What Drives the Swiss Franc?

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Abstract

This paper analyzes the behavior of the Swiss franc (CHF) over the past 35 years. It relates the evolution of the CHF exchange rates to economic fundamentals like the relative competitiveness of the Swiss export sector, accumulated current accounts, interest rate differentials and oil prices. Some factors like the introduction of the euro, a relative increase in Swiss domestic productivity and higher oil prices seem to have modified the CHF behavior in the last decade, but more data will be needed to draw definitive conclusions. The paper relies on different data sources and assesses potential exchange rate determinants under different angles. Overall, measurement and econometric issues would make it difficult to determine a unique econometric specification or specific values for equilibrium exchange rates.

JEL classification: F31; F32

Keywords: Swiss franc; exchange rates; fundamentals

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1. Introduction

This paper assesses the potential factors influencing the evolution of the Swiss franc exchange rates. As no encompassing theoretical framework exists in the literature, I use an empirical approach coined in the literature as the Behavioral Equilibrium Exchange Rate (BEER) approach, and analyze what drives the evolution of CHF relative to the euro, the US dollar and the 24 main trading partners of Switzerland.

Many factors can potentially drive currency developments. This paper discusses the main factors usually considered in the vast empirical literature on exchange rates and for which reliable data is available. It is thus a descriptive analysis that tries to characterize and relate main CHF developments to selected economic variables, and does not attempt to address monetary policy questions or to provide a framework for exchange rate forecasting.

I start in section 2 by displaying the behavior of the different Swiss franc real exchange rates. Then, in section 3, I discuss potential determinants of the Swiss franc and present econometric results. I distinguish between relative tradable and non-tradable good price movements, and argue that different CHF exchange rates can be characterized differently in that respect. Direct and indirect evidence on Balassa-Samuelson effects, the most common argument to explain relative tradable vs. non-tradable good price developments, are then presented and related to real exchange rate movements in light of historical and structural developments in order to shed some light on the evolution of CHF exchange rates. I then discuss and quantify the effects of other main factors usually studied in the empirical exchange rate literature, like accumulated current accounts, interest rate differentials and oil prices.

The introduction of the euro has represented a major event in the currency market, especially for Switzerland in the middle of the European continent. Section 4 presents recent changes in CHF fluctuations following the introduction of the euro, suggesting some structural changes in CHF dynamics. Finally, the last section provides some conclusions. The analysis suggests that some factors like the introduction of the euro, a relative increase in Swiss domestic productivity and higher oil prices seem to have affected the behavior of the Swiss franc over the past ten year, but more data will be needed to draw definitive conclusions.

2. Long-term behavior of the Swiss franc real exchange rates

2.1. Exchange rate concepts and definitions

The main exchange rate concept, relevant for exporters as well as policy makers, is the real exchange rate. Let e be the nominal exchange rate, expressed as units of foreign currency for one Swiss franc, i.e. an increase in e represents an appreciation of the Swiss franc, and let the real exchange rate be

$$q = e + p^C - p^{*C}, \tag{1}$$

where p^C is the consumer price index (CPI) and a star denotes a foreign variable. Lower-case variables are logarithms.

Two types of exchange rates will be analyzed. First, I compute an effective exchange rate relative to 24 trading partners of Switzerland, using average overall trade weights that take into account third-market effects (see appendix). These overall weights incorporate both export and import patterns. Accounting for third-market effects means that the weights' computation captures the competition faced by Swiss exporters in foreign markets from both domestic producers and exporters from third countries. For example, it measures the competition faced by Swiss exporters from German producers both in Germany and in other countries where German exporters are present. The second exchange rate considered is the CHF/euro exchange rate, where the same third-market effects weighting scheme (but with only euro area countries) as described above is used. I will also analyze the behavior of the CHF/dollar exchange rate.

2.2. Real exchange rates evolution

The behavior of the Swiss franc (CHF) real exchange rates (RER) relative to the German mark (DM), where the irrevocable exchange rate euro/DM is used since 1999, the euro, the US dollar (US$), and to the currencies of Switzerland's 24 main trading partners are displayed in Figure 1, since the beginning of the floating period in 1973. Data sources are described in the appendix.

The Swiss real exchange rate thus exhibits different behavior depending on the currency considered. It displays an upward trend (appreciation) relative to European currencies and relative to its main trading partners in general (effective RER), but there is no clear long-term trend relative to the US dollar. Causes of these different evolutions will be analyzed below.

3. Determinants of Swiss franc trends and fluctuations

This section analyzes the potential factors influencing the evolution of the Swiss franc.

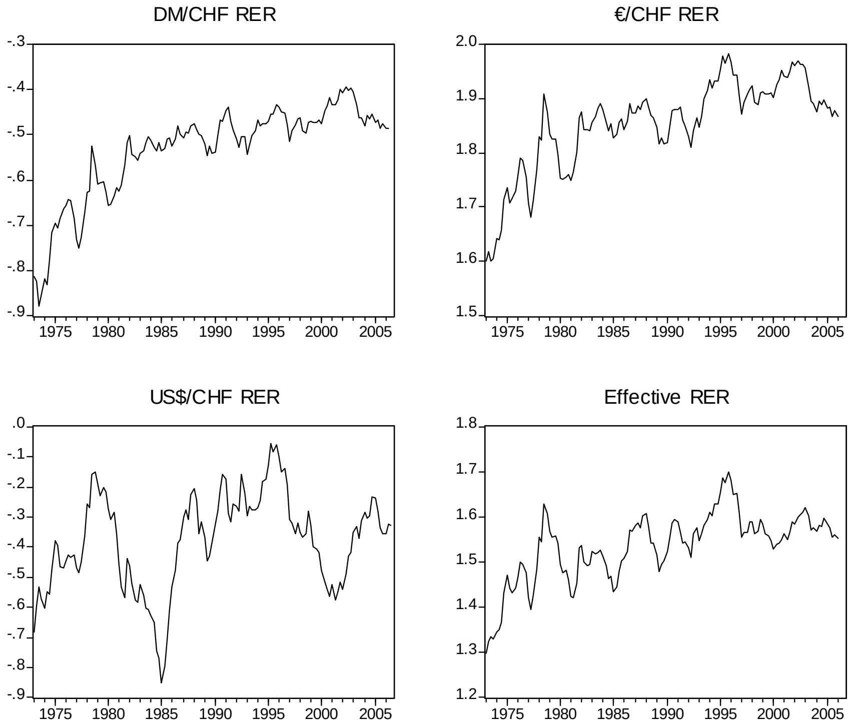

FIG. 1. Swiss Franc Real Exchange Rates

3.1. Purchasing power parity

According to the Purchasing Power Parity (PPP) theory, the real exchange rate should fluctuate around a constant. From Figure 1 above, this is obviously not the case for the euro/CHF nor for the effective real exchange rates. The real exchange rates of the Swiss franc relative to these currencies are appreciating over time. Assuming a constant exchange rate, as it is done when the PPP methodology is used to compute equilibrium exchange rates, is thus inappropriate to assess the equilibrium value of the euro/CHF or the effective exchange rate of the Swiss franc.

Figure 2 further illustrates this point by displaying the nominal exchange rate euro/CHF and PPP computed with basis periods in 1980 and 1990. As time passes,

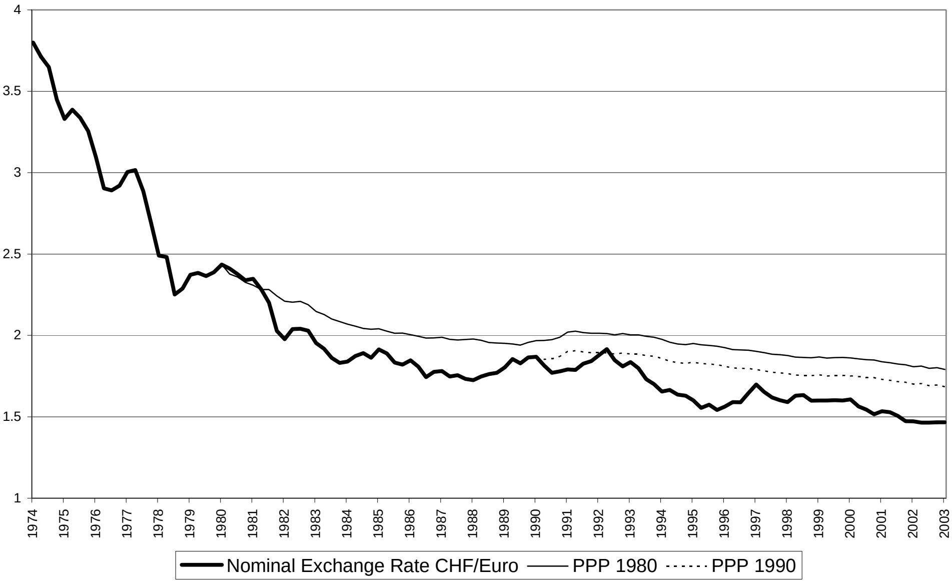

Fig. 2. Nominal Exchange Rate (CHF/Euro) and PPP

the Swiss franc appears increasingly over-valued. Even if we take the mean of the sample as the basis value or another method to determine the exchange rate equation constant, a trend-appreciating currency would always appear over-valued at the end of the sample if PPP is used.

