_{j=0}^{1} \gamma_j^M \ln(RGDP_{t-j}) + \epsilon_{i,t} \quad (1)$$

The net balances, rather than the gross series, are thus regressed on their lags; the contemporaneous and lagged values of the REER; and the proxies for domestic and foreign demand, namely, the real GDP in Switzerland and the trade-weighted GDP of Switzerland's

most important trading partners, respectively[36]. A constant α_t and a time trend t are also included; ε_t is the error term. The static REER elasticity of the CA (and other relevant external balances) are then retrieved by combining the estimated coefficients from the previous equation as follows:

$$\eta^{CA} = \frac{\sum_{j=0}^{n} \hat{\beta}_j^N}{1 - \sum_{j=0}^{n} \hat{\delta}_j^N} = \frac{\Delta \log(CA)}{\Delta \log(REER)}$$

The CGER-inspired estimation is dynamic in its repressors but static in the results. It produces a static elasticity of the CA balance to the REER, equivalent to the average reaction starting t+4 quarters after the appreciation. Conceptually, it is close to identical to the estimation by Cubeddu et al. (2018) but may differ in the precise specification (Cubeddu et al. (2018) do not report details on the specification for each country).

Relative to Fischer et al. (2012), who estimate the CA-exchange rate elasticity specifically in the case of Switzerland, our static CGER-inspired estimation differs in various ways. For example, we use quarterly rather than annual data, which allows us to account for the dynamic proprieties of the dependent variable. Related, our elasticity is estimated over a different time horizon, namely, starting 4 quarters after the appreciation. This will somewhat complicate the comparison of our results with those from Fischer et al. (2012), who estimate the contemporaneous reaction with annual data. However, similar to Fischer et al. (2012), our CGER-inspired estimation does not distinguish between different types of exchange rate drivers.

Appendix Table 5 shows the long-run elasticity of the current account and its components when calculated by the CGER-inspired approach previously explained. In line with the results from the VAR analysis, the reaction of the CA (Column 1) is positive but close to zero and completely insignificant from a statistical point of view. The same is true for the nominal trade and income balances (Columns 2 and 3). Columns 4 and 5 confirm that accounting for NMG strengthens the negative reaction of the TB but does not significantly alter the reaction of the CA balance.

Estimates from the CGER-inspired approach also confirm that part of the offsetting effects between prices and quantities is persistent. Columns (1) and (2) of **Appendix Table 6** report the long-run elasticities of the nominal and real business cycle goods balance, respectively. Again, the negative effect on the real trade balance is offset by a positive effect on the terms of trade, leaving the effect on the nominal trade balance very close to zero.[37]

[36] Between 1983Q1 and 1996Q1 the 13 main trading partners are used to proxy for foreign demand, accounting for 74% of total exports: Australia, Austria Belgium, Canada, Germany, Spain, France, UK, Italy, Japan, Korea, the Netherlands and the USA. From 1996 onward Brazil, China and Poland are also included, bringing the combined share to 77% of total exports.

[37] The reaction of the terms-of-trade is consistent with a world where trade is generally invoiced in the producer's currency, which is the traditional assumption behind the expenditure-switching hypothesis. In such a setup, Swiss exports are invoiced in CHF and would not decline mechanically, while imports, invoiced in foreign currencies, would become cheaper. This mechanical effect on the terms-of-trade

Appendix Table 4: Elasticity of the main components of the Income Balance

	(1)	(2)	(3)	(4)	(5)	(6)
	Primary Income	Investment Income	Direct Investment	Portfolio Investment	Other Investment	Labor Income
Balance	0.261	1.618**	9.438***	-0.0658	0.432	-3.280
	(0.719)	(0.018)	(0.000)	(0.934)	(0.567)	(0.778)
Receipts	-1.871**	-1.909***	0.715	-1.192**	-4.026***	1.029
	(0.013)	(0.007)	(0.790)	(0.027)	(0.000)	(0.937)
Expenses	-2.771***	-3.921***	-10.94***	-1.589	-3.152	0.865*
	(0.000)	(0.000)	(0.000)	(0.241)	(0.306)	(0.067)

