RIETI Discussion Paper Series 14-E-031

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THORBECKE, Willem
RIETI

KATO Atsuyuki
RIETI

Research Institute of Economy, Trade & Industry, IAA

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http://www.rieti.go.jp/en/

RIETI Discussion Paper Series 14-E-031
June 2014

Export Sophistication and Exchange Rate Elasticities: The Case of Switzerland[1]

Willem THORBECKE*
Research Institute of Economy, Trade and Industry

KATO Atsuyuki **
Waseda University

Abstract

In 2011, Switzerland announced a floor for the Swiss franc, and it immediately depreciated by 10 percent. Many argue that depreciations should not matter for Switzerland's export basket because luxury brands and high value added products predominate, and these should compete on quality rather than price. We measure the sophistication of Swiss exports using Hausmann et al.'s (2007) and Kwan's (2002) measures and find them to be the most sophisticated in the world. We also estimate export equations and find price elasticities exceeding unity. These findings run counter to the claim that countries exporting high end goods should have low exchange rate elasticities.

Keywords: Export sophistication, Exchange rate elasticities, Switzerland
JEL classification: F10, F40

[1]This study is conducted as a part of the Project "East Asian Production Networks, Trade, Exchange Rates, and Global Imbalances" undertaken at Research Institute of Economy, Trade and Industry(RIETI).

*Address: Research Institute of Economy, Trade and Industry, 1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo, 100-8901 Japan; Tel.: +81-3-3501-8248; Fax: +81-3-3501-8414; E-mail: willem-thorbecke@rieti.go.jp

**Address: Graduate School of Asia-Pacific Studies, Waseda University, 1-21-1 Nishiwaseda, Shinjuku-ku, Tokyo, 169-0051 Japan; Tel.: +81-3-5286-1766; Fax: +81-3-5272-4533; E-mail: akato@aoni.waseda.jp

1 Introduction

The Swiss franc began appreciating in the spring of 2011 as the Eurozone Crisis intensified and Switzerland experienced safe haven capital inflows. In September 2011 the Swiss National Bank announced that the strong franc was multiplying deflationary risks and that it would set a floor of 1.2 francs to the euro. The franc immediately depreciated by 10 percent. How do changes in the franc affect exports?

Many have observed that Swiss exports are technologically advanced, and that because of this exchange rate changes may not affect them. For instance, the International Monetary Fund (2013, 18) stated that Swiss "exporting industries may be built around production of very specific items, which are particularly valued for their brands or special characteristics and hence face limited price competition." In this paper we investigate these issues quantitatively.

To measure the sophistication of Swiss exports, we use the methods of Hausmann, Hwang, and Rodrik (2007) and Kwan (2002). They pioneered the construction of product sophistication indices and country sophistication indices for a country's exports. They posited that products exported by richer countries tend to be more technologically advanced. As Lall, Weiss, and Zhang (2006) noted, one reason for this is that goods exported by wealthy countries have higher labor costs. To be competitive in world markets, they thus need to be produced using more sophisticated production processes.

We find that Switzerland has the most sophisticated export structure according to Hausmann et al's (2007) measure for every year after 1996 and according to Kwan's (2002) measure for every year after 1980. We also investigate Switzerland's export structure using OECD classifications. They categorize technology levels based on the ratio of R&D spending to value-added (see, e.g., Hatzichronoglou, 1997). According to this measure, 47 percent of Swiss manufacturing exports in 2011 were classified as high-tech. This was the third highest in the world. Given its advanced export structure, one might assume that Swiss goods do not compete primarily based on price and hence that exchange rate changes would have only a limited impact on exports.

There are several excellent papers that estimate Swiss export elasticities using disaggregated data. For instance, Auer and Saure (2012) analyzed a panel of Swiss exports disaggregated along both regional and industry lines (see also Auer and Saure, 2011). They employed data on the 25 largest categories of Swiss exports to the 27 most important export markets over the 2005Q1-2010Q3 period. Using a gravity model, they reported that a 10% appreciation of the Swiss franc against a trading partner's currency would decrease Swiss exports to that partner by 4.2% and a 10% increase in the trading partner's GDP would increase Swiss exports to that partner by 9.2%.

Our goal is to investigate the macroeconomic effects of changes in the franc using aggregate Swiss exports and a long time series. We find that there is a long run (cointegrating) relationship between Swiss exports of goods or of goods and services, the Swiss real effective exchange rate, and GDP in importing countries. We also find that exchange rate elasticities are greater than or equal to unity. The fact that exchange rates matter for a country with such an advanced export structure runs counter to the claim that high end exports should have low exchange rate elasticities (see Bénassy-Quéré, Gourinchas, Martin, and Plantin, 2014, for a discussion of this issue for French exports).

The next section investigates Switzerland's export structure using the methods of Hausmann et al. (2007) and Kwan (2002). Section 3 estimates export elasticities for Switzerland using Johansen maximum likelihood and dynamic ordinary least squares (DOLS) estimation. Section 4 concludes.

2 Measuring the sophistication of Swiss exports

2.1 Data and methodology

Kwan (2002) assumed that countries with higher incomes will export higher value added products. He constructed a product sophistication index (PSI) by calculating a weighted average of the per capita GDPs of the product's exporters, using the countries' shares of global exports as weights. For example, if machine tools are only exported by country A, country B, country C, and country D and if their respective shares of the global export market are 60%, 20%, 10%, and 10% and their respective per capita GDP values are $30,000, $20,000, $10,000, and $5,000 then the PSI for machine tools would be $30,000*60% + $20,000*20% + $10,000*10% + $5,000*10% = $23,500.

Formally, the product sophistication index for a product k can be written as:

$$PSI_k \quad = \quad \frac{\sum_j x_{jk} Y_j}{X_k}, \qquad (1)$$

where PSI_k is the product sophistication index for product k, x_{jk} are exports of product k by country j, Y_j is per capita gross domestic product in country j, and X_k are total world exports of product k. Equation (1) is thus a weighted average of the per capita GDPs of product k's exporters, using the countries' shares of global exports of k as weights.

A couple of examples can help to clarify equation (1). Table 1 presents the per capita incomes of the leading exporters of medical equipment (ISIC 3311). This 4-digit category includes sophisticated electronic machinery used for diagnoses and surgery and other advanced products. Table 2 presents the per capita incomes of the leading exporters of textile fabric and fibers (ISIC 1711). This category includes lower technology goods such as cotton fabrics and spun fibers. For medical equipment, only two of the nineteen leading exporters do not have per capita GDPs above USD 20,000. For textile fabrics and fibers, on the other hand, nine of the nineteen leading exporters do not have per capita GDPs above USD 20,000. The value of the PSI for medical equipment is thus high ($33,896) while the value of the PSI for textile fabrics and fibers is low ($14,027).

Kwan calculated the country's sophistication index (CSI) by assuming that the larger the share of sophisticated products in a country's exports, the more advanced its export basket is. For example, if the PSI is $30,000 for machine tools, $27,000 for computers, and $10,000 for clothing and if a country's export basket is composed of 50% machine tools, 25% computers, and 25% clothing, then the country's sophistication index (CSI) would be $30,000*50% + $27,000 *25% + $10,000*25% = $24,250. A country that has a larger share of low PSI products in its export structure would thus have a lower CSI.

Formally, the sophistication index for country j can be written as:

$$CSI_j = \frac{\sum_k x_{jk} PSI_k}{X_j}, \qquad (2)$$

where CSI_j is the country sophistication index for country j, x_{jk} are exports of product k by country j, PSI_k is the product sophistication index for product k, and X_k are total exports of country j to the world. Equation (2) is thus a weighted average of the product sophistication indexes of the goods that country j exports, using the percentage of country j's total exports in each good as weights.

Hausmann et al. (2007) claimed that the weighting scheme in equation (1) gives too much weight to large countries. As an example, they observed that the value of US exports of blazers in 1995 equaled $28,800,000 while the value of Bangladeshi exports of blazers equaled $19,400,000. The value for the US amounted to 0.005 percent of its exports while the value for Bangladesh equaled 0.6 percent of its exports. While blazer exports are thus more important for Bangladesh than for the US, equation (1) would weigh US income more heavily than Bangladeshi income in calculating the PSI for blazers.

Hausmann et al. (2007) therefore proposed a different weighting scheme. They recommended weighting per capita GDP in equation (1) by each country's revealed comparative advantage in product k. They called the resulting measure the productivity level of product k:

$$PRODY_k \;=\; \sum_j \frac{\left(\frac{x_{jk}}{X_j}\right)}{\sum_j \left(\frac{x_{jk}}{X_j}\right)} Y_j\,, \qquad (3)$$

where $PRODY_k$ is the productivity level of good k, x_{jk}/X_j is the share of commodity k in the country's overall export basket, and $\sum_j (x_{jk}/X_j)$ is the sum of the value shares across all countries j exporting product k, and Y_j is per capita GDP in country j. Equation (3) thus weighs a country's per capita GDPs by the country's revealed comparative advantage in product k.

Hausmann et al. (2007) then used PRODY to calculate each country's sophistication index. They called this measure the productivity level associated with a country's export basket (EXPY):

$$EXPY_j \;=\; \frac{\sum_k x_{jk} PRODY_k}{X_j}, \qquad (4)$$

where $EXPY_j$ is the productivity level associated with country j's export basket, $PRODY_k$ is the productivity level of good k, and the other variables are defined after equation (2).

We use both Kwan's (2002) approach (equations (1) and (2)) and Hausmann et al's (2007) approach (equations (3) and (4)) to measure PSI's for individual products and CSI's for each country's export basket. Exports are disaggregated at the four-digit ISIC level and are measured in U.S. dollars for the world's 89 leading exporters. Per capita GDP is also measured in (constant) US dollars. These data are obtained from the CEPII-CHELEM database.

We also investigate Switzerland's export structure using OECD classifications. They categorize products as high tech based on the ratio of R&D spending to value-added (see Hatzichronoglou, 1997). Their measure provides us with independent evidence that we can compare with the results obtained using Kwan's (2002) and Hausmann et al.'s (2007) techniques.

2.2 Results

Table 3 presents the results. According to Kwan's (2002) measure Switzerland has the highest country sophistication index for every year in our sample. According to Hausmann et al's (2007) measure, Switzerland has the highest CSI for every year starting in 1996 and is always in the top six.

Table 4 presents the percentage of Swiss exports in individual 4 digit ISIC categories in 2011 and the associated product sophistication index calculated using Kwan's (2002) methodology. The results are similar when the PSI is calculated using Hausmann et al's (2007) approach. For Switzerland, 41.8% of exports are in categories with PSI's above $35,000.[1] The corresponding values for G-7 countries are 5.2% for Canada, 18.8% for France, 10.1% for Germany, 6.9% for Italy, 2.7% for Japan, 15.2% for the U.K., and 10.4% for the U.S. For Switzerland, 53.1% of exports are in categories with PSI's above $30,000. This compares with 12.2% for Canada, 29.4% for France, 22.1% for Germany, 16.8% for Italy, 15.8% for Japan,

[1] Table 4 only includes products that make up at least 0.5 percent of Swiss exports in 2011. Including products that make up less than 0.5 percent yields the sum of 41.8% for categories with PSI's above $35,000.

26.8% for the U.K., and 22.6% for the U.S. The sophistication of Swiss exports is thus an outlier relative to other advanced economies.

Another way to measure the sophistication of Swiss exports is to examine the percentage of manufactured exports that are classified by the OECD as high tech. For Switzerland, 46.7% of exports in 2011 are classified as high-tech based on this criterion.[2] This compares with 10.4% for Canada, 25.7% for France, 18.6% for Germany, 10.7% for Italy, 19.9% for Japan, 24.5% for the U.K., and 21.1% for the U.S.[3] Thus according to this measure also the Swiss export basket is highly advanced.

Table 4 indicates that 35% of exports are in ISIC category 24 (chemicals), 16% are in category 33 (medical, precision, and optical instruments), and 12% are in category 29 (machinery and equipment). Thus two-thirds of Swiss exports are from these three advanced industries.

By contrast, traditional lower technology Swiss products make up a small share of Swiss exports. Swiss chocolates are renowned, yet equal only 0.5 percent of exports in Table 4. Swiss cheeses and dairy products are world class, yet make up such a small share of exports (0.4 percent) that they are not listed in Table 4. Swiss wines have been produced and consumed in Valais, Vaud, and other cantons for millennia, yet account for only 0.06 percent of exports. Swiss fruit farms line the Rhone Valley, but fruits equal 0.01 percent of exports.

Table 4 also indicates that intermediate goods exports such as engines, electronic components, and parts for vehicles are not large. In total, intermediate goods accounted for 11% of Swiss exports (and also of Swiss imports) in 2011. Thus cross-border supply chains are not as important in Switzerland as they are for East Asian countries, where the share of intermediate

[2] This is the third highest in the world, behind Ireland (53.8%) and Hong Kong (52.4%).
[3] Foders and Vogelsang (2014) reported that Germany specializes in medium-range technology products.

goods in exports and imports often exceeds 30%. In addition, Table 4 indicates that primary products make up a minuscule part of Swiss exports. Finally, although not shown in Table 4, 80 percent of Swiss exports in 2011 went to OECD countries.

Table 4 examined Swiss goods exports, but it is important to also consider services exports. According to the CEPII-CHELEM data, in 2011 a little less than one-fourth of Swiss exports were services, and the rest were goods. According to World Bank data, in 2011 Swiss services exports were divided almost equally between information and communications technology (ICT) services exports, financial and insurance services exports, and transport and travel services exports. The first two categories represent sophisticated exports and the third category includes tourism, a mainstay of the Swiss economy.

Thus Switzerland exports sophisticated goods and services largely to developed economies. One might expect these to compete on quality more than on price, and thus for the price elasticities of exports to be small. We investigate this issue in the next section.

3 Estimating export elasticities

3.1 Data and methodology

To estimate trade elasticities we use the workhorse imperfect substitutes model (see Goldstein and Khan, 2005). Export functions can be written as:

$$ex_t = \alpha_1 + \alpha_2 reer_t + \alpha_3 y_t^* + \varepsilon_t , \qquad (5)$$

where ex_t represents real exports, $reer_t$ represents the real effective exchange rate, and y_t^* represents real foreign income.

We estimate equation (5) using dynamic ordinary least squares (DOLS). DOLS yields consistent and efficient estimates (Stock and Watson, 1993). The DOLS estimator also has smaller bias and root mean squared error than other cointegrating regression estimators in cases where the sample is not large enough to justify applying asymptotic theory (Montalvo, 1995). DOLS estimates of the long run parameters α_1, α_2, and α_3 can be obtained from the following regression:

$$ex_t = \alpha_1 + \alpha_2 reer_t + \alpha_3 y_t * + \sum_{k=-K}^{K} \beta_{1,k} \Delta reer_{t+k} + \sum_{k=-K}^{K} \beta_{2,k} \Delta y_{t+k} * + \varepsilon_t \qquad (6)$$

where K represents the number of leads and lags of the first differenced variables and the other variables are defined above. We use the Schwarz Criterion to determine the number of leads and lags.

Equation (5) can also be written in vector error correction form as:

$$\Delta ex_t = \beta_{10} + \varphi_1(ex_{t-1} - \alpha_1 - \alpha_2 reer_{t-1} - \alpha_3 y_{t-1}*) + \beta_{11}(L)\Delta ex_{t-1} + \beta_{12}(L)\Delta reer_{t-1} + \beta_{13}(L)\Delta y_{t-1}* + \nu_{1t} \qquad (7a)$$

$$\Delta reer_t = \beta_{20} + \varphi_2(ex_{t-1} - \alpha_1 - \alpha_2 reer_{t-1} - \alpha_3 y_{t-1}*) + \beta_{21}(L)\Delta ex_{t-1} + \beta_{22}(L)\Delta reer_{t-1} + \beta_{23}(L)\Delta y_{t-1}* + \nu_{2t} \qquad (7b)$$

$$\Delta y_t* = \beta_{30} + \varphi_3(ex_{t-1} - \alpha_1 - \alpha_2 reer_{t-1} - \alpha_3 y_{t-1}*) + \beta_{31}(L)\Delta ex_{t-1} + \beta_{32}(L)\Delta reer_{t-1} + B_{33}(L)\Delta y_{t-1}* + \nu_{3t} . \qquad (7c)$$

φ_1, φ_2, and φ_3 are error correction coefficients that measure how quickly exports, the real exchange rate, and income respectively respond to disequilibria. If these endogenous variables move towards their equilibrium values, the corresponding correction coefficients will be negative and statistically significant. The L's represent polynomials in the lag operator. We estimate equations (7a) – (7c) using Johansen maximum likelihood methods.

Our aim is to use a long time series and aggregate data to estimate the trade elasticities. Table 3 indicates that Switzerland has had a sophisticated export basket from the early 1980s to the present, so we use data from 1980 to 2013. We obtain quarterly data on goods exports and goods and services exports from the IMF's International Financial Statistics (IFS). We are unable to obtain an export price index over our sample period, so we deflate exports using the Swiss producer price index also obtained from IFS. The only reer exchange rate series available over our period are the CPI-deflated reer obtained from IFS and the CPI-deflated series obtained from the Bank for International Settlements (BIS). We use both of these measures.[4]

For rest of the world income (y_t*) we use a geometrically weighted average of income changes in Switzerland's top ten export destinations over our sample period.[5] The index is constructed using the formula:

$$y_t* = y_{t-1} * \prod_{i=1}^{10} (y_{i,t} / y_{i,t-1})^{w_{i,t}} \tag{8}$$

where i represents one of the 10 largest importing countries, y_i is income in country i, and w_i is the share of Swiss exports going to country i relative to Swiss exports going to the ten largest export markets. The weights are calculated using data on Swiss goods exports obtained from the CEPII-CHELEM database. The index is set equal to 100 in 1980q1.

As a second measure of rest of the world income we use quarterly data on real income in OECD countries. These data should be useful since the lion's share of Swiss exports goes to OECD countries. The data are seasonally adjusted and are obtained from the OECD.[6]

Augmented Dickey-Fuller tests indicate that the series are integrated of order one. The trace statistic and the maximum eigenvalue statistic then allow us to reject at the 5% level the null of no cointegrating relations against the alternative of one cointegrating relation.[7]

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[4] The website for the IMF is www.imf.org. The website for the BIS is www.bis.org.
[5] These countries are Austria, France, Germany, Hong Kong, Italy, Japan, the Netherlands, Spain, the United Kingdom, and the United States.
[6] The website for these data is http://stats.oecd.org
[7] We employed the two tests and five assumptions concerning intercepts and trends both within and outside the cointegrating equation. For goods exports, in eight of the ten cases the results pointed to one cointegrating relationship. For goods and services exports, in seven of the ten cases the results indicated one cointegrating relationship.

3.2 Results

Table 5 presents the results from estimating equation (5) with goods exports as the dependent variable and with y* measured as the weighted average of income in the top ten importing countries. Results with y* measured using the OECD variable are similar and available on request. The first row presents the results using the IMF reer variable and the second row using the BIS reer measure BIS. The first and third columns present results without a trend and the second and fourth columns present results with a trend.

In the first and third columns, the trade elasticities are of the expected signs and statistically significant. They indicate that a 10 percent appreciation of the reer would reduce exports by about 5 percent and a 10 percent increase in income in the rest of the world would increase exports by about 18 percent.

In the second and fourth columns, the exchange rate elasticities are of the expected signs and statistically significant. They indicate that a 10 percent appreciation of the reer would reduce exports by 11 or 12 percent. The income elasticities, however, are no longer of the expected sign. Since rest of the world income resembles a deterministic trend, there is a high degree of multicollinearity between these two variables and it is thus hard to estimate the coefficients separately.

The Schwarz Information Criterion, the adjusted R-squared, and the other summary statistics point to the specification with a trend. In addition, as Figure 1 shows, the residuals are well behaved when a trend is included but not when it is excluded. We thus focus on the findings with a time trend included.

Table 6 provides Johansen maximum likelihood estimates for equations (7a) – (7c) with a trend included in the cointegrating equation. The exchange rate elasticities remain of the expected sign and statistically significant. They indicate that a 10 percent appreciation would reduce exports by 15 percent. The error correction coefficients for exports are also negative and statistically significant, indicating that exports return to their equilibrium values. The correction coefficients imply that the gap between the current value of exports and the equilibrium value closes at a rate of 20 percent per quarter.

Table 7 presents the DOLS estimates for goods and services exports and Table 8 presents the Johansen estimates. The results are similar to the findings for goods exports in Tables 5 and 6. When a trend term is included the exchange rate elasticity equals unity. One difference with the results for goods and services as compared to the results for goods is that the error correction coefficient for goods and services exports is almost twice as large. It indicates that the gap between the current value of exports and the equilibrium value closes at a rate of 36 percent per quarter. Evidently services exports adjust more quickly and cause goods and services exports to move to their equilibrium values more rapidly than goods exports alone do. This may reflect responses to changes in the price competitiveness of tourism in Switzerland.

The important implication of the results presented here is that Swiss exports are sensitive to exchange rate changes. In our preferred specifications, the exchange rate elasticities for goods exports exceed unity and the exchange rate elasticities for goods and services exports equal unity. Even though the Swiss export basket is the most advanced in the world, it remains sensitive to price changes in the world economy.

4 Conclusion

Many have observed that Switzerland exports high value added goods. These include luxury watches, pharmaceutical products, chemicals, and machinery.

We measure the sophistication of Swiss exports using several measures. Using the methods of Hausmann et al. (2007) and Kwan (2002) we find that Switzerland has the most advanced export structure in the world. Using the OECD classification, we find that Switzerland has the third highest share of high technology exports relative to total manufactured exports.

Given the sophistication of its export structure, one might expect the price elasticity of Swiss exports to be small. We test for this using aggregate exports and dynamic ordinary least squares and Johansen maximum likelihood techniques. In our preferred specifications, we find large exchange rate elasticities.

Bénassy-Quéré, Gourinchas, Martin, and Plantin (2014) and Héricourt, Martin, and Orefice (2014) noted that it is commonly assumed that higher end exports should have lower exchange rate elasticities. To test for this they investigated French firms that have the highest export unit values within each product category and reported that exchange rate changes exert first order effects even on these goods. They noted, though, that further work is needed to confirm their findings. Future research should continue investigating the relationship between export sophistication and exchange rate elasticities.

Acknowledgments We thank Jaime de Melo, Masahisa Fujita, Takatoshi Ito, Masayuki Morikawa, Atsushi Nakajima, Yasuhiko Yoshida, and seminar participants at the Research Institute of Economy, Trade and Industry for valuable comments. Any errors are our responsibility.

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Table 1 Leading exporters of medical equipment in 2011

Country	Country's real per capita income in 2011 (US dollars)	Share of world medical equipment exports in 2011
United States	42247	19.7
Germany	37092	14.5
The Netherlands	41527	8.1
China, People's Rep.	3111	5.9
Switzerland	53544	5.5
Ireland	44437	5.1
Mexico	8326	4.8
France	34436	4.8
Belgium	37058	4.1
Japan	36061	4.0
United Kingdom	37615	3.2
Italy	29183	2.1
Denmark	46417	1.7
Sweden	44175	1.7
Singapore	34187	1.5
South Korea	21519	1.1
Israel	22065	0.9
Australia	39567	0.8
Austria	40073	0.8

Note: Medical equipment comes from ISIC Category 3311. Per capita GDP is measured in constant US dollars.
Source: CEPII-CHELEM database.

Table 2 Leading exporters of textile fabric and fibers in 2011

Country	Country's real per capita income in 2011 (US dollars)	Share of world textile fabric and fibers exports in 2011
China, People's Rep.	3111	18.0
India	1077	8.2
Italy	29183	7.3
Pakistan	779	4.6
Germany	37092	4.3
United States	42247	3.8
Turkey	8319	3.6
South Korea	21519	3.4
Indonesia	1651	3.0
Taiwan	20000	3.0
Japan	36061	2.9
Hong Kong	31816	2.4
Belgium	37058	1.9
Spain	25762	1.8
France	34436	1.8
Thailand	3032	1.7
Vietnam	894	1.6
United Kingdom	37615	1.4
Czech Republic	14326	0.8

Note: Textile fabrics and fibers come from ISIC Category 1711. Per capita GDP is measured in constant US dollars.
Source: CEPII-CHELEM database.

Table 3 Switzerland country sophistication index and world ranking, 1982-2011

Year	Country sophistication index (Kwan's measure)	Ranking	Country sophistication index (Hausmann et al's measure)	Rank-ing
2011	30070	1	25338	1
2007	31396	1	25081	1
2002	29680	1	24510	1
1996	26753	1	23480	1
1992	26085	1	22976	3
1987	23784	1	23320	6
1982	20733	1	23052	5

Note: The country sophistication index (CSI) is calculated using the methods of Kwan (2002) and Hausmann et al. (2007). The higher the value of the CSI, the more sophisticated the export basket of the country.
Source: CEPII-CHELEM database and calculations by the authors.

Table 4 Percent of Switzerland's exports by product category in 2011			
Product category (four-digit ISIC classification)	Product sophistication index (Kwan's measure)	Percent of Switzerland's exports in the product category	Technological intensity of export category (OECD measure)
Watches and Clocks (3330)	38714	9.6	High
Pharmaceutical products (2423)	35683	26.2	High
Arts (9214)	35265	0.6	-
Medical equipment (3311)	33896	4.1	High
Aeronautics (3530)	33699	0.9	High
Other special purpose machinery (2929)	32706	3.2	Medium High
Engines Turbines (2911)	32364	0.9	Medium High
Machinery for food (2925)	31627	0.5	Medium High
Paints Ink (2422)	31145	0.6	Medium High
Chemical products (2429)	31010	2.1	Medium High
Measuring instruments (3312)	30928	2.2	High
Pulp and Paper (2101)	30843	0.7	Low
Lifting equipment (2915)	29547	0.5	Medium High
Machine tools (2922)	29043	2.4	Medium High
Other food products (1549)	28985	1.4	Low
Electricity (4010)	28702	2.4	-
Pumps (2912)	28540	1.8	Medium High
Soaps and Perfumes (2424)	28422	0.8	Medium High
Tobacco (1600)	28107	0.5	Low
Parts for vehicles (3430)	27597	0.7	Medium High
Primary plastic (2413)	27450	0.7	Medium High

Pesticides (2421)	27262	0.5	Medium High
Chocolates (1543)	26835	0.5	Low
Electrical distribution & control devices (3120)	26500	1.8	Medium High
General purpose machinery (2919)	26279	1.4	Medium High
Basic chemicals except fertilizer (2411)	26259	0.5	Medium High
Machinery for textiles (2926)	26089	0.6	Medium High
Plastic products (2520)	25795	1.7	Medium Low
Cutlery tools (2893)	24964	0.7	Medium Low
Precious and nonferrous metals (2720)	23900	4.7	Medium Low
Fabricated metal products (2899)	23697	1.4	Medium Low
Basic iron and steel (2710)	23357	1.2	Medium Low
Electric motors (3110)	23059	1.5	Medium High
Electronic components (3210)	21361	0.7	High
Electrical equipment (3190)	20728	0.5	Medium High
Jewelry (3691)	18805	4.7	Medium Low
Computer equipment (3000)	16391	0.5	High

Note: The product sophistication index (PSI) is calculated using the method of Kwan (2002).
The higher the value of the PSI, the more sophisticated the product.
Source: CEPII-CHELEM database and calculations by the authors.

Table 5 Dynamic OLS estimates for Swiss goods exports to the world

	(1)	(2)	(3)	(4)
REER Elasticity	-0.50***	-1.16***		
(IMF REER)	(0.18)	(0.07)		
REER Elasticity			-0.44**	-1.10***
(BIS REER)			(0.18)	(0.08)
Income Elasticity	1.80***	-0.53***	1.78***	-0.43***
	(0.03)	(0.11)	(0.03)	(0.12)
Time		0.02***		0.01***
		(0.00)		(0.000)
No. of Leads and Lags	0,0	0,6	0,0	0,3
Adjusted R-squared	0.95	0.99	0.95	0.99
Schwarz Criterion	-1.84	-3.16	-1.82	-3.13
Log Likelihood	141.0	249.9	139.5	238.3
No. of observations	132	126	132	129
Sample Period	1980:2-2013:1	1981:4-2013:1	1980:2-2013:1	1981:1-2013:1

Notes: DOLS estimates. Heteroskedasticity-consistent standard errors are in parentheses. Seasonal dummies are included. Columns (1) and (2) use CPI-deflated real exchange rates obtained from the IMF International Financial Statistics. Columns (3) and (4) use CPI-deflated real exchange rates obtained from the Bank for International Settlements. The number of leads and lags of the first differenced variables is determined by the Schwarz Criterion.
*** (**) denotes significance at the 1% (5%) level.

Table 6 Johansen MLE estimates for Swiss goods exports to the world

	Number of cointe-grating vectors	Number of obser-vations	REER elasticity	Income elasticity	Error correction coefficients		
					Exports	REER	Income
Swiss Goods Exports	1,1	124	-1.52**	-0.72***	-0.20***	-0.15***	-0.01
			(0.17)	(0.24)	(0.06)	(0.04)	(0.01)
(CPI-deflated IMF REER. Lags: 3; Sample: 1981:I-2013:I; Trend in cointegrating equation and vector autoregression; Seasonal dummies for the first, second, and third quarters included)							
Swiss Goods Exports	1,1	124	-1.50**	-0.74***	-0.19***	-0.15***	-0.02
			(0.17)	(0.24)	(0.06)	(0.04)	(0.01)
(CPI-deflated BIS REER. Lags: 3; Sample: 1981:I-2013:I; Trend in cointegrating equation and vector autoregression; Seasonal dummies for the first, second, and third quarters included)							

Notes: Lag length was selected based on the Schwarz Criterion. Number of Cointegrating Vectors indicates the number of cointegrating relations according to the trace and maximum eigenvalue tests at the 5% level. Seasonal dummies are included.

*** (**) denotes significance at the 1% (5%) level.

Table 7 Dynamic OLS estimates for Swiss goods and services exports to the world

	(1)	(2)	(3)	(4)
REER Elasticity	-0.47***	-1.08***		
(IMF REER)	(0.18)	(0.05)		
REER Elasticity			-0.40**	-1.05***
(BIS REER)			(0.18)	(0.05)
Income Elasticity	1.89***	-0.52***	1.87***	-0.46***
	(0.03)	(0.07)	(0.03)	(0.08)
Time		0.02***		0.02***
		(0.00)		(0.00)
No. of Leads and Lags	0,0	0,6	0,0	0,4
Adjusted R-squared	0.96	0.99	0.96	0.99
Schwarz Criterion	-1.91	-3.94	-1.88	-3.65
Log Likelihood	144.6	296.6	142.7	272.9
No. of observations	131	125	131	127
Sample Period	1980:2-2012:4	1981:4-2012:4	1980:2-2012:4	1981:2-2012:4

Notes: DOLS estimates. Heteroskedasticity-consistent standard errors are in parentheses. Columns (1) and (2) use CPI-deflated real exchange rates obtained from the IMF International Financial Statistics. Columns (3) and (4) use CPI-deflated real exchange rates obtained from the Bank for International Settlements. The number of leads and lags of the first differenced variables is determined by the Schwarz Criterion.
*** (**) denotes significance at the 1% (5%) level.

Table 8 Johansen MLE estimates for Swiss goods and services exports to the world

	Number of cointegrating vectors	Number of observations	REER elasticity	Income elasticity	Error correction coefficients		
					Exports	REER	Income
Swiss Goods & Services Exports	1,1	132	-0.96***	-0.19	-0.36***	0.02	-0.04**
			(0.13)	(0.20)	(0.07)	(0.05)	(0.02)
(CPI-deflated IMF REER. Lags: 0; Sample: 1980:2-2012:4; Trend in cointegrating equation and vector autoregression)							
Swiss Goods & Services Exports	1,1	132	-0.99**	-0.26	-0.36***	0.00	-0.05
			(0.26)	(0.20)	(0.00)	(0.05)	(0.01)
(CPI-deflated BIS REER. Lags: 0; Sample: 1980:2-2012:4; Trend in cointegrating equation and vector autoregression)							

Notes: Lag length was selected based on the Schwarz Criterion. Number of Cointegrating Vectors indicates the number of cointegrating relations according to the trace and maximum eigenvalue tests at the 5% level.
*** (**) denotes significance at the 1% (5%) level.

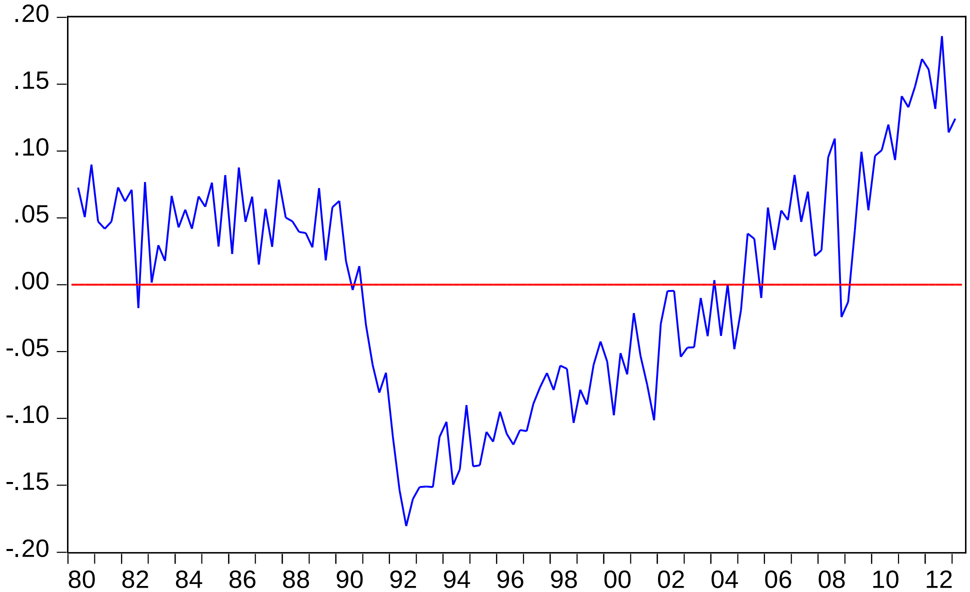

Fig. 1a Residuals from the DOLS regression without a time trend (reported in Table 5, column (1)).
Source: Authors' calculations.

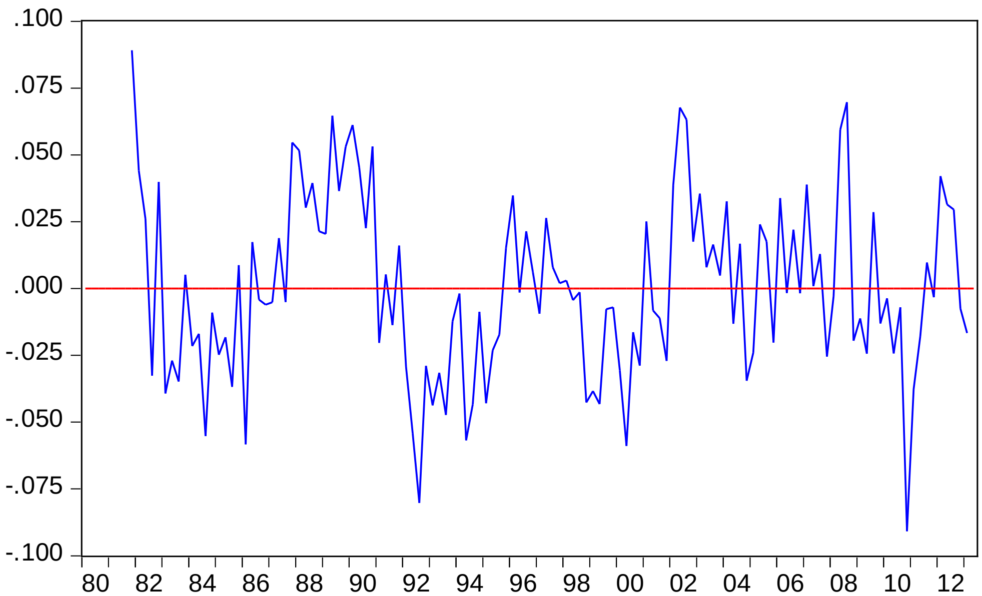

Fig. 1b Residuals from the DOLS regression with a time trend (reported in Table 5, column (2)).
Source: Authors' calculations.