

Lassmann, Andrea

Working Paper

Exchange rate transmission and export activity at the firm level

KOF Working Papers, No. 331

Provided in Cooperation with:

KOF Swiss Economic Institute, ETH Zurich

Suggested Citation: Lassmann, Andrea (2013) : Exchange rate transmission and export activity at the firm level, KOF Working Papers, No. 331, ETH Zurich, KOF Swiss Economic Institute, Zurich, <https://doi.org/10.3929/ethz-a-007623291>

This Version is available at:

<https://hdl.handle.net/10419/80832>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

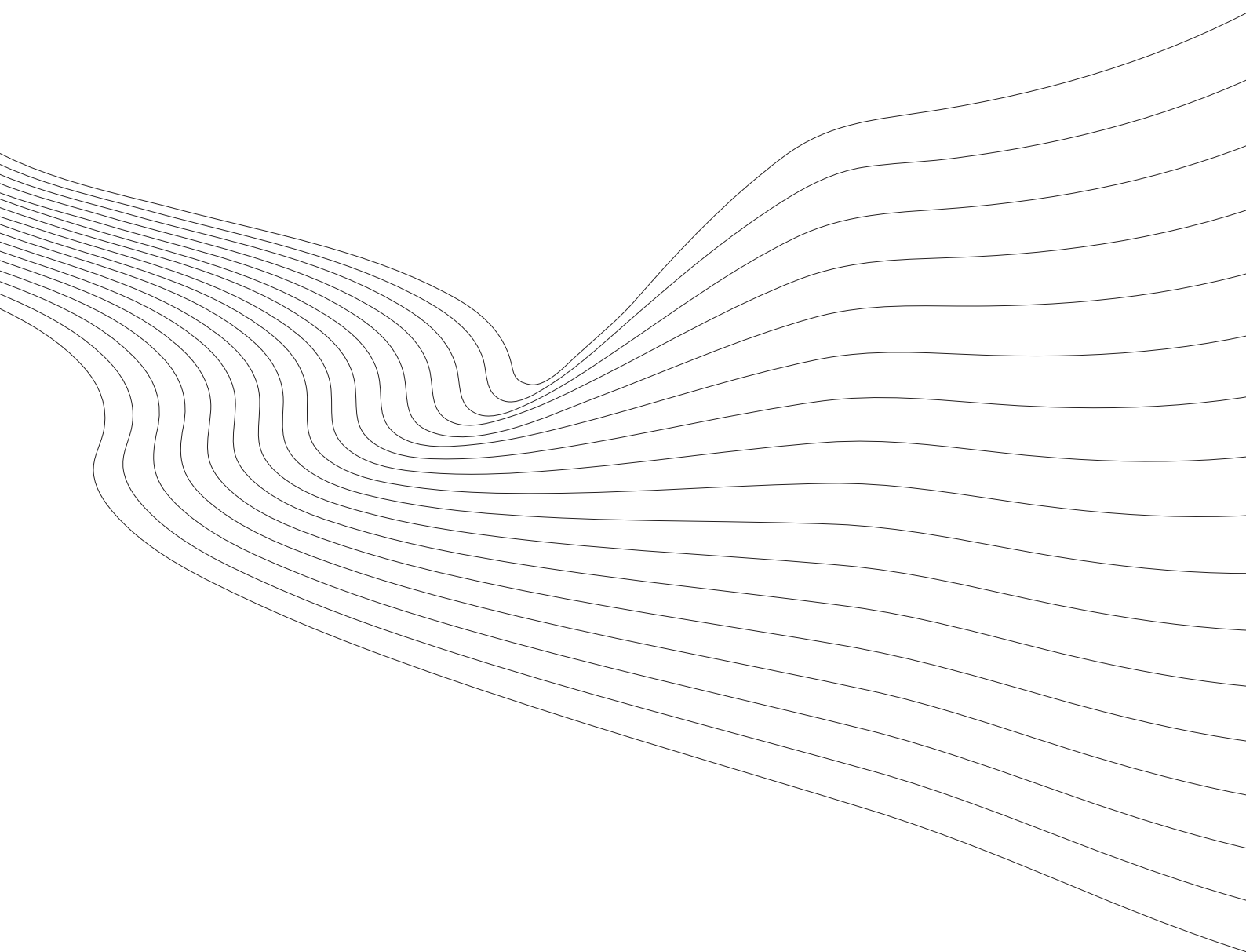
You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

KOF Working Papers

Exchange Rate Transmission and Export Activity at the Firm Level

Andrea Lassmann



KOF

ETH Zurich
KOF Swiss Economic Institute
WEH D 4
Weinbergstrasse 35
8092 Zurich
Switzerland

Phone +41 44 632 42 39
Fax +41 44 632 12 18
www.kof.ethz.ch
kof@kof.ethz.ch

Exchange Rate Transmission and Export Activity at the Firm Level*

Andrea Lassmann

KOF Swiss Economic Institute, ETH Zurich

February 2013

Abstract

This paper analyses how exchange rate shocks are transmitted at the firm level and establishes a nexus to firm-level export activity. Using precise survey data from a sample of Swiss firms, I find that an appreciation increases the probability of a decrease in firm-level costs, prices and profits. Exchange rate movements are passed through to import prices, absorbed in firm selling prices and lead to adjustments in firm profits. The pattern is non-linear across firms with a varying degree of international exposure. The likelihood of adjustments is increasing in firm-level export share in total turnover. I also show that exchange rate variability affects adjustment probabilities. The analysis suggests that Swiss firms take prices as given. Exchange rate shocks are absorbed through a reduction in both costs and prices, however, these adjustments are not proportional such that overall profits decline during appreciation periods.

Keywords: EXCHANGE RATE; EXCHANGE RATE PASS-THROUGH; MARKET STRUCTURE; FIRM-LEVEL DATA; COSTS; LOCAL PRICES; PROFITS; EXPORTS.

JEL-classification: D22; D4; E31, F14, F31.

**Acknowledgements:* I am grateful to Matthias Bannert, Richard Etter, Christoph Fellmann for help with the data and to Peter Egger, Eva Köberl, Michael Lamla, Sarah Lein, Heiner Mikosch and Jan-Egbert Sturm for helpful comments. I benefited from comments of participants at the Macro and Financial Econometrics Conference 2011, the Spring Meeting of Young Economists 2011, the 16th Annual International Conference on Macroeconomic Analysis and International Finance 2012, and the 31st CIRET Conference 2012. Email: lassmann@kof.ethz.ch; Address: KOF Swiss Economic Institute, WEH D4, Weinbergstrasse 35, 8092 Zurich, Switzerland.

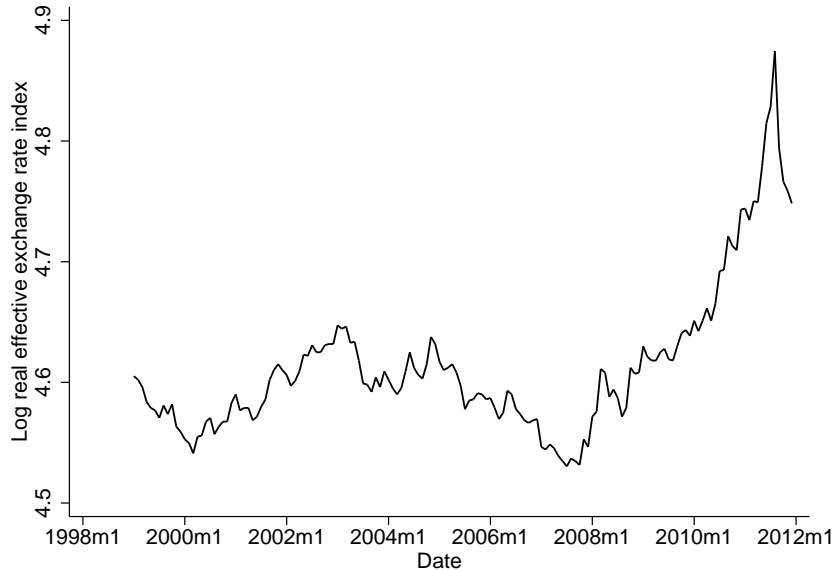
1 Introduction

How are exchange rate movements transmitted to prices and output? This topic has gained ample attention in the literature. The implications of exchange rate shocks for prices and traded output are well studied at the macroeconomic level, but there is limited evidence at the level of the firm (see Gopinath and Rigobon, 2008; Gopinath, Itskhoki, and Rigobon, 2010; Moser, Urban, and Weder, 2010; Nucci and Pozzolo, 2010; Berman, Martin, and Meyer, 2012 for exceptions).

This paper seeks to provide micro-level evidence on the relationship between the exchange rate, costs, prices and profits. Using a rich set of survey data that covers a product-specific panel of Swiss firms, it disentangles the transmission and absorption of exchange rate shocks specific to firms and products by analyzing changes in the costs of intermediate goods, the price setting behavior, the evolution of profits and the interdependence of these variables with foreign market exposure in response to exchange rate movements in Switzerland. These patterns may ultimately help us to gain first insights in the underlying market structure. In a concentrated market with primarily domestic firms we expect that movements of the exchange rate will barely induce price adjustments. With increasing competition and import shares in total sales we expect the role of the exchange rate to increase (Dornbusch, 1987). The use of micro data is particularly appealing to study the transmission mechanism for several reasons. First, one can observe the transmission of exchange rate shocks directly at the firm level instead of solely relying on aggregate data. This allows for a better isolation of the relationship between the exchange rate and firm-level outcomes due to the availability of numerous individual characteristics. Contrary to aggregate data, survey data may mitigate omitted variable bias and feature precise measures of firm-level costs, prices and profits. Second, by covering firms producing for the domestic market as well as exporting firms, survey data may provide insights into the heterogeneity of transmission patterns across firms with a varying degree of exposure to foreign markets and competition.

Switzerland is a small open economy with monetary autonomy that provides an interesting environment to test this relationship empirically. During the past ten years, the Swiss Franc first experienced a slight appreciation after 2000, followed by a depreciation during the 2003–2007 boom. Historically a safe-haven currency, it appreciated sharply after the past financial crisis (see Figure 1), hence Switzerland represents an environment in which large movements in the exchange rate occur after a shock to fundamentals. The ongoing appreciation was stopped by interventions of the Swiss National Bank starting in autumn 2011. At the same time, Swiss manufacturing exports grew by 9.4% in 2010 and by 6.3% in 2011, industrial production

Figure 1: Development of the Swiss Franc, 1999–2011



grew by 6.5% and 1.4%, respectively, and manufacturing wages grew by 0.6% and 1%.¹ Previous work provides some explanations. The rebound in foreign demand after the past recession may have partly compensated for the change in the terms of trade.² Lags on the exchange rate may lead to a *J-curve* effect in the current account and, hence, persistent trade responses to large exchange rate movements (the so-called hysteresis of trade, see Baldwin and Krugman, 1989) cannot yet be identified. The short-run dynamics of the interest rate and the exchange rate may further dampen changes in the terms of trade (Dornbusch, 1976). But naturally the question arose whether and to what extent firms absorbed the cost shock induced by a large exchange rate shock and under periods of distress in the economic fundamentals.

While the ability of a firm to adjust prices to the state of the economy may be limited and aggregate prices are sticky, prices may be volatile at the micro level.³ This paper

¹Sources: BFS Federal Statistical Office; KOF Konjunkturforschungsstelle, ETH Zurich; SECO; September 2012.

²See Lamla and Lassmann (2011).

³For recent empirical tests of time-dependent sticky price models (Taylor, 1980; Calvo, 1983) or state-dependent sticky price models (Dotsey, King, and Wolman, 1999; Golosov and Lucas, 2007) see e.g., Alvarez, Dhyne, Hoeberichts, Kwapil, Bihan, Lünnemann, Martins, Sabbatini, Stahl, Vermeulen, and Vilmunen (2006); Gopinath and Rigobon (2008); Klenow and Kryvtsov (2008);

studies the action a firm chooses conditional on real aggregate shocks, aggregate prices and idiosyncratic firm-state conditions by analyzing its reaction to exchange rate shocks conditional on an observed adjustment in the outcome. The following channels through which exchange rate movements are transmitted may be identified. If exchange rates are passed through to import prices, and consequently, to consumer prices, prices adjust as a consequence of the cost shock. Thus the expected sign of the marginal effect of an appreciation is negative for an increase and positive for a decrease in the outcome. The magnitude of these adjustments will depend on the curvature of demand, or more specifically, on the market structure and the share of intermediate inputs in total sales (Dornbusch, 1987). This is particularly true if firms price in producer currency instead of local currency, an important factor for Swiss firms that are (a) located in a small economy, taking prices in the world market as given according to the same theory, and are (b) directly exposed to European competition due to geographical proximity. Indeed, Fischer, Lutz, and Wälti (2007) report that 52% of a sample of Swiss exporting firms apply a mix of local currency pricing (LCP) and producer currency pricing (PCP), while only 28.4% apply pure LCP and 16.6% apply pure PCP. If costs and prices move in proportion as a reaction to the exchange rate shock, holding all other factors constant, output is not adjusted and there will be no real effect on the economy.

