

Long-run effects of exchange rate appreciation: Another puzzle?

Marlene Amstad and Beatrice Weder di Mauro

The Chinese University of Hong Kong, Shenzhen; INSEAD, CEPR and ABFER

In the short to medium run, open economy textbook models predict that a real exchange rate appreciation shock negatively impacts macroeconomic performance. Over the long run, exchange rate appreciation and economic growth are predicted to be positively associated due to Balassa-Samuelson effects. In this case, the causality runs from growth to appreciation and exchange rate changes merely reflect underlying economic development, they are not driving them. This paper starts with a selective review of recent empirical literature, which is more ambivalent and suggests several reasons as to why the sensitivity to exchange rate appreciation shocks seems lower than predicted by theory. Reviewing the long-run association of appreciation and growth suggests that causality may also be at issue and raises another puzzle, particularly pronounced in Switzerland.

JEL codes: F41, F43, O42

Key words: real exchange rate, appreciation, growth

*The president “was confused about the dollar:
Was it a strong one that’s good for the economy? Or a weak one?”
Donald Trump purportedly asked National Security Advisor Flynn*

Introduction

The confusion of Donald Trump may seem surprising, but the economics profession has pondered a similar question: “Do exchange rates and exchange rate regimes matter? And if so, how?” At issue are the channels through which movements in the (real) exchange rate transmit into the domestic economy, the timing, and the quantitative impact as well as the causality of these effects. The dominant view holds that the real exchange rate is one of the most important prices in an open economy and significantly impacts the real sector. In the short to medium run, the textbook sees appreciations as mostly hurtful to economic performance, implying a negative correlation between the real exchange rate and growth. In contrast, in the long run, higher (catch-up) growth is expected to lead to an exchange rate appreciation, implying a positive correlation between long-run appreciation and growth. Note that in the short run, the causality runs from the exchange rate to real performance while in the long run, the presumption is

that the exchange rate merely responds to real productivity growth. However, a growing body of empirical research casts doubt on these predictions.

These issues are of particular importance for Switzerland, since the country has experienced both exchange rate appreciation shocks and long-run trend appreciation. Switzerland has seen strong appreciation pressures in times of heightened geopolitical uncertainty or euro area fragility. The Swiss National Bank intervened in attempts to mitigate their impact on the exchange rate, and between September 2011 and January 2015 maintained an exchange floor. When it abandoned the exchange rate floor, the Swiss franc briefly appreciated by more than 30% against the euro before stabilizing, albeit at a somewhat overvalued rate (SNB, 2017). Maybe even more remarkable than these appreciation shocks is Switzerland's long-run experience with trend appreciation. As we show in Section four, the Swiss economy stands out among advanced countries as having experienced the highest real exchange rate appreciation over the last 35 years. Thus, understanding the short- and long-run consequences of appreciations is crucial for Switzerland.

The aims of this paper are threefold. First, we provide a selective review of the theory and evidence on the impact of real exchange rate changes in the short to medium run (Sections 1 and 2). Second, we review the long-run association between appreciation and growth and suggest that causality may be at issue (Section 3). Third, we look at the correlations between long-run growth and appreciation among advanced countries and suggest that this raises a new exchange rate puzzle, possibly specific to Switzerland (Section 4).¹

1 The impact of real exchange rates in the short run: Large in theory

In the short term, the textbook open economy model predicts a negative correlation between real exchange appreciation and growth. The literature distinguishes three different channels of transmission: trade, capital flows and balance sheets.

In the classic Mundell-Fleming model, real exchange rate movements affect output through the *trade channel* – depreciations increase net exports and appreciations decrease net exports. This may happen with a lag as J-curve effects play out and volumes adjust to changed relative prices, but the typical student of macroeconomics will learn that in the end, an appreciation negatively impacts net exports, whereas net exports benefit from a real depreciation. Depreciations and appreciations are generally thought to have opposing but symmetric impacts on

¹ The international macro literature already has a large collection of exchange rate puzzles, as summarized for instance by OBSTFELD and ROGOFF (2000)

net trade. In the Mundellian logic, the exchange rate is the main instrument for adjustment following a shock to the economy. Consequently, the optimal currency area theory postulates that the loss of the nominal exchange rate as an instrument for changing the real exchange rate can be very costly. The magnitude of the cost depends on many factors, which together determine whether it is optimal for a country to join a currency union.² But the entire optimal currency area argument ultimately rests on the expectation that real exchange rate changes have a deep impact on output and employment through the trade channel. For the same reason, the exchange rate–trade nexus has been at the center of the international monetary policy debate for decades, with controversies ranging from competitive devaluations and “beggar thy neighbor” policies, to the creation and demise of the Bretton Woods system, to G7 coordination such as the Louvre and the Plaza Accords, to the recent debates about “currency wars” and the branding of some countries as “currency manipulators”.

In addition to negative trade effects, emerging markets and also have reasons to feel uneasy about appreciations associated with surges in *capital flows*, since inflows are frequently followed by a sudden stop and possibly a currency crisis. Emerging markets have experienced repeated periods of “risk on”, leading to waves of yield-seeking international capital flows leaving them with the choice between intervening or tolerating exchange rate appreciation, which in turn would hurt their exports sector. Episodes of sudden stops and capital flight are often associated with global risk perceptions and contagion, which matter more than domestic macroeconomic fundamentals but end up negatively impacting growth (FORBES and WARNOCK, 2012).

Theories of third-generation currency crises point to an additional channel for the impact of exchange rates on the economy, namely, the currency composition of *balance sheets* in the financial, public and corporate sectors. A currency crisis is a sudden exchange rate shock resulting from a run (speculative attack) on foreign exchange reserves.³ In third-generation currency crisis models, the exchange rate shock propagates through a currency mismatch between liabilities and assets in the

2 These factors include the frequency and type of shocks (higher costs if shocks are frequent, asymmetric and real), the degree of openness and integration (lower incidence of asymmetric shocks for highly integrated countries), on the ability of other instruments to accommodate or buffer a negative shock (better if prices and wages are flexible, rigidities in labor markets low and cross border migration high) and on the availability of countercyclical buffers (better if there are common fiscal instruments with discretionary or automatic temporary transfers). Last but not least, the net cost of giving up the exchange rate instrument depends on the prospects of the alternative regime (challenging for central banks with little credibility and for floaters with excess volatility, overshooting and persistent misalignments). For an example of a textbook view of optimal currency area theory, see BALDWIN and WYPLOSZ (2015).

3 The underlying causes vary depending on the type of crisis, and include persistent fiscal deficits – as in the first-generation model a la KRUGMAN (1979) – a combination of fundamental fragility with self-fulfilling expectation equilibria – as in a second-generation model by OBSTFELD (1996) – or a fragility in the balance sheet of the financial sector – as, for example, in CHANG and VELASCO (2001).

balance sheets of the public, the financial or the corporate sector. This mismatch is larger the more the country is suffering from “original sin” – that is, an inability to borrow abroad in domestic currency.⁴ In this case, a sudden depreciation will lead to an inflation of liabilities denominated in foreign currency. Balance sheets of the government, the banking system and the corporate sector deteriorate simultaneously, thus a currency crisis is frequently associated with a banking crisis – a so-called twin crisis (KAMINSKY and REINHART, 1999). Moreover, if the government attempts to rescue the banking system, this may further impair the sovereign’s credit rating and induce a run on government bonds. Instead, if the government defaults, this immediately impairs the assets of the banking system, which in turn can lead to a reduction in credit to the private sector, exacerbating the decline in output and reducing tax revenues (GENNAIOLI, MARTIN and ROSSI, 2014). In a currency crisis, the financial sector and the public sector find themselves locked in a deadly embrace, bound by the interdependence in their balance sheets. Altogether, this means that balance sheet effects in currency and financial crises can be highly disruptive and the economic costs large.

In contrast to the trade channel, balance sheet effects may be *asymmetric* (that is, different for depreciations than for appreciations). There is an inherent non-linearity in balance sheets that can introduce asymmetry: balance sheet shrinkage through asset deterioration is usually limited by insolvency, while there is no such technical limit for balance sheet expansion. Similarly, a central bank fighting against appreciation does not have to fear a run on foreign reserves. Its foreign reserves are expanding rather than shrinking the balance sheet, in theory a process that is unlimited. In practice, the accumulation of foreign reserves may also be bounded, for instance by concerns about financial risks and central bank losses in the case of a capital flow reversal. These risks might result in dynamics akin to the self-fulfilling prophecies in second-generation currency crisis models: they trigger a run (on the domestic currency) followed by the demise of the peg and an exchange rate (appreciation) shock. However, the balance sheet effects that make depreciation shocks so harmful in many emerging markets are less likely to carry over to appreciation shocks. In particular, if there is no currency mismatch in financial or corporate balance sheets, this channel is muted and the consequences of the appreciation crisis in the real sector will play out through the trade channel only.

Overall, through a variety of channels, appreciations are expected to have a negative on growth in the short to medium term.

4 See, for instance, EICHENGREEN, HAUSMANN and PANIZZA (2005).

2 The impact of real exchange rates and recent empirical evidence

There are several different lines of attack on the textbook view, most of which are empirical and apply to the long run. For the trade channel, global value chains, as well as sectoral and geographic differences in exchange rate sensitivity, are among the most commonly cited reasons why macro performance is often found empirically to be less hurt by an appreciation than theory suggests. For the capital flow and balance sheet channels, a global financial cycle may be muting the impact of exchange rates and exchange rate regimes.

A straightforward reason to doubt whether a change in the exchange rate impacts the wider economy to a great extent is that producers have a cost incentive to adapt to the exchange rate environment by shifting towards products and services, as well as a customer base, with *lower exchange rate sensitivity*. If exports and/or imports do respond less elastically to changes in relative prices of home and foreign goods, the resulting effect of prices on net exports will be small, particularly relative to the quantitative demand effect.⁵ HANSLIN GROSSMANN, LEIN and SCHMIDT (2016) find, for Switzerland, that exports of the two largest export sectors are relatively sensitive to long-run foreign demand developments, but they are relatively insensitive to changes in the exchange rate. This leads the authors to observe that foreign demand is more important for structural considerations than the exchange rate.⁶ Similarly, TILLE (2017) finds that Swiss exports held up well even during the severe appreciation phase since 2007 due to a shift towards sectors with a relatively low exchange rate elasticity (such as merchanting and the chemical industry).⁷

The highly adaptive behavior of entrepreneurs is supported by the finding of DARUICH, EASTERLY and RESHEF (2016) that export specializations may be surprising nimble. They study product churning at a disaggregated level and show, for a large cross-section of countries, that the probability of a product being in a country's top 20 exported goods and remaining there after one decade is very small. In other words, the ranking within countries' top exporting goods is highly mobile and volatile. It would appear that either existing firms are highly adaptive in reinventing themselves, or the turnover among old and new firms is very high. It also seems plausible that firms use this flexibility in specialization in a way

5 If underlying savings and investment remain unaffected, an appreciation of the currency may fail to reduce the current account surplus, a point made in the context of the debate on the global imbalances and the Chinese surplus (DEVEREUX and GENBERG, 2007).

6 See also FLÜCKIGER, RUTZER and WEDER (2016).

7 Meanwhile, AUER and SAURE (2012) add a note of caution and document that the timing of global demand growth can completely mask the effect of the strength of the Swiss franc. The failure to account for periods of pronounced appreciation of the franc that coincide with a strong recovery of global demand could lead to underestimating the importance of the exchange rate for Swiss export performance.

that takes into consideration the exchange rate environment by moving towards products/services (often referred to as “niche products”) and costumer bases that are less sensitive to exchange rates.

A second reason for low exchange rate sensitivity of the economy could be the expansion of *global value chains*. Over the past decade, production processes have been unbundled and farmed out across borders, forming ever-lengthening global value chains. An increasing part of any final good will therefore contain intermediate goods from abroad, and in some cases the intermediate goods may themselves have crossed the border several times. Global value chains mute the impact of exchange rates in terms of quantity and prices.⁸ Global value chains also lower the price effects triggered by an appreciation. At the same time as an appreciation increases the foreign currency price of an exported good, it also reduces the cost of the imported intermediary. The exporter could use this cost reduction to mitigate the effect of the appreciation by reducing the foreign currency price of the exported good. In other words, a global value chain may provide some natural hedge against an appreciation. However, the literature has found the exchange rate pass-through to import prices to be incomplete.⁹ After the global financial crisis, the pass-through has been found to remain relatively low and stable over time for advanced economies and decreasing for emerging economies (JAŠOVÁ, MOESSNER and TAKÁTS, 2016). To summarize, in a world of global value chains, exchange rate changes can be expected to matter less.

Turning from a trade to a capital flow and balance sheet related angle, REY (2013, 2016) postulates the existence of a *global financial cycle* in asset prices and capital flows that affects all countries equally, independently of whether they have fixed or floating exchange rates.¹⁰ BUSSIÈRE, LOPEZ and TILLE (2015) study real exchange rate appreciations episodes of one and three years for a large cross-section of countries. They find that appreciations associated with capital inflows tend to reduce growth, in particular in emerging markets, while appreciations associated with a productivity boom tend to increase growth.

A recent strain of literature identifies a *financial channel in exchange rates*, which advances that exchange rates may increase risk-taking. In this view, an appreciation is associated with looser financial conditions and therefore is expansionary. The

8 For instance, in China an appreciation of the renminbi would not only reduce export values, but likely would also induce a fall in the imports because a significant part of Chinese exports has a large import content from South East Asian countries. GARCIA-HERRERO and KOIVU (2008) show that this limits the net effect of an appreciation on the Chinese current account while transmitting some of the reduction in trade to the countries in the rest of Asia.

9 See, for instance, GOPINATH, ITSCHKOKI and RIGOBON (2010).

10 However, there is also a growing number of studies that doubt whether the evidence on a global financial cycle is robust (e.g., CERUTTI, CLAESSENS and ROSE, 2017).

exchange rate acts as a key economic variable for the conduct of monetary policy as it influences local currency yield curve, determines financial conditions, and acts as a transmission channel of global liquidity.¹¹ However, the impact of exchange rates works in the opposite direction to the textbook. In this context, HOFMANN, SHIM and SHIN (2017) emphasize the financial risk-taking channel of currency appreciation associated with the global role of the dollar. They document that appreciations go hand-in-hand with easier financial conditions and compressed sovereign bond spreads due to a reduction in the credit risk premium. Crucially, the relevant exchange rate involved in yield compression is the bilateral dollar exchange rate, not the trade-weighted exchange rate.

Generally, it seems surprisingly difficult to empirically pin down the effects, extent and direction of impact of different exchange rate regimes, irrespective of the classification method used.¹² Overall, we close this selective empirical review by referring to ROSE's (2011) verdict on the literature on exchange rate regimes. He concludes that the only robust finding on the effects of exchange rate regimes is that there is no robust finding. Rose points to the experience of similar countries¹³ with widely different exchange rate regimes and yet no discernable differences in long-run economic performance. We turn to the long run next.

3 Real appreciation and growth in the long run

In the long run, the textbook predicts a positive correlation between appreciation and growth with the direction of causality running from growth to the exchange rate. More precisely, sustained growth will cause real long-term appreciation. In the classic Balassa-Samuelson effect, a catching-up process drives differential productivity growth between the tradable and the non-tradable sectors down, and wages in both the tradable and non-tradable sectors up, thus leading to an appreciation of the real exchange rate. An alternative underlying reason for a sectorial productivity differential with macro-sized effects may be a commodity boom or oil discovery (as in "Dutch disease" models), or sustained and large inflows of capital (for instance, in the form of aid in a small economy). The expanding sector draws in resources from the traditional export sector, resulting in higher wage growth, a real exchange rate appreciation and a decline in the traditional export sector. In a mature economy, this will be equivalent to

11 For instance, KALEMI-OZCAN, LU and SHIM (2017) document that exchange rate appreciations have led to an increase in leverage in ten Asian emerging markets.

12 See KLEIN and SHAMBAUGH (2015), GHOSH, GULDE and WOLF (2003) and LEVY-YEYATI and STURTZENEGGER (2003) for causes and consequences of the choice of exchange rate regime.

13 For example, Hong Kong and Singapore (one on a peg to the US dollar for more than 30 years, the other on a managed float (REER targeting) with undisclosed basket weights).

accelerated deindustrialization. In all these cases, theory predicts a real exchange rate appreciation as a consequence of an underlying economic expansion process.

The assumptions in Balassa-Samuelson are rather restrictive. The mechanics work over increased wages in the tradable sector that translates into increased wages in the non-tradable sector. It therefore assumes full employment in the tradable sector and full flexibility from the non-tradable to tradable sector. Most obviously, the former is doubted, for instance in the case of China with migrant workers entering the tradable sector. Not surprisingly, adaptations of Balassa-Samuelson have been suggested which relax the restrictive assumptions.

Testing Balassa-Samuelson is complicated by the high data requirements. Productivity is notoriously hard to measure consistently and compare over different industries, let alone countries and several decades. Nevertheless, there is a broad body of literature dedicated to the empirical evaluation of the Balassa-Samuelson hypothesis. TICA and DRUŽIC (2006) provide an overview concluding that the majority find supportive evidence, but with widely varying strength.¹⁴ Indeed, GUBLER and SAX (2017) found more recently that evidence for a Balassa-Samuelson effect is crucially driven by the choice of dataset and country sample. For an OECD country panel from 1970 to 2008, they even find a robust negative relationship between productivity in the tradable sector and the real exchange rate over the last two decades.¹⁵ Overall, the evidence on Balassa-Samuelson can be described as mixed.

Entrepreneurs sometimes hold theories on exchange rate appreciation which differ markedly from the Balassa-Samuelson effect not in terms of the positive long-run relationship between exchange rates and growth, but in terms of the underlying mechanisms. In the German-speaking area, a *Schumpeterian view* is popular which holds that the causality between exchange rates and productivity growth starts with the former. While Balassa-Samuelson see productivity differentials driving exchange rates, this view postulates exchange rates driving productivity. Some European entrepreneurs claim that “living with an appreciating currency” means that firms have to increase productivity and innovate constantly, which ultimately increases their competitiveness and allows them to maintain or even expand market share and profitability. They claim that the expectation of a long-term upward currency pressure, despite short-term negative effects, also has positive impacts in that it amounts to a “fitness program” – or in Schumpeters’ words, “a creative destruction” – and encourages restructuring and reforms

14 For more recent empirical support for the BS hypothesis based on a disaggregation of the tradable and non-tradable sector, see RICCI, MILESI-FERRETTI and LEE (2013) or BERKA, DEVEREUX and ENGEL (2014).

15 They refer to the negative instead of the expected positive relationship as “Balassa-Samuelson reversed”. Note that the concept we discuss below is different – it assumes that the causality is reversed, not the sign.

that otherwise would not be undertaken, or at least not as rigorously. Thus, they doubt that exchange rate depreciation in the long run “over all” improves the competitiveness of firms, but rather just relaxes the necessary pressure to remain “on edge”. In Germany, it is not unusual to hear the argument that the real exchange rate depreciation in the recent period is “overall/all considered” hurting German competitiveness because it reduces incentives to innovate.¹⁶

Such Schumpeterian views about the benefits of appreciation should inherently suffer from survival bias. Only entrepreneurs who successfully adapted to the pressures of appreciation will be around to tell their story, the others would have suffered the destructive part of the “creative destruction”. However, surviving entrepreneurs would likely be aware if there had been mass exit of competitors or neighbors. Moreover, since many of them are competing successfully on a global scale and putting their own wealth at risk, their views should at least be taken to be a puzzle.

Further, it seems that Schumpeter is very popular in the alpine machine cluster, which has demonstrated surprising resilience. The machines and tool making industry has remained strong in the alpine region ever since it progressed from making textiles, to making machines that make textiles, to all sorts of large and small companies that make leading engineering products and sell them all over the world. Many family-owned firms today command a dominating global position in a particular market niche.¹⁷ Figure A1 in the appendix shows that the alpine cluster’s dominance in automotive, IT, metal manufacturing and production technology is clearly visible on the European map, extending from northern Italy, through Switzerland, into Germany. Interestingly, this cluster spans different countries with different political systems, fiscal regulatory and administrative practices and, last but not least, different exchange rate regimes. We examine their long-run economic and exchange rate performance next.

4 Appreciation in the very long run

Based on the macro literature discussed above, exchange rate appreciation should hurt growth in the short run, but the long-run correlation between growth and exchange rates is expected to be positive. In this section, we take a few snapshots of the long-run relationship in a cross-section of countries. We are especially interested in the long-run dynamics of advanced countries that, like Switzerland, already started in pole positions. Therefore, we restrict the country sample to countries that joined the OECD in the first wave in the 1960s. In the

16 An example of this kind of argument is found in the news report at: <https://deutsche-wirtschafts-nachrichten.de/2017/09/24/merkels-vermaechtnis-deutschland-spielt-nicht-mehr-der-welt-liga/>

17 For case studies, see, for instance, ENRIGHT and WEDER (1995).

previous section, we suggested that even if a positive relationship is found, there could be two different mechanisms at work. Balassa-Samuelson suggests that productivity drives growth, while the Schumpeterian effect is reversed and runs from the appreciation to stimulating productivity growth. Both positive effects could potentially reinforce each other and together counterbalance the short-term negative relationship between exchange rates and growth. Our interest here is not in disentangling these effects, nor do we attempt to solve the endogeneity problem. Our aim is to establish some simple facts on the relationship of the exchange rate and growth over several decades. With most of the exchange rate literature focused on the short term, relationships which span several business cycles are less well known.

We start by taking three snapshots. The first aims at the expected positive relationship between the real effective exchange rate (REER) and growth in the long run; the second at the expected positive association of productivity growth and appreciation; the third checks whether the initial level of income, as a proxy of the potential for catch up productivity growth, is negatively associated with subsequent appreciation, as would be predicted by Balassa-Samuelson.

Figure 1

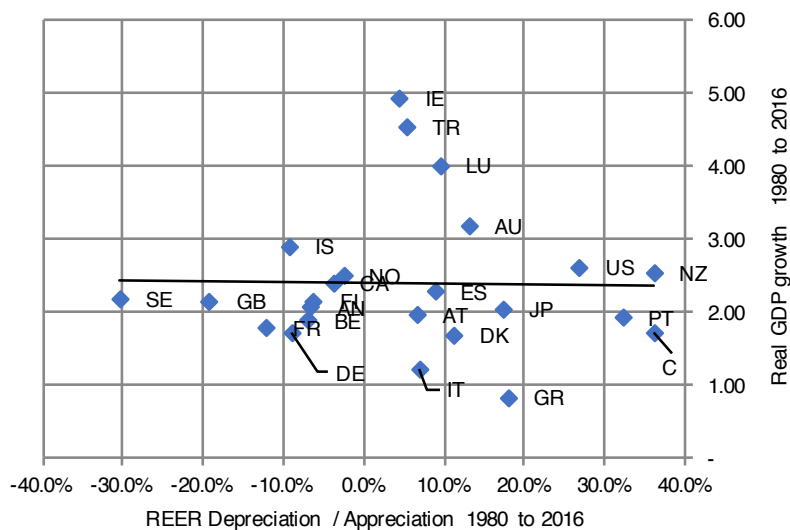


Figure 2 Productivity and REER

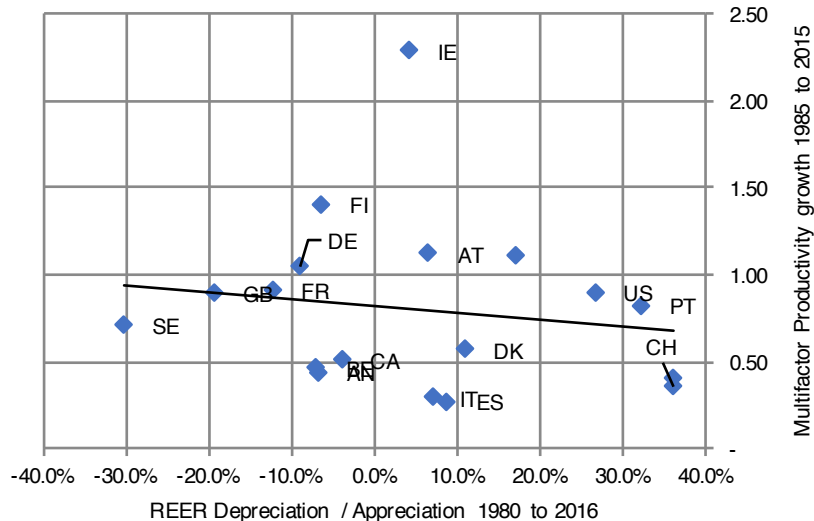


Figure 3 Catch up, initial GDP per capital and REER

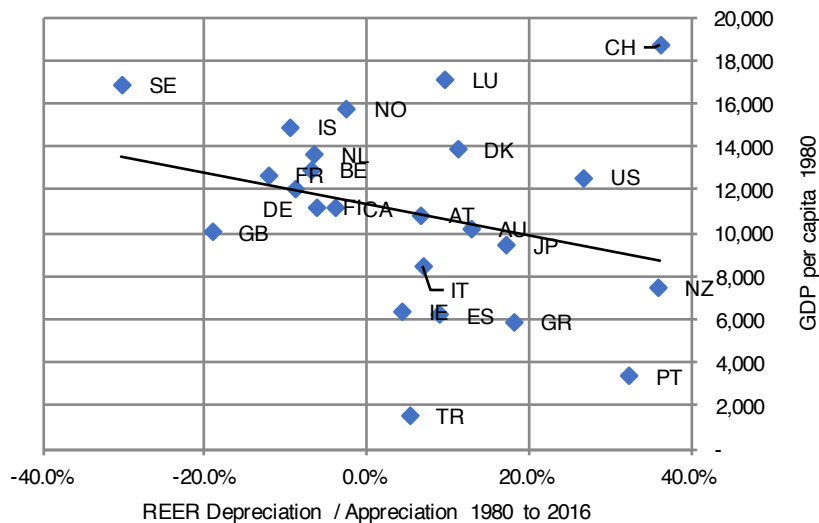


Figure 1 shows the first correlation between REER and GDP growth from 1980 to 2016. We see that in our group of advanced countries, REER appreciation and GDP growth do not seem to be strongly related.¹⁸ Countries with appreciation rates of almost 40% had similar growth rates as countries with depreciation rates of 20% and more. For example, Germany, France, Switzerland and Portugal all grew by 1.7% to 1.9% from 1980 to 2016. However, France and Germany saw a real depreciation of around 10%, while Portugal and Switzerland had a real appreciation of more than 30%. So, the expectation of a positive relationship between REER and growth in the long run is not confirmed. This might be related to our focus on advanced economies while the textbook case applies mostly to developing economies.¹⁹

Figure 2 looks at direct more evidence of a Balassa-Samuelson or Schumpeter effect in the correlation of multifactor productivity growth (as measured by the OECD) and REER. We do not find clear evidence of a correlation, which can be interpreted as being in line with the mixed support for Balassa-Samuelson in the empirical literature cited earlier. Figure 3 looks at the Balassa-Samuelson prediction from a different perspective and seems more promising. The level of initial GDP per capita relative to the frontrunners can be interpreted as a proxy for the catch-up potential of productivity in the non-tradable sector. Therefore, countries with lower initial GDP per capita would be predicted to see more real effective appreciation as their non-tradable productivity converges towards that of the tradable sector. So, in this case we expect to see a negative correlation, and this is indeed what seems to emerge.

However, Figure 3 also reveals a notable outlier – namely, Switzerland. The country started with a very high GDP per capita, so had little catch-up potential according to Balassa-Samuelson, and yet experienced a very high real exchange rate appreciation.

This begs the question whether there might be a specifically Swiss puzzle in this data. In comparison with other OECD countries, Switzerland's real effective exchange rate development stands out with respect to different metrics (see Table A1 in the appendix). Since 1980, Switzerland saw the highest appreciation in our sample of OECD countries (followed very closely by New Zealand). Since 1960, REER appreciation was almost 100% and was only surpassed by Japan. Meanwhile, other advanced countries like the United States showed in 2016 at

18 Note that for inflation rather than growth, this finding is well established in the literature as the role of exchange rate and import price shocks in explaining consumer price fluctuations has routinely be found to be relatively modest in industrialized countries; for an overview, see McCARTHY (2007).

19 In a broader panel that includes developing markets with a catch-up effect the relationship is more pronounced, but somewhat depends on the inclusion of China.

the same REER as in 1960, Germany's REER appreciated by a modest 10%, and the United Kingdom's REER depreciated at about the same rate. In addition, Switzerland also ranks highly in terms of REER surges. Since 1960 it has experienced the second highest one-year appreciation spell and is among the top three with regard to largest five-year appreciation spells. Against this background, as shown above, growth held up astonishingly well.²⁰

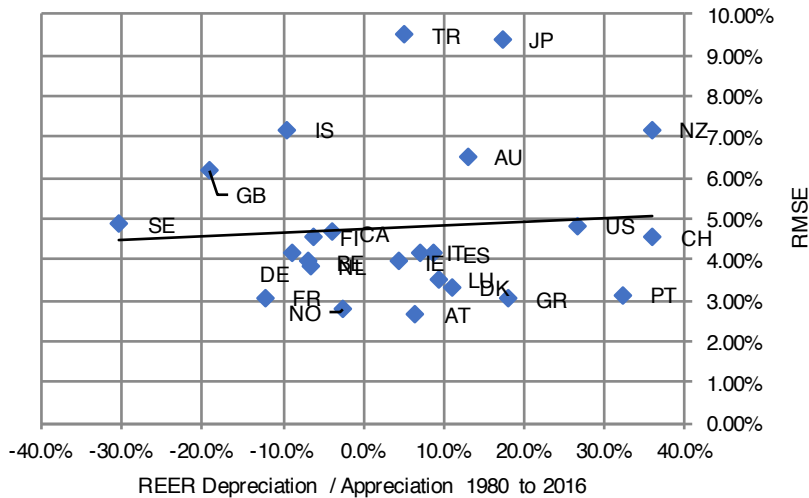
Could this be part of a broader puzzle? Could it be that Schumpeter is particularly visible here, as entrepreneurs claim? Could it be that the experience of secular exchange rate appreciation has conditioned Swiss entrepreneurs to drive productivity growth? We cannot test this hypothesis, nor establish causality, with these aggregate data. Even with more disaggregated data, it would be non-trivial to design a test that establishes the causality and disentangles these two hypotheses from short-term negative impacts of appreciation.

However, we do attempt one other look at the data by distinguishing between *expected* and *not expected* appreciation. One possible interpretation of the Schumpeter story is that trend appreciations can potentially translate into a more innovative, growth-fostering environment, since they are expected by the private sector. On the other hand, if appreciations came as unexpected shocks, they would be more harmful.

Table A1 in the appendix includes a simple approximate measure for expected exchange rate changes based on past observations. It calculates the root-mean-squared-errors (RMSE) for the current exchange rate against a simple forecast using the average exchange rates over a five-year rolling window – a common time horizon common innovation budgets. The RMSEs show by how much the realized REER deviates from its five-year rolling window.

Figure 4 plots the RMSE against the REER. A country where appreciation is mostly expected will combine a low RMSE with a high long-run appreciation rate. Meanwhile, a country showing a high appreciation along with a high RMSE can be interpreted as reflecting mostly unexpected appreciation. It is notable that, by this measure, more extreme long-run appreciation or depreciation experiences do not seem to translate into higher uncertainty. Higher RMSEs are found in the middle rather than at the extremes. Members of the euro area (or its predecessor regime) appear to be somewhat clustered below average in terms of RMSE, possibly a sign of some stability and predictability of the regime, in spite of large differences in REER dynamics.

20 KAUFMANN and RENKIN (2017) show that the reaction was much less resilient in terms of employment during the years following the lift of the exchange rate floor.

Figure 4 RMSE and REER

Switzerland does not stick out a first sight on this chart, but the comparison between Switzerland and New Zealand is interesting. Both appreciated by almost 40%, but New Zealand shows a high RMSE while Switzerland shows a RMSE in the lower third of our sample, suggesting that the appreciation in the Swiss case was more expected than in the case of New Zealand. A Swiss entrepreneur with a Schumpeterian view can therefore be expected to engage more decisively to shelter her business from the impact of exchange rates.

The measure we used is crude and represents a strictly backward-looking expectation framework without any adaptive element. Further, as is the case with the well-accepted concept of inflation expectations, exchange rate expectations do not need to be rational, but may still induce changes in economic behavior that impose costs or benefits on the economy. This is the case when entrepreneurs do not use past realized exchange rates in their forecasts but, irrespective of the recent past, assume a more or less constant upward pressure – an expectation that seems plausible in the case of Switzerland.

While the concept of expected exchange rate appreciation might provide some support for the Schumpeter view for Switzerland, it certainly does not amount to a strong case nor proof of this effect. And there are also other reasons for a more

skeptical view on Schumpeter.²¹ Recall from Figure 2 that Switzerland does not have higher productivity growth overall, at least not when measured using OECD multifactor productivity data. Measuring productivity differently might yield a more nuanced result.²² In particular, firm-level data might help to unravel this puzzle. Maybe not the aggregate but the surviving industrial firms would show higher productivity. All of this merits further research.

5 Conclusions

Given the strong stance that theory takes, real effective exchange rates and exchange rate regimes are surprisingly loosely related empirically to economic performance even in the short to medium run. We first provide a selective review of the literature which shows why exchange rate changes matter in theory and why, in practice, the impact on macro performance might be muted. The paper then focuses on the relationship of real effective exchange rates and growth over the very long term, stretching beyond business cycle frequency. The observations are limited to developed countries with low catch-up effects. We find that OECD countries with vastly different exchange rate developments and exchange rate regimes showed similar growth rates and mildly different initial GDP per capita over the past 40 years or so.

Special emphasis is given to appreciations with a seemingly much milder impact on growth than postulated by theory. In this context, Switzerland stands out as it combines extraordinary high real effective appreciation with stable growth over the long term. We also consider a reversed causality Schumpeterian proposition, sometimes put forward by entrepreneurs, that a constant upward pressure in exchange rates triggers additional efforts and favors structural reforms in firms – and therefore might mute the negative impact on growth. Preliminary observations using OECD productivity measures at the country level provide no clear indication either in favor of or against the reverse causality story. In our view, this points to the importance of looking into firm-level, or even product-level, data to systematically evaluate the possibility of reverse causality as a reason for the muted net impact of exchange rates on growth over the long term. For the time being, we suggest that the causality from macro performance to exchange rates is another puzzle, adding to the collection of puzzles in international macroeconomics.

21 For a panel of Swiss firms, KAISER, SIEGENTHALER, SPESCHA and WÖRTER (2017) find that appreciations lower R&D investments as well as productivity at least in the short term.

22 FAUCEGLIA, PLASCHNICK and RUEDA MAURER (2017) find that average export quality increases in response to a currency appreciation.

References

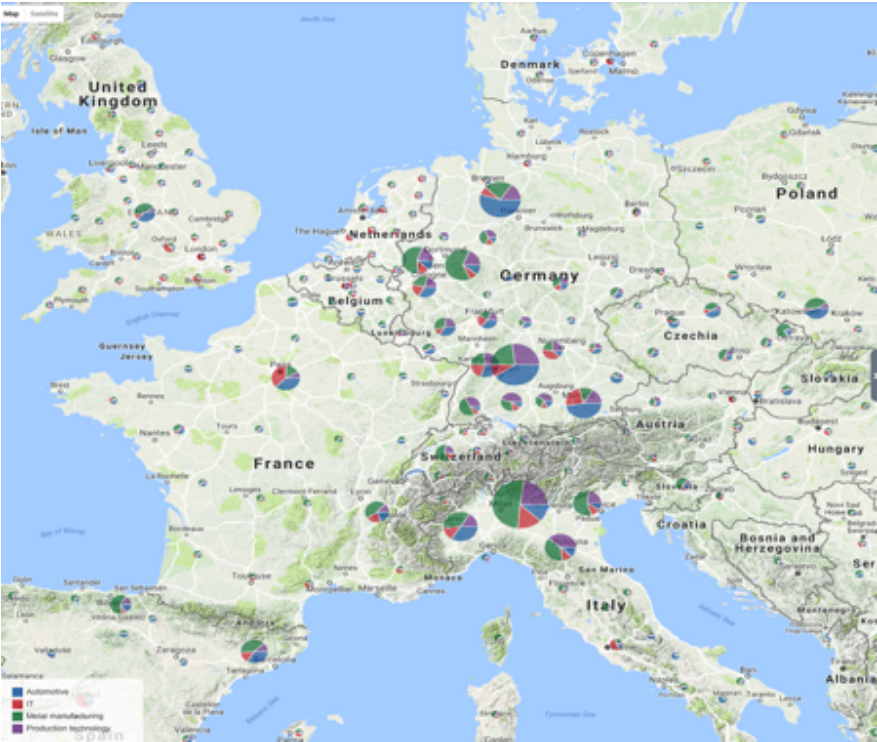
- AUER, RAPHAEL and PHILIP SAURE (2012), CHF strength and Swiss export performance – evidence and outlook from a disaggregate analysis, *Applied Economic Letters* 19, pp. 521–531.
- BALDWIN, RICHARD and CHARLES WYPLOSZ (2015), *The Economics of European Integration*, McGraw-Hill, London.
- BERKA, MARTIN, MICHAEL B. DEVEREUX and CHARLES ENGEL (2014), Real exchange rates and sectoral productivity in the eurozone, NBER Working Paper No. 20510, Cambridge, MA.
- BUSSIÈRE, MATTHIEU, CLAUDE LOPEZ and CÉDRIC TILLE (2015), Do Real Exchange Rate Appreciations Matter for Growth?, *Economic Policy* 30 (81), pp. 5–45.
- CERUTTI, EUGENIO M., STIJN CLAESSENS and ANDREW K. ROSE (2017), How Important is the Global Financial Cycle? Evidence from Capital Flows, IMF Working Paper No 17119.
- CHANG, ROBERTO and ANDRES VELASCO (2001), A model of financial crises in emerging markets, *Quarterly Journal of Economics* 116, pp. 489–517.
- DARUICH DIEGO, WILLIAM EASTERLY and ARIELL RESHEF (2016), The surprising Instability of Export Specializations, NBER Working Paper No. 22869.
- DEVEREUX, MICHAEL B. and HANS GENBERG (2007), Currency Appreciation and Current Account Adjustment, *Journal of International Money and Finance* 26 (4), pp. 570–86.
- EICHENGREEN, BARRY, RICARDO HAUSMANN and UGO PANIZZA (2005), The mystery of original sin, in: EICHENGREEN, BARRY and RICARDO HAUSMANN (editors), *Other people's money: Debt denomination and financial instability in emerging-market economies*, University of Chicago Press, pp. 233–265.
- ENRIGHT, MICHAEL J. and ROLF WEDER (Editors) (1995), *Studies in Swiss Competitive Advantage*, Peter Lang, Bern.
- FLÜCKIGER, MATTHIAS, CHRISTIAN RUTZER and ROLF WEDER (2016), Die Schweizer Wirtschaft zwischen Hammer und Amboss: Eine Analyse der Franken-Schocks 2010/11 und 2015, *Aussenwirtschaft* 67 (3), pp. 95–133.
- FAUCEGLIA, DARIO, BJÖRN PLASCHNICK and MARIA RUEDA MAURER (2017), *Exchange Rate Fluctuations and Quality Composition of Exports: Evidence from Swiss Product-Level Data*, Studie im Auftrag des Seco.
- FORBES, KRISTIN and FRANCIS WARNOCK (2012), Capital Flow Waves: Surges, Stops, Flight and Retrenchment, *Journal of International Economics* 88 (2), pp. 235–251.
- GARCIA-HERRERO, ALICIA and TUULI KIOVU (2010), The Impact of China's Exchange Rate Policy on Trade in Asia, in: EVENETT, SIMON (Editor), *The US-Sino Currency Dispute: New Insights from Economics, Politics, and Law*, CEPR Press, London

- GENNAIOLI, NICOLA, ALBERTO MARTIN and STEFANO ROSSI (2014), Sovereign default, domestic banks and Financial Institutions, *Journal of Finance* 69, pp. 819-866.
- GHOSH, ATISH, ANNE-MARIE GULDE and HOLGER WOLF (2003), *Exchange Rate Regimes: Choices and Consequences*, MIT Press, Cambridge, MA.
- GOPINATH, GITA, OLEG ITSKHOKI and ROBERTO RIGOBON (2010), Currency Choice and Exchange Rate Pass-Through, *American Economic Review* 100 (1), pp. 304-36.
- GUBLER, MATTHIAS and CHRISTOPH SAX (2017), The Balassa Samuelson Effect reversed: New evidence from OECD countries, Swiss National Bank Working Paper No. 1/2017.
- HANSLIN GROSSMANN, SANDRA, SARAH LEIN and CAROLINE SCHMIDT (2016), Exchange rate and foreign GDP elasticities of Swiss exports across sectors and destination countries. *Applied Economics* 48 (57), pp. 5546-5562.
- HOFMANN, BORIS, ILHYOCK SHIM and HYUN SONG SHIN (2017), Sovereign yields and the risk-taking channel of currency appreciation, BIS Working Paper No 538.
- JASOVÁ, MARTINA, RICHILD MOESSNER and ELOD TAKÁTS (2016), Exchange rate passthrough: What has changed since the crisis?, BIS Working Paper. No 583.
- KAISER, BORIS., MICHAEL SIEGENTHALER, ANDRIN SPESCHA and MARTIN WÖRTER (2017), *The Impact of Real Exchange Rates on Swiss Firms: Innovation, Investment, Productivity and Business Demography*, Strukturberichterstattung No. 56/6, Study on behalf of the State Secretariat for Economic Affairs.
- KAUFMANN, DANIEL and TOBIAS RENKIN (2017), *Manufacturing Prices and Employment After the Swiss Franc Shock*, Studie im Auftrag des Seco.
- KALEMI-OZCAN, SEBNEM, XIAOXI LU and ILLHYOCK SHIM (2017), Exchange Rate Appreciations and Corporate Risk Taking, mimeo.
- KAMINSKY, GRACIELA and CARMEN REINHART (1999), The twin crises: the causes of banking and balance- of-payments problems, *American Economic Review* 89, pp. 473-500.
- KLEIN, MICHAEL and JAY C. SHAMBAUGH (2015), *Exchange Rate Regimes in the Modern Era*, MIT Press, Cambridge, MA.
- KRUGMAN, PAUL (1979), A model of balance of payments crises, *Journal of Money, Credit and Banking* 11, pp. 311-25.
- LEVY-YEYATI, EDUARDO and FEDERICO STURZENEGGER (2003), To Float or Fix: Evidence on the Impact of Exchange Rate Regimes on Growth, *American Economic Review* 93 (4), pp. 1173-93.
- MCCARTHY, JONATHAN (2007), Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economies, *Eastern Economic Journal* 33 (4), pp. 511-537.

- OBSTFELD, MAURICE (1996), Models of currency crises with self-fulfilling features, *European Economic Review* 40, pp. 1037–1047.
- OBSTFELD, MAURICE and KENNETH ROGOFF (2000), The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?, in: BERNANKE, BEN and KENNETH ROGOFF (Editors), *NBER Macroeconomics Annual 2000*, Volume 15, MIT Press, Cambridge, MA.
- REY, HÉLÈNE (2013), Dilemma not trilemma: the global cycle and monetary policy independence, *Proceedings - Economic Policy Symposium - Jackson Hole*, Federal Reserve Bank of Kansas City.
- REY, HÉLÈNE (2016), International Channels of Transmission of Monetary Policy and the Mundellian Trilemma, *IMF Economic Review* 64 (1), pp. 6–35.
- RICCI, LUCA ANTONIO, GIAN MARIA MILESI-FERRETTI, and JAEWOO LEE (2013), Real Exchange Rates and Fundamentals: A Cross-Country Perspective, *Journal of Money, Credit and Banking* 45 (5), pp. 845–865.
- ROSE, ANDREW K. (2011), Exchange Rate Regimes in the Modern Era: Fixed, Floating, and Flaky, *Journal of Economic Literature* 49 (3), pp. 652–672.
- SWISS NATIONAL BANK (SNB) (2017), Bericht ueber die Geldpolitik, *Quartalsheft* 2/2017.
- TICA, JOSIP and IVO DRUŽIĆ (2006), The Harrod-Balassa-Samuelson Effect: A Survey of Empirical Evidence, FEB Working Paper Series No. 06-7/686, Faculty of Economics and Business, University of Zagreb.
- TILLE, CEDRIC (2017), The changing international linkages of Switzerland: An overview, CEPR Discussion Paper No. 12176.

Appendix

Figure A1: The Alpine machine cluster



Note: Size of pie is number of employees.
Source: European Cluster Observatory.

Table A1

Country	Appr. 1980- 2016	Appr. 1960- 2016	Max 1Y appr. spell	Max 5Y appr. spell	GDP pc 1980	GDP pc 2016	RMSE 1980- 2016
Switzerland	36%	94%	17.1%	6.6%	18,785	78,813	4.5%
New Zealand	36%	20%	16.1%	5.8%	7,467	39,427	7.2%
Portugal	32%	33%	10.0%	4.1%	3,369	19,813	3.1%
United States	27%	0%	13.4%	5.4%	12,598	57,467	4.8%
Greece	18%	-3%	11.6%	3.2%	5,894	18,104	3.0%
Japan	17%	106%	30.5%	9.2%	9,417	38,894	9.4%
Australia	13%	9%	15.7%	5.5%	10,202	49,928	6.5%
Denmark	11%	46%	9.3%	3.2%	13,884	53,418	3.3%
Luxembourg	9%	6%	10.9%	2.8%	17,114	102,831	3.5%
Spain	9%	65%	15.2%	4.6%	6,192	26,528	4.1%
Italy	7%	0%	10.6%	3.2%	8,429	30,527	4.2%
Austria	7%	29%	8.3%	3.0%	10,843	44,177	2.7%
Turkey	5%	-32%	14.1%	7.8%	1,564	10,788	9.5%
Ireland	4%	11%	10.8%	4.0%	6,379	61,606	3.9%
Norway	-3%	18%	8.4%	2.9%	15,772	70,812	2.8%
Canada	-4%	-27%	10.2%	4.8%	11,135	42,158	4.6%
Finland	-6%	-8%	9.9%	3.1%	11,232	43,090	4.6%
Netherlands	-7%	34%	9.9%	3.6%	13,616	45,295	3.8%
Belgium	-7%	6%	8.5%	3.4%	12,933	41,096	3.9%
Germany	-9%	11%	10.7%	4.0%	12,092	41,936	4.2%
Iceland	-10%	-14%	16.1%	5.4%	14,943	59,977	7.2%
France	-12%	-9%	10.9%	1.9%	12,713	36,855	3.1%
United Kingdom	-19%	-10%	16.5%	5.1%	10,032	39,899	6.1%
Sweden	-30%	-27%	8.0%	2.3%	16,857	51,600	4.9%

Data Source: REER from Bruegel, GDP per capita from World Bank, in current dollars

Notes: Country set: Countries that joined the OCECD in 1960s.
RMSE: root mean squared errors calculated as difference from the current exchange rate to the five-year rolling moving average