We thus need to understand the causes of the trend real appreciation of the Swiss franc that makes PPP break down for the euro/CHF exchange rate but not for the US$/CHF, given that the US$/CHF exchange rate does not exhibit a trend.

There are several reasons why PPP might not hold, for any currency[1]. For example, consumers' preferences differ from one country to another, and so do their consumption baskets and CPI. Moreover, there are transportation and adjustment costs that

[1]For a critical review of equilibrium exchange rate theories and methods, see e.g. Driver and Westaway (2004) and Égert, Halpern and MacDonald (2006).

make the law of one price for tradable goods break down. And also importantly, the law of one price might fail as countries are trading differentiated products and price discrimination occurs between countries' markets.

The most severe deviation from PPP might however come from a divergence between prices of non-tradable goods and services between countries. We can express the consumer price index p^C as a weighted average of tradable p^T and non-tradable p^{NT} good prices; assuming the same share across countries, we get

$$p^C = \alpha p^T + (1-\alpha)\, p^{NT}$$

and

$$p^{*C} = \alpha p^{*T} + (1-\alpha)\, p^{*NT}.$$

Using equation (1), we then obtain

$$q = e + \left[\alpha p^T + (1-\alpha)\, p^{NT}\right] - \left[\alpha p^{*T} + (1-\alpha)\, p^{*NT}\right],$$

and, re-arranging,

$$q = e + p^{*T} - p^T + (1-\alpha)\left[\left(p^{*NT} - p^{*T}\right) - \left(p^{NT} - p^T\right)\right].$$

The real exchange rate can thus be decomposed as the real exchange rate of tradable goods q^T and the relative evolution of the tradable vs. non-tradable good prices $q^{NT/T}$ of the countries considered,

$$q = q^T + q^{NT/T},$$

were $q^T = e + p^{*T} - p^T$ and $q^{NT/T} = (1-\alpha)\left[\left(p^{*NT} - p^{*T}\right) - \left(p^{NT} - p^T\right)\right]$.

The main question is then to find out whether the real exchange rate is mostly driven by deviations from the law of one price (PPP) for tradable goods, or by persistent changes in the relative tradable vs. non-tradable goods price ratio. Two questions should be addressed in the empirical analysis. First, we need to know whether variations in relative prices $q^{NT/T}$ are significant or not. And if so, we want to assess at which frequency these relative prices are relevant for the evolution of the real exchange rate, i.e. whether relative prices drive the real exchange rate for relatively short-term fluctuations or for long-term trends.

Analyzes of other industrialized currencies have usually shown that the relative price ratio $q^{NT/T}$ is not significant. In fact, this ratio is significant only for a few developing countries. However, in contrast, as shown in the analysis below, the ratio $q^{NT/T}$ is highly significant in CHF equations and explains substantial fluctuations of the CHF relative to other currencies, both in the short and long run. This relative price ratio in fact explains major as well as minor fluctuations for CHF/euro exchange rate, but only long-term trends for the CHF/dollar exchange rate. The PPP for tradable goods thus holds at different frequencies: US dollar tradable PPP deviations are much more substantial and persistent and explain major exchange rate fluctuations; in contrast, euro tradable PPP deviations are small and relatively short-lived (2-5 years), and major CHF/euro exchange rate fluctuations are explained by the relative price ratio $q^{NT/T}$.

Different factors can drive the $q^{NT/T}$ ratio. The most common explanation is the Balassa-Samuelson (BS) effect. I will argue below that it is the most plausible cause, based on divergent evolutions of euro and US dollar exchange rate developments relative to the Swiss franc, on the evolution of the current account, as well as on the effects of historical facts like the German reunification on the joint behavior of the BS proxy and the real exchange rate. Moreover, as shown in section 3.2.2, the BS effect is supported by direct sectorial productivity evidence in the 1990s, although recent developments of direct and indirect evidence diverge.

After determining that it is the relative non-tradable/tradable price ratio that mainly drives the CHF/euro exchange rate, I then look at factors potentially affecting the purchasing power parity of tradable goods, like accumulated current accounts and oil prices, which cause exchange rate movements in order to re-equilibrate the balance of payment.

3.2. Balassa-Samuelson effect

A potential cause of departing from PPP is the Balassa-Samuelson (BS) effect (see Balassa, 1964, and Samuelson, 1964), through which a country with relatively fast increases in productivity in its export sector experiences a real appreciation via an increase in relative prices of non-tradable to tradable goods and services.

3.2.1. Indirect measurement

As direct evidence on sectorial productivity is not available for the whole period considered, consider first an indirect measure (BS), i.e. the relative ratio of the Consumer Price Index (CPI) to the Producer Price Index (PPI) for the countries considered. The proxy can be written as $(CPI/PPI)\,/\,(CPI^{*}/PPI^{*})$, where a star (*) represents a weighted average of the trading partners considered. The CPI contains more non-tradable goods and services than does the PPI, thus this ratio represents a proxy for the relative evolution of the prices of non-tradable to tradable goods and services. A country with relatively higher productivity increases in its export sector experiences a relatively higher price increase in its domestic sector, and thus an increasing CPI/PPI ratio. The proxy should therefore account for deviations from PPP due to the BS effect.

As seen in Figures 3-5, the real exchange rate (RER) of the Swiss franc indeed seems mainly driven by the evolution of the relative prices of the domestic and export sectors, according to the BS effect, and its long-term (trend) evolution depends on the foreign currency considered. The RER of the Swiss franc relative to Germany is displayed in Figure 3, together with the BS proxy. After trending upwards in the 1970s, the RER and the BS proxy remain relatively stable in the 1980s, until the German reunification, when both variables shift upwards, reflecting that firms from the former East Germany were less competitive.

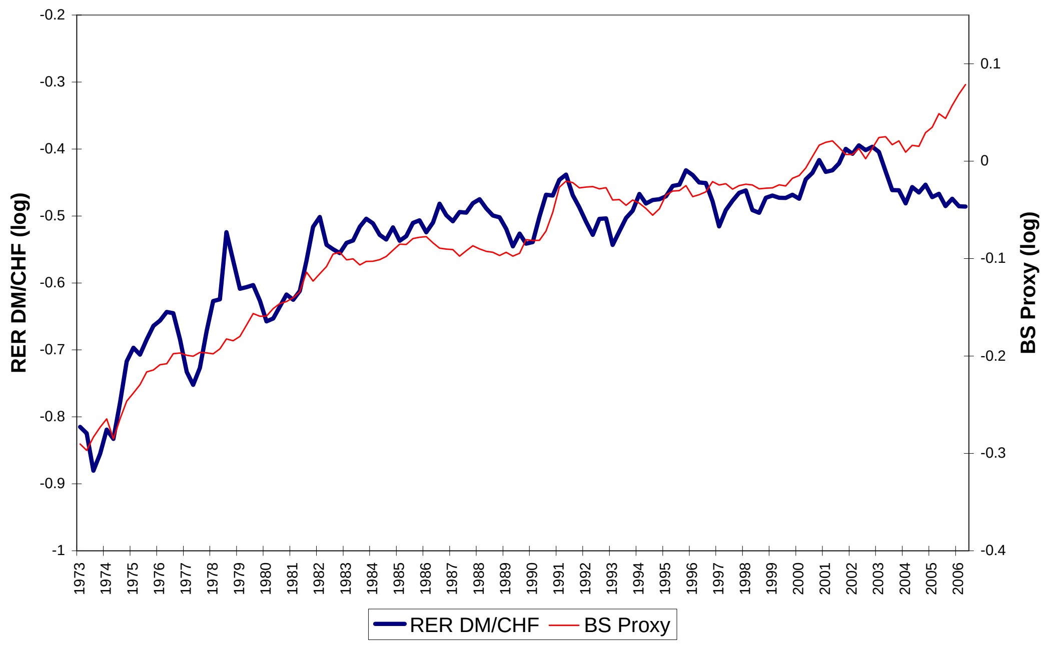

Fig. 3. RER DM/CHF and BS Proxy

The RER of the Swiss franc relative to the euro (euro zone as a whole) and the US dollar display different behaviors, as shown in Figures 4 and 5.

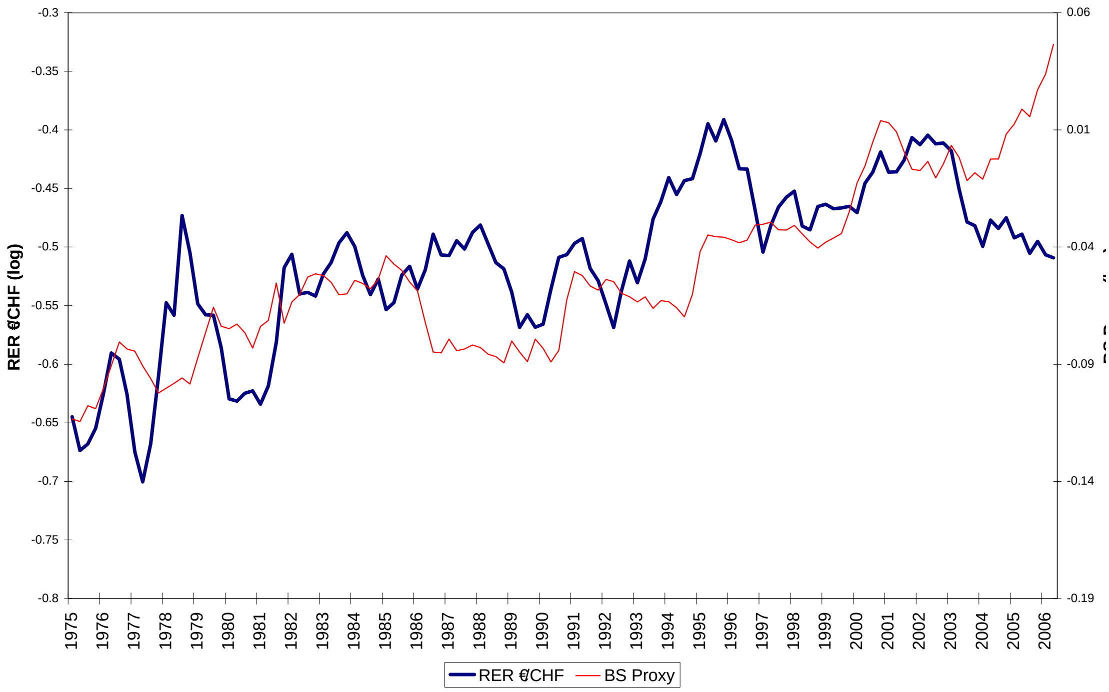

Fig. 4. RER Euro/CHF and BS Proxy

While the Swiss franc steadily appreciates in real terms against the euro, it does not show a clear trend against the dollar. This situation can be explained by more competitive export sectors in Switzerland and in the US than in Europe, or a more flexible domestic sector in Europe than in the US and in Switzerland. The former explanation seems more plausible given the structure of US and European markets, thus a particularly competitive Swiss export sector seems responsible for the real appreciation.

An important observation is that the appreciation of the Swiss franc does not follow a linear trend. It differs from one country to another, and even for a given country, the

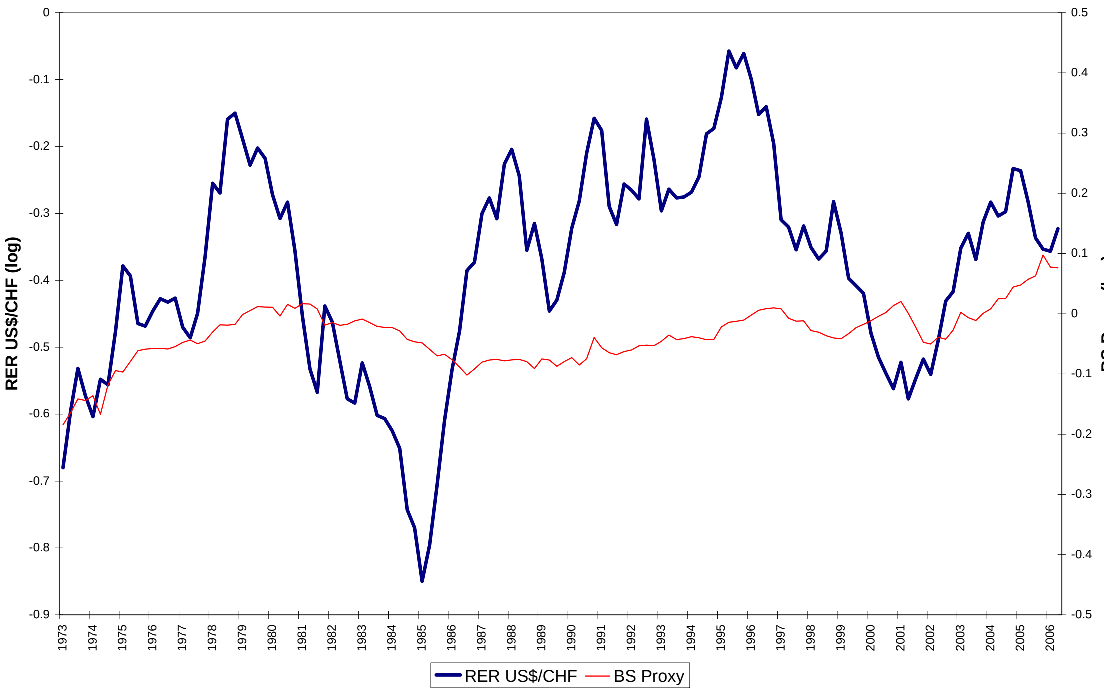

Fig. 5. RER US$/CHF and BS Proxy

real appreciation is not continuous and depends, among other things, of the evolution of relative productivities. For example, in the case of Germany, an initial trend was followed by a stability period in the 1980s, and a one-time shift occurred with the German reunification.

As this proxy only represents an indirect measure of the BS effect, it is not possible to assess to which extent the development of these relative prices reflects the BS effect alone. However, the basic assumption of the BS argument is that productivity in the domestic sector does not vary much from one country to another. A standard illustration is the haircut business, or public administrations. Even if we could argue that one country is more productive than another in a few domestic industries, it is not plausible to assume that a country *continuously* looses in productivity in this way, i.e.

that the relative Swiss domestic sector productivity *growth rate* has been relatively *decreasing* in the past 30 years, especially given the state of domestic competitiveness of Switzerland main trading partners. Direct as well as indirect evidence of a BS effect for the CHF/DM exchange rate has been documented in Aebersold and Brunetti (1998). Moreover, as pointed out by Genberg and Kadareja (2001), the strong Swiss current account position suggests no loss of competitiveness and supports the BS explanation based on productivity differentials.

Another important fact is that the CHF/euro exchange rate evolves closely with the BS proxy, even in the short-run, meaning that deviations from tradable PPP is small and short-lived. In contrast deviations from tradable PPP are substantial and persistent for the US dollar. The competitiveness of the export sector is thus more often and significantly distorted with respect to the dollar zone than with respect to the euro zone.

The situation of the mid-1990s can be assessed with the above graphs. The mid-1990s was a particularly turbulent time on foreign exchange markets, with speculative attacks on the European monetary system. From Figure 3, which displays the DM/CHF exchange rate, the CHF does not appear to have been misaligned at that time, whereas a relative strong CHF appears from Figure 4, which displays the euro/CHF exchange rate, during this period. This thus seems to reflect the fact that, during the 1990s, the apparent strong Swiss franc was due to weak (undervalued) European currencies, which were under speculative attacks, rather than an overvaluation of the Swiss franc itself.