How can the transmission channels be characterized in more detail? The magnitude of changes in costs will be determined by the share of imported inputs in total sales and the elasticity of substitution between imported and domestic inputs; the magnitude of price adjustments will depend on the share of exports in total sales, market structure and the pass-through elasticity (see Nucci and Pozzolo, 2010). These patterns will finally determine whether and in which direction profits adjust. If the firm has market power and demand is inelastic, its costs of intermediate goods may decline while prices and output are not adjusted, such that overall profits increase. In a highly competitive environment with high elasticity of demand, it is more costly for the firm not to adjust (Barro, 1972). Thus, it will be more likely to adjust the mark-up. Holding traded quantities constant, an appreciation will be neutral if the adjustment is proportional to the decrease in import prices; it incurs losses if the exchange rate pass-through (ERPT) to import prices is low.

The analysis reveals the following findings. First, exchange rate movements are passed through to firm-level costs – since these are measured by changes in the costs of intermediate inputs and raw materials, they can also be thought of as measuring import prices – and Swiss firms absorb these movements to a large extent in their prices such that an appreciation of the exchange rate leads to reduced firm-level

Nakamura and Steinsson (2008).

profits. Although firms seem to benefit from lower costs of intermediate goods, their profits decline overall during appreciation periods. What are the quantitative effects? An increase in the exchange rate index by one index point raises the probability of observing a decrease in costs by 1.7 percentage points, in selling prices by 0.8 percentage points, and in profits by 0.6 percentage points. Second, the probability of adjustments in prices and profits is non-linear in the sense that it depends on the degree of export exposure: the likelihood of observing reductions in both prices and profits rises with increasing export exposure. In contrast, the marginal effect of an appreciation on the probability of observing changes in the costs of intermediate goods and raw materials is rather constant across firms. The results suggest that Swiss firms take prices as given. This is consistent with the fact that only a minority of Swiss firms seem to apply pure LCP (Fischer, Lutz, and Wälti, 2007). Substantial differences across industries in the relationship between exchange rates and the outcomes of interest point to differences in market structure across industries (Dornbusch, 1987). It is also shown that price adjustment probabilities do slightly increase in the magnitude of exchange rate movements, whereas cost and profit adjustment probabilities decrease with larger exchange rate movements. Furthermore, exchange rate variability affects the adjustment probabilities. Finally, the analysis confirms a considerable role of foreign demand and the importance of firm-state conditions such as profits and costs, capacity utilization, competition and firm-level constraints (see Lein, 2010). My findings show that firms absorb movements in the exchange rate and help to explain why we did not observe a drop in the real economy after the recent appreciation at the aggregate level.

The data at hand allow me to study the transmission of exchange rate shocks through the price channel. The analysis is constrained by three limitations to the data (see also Lein, 2010). First, the quantitative extent of ERPT cannot be measured due to the qualitative nature of the variables of interest. Second, the data lack information on real variables such as changes in quantities. As a consequence, it is neither possible to analyze quantity adjustments and disentangle how changes in both prices and volumes contribute to changes in profits, nor to study the transmission to real outcomes. Third, it cannot be tracked whether firms discriminate across foreign markets, the key source for incomplete pass-through.⁴

The remainder of this paper is organized as follows. The next section describes the data and summary statistics. Section 3 presents results and robustness checks and Section 5 concludes.

⁴Later on, this entails that aggregate variables have to be used, and that firms will only provide one answer in case they exert market power and differentiate prices across export markets (price discrimination).

2 Data and descriptive statistics

The unbalanced panel used in this paper covers 80,681 quarterly observations from 2,645 firms in the Swiss manufacturing sector between Q2 1999 and Q4 2011 and is conducted by the KOF Swiss Economic Institute in order to construct business tendency indicators. The average number of quarterly observations by firm is 46.4. Firms refer to their principal product, or receive one questionnaire per product if they produce several main products. This distinction allows for product-specific adjustment patterns of multi-product firms and is a nice feature of the data at hand. The number of 4-digit-level products is 174 and the number of firm-product combinations is 3,058.⁵

I merge these data with ones on firms' export shares. The match is 80,123 observations (98.7%). After dropping observations with doubles (4 obs.) or invalid information (57 obs.), the sample includes 80,062 observations from 2,533 firms and 2,932 firm-product combinations in 174 industries. The data is finally merged with macroeconomic variables. These include the real effective exchange rate index (Swiss National Bank, 1999=100), log real Swiss GDP, log real foreign output (Eurostat, in 2000 Euro) and the Swiss Consumer Price Index (Swiss Federal Statistical Office, CPI 2000=100).⁶

Table 1 indicates the survey questions and available response categories.⁷ The survey includes coincident questions about selling prices, profits, changes in the competitive situation of the firm, capacity utilization, the scope of production and different sorts of constraints as well as one-quarter-ahead expectations with respect to selling prices, costs, number of employees and exports. The response categories are mostly of qualitative nature. I code the response 1 in case firms indicated that the expected costs for intermediate products and raw materials, the selling price and profits⁸ increased, 0 if they remained unchanged and -1 if they decreased. Similarly, it is 1 in case the competitive situation with respect to the domestic and foreign markets

⁵The products are classified according to the Swiss *Nomenclature Générale des Activités économiques (NOGA 2002)*, which corresponds to the United Nation's *ISIC Rev. 3.1* and the European *NACE Rev. 1.1* classifications.

⁶Foreign output is calculated as the weighted sum of the real GDP of Switzerland's historically most important export markets, the EU, the United States and Japan. The weights are based on real export figures by the Swiss Federal Customs Administration, vary over time and, on average, amount to $w = 0.818$ for the EU (27 countries), $w = 0.135$ for the U.S. and $w = 0.047$ for Japan.

⁷The same survey was analyzed by Lein and Köberl (2009); Lein (2010); and Mikosch (2011). Note that the set-up of this table and of Tables 2, 3 and A.1 is adopted from Lein (2010). Similarly, Figures 2-5 follow Lein (2010). See the same author for a detailed description of the survey and sample correlations. Sample correlations are also shown in Table A.1 in Appendix A.

⁸The term profits in this paper corresponds to *revenue* in Lein (2010).

Table 1: KOF quarterly manufacturing survey questionnaire design

Variable	Question	Response
Expected cost	You expect the costs for intermediate products and raw materials in the next 3 months to	increase; remain unchanged; decrease
Price	The selling price you charged during the past 3 month has	increased; remained unchanged; decreased
Profit	During the past 3 months your profits have	increased; remained unchanged; decreased
Domestic competition	During the past 3 months your national competitive situation has	improved; remained unchanged; deteriorated
EU competition	During the past 3 months your competitive situation in the EU has	improved; remained unchanged; deteriorated
Non-EU competition	During the past 3 months your competitive situation outside of the EU has	improved; remained unchanged; deteriorated
Capacity utilisation	At what capacity has your firm been running in the past 3 months as a percentage of full	50%;55%;60%;...;110%
Scope	Production is secured for	number of months

Table 2: Descriptive statistics of firm-level variables

Variable	Obs.	Mean	S.D.	Median	Increase		Unchanged		Decrease	
					Obs.	ln %	Obs.	ln %	Obs.	ln %
Number of employees	79992	128.67	413.24	35						
Expected cost	53529	0.22	0.55	0	15047	28.1	34983	65.4	3499	6.5
Price	53529	-0.08	0.50	0	4667	8.7	39690	74.2	9172	17.1
Profit	53529	-0.13	0.61	0	6896	12.9	32675	61.0	13958	26.1
Domestic competition	53529	0.01	0.45	0	5516	10.3	42794	80.0	5219	9.8
EU competition	47543	-0.06	0.90	0	17920	37.7	8818	18.6	20805	43.8
Non-EU competition	49266	0.07	0.89	0	21335	43.3	10.175	20.7	17756	36.0
Technical capacity	53529	0.09	0.41	0	7029	13.1	44055	82.3	2445	4.6
Capacity utilisation	46487	81.8	13.7	85						
Scope	45373	3.45	5.20	2						
Export share	80062	2.15	1.24	2						

The table presents summary statistics from Q2 1999 to Q4 2011. Expected costs (in the next quarter), Price, Profit, domestic competition, EU competition, non-EU competition and technical capacity: 1=increase, 0=unchanged, -1=decrease; capacity utilisation: in %; scope: in months; export share in total turnover: 1=0-4%, 2=5-33%, 3=34-66%, 4=67-100%. The table reports the number of observations (*Obs.*) for each variable and for each response category as well as the frequency of the response categories (*ln %*). In addition, the mean, standard deviation (*S.D.*) and the median are reported for each variable.

Table 3: Descriptive statistics of firm-level variables by export category

Variable	Obs.	Mean	S.D.	Median	Increase Obs.	In %	Unchanged Obs.	In %	Decrease Obs.	In %
Export share=1 (0-4%)										
Number of employees	36981	61	162	18						
Expected cost	24296	0.24	0.54	0	7130	29.4	15898	65.4	1268	5.2
Price	24296	-0.10	0.49	0	1867	7.7	18099	74.5	4330	17.8
Profit	24296	-0.15	0.58	0	2549	10.5	15456	63.6	6291	25.9
Domestic competition	24296	-0.01	0.48	0	2671	11.0	18716	77.0	2909	12.0
EU competition	23250	0.54	0.74	1	16004	68.8	3738	16.1	3508	15.1
Non-EU competition	23777	0.62	0.66	1	17075	71.8	4329	18.2	2373	10.0
Technical capacity	24296	0.06	0.38	0	2571	10.6	20615	84.9	1110	4.6
Capacity utilisation	20939	81.24	13.86	80						
Scope	19850	3.11	5.12	2						
Export share=2 (5-33%)										
Number of employees	13392	125	300	40						
Expected cost	9062	0.23	0.57	0	2738	30.2	5673	62.6	651	7.2
Price	9062	-0.04	0.51	0	998	11.0	6721	74.2	1343	14.8
Profit	9062	-0.12	0.61	0	1206	13.3	5528	61.0	2328	25.7
Domestic competition	9062	0.03	0.46	0	1119	12.4	7135	78.7	808	8.9
EU competition	7553	-0.50	0.74	-1	1141	15.1	1501	19.9	4911	65.0
Non-EU competition	8190	-0.15	0.88	0	2608	31.8	1726	21.1	3856	47.1
Technical capacity	9062	0.09	0.41	0	1220	13.5	7445	82.2	397	4.4
Capacity utilisation	7983	80.92	13.54	80						
Scope	7923	3.46	4.66	2						
Export share=3 (34-66%)										
Number of employees	10108	145	256	63						
Expected cost	6970	0.21	0.56	0	1962	28.2	4509	64.7	499	7.2
Price	6970	-0.07	0.52	0	706	10.1	5088	73.0	1176	16.9
Profit	6970	-0.13	0.63	0	1016	14.6	4066	58.3	1888	27.1
Domestic competition	6970	0.00	0.43	0	655	9.4	5682	81.5	633	9.1
EU competition	5693	-0.69	0.57	-1	305	5.4	1143	20.1	4245	74.6
Non-EU competition	6119	-0.51	0.73	-1	865	14.1	1276	20.9	3978	65.0
Technical capacity	6970	0.12	0.43	0	1079	15.5	5616	80.6	275	4.0
Capacity utilisation	6102	82.07	13.54	85						
Scope	5990	3.49	5.04	2						
Export share=4 (67-100%)										
Number of employees	19511	250	729	86						
Expected cost	13201	0.16	0.55	0	3217	24.4	8903	67.4	1081	8.2
Price	13201	-0.09	0.50	0	1096	8.3	9782	74.1	2323	17.6
Profit	13201	-0.10	0.64	0	2125	16.1	7625	57.8	3451	26.1
Domestic competition	13201	0.02	0.38	0	1071	8.1	11261	85.3	869	6.6
EU competition	11047	-0.69	0.55	-1	470	4.3	2436	22.1	8141	73.7
Non-EU competition	11180	-0.60	0.62	-1	787	7.0	2844	25.4	7549	67.5
Technical capacity	13201	0.11	0.45	0	2159	16.4	10379	78.6	663	5.0
Capacity utilisation	11463	83.14	13.45	85						
Scope	11610	3.99	5.68	3						

The table presents summary statistics from Q2 1999 to Q4 2011. Expected costs (in the next quarter), Price, Profit, domestic competition, EU competition, non-EU competition and technical capacity: 1=increase, 0=unchanged, -1=decrease; capacity utilisation: in %; scope: in months; export share in total turnover: 1=0-4%, 2=5-33%, 3=34-66%, 4=67-100%. The table reports the number of observations (Obs.) for each variable and for each response category as well as the frequency of the response categories (In %). In addition, the mean, standard deviation (S.D.) and the median are reported for each variable.