Note: The table shows the estimated long-run elasticities of different proxies for the external balance with respect to a 1% appreciation, as illustrated in equation (1). Standard errors are calculated with the Delta method. p values are in parentheses; * p<0.10, ** p<0.05, *** p<0.01

Appendix Table 4 shows that the short-term effects on the income balance are largely supported by our static estimate. Consistent with **Figure 8**, the reaction of the overall income balance (Column 1) is positive but not statistically significant at standard levels. Consistent with **Figure 14**, the long-run effects on net investment income (Column 2), particularly on net income from direct investment (Column 3), are positive and significant. The reactions of the other components of the primary income balance are either inelastic or too imprecisely estimated to be significantly different from zero.

Appendix Table 5: Elasticity of the Current Account and its components

	(1)	(2)	(3)	(4)	(5)
	CA	**TB**	**IB**	**CA w/out NMG**	**TB w/out NMG**
Balance	0.0404	-0.0740	0.0357	0.0240	-0.461
	(0.797)	(0.551)	(0.952)	(0.918)	(0.275)
Receipts	-1.256**	-1.493*	-1.873**	-1.378***	-1.692***
	(0.017)	(0.061)	(0.048)	(0.000)	(0.001)
Expenses	-1.163***	-1.012	-2.846***	-1.168*	-0.735
	(0.010)	(0.185)	(0.000)	(0.088)	(0.428)

Note: The table shows the estimated static elasticities of different proxies for the external balance with respect to a 1% appreciation, as illustrated in equation (1). Standard errors calculated with Delta method. p values are in parentheses; * p<0.10, ** p<0.05, *** p<0.01

would go into the opposite direction under the local currency paradigm (e.g., imports invoiced in CHF and exports invoiced in the foreign currency) and would disappear if imports and exports are invoiced in same currency, such as under the dominant currency paradigm.

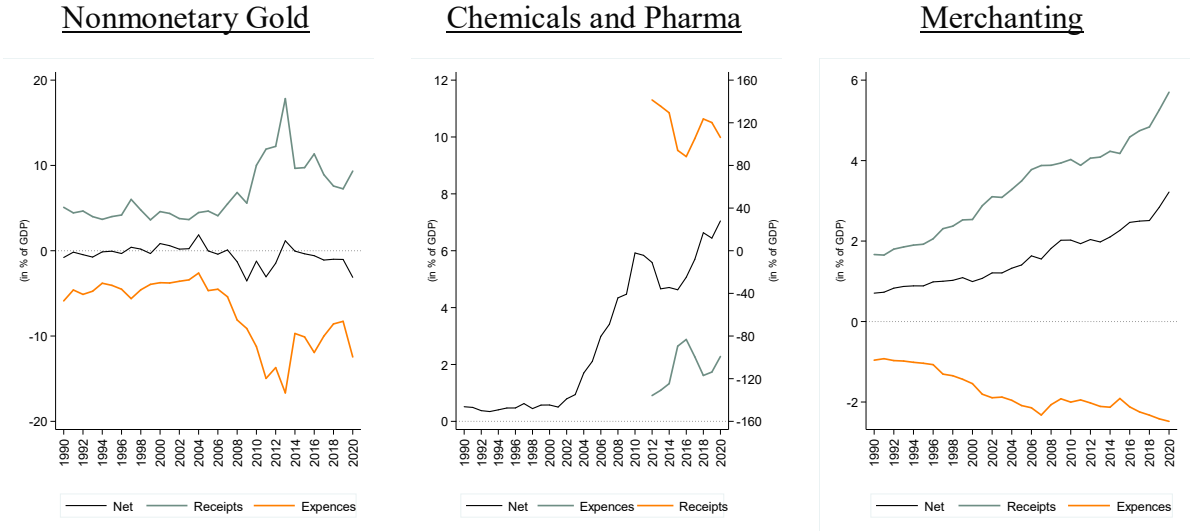
Appendix Table 6: Long-Run Elasticity of the Nominal and Real Goods Trade Balance