3.2.2. Direct measurement

This section provides direct evidence on the factors driving the Balassa-Samuelson (BS) effect. It shows a recent stabilization of the BS effect with respect to the euro and a recent inversion of the effect with respect to the US dollar.

Figure 6 presents the evolution of Swiss labour productivity in the tradable and in the non-tradable sectors. Productivity is computed as value-added over employed

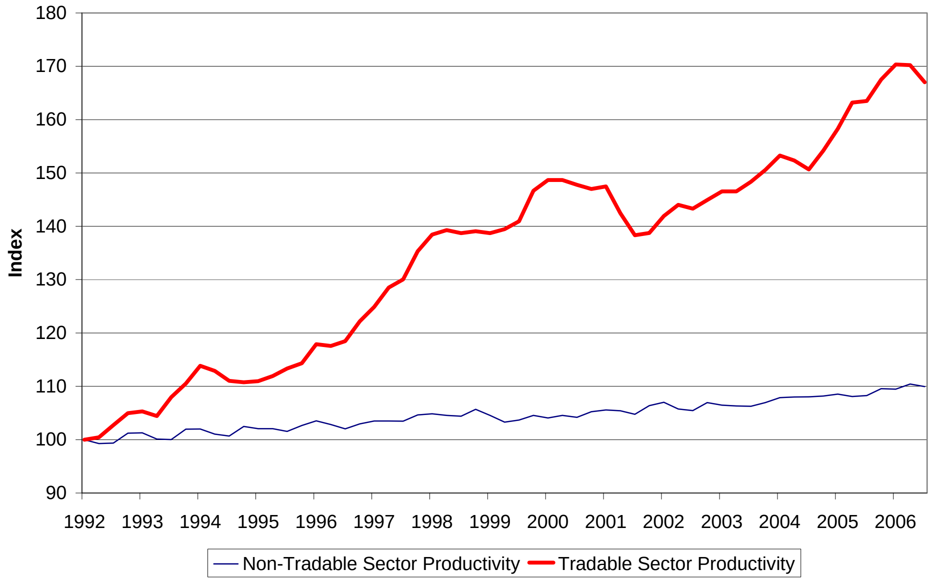

FIG. 6. Swiss Sectoral Productivities

people. The main tradable sectors are financial services and manufacturing; the main non-tradable sectors are public administration and real estate. Two main facts emerge from this graph. First, productivity in the tradable sector increases much faster than productivity in the non-tradable sector. And second, there is no apparent recent change in trend in productivity of the non-tradable sector.

Graph 7 presents the evolution of the ratio of Swiss non-tradable over tradable productivity relative to the corresponding ratio for Germany, the euro area and the US. The displayed ratio can thus be written as

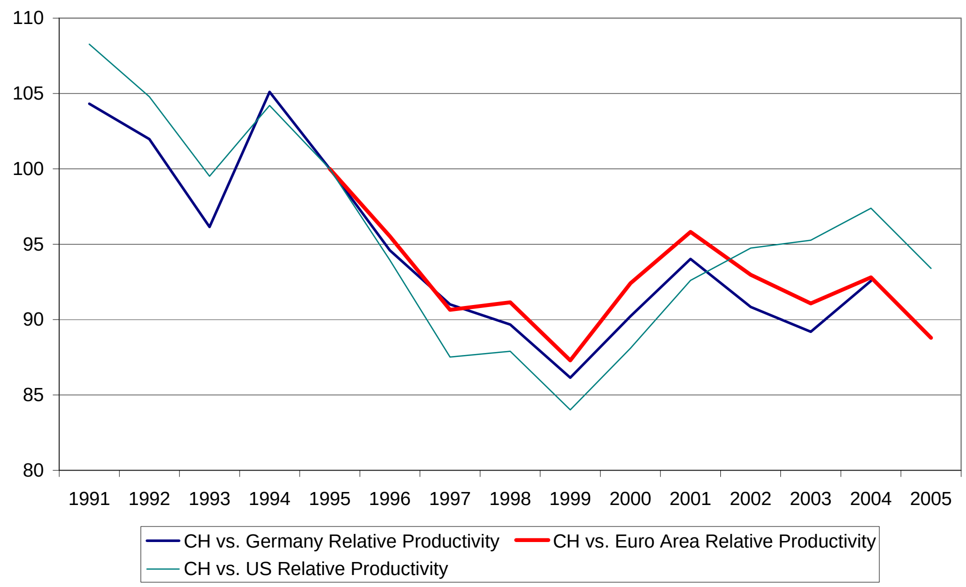

FIG. 7. Relative Labor Productivities of Switzerland vs. Germany, the Euro Area and the US

$$\frac{\frac{\text{productivity of Swiss non-tradable sector}}{\text{productivity of Swiss tradable sector}}}{\frac{\text{productivity of country X non-tradable sector}}{\text{productivity of country X tradable sector}}}.$$

A decrease in this ratio represents the BS effect, i.e. should imply a real appreciation of the Swiss franc. After a decrease during the 1990s, this ratio has somewhat stabilized relative to the euro area and is now at a similar level than in 1999. By contrast, it has been increasing relative to the US since 1999.

To understand what drives this ratio, consider Figure 8, which presents the ratio of the productivity of the Swiss non-tradable sector relative to the non-tradable sector productivity of its trading partners, and the ratio of the productivity of the Swiss tradable sector relative to the tradable sector productivity of its trading partners.

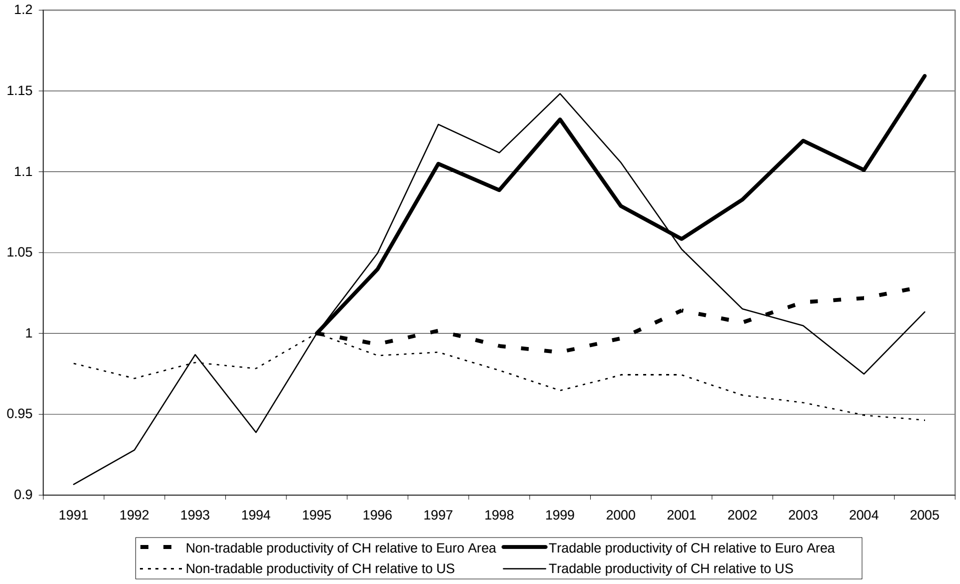

FIG. 8. Relative Sectorial Productivities

The ratios displayed are thus

$$\frac{\text{productivity of Swiss non-tradable sector}}{\text{productivity of country X non-tradable sector}}$$

and

$$\frac{\text{productivity of Swiss tradable sector}}{\text{productivity of country X tradable sector}}.$$

Several interesting observations appear from Figure 8. First, the Swiss non-tradable sector has recently become relatively more productive than the non-tradable sector of the euro area, but relatively less productive than the US non-tradable sector. Second, productivity in the US tradable sector since 1999 outpaced the corresponding Swiss productivity. By contrast, productivity in the Swiss tradable sector exceeded

European tradable sector productivity. All in all, Swiss productivity has recently been more in line with European than the more dynamic US productivity. Thus, the inverse BS effect that appears relative to the US since 1999 (in Figure 7) is due to an increase in the US tradable sector productivity relative to the Swiss tradable sector productivity, rather than a relative productivity increase from the Swiss non-tradable sector. However, since the beginning of this decade, Swiss domestic (internal) sector productivity has increased faster than its European counterpart; this has offset the faster relative productivity of the Swiss export sector and thus attenuated (flattened) the Balassa-Samuelson effect.

Thus, although the indirect proxy BS presented in the previous section seems to explain well the long-term evolution of Swiss franc exchange rates, more direct evidence points to a recent diverging evolution, thus adding uncertainty in assessing the potential development of the CHF exchange rates trend-evolution.

The mechanisms underlying the BS effect also provide some clues about the potential future trend evolution of the Swiss franc, which should depend on several factors. As we saw on Figures 3-5, the real appreciation does not systematically follow a trend, and the situation differs with respect to the currencies considered. On the one hand, if productivity in the EU is boosted by the effect of higher integration, we can imagine the bilateral exchange rate CHF/euro to evolve similarly to the exchange rate CHF/dollar, with no long-run trend. If, on the other hand, the EU grows more heterogeneously and includes less competitive countries, then gains in the Swiss tradable sector will keep appreciating the Swiss franc RER. From the Swiss side, bilateral agreements with the EU leading to free movements for workers imply that an assumption of BS, which is that labor supply is fixed, does not hold anymore and can thus contribute to dampen the RER appreciation. Moreover, progress in the liberalization and revitalization of the Swiss internal sector would dampen appreciation pressures as well. The net effect of those different influences is difficult to quantify, and might take time to unfold.

3.3. Other potential determinants

This section discusses other potential determinants of the Swiss franc real exchange rates, and the corresponding variables will be used in the econometric analysis that follows.

As there are no encompassing theory of exchange rate and thus no dominant approach of modeling equilibrium exchange rates, different approaches, more or less theoretical, more or less oriented on the long- or short-run, coexist in the literature[2]. The approach of this paper is to try explaining short- to medium-term CHF exchange rates developments. In doing so, I consider various economic variables that different theories have revealed as important. The methodology used is referred to as the Behavioral Equilibrium Exchange Rate (BEER) approach in the literature. The advantage of this methodology is that it does not requires long data series and strong assumptions regarding long-term equilibria, and it allows to assess short- to medium term exchange rate developments by relating them directly to economic fundamentals via simple single-equation regression methods.

The analysis is mostly based on Maeso-Fernandez, Osbat and Schnatz (MOS, 2001). Each variable discussed here has been computed as the ratio (or difference) of the Swiss variable divided by the corresponding weighted average of its trading partners,

[2] For a review of different methodologies, see e.g. Driver and Westaway (2004), and Égert, Halpern and MacDonald (2006).

where the weights account for imports, exports and third-market effects as discussed in section 2.1.

The uncovered interest rate parity condition is assumed in many economic models. In empirical analyses, the real exchange rate is usually expressed as

$$q_t = \overline{q}_t + (r_t - r_t^*) \, , \tag{2}$$

where $\overline{q}_t$ represents the equilibrium exchange rate and the second term in the RHS represents real interest rate deviation from its trading partners counterpart. The idea is that the exchange rate fluctuates around its equilibrium with interest rate differentials. Given that interest rate differentials are usually non-stationary empirically, they are included in econometric analyses; an increase in the differential is associated with a stronger current exchange rate as the currency is expected to depreciate later on. This condition thus translates into a positive relationship between the real interest rate differential and the real exchange rate, i.e. a higher interest rate relative to partners countries is associated with a stronger currency. Thus short- and long-term interest rate differentials are examined.

Terms of trade shocks can also affect real exchange rates. Oil price fluctuations (Oil), for example, can have a significant impact on the terms of trade of a small open economy like Switzerland, without many natural resources. The sign of the empirical effect of oil prices on a specific exchange rate is a priory unknown, and depends on the weights of the different trading partners. An increase in oil price should affect negatively the terms of trade and the competitiveness of a country that is relatively more dependent on oil than its trading partners, and should thus have a depreciating influence on the corresponding currency. In the empirical analysis, the real price of oil deflated by the US producer price index is used.

Another potential determinant of real exchange rates is the net foreign asset position. As a country accumulates international assets, its exchange rate needs to appreciate to re-equilibrate the balance of payments. The variable ACA used in the analysis is the accumulated current account position as a percentage of GDP.

An additional cause of Swiss franc fluctuations, which seems related to the international status of the Swiss currency, has been responsible for a structural break since the introduction of the euro in 1999. It is discussed in section 4.

Figure 9 displays the evolution of the real euro/CHF exchange rate and its potential determinants, i.e. Swiss relative to euro area corresponding variables. The Swiss franc appreciated in the 1970s until the early 1980s, then had a relatively flat tendency until the early 1990s. It further appreciated in the early 1990s before exhibiting a flat trend again. This evolution reflects the evolution of the BS proxy and of current accounts. Both the BS proxy and the current account (relative to euro area countries) increased during the 1970s until the early 1980s, then decreased or were flat since the first half of the 1980s, and increased again in the early 1990s; oil prices decreased a lot in the 1980s, which might have offset the relatively decreasing current account at that time, given that oil prices affect negatively the Swiss franc as the estimations in section 3.4 show. Since the mid-1990s, the relative decrease in current account, and later the increase in oil prices, have offset the increase in the BS effect for the evolution of the real exchange rate, which has had a flat trend since. It is more difficult to relate the Swiss franc evolution with interest rate differentials; this will be confirmed by non-significant estimated coefficients in section 3.4.

Figure 10 displays the same variables but relative all 24 trading partners, i.e. the

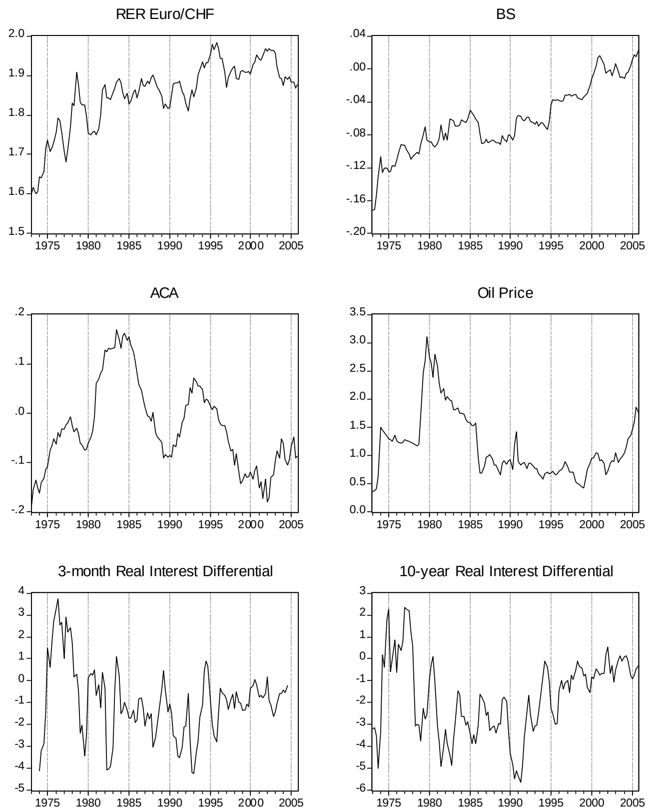

FIG. 9. Euro/CHF Real Exchange Rate and Determinants

effective exchange rate and its determinants. After appreciating since the 1970s, the real effective exchange rate of the Swiss franc has exhibited no trend since the late 1990s. Contrary to the euro/CHF exchange rate, the current account is estimated as non-significant (see section 3.4). Thus the exchange rate evolution could be understood in terms of the BS proxy and the oil price. The exchange rate kept appreciating in the 1980s despite the decrease or flattening of the BS effect as oil prices were decreasing. And more recently, the exchange rate flattened despite the increasing BS effect as oil prices increased. As in the euro case, interest rate differentials are econometrically insignificant.

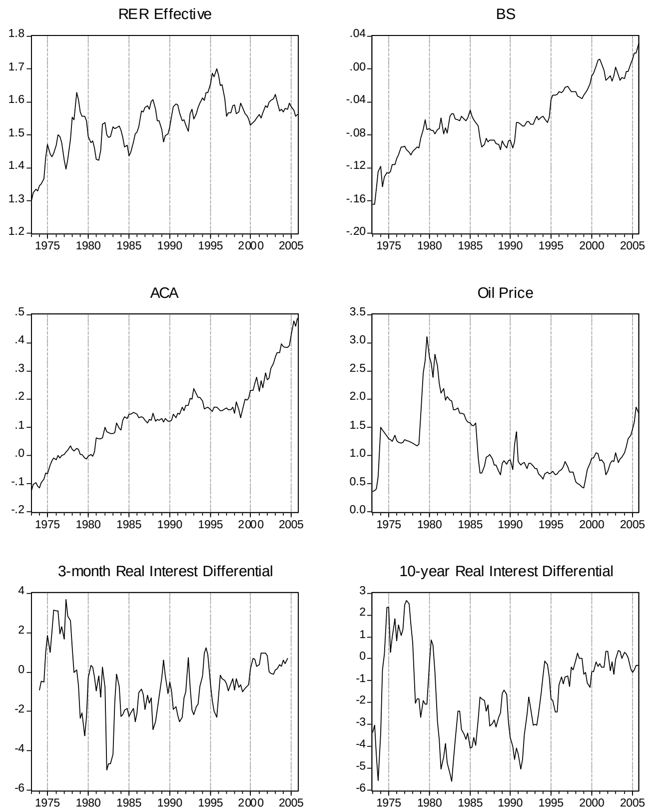

FIG. 10. Real Effective Exchange Rate and Determinants

3.4. Econometric relationships

This section presents econometric results of exchange rate equations relating real exchange rates to economic fundamentals. The analysis does not rely on specific integration or cointegration tests, as these tests suffer from important size and power problems in finite sample, and are sensitive to sample and lag length. In this exchange rate literature, even if integration or cointegration tests do sometimes fail, given small samples, series are considered as integrated, as they can be visually characterized by strong inertia.

Results of cointegrating vectors of VECM and OLS regressions are displayed in Table 1. The dependant variables are the real effective (eff) and real euro/CHF (euro) exchange rates. The sample is 1973-2006, with quarterly logarithmic data. Four lags are included in VECMs, and Newey-West standard errors are displayed for OLS estimates[3]. Short- and long-term interest rate differentials have not been included in the final regressions as their estimated effects were economically negligible and rarely econometrically significant.

	VECM (eff)	OLS (eff)	VECM (euro)	OLS (euro)
BS	0.62	1.11	1.26	1.57
	(0.36)	(0.29)	(0.24)	(0.24)
ACA	0.15		0.51	0.31
	(0.12)		(0.12)	(0.10)
Oil	-0.03	-0.035	-0.08	-0.05
	(0.01)	(0.016)	(0.02)	(0.01)

Table 1. Econometric Results

We thus see that BS effects continue to be important for long-term trends of the Swiss currency, even when other variables are included. We also see that terms-of-trade shocks, i.e. oil shocks, and relative current account positions have significant influences on the CHF exchange rate developments.

Figures 11 and 12 display fitted relative to observed exchange rates and residuals, for respectively the effective and euro/CHF exchange rates. The fitted value of the effective rate reflects mainly the upward trend appreciation, although with some flattening episodes. In the case of the euro/CHF exchange rate, the fitted rate matches the upward trend as well as the major fluctuations around it. These fluctuations re-

[3]P-values (of no cointegrating equation) of cointegration tests are .038 (trace test) and .00 (max-eigenvalue test) for the effective exchange rate equation, and respectively .053 and .068 for the euro equation, with the standard linear deterministic trend assumption; both tests for the euro equation however indicate the presence of one cointegrating equation at the 5 percent level when the sample ends in 1999, i.e. before the introduction of the euro, with very similar coefficients.

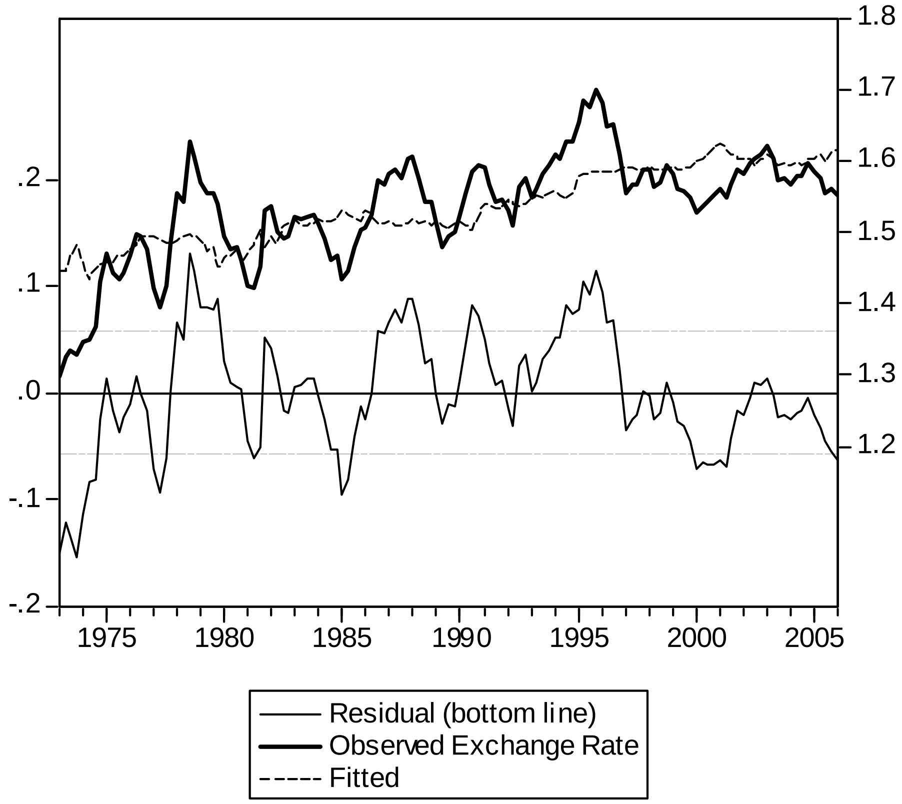

FIG. 11. Real Effective CHF: Observed and Fitted

flect the evolution of macroeconomic determinants as discussed in section 3.3. Even though, given the small sample, we cannot be very confident in point estimates, periods of relatively clear and persistent Swiss franc strength appear in the late 1970s, in the second part of the 1980s and in the mid-1990s when the EMS crisis occurred.

4. Recent structural changes in Swiss franc fluctuations

Swiss franc fluctuations have been affected by the introduction of the euro in 1999. As can be seen from Figure 13, before the introduction of the European currency the

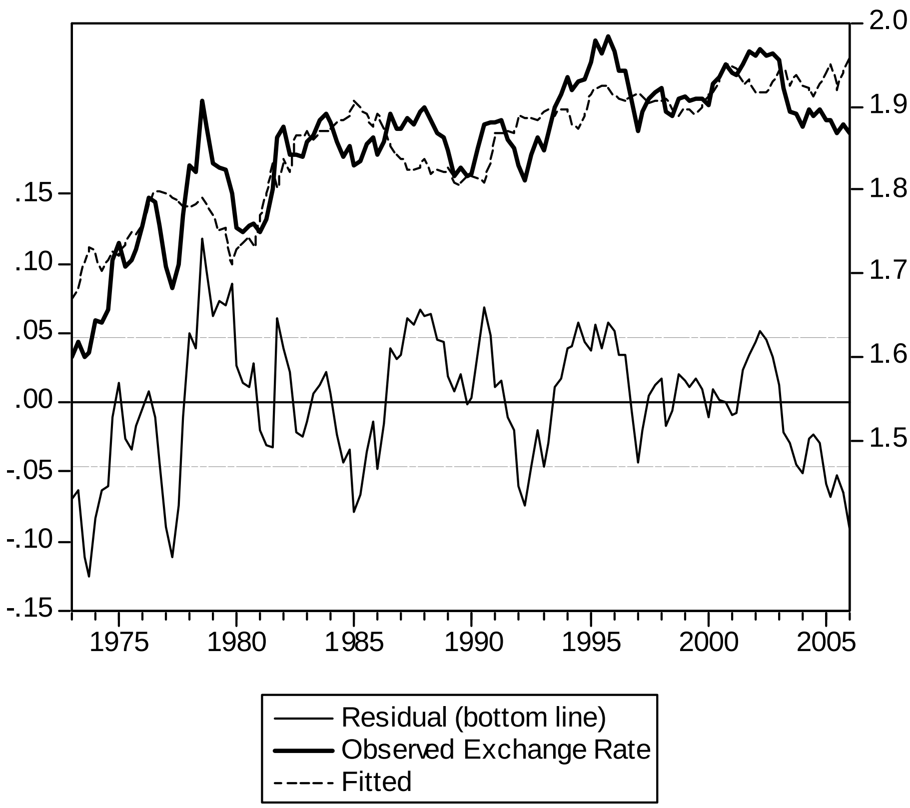

Fig. 12. Euro/CHF Real Exchange Rate: Observed and Fitted

Swiss franc was over-reacting to US dollar fluctuations, i.e. when the dollar depreciated, the Swiss franc appreciated even more with respect to the DM, exacerbating exchange rate fluctuations and their impacts on Swiss exporters. However, after the euro was introduced, this phenomenon was reversed. US dollar exchange rate shocks are thus now partly offset by opposite movements of the Swiss franc relative to the European currency. This dampens exchange rate fluctuations that exporters have to face, and allows the Swiss franc to evolve closer to its fundamentals even though the Swiss National Bank does not have an exchange rate target.

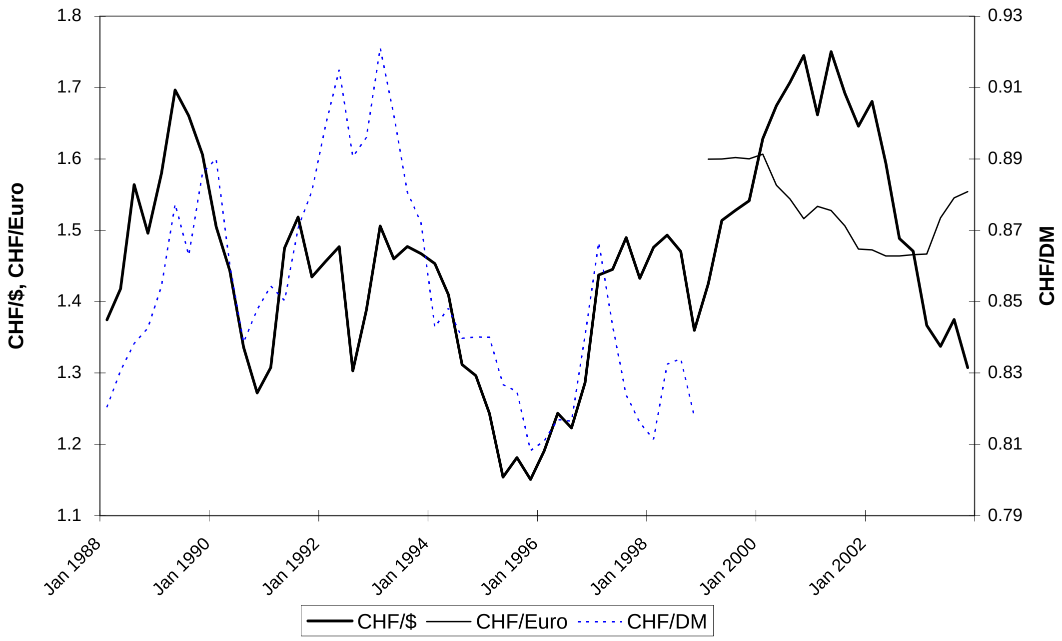

FIG. 13. CHF New Behavior

This phenomenon did not only affect the Swiss franc. As shown in Figure 14, the British Pound has been affected by that phenomenon and in the same way.

Thus the euro seems to be considered as a true counter-weight to the US dollar, and the traditional strong currencies seem to have lost part of their safe-haven status that affected their cyclical movements.

5. Conclusions

This paper has presented and analyzed different potential determinants of Swiss franc exchange rates. The different behaviors of the Swiss franc exchange rates relative to different currencies are generally well matched, in their trends and fluctuations, by the potential determinants examined. Issues however arise as the measurement

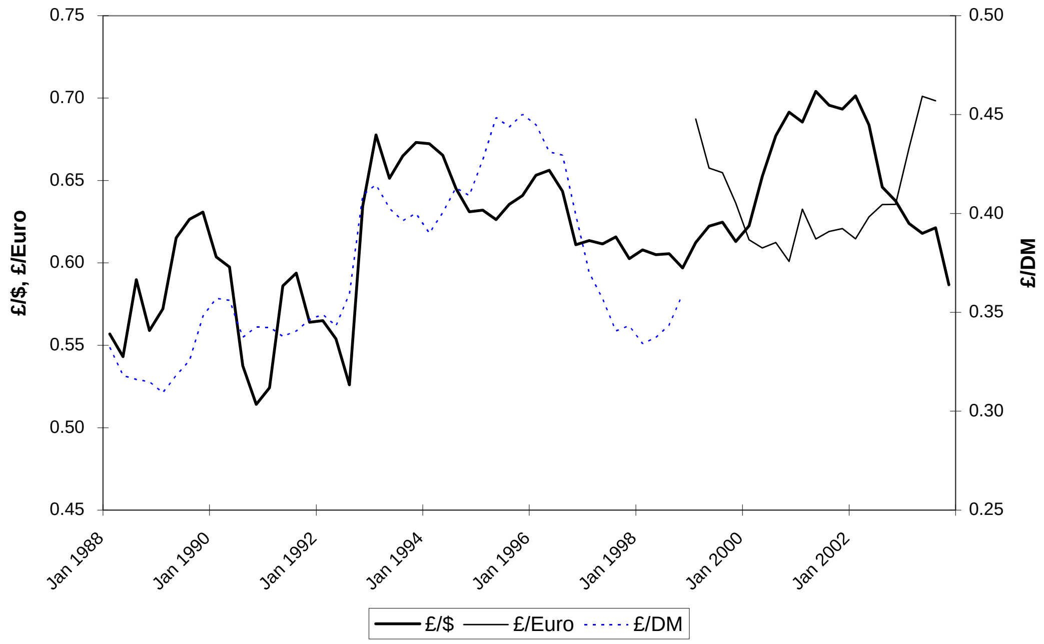

FIG. 14. British Pound New Behavior

of potential determinants are not always precisely defined, and different data sources and methodology sometimes lead to different results, as it is for example the case for the Balassa-Samuelson effect recently.

Some interesting facts stand out from the analysis:

- The Swiss franc has been appreciating in real terms, over the past three decades, against the euro and trading partner currencies in general (i.e. the effective exchange rate), but not against the US dollar.

- Bilateral exchange rates match well with a Balassa-Samuelson proxy, and the highly competitive Swiss export sector seems to have been the driving factor behind the long-term appreciation of the Swiss franc relative to the German mark and the euro.

- Other factors, like oil prices, current account positions, and (not always significant) interest rate differentials also affect the Swiss franc evolution; the rise in oil prices could partially explain the recent weakness of the Swiss franc.

- There have frequently been substantial and persistent exchange rate movements not explained by fundamentals, especially with respect to the US dollar.

- Over the 1990s, the apparent strong Swiss franc seems to have been due to weak (undervalued) European currencies rather than an overvaluation of the Swiss franc itself.

- Since the beginning of this decade, Swiss domestic (internal) sector productivity has increased faster than its European counterpart; this has offset the faster relative productivity of the Swiss export sector and thus attenuated (flattened) the Balassa-Samuelson effect; in other words, this would be a reason for the upward trend in the CHF/euro real exchange rate to flatten and thus partly for the recent weakness of the Swiss franc. However, on the contrary, indirect evidence on the Balassa-Samuelson effect do not point towards a change in that appreciating trend. The empirical evidence is thus mixed.

- The short- and medium-term behavior of the Swiss franc has recently been affected by the introduction of the euro, which has had a stabilizing effect on Swiss franc fluctuations as the CHF/euro and CHF/dollar exchange rates have moved in opposite directions; the recent weakness of the Swiss franc with respect to the euro could thus have been partly caused by a weak dollar.

Even though such an empirical analysis can lead to interesting observations, the literature on exchange rates is still far from being able to provide robust answers on what drives a given exchange rate at a particular point in time. This is not only due to data limitations, but also to a lack of theory encompassing the different explanations suggested thus far in the literature.

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Appendix: Data sources and computations of variables

A. Data used in computing exchange rates and their determinants:

The data set includes the following countries: Switzerland (CH), United States (US), United Kingdom (UK), Japan (JP), Canada (CA), Australia (AU), Denmark (DK), Sweden (SE), Norway (NO), Korea (KO), Hong Kong (HK), Singapore (SG), Austria (AT), Belgium (BE), France (FR), Germany (DE), Italy (IT), Luxembourg (LU), Netherlands (NL), Finland (FI), Greece (GR), Ireland (IE), Portugal (PT) and Spain (ES).

Using trade weights obtained from the ECB, the series are generally aggregated by geometric averaging. The weights, which were calculated for the reference period 1999-2001, include third market effects. See ECB 2000 for a description.

The data set is quarterly and covers the period 1970:1 to 2006:4. Some series were converted from annual into quarterly values by a spline method. Due to lags in the publication, the data set exhibits increasingly missing values near the end. Similarly, some series start later than 1970:1 such that missing values also occur at the beginning of the sample. Missing values are omitted by rebasing the weights skipping the corresponding country.

In order to calculate the variables RER, TNT, OIL, TBD, RID and SRID, the following time series are used:

Nominal exchange rates: International Financial Statistics [IFS], line rf, nominal exchange rate per US dollar. For EMU countries, exchange rates before the introduction of the Euro were converted into Euro rates by multiplying with fixed exchange rates (e.g. DEM/EUR is 1.95583).

Consumer Price Index: IFS, line 64. Harmonised CPI (line 64h) for EMU countries from 1999:1 onwards. For HK, from 1974:3 to 1980:3 the average of the HK Census and Statistics Department's CPI(A), CPI(B) and CPI(C) represents CPI.

Wholesale Price Index: IFS, line 63. PT uses OECD Main Economic Indicator [MEI] data line PPIAMP01.IXOB from 1990 onwards; no data before. No data before 1993 for HK. For NO, BE, FR, IT and LU, early data are taken from the paper version of IFS.

Oil price: IFS, line 00176AADZF, spot price in US dollar.

Long-term interest rates: IFS, line 61. No data for HK and SG. No data for ES before 1978:4. No data for PT before 1976:1. For SE, OECD MEI line IRLTGV02 from 1987:1 on. Finland uses line 61 since 1993, BIS HGAAFI22 from 1988:1 to 1993:1 and BIS HPHAFI93 before.

Short-term interest rates: IFS, line 60b. For CH and CA, OECD MEI line irt3. For UK, IFS line 60c. For HK, short-term interest rates from the HK Monetary Authority from 1980:1 to 1993:1. For KO and FI, IFS line 60 from 1974:1 to 1976:4 and 1970:1 to 1977:4, respectively. For GR, IFS line 60l up to 1985:2 and line 60c onwards. For IE, missing values replaced by 60c. For PT, line 60 before 1981:01.

Nominal GDP: IFS, line 99b. For US, JP, CA and AU, values divided by four to convert into quarter-on-quarter values. For some countries, data converted into quarterly values using a spline method. Some series were seasonally adjusted using TRAMO-SEATS.

Net Foreign Asset: IFS, line 78aldzf. For some countries, missing values back to 1973 were replaced using the paper version of IFS or the Milesi-Ferretti database[4]. For US, UK, CA, AU, SE, SG, AT, DE, IT and NL, values represent the cumulated

[4]See Lane, P.R., Milesi-Ferretti, G.M., 2001. The external wealth of nations: Measures of foreign assets and liabilities for industrial and developing countries. Journal of International Economics.

sum of current account data (78aldzf). Starting point is the value of Milesi-Ferretti for the year 1972. For JP, KO, HK, BE, FR, LU, FI, IE, PT and ES, the values represent linearly interpolated values of Milesi-Ferretti up to the point when IFS data is available. No values for DK, NO and GR.

Real GDP: IFS, line 99bv. For most countries, values were seasonally adjusted and converted to quarterly values. No values for SG and GR.

Purchasing Power Parity: IMF World Economic Outlook database, Implied PPP conversion rate denoted in USD from 1980 to 2006[5].

Variables have been computed as follows:

RER: The real exchange rate of a country is the ratio of the nominal exchange rate divided by the consumer price index. RER is then the ratio of the Swiss ratio over the weighted ratio of its partner countries.

TNT: The ratio of consumer and producer prices in Switzerland relative to the ratio of its trading partners.

OIL: Oil price divided by the US producer price index.

TBD: Difference in the trade balances of Switzerland and partner countries denominated in percentages of nominal GDP. Geometric mean is not used for the aggregation of the partner countries' values. Instead, imports and exports are summed across partner countries divided by the corresponding sum of GDPs.

GDP: Ratio of GDP in per-capita terms at PPP levels in Switzerland over the same variable from the other countries. For this purpose, real GDP values were multiplied by the PPP conversion factors.

RID: Subtraction of consumer price inflation from current long-term interest rates. RID is the difference between Swiss real interests and the real interest rates of its

[5] See http://www.imf.org/external/pubs/ft/weo/2007/01/data/index.aspx

partners. Consumer price inflation is the year-on-year percentage change in the price level.

SRID: The same ratio as RID but using short-term interest rates instead.

B. Data used in computing direct evidence on the BS effect:

In order to calculate sectorial labour productivities, data about sectorial employment and sectorial Gross Value Added [GVA] are needed. For Germany and Switzerland, quarterly data is only available for 7 and 11 sectors, respectively. On an annual base, such data is available for 85 sectors in Germany and 88 sectors in the US. Swiss data is not available on an annual base and, hence, it was aggregated. Swiss data stems from the Swiss Federal Office of Statistics [BfS][6], German data is from the Genesis database of the Federal Statistical Office[7] and US data is from the Bureau of Economic Analysis[8].

In addition, such data is available for 33 sectors for Belgium, Czech Republic, Germany, Denmark, Euro Area, Euro Area 11, Euro Area 12, Euro Area 13, EU15, EU25, Finland, Italy, Luxembourg, Hungary, Netherlands, Norway, Sweden, Slovenia and the United Kingdom from Eurostat[9].

Quarterly data is available from 1992:1 to 2006:2. Annual US data is used from 1991 to 2005. Annual German data spans the period 1991 to 2005. Depending on the country, Eurostat data begins between 1988 and 1995 and ends between 2003 and 2005.

According to a self-defined binary indicator, these sectors are separated into an export-oriented sector and an interior sector. For each country, the relative labour

[6] See www.bfs.admin.ch
[7] See https://www-genesis.destatis.de/genesis/online/logon
[8] See http://www.bea.gov/industry/index.htm#annual
[9] See the database of Eurostat at http://epp.eurostat.ec.europa.eu/. Annual, detailed breakdowns of national accounts can be found in the tree Economy and Finance.

$$R_{j,t} = \frac{\dfrac{\sum_{s}^{S} GVA_{s,t}^{NT}}{\sum_{s}^{S} E_{s,t}^{NT}}}{\dfrac{\sum_{s}^{S} GVA_{s,t}^{T}}{\sum_{s}^{S} E_{s,t}^{T}}}$$

FIG. 15.

$$R_{j,k,t} = \frac{\left(\left(R_{j,t}\right)^{-1}\right)^{\alpha_{j,t}}}{\left(\left(R_{k,t}\right)^{-1}\right)^{\alpha_{k,t}}}$$

FIG. 16.

productivity index is then calculated according to the following formula:where $R_{j,t}$ denotes the ratio of labour productivities at time t in country j. Subsequently, these ratios are divided by the ratios of the other countries to obtain a relative labour productivity index according to the Balassa-Samuelson hypothesis. The same ratio within a country was also calculated in an inverted version. The inverted ratios are exponentially weighted by: $\alpha_{j,t}$ and $\alpha_{k,t}$ are weights which are equal to the weight of the non-tradable sector in the CPI at time t in country j and k, respectively.

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