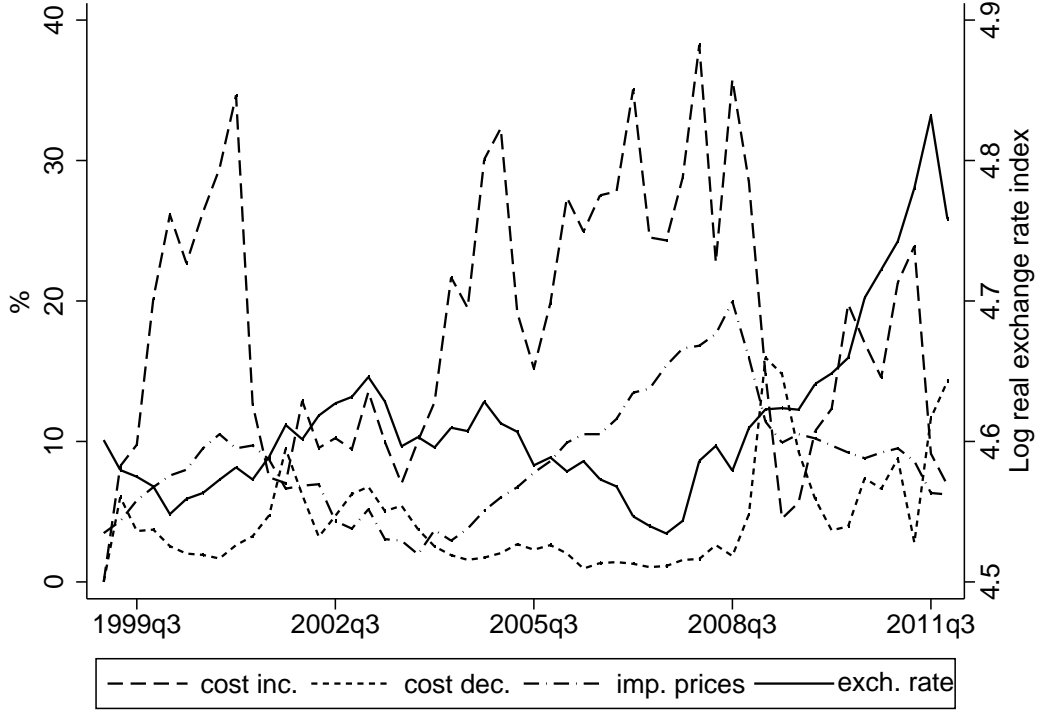
improved, 0 if it remained constant and -1 in case it deteriorated; 1 if technical capacities are more than sufficient, 0 if they are sufficient and -1 in case they are insufficient. Furthermore, firms indicate the degree of capacity utilization in percent as well as the scope of production in months. Finally, the questionnaire asks whether the firm is faced with constraints with respect to demand, employment, capacity or other constraints (1) or not (0).

Summary statistics of the KOF survey variables are shown in Table 2. I analyze the following firm-level characteristics. The *export share* is a categorical variable that takes the value of 1 if a firm's export share in total turnover is 0–4%, 2 if the share is 5–33%, 3 if it is 34–66% and 4 if $> 66\%$. The median share is between 5 and 33%. The median of the *expected cost* of intermediate goods and raw materials, the *selling price* in Swiss Francs, *profits*, the *competitive situation* in the domestic, EU and extra-EU markets, and *technical capacity* is zero, i.e., these variables remain constant most of the time. The median *capacity utilization* is 85% and the median *scope of production* is 2 months. According to Table 2, prices, profits and the competitive situation within the EU more frequently decrease than increase, while costs, the competitive situation within the domestic market and within extra-EU markets as well as technical capacity more frequently increase than decrease.

Table 3 reports summary statistics by export category. First, it is evident that larger firms (in terms of employees) export more (see Bernard, Eaton, Jensen, and Kortum, 2003; Bernard, Jensen, Redding, and Schott, 2007). Second, the table reveals that the moments of most variables are similar across firms with varying export shares. The variables measuring changes in EU and extra-EU competition stand out. Their median is 1 in case of domestically oriented firms, while it is -1 for firms with higher export shares in total sales. More specifically, the aggregate frequency of a decline in the competitive situation of the firm outside Switzerland is around 70% for firms exporting at least 34% of their sales, while it is only 10–15% for the firms with an export share between 0 and 4%.

Figures 2–4 illustrate the coincident frequency of aggregated cost, price and profit adjustments and the evolution of the exchange rate over the sample period. At first glance, the following patterns can be noticed: there is some (positive) correlation between reductions in expected costs of intermediate products and raw materials and the exchange rate – it amounts to 0.53 – and a smaller (negative) correlation between increases in costs and the exchange rate – it is -0.21 , whereas the correlation between aggregate import prices and the exchange rate is very low (-0.003); similarly, the (positive) correlation between an appreciation of the exchange rate index and the frequency of price decreases seems to be stronger than the (negative) correlation between the exchange rate index and the frequency of price increases: it amounts

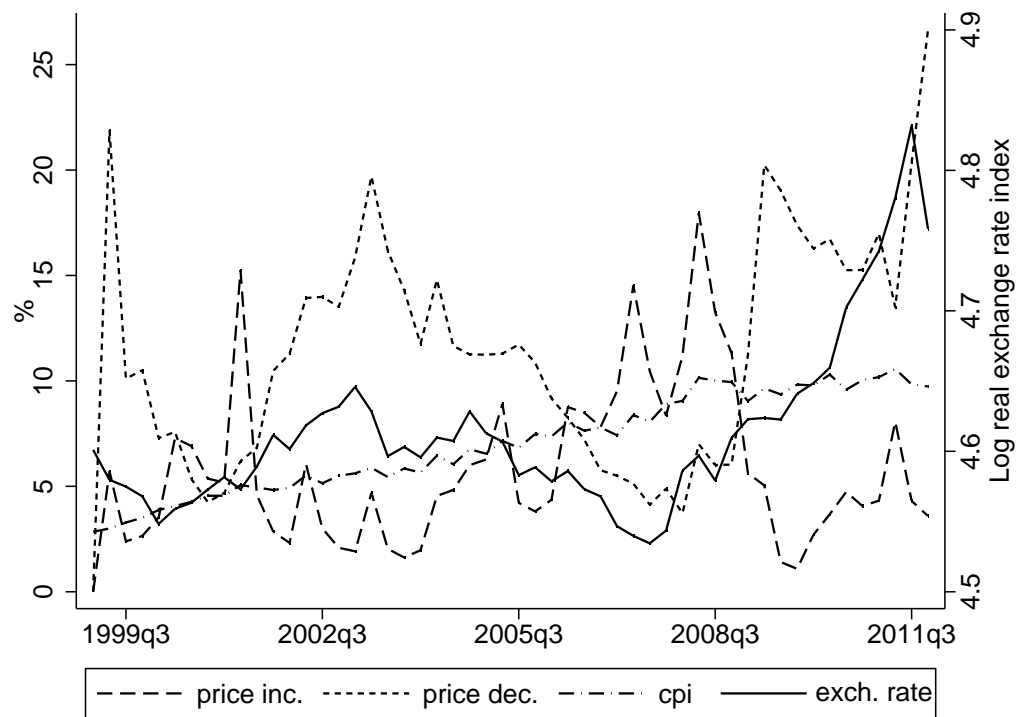
Figure 2: The exchange rate and changes in expected costs



Aggregated frequency of increase/decrease in costs (KOF Swiss Economic Institute quarterly manufacturing survey); real effective exchange rate index, 1999=100 (Swiss National Bank); deflator of goods imports (KOF Swiss Economic Institute).

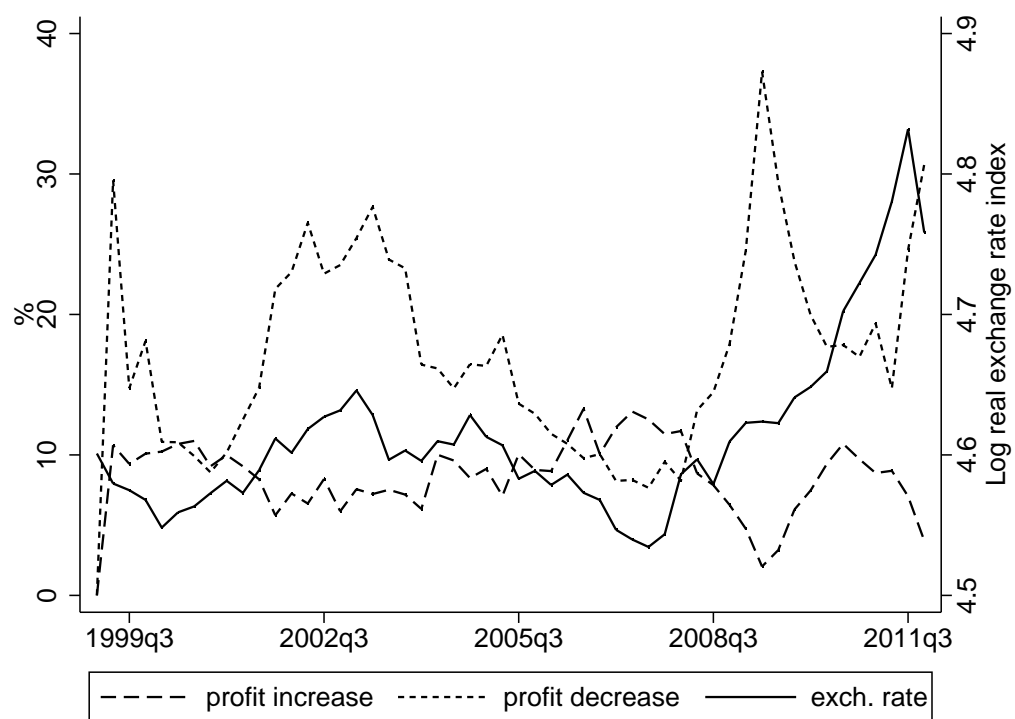
to 0.61 and to -0.13 , respectively. The correlation between the aggregate consumer price index and the exchange rate is even higher and amounts to 0.75; the correlation between the exchange rate and the frequency of decreases in profits is 0.39 and the correlation between the exchange rate and the frequency of increases in profits is -0.35 . During the turmoil caused by the recent financial crisis these patterns seem less clear. In addition, Figure 5 plots the evolution of changes in profits and real value added in the manufacturing sector. The correlations are much lower and amount to 0.03 and -0.1 . I continue by analyzing the relationship between the exchange rate and adjustments in outcomes empirically in the following section.