	(1) **Nom. BC Goods**	(2) **Real BC Goods**	(3) **TOT**
Balance	-0.0212 (0.896)	-0.392** (0.027)	0.419** (0.017)
Receipts	-1.497* (0.074)	-1.101*** (0.000)	-0.905 (0.297)
Expenses	-0.853 (0.310)	-0.467 (0.307)	-0.500* (0.099)

Note: The table shows the estimated long-run elasticities of the nominal and real trade balance as well as terms-of-trade (TOT) with respect to a 1% appreciation, as illustrated in equation (1). Standard errors calculated with the Delta method. p values are in parentheses; * p<0.10, ** p<0.05, *** p<0.01

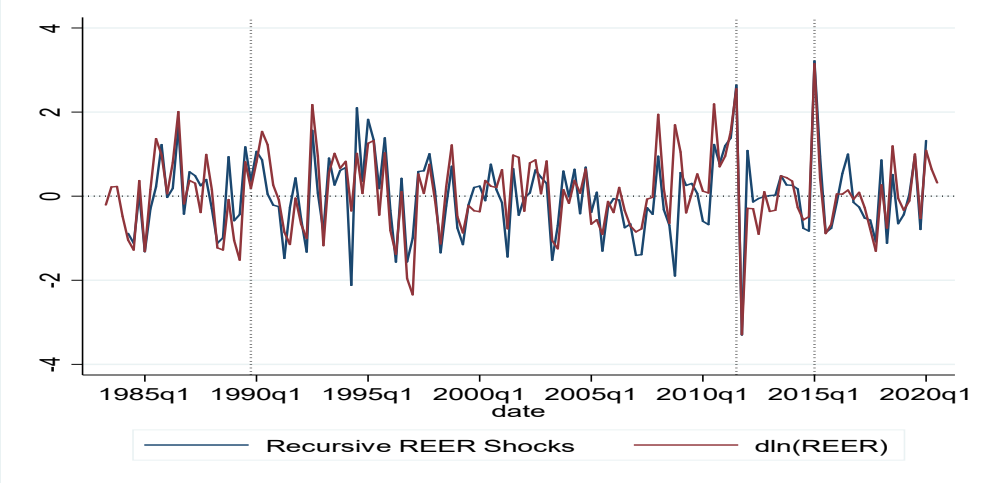
6.5. Additional Tables and Figures

Appendix Figure 1: Gold, Merchanting and Chemicals



Note: The figure shows gross and net trade flows of i) nonmonetary gold, ii) merchanting (with gross flows on the rhs), and iii) chemicals and pharmaceuticals, all in % of GDP.

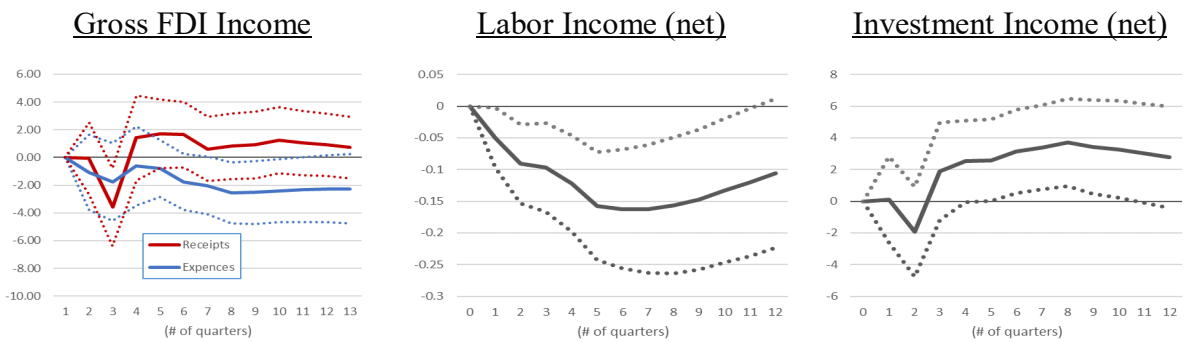
Appendix Figure 2: Recursive REER Shocks vs. Simple REER Differences



Note: The figure compares the recursively identified REER shocks using CA/gdp as proxy for the external balance with the log-differences of REER. It shows that while the two lines almost perfectly overlap for the biggest REER-movements (e.g., installation and withdrawal of the exchange rate floor), they differ more substantially during "normal" times.

Appendix Figure 3: Sensitivity of Different Consumer Prices

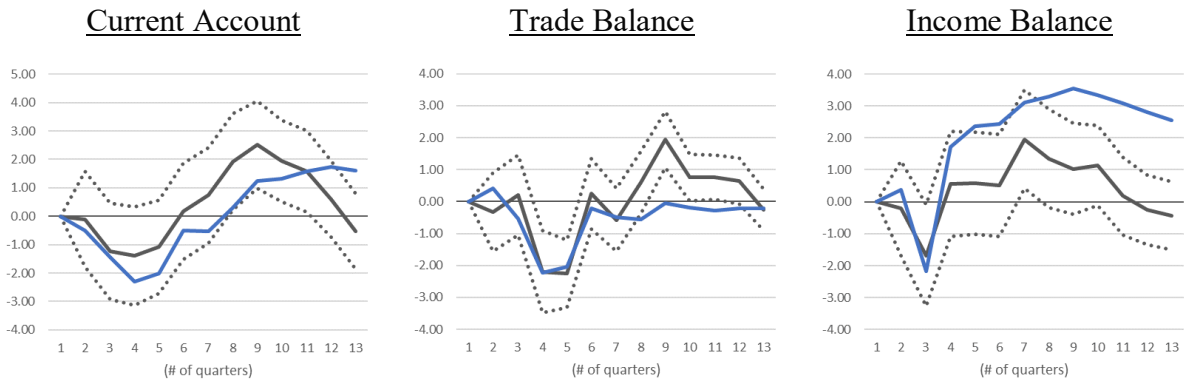
Appendix Figure 4: The Reaction of the Income Balance



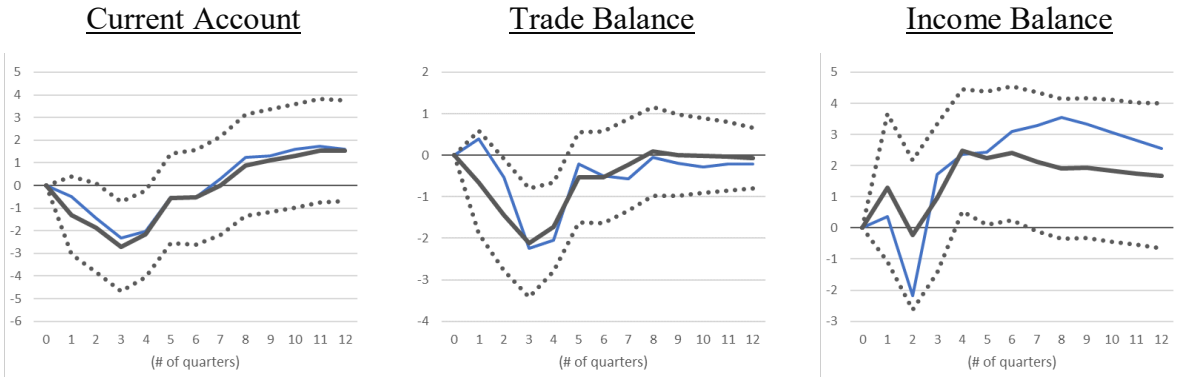
Note: The figures shows the impulse response functions of different types of consumer price indices (all in logs) and the income balance to a 10% NEER appreciation. Dotted lines show the 90% confidence intervals.

6.6. Sensitivity analysis tables

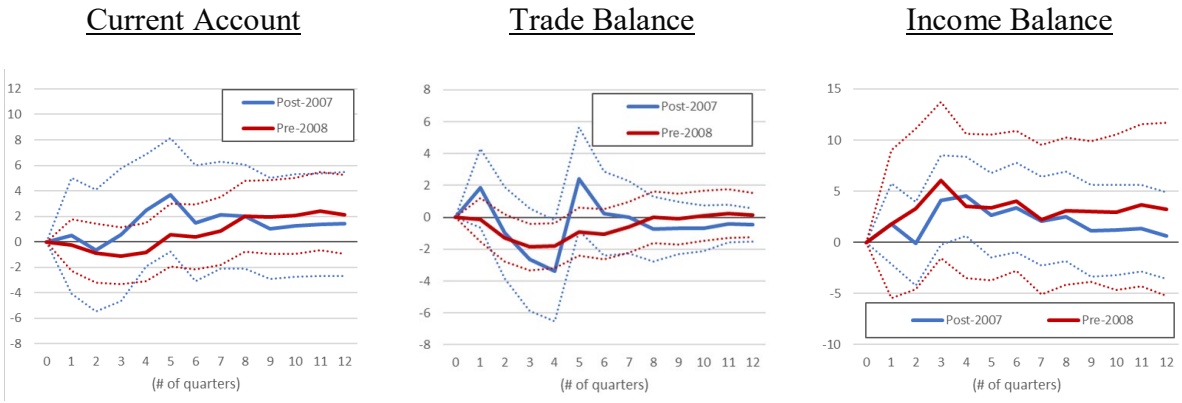
Appendix Figure 5: Estimating VAR in First Difference



Appendix Figure 6: Omitting the Great Financial Crisis



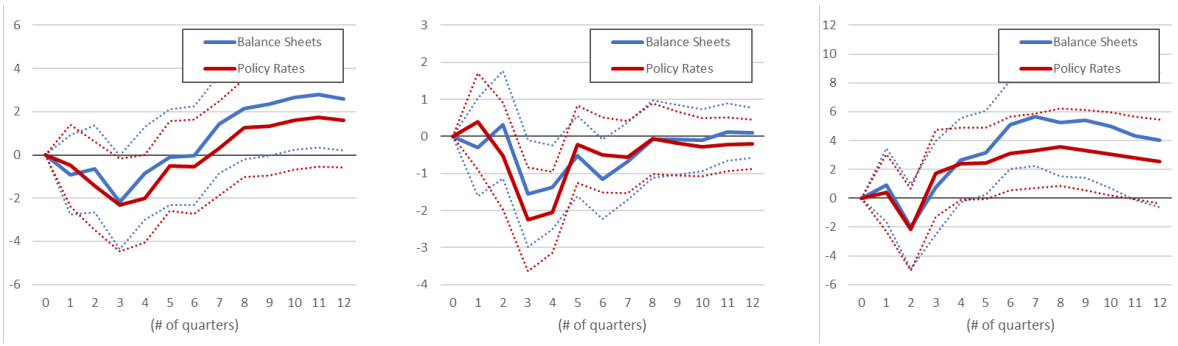
Appendix Figure 7: Sensitivity to Time Sample



Note: The figures shows the IRF of the CA and its main components (in % of GDP) to a 10% REER appreciation, respectively using the pre- and post-GFC samples. Confidence intervals: 90%.

Appendix Figure 8: Central Bank Balance Sheet as Monetary Policy Proxy

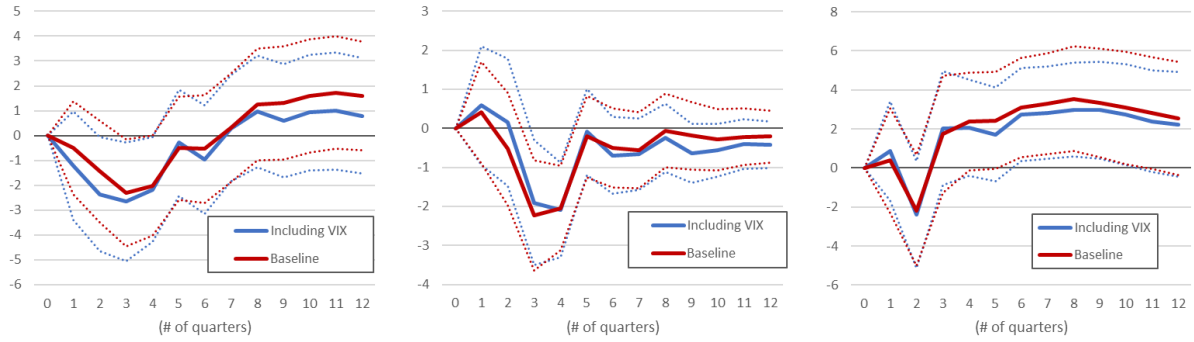
Current Account | Trade Balance | Income Balance



Note: The figure shows the IRF of the CA and its main components (in % of GDP) to a 10% REER appreciation, respectively using policy interest rates and central bank balance sheets to proxy for domestic and global monetary policy conditions. Confidence intervals: 90%.

Appendix Figure 9: The Effect of the REER Controlling for Risk Aversion

Current Account | Trade Balance | Income Balance



Note: The figure compares the baseline IRF (red) of the CA and its main components (in % of GDP, to a 10% REER appreciation) to the equivalent ones when including the VIX (blue, quarterly average) as additional endogenous variable. Confidence intervals: 90%.

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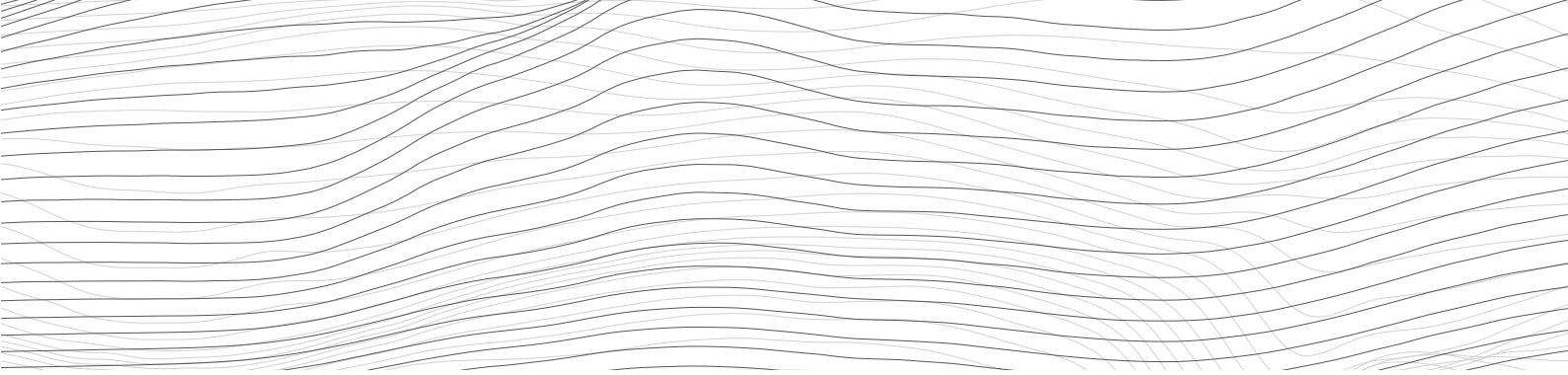

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