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Industry Composition and the Effects of Exchange Rates on Exports – Why Switzerland is Special

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We identify the role of industrial composition on the elasticity of aggregate export volume with respect to the exchange rate. In an annual panel covering the time from 1972 to 2000, 865 sectors, and bilateral trade flows between 24 OECD economies, we estimate sectoral elasticities of export volume with respect to the exchange rate. We then combine the resulting 865 elasticity estimates with the weight of each sector in each of the countries' export basket. The resulting country-specific average exchange rate elasticity varies substantially as countries specialize in very different sectors. It ranges from 0.83 for Switzerland to 1.06 in Turkey, with the average being 0.94. Consequently, our results demonstrate that the low response of Swiss export performance to the strong real appreciation of the Swiss Franc observed during 2008 to 2011 can partly be explained by the unique industrial composition of the Swiss economy.

JEL Codes: F12, F14, F17
Keywords: Exchange rates, External adjustment, Trade elasticity, Export basket, Industry structure, Switzerland

1 Introduction

Against all economic intuition and theory, the volume of Swiss exports has been steadily rising over the past year, despite the substantial appreciation of the Swiss Franc (CHF). This increase is documented in Figure 1, which displays the trends of Swiss imports and exports during the past five years on the left axis and the trends of the CHF/euro exchange rate on the right axis. Exports in Figure 1 are denoted in CHF; the rise in exports is even more pronounced when denoted in euros.

Why has Swiss export performance been so strong during the past few quarters despite the strong appreciation of the CHF? The first reason is that following the great trade collapse during 2009 (see Baldwin 2009 and for Switzerland see again Figure 1), there has been a remarkable rebound of global trade that has affected Switzerland. Still, the Swiss case seems extraordinary in that the recovery from the great trade collapse has been about

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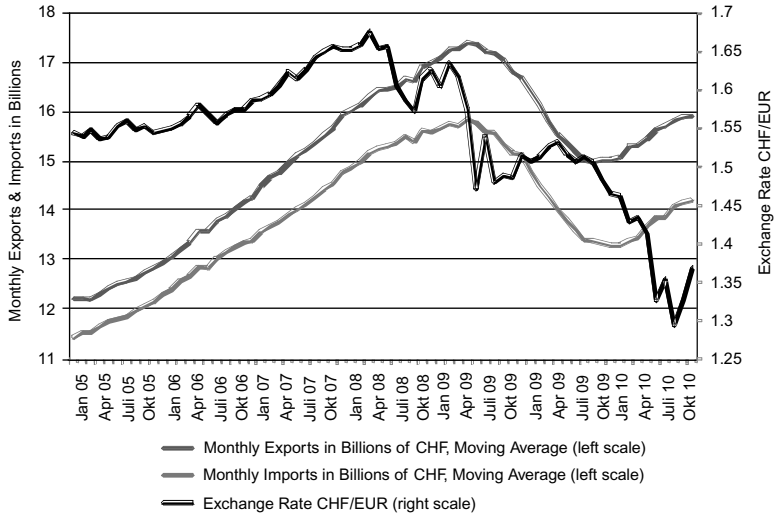
in line with the rest of the world, despite a very significant strengthening of the CHF against all its major trade partner currencies.

Figure 1: Trade and the Exchange Rate



In this paper, we use historical data on exchange rates and trade at the sectoral level to document that a key factor behind this limited role of the exchange rate is the unique industry composition of Switzerland. In particular, we document that the Swiss export basket is heavily concentrated in price-insensitive goods like machinery or pharmaceuticals, where prices and, thus, the exchange rate are comparatively unimportant determinants of demand. This special export basket makes aggregate Swiss exports less responsive to exchange rate changes than exports of other OECD nations.

Our approach is the following. We use a large panel dataset of sectoral bilateral trade data between OECD nations to estimate separate gravity equations at the sector level. These gravity equations are estimated in terms of changes and include the exchange rate as dependent variable, meaning they relate the growth of bilateral trade volume to the bilateral exchange rates change. Because we estimate such a gravity model for each sector separately, we obtain a sector-specific elasticity of trade volume with respect to the exchange rate. Thereafter, we calculate the nation's aggregate elasticity of trade with respect to the exchange rate by building an index that takes into account the elasticity of demand with respect to the exchange rate in

each sector multiplied by the importance of this sector in the respective nation. Following this approach, Switzerland's globally unique industrial composition is found to be a major reason for the rather limited effect of the CHF appreciation on Swiss exports.

2 Literature review

For any type of good, demand is likely to grow whenever expenditure in its export destinations rises. Conversely, demand falls when the currency appreciates against the trade partner currency, making exports expensive. These two forces have been implemented in the "classic" workhorse model for estimating trade elasticities relating the volume of exports or imports to real foreign and domestic income and relative prices (in log form):

$$\ln(Exports)_{Exp,imp} = a + b * ln(GDP_{Imp,t}) + c * \ln(Exrate_{Exp.Imp}) + \varepsilon_{Exp,Imp} \quad (1)$$

Such a model derives directly from a gravity equation in the spirit of Anderson and van Wincoop (2003) and assumes that domestic and foreign tradable goods are imperfect substitutes and that the elasticities with respect to economic activity and relative prices are constant over time and across sectors (see Hooper, Johnson and Marquez 2000) for a summary of the assumptions underlying this model).

One key paradox, however, has been that when estimating equation (1), one finds very different coefficients when evaluating the trends of exports from various countries. For example, in Hooper, Johnson and Marquez's (2000) analysis of trade elasticities in the G-7 economies, the elasticity of export volume with respect to relative prices ranges from –0.2 for France to –1.6 for the United Kingdom (also see the conflicting point estimates of Stern, Baum and Greene 1979 and Wilson and Takacs 1979).

A key source for the heterogeneity in how income growth and the exchange rate affect aggregate export volume may be an underlying heterogeneity in the sectoral composition of the exports of various nations.[1] A large literature has used structural approaches to understand the sectoral determinants of demand patterns at the sectoral level (see Feenstra 1994 and more re-

1 Krugman (1989) argues that differences across countries in estimated income elasticities of import demand are due to the omission of an exporter supply effect. Gangon (2003) finds strong evidence of such a supply effect equivalent to roughly half the magnitude of the income elasticity, which equals 1.5.

cently Broda and Weinstein 2006), typically uncovering a very high degree of heterogeneity of demand elasticities across various sectors. If certain countries specialize in sectors with elastic demand, whereas others specialize in sectors with inelastic demand, the elasticity of their aggregate exports will vary.

Given that Switzerland is strongly specialized in only a few industries, it is likely that considerations concerning its export composition are very important when understanding Swiss export performance. For example, Switzerland's recent export performance could be exceptional because of a concentration in sectors characterized by resilient demand during the 2007–2009 financial crisis. In fact, formal evidence exists for this channel (see Schmidt 2009 and 2010), as does much anecdotal evidence (see for example Lanz 2011).

Second, Switzerland's exports could also be exceptional because of a concentration in sectors with low exchange rate sensitivity. For example, it is more than likely that for industries such as precision instruments, in which only few nations compete, export demand does not change much with the exchange rate. On the other hand, demand in industries such as apparel is likely to be sensitive to the exchange rate. Obviously, precision instruments are more important for Switzerland than for other economies, and consequently, the overall low importance of the exchange rate for Swiss exports could result from the sectoral composition of exports.

With the two drivers of export performance – exchange rates and foreign GDP – in mind, we aim to understand whether Switzerland's export composition is exceptional in terms of average elasticity. We then formally investigate both of these factors in a unified statistical framework. Our analysis is related to Mann and Plück (2005), who assess the importance of disaggregating trade flows, focusing on the US trade imbalance vis-à-vis the rest of the world and the necessary exchange rate adjustments to achieve balanced trade. Finally, our approach is also related to Goldberg and Campa (2010), who analyze the importance of industry composition for the average pass through rate of exchange rate fluctuations into domestic consumer prices.

3 Exchange rates and demand growth as drivers of exports

We use a panel dataset that enables us to estimate sector-specific elasticities of export demand with respect to foreign GDP and bilateral exchange rates. To estimate these gravity specifications at the sector level, we collect bilateral trade data from the National Bureau of Economic Research – United Nations (NBER-UN) Trade Data, which covers 865 sectors (at the 4-digit level of the Standard International Trade Classification, revision 2) with a large enough number of observations necessary for the estimation. We obtain data on bilateral exchange rates and information on GDP from Datastream.

The NBER-UN trade data covers nearly all countries of the world, but we include only OECD countries in our analysis because this is the group that most researchers would argue to be the benchmark for the Swiss economy. Because the overlap of the NBER-UN trade data and the other variables in the study yield an annual panel that includes the years from 1972 to 2000, we exclude the former members of the Warsaw Pact who are now OECD members.

Our sample, thus, includes 24 countries (Austria, Australia, Belgium, Canada, Switzerland, Denmark, Germany, Mexico, Spain, Finland, France, Great Britain, Greece, Israel, Italy, Japan, South Korea, Netherlands, Norway, New Zealand, Portugal, Sweden, Turkey, and the United States) and $24*(24-1) = 552$ country pairs.

For each sector, we estimate the elasticity of bilateral trade with respect to the bilateral exchange rate and with respect to foreign GDP. Subsequently, we compute averages weighted by the country-specific importance of each sector.

We start our approach from a standard gravity equation in the spirit of ANDERSON and VAN WINCOOP (2003), augmented by the time dimension: it relates bilateral trade flows at the sectoral level to both time-constant country characteristics and to other measures that vary over time. A baseline estimation conditions on bilateral geographic distance, a common border or language, and other measures constant throughout time. Second, it includes time-varying measures such as importer GDP, exporter GDP, and the bilateral exchange rate. We capture all time-constant factors by exporter-importer fixed effects:

$$\ln(\text{Exports}_{s,\text{Exporter, Importer},t}) = \alpha_c + \alpha_{e,s}\ln(\text{GDP}_{\text{Exporter},t}) + \alpha_{i,s}\ln(\text{GDP}_{\text{Importer},t}) + \beta_s \ln(\text{EXR}_{\text{Exporter, Importer}})\ \text{Dummy}_{\text{Exporter, Importer,}} + \tilde{\varepsilon}_{s,\text{Exporter, Importer},t} \quad (2)$$

We are not interested in levels of exports, but rather in how export levels comove with the exchange rate, i.e. in changes. Denoting the percentage change in a variable by a "Δ", subtracting the lagged value of exports on both sides of the above equation yields a panel estimation that relates the sensitivity of exports to both foreign GDP growth and to the bilateral exchange rate for each sector s separately[2]:

$$\Delta Exports_{s,\ Exporter,\ Importer} = \alpha_{e,\ s}\,\Delta GDP_{Exporter,\ t} + \alpha_{i,\ s}\,\Delta GDP_{Importer,\ t} + \beta_s \Delta EXR_{Exporter,\ Importer} + \varepsilon_{s,\ Exporter,\ Importer} \quad (3)$$

The annual percentage change of bilateral export volume (in exporter currency) from one country (exporter) to another country (importer) is denoted by $\Delta Exports_{s,\ Exporter,\ Importer}$, the percentage change in the foreign market GDP (in local currency units) is denoted by $\Delta GDP_{Importer}$, and the nominal percentage change in the bilateral exchange rate by $\Delta EXR_{Exporter,\ Importer}$.

The above equation constitutes our main equation of interest. In each of the 865 SITC sectors, we next estimate this gravity-style estimation relating the change in the exchange rate and the change in importer GDP to the change in the import volume. This estimation yields 865 coefficients for the elasticity of the export volume with respect to the exchange rate and also 865 coefficients for the elasticity of the export volume with respect to import GDP.

Do elasticity estimates obtained in this way make sense? Table 1 presents some examples for selected sectors. We first pick the two sectors close to the 10th decile in the distribution of estimated exchange rate elasticities. Indeed, the two sectors are "Centrifuges" and "Milling Machinery", both sectors for which anecdotal evidence suggests that product characteristics such as good quality are relatively more important than in other sectors, whereas the good's price plays a relatively minor role.

2 Given that exports are a part of exporter GDP, regressing changes in exports on changes of exporter GDP amounts to some extent to a spurious regression. We, thus, drop exporter GDP from all specifications.

Table 1: GDP Elasticity and Exchange Rate Sensitivity for Selected Sectors

Low Response to Exchange Rate Changes (Sectors Close to the 10th decile)		
Sector Description	***GDP Elasticity***	***Exchange Rate Sensitivity***
Centrifuges	0.3079868	0.549822
Milling Machinery	0.1520641	0.5651883
High Response to Exchange Rate Changes (Sectors Close to the 90th decile)		
Sector Description	***GDP Elasticity***	***Exchange Rate Sensitivity***
Apparel and Clothing	0.3176782	1.255084
Frozen Fish Filets	0.0510448	1.245665
Low Response to GDP Growth (Sectors Close to the 10th decile)		
Sector Description	***GDP Elasticity***	***Exchange Rate Sensitivity***
Bird Eggs Not in Shell	0.127234	1.42264
Wheat	0.1240657	0.4068199
High Response to GDP Growth (Sectors Close to the 90th decile)		
Sector Description	***GDP Elasticity***	***Exchange Rate Sensitivity***
Poultry, Whole	0.850571	1.12123
Refractory Ceramic Goods	0.8491695	1.091864

In contrast, two sectors close to the 90th decile in the distribution of estimated exchange rate elasticities are "Apparel and Clothing" and "Frozen Fish Filets", two sectors one would indeed expect to be competitive so that the exchange rate might matter substantially with regard to demand. Also, our estimated elasticities of demand with respect to importer GDP make sense intuitively: for example, the demand for wheat and eggs seems satiated in the OECD economies included in our sample, and it should co-move little with importer GDP demand. Demand for poultry might not be as saturated, especially in the poorer countries of the OECD. Indeed, we find that the elasticity is much higher for poultry than for wheat or eggs. Also, demand for technical goods, here exemplified by "Refractory Ceramic Goods" co-moves more than one-to-one with the importer GDP, i.e., they are superior goods.

What is the range of the estimated elasticities, and is there substantial variation across the sectors? In Figures 2 and 3, we examine the distribution of estimated elasticities. Figure 2 presents a histogram of the estimated elasticities with respect to the exchange rate. There are no fat tales and the elasticity is estimated positive in almost all sectors. Most importantly, the estima-

tion reveals that there is a substantial variation in the elasticity, with a large mass of observations lying in the interval 0 to 2. Also the distribution of elasticities with respect to the importer GDP growth is well behaved and lies within a reasonable range (see Figure 3).

Figure 2: Histogramm: Estimated Exchange-Rate-Elasticities (865 good categories)

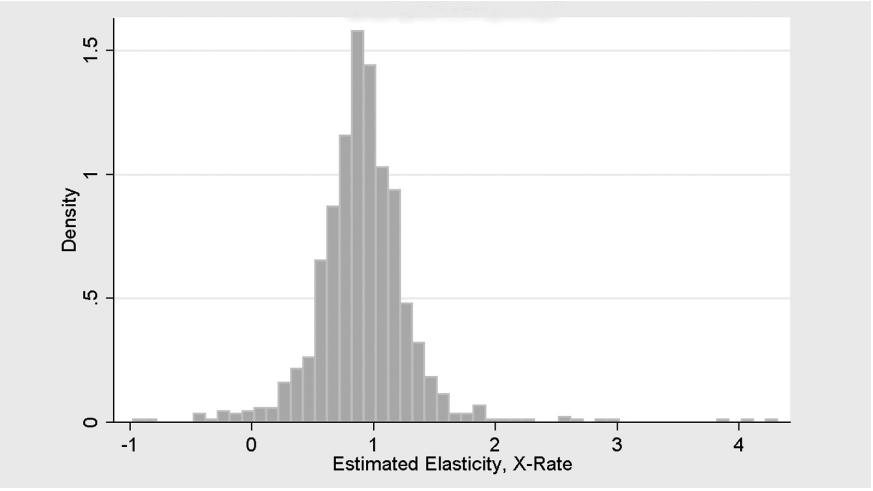
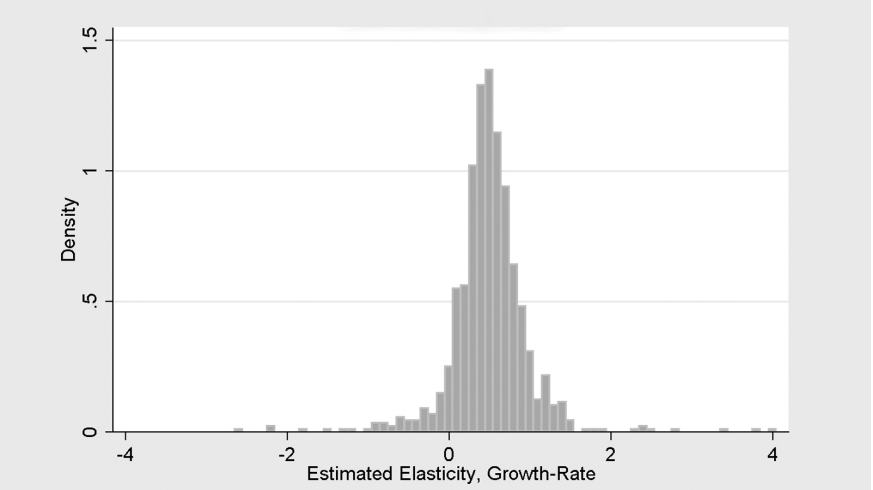


Figure 3: Histogramm: Estimated Growth-Rate-Elasticities (865 good categories)



4 Industrial composition and aggregate exchange rate elasticity

We next conduct an international comparison to document that the unique structure of the Swiss industry can explain part of the limited importance of the exchange rate for Swiss exports. More precisely, we show that Swiss exports exhibit a high share of industries with low exchange rate elasticity. The corresponding aggregate Swiss elasticity to foreign GDP, in contrast, is not exceptional by international comparison. The analysis in the previous section unveils that elasticities of import volume with respect to the exchange rate and importer GDP vary widely across sectors. This observation constitutes strong reasons to believe that a nation's industrial composition has a first order impact on how important the exchange rate is for aggregate export performance.

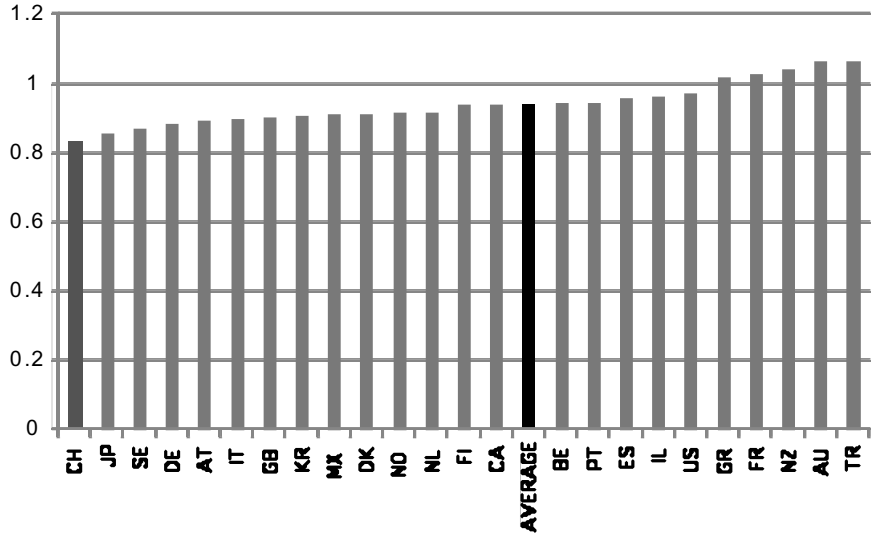
In the second step of the analysis, we construct a measure of a country's average exchange rate sensitivity that is based on the exchange rate sensitivity at the sectoral level and the importance of the respective sector for the country. For example, for Switzerland, the average weighted coefficient is equal to

$$\alpha_{CH} = \sum_{\text{all Sectors}} w_{sector,CH}\alpha_{sector} \qquad (4)$$

where $w_{Sector,CH}$ is the export weight of sector s in Switzerland, i.e., the share of Swiss exports that is in sector s ($\sum_{all\ Sectors} W_{sector,CH} = 1$). The measure thus constructed has the following economic interpretation. If the CHF appreciates by 1% against all other currencies, Swiss export volume in CHF decreases by α_{CH}%.

Figure 4 shows that the Swiss export industry is exceptional: in our sample of 24 OECD economies, Switzerland is the country most concentrated in sectors featuring low sensitivity of demand with respect to exchange rate changes. Overall, the Swiss export performance is thus much less affected by the strength of its currency than any other nation would be.

Figure 4: Elasticity of Export Volume to Exchange Rate

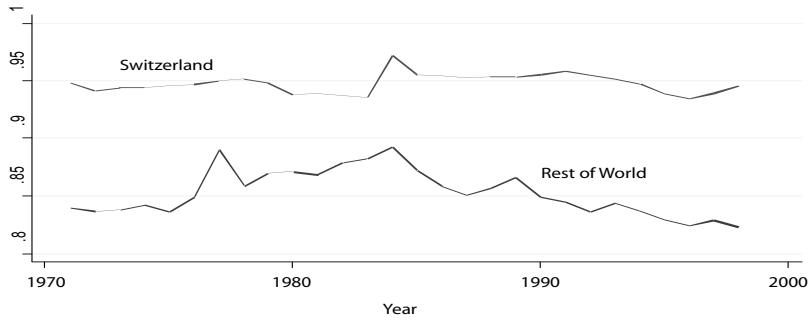


To determine whether this extraordinary composition of Swiss exports is a new phenomenon or whether it has always existed, we decompose the estimates by year. Figure 5 displays the yearly average elasticity[3] of Swiss exports and compares its evolution with the corresponding numbers for rest of the countries (un-weighted averages over the countries). A quick inspection shows that the exceptional Swiss industry composition has already existed for the last two decades. However, the difference with the rest of the world has become even more pronounced.[4]

3 It is important to note that our empirical estimation technique restricts the sector-specific elasticities to be constant over time. The time-changing average elasticity thus can only result from a shifting sectoral composition of the world's (or Switzerland's) industry composition.

4 Our dataset only spans the years leading up to 2000; it would be worthwhile to reproduce this finding for more recent data. However, this is not possible because datasets that do include recent years do not reach back far enough in time that we have sufficient information to conduct the analysis undertaken here.

Figure 5: Elasticity of Exports to Exchange Rates (Yearly Averages)

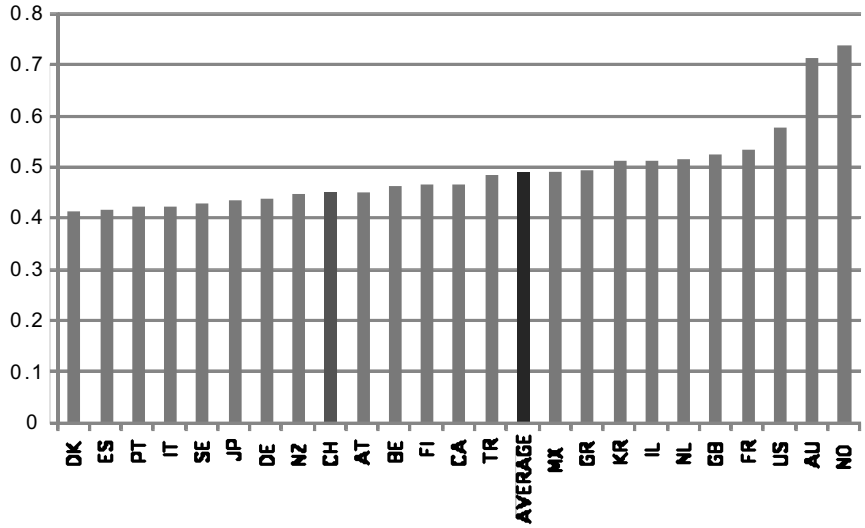


Next, we turn to the parallel cross-country comparison of the export sensitivity to demand growth in export markets. The weighted averages of elasticities are computed parallel to those regarding exchange rates. For example, this variable for Switzerland is equal to

$$\beta_{CH} = \sum_{\text{all Sectors}} w_{sector,CH}\beta_{sector} \tag{5}$$

This measure has the following economic interpretation. If GDP growth in all trade partners of Switzerland is equal to 1%, Swiss export volume in CHF increases by β_{CH}%. Figure 6 shows that in terms of GDP sensitivity the Swiss export composition is not special compared to other OECD nations and that the average elasticity of Swiss exports with respect to GDP is not too far off from the average. The collection of observation gathered in this section leads us to conclude that a truly remarkable feature of Swiss exports is its relative high insensitivity to exchange rate fluctuations.

Figure 6: Elasticity of Export Volume to Importer GDP



5 The sensitivity of imports to exchange rate movements

A second question of interest concerns how the trade balance reacts to exchange rate changes. To answer this question, we also need to know how Swiss imports react to the exchange rate. We, thus, define the weighted elasticity of Swiss imports with respect to the exchange rate and foreign GDP to equal

$$\tilde{\alpha}_{CH} = \sum_{\text{all Sectors}} \hat{w}_{sector,CH} \alpha_{sector} \tag{6}$$

and

$$\tilde{\beta}_{CH} = \sum_{\text{all Sectors}} \hat{w}_{sector,CH} \beta_{sector} \tag{7},$$

respectively. Here, $\tilde{W}_{sector,CH}$ is the import weight of sector *s* in Switzerland, i.e., the share of Swiss imports in sector *s*.

Figures 7 and 8 document that the Swiss import composition is in no way special when it comes to how imports react to changes of the exchange rate or the GDP of trade nations. Both the average response of imports to the exchange rate as well as the average response of imports to importer GDP is close to the sample average.

Figure 7: Elasticity Import Volume to Exchange Rate

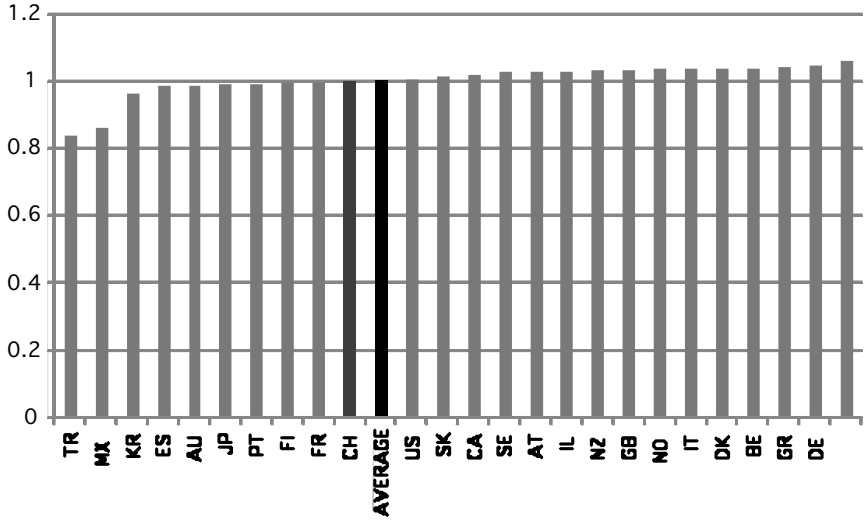
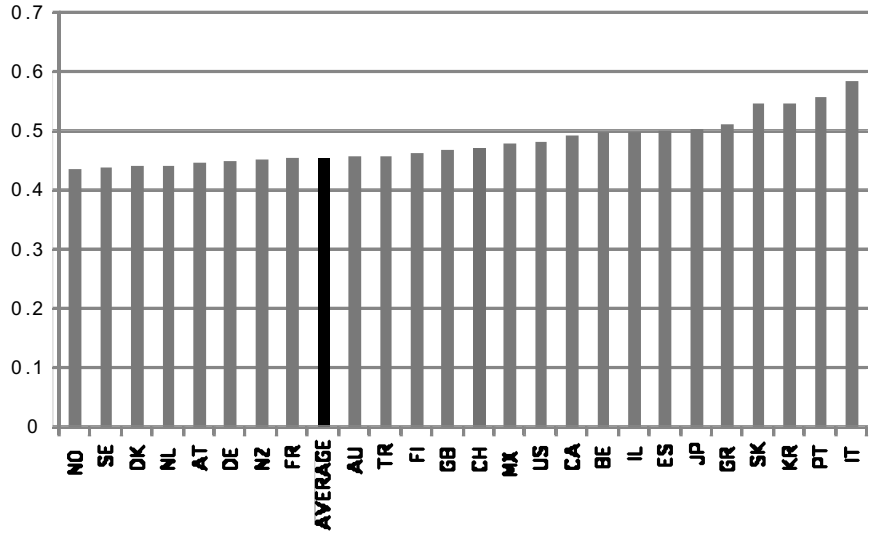


Figure 8: Elasticity Import Volume to Importer Value



Conclusion

In times of a strong CHF appreciation, the Swiss export performance has proven to be exceptionally robust. This observation may be explained by the fact that global demand has recovered and that, during the recent crisis, pressures for protectionist measures have been rather contained (see, for example EVENETT 2010). Still, what is puzzling is that Swiss exports have risen as fast as those of other rich nations, despite the strong appreciation of the CHF. We have documented that this puzzling observation can partly be attributed to the unique composition of the Swiss export basket. What does this result imply for the outlook of Swiss exports in the near future? For example, what would happen if the CHF strength intensified? Our results suggest that if this were the case, there would be a substantial but not dramatic decrease of Swiss exports. Our results also indicate that although Swiss exports are atypical, the behavior of imports is very comparable to that of other OECD economies.

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