Figure 3: The exchange rate and price adjustments



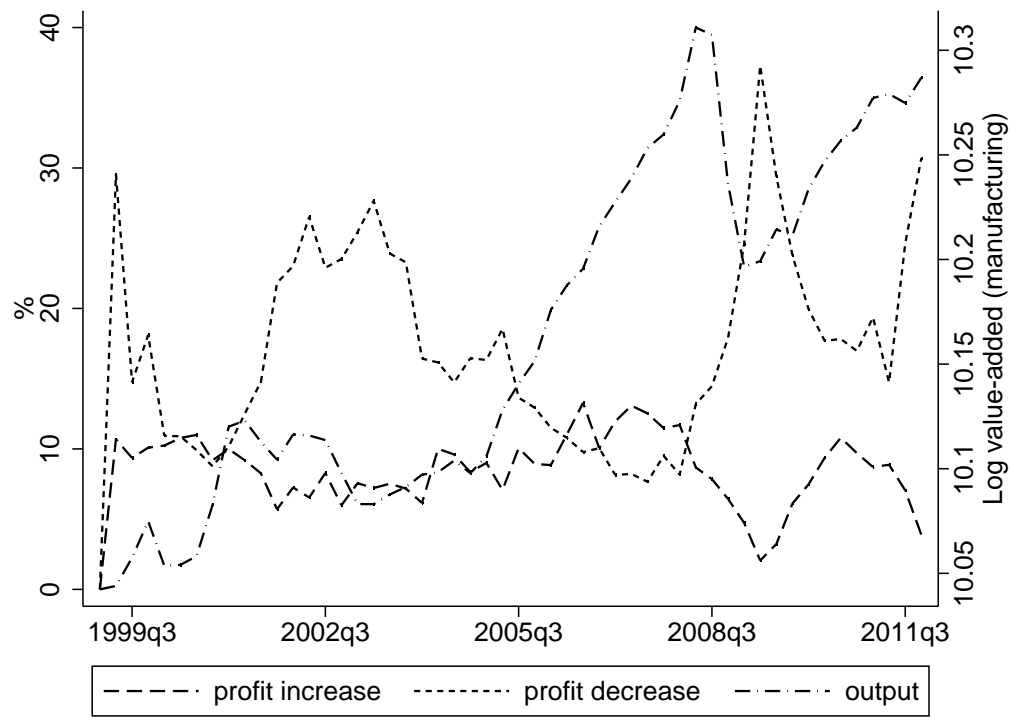
Aggregated frequency of increase/decrease in costs (KOF Swiss Economic Institute quarterly manufacturing survey); real effective exchange rate index, 1999=100 (Swiss National Bank); consumer price index, 2000=100 (Swiss Federal Statistical Office).

Figure 4: The exchange rate and changes in profits



Aggregated frequency of increase/decrease in costs (KOF Swiss Economic Institute quarterly manufacturing survey); real effective exchange rate index, 1999=100 (Swiss National Bank).

Figure 5: Manufacturing value added and changes in profits



Aggregated frequency of increase/decrease in costs (KOF Swiss Economic Institute quarterly manufacturing survey);
real manufacturing value added (KOF Swiss Economics Institute).

3 Estimation of exchange rate transmission

I estimate the transmission of an exchange rate shock on expected costs of intermediate goods and raw materials (denoted by c_{it}), selling prices (denoted by p_{it}) and profits (denoted by π_{it}). To take the stickiness in prices into consideration, the effect is estimated conditional on an observed adjustment in outcome. I account for aggregate shocks by including demand shifters and aggregate domestic prices as in a standard pass-through equation.⁹ In order to allow for idiosyncratic firm-state conditions that determine adjustment in outcomes, I include variables that determine price setting at the firm level as described in Section 2 and control for unobserved heterogeneity across firms by including firm fixed effects. Specifically, the probability of a change in outcome y_{it} is estimated by the following panel fixed effects logit model conditional on an observed price change (see Lein and Köberl, 2009):

$$P(y_{it} = 1 | x_{it}, \bar{y}_{it}) = \frac{\exp(x'_{it}b)}{1 + \exp(x'_{it}b)} \quad (1)$$

with $i = 1, \dots, n$ product-firm combinations and $t = 1, \dots, T$ quarterly time observations for the $i - th$ firm-product combination. Vector x'_{it} includes the set of differenced explanatory variables at the macro level, the micro-level variables at $t - 1$, as well as seasonal (quarterly) dummies.¹⁰ I accumulate the differenced macroeconomic variables since a firm last reported a change in each of the outcomes. This procedure seeks to account for the possibility of heterogeneous lags $\ell \in (1, 51)$, depending on the past evolution of the macroeconomic environment that is relevant to the firm's change in outcome. The i -specific (time-varying) lag structure $\tau = 1, \dots, N$ for any macro-level variable $\omega_{i,\tau}$ is given by $\omega_{i,\tau} \equiv \sum_{\ell=1}^{L_n} \Delta\omega_{i,t-\ell}$.¹¹ The macroeconomic variables in the baseline regression include the real effective exchange rate

⁹Empirical literature typically studies the role of the exchange rate by estimating the aggregate pass-through of exchange rates into import prices using an equation of the following form (see Goldberg and Knetter, 1997): $\Delta p_t = \alpha + \gamma \Delta e_t + \delta \Delta c_t + \phi \Delta d_t + \epsilon_t$, where Δp is the percentage change in the import price, Δe is the percentage change in the exchange rate, Δc is the percentage change in marginal costs in the foreign currency, Δd are changes in import demand shifters, ϵ is a time-specific error term and t denotes the time period.

¹⁰Note that there would be high correlation between the macro-level variables and time dummies if the latter were included (multicollinearity), especially since the variation across firms is low. As a consequence, the coefficients on the variables of interest could not be precisely estimated. Prices have been shown to exhibit seasonal patterns (e.g., Lein, 2010) and the seasonal dummies prove jointly significant in all equations. I follow Lein and Köberl (2009) by including seasonal dummies for the first three quarters.

¹¹Note that missing observations might bias the number of accumulated quarters since the last change. Note further that the lag refers to a change in the respective outcome, i.e. an increase or decrease in costs, prices and profits, and not to a change in costs, prices or profits. The cumulation

index (denoted $\Delta e_{i,\tau}$), log real foreign activity (denoted $\Delta \theta_{i,\tau}$) and domestic inflation measured by the CPI (denoted $\Delta \rho_{i,\tau}$).¹² Note that in the remainder of this paper, differences (Δ) and subscripts (it) and (i, τ) will be suppressed. The micro-level variables are lagged at $t-1$ and include changes in expected costs, selling prices and profits,¹³ domestic, EU and rest-of-world competition, capacity utilization in %, scope of production and a set of constraints (demand, employment, capacity and other constraints). Y_{it} measures either an increase (Expected cost _{it} = 1) or decrease in costs c_{it} (Expected cost _{it} = -1); an increase (Price _{it} = 1) or decrease in price p_{it} (Price _{it} = -1); an increase (Profit _{it} = 1) or decline in profit π_{it} (Profit _{it} = -1) at time t in order to account for possible asymmetries in the adjustment behavior.

Table 4 reports marginal effects calculated at sample means of all other variables and fixed effects at zero and is structured in the following way. The dependent variable is an increase in the respective outcome in Columns (1), (2), (5), (6), (9) and (10) and a decrease in Columns (3), (4), (7), (8), (11) and (12). Odd-numbered columns include only the macro variables, while columns with even figures include the extended set of explanatory variables. The tables in the remainder of the paper always include the micro-level variables but are structured similarly otherwise. The results may be summarized as follows. The analysis suggests that the relationship between exchange rate fluctuations and adjustments in prices and profits affects both the probability of an increase and a decline in the respective outcome. Foreign demand plays a strong and dominant role with respect to all outcomes considered. The inclusion of micro-level variables reduces the bias from omitting important variables and most of them are significant determinants of the outcome variables.

An increase in the exchange rate index (corresponding to an appreciation of the Swiss Franc by one index point) is significantly and negatively related to the probability of an increase in costs c and significantly and positively related to the likelihood of a

leads to lags of 1 up to 48 quarters. The mean number of lags is 4 quarters for an increase in costs, 7 for a decline in costs, 6 for a price increase, 6 for a price decrease, 6 for a profit increase and 4 for a profit decrease. The medians correspond to 2, 4, 4, 3, 3 and 3 quarters, respectively. Since the firm-specific lags may be endogenous to the exchange rate, I alternatively accumulated the macro-economic variables over four quarters, which was the approximate end of the J-curve effect during the past crisis. This accumulation yielded results that were robust compared to those reported.

¹²Table A.2 in the Appendix of this paper shows that the marginal effect of the exchange rate is robust to the exclusion of the macro-level variables as well as the inclusion of Swiss GDP growth. However, domestic GDP is highly correlated with the remaining macro-level variables. I am primarily interested in the effect of the foreign demand shifter and thus omit domestic GDP.

¹³Note that x'_{it} excludes the respective outcome (cost, price or profit) variable. The inclusion of these variables may pose endogeneity concerns, however, they are neither the variable of interest nor are the results sensitive to their exclusion.

Table 4: The transmission of exchange rate shocks to firm-level costs, price adjustments and profits

	Exp. cost increase		Exp. cost decrease		Price increase		Price decrease		Profit increase		Profit decrease	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Exchange rate e	-0.023 (0.001)***	-0.022 (0.002)***	0.017 (0.001)***	0.017 (0.003)***	-0.017 (0.001)***	-0.005 (0.002)***	0.012 (0.001)***	0.008 (0.002)***	-0.012 (0.001)***	-0.008 (0.002)***	0.007 (0.001)***	0.006 (0.001)***
Log foreign GDP ϑ	-0.608 (0.178)***	-0.459 (0.235)*	-4.226 (0.221)***	-4.275 (0.669)***	-0.722 (0.229)***	-0.149 (0.149)	-2.467 (0.179)***	-1.503 (0.339)***	1.237 (0.213)***	1.621 (0.278)***	-4.316 (0.167)***	-3.545 (0.229)***
Domestic inflation ρ	0.059 (0.004)***	0.052 (0.007)***	0.044 (0.005)***	0.070 (0.012)***	0.040 (0.005)***	0.014 (0.006)**	-0.054 (0.004)***	-0.022 (0.006)***	-0.033 (0.005)***	-0.033 (0.006)***	-0.016 (0.004)***	0.017 (0.005)***
Exp. cost						0.104 (0.036)***		-0.060 (0.013)***		0.027 (0.009)***		-0.030 (0.007)***
Price		0.007 (0.008)		-0.021 (0.013)						0.058 (0.011)***		-0.090 (0.008)***
Profit		0.039 (0.007)***		-0.039 (0.013)***		0.019 (0.008)**		-0.066 (0.014)***				
Capacity utilisation (%)		0.002 (3.57e-04)***		-2.56e-04 (0.001)		0.001 (6.60e-04)		-0.002 (4.26e-04)***		-4.50e-04 (0.001)		-0.002 (3.61e-04)***
Scope		0.001 (0.001)		-0.001 (0.001)		0.001 (0.001)		-0.002 (0.001)*		0.001 (0.001)		-0.001* (0.001)*
Domestic competition		0.012 (0.009)		-0.023 (0.016)		0.024 (0.010)**		-0.047 (0.012)***		0.104 (0.012)***		-0.076 (0.009)***
EU competition		-0.008 (0.008)		0.013 (0.015)		-0.002 (0.006)		0.003 (0.009)		0.025 (0.011)**		0.008 (0.009)
ROW competition		0.002 (0.007)		0.020 (0.014)		-0.005 (0.005)		0.013 (0.009)		-0.009 (0.010)		0.007 (0.008)
Demand constraints		-0.039 (0.010)***		0.029 (0.017)*		-0.050 (0.020)**		0.053 (0.014)***		-0.047 (0.013)***		0.098 (0.010)***
Employment constraints		0.050 (0.013)***		-0.019 (0.026)		0.009 (0.010)		-0.061 (0.019)***		0.055 (0.017)***		-0.053 (0.016)***
Capacity constraints		0.010 (0.016)		-0.003 (0.030)		0.020 (0.012)		-0.001 (0.018)		0.051 (0.020)**		0.005 (0.019)
Other constraints		0.027 (0.011)**		0.017 (0.020)		0.010 (0.009)		-0.011 (0.012)		0.039 (0.016)**		0.003 (0.012)
Export share (1-4)		0.026 (0.033)		-0.015 (0.070)		0.033 (0.017)*		-0.009 (0.033)		0.043 (0.038)		0.060 (0.036)
Obs.	47022	26295	31751	15373	34472	18055	38324	19556	38930	20800	47183	25632
Marginal effects at sample means from panel fixed-effects logit regressions (Q2 1999-Q4 2011) including seasonal dummies and a dummy for changes in VAT. The dependent variable is a dummy for an increase/decrease in the outcome (expected costs of intermediate goods and raw material, sales price, profit). Changes in macro variables accumulated since firm's last change in outcome. Standard errors in parentheses. (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.												

decrease in c as shown in Table 4. What is the magnitude of this relationship? The marginal effects of e on the probability of a change in c amount to -0.022 and 0.017 in Column (2) and Column (4). Accordingly, an increase in the exchange rate index by one index point reduces the likelihood of an increase in c by 2.2 percentage points and raises the probability of a decline in c by 1.7 percentage points. Foreign demand growth θ plays a strong and significant role for the probability of a decrease in c and domestic inflation ρ is significantly related to the probability of changes in c in both directions. Amongst the firm-level variables, the existence of demand constraints is negatively and significantly related to an increase in costs, while the relationship is positive for an increase in profits, higher capacity utilization, the existence of employment constraints and other constraints. The probability of a decrease in c is positively affected by the existence of demand constraints and negatively affected by an increase in profits. What do these results tell us? The table suggests that exchange rate movements are passed through to firm-level costs. By the definition of the variable as the expected costs of *intermediate* goods and raw materials, this can be interpreted alternatively as a pass-through to import prices. Consequently, an appreciation overall reduces the costs of intermediate goods and raw materials for Swiss firms.

