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Abstract

Using disaggregated quarterly trade data for Switzerland over 2004-2011, we study exchange rate pass through (ERPT) into imported intermediate input prices and its role in the price setting behavior of exporters. We explicitly include disaggregated proxies for imported input prices in our analyses to investigate whether Swiss exporters may have "naturally hedged" exchange rate risks by sourcing inputs from abroad, especially during periods of strong CHF appreciation. Our results indicate high ERPT into imported input prices in all sectors and strong sectoral ERPT heterogeneity on the export side in both the short and long-run. They also suggest the use of "natural hedging" as an effective strategy to reduce exchange rate risks. Significantly however, Swiss exporters may not have adjusted export pricing practice in response to a strong CHF in the wake of the Euro crisis, which questions central bank intervention during that period.

Keywords: exchange rates, exchange-rate-pass-through, international trade, prices

JEL classification: F31, F41

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1 Introduction

This paper studies exchange rate driven adjustments of imported intermediate input prices (henceforth, imported input prices) and their role in the price setting behaviour of exporters. The principal aim is thereby to investigate to what extent exporters are able to "naturally hedge" exchange rate risk when sourcing inputs from abroad rather than domestically. While recent empirical research in trade makes use of firm- or plant-level data, this paper studies hitherto unexplored areas using monthly/quarterly product level trade data at the 8-digit level for Switzerland between 2004 and 2011.

Exploring the role of imported inputs in exchange rate adjustments of exports has a relatively long tradition in the empirical trade literature (see for example sector-level studies by Athukorala and Menon (1994) and Goldberg and Campa, 2010, or more recently, firm-level studies by Greenaway et al., 2010 and Berman et al., 2011). The rationale for studying this channel is the potential role of exchange rate appreciation (depreciation) not just in raising (lowering) the foreign export prices of traded goods and services, but also in lowering (raising) the prices of imported inputs. Domestic firms may thus have the means to absorb some of the effect of exchange rate variations through importing inputs, which may lead to ambiguous effects on export prices. However, this rationale only holds if exchange rate pass-through (ERPT) into export prices and/or imported input prices is non-zero. The existing empirical literature mainly focuses on (semi-)final goods price adjustments and investigates the cost effect due to imported inputs with measures such as the ratio of imported intermediate inputs relative to total intermediate inputs (see Greenaway et al., 2010) or, in studies with firm data, the ratio of total imports relative to total sales (see Berman et al., 2011). These studies however do not look at actual price developments of imported inputs as a result of exchange rate shocks. Stated differently, they implicitly assume full ERPT into imported input prices, which is a rather strong assumption given the overwhelming existing evidence of partial ERPT into import prices in general (see for instance Campa and Goldberg, 2005).

To the best of our knowledge, this paper is the first (i) to investigate in detail how imported input prices faced by each (exporting) industry develop over time and (ii) to study the effectiveness of "natural hedging" of exchange rate risk by quantifying the effect of exchange rate fluctuations on these imported input prices. Finally (iii), we examine total pass-through effects on export prices, that is, the combined effect of pricing-to-market behavior (the simple effect of exchange rate movements on export prices) and the cost-changing effects of exchange rate changes through imported inputs. This third step will tell us whether exporters use "natural hedging" to stabilize profit margins (mark-ups) in a specific export market.

Looking at imported input prices in Switzerland is particularly interesting as the Swiss economy has high ratios of imported intermediate inputs relative to total intermediate inputs, especially in the manufacturing sector (see Table 1), and about half of total imports are processed and re-exported (see Seco, 2011). Given significant "natural hedging", it is thus a relevant question whether Swiss exporters are (at least to some extent) spared from loosing competitive advantage despite the strong appreciation of the Swiss Franc (CHF). Last but not least, investigating this issue with Swiss data also contributes to the ongoing debate on the "strong" CHF. According to a recent study by the State Secretariat for Economic Affairs (Seco, 2011), imported goods prices fell by 40 percent three or four quarters after the appreciation. The prices however did not fall as much as the CHF appreciated. While the focus of the ongoing discussion is more related to imported consumer goods, it might be that prices of imported inputs did not (or not yet) fully adjust as well, which provides another motivation for this study and reason to investigate the recent "Strong Franc" period also separately.

The paper proceeds as follows. Section 2 presents the recent evolution of imported input prices and describes the data . Section 3 provides a brief review of the relevant literature. Section 4 introduces the theoretical framework which forms the basis for the empirical set up in Section 5. Section 6 describes the results from estimation and Section 7 concludes.

2 Data at-a-glance

This section first documents the extent to which Swiss goods industries use imports of intermediate inputs, among other things, as a means to lower exchange rate risks ("natural hedging"). We then trace the evolution of imported input prices that these industries have faced since 2005 compared to nominal effective exchange rates and crude oil prices .

Prima facie, our data suggest that Swiss industries practiced considerable "natural hedging". The first column of Table 1 shows ratios of imported inputs relative to the sum of total inputs and total compensation to employees (or total production costs) while the second column shows ratios of imported inputs relative to total inputs. Data and the sector classification are taken from the 2001 input-output table (I-O table) for Switzerland published by the OECD. As Table 1 shows, imported inputs make up more than 10 percent of total production costs in all Swiss sectors and are particularly high in some manufacturing sectors (e.g. Textiles 27 percent, or Electrical machinery 25 percent). By construction, these figures are even higher when looking at the simple ratios of imported relative to total intermediate inputs (e.g. Textiles 38 percent, or Electrical machinery 31 percent).

"Natural hedging" is only an effective tool to lower exchange rate risks if imported input prices do in fact react to exchange rate fluctuations. To gain more insight into the price and exchange rate developments, Figure 1 looks at the imported input price indexes for all goods sectors and at the nominal effective exchange rate index (calculated by the Bank of International Settlement) from January 2005 to September 2011. We calculate imported input price indexes by import-weighted unit values at the 8-digit level and for each trading partner separately.[1]. Despite their well-known shortcomings, the usesing of unit values as proxies for import or export prices is standard in the exchange rate pass-through literature because of their relatively wide availability (see for exampleBerman et al., 2011). Compared to most earlier studies, unit values in this paper come even closer to prices as products are highly disaggregated (8-digit level) and separate unit values are calculated for imports of each trading partner. Furthermore, unit values allowed us to discriminate between intermediate and consumer goods by using the WTO classification of intermediate/input goods published by the UN Comtrade.[2] This enabled us to be the first to construct industry-level imported input price indexes as genuine price indexes are not available neither at the aggregate nor at the sectoral level. Trade data is obtained from the Swiss Federal Customs Administration. As energy prices are likely to make up a significant amount of production costs , imported input prices faced by Swiss industries are likely to be correlated with energy prices. To visualize this relationship, Figure 1 also includes a line for a crude oil price index (calculated from simple averages of three spot crude oil prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh). All indexes are set to 100 in January 2005. To eliminate seasonal fluctuations, all reported figures correspond to averages of the last 12 months (e.g. the oil price index for March 2005 corresponds to the average oil price index between April 2004 and March 2005).

The figure is divided into three panels (a, b, and c). Each panel looks at imported input price developments for sectors facing a similar pattern. The time axis is roughly divided into five phases: boom, commodity crisis, economic crisis, economic recovery, strong Franc.

[1] Appendix A provides a detailed description how we constructed the imported input price indexes.

[2] see http://wits.worldbank.org/wits/data_details.html.

Table 1: Standard "natural hedging" measures

		(Imported inputs) / (Total inputs + Compensation of employees)	(Imported inputs) / (Total inputs)
1	Agriculture	0.18	0.22
2	Mining & quarrying	0.09	0.13
3	Food & beverages	0.14	0.17
4	Textiles	0.27	0.38
5	Wood products	0.11	0.18
6	Paper products	0.14	0.21
7	Chemicals & pharmaceuticals	0.24	0.29
8	Rubber & plastics products	0.19	0.27
9	Mineral products	0.18	0.27
10	Iron & steel	0.25	0.35
11	Fabricated metal products	0.21	0.35
12	Machinery & equipment	0.17	0.25
13	Electrical machinery	0.25	0.31
14	Communication equipment	0.21	0.32
15	Precision instruments	0.16	0.22

Source: OECD

Panel-a sectors import intermediates with the least price fluctuations and are at first sight the least responsive to oil price shocks, in particular from January 2008 to May 2009. During the commodity crisis, imported input prices even decreased slightly while crude oil prices almost doubled. Panel-b and panel-c sectors clearly show the expected positive relationship between oil prices and imported input prices. Panel-c sector prices are relatively more volatile (in both directions) than panel-b sectors. For some panel-c sectors (e.g. Iron & steel) imported input prices increased by a factor of four between January 2005 and September 2008, which is a bigger price hike compared to the oil shock during the same period.

Figure 1 also shows that the nominal effective exchange rate index is relatively stable from January 2005 to January 2009, followed by a steady appreciation of the CHF over 2009 and a sharp appreciation in 2010 and 2011. Interestingly, input prices show a decline during the period of steady CHF appreciation during 2009 but a rise in the "strong" CHF phase up until May 2011, which suggests that these prices were more correlated with oil

Figure 1: Development of imported input prices faced by output sectors: 2005-2011