Columns (5)–(8) of Table 4 report the results for adjustments of selling price p as the dependent variable. It is shown that an appreciation is negatively and significantly related to the probability of an increase in p and positively and significantly related to the likelihood of a decline in p . The marginal effects amount to -0.005 and 0.008 , respectively. An increase in θ by 1% strongly affects the probability of a downward adjustment of p and changes in ρ again relate to both an increase and a decrease in p . The marginal effect of e in Columns (6) and (8) declines compared to the results reported in Columns (5) and (7), indicating that the inclusion of the firm-state variables is important. Among the firm-level variables, the probability of an increase in p is positively affected by an increase in costs, profits, capacity utilization, export share, and an improvement in the domestic competitive situation; it is negatively affected by the existence of demand constraints. Vice versa, demand constraints are positively related and an increase in costs, profits, capacity utilization, scope of production, an improvement in the domestic competitive situation and the existence of employment constraints are negatively related to the probability of a decline in p .

Columns (9)–(12) of Table 4 suggest that a jump in the exchange rate index by one point reduces the probability of an increase in profit π by 0.8 percentage points and increases the likelihood of a decrease in π by 0.6 percentage points in Columns (10) and (12). Foreign demand growth is an important determinant throughout all spec-

ifications in the table, as are domestic prices. In addition, the following firm-state variables are related to the probability of an increase in π . An increase in costs, prices, an improvement in the firm's competitive situation within Switzerland and in the EU as well as employment constraints, capacity constraints and other constraints affect the dependent variable positively in Column (10); the sign of the dummy measuring demand constraints is negative. Reversely, the sign of the marginal effect of an increase in costs, prices, capacity utilization, scope, an improvement in domestic competition and employment constraints is negative; the sign of the marginal effect of demand constraints and the export share is positive in Column (12).

Figures 2–4 in the previous section suggest that the correlation might have been distorted during the turmoil caused by the recent financial crisis. To test the robustness of the results to the exclusion of the financial crisis period, Table 5 reports results that are based on the time period before the crisis, ranging from Q2 1999 to Q4 2007. The marginal effects of e become higher throughout. They amount to -0.025 and 0.038 for the probability of a cost increase and decrease; to -0.004 and 0.02 for the probability of a price increase and decrease; and to -0.011 and to 0.029 for the probability of a profit increase and decline. At the same time, the role of θ remains the most important determinant of changes in outcome. To summarize, the results suggest that the previous transmission pattern holds but was clearly distorted during the recent period of fundamental distress.

A further robustness check reports results based on one lag ($t-1$) of all variables in x'_{it} to evaluate the short-term exchange rate effect (see Table A.3 in Appendix A). The results are mostly significant and robust to the above specifications, however, the effect of θ becomes even stronger.

3.1 Exchange rate transmission and export activity

This section addresses the heterogeneity of a possible exchange rate effect across firms with varying degree of exposure to foreign competition, ranging from firms producing mainly for the domestic market to firms with export shares in total turnover of over two thirds.¹⁴ It is possible that firms are heterogeneous in general across these categories. Thus, the upper panel of Table 6 allows for different slopes by reporting the marginal effect of e by export share.¹⁵ The results can be summarized as follows. As before, the table reveals that an appreciation of the exchange rate

¹⁴Recall that this variable is categorical and takes the value of 1 if the export share in total turnover amounts to 0–4%, 2 if the share is 5–33%, 3 if it is 34–66% and 4 if $> 66\%$.

¹⁵For the sake of brevity, the table omits all other covariates.

Table 5: The transmission of exchange rate shocks to firm-level costs, price adjustments and profits prior to the financial crisis

	Exp. cost increase	Exp. cost decrease	Price increase	Price decrease	Profit increase	Profit decrease
	(1)	(2)	(3)	(4)	(5)	(6)
Exchange rate e	-0.025 (0.003)***	0.038 (0.012)***	-0.004 (0.002)**	0.020 (0.004)***	-0.011 (0.003)***	0.029 (0.002)***
Log foreign GDP ϑ	-1.317 (0.429)***	0.664 (0.990)	0.788 (0.379)**	-2.022 (0.611)***	0.149 (0.526)	-1.359 (0.503)***
Domestic inflation p	0.025 (0.009)***	-3.97e-04 (0.024)	-0.011 (0.008)	0.001 (0.012)	0.002 (0.012)	-0.020 (0.011)*
Exp. cost			0.113 (0.039)***	-0.054 (0.013)***	0.025 (0.011)**	-0.023 (0.009)**
Price	8.12e-05 (0.009)	-0.038 (0.022)*			0.049 (0.013)***	-0.069 (0.010)***
Profit	0.038 (0.009)***	-0.014 (0.017)	0.015 (0.008)*	-0.067 (0.015)***		
Capacity utilisation (%)	0.003 (4.37e-04)***	-0.001 (0.001)	0.001 (3.66e-04)***	-0.001 (0.001)*	-3.16e-04 (0.001)	-0.002 (0.001)***
Scope	0.001 (0.001)	0.001 (0.002)	0.001 (0.001)	-0.001 (0.001)	-0.001 (0.001)	-3.64e-04 (0.001)
Domestic competition	0.008 (0.010)	-0.038 (0.023)	0.022 (0.011)**	-0.045 (0.014)***	0.097 (0.015)***	-0.068 (0.011)***
EU competition	-0.021 (0.010)**	0.028 (0.022)	-0.012 (0.008)	0.017 (0.012)	0.006 (0.013)	0.011 (0.011)
ROW competition	0.008 (0.009)	0.016 (0.019)	-0.001 (0.006)	0.012 (0.012)	-0.004 (0.012)	0.007 (0.010)
Demand constraints	-0.047 (0.012)***	0.046 (0.028)*	-0.061 (0.024)**	0.088 (0.020)***	-0.059 (0.016)***	0.112 (0.012)***
Employment constraints	0.037 (0.015)**	0.011 (0.032)	0.010 (0.011)	-0.074 (0.023)***	0.044 (0.019)**	-0.067 (0.018)***
Capacity constraints	0.006 (0.018)	0.011 (0.038)	0.016 (0.014)	0.011 (0.024)	0.047 (0.023)**	0.008 (0.023)
Other constraints	0.026 (0.013)**	0.040 (0.030)	0.008 (0.010)	-0.002 (0.016)	0.026 (0.018)	0.004 (0.015)
Export share (1-4)	0.026 (0.033)	-0.009 (0.106)	0.052 (0.016)***	-0.031 (0.040)	0.043 (0.039)	0.057 (0.038)
Obs.	18634	7692	11616	12429	14226	17296

Marginal effects at sample means from panel fixed-effects logit regressions (Q2 1999-Q4 2007) including seasonal dummies and a dummy for changes in VAT. The dependent variable is a dummy for an increase/decrease in the outcome (expected costs of intermediate goods and raw material, sales price, profit). Changes in macro variables accumulated since firm's last change in outcome. Standard errors in parentheses (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

Table 6: The transmission of exchange rate shocks across export categories

	(1)	(2)	(3)	(4)	(5)	(6)
	Exp. cost inc.	Exp. cost dec.	Price inc.	Price dec.	Profit inc.	Profit dec.
Φ_{it}						
1	-0.025 (0.002)***	0.018 (0.002)***	-0.009 (0.002)***	0.006 (0.001)***	-0.006 (0.002)***	0.001 (0.001)
2	-0.021 (0.003)***	0.013 (0.004)***	-0.003 (0.002)*	0.009 (0.003)***	-0.013 (0.003)***	0.004 (0.002)*
3	-0.019 (0.004)***	0.020 (0.006)***	-0.003 (0.002)	0.008 (0.003)**	-0.009 (0.004)**	0.012 (0.003)***
4	-0.022 (0.003)***	0.018 (0.003)***	-0.003 (0.002)	0.015 (0.004)***	-0.007 (0.003)***	0.018 (0.002)***
Obs.	26295	15373	18055	19556	20800	25632

Notes: Marginal effects of exchange rate growth from conditional logit regressions evaluated at four categories of export share, including seasonal dummies and a dummy for changes in VAT (Q2 1999-Q4 2011). Φ_{it} denotes the export share that firm i indicates at time t (1=0-4%; 2=5-33%; 3=34-66%; 4=67-100%). The dependent variable is a dummy for an increase/decrease in the outcome (expected costs of intermediate goods and raw material, sales price, profit). Changes in macro variables accumulated since firm's last change in outcome. Marginal effects evaluated at means of covariates and fixed effects at zero otherwise (not shown). Standard errors in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

is negatively and significantly related to the likelihood of increases in the costs of intermediate inputs, selling prices and profits and positively and significantly related to the probability of a decrease.

In addition, the table illustrates the following. Exchange rate shocks are generally transmitted to prices and profits of firms within all categories. However, the marginal effect becomes higher with an increasing export share regarding a decline in p and π . The marginal effect of e ranges from 0.006 for domestic firms to 0.015 for firms producing mainly for foreign markets in Column (4) regarding a decrease in prices; it ranges from 0.001 (even insignificant) to 0.018 in Column (6) regarding a profit decline. This pattern can neither be observed regarding the likelihood of a decrease in c (the marginal effect ranges from 0.013 to 0.02), nor regarding the likelihood of an increase in either outcome. The marginal effect ranges from -0.019 to -0.025 in Column (1) regarding a cost increase. It is not only higher for domestically producing firms in Column (3) regarding an upward adjustment in prices than for the remaining levels of exposure but it also becomes insignificant. It is hump-shaped with respect to the probability of an increase in π as shown in Column (5), with the marginal effect peaking at -0.013 for firms with intermediate export shares.¹⁶

¹⁶An interaction of the exchange rate – a continuous variable – and the export share – a categorical variable – could yield further insights as to the absorption pattern of firms with increasing export propensity over different values of the continuous variable. However, the interaction effect

The linear effect on changes in c may be due to constant overall intermediate input shares or the existence of intermediate importers. One explanation for the fact that the pattern found for adjustment in selling prices and profits is nonlinear across firms with differing export share is exposure to competition and overall low pricing power (see Dornbusch, 1987).

4 Sensitivity analysis and extensions

The previous section has studied the firm-level response to exchange rate shocks at the aggregate level and across different export categories and has provided a number of robustness checks. This section decomposes the data further and provides additional robustness checks. First, I study the transmission pattern at the industry level. Second, I analyze possible response nonlinearities by evaluating the exchange rate effect at different values and by accounting for exchange rate variability. Finally, I test whether further outcomes are affected.

4.1 Exchange rate transmission by industry

The transmission of shocks may not only differ across aggregate export activity but also across industries. This level of disaggregation allows better insights into the underlying market structure. The results of this exercise may best be summarized in Figure 6. The figures plot the kernel density of the marginal effects of the exchange rate variables for different industries together with the average over all industries included in the estimation.¹⁷ Although the loss of degrees of freedom of estimating Equation 1 at the industry level due to the drop in the number of observations implies that the precision of the estimates becomes lower, it is shown that the sign holds for most industries and that there is considerable dispersion across industries. What does this mean for selected industries? If we consider for instance the three

is only significantly different from zero for some values of the exchange rate for an increase in p and a decline in π . Specifically, the difference in price increase probabilities between the first and second export category as well as the first and third export category is positive and increasing in e . The difference in profit decrease probabilities is positive and increasing in e between the first and fourth export category. Note that the interaction effect in nonlinear models is not just the marginal effect of the interaction term and, as a consequence, cannot be calculated as a linear function of the constitutive terms as in linear models (see Ai and Norton, 2003). In particular, the sign, magnitude and statistical significance of the interaction effect may differ across observations.