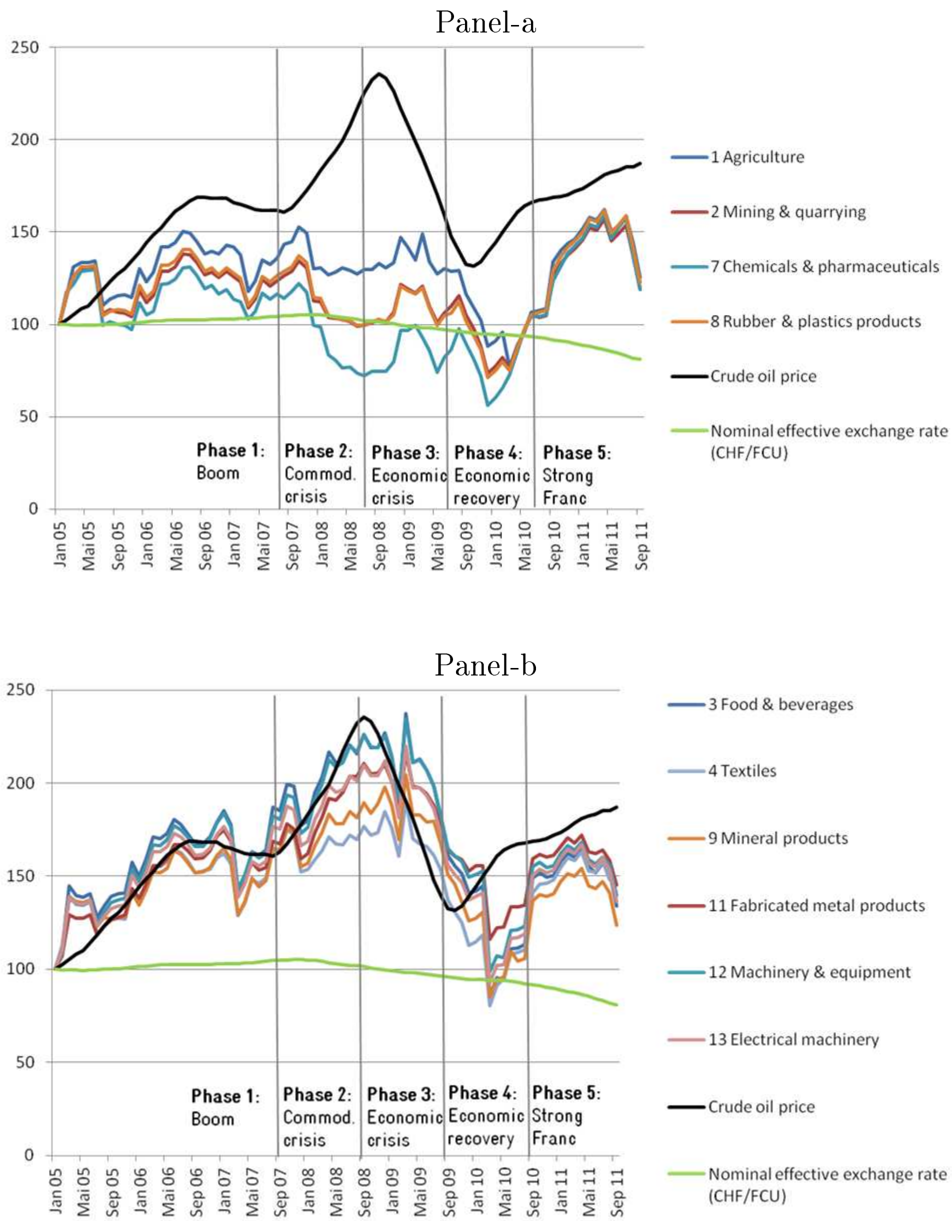
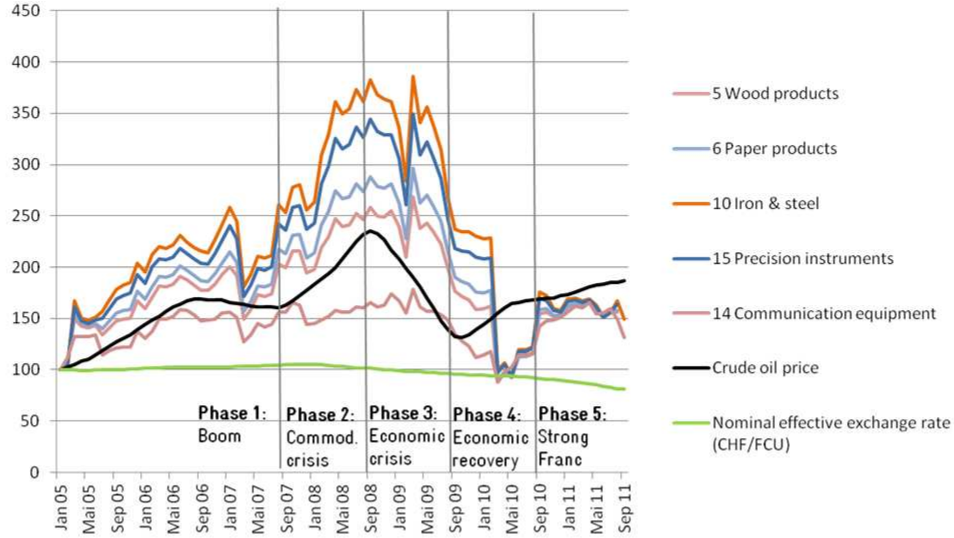


Figure 1: continued

Panel-c



Notes: Figures are averages of the last 12 months; all price indexes are based on prices in CHF; FCU denotes foreign currency units.
Source: Swiss Federal Customs Administration, Bank for International Settlements

prices during this period (with a close to six month lag). It was only after May 2011 that the price decreasing impulse of the strong Franc seemed to overcompensate the price increasing tendencies of the oil price hike thereby providing preliminary evidence for the effectiveness of "natural hedging" as a tool to lower exchange rate risks. Thus, in course of the continued CHF appreciation, prices of imported inputs started to fall, which is likely to have decreased the exposure of Swiss exporters to the adverse exchange rate situation .

3 Related literature

This section highlights results and empirical issues from previous work closely related to our paper. A complete overview of the extensive pass-through literature is beyond the scope of this brief review (see for example Goldberg and Knetter, 1996 and Greenaway et al., 2010 for more extensive literature reviews).

Athukorala and Menon (1994) examine the pricing behavior of Japanese exporters by taking into account the aggregate changes of intermediate costs arising from exchange rate movements. Their investigation of quarterly export prices reveals that the pass-through rate into foreign currency prices for total manufacturing exports declines from 0.78 to 0.67 if the cost-saving effect of exchange rate appreciations is considered. Separate estimations for seven manufacturing sub-industries reveal a substantial upward aggregation bias: At the disaggregated level, total ERPT ranges from 0.04 for textiles to 0.53 for transport equipment. All estimates are thus lower than 0.67 at the aggregated level. In this paper, we go a step further by investigating average ERPT into export prices for 15 goods sectors using price data (unit values) at a highly disaggregated (HS 8-digit) and bilateral level. Moreover, we explicitly include disaggregated proxies of imported input prices faced by exporting industries in each period. Finally, we also estimate how these intermediate import prices themselves react to exchange rate changes (again using highly disaggregated data) to investigate whether "natural hedging" is effective.

In a recent study using a panel of French firms, Berman et al. (2011) find a positive net "natural hedging" effect (defined as the interaction between the real exchange rate and firm intermediate imports over sales) on EUR export prices and thus - in line with Athukorala and Menon (1994) - smaller ERPT into foreign currency prices when taking the cost adjustment into account. Similarly, Greenaway et al. (2010) investigate a panel of UK manufacturing firms and suggest that the negative effect of an exchange rate appreciation on firm exports is lower in industries that import a greater share of inputs. According to Greenaway et al. (2010), their imported input weighted exchange rate, which varies at the sectoral-level, should account for import price changes resulting from exchange rate changes. They implicitly assume that an appreciation of the domestic currency would lower import prices. A shortcoming of both studies is that they draw conclusions on the behavior of import prices without actually studying them.

As indicated by Athukorala and Menon (1994) and Greenaway et al. (2010), industry variation in the pass-through rates are likely to reflect differences in the cost structures across industries. Along the same line Campa and Goldberg (1997) and Hummels et al. (2001) point to the increasingly important role of global supply chainsand, accordingly, to the share of imported inputs as an important determinant of industry cost structure. Acknowledging the cost contribution of imported inputs, we emphasize the cost sensitivity of imported inputs to exchange rate movements and its subsequent effect on export pricing. The sensitivity of prices at the importer side also influences the ERPT at the exporter side, but this interconnection has surprisingly not received enough attention in the empirical ERPT literature. Aksoy and Riyanto (2000) formalize this issue and show that ERPT in the downstream export market depends on the pricing behavior of foreign upstream suppliers. Finally,Ihrig et al. (2006) argue that the decline of pass-through rates into domestic prices experienced in all G-7 countries over the last two decades may also be a consequence of the steady rise of cross-border production arrangements.

In other related work, Goldberg and Campa (2010) calibrate a model of the CPI sensitivity to exchange rates with data from 21 OECD countries and find that the goods cost shares of imported inputs are the dominant channel through which exchange rate shocks get transmitted into consumer prices. For the calibration exercise, they use the strong assumption that an exchange rate change is completely passed through into the imported input prices. This contrasts for instance with the low pass-through rate of 0.22 into US import prices reported by Gopinath and Rigobon (2008). Campa and Gonzalez Minguez (2006) show that differences of ERPT into domestic prices in the Euro zone countries may be explained by the degree of openness to non-euro imports of each country. Campa and Goldberg (1995, 1999) provide evidence for the US, UK, Japan and Canada that suggests that sectoral investment rates respond to exchange rate fluctuations depending primarily on a sector‘s exposure to imported inputs and export markets. Their empirical findings suggest that a depreciation of the domestic currency tends to reduce investments particularly in competitive sectors that employ a large fraction of imported inputs, whereas high mark-up sectors with lower imported input shares are less affected by exchange rates. A possible explanation is again that the sensitivity of imported input prices to exchange rates differs across sectors, probably reflecting distinct competitive environments. Yet the issue remains unresolved in all the cited studies. Our paper fills this gap in the pass-through literature by recognizing explicitly in the empirical framework that the exporters‘ pricing decisions have become inextricably intertwined with the pricing behavior of foreign suppliers.

4 Theoretical framework

This section develops the analytical framework from which we derive our pass-through estimating equations with regard to imported input prices in 4.1 and export prices in 4.2. More details on the empirical strategy and econometric techniques are discussed in Section 5.

4.1 Import price equation

We assume an exporting sector s specific Cobb-Douglas production function with the share α_s corresponding to imported inputs and the share $1-\alpha_s$ to domestic inputs including labor services.

$$Q_s = (K^*)^{\alpha_s} \cdot (K)^{1-\alpha_s}\,, \tag{1}$$

The marginal cost function dual to (1) is given by :

$$MC_s(W, W^*(E), \alpha_s, E) = A_s \cdot W^{1-\alpha_s} \cdot (EW^*(E,Z))^{\alpha_s}\,, \qquad A_s = \alpha_s^{-\alpha_s} \cdot (1-\alpha_s)^{\alpha_s - 1}, \tag{2}$$

where W is the price of domestic inputs, W^* denotes the price of imported inputs denominated in the foreign currency and E is the bilateral exchange rate between Switzerland and the import source country defined as CHF per unit of the foreign currency. Z includes all factors that affect the foreign currency price of imported inputs W^* such as the state of the business cycle or increases in producer prices due to changes in foreign wages or commodity prices. Taking logs and then totally differentiating (2) leads to the following expression:

$$\tilde{MC_s} = \widetilde{A} + (1-\alpha_s)\widetilde{W} + \alpha_s \left(\tilde{E} + \frac{\partial w^*}{\partial W^*}\frac{\partial W^*}{\partial e}\tilde{E} + \frac{\partial w^*}{\partial W^*}\frac{\partial W^*}{\partial z}\tilde{Z} \right) \tag{3}$$

where a "$\backsim$" over a variable denotes percentage changes and small letters denote the log of the variables. It is clear from (3) that a higher share of imported inputs, α_s, results in a higher sensitivity of marginal costs to exchange rate fluctuations. Price changes of imported inputs in CHF can be decomposed into the direct effect $\widetilde{E}$ on the Swiss price of imported inputs and the indirect consequence of an exchange rate change on the pricing behavior of foreign suppliers, $\tilde{W}^* = \frac{\partial w^*}{\partial W^*}\frac{\partial W^*}{\partial e}\tilde{E}$. An interesting limiting case is local currency pricing (LCP) in which the pass-through rate is zero or formally:

$$\widetilde{E} + \frac{\partial w^*}{\partial W^*}\frac{\partial W^*}{\partial e}\tilde{E} = 0 \tag{4}$$

The price reducing effect of an appreciation is here completely offset by the price increases of the foreign suppliers. More generally, percentage changes of imported input prices in

CHF, $\tilde{P_s^m}$, due to exchange rates movements, which corresponds to the term in brackets in (3), can be defined as follows:

$$\tilde{P_s^m} = \left(1 + \frac{\partial w^*}{\partial e}\right) \cdot \tilde{E} + \frac{\partial w^*}{\partial z} \cdot \widetilde{Z}, \tag{5}$$

Thus the effect of a percentage change in the bilateral exchange rate $\tilde{E}$ depends on the elasticity of the foreign currency input prices to exchange rates or equivalently on the elasticity of mark-ups to exchange rates, $\frac{\partial w^*}{\partial e}$. If this elasticity equals zero, we obtain full pass-through. Conversely, if foreign suppliers adjust foreign prices and mark-ups when the exchange rate fluctuates, pass-through will be less than complete,$\frac{\partial w^*}{\partial e} < 0$, or amplified,$\frac{\partial w^*}{\partial e} > 0$. In line with equation (5), our empirical equation takes the following logarithmic specification using first-differences and adding time dimension t (see more details in 5.1):

$$dp_{ts}^m = \theta_{ts} + \beta_s de_t + \epsilon_{ts} \tag{6}$$

where d is the first-difference operator, β_s corresponds to the sector-specific pass-through coefficient. $\beta_s = 1$ would mean that this sector is characterized by full pass-through or producer currency pricing (PCP). In contrast, $\beta_s = 0$ indicates zero pass-through or local currency pricing (LCP) of foreign input suppliers in the Swiss market as illustrated in equation (4).[3] In the intermediate case, $\beta < 1$, we have incomplete pass-through, which suggests that foreign input suppliers raise their prices and mark-ups when the CHF appreciates. Knetter (1989) points out that this occurs when foreign input suppliers‘ perceived elasticity of demand rises with the local price (CHF). Then, a depreciation of the supplier‘s currency, $\tilde{E} < 0$, induces foreign suppliers to increase their profit margins. This relationship would be reflected in the negative elasticity between the foreign input price and the exchange rate in equation (5), $\frac{\partial w^*}{\partial e} < 0$. Conversely, a $\beta > 1$ shows that exchange rate changes are transmitted into imported input prices in an amplified manner. This could indicate that the foreign input suppliers‘ demand elasticity may fall with the Swiss price of foreign inputs resulting in $\frac{\partial w^*}{\partial e} > 0$. Full pass-through, $\frac{\partial w^*}{\partial e} = 0$, indicates that the perceived demand elasticity does not change with the local price.[4] A set of fixed effects θ_{ts} in (6) captures changes in foreign input prices in a specific sector s over time that can be attributed to changes in the economic conditions, the production costs (Z in equation 5) in the exporting country, demand conditions in the importing country or

[3] All exchange rate movements are fully absorbed in the mark-ups of foreign suppliers in this case.

[4] This would be the case with a CES demand function.

changes in commodity prices (more details on the estimating import equation in Section 5.1).

4.2 Export price equation

In an imperfectly competitive environment such as the popular monopolistic competition framework, economic agents are price setters and their first order conditions from profit maximization can be stated in the following way:

$$P_{js}^{e} = MK_{js}\left(\frac{P_{js}^{*}(E)}{P_j}, Z_j, MC_s(E,W)\right) \cdot MC_s(E,W), \qquad MK_{js} = \frac{P_{js}^{e}}{MC_s}, \quad P_{js}^{*} = \frac{P_{js}^{e}(E)}{E}, \tag{7}$$

where P_{js}^{e} is the FOB average export price in CHF of sector s delivering to country j, P_{js}^{*} is the corresponding price in local currency, MC_s denotes the sector-specific marginal cost (see also equations 2 and 3) and MK_{js} represent the sector-destination specific mark-ups. Taking logs and totally differentiating (7) with respect to the bilateral exchange rate in terms of CHF per unit of the destination currency E, the destination price index P_j, the demand-shifter Z_j and the domestic input prices W, we obtain:

$$\tilde{P}_{js}^{e} = \left(\frac{\partial mk_{js}}{\partial P_{js}^{*}}\frac{\partial P_{js}^{*}}{\partial e}\right) \cdot \tilde{E} + \left(\frac{\partial mk_{js}}{\partial MC_s}\frac{\partial MC_s}{\partial e} + \frac{\partial mc_s}{\partial e}\right) \cdot \tilde{E} + \tag{8}$$

$$+\frac{\partial mk_{js}}{\partial p_j} \cdot \tilde{P}_j + \left(\frac{\partial mk_{js}}{\partial MC_s} + 1\right) \cdot \frac{\partial mc_s}{\partial w} \cdot \tilde{W} + \frac{\partial mk_{js}}{\partial z_j} \cdot \tilde{Z}_j,$$

$$\frac{\partial mk_{js}}{\partial MC_s} \leq 0, \quad \frac{\partial mc_s}{\partial e} \geq 0, \quad \frac{\partial mk_{js}}{\partial P_j} > 0, \quad \frac{\partial mk_{js}}{\partial Z_j} > 0, \quad \frac{\partial mc_s}{\partial W} > 0$$

The exporter‘s price equations (7) and (8) show that the mark-up is a function of the ratio between the price of the Swiss export good price in local currency, P_{js}^{*}, divided by an average price index, P_j, that encompasses close substitutes available in market j.

The export price reaction to exchange rate changes depends on the reaction of the mark-ups to currency movements, $\frac{\partial mk_{js}}{\partial P^*_{js}}\frac{\partial P^*_{js}}{\partial e}$. As on the import side, this elasticity depends on how exporters perceive the demand schedule in a specific export market. For instance, a positive relationship between a CHF depreciation and the mark-up, $\frac{\partial mk_{js}}{\partial P^*_{js}}\frac{\partial P^*_{js}}{\partial e} > 0$ holds whenever a firm is confronted with a residual demand that exhibits an increasing elasticity with the price - this is the case for demand functions that are less convex than in the CES case - irrespective of the form of imperfect competition as highlighted by Knetter (1989) and illustrated by Yang (1997) and Dornbusch (1987) for extended Dixit-Stiglitz and Cournot frameworks.[5] [6] With such a perceived demand function, exporters that face an appreciated currency , $\tilde{E} < 0$, try to remain competitive by reducing mark-ups. A mark-up elasticity of one, $\frac{\partial mk_{js}}{\partial P^*_{js}}\frac{\partial P^*_{js}}{\partial e} = 1$, corresponds to local currency pricing (LCP) wherein the mark-up fully absorbs exchange rate movements. If the demand curve is more convex than in the CES case, it could occur that exporters increase the mark-up when the exporter‘s currency appreciates leading to an overreaction of local prices to exchange rate changes. The second term in (8) illustrates the effect of exchange rate changes on marginal costs and mark-ups working through imported input prices.[7] Contingent on the imported input price reactions (see equations 5 and 6), exporters may benefit from lower marginal costs through cheaper foreign inputs when their currency appreciates, $\frac{\partial mc_s}{\partial e} \geq 0$ and may also increase profit margins, $\frac{\partial mk_{js}}{\partial MC_S}\frac{\partial MC_s}{\partial e} \leq 0$. The mark-up adjustment depends again on the perceived demand elasticity. Furthermore, as in Melitz and Ottaviano (2008), more competitive export markets are characterized by lower local prices, P_j, for similar goods and thus higher demand elasticities which force exporters to reduce export prices, $\frac{\partial mk_{js}}{\partial p_j} > 0$. From (8) one can also note that controlling for differences and changes of marginal costs preferably at the product level is important due to their direct impact on export prices and through their effect on the price-cost margins since sectors with lower marginal costs MC_j are able to set higher mark-ups, $\frac{\partial mk_{js}}{\partial MC_s} \leq 0$. [8] Z_j is a demand shifter related to destination-specific preferences for a good but also on general economic conditions in

[5] In the extended Dixit-Stiglitz framework of Yang (1997) based on Dornbusch (1987) firms take into account their non-negligible effect of quantity decisions on the aggregate industry price index. Atkeson and Burstein (2008) show that the endogenous mark-up in our sense, , $\frac{\partial mk_{js}}{\partial e} > 0$, that leads to incomplete pass-through can be even introduced in a CES-framework with small modifications.

[6] Our derivation of the exporter‘s pricing and pass-through in (7) and (8) is therefore not limited to monopolistic competition frameworks but holds more generally as well.

[7] Please note that the bilateral exchange rate variable, $\tilde{E}$, in the first and second term of (8) can differ according to the origins of the imported inputs used and the specific destination of an export good.

[8] This holds again for demand curves that are less convex than in the CES case (i.e. elasticity increases with price).

market j. Stronger preferences and better conditions both increase the exporters' ability to raise export prices and margins, $\frac{\partial mk_{js}}{\partial z_j} > 0$.

Equation (8) leads us directly to our empirical specification (9):

$$dp^e_{t,j,s} = \theta_{t,j,s} + \gamma_1 * de_{t,} + \gamma_2 * dp^m_{t,s} + \varepsilon_{t,j,s}, \tag{9}$$

where γ_1 denotes the pricing-to-market coefficient (PTM) and corresponds to the mark-up elasticity to exchange rates in equation (8), $\gamma_1 = \frac{\partial mk_{js}}{\partial P^*_{js}} \frac{\partial P^*_{js}}{\partial e}$. A PTM coefficient equaling one, $\gamma_1 = 1$, represents local currency pricing (LCP) in the sense that export prices in CHF and mark-ups move one-to-one with exchange rates. As a consequence, a CHF appreciation erodes profit margins. Exchange rate pass-through into local prices (in FCU) would then be zero. More specifically, the pass-through effects (in local/foreign prices) are calculated as $1 - \gamma_1$ and are therefore negatively related to PTM behavior. γ_2 corresponds to the cost-adjustment coefficient and shows how export prices change when imported input prices change. As a result, it should be clear that not accounting for the cost-effect of exchange rate movements on the prices of imported inputs may create a bias in the pass-through estimations on the export side as also argued by Goldberg and Knetter (1996). The remaining variables affecting export prices as emphasized in equation (8) are captured by a set of fixed effects intended to account for changes of marginal costs, demand conditions at destination and product-specific differences of competitive pressure, preferences and production costs (more details on the estimating export equation in Section 5.2).

5 Empirical strategy and econometric issues

Our theoretical derivations in Section 4 directly lead to estimations in first differences in line with equations (6) and (9). Most other studies in the ERPT literature however introduce theoretical considerations that require estimations in levels (see for example, Campa and Goldberg, 2005 or Gaulier et al., 2008). These studies often perform unit root tests and generally cannot reject the null of unit roots in price and exchange rate series. To avoid the problem of spurious regression in dealing with potentially non-stationary time series, these researchers estimate their empirical models in first differences.[9]

[9]Previous ERPT studies often test and reject the existence of theory-grounded cointegration relationships (see for instance Campa and Goldberg, 2005 and Campa and Gonzalez Minguez, 2006) . Aside from the generally low power of panel cointegration tests, additional severe testing and aggregation difficulties

To be consistent with the existing literature and to emphasize the need for estimations in first differences not only from a theoretical but also from an econometric point of view, we perform panel unit root tests on our import and export price as well as exchange rate series. Taking account of cross-sectional dependence (particularly important in our exchange rate series) and seasonalities (particularly important in our price series), we cannot decisively reject the null of unit roots and thus the non-stationarity of our time series. Appendix B describes these preliminary diagnostics in greater detail.

The stationarity tests make us even more convinced to estimate first-difference models, which will be further described in this section. Section 6.1 introduces the empirical strategy for ERPT into imported input prices and Section 6.2 for ERPT into export prices taking into account the cost adjustments through imported inputs. This two-step approach allows us to investigate on the one hand whether exporters potentially benefit from "natural hedging" practice (i.e. whether imported input prices adjust with exchange rates) and on the other hand whether exporters use such input cost/price adjustments to stabilize profit margins in the export markets.).

5.1 ERPT into imported input prices

The empirical equation (6) for ERPT into imported input prices is estimated for each I-O input sector si separately and lagged exchange rate terms are added to allow for the possibility of gradual adjustment of these prices. More formally, the estimation equation is specified as follows for each I-O input sector si:

$$dp^m_{t,i,k} = \theta_{t,i,k} + \sum_{t=0}^{-2} (\beta_t * de_{t,i}) + u_{t,i,k}, \tag{10}$$

where d is the first-difference operator, t is the time component defined as one quarter, i is the foreign supplier and k refers to the intermediate product. The index si is omitted. Notations are consistent with the previous section, where lower case letters designate logarithms. Namely, $p^m_{t,i,k}$ is the log of imported input price indexes defined as unit values (import value in CHF per kg, which are set to 100 in Q1-2004) and $e_{t,i}$ is the log of the

arise in large cross-sectional heterogenous panels as ours in order to establish a robust sector-level cointegration relationship (see for instance Trapani and Urga, 2010). Moreover, our theoretical framework does not lead to an equation in levels on which a cointegration relationship is usually based. For these reasons, we decided against testing for cointegration.

nominal bilateral exchange rate index defined as CHF per unit of the foreign supplier i's currency. The average short-run relationship between exchange rates and the imported input prices in each si is given by the estimated coefficient β_0 . The long-run elasticity is given by the sum of the coefficients on the contemporaneous exchange rate and two lags of exchange rate terms $\sum_{t=0}^{-2} \beta_t$.[10] Finally, the set of fixed effects $\theta_{t,i,k}$ capture all developments affecting country i's intermediate products k at time t, in particular the changes in production costs (including commodity price changes) in source country i as well as the evolution of demand conditions in the importing country, Switzerland. Marginal costs and demand conditions are difficult to measure - especially at the product level. Other researchers have used - as a remedy - aggregate measures such as consumer-price- , producer-price- or labour-cost-indexes as marginal cost proxies and GDP as proxies for demand conditions (see for example Campa and Goldberg, 2005 or Auer and Chaney, 2009). Given that the data used in this paper provide bilateral, sectoral and time dimensions and have only one importing country (Switzerland), the use of fixed effects (defined as $\theta_{t,i,k}$) allows us to overcome this problem.

However, each si panel used for the import regressions includes around 170 intermediate inputs k at the 8-digit level of disaggregation in the harmonized system ($hs8$ hereafter), 37 supplier countries and 24 quarters[11]. Capturing fixed effects according to equation (8) would thus include more than 150'000 dummy variables. Given that each regression is run with around 10'000 observations, there are not (at all) enough degrees of freedom and robust estimations cannot be run. To increase the degrees of freedom (while keeping the product dimension), it is firstly assumed that the time- and supplier-varying fixed effects are homogenous enough across all $hs8$ products of a given si sector, so that the k dimension can be neglected. Nevertheless, simple $hs6$-specific fixed effects (not varying across time and suppliers), which control for $hs6$-level determinants of price adjustments, are added to the estimation equation. Moreover, we divide thetime dimension into seven adhoc phases p, where all include data for four quarters and run from Q4 of one year to Q3 of the next year. Each phase corresponds to a time period in which crude oil prices have on average either hiked, remained relatively constant or decreased during the 12 previous months (see Section 2 and Figure 1). The underlying assumption is thus that marginal costs of inputs,

[10] Variable deletion F-tests have confirmed that these high sectoral long-run pass-through rates are mostly achieved within three quarters. In the benchmark specifications, we thus only used two lags for the long-run analysis.

[11] The 37 foreign supplier countries include all OECD and BRICS countries, which are also the most important import suppliers of Switzerland during the investigated period (Q4-2004 - Q3-2011)

which are captured by the fixed effects and are likely to be driven by energy prices or crude oil prices, have changed in each of these phases but remained constant within a phase as adhoc defined here. The three fixed effect adjustments mean that not more than 500 dummies are used for each regression, which allows enough degrees of freedom for our empirical analyses.

Equation (10) is thus adjusted and estimated (for each si) as follows:

$$dp^m_{t,i,k} = \theta_{p,i} + \lambda_{hs6} + \sum_{t=0}^{-2}(\beta_t * de_{t,i}) + u_{t,i,k}. \tag{11}$$

The foreign suppplier and phase dummies $\theta_{p,i}$ in specification (11) pick up all relative changes of marginal cost and demand conditions over time between the foreign (exporting) country and Switzerland as the importing country. λ_{hs6} takes into account product-specific differences of marginal costs that may affect pricing behavior.[12]

In order to see to what extent I-O output sectors so face imported input price adjustments when exchange rates change, the estimated short- and long-run ERPT effects on imported input prices have to be reweighted according to each si's share of each so's total imported inputs. These shares are calculated from the I-O table 2001 for Switzerland and are denoted as R^{si}_{so}, where $\sum_{si}\left[R^{si}_{so}\right] = R_{so}$. Average short-run ERPT effects on imported input prices per I-O output sector so are thus given as follows[13]:

$$\beta^{so}_0 = \sum_{si}\left[R^{si}_{so} * \beta^{si}_0\right]; \tag{12}$$

and the long-run effects as follows:

$$\sum_{t=0}^{-2}\beta^{so}_t = \sum_{si}\left[R^{si}_{so} * \sum_{t=0}^{-2}\beta^{si}_t\right]. \tag{13}$$

We calculated the standard errors of the linear combinations (12) and (13) that take into account the variance-covariance structure of the estimated coefficients β^{si}_t.

[12] We thus implicitly assume that relative cost and demand changes occur homogenously across *hs8*-level products within a specific sector s.

[13] As I-O tables are not updated each period, it is assumed that the import structure of inputs per so is not varying over time, which is a necessary but restrictive limitation of our analysis. Comparisons of Swiss I-0 tables between 2001 through 2008 show that the import structure of inputs in fact remains relatively stable over time.

5.2 ERPT into export prices

Our export regressions estimate ERPT on export prices in line with our theoretical considerations and equation (9). Similar to the estimation strategy applied for the import side, first-difference equations, with lagged exchange rate terms to allow for the possibility of gradual adjustment of export prices, are estimated for each I-O output sector *so* as follows:

$$dp^e_{t,j,f} = \theta_{p,j} + \lambda_{hs6} + \sum_{t=0}^{-2}(\gamma_{1,t} * de_{t,j}) + \sum_{t=0}^{-2}(\gamma_{2,t} * dp^m_t) + v_{t,j,f}, \tag{14}$$

where index j stands for export destination f for export product at the $hs8$ level and *so* is omitted. Letters or expressions already used in equation (9) have the same interpretation; lower case letters still designate logarithms and dimensionality problems are dealt with similarly as for the import side. The variable $p^e_{t,j,f}$ is the log of the export price index, $e_{t,j}$ is the nominal and bilateral exchange rate index defined as CHF per unit of export destination j's currency and p^m_t is the log of the imported input price index in time t. Appendix A explains in detail how p^m_t is constructed[14]. The fixed effects $\theta_{p,j}$ control for phase and destination dependent demand shifts for instance due to changes in general economic conditions. As in the import side equation (11), these fixed effects absorb all relative cost and demand changes between Switzerland and one specific destination country.[15] Fixed effects λ_{hs6} capture variations in domestic marginal costs for different export products at the *hs6*-level.

Short-run total exchange rate pass-through, TPT, (on foreign currency export prices) per *so* is in line with our theoretical framework defined as:

$$1 - \left[\gamma^{so}_{1,0} + \gamma^{so}_{2,0}\right]; \tag{15}$$

and for the long-run it is defined as:

[14] Notice that the imported intermediate input price indexes for each I-O output sector have been used in Section 2 and have only variation over time for each *io* sector and not variation across products. This data shortcoming requires the assumption that input price developments faced by different producers/products within a *so* are the same.

[15] As an example, if domestic sourcing gets more expensive for whatever reason (e.g. domestic agricultural intermediates get more expensive for the food sector), this changes the relative demand and cost conditions for Swiss exporters vs. foreign producers and are hence captured by the $\theta_{p,j}$ dummies. In robustness checks, we also estimated models with *(non-time varying) destination country dummies* but *time-varying product dummies* instead. The ERPT coefficients turned out to be similar.

$$1 - \left[\sum_{t=0}^{-2} \left[\gamma_{1,t}^{so} + \gamma_{2,t}^{so} \right] \right], \tag{16}$$

where the first terms within the brackets in (15) and (16) correspond to mark-up adjustments due to exchange rate changes, or PTM effects. The second terms in (15) and (16) show the cost-adjustment effects through imported inputs, CAE.[16]

6 Results

Table 2 presents sectoral ERPT coefficients for imported input prices. The first two columns display average short and long-run elasticities in each input sector, while the the last two columns report the responses of imported input prices faced by each output/export sector. These latter figures are calculated as weighted averages of pass-through coefficients across input sectors according to their import weight in a respective output sector. The weights are taken from Swiss 2001 IO-tables (see equation 12 and 13). To account for possible auto-correlation in the errors within a panel unit (defined in terms of $hs8$-product and source-country i), we report robust-clustered standard errors using the source-country hs8-product as the clustering unit. This strategy is followed in all regressions reported in this paper.

Looking firstly at the results in column 1 and 2, we cannot reject full pass-through in the short- and long-run for many sectors, whereas we are able to reject zero ERPT in the vast majority of input sectors. There is some sectoral heterogeneity in the short-run, but the estimated long-run coefficients are not significantly different from one in 7 out of 14 sectors and statistically above one in 3 sectors (Wood products, Iron & steel and Fabricated

[16] It should be noted that the theoretically derived CAE term is defined as follows: $\gamma_{2,t}^{so} * \beta_t^{so}$. These beta and gamma coefficients are however estimated in two different samples, the imported input price sample and the export price sample. As a result, obtaining the appropriate standard errors for these estimates (i.e. the product of the estimates) is a non-trivial task and cannot be accomplished with conventional bootstrapping methods. One possible remedy is to construct firstly all variables needed for the import regression within the export price sample, which does however substantially reduce variation in the data. Secondly, the new import regression and the export regression is estimated through seemingly unrelated equations (SUR) in order to apply new post-estimation simulations to calculate non-linear combinations and their standard errors. We estimated such models and came to the same conclusions as with the simpler and straightforward approach described in the main text. Not least, estimates from the two alternatives do not substantially differ as the $\gamma_{2,t}^{so}$ coefficients are not significantly different from zero for most sectors and/or the magnitude is close to zero. The combined effects $\gamma_{2,t}^{so} * \beta_t^{so}$ are thus also close to zero. We are grateful to Giovanni Mellace for important suggestions on these issues.

metal products). With regard to imported input prices faced by each output sector in the third and fourth column, the picture remains unchanged with complete pass-through or exchange rate amplification (coefficients above one) being the appropriate characterization of the input price reactions to exchange rate movements.[17]

The magnitudes of the pass-through coefficients into imported input prices may be surprisingly high but in line with the existing evidence of high pass-through into Swiss import prices. For instance, Campa and Goldberg (2005) estimate a long-run pass-through rate of 0.94, which is not significantly different from one, for the Swiss manufacturing sector as a whole. Gaulier et al. (2008) estimate ERPT for each HS 4-digit product line separately and obtain an average ERPT of 0.7 for Switzerland. Only about 30% of the estimated pass-through coefficients are statistically different from one. For countries in the Euro area, Campa and Gonzalez Minguez (2006) conclude that industry-specific pass-through rates into import prices are on the order of 0.8 and that many industries within a country reach full pass-trough after four months only. Furthermore, Campa and Gonzalez Minguez (2006) show that pass-through into producer price indexes is more than double the size of transmission into consumer prices suggesting higher pass-through into imported input goods compared to consumer goods. However, our results are somewhat in contradiction to the recent study conducted by the State Secretariat for Economic Affairs (Seco, 2011) that estimated fairly low average ERPT into Swiss import price indexes of 0.4 after three to four quarters.[18]

How can this high pass-through rate at the upper bound of prior estimates be explained? It is important to bear in mind that we only included input (intermediate) goods in the import regressions, while studies employing more aggregate price indexes are likely to be biased towards consumer goods. In line with equation 5 in Section 4, high ERPT can be explained by a input demand elasticity that changes little with local prices (in CHF). This is reasonable for highly customized input goods tailored to specific needs of firms. Recent theoretical advances complement the imperfect competition model with mark-up pricing from Section 4 with distribution costs in the local market in order to explain ERPT (see for example, Corsetti and Dedola, 2005 in a general-equilibrium framework or in Berman et al., 2011 in a Melitz-type model). According to Goldberg and Campa (2010) and Berman et al. (2011), 30-60% of local consumer goods prices are made up by distribution costs as opposed to a much lower distribution cost share for intermediate goods. This is important

[17]For instance, a coefficient of 1.33 for the Textiles sector in the long-run (column 2 of Table 2) indicates that foreign suppliers increase CHF prices by about 13.3% when the CHF depreciates by 10%.

[18]Stulz (2007) also obtains an ERPT of 0.4.

because a lower share of distribution costs incurred in local currency lowers the incentive for pricing-to-market (PTM) and thus increases pass-through rates in all models emphasizing distribution costs.[19]Our import side results support this class of models and suggest that prices of imported inputs faced by Swiss output/export industries are mainly invoiced in currencies of the foreign suppliers (PCP). As a consequence, Swiss industries highly benefit from exchange rate appreciations through cheaper imported inputs, in particular in those industries with a higher share of foreign inputs. Hence, exporters can potentially benefit from "natural hedging" practices in times of currency appreciations if imported price changes are not transmitted to foreign consumers. Moreover, variable deletion F-tests confirmed that these high sectoral long-run pass-through rates are mostly achieved within three quarters, therefore we used only two lags for the long-run analysis[20].

As a robustness check, we performed the same estimations adding interaction terms for each exchange rate variable with a dummy that equals one for all observations during the "strong Franc" period (Q1 2010 - Q3 2011, or since the nominal CHF/EUR exchange rate reached a level below 1.25 for the first time) in order to study the pricing behavior during this exceptional time. However, we couldn't find statistical evidence that the pricing strategies of foreign suppliers changed during the strong CHF period in the wake of the Euro crisis.

Table 3 displays the short-run PTM and pass-through coefficients as well as cost-adjustment effects due to imported input price changes on the export side. We find substantial sectoral heterogeneity indicating along the lines of Knetter (1993) that sectoral differences are important factors in explaining ERPT. The results for direct ERPT (DPT, column 4) show that 6 sectors out of 15 report partial ERPT[21], 4 sectors are characterized by full pass-through[22] and ERPT for 2 sectors is not statistically different from zero.[23] According to Yang (1997), sectors with differentiated goods, which have no close substitutes available that prevent foreign costumers from switching to other products when local prices (in foreign currency units, FCU) rise, should attain higher ERPT rates. As displayed in Table 7 (Appendix C), this is the case in the short-run for sectors containing a high share of differ-

[19]Previous empirical studies come to similar conclusions: Using French firm-level data, Berman et al. (2011) show that ERPT is substantially higher for intermediate goods than for consumer goods. Gaulier et al. (2006) reach the same conclusion using disaggregated trade data.

[20]We also estimated equations with four lags which yielded similar results.

[21]Food & beverages, Textiles, Rubber & plastics products, Fabricated metal products, Mineral products and Electrical machinery.

[22]Paper products, Iron & steel, Machinery & equipment and Precision instruments.

[23]Wood products and Chemicals & pharmaceuticals.

Table 2: Exchange rate pass-through into imported input prices (in CHF)

		By input sector		By output sector*	
		Short-run	Long-run	Short-run	Long-run
1	Agriculture	0.49	0.71	$0.50^{a/b}$	1.34^{a}
		(0.38)	(0.70)	(0.22)	(0.42)
2	Mining & quarrying	2.78	6.54	1.09	3.09^{a}
		(3.76)	(3.90)	(1.05)	(1.13)
3	Food & beverages	0.72^{a}	1.51^{a}	0.61^{a}	1.18^{a}
		(0.21)	(0.38)	(0.21)	(0.41)
4	Textiles	0.79^{a}	1.33^{a}	0.71^{a}	1.45^{a}
		(0.15)	(0.33)	(0.16)	(0.33)
5	Wood products	1.13^{a}	$1.71^{a/b}$	0.97^{a}	$1.79^{a/b}$
		(0.18)	(0.34)	(0.16)	(0.33)
6	Paper products	$0.58^{a/b}$	1.37^{a}	$0.61^{a/b}$	1.60^{a}
		(0.11)	(0.31)	(0.16)	(0.33)
7	Chemicals & pharmaceuticals	0.18^{b}	1.79^{a}	0.75	$2.65^{a/b}$
		(0.40)	(0.60)	(0.72)	(0.83)
8	Rubber & plastics products	0.72^{a}	1.56^{a}	0.34^{b}	1.81^{a}
		(0.17)	(0.34)	(0.31)	(0.49)
9	Mineral products	0.86^{a}	1.62^{a}	1.46	3.48^{a}
		(0.30)	(0.43)	(1.36)	(1.44)
10	Iron & steel	1.12^{a}	$2.32^{a/b}$	1.18^{a}	$2.65^{a/b}$
		(0.32)	(0.60)	(0.44)	(0.63)
11	Fabricated metal products	0.73^{a}	$1.99^{a/b}$	1.03^{a}	$2.27^{a/b}$
		(0.18)	(0.39)	(0.26)	(0.51)
12	Machinery & equipment	0.55	1.85	0.68^{a}	$1.88^{a/b}$
		(0.99)	(1.12)	(0.30)	(0.44)
13	Electrical machinery	0.30	1.59^{a}	0.61^{a}	$1.84^{a/b}$
		(0.51)	(0.58)	(0.26)	(0.41)
14	Communication equipment	..	..	0.73^{a}	$1,89^{a/b}$
		..	..	(0.19)	(0.38)
15	Precision instruments	0.88^{a}	0.92	0.85^{a}	$1.76^{a/b}$
		(0.35)	(0.78)	(0.17)	(0.38)

Notes: *Weighted average ERPT faced by each output sector [weights from I-O table]; by input sector: short-run = β_0^{si}, long-run = $\sum_{t=0}^{-2} \beta_t^{so}$; by output sector: short-run = β_0^{so}, long-run = $\sum_{t=0}^{-2} \beta_t^{so}$; $^{a/b}$H0 of zero/full pass-through rejected at the 95%-level; estimated with WLS [weight = import value], robust-clustered standard errors in parentheses [cluster unit = (*hs8*)*(source country)]; phase-source varying fixed effects as well as *hs*6 varying fixed effects; coefficients missing for input sector 14 as no *hs8* input product classified within sector 14.

entiated and customized products such as Precision instruments, Machinery & equipment, Fabricated metal and Rubber & plastics products. In contrast, more competitive sectors with less product differentiation such as, for example, Textiles or Wood products are less able to pass-through exchange rate changes to foreign customers. This indicates that the degree of competition within a sector may be indeed an important determinant of the pricing behavior of exporters. An alternative explanation for sectoral heterogeneity would be that distribution costs (incurred in the local currency) as a share of marginal costs are higher in some sectors increasing the incentives to set prices directly in the local currency (LCP) (see Corsetti and Dedola, 2005). Also this second rationalization of sectoral ERPT heterogeneity holds remarkably well in the short-run (see also Appendix C and Table 7 for more details).

The cost-adjustment effects denoted by Indirect (CAE) in the second column of Table 3 are overwhelmingly insignificant meaning that exporters do not pass on imported input price changes to foreign consumers. Given full pass-through rates in almost all sectors on the imported input side (see Table 2), these insignificant CAE coefficients imply that an appreciation of the exporter currency (CHF) leads to higher profit margins. This supports the view of imported inputs as a natural mean for hedging exchange rate risks.

Table 4 shows the corresponding long-run results and gives additional insights with regard to PTM and cost-adjustment behavior at the sectoral level. Consistent with the short-run results and in line with Yang (1997), the Machinery & equipment and Precision instruments sectors are able to keep profit margins stable by passing on exchange rate shocks completely to foreign clients. Conversely, the average exporter in the Wood products, Textiles or the Food & beverages sectors engages at least partly in PTM (see column 1, Table 4), thereby stabilizing local prices and absorbing some of the exchange rate movements in the mark-up. Overall, our explanation of the sectoral ERPT heterogeneity based on product competition and distribution margins is however less supported in the long-run (see again Appendix C and Table 7 for more details).

The cost-adjustment coefficients CAE in the second column of Table 4 see no statistical significance and/or small magnitudes confirming the corresponding short-run CAE results described above. In sum, the cost-savings accrued on the inputs from the recent CHF appreciation period compensate for the partly squeezed profit margins on the export side.

Tables 5 and 6 report the results of export price regressions in which imported input prices are replaced with an imported input weighted exchange rate for the short- and long-run. This set of regressions is intended to check the robustness of the results concerning the responsiveness of export prices to imported input price adjustments. The CAE results reported in Table 5 and 6 corroborate the general finding about small or non-responsiveness of export and local prices to imported input price changes. The magnitudes of the CAE coefficients are generally higher, but except for three (mostly commodity intensive) sectors in the short- and long run, the CAE are not statistically significant. It is therefore safe to conclude that in the vast majority of the investigated goods sectors, firms do not adjust export prices in response to exchange rate driven changes of production costs. As price adjustments are costly and a large bulk of the production costs is likely to be incurred in CHF (including compensation of employees, see Table 1), Swiss exporters optimally choose to absorb changes of the imported input prices in their mark-ups. Put differently, looking at direct (DPT) and total (TPT) pass-through coefficients in Table 3 and 4, we recognize that imported input price changes are not passed on to foreign consumers and do hence not significantly change ERPT behavior. This finding differs with the results of Athukorala and Menon (1994) and Berman et al. (2011) which report diminished ERPT coefficients when imported inputs are considered. As a consequence, their results imply that “natural hedging” of exchange rate risks is less pronounced in their studies.

As with the import estimations, we also checked whether pricing behavior on the export side differed during the “strong Franc” period and again found no convincing support for this hypothesis. Thus, our results also hold good during the period of the recent CHF appreciation.

Table 3: Exchange rate pass-through into export prices (in CHF and in foreign currency units, FCU) - short-run

		In CHF			In FCU	
		Direct (PTM)	Indirect (CAE)	Total (1-TPT)	Direct (DPT)	Total (TPT)
1	Agriculture	0.59	-0.00^{b}	0.59	0.41	0.41
		(0.55)	(0.02)	(0.56)	(0.55)	(0.56)
2	Mining & quarrying	0.70	-0.01^{b}	0.69	0.30	0.31
		(0.50)	(0.01)	(0.50)	(0.50)	(0.50)
3	Food & beverages	0.33$^{a/b}$	-0.01$^{a/b}$	0.32$^{a/b}$	0.67$^{a/b}$	0.68$^{a/b}$
		(0.11)	(0.01)	(0.11)	(0.11)	(0.11)
4	Textiles	0.62$^{a/b}$	0.02$^{a/b}$	0.65$^{a/b}$	0.38$^{a/b}$	0.35$^{a/b}$
		(0.08)	(0.01)	(0.09)	(0.08)	(0.09)
5	Wood products	1.08^{a}	-0.00^{b}	1.08^{a}	-0.08	-0.08
		(0.38)	(0.02)	(0.39)	(0.38)	(0.40)
6	Paper products	0.18	0.01^{b}	0.19	0.82^{a}	0.81^{a}
		(0.20)	(0.02)	(0.21)	(0.20)	(0.21)
7	Chemicals & pharmaceuticals	0.69^{a}	-0.02^{b}	0.67^{a}	0.31	0.33
		(0.32)	(0.03)	(0.31)	(0.33)	(0.31)
8	Rubber & plastics products	0.44$^{a/b}$	0.00^{b}	0.44$^{a/b}$	0.56$^{a/b}$	0.56$^{a/b}$
		(0.09)	(0.01)	(0.10)	(0.09)	(0.10)
9	Mineral products	0.52$^{a/b}$	-0.02^{b}	0.49$^{a/b}$	0.48$^{a/b}$	0.51$^{a/b}$
		(0.19)	(0.02)	(0.20)	(0.19)	(0.20)
10	Iron & steel	-0.14	-0.03$^{a/b}$	-0.17	1.14^{a}	1.17
		(0.41)	(0.01)	(0.41)	(0.41)	(0.41)
11	Fabricated metal products	0.30$^{a/b}$	-0.01^{b}	0.29$^{a/b}$	0.70$^{a/b}$	0.71$^{a/b}$
		(0.10)	(0.01)	(0.10)	(0.10)	(0.10)
12	Machinery & equipment	0.27	-0.00^{b}	0.26	0.73^{a}	0.74^{a}
		(0.21)	(0.01)	(0.22)	(0.21)	(0.22)
13	Electrical machinery	0.62$^{a/b}$	-0.02^{b}	0.60$^{a/b}$	0.38$^{a/b}$	0.40$^{a/b}$
		(0.18)	(0.01)	(0.18)	(0.18)	(0.18)
14	Communication equipment	0.73	-0.03^{b}	0.70	0.27	0.30
		(0.37)	(0.03)	(0.39)	(0.37)	(0.39)
15	Precision instruments	0.16	-0.00^{b}	0.16	0.84^{a}	0.84^{a}
		(0.13)	(0.01)	(0.13)	(0.13)	(0.13)

Notes: PTM (pricing to market coefficient) = $\gamma_{1,0}^{so}$, CAE (cost adjustment effect) = $\gamma_{2,0}^{so}$, 1-TPT = $\gamma_{1,0}^{so} + \gamma_{2,0}^{so}$, DPT = $1 - \gamma_{1,0}^{so}$, TPT (total pass-through coefficient) = $1 - (\gamma_{1,0}^{so} + \gamma_{2,0}^{so})$; $^{a/b}$H0 of zero/one PTM, CAE or pass-through (DPT and TPT) rejected at the 95%-level, respectively; estimated with weighted least squares [weight = import value], robust-clustered standard errors in parentheses [cluster unit = (*hs8*)*(source country)]; phase-source varying fixed effects as well as *hs6* varying fixed effects.

Table 4: Exchange rate pass-through into export prices (in CHF and in foreign currency units, FCU) - long-run

		In CHF			In FCU	
		Direct (PTM)	Indirect (CAE)	Total (1-TPT)	Direct (DPT)	Total (TPT)
1	Agriculture	0.31	-0.05^{b}	0.26	0.69	0.74
		(0.83)	(0.04)	(0.85)	(0.84)	(0.85)
2	Mining & quarrying	0.99	-0.14$^{a/b}$	0.85	0.01	0.15
		(1.00)	(0.04)	(1.02)	(1.00)	(1.02)
3	Food & beverages	0.35$^{a/b}$	-0.02$^{a/b}$	0.32$^{a/b}$	0.65$^{a/b}$	0.67$^{a/b}$
		(0.14)	(0.01)	(0.15)	(0.14)	(0.15)
4	Textiles	0.71$^{a/b}$	0.05$^{a/b}$	0.76^{a}	0.29$^{a/b}$	0.24^{b}
		(0.14)	(0.01)	(0.15)	(0.14)	(0.15)
5	Wood products	1.40^{a}	0.01	1.41^{a}	-0.40^{b}	-0.41^{b}
		(0.43)	(0.04)	(0.46)	(0.43)	(0.46)
6	Paper products	0.33	0.04^{b}	0.37	0.67	0.63
		(0.42)	(0.04)	(0.45)	(0.42)	(0.45)
7	Chemicals & pharmaceuticals	0.49	-0.09^{b}	0.40	0.51	0.60
		(0.62)	(0.07)	(0.59)	(0.62)	(0.59)
8	Rubber & plastics products	0.85^{a}	-0.02	0.83^{a}	0.15^{b}	0.17^{b}
		(0.21)	(0.01)	(0.21)	(0.21)	(0.21)
9	Mineral products	0.55	-0.01^{b}	0.53	0.45	0.47
		(0.41)	(0.03)	(0.42)	(0.41)	(0.42)
10	Iron & steel	0.47	-0.04^{b}	0.43	0.53	0.57
		(0.64)	(0.03)	(0.63)	(0.64)	(0.63)
11	Fabricated metal products	0.55$^{a/b}$	-0.03^{b}	0.52$^{a/b}$	0.45$^{a/b}$	0.49$^{a/b}$
		(0.17)	(0.02)	(0.18)	(0.17)	(0.18)
12	Machinery & equipment	-0.04^{b}	0.01^{b}	-0.02^{b}	1.04^{a}	1.02^{a}
		(0.34)	(0.03)	(0.34)	(0.34)	(0.34)
13	Electrical machinery	0.944^{a}	-0.07$^{a/b}$	0.87^{a}	0.06^{b}	0.13^{b}
		(0.38)	(0.04)	(0.37)	(0.38)	(0.38)
14	Communication equipment	0.73	0.01^{b}	0.74	0.27	0.26
		(0.68)	(0.07)	(0.70)	(0.68)	(0.70)
15	Precision instruments	-0.09^{b}	-0.00^{b}	-0.09^{b}	1.09^{a}	1.09^{a}
		(0.23)	(0.01)	(0.23)	(0.23)	(0.23)

Notes: PTM (pricing to market coefficient) $=\sum_{t=0}^{-2} \gamma_{1,t}^{so}$, CAE (cost adjustment effect) $= \sum_{t=0}^{-2} \gamma_{2,t}^{so}$, 1-TPT $= \sum_{t=0}^{-2} \left(\gamma_{1,t}^{so} + \gamma_{2,t}^{so}\right)$, DPT $= 1 - \sum_{t=0}^{-2} \gamma_{1,t}^{so}$, TPT (total pass-through coefficient) $= 1 - \sum_{t=0}^{-2} \left(\gamma_{1,t}^{so} + \gamma_{2,t}^{so}\right)$; $^{a/b}$H0 of zero/one PTM, CAE or pass-through (DPT and TPT) rejected at the 95%-level, respectively; estimated with weighted least squares [weight = import value], robust-clustered standard errors in parentheses [cluster unit = (*hs8*)*(source country)]; phase-source varying fixed effects as well as *hs6* varying fixed effects.

Table 5: Exchange rate pass-through into export prices (in CHF and in foreign currency units, FCU) - short-run (import weighted exchange rates used for CAE)

		In CHF			In FCU	
		Direct (PTM)	Indirect (CAE)	Total (1-TPT)	Direct (DPT)	Total (TPT)
1	Agriculture	0.21	0.47	0.69	0.79	0.32
		(1.03)	(1.00)	(0.42)	(1.04)	(0.42)
2	Mining & quarrying	-0.02^{b}	2.78$^{a/b}$	2.76$^{a/b}$	1.02^{a}	-1.76$^{a/b}$
		(0.20)	(0.35)	(0.29)	(0.20)	(0.29)
3	Food & beverages	0.42$^{a/b}$	-0.04^{b}	0.38$^{a/b}$	0.58$^{a/b}$	0.62$^{a/b}$
		(0.12)	(0.12)	(0.11)	(0.12)	(0.11)
4	Textiles	0.75$^{a/b}$	-0.65$^{a/b}$	0.10	0.25$^{a/b}$	0.90^{a}
		-0.10	(0.16)	(0.13)	(0.10)	(0.13)
5	Wood products	0.52	0.94	1.46^{a}	0.48	-0.46^{b}
		(0.27)	(0.51)	(0.42)	(0.27)	(0.42)
6	Paper products	-0.04^{b}	0.11^{b}	0.07^{b}	1.04^{a}	0.93^{a}
		(0.27)	(0.34)	(0.19)	(0.27)	(0.19)
7	Chemicals & pharmaceuticals	0.64^{a}	0.31	0.95	0.36^{b}	0.05
		(0.32)	(0.53)	(0.56)	(0.32)	(0.56)
8	Rubber & plastics products	0.40$^{a/b}$	0.41^{b}	0.81^{a}	0.60$^{a/b}$	0.19^{b}
		(0.16)	(0.24)	(0.15)	(0.16)	(0.15)
9	Mineral products	0.62^{a}	0.063^{b}	0.69^{a}	0.38^{b}	0.31^{b}
		(0.20)	(0.25)	(0.20)	(0.20)	(0.20)
10	Iron & steel	-0.54^{b}	1.61^{a}	1.07^{a}	1.54^{a}	-0.07^{b}
		(0.38)	(0.40)	(0.42)	(0.38)	(0.42)
11	Fabricated metal products	0.25^{b}	0.32^{b}	0.57$^{a/b}$	0.75^{a}	0.43$^{a/b}$
		(0.13)	(0.21)	(0.16)	(0.13)	(0.16)
12	Machinery & equipment	0.26^{b}	-0.05^{b}	0.21^{b}	0.74^{a}	0.79^{a}
		(0.24)	(0.39)	(0.33)	(0.24)	(0.33)
13	Electrical machinery	0.51$^{a/b}$	0.60	1.11^{a}	0.49$^{a/b}$	-0.11^{b}
		(0.24)	(0.36)	(0.30)	(0.24)	(0.30)
14	Communication equipment	0.87	-0.24	0.64	0.13	0.36
		(0.47)	(0.75)	(0.58)	(0.47)	(0.58)
15	Precision instruments	0.20^{b}	-0.14^{b}	0.06^{b}	0.80^{a}	0.94^{a}
		(0.12)	(0.36)	(0.35)	(0.12)	(0.35)

Notes: PTM (pricing to market coefficient) = $\gamma_{1,0}^{so}$, CAE (cost adjustment effect) = $\gamma_{2,0}^{so}$, 1-TPT = $\gamma_{1,0}^{so} + \gamma_{2,0}^{so}$, DPT = $1 - \gamma_{1,0}^{so}$, TPT (total pass-through coefficient) = $1 - (\gamma_{1,0}^{so} + \gamma_{2,0}^{so})$; $^{a/b}$H0 of zero/one PTM, CAE or pass-through (DPT and TPT) rejected at the 95%-level, respectively; estimated with weighted least squares [weight = import value], robust-clustered standard errors in parentheses [cluster unit = (*hs8*)*(source country)]; phase-source varying fixed effects as well as *hs6* varying fixed effects.

Table 6: Exchange rate pass-through into export prices (in CHF and in foreign currency units, FCU) - long-run (import weighted exchange rates used for CAE)

		In CHF			In FCU	
		Direct (PTM)	Indirect (CAE)	Total (1 - TPT)	Direct (DPT)	Total (TPT)
1	Agriculture	-0.47	1.50	1.02	1.47	-0.03
		(1.28)	(1.50)	(1.19)	(1.28)	(1.19)
2	Mining & quarrying	0.05^{b}	$7.70^{a/b}$	$7.75^{a/b}$	0.95^{a}	$-6.75^{a/b}$
		(0.42)	(1.01)	(0.87)	(0.42)	(0.87)
3	Food & beverages	$0.48^{a/b}$	0.08^{b}	0.56^{a}	$0.52^{a/b}$	0.45^{b}
		(0.11)	(0.26)	(0.24)	(0.11)	(0.24)
4	Textiles	0.78^{a}	-0.38^{b}	0.40^{b}	0.22^{b}	0.60^{a}
		(0.16)	(0.31)	(0.28)	(0.16)	(0.28)
5	Wood products	0.69	1.25	$1.94^{a/b}$	0.31	$-0.95^{a/b}$
		(0.46)	(0.64)	(0.39)	(0.46)	(0.39)
6	Paper products	-0.23^{b}	0.33	0.11^{b}	1.23^{a}	0.89^{a}
		(0.52)	(0.64)	(0.39)	(0.52)	(0.39)
7	Chemicals & pharmaceuticals	0.54	-0.70	-0.15	0.46	1.15
		(0.62)	(1.46)	(1.38)	(0.62)	(1.38)
8	Rubber & plastics products	0.32^{b}	$2.20^{a/b}$	$2.52^{a/b}$	0.68^{a}	$-1.52^{a/b}$
		(0.23)	(0.49)	(0.41)	(0.23)	(0.41)
9	Mineral products	0.63	0.43	1.06	0.37	-0.06
		(0.50)	(0.69)	(0.55)	(0.50)	(0.55)
10	Iron & steel	0.51	-1.48^{b}	-0.97	0.49	1.97
		(0.79)	(1.09)	(1.07)	(0.79)	(1.07)
11	Fabricated metal products	0.32^{b}	1.18^{a}	1.50^{a}	0.68^{a}	-0.50^{b}
		(0.21)	(0.49)	(0.40)	(0.21)	(0.40)
12	Machinery & equipment	0.02^{b}	-0.46	-0.44^{b}	0.98^{a}	1.44^{a}
		(0.37)	(0.74)	(0.69)	(0.37)	(0.69)
13	Electrical machinery	0.72	1.37	2.10^{a}	0.28	-1.10^{b}
		(0.44)	(0.72)	(0.77)	(0.44)	(0.77)
14	Communication equipment	0.96	-0.75	0.21	0.04	0.79
		(0.59)	(1.47)	(1.46)	(0.59)	(1.46)
15	Precision instruments	0.06^{b}	-0.85^{b}	-0.79^{b}	0.94^{a}	1.79^{a}
		(0.20)	(0.87)	(0.84)	(0.20)	(0.84)

Notes: PTM (pricing to market coefficient) $=\sum_{t=0}^{-2}\gamma_{1,t}^{so}$, CAE (cost adjustment effect) $=\sum_{t=0}^{-2}\gamma_{2,t}^{so}$, 1-TPT $=\sum_{t=0}^{-2}\left(\gamma_{1,t}^{so}+\gamma_{2,t}^{so}\right)$, DPT $=1-\sum_{t=0}^{-2}\gamma_{1,t}^{so}$, TPT (total pass-through coefficient) $=1-\sum_{t=0}^{-2}\left(\gamma_{1,t}^{so}+\gamma_{2,t}^{so}\right)$; $^{a/b}$H0 of zero/one PTM, CAE or pass-through (DPT and TPT) rejected at the 95%-level, respectively; estimated with weighted least squares [weight = import value], robust-clustered standard errors in parentheses [cluster unit = (*hs8*)*(source country)]; phase-source varying fixed effects as well as *hs6* varying fixed effects.

7 Conclusion

This paper uses highly disaggregated trade data for Switzerland over 2004-2011 to examine at length whether Swiss exporters systematically respond to exchange rate changes by adjusting their prices. Given the high share of imported intermediates in total intermediate inputs in Swiss manufacturing, of underlying significance is the impact of exchange rate changes on the prices of these imported inputs as the latter may serve as a "natural" channel by which exporters can maintain their competitive advantage despite an appreciation of the CHF.

Our results, that are impervious to various robustness checks, firstly, indicate high ERPT into imported input prices in all sectors. We cannot reject full pass-through in the short- and long-run for many sectors, whereas we are able to reject zero ERPT in the vast majority of input sectors. While in line with related literature, these results depart from Stulz (2007) and Seco (2011) who study ERPT into import prices more generally (not only intermediate imports). This difference could be due to low input demand elasticities with respect to local prices and/or low share of distribution costs for inputs.

On the export side, our results indicate strong sectoral ERPT heterogeneity in both the short and long-run. Moreover, the cost-adjustment effects are found to be overwhelmingly insignificant implying that exporters do not pass on imported input price changes to foreign consumers. Thus, an appreciation of the CHF leads to higher profit margins and imported inputs act as a natural mean for hedging exchange rate risks.

The appreciation of the CHF began in 2009 and progressed steadily until the middle of 2010 after which it accelerated in response to the ensuing Euro crisis. The last one year has witnessed considerable intervention by the Swiss Central Bank to assuage Swiss exporters of the adverse effects of this appreciation. However, our final empirical result suggests that the pricing strategies of Swiss exporters may not have changed in response to the strong CHF in wake of the Euro crisis, which therefore questions central bank intervention during that period.

Future research may like to investigate this "natural hedging" hypothesis over a longer time period. The extent of under- or over-valuation of the domestic currency may also have a bearing on these results. It would also be interesting to examine the extent to which these results are driven by adjustments at the extensive margin. Finally, it would be useful to extend this analysis to a sample of other countries, both developing and developed. To the extent that these results hold across countries, they would have significant implications for monetary policy.

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A Construction of the imported intermediate input price index

Imported input price indexes are calculated using unit values at the 8-digit level and for eachmonth and each trading partner separately. Solely imported intermediate 8-digit goods are considered in these calculations, for which the WTO classification of intermediate goods (published by UN Comtrade[24]) is used. Import-weighted averages are constructed from these unit values for each 2-digit ISIC product group, which are further averaged for each sector used in I-O tables[25]. To get the average imported intermediate input prices (or unit values) faced by Swiss industries, the constructed sector price averages are reweighted according to the share of imports from each input sector in each output sector. These weights are taken from the 2001 I-O table for Switzerland[26]. More formally, these prices indexes are constructed as follows :

$$P^m_{t,so} = \left[\sum\nolimits_{t,so,si,isic2} \left\{ \left[\sum\nolimits_{t,isic2,k,i} \left(\frac{IV_{t,isic2,hs8,i}}{IV_{t,isic2}}\right)(UV_{t,isic2,hs8,i})\right]_{t,isic2} * \left(\frac{IV_{si,isic2}}{IV_{si}}\right) * (R^{si}_{so}) \right\}\right]_{so,t},$$

where t is the time period (month[27]), i is the source country of imports, k is the HS 8-digit input product, $isic2$ is the ISIC 2-digit sector, si is the I-O imported input sector and so is the I-O output sector. IV stands for import values in CHF, UV are unit values (or import values divided by weight of imported goods in kg) and R^{si}_{so} is the share of imported inputs from I-O input sector si in I-O output sector so. A limiting feature of our data is that these I-O weights do not vary over time and are thus assumed to remain constant across the whole study period. Finally, $P^m_{t,so}$ is the average imported intermediate input price faced by each (output) sector, ioo, in each period, t. In Figure 1 these prices are indexed and averaged over 12-months, where January 2005 is taken as the base period (January 2005 = 100). In the export side estimations these imported input price indexes are again used as an independent variable.

[24] http://wits.worldbank.org/wits/data_details.html

[25] Each I-O table sector consists of one up to five 2-digit ISIC product groups.

[26] The I-O table for Switzerland was last updated in 2008 and is published by the OECD. In order to avoid endogeneity in the construction of the price indexes, a pre-study period I-O table (2001) is used.

[27] Notice that in the empirical strategy (Section 4), time t is one quarter.

B Preliminary diagnostics: unit root tests

Although our theoretical framework leads us to an estimation in first-differences, we reconfirm this approach from an econometric point of view in this appendix section. Our panel data has a significant time series component, which raises the risk of spurious regression when estimating a model in levels. We thus tested our panel series for unit roots/non-stationarity. Not least, this is done for consistency with other studies in this field, which are often modeled in levels and therefore had to perform such tests. In general, other ERPT studies find non-stationary series and thus also end up estimating in first differences.

Recent studies by O'Connell (1998)and Breitung and Das (2005) have highlighted that, in the presence of contemporaneous correlation, standard panel unit root tests like those proposed by Maddala and Wu (1999), Levin et al. (2002) and Im et al. (2003) suffer from severe oversize problem. Our panel unit root tests therefore needed to be preceded by tests for cross-sectional dependence. We performed these tests for each HS-6 digit product line separately for both the import and the export side. Using the Modified Lagrange Multiplier test for cross-sectional dependence in **?**, we found that the null of cross-sectional independence was non-surprisingly rejected in all cases of the nominal exchange rate (NER) series but in only 27% of the tests in the case of the import price series. On the export side, we found the null of cross-sectional independence to be decisively rejected in 99% of these tests in the case of NER and in 39% of the tests in the case of export prices. Our results thus provided evidence of cross-sectional dependence in our data on NER and to a limited extent on import and export prices.

If cross-sectional dependence is weak, literature suggests using robust panel unit root tests such as the one proposed by Im et al. (2003) or Breitung and Das (2005) depending on the data and sample size. However, if cross-sectional dependence is strong, estimation would require either decomposing the time series into common and idiosyncratic factors and testing them separately for the presence of unit roots (e.g. Bai and Ng, 2004) or using cross-sectional demeaned tests such as the IPS test (CIPS) suggested by Pesaran (2007). Unfortunately, however, there seems to be no consensus in literature on the definition of weak or strong dependence (Sarafidis and Wansbeek, 2010).

In view of the above, the first method used to test for unit roots was the Im et al. (2003) panel unit root test. Once again, we performed these tests at the HS-6 digit level for both the import and export side. We found that the null of "all panels contain unit roots" was rejected in only 3% of the tests for the NER data but in 97% of the tests for import prices.

On the export side, the null was rejected in only 5% of the cases for the NER data but in 95% of the tests for export prices. This first set of tests points to our NER data being a random walk and suggests that our import and export prices may be stationary.

Under the assumption of strong cross-sectional dependence, we next used the cross-sectional demeaned version of the IPS test (CIPS) suggested by Pesaran (2007) which accounts for the dynamics in the common factor by using cross-sectional averages and their lagged values (without having to estimate the common factor first). The results from the CIPS corroborated those from Im et al. (2003) - the null of unit root was rejected in only 1% of the tests for NER; on the export side, the null of unit root was rejected in all of cases for NER but in 72% for export prices.

However, it is probably more appropriate to consider long-run data to adjust for seasonal variations. Including four lags for each panel series while performing the CIPS test, we found the the null of unit root was never rejected for NER on both the import and export side and rejected in only 1% and 2% of the tests for imported input prices and export prices, respectively. Thus, all our panel series seem to be non-stationary when adjusting for seasonalities.

Having thus performed various unit root tests, we could not rule out non-stationarity in our data and therefore, even from an econometric point of view, we were on the safe side to estimate our empirical models in first-differences.

C Descriptive analysis of sectoral ERPT heterogeneity

In Table 7, we illustrate more systematically whether the sectoral heteorogeneity in ERPT may be attributed to the competitive environment and/or the share of local distribution costs. Along the lines of Yang (1997), sectors with a higher share of differentiated goods should be able to pass on exchange rate shocks more easily to foreign consumers and should hence be characterized by higher ERPT rates (see Supposition 1 in Table 7). While this supposition is at least partly confirmed in the short-run (9 sectors confirmed vs. 6 sectors rejected), it holds less in the longer-run (5 sectors confirmed vs. 10 sectors rejected).

Supposition 2 states that sectors with smaller shares of distribution costs have higher ERPT rates and vice versa. Why should this be the case? Firms with a high share of local distribution costs are more inclined to engage in PTM (low ERPT) and to keep local prices stable (see Section 6). Again, this supposition finds more confirmation in the short-run with 11 sectors confirmed against 4 sectors rejected. In contrast, in the long-run we find 7 confirmations versus 8 rejections.

In sum, the two suppositions seem to explain quite well the short-run ERPT behavior but fail to characterize the pricing in the long-run. However, one should be cautious in the interpretation of Table 7 because the number of sectors included in the analysis is too small (15 sectors[28]) for proper statistical inference. The small number of sectors means that the aggregation level is probably too high, covering the underlying heterogeneity in terms of distribution costs and product differentiation of more disaggregated product groups within a sector. One would thus need more observations for a regression analysis that controls for other confounding factors (see for instance Campa and Goldberg, 2005 and Gaulier et al., 2008). This was, however, not our main research focus and thus beyond the scope of this paper.

[28] This was dictated by the sectoral breakdown of Swiss I-O Tables in order to address our main research questions related to "Natural hedging".

Table 7: Descriptive analysis of sectoral ERPT heterogeneity

Supposition 1:
Sectors exporting more differentiated products have higher ERPT rates; and vice versa

	Confirmed	Rejected
Short-run ERPT (see Table 3, Direct DPT)		
High ERPT rates (>50%); high share of differentiated goods exported (>80%)	Precision instruments^{a}; Fabricated metal products$^{a/b}$; Machinery & equipment^{a}; Rubber & plastics products$^{a/b}$	Electrical machinery$^{a/b}$; Mineral products$^{a/b}$; Communication equipment
Low ERPT rates (<50%); low share of differentiated goods exported (<80%)	Textiles$^{a/b}$; Wood products; Chemicals & pharmaceuticals; Agriculture; Mining & quarrying	Food & beverages$^{a/b}$; Paper products^{a}; Iron & steel^{a}
Long-run ERPT (see Table 4, Direct DPT)		
High ERPT rates (>50%); high share of differentiated goods (>80%)	Precision instruments^{a}; Machinery & equipment^{a};	Fabricated metal products$^{a/b}$; Electrical machinery^{b}; Mineral products; Rubber & plastics products^{b}; Communication equipment
Low ERPT rates (<50%); low share of differentiated goods (<80%)	Textiles$^{a/b}$; Wood products^{b}; Mining & quarrying	Food & beverages$^{a/b}$; Paper products; Chemicals & pharmaceuticals; Agriculture; Iron & steel

Notes: Share of differentiated goods = Share of differentiated goods exported of all goods exported in a sector; supposition is confirmed if sectors in the group of high shares of differentiated goods are also in the group of high ERPT rates, and vice versa; $^{a/b}$H0 of zero/full ERPT rejected at the 95%-level

Table 7: continued

Supposition 2:
Sectors exporting products with smaller shares of distribution costs have higher ERPT rates; and vice versa

	Confirmed	Rejected
Short-run ERPT (see Table 3, Direct DPT)		
High ERPT rates (>50%); low share of distribution costs (10-14%)	Iron & steel^{a}; Rubber & plastics products$^{a/b}$; Paper products^{a}; Fabricated metal products$^{a/b}$; Machinery & equipment^{a}	Electrical machinery$^{a/b}$; Wood products;
Low ERPT rates (>50%); high share of distribution costs (14-27%)	Communication equipment; Agriculture; Chemicals & pharmaceuticals; Mineral products$^{a/b}$; Mining & quarrying; Textiles$^{a/b}$	Food & beverages$^{a/b}$; Precision instruments^{a};
	Long-run ERPT (see Table 4, Direct DPT)	
High ERPT rates (>50%); low share of distribution costs (10-14%)	Iron & steel; Paper products; Machinery & equipment^{a}	Electrical machinery^{b}; Wood products^{b}; Rubber & plastics products^{b}; Fabricated metal products$^{a/b}$;
Low ERPT rates (>50%); high share of distribution costs (14-27%)	Communication equipment; Mineral products; Mining & quarrying; Textiles$^{a/b}$	Agriculture; Chemicals & pharmaceuticals; Food & beverages$^{a/b}$; Precision instruments^{a};

Notes: Share of distribution costs = Distribution cost share of final price (taken from Goldberg and Campa, 2010); supposition is confirmed if sectors in the group of low shares of distribution costs are also in the group of high ERPT rates, and vice versa; $^{a/b}$H0 of zero/full ERPT rejected at the 95%-level