¹⁷Due to the variation in the number of observations across industries, the estimates do not converge for some industries. This explains why the number of industries differs across outcomes.

largest industries in terms of export and import activity, we find that the marginal effect is equal in sign and similar in magnitude to the previous outcomes. However, it is insignificant on all outcomes in *Manufacture of chemicals and chemical products* (NOGA 24) and in *Manufacture of machinery and equipment n.e.c.* (NOGA 29). The marginal effect on the probability of a decrease in prices is 0.009 and insignificant otherwise in *Manufacture of medical, precision and optical instruments, watches and clocks* (NOGA 33). The median export share category in these three industries is 4, 3 and 3, respectively, which is well above the aggregate median of 2 as shown in Table 2.¹⁸ This would rather suggest a higher effect relative to an average industry. Although the data lack measures of the level of competition and although the results may be less precise at this level of disaggregation, market power and specialization are possible explanations for the insignificant effect in certain industries.

4.2 Exchange rate transmission during periods of distress

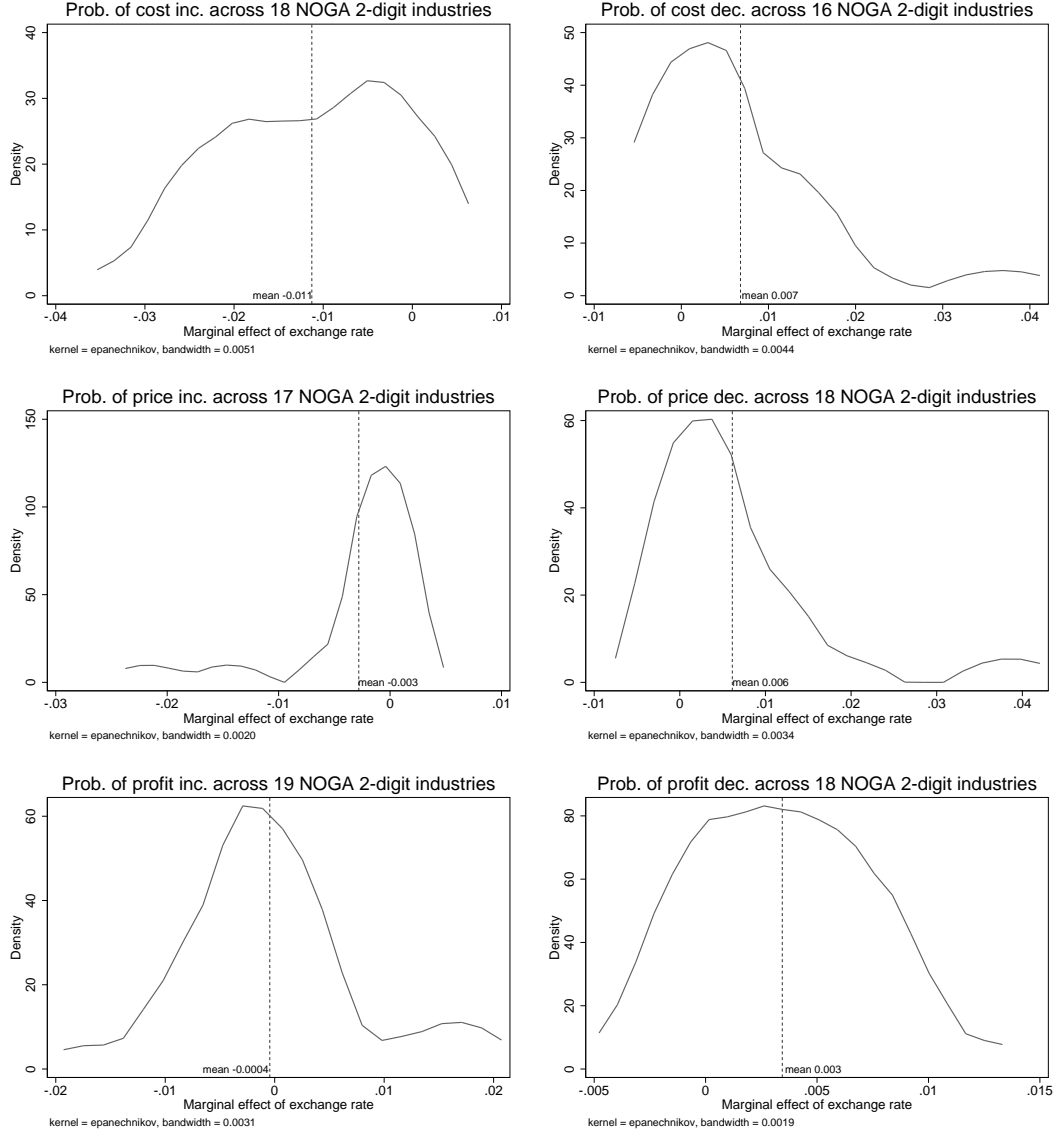
The recent period provides a particularly interesting environment to test the magnitude of transmission in terms of observing nonlinearities in the adjustment probabilities during periods of distress in the underlying fundamentals, and in this particular case, of large exchange rate shocks. I evaluate the marginal effect of the exchange rate over the distribution of the differenced exchange rate index with accumulated lags.¹⁹ The marginal effects are shown in Figure 7. The results can be summarized as follows. With increasing e the likelihood of observing a decline in costs and profits declines. The likelihood that a firm adjusts its selling price downwards is increasing in e up to some point from which the probability remains constant. The (negative) probability of observing an upward adjustment in c and π is decreasing in e , while the (negative) marginal effect on observing an increase in p is increasing in e . These results have interesting policy implications since they suggest that overall the slope of adjustment probabilities declines as the appreciation becomes stronger.

Furthermore, I examine how the adjustment probabilities vary over different values of e at all four export categories. The exchange rate variable has a leptokurtic distribution and evaluating the marginal effects at values other than the mean yields additional information about differences in transmission patterns across export categories. Figure 8 shows that the marginal effects differ across categories – although only slightly in magnitude – and, in the case of profit adjustment probabilities, even in slopes. For instance, cost decrease probabilities are decreasing in e , and at the

¹⁸Recall that category 1 corresponds to an export share in turnover of 0–4%, category 2 corresponds to 5–33%, category 3 corresponds to 34–66%, and 4 corresponds to 67–100%.

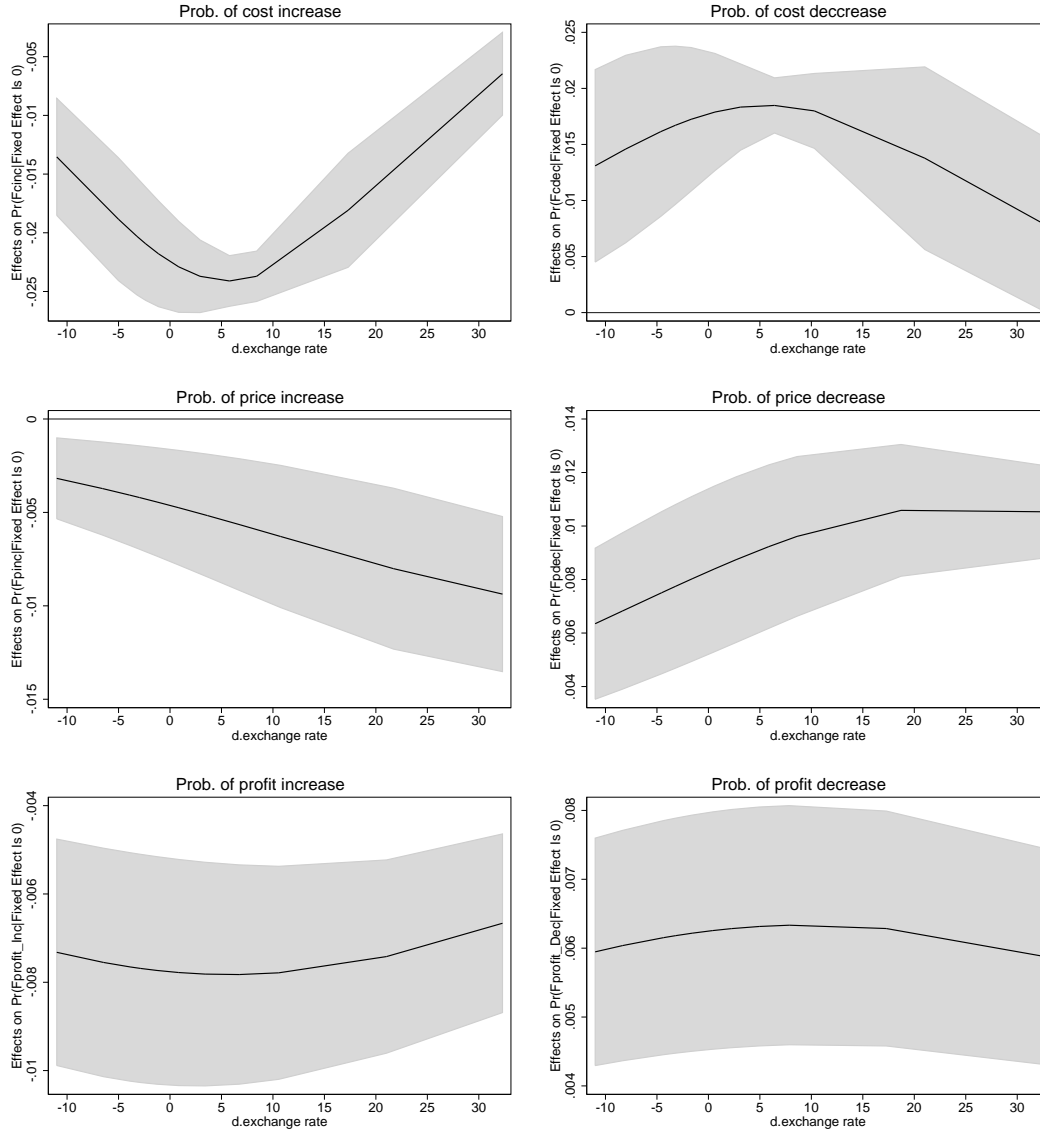
¹⁹I evaluate the marginal effects at the percentiles.

Figure 6: The transmission of exchange rate shocks across industries



Notes: Marginal effects at sample means from panel fixed-effects logit regressions (Q2 1999–Q4 2011) including seasonal dummies and a dummy for changes in VAT. The dependent variable is a dummy for an increase/decrease in the outcome (expected costs of intermediate goods and raw material, selling price, profit). Changes in macro variables accumulated since firm's last change in outcome.

Figure 7: The transmission of exchange rate shocks during periods of distress



Notes: Marginal effects from panel fixed-effects logit regressions (Q2 1999–Q4 2011) including seasonal dummies and a dummy for changes in VAT. The dependent variable is a dummy for an increase/decrease in the outcome (expected costs of intermediate goods and raw material, selling price, profit). Changes in macro variables since firm's last change in outcome.

same time, the probabilities become higher for firms with higher export shares compared to those with lower exposure. The probabilities of price decreases are lower in magnitude at higher export exposure, but the decline in the marginal effect is stronger in e for the domestic firms. The pattern of profit reduction probabilities is characterized by a steeper decline in e with increasing export share, leading to lower marginal effects at higher values of e . These patterns are similar for upward adjustments in outcomes.

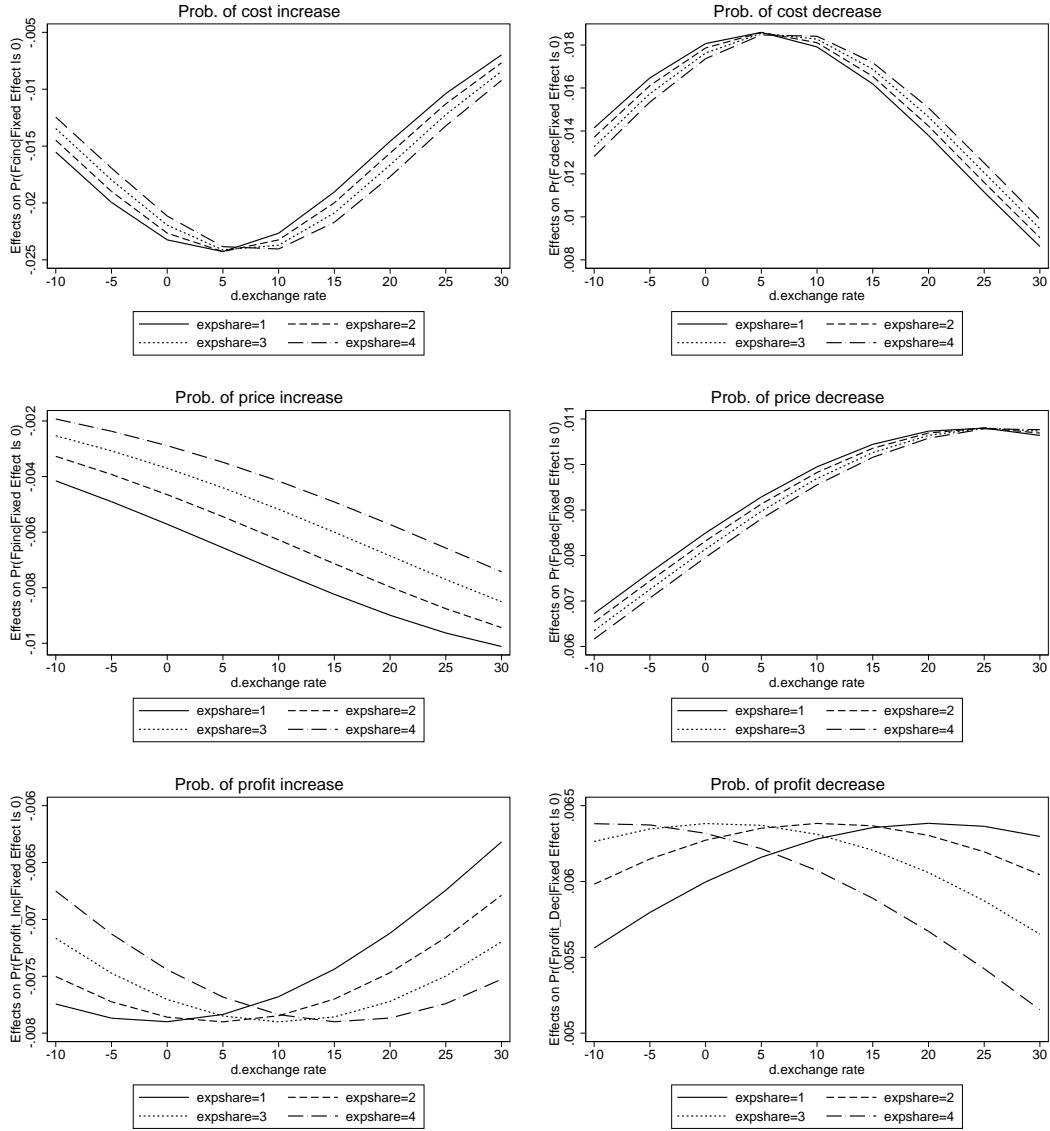
In addition to changes in the exchange rate, its variability may as well affect adjustment mechanisms at the firm level. I measure exchange rate variability by the standard deviation of e as suggested in Brodsky (1984):²⁰

$$\sigma_{i,\tau} = \sqrt{\sum_{t=1}^T (\Delta e_{i,\tau} - \frac{1}{T} \sum_{t=1}^T \Delta e_{i,\tau})^2 / (n-2)} \quad (2)$$

In contrast to the previous sections, overall changes in the variables of interest can now be analyzed in a meaningful way in addition to investigating observed increases and decreases in the dependent variable. The disadvantage of including $\sigma_{i,\tau}$ (henceforth σ) is that moderate collinearity issues arise as the z-statistics partly increase and hence the results have to be interpreted with caution. However, they may complement the previous findings. Table 7 includes σ in addition to the variables in vector x'_{it} of Equation (1). The marginal effect of σ on observing an adjustment in costs, prices and profits in Columns (1)–(3) is negative, hence a stronger standard deviation reduces the likelihood of a change in the respective outcome. This is in contrast to the literature on the effect of exchange rate variability (e.g., Campa and Goldberg, 2005). The marginal effects in Columns (1)–(3) amount to -0.028 , -0.007 and -0.024 regarding adjustments in c , p and π . However, the evidence turns out to be in line with the previous results if I account again for asymmetries in the behavior of the dependent variables as before. It reveals that increased volatility is also negatively related to observing an increase in c , p and π . The respective marginal effects amount to -0.024 , -0.003 and -0.004 in Columns (4), (6) and (8). The marginal effect of σ on the probability to observe a decrease in c is positive and amounts to 0.01 ; it is negative but insignificant with respect to the likelihood of a decrease in p (-0.001); and it is 0.003 for the probability of a reduction in π .

²⁰The author notes that the distribution of exchange rate indices is typically leptokurtic rather than normal. This is true for the data at hand as well: the kurtosis amounts to more than 10. However, he argues that using the standard deviation as a measure for variability is entirely consistent because by giving more weight to extreme observations, one accounts for the assumption that economic agents are risk averse, implying that extreme observations do have a large affect on agents.

Figure 8: The transmission of exchange rate shocks across export categories



Notes: Marginal effects from panel fixed-effects logit regressions (Q2 1999–Q4 2011) including seasonal dummies and a dummy for changes in VAT. The dependent variable is a dummy for an increase/decrease in the outcome (expected costs of intermediate goods and raw material, selling price, profit). Changes in macro variables since firm's last change in outcome.

Table 7: The effect of exchange rate variability on changes in firm-level costs, price adjustments and changes in firm-level profits

	Exp. cost	Price	Profit	Exp. cost		Price		Profit	
	Δ	Δ	Δ	Inc.	Dec.	Inc.	Dec.	Inc.	Dec.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Exchange rate e	-0.012 (0.001)***	-0.008 (0.002)***	-0.006 (0.002)***	-0.014 (0.001)***	0.014 (0.002)***	-0.004 (0.002)**	0.009 (0.002)***	-0.006 (0.002)***	0.006 (0.001)***
Exchange rate var. σ	-0.028 (0.002)***	-0.007 (0.002)***	-0.024 (0.002)***	-0.024 (0.001)***	0.010 (0.002)***	-0.003 (0.001)**	-0.001 (0.001)	-0.004 (0.002)***	0.003 (0.001)**
Log foreign GDP ϑ	1.162 (0.302)***	-0.539 (0.326)*	1.433 (0.381)***	1.216 (0.265)***	-4.929 (0.596)***	0.056 (0.162)	-1.446 (0.338)***	1.932 (0.296)***	-3.708 (0.243)***
Domestic inflation ρ	0.081 (0.006)***	0.031 (0.008)***	-0.013 (0.007)*	0.081 (0.006)***	0.040 (0.009)***	0.021 (0.008)***	-0.019 (0.006)***	-0.023 (0.007)***	0.010 (0.006)*
Exp. cost	0.160 (0.027)***	0.004 (0.009)	0.004 (0.009)			0.109 (0.037)***	-0.061 (0.013)***	0.024 (0.009)***	-0.029 (0.007)***
Price	1.95e-04 (0.008)		0.031 (0.010)***	-0.003 (0.008)	-0.019 (0.013)			0.056 (0.010)***	-0.091 (0.008)***
Profit	0.033 (0.007)***	0.027 (0.010)***		0.037 (0.007)***	-0.038 (0.012)***	0.020 (0.008)**	-0.066 (0.014)***		
Capacity utilisation (%)	0.001 (3.97e-04)***	0.002 (4.92e-04)***	-3.10e-04 (0.001)	0.001 (3.91e-04)***	-1.02e-04 (0.001)	0.001 (4.27e-04)***	-0.002 (3.81e-04)***	-0.001 (0.001)	-0.002 (3.62e-04)***
Scope	0.001 (0.001)	0.001 (0.001)	-2.40e-04 (0.001)	0.001 (0.001)	-3.11e-04 (0.001)	0.001 (0.001)	-0.002 (0.001)*	4.68e-04 (0.001)	-0.002 (0.001)*
Domestic competition	0.007 (0.009)	0.031 (0.013)**	0.071 (0.011)***	0.009 (0.009)	-0.023 (0.016)	0.025 (0.011)**	-0.046 (0.012)***	0.101 (0.012)***	-0.076 (0.010)***
EU competition	-0.010 (0.008)	0.006 (0.011)	0.027 (0.011)**	-0.008 (0.008)	0.014 (0.015)	-0.002 (0.006)	0.003 (0.009)	0.025 (0.011)**	0.008 (0.009)
ROW competition	0.004 (0.008)	-0.002 (0.010)	-0.006 (0.010)	-9.11e-05 (0.007)	0.020 (0.014)	-0.005 (0.006)	0.013 (0.008)	-0.009 (0.010)	0.007 (0.008)
Demand constraints	-0.033 (0.009)***	-0.069 (0.018)***	0.008 (0.012)	-0.035 (0.009)***	0.032 (0.017)*	-0.053 (0.020)***	0.053 (0.014)***	-0.046 (0.013)***	0.099 (0.010)***
Employment constraints	0.041 (0.013)***	0.010 (0.017)	0.041 (0.016)**	0.038 (0.013)***	-0.013 (0.026)	0.008 (0.010)	-0.061 (0.019)***	0.053 (0.017)***	-0.052 (0.016)***
Capacity constraints	0.012 (0.017)	0.037 (0.021)*	0.057 (0.020)***	0.009 (0.016)	0.005 (0.030)	0.020 (0.013)	-0.001 (0.018)	0.051 (0.020)**	0.005 (0.019)
Other constraints	0.027 (0.012)**	0.028 (0.016)*	0.043 (0.015)***	0.022 (0.011)*	0.022 (0.020)	0.010 (0.009)	-0.012 (0.011)	0.037 (0.016)**	0.004 (0.012)
Export share (1-4)	0.023 (0.034)	-0.015 (0.048)	0.047 (0.034)	0.026 (0.035)	-0.014 (0.068)	0.035 (0.018)*	-0.009 (0.033)	0.043 (0.039)	0.060 (0.036)
Obs.	25301	16937	18378	26295	15373	18055	19556	20800	25632

Marginal effects at sample means from panel fixed-effects logit regressions (Q2 1999-Q4 2011) including seasonal dummies and a dummy for changes in VAT. The dependent variable is a dummy for an increase/decrease in the outcome (expected costs of intermediate goods and raw material, sales price, profit). Changes in macro variables accumulated since firm's last change in outcome. Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

To summarize, increased variability reduces the probability of adjustments in costs, prices and profits but – except for reductions in selling prices – the variable carries the same sign as the exchange rate variable once I account again for asymmetric adjustments.²¹

²¹Furthermore, I tested possible asymmetries in the transmission of exchange rate movements that can be studied by analyzing an increase in the exchange rate index (i.e., an appreciation) and a decrease in the exchange rate index (a depreciation of the Swiss Franc) separately. The insignificance of most results together with ambiguous signs of the estimates and sometimes suspiciously low estimates, however, suggest that the estimates are much less precise due to the drop in the number of observations.

4.3 Exchange rate shocks and expectations on outcomes

This paragraph seeks to test the transmission of exchange rate fluctuations to quantity margins at the firm level. The relationship between the exchange rate and real outcomes have been analyzed at the firm level by Nucci and Pozzolo (2010) for Italy (employment) and by Berman, Martin, and Meyer (2012) for France (exports). The data used in this paper do not include realized outcomes with respect to employment and exports. Thus the quantity parameter cannot be observed. Instead firms report qualitative information on expected changes in employment and exports for the next quarter, which can be used with caution as proxies for realized outcomes. Table 8 shows that expected employment adjusts in a similar way as above: the marginal effect of e is negative and significant on the likelihood of an increase in expected employment (-0.025) in Column (1) and positive and significant on the probability of a decrease (0.047) in Column (2). The evidence with respect to expected exports is in line with the findings from previous sections. The marginal effect on the likelihood of observing an increase in expected exports is negative and significant (-0.013) as shown in Column (3). The marginal effect is insignificant and close to zero in Column (4). If firms absorb exchange rates in their prices, export volumes may be held constant and a missing effect is therefore in line with the previous results. But at the same time, the marginal effect of θ on an increase in exports is negative and significant, suggesting that the results have to be handled with care and may not permit conclusions for economic policy.

5 Conclusions

In this paper, I have analyzed how Swiss manufacturing firms react to exchange rate fluctuations in terms of costs, prices and profits. First, I found that exchange rate shocks positively affect the probability of a decrease in outcome and negatively affect the probability of an increase in either outcome. Second, the probability of changes in costs, prices and profits is non-linear in the sense that it depends on the degree of export exposure: an appreciation affects the probability of a decrease in prices and profits more with an increasing share of exports in total sales. This nonlinearity cannot be observed with respect to the likelihood of a decrease in costs. Third, the marginal effect varies across industries, pointing to heterogeneous levels of competition and market power within the Swiss manufacturing industry. Fourth, adjustment probabilities are heterogeneous in the magnitude of exchange rate movements and affected by exchange rate variability. Finally, the analysis confirms the importance of controlling for firm-state variables beyond the overall impact of the

Table 8: The transmission of exchange rate shocks to expectations about the number of employees and exports in the next quarter

	Exp. no. of employees		Exp. exports	
	Inc.	Dec.	Inc.	Dec.
	(1)	(2)	(3)	(4)
Exchange rate e	-0.025 (0.006)***	0.047 (0.004)***	-0.013 (0.002)***	-0.001 (0.001)
Log foreign GDP ϑ	4.297 (1.499)***	1.721 (1.541)	-3.007 (0.539)***	-2.057 (0.443)***
Domestic inflation ρ	0.006 (0.028)	-0.041 (0.037)	-0.054 (0.011)***	-0.007 (0.005)
Exp. cost	-0.004 (0.013)	-0.042 (0.017)**	0.011 (0.013)	-0.001 (0.006)
Price	-0.019 (0.016)	-0.014 (0.019)	-0.025 (0.016)	0.032 (0.010)***
Profit	0.001 (0.011)	-0.056 (0.015)***	0.008 (0.013)	0.001 (0.006)
Capacity utilisation (%)	-4.82e-04 (0.001)	0.001 (0.001)	2.78e-04 (0.001)	0.001 (3.50e-04)***
Scope	-0.001 (0.001)	0.001 (0.002)	0.001 (0.001)	1.65e-04 (0.001)
Domestic competition	0.023 (0.015)	-0.023 (0.019)	-0.014 (0.015)	-0.003 (0.008)
EU competition	0.027 (0.016)	-0.017 (0.021)	0.164 (0.011)***	-0.079 (0.015)***
ROW competition	0.010 (0.013)	0.012 (0.019)	0.062 (0.013)***	-0.020 (0.007)***
Demand constraints	-0.035 (0.020)*	0.065 (0.021)***	-0.048 (0.017)***	0.002 (0.009)
Employment constraints	0.077 (0.026)***	-0.051 (0.030)*	-0.010 (0.025)	0.011 (0.012)
Capacity constraints	0.003 (0.027)	-0.052 (0.042)	-0.019 (0.036)	-0.018 (0.015)
Other constraints	0.022 (0.019)	-0.014 (0.027)	-0.029 (0.022)	-0.031 (0.012)**
Export share (1-4)	0.099 (0.023)***	-0.055 (0.066)	-0.063 (0.052)	0.030 (0.022)
Obs.	5991	5915	10182	19447

Marginal effects at sample means from panel fixed-effects logit regressions (Q2 1999-Q4 2011) including seasonal dummies and a dummy for changes in VAT. The dependent variable is a dummy for an increase/decrease in the outcome (expected number of employees and expected exports in the next quarter). Changes in macro variables accumulated since firm's last change in outcome. Standard errors in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$).

exchange rate such as profits and costs, capacity utilization, competition and firm-level constraints. My findings suggest that exchange rate shocks are passed through to import prices and absorbed in the selling prices of Swiss firms. An explanation for this finding is that Switzerland is a small open economy and Swiss firms may take prices as given. The reduction in costs is not proportional to the decrease in prices, hence overall profits decline during appreciation periods. Ultimately, the absorption pattern can explain why at the aggregate level, the recent strong appreciation did not lead to reduced export volumes and real output.

References

- Ai, Chunrong, and Edward C. Norton, 2003. Interaction Terms in Logit and Probit Models. *Economics Letters* 80 (1), 123–129.
- Alvarez, Luis J., Emmanuel Dhyne, Marco M. Hoeberichts, Claudia Kwapil, Hervé Bihan, Patrick Lünnemann, Fernando Martins, Roberto Sabbatini, Harald Stahl, Philip Vermeulen, and Jouko Vilmunen, 2006. Sticky Prices in the Euro Area: A Summary of New Micro-Evidence. *Journal of the European Economic Association* 4 (2-3), 575–584.
- Baldwin, Richard, and Paul Krugman, 1989. Persistent Trade Effects of Large Exchange Rate Shocks. *The Quarterly Journal of Economics* 104 (4), 635–654.
- Barro, Robert J., 1972. A Theory of Monopolistic Price Adjustment. *Review of Economic Studies* 39 (1), 17–26.
- Berman, Nicolas, Philippe Martin, and Thierry Mayer, 2012. How do Different Exporters React to Exchange Rate Changes? Theory, Empirics and Aggregate Implications. *The Quarterly Journal of Economics* 127 (1), 437–492.
- Bernard, Andrew B., Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum, 2003. Plants and Productivity in International Trade. *American Economic Review* 93 (4), 1268–1290.
- Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott, 2007. Firms in International Trade. *Journal of Economic Perspectives* 21 (3), 105–130.
- Brodsky, David A., 1984. Fixed Versus Flexible Exchange Rates and the Measurement of Exchange Rate Instability. *Journal of International Economics* 16, 295–306.
- Calvo, Guillermo A., 1983. Staggered Prices in a Utility-Maximizing Framework. *Journal of Monetary Economics* 12, 383–398.
- Campa, José M., and Linda S. Goldberg, 2005. Exchange-Rate Pass-Through into Import Prices. *Review of Economics and Statistics* 87 (4), 679–690.
- Dornbusch, Rudiger, 1976. Expectations and Exchange Rate Dynamics. *Journal of Political Economy* 84 (6), 1161–1176.
- Dornbusch, Rudiger, 1987. Exchange Rates and Prices. *American Economic Review* 77 (1), 93–106.
- Dotsey, Michael, Robert G. King, and Alexander L. Wolman, 1999. State-Dependent Pricing and the General Equilibrium Dynamics of Money and Output. *The Quarterly Journal of Economics* 114, 655–690.
- Fischer, Andreas M., Matthias Lutz, and Manuel Wälti, 2007. Who Prices Locally? Survey Evidence of Swiss Exporters. SNB Working Papers No. 2007–16, Swiss National Bank (SNB).
- Goldberg, Pinelopi K., and Michael M. Knetter, 1997. Goods Prices and Exchange Rates: What Have We Learned? *Journal of Economic Literature* 35 (3), 1243–1272.
- Golosov, Mikhail, and Robert E. Lucas, 2007. Menu Costs and Phillips Curves. *Journal of Political Economy* 115, 171–199.

- Gopinath, Gita, and Roberto Rigobon, 2008. Sticky Borders. *The Quarterly Journal of Economics* 123 (2), 531–575.
- Gopinath, Gita, Oleg Itskhoki, and Roberto Rigobon, 2010. Currency Choice and Exchange Rate Pass-Through. *American Economic Review* 100 (1), 304–336.
- Klenow, Peter J., and Oleg Kryvtsov, 2008. State-Dependent or Time-Dependent Pricing: Does It Matter for Recent U.S. Inflation? *The Quarterly Journal of Economics* 123 (3), 863–904.
- Lamla, Michael, and Andrea Lassmann, 2011. Der Einfluss der Wechselkursentwicklung auf die Schweizerischen Warenexporte: Eine Disaggregierte Analyse. *KOF Analysen*, Sommer 2011, 31–49, KOF Swiss Economic Institute, ETH Zurich.
- Lein, Sarah, 2010. When Do Firms Adjust Prices? Evidence from Micro Panel Data. *Journal of Monetary Economics* 57 (6), 696–715.
- Lein, Sarah, and Eva Köberl, 2009. Capacity Utilization, Constraints and Price Adjustments under the Microscope. KOF Working Paper Series No. 239, KOF Swiss Economic Institute, ETH Zurich.
- Mikosch, Heiner, 2011. Sticky Prices, Competition and the Phillips Curve. Mimeo, KOF Swiss Economic Institute, ETH Zurich.
- Moser, Christoph, Dieter Urban, and Beatrice Weder di Mauro, 2010. International Competitiveness, Job Creation and Job Destruction – An Establishment-Level Study of German Job Flows. *Journal of International Economics* 80, 302–317.
- Nakamura, Emi, and Jón Steinsson, 2008. Five Facts About Prices: A Reevaluation of Menu Cost Models. *The Quarterly Journal of Economics* 123 (4), 1415–1464.
- Nucci, Francesco, and Alberto F. Pozzolo, 2010. The Exchange Rate, Employment and Hours: What Firm-Level Data Say. *Journal of International Economics* 82, 112–123.
- Taylor, John B., 1980. Aggregate Dynamics and Staggered Contracts. *Journal of Political Economy* 88, 1–23.

A Appendix

Table A.1: Correlation of sample variables

Correlations of raw variables													
	θ	θ	ρ	Domestic GDP	Exp. cost	Price	Profit	Capacity utilisation	Scope	Domestic comp.	EU comp.	ROW comp.	Demand const.
θ	1												
θ	0.57	1											
ρ	0.72	0.94	1										
Domestic GDP	0.74	0.93	0.97	1									
Exp. cost	-0.08	0.10	0.05	0.03	1								
Price	-0.07	0.07	0.05	0.03	0.15	1							
Profit	-0.05	0.04	0.02	-0.01	0.07	0.36	1						
Capacity utilisation	0.00	0.11	0.08	0.06	0.07	0.13	0.26	1					
Scope	-0.02	0.00	0.00	0.00	0.00	0.04	0.07	0.09	1				
Domestic comp.	-0.05	-0.03	-0.03	-0.04	0.04	0.17	0.29	0.15	0.06	1			
EU comp.	0.03	-0.02	-0.01	-0.01	0.02	-0.09	-0.08	-0.05	-0.06	-0.05	1		
ROW comp.	0.02	-0.02	-0.01	-0.01	0.03	-0.07	-0.08	-0.05	-0.12	-0.15	0.04	1	
Demand const.	-0.06	-0.17	-0.20	-0.16	-0.06	-0.15	-0.24	-0.34	0.03	0.09	0.00	0.04	1
Employment const.	-0.11	-0.09	-0.08	-0.10	0.06	0.07	0.10	0.14	0.03	0.06	0.00	-0.15	1
Capacity const.	-0.05	-0.03	-0.03	-0.05	0.04	0.05	0.08	0.13	0.03	0.02	-0.04	-0.05	0.18
Other const.	-0.03	-0.06	-0.05	-0.06	0.02	-0.03	-0.02	-0.01	0.02	-0.02	-0.01	-0.01	-0.11
Export share	-0.04	-0.01	-0.02	-0.02	-0.05	0.05	0.09	0.07	0.08	0.06	-0.60	-0.60	-0.02
													1
													0.01

Correlations of differenced macro variables with accumulated lags													
	θ	θ	ρ	Dom. GDP	Price increase	θ	ρ	Dom. GDP	Price increase	θ	ρ	Dom. GDP	Price increase
Exp. cost increase													
θ	1												
θ	-0.09	1											
Dom. GDP	0.06	0.83	1										
ρ	0.16	0.69	0.74	1									
Exp. cost decrease													
θ	1												
θ	0.12	1											
Domestic GDP	0.23	0.90	1										
ρ	0.32	0.84	0.90	1									

Correlations of differenced macro variables with accumulated lags													
	θ	θ	ρ	Dom. GDP	Price decrease	θ	ρ	Dom. GDP	Price decrease	θ	ρ	Dom. GDP	Price decrease
Exp. cost increase													
θ	1												
θ	-0.09	1											
Dom. GDP	0.06	0.83	1										
ρ	0.16	0.69	0.74	1									
Exp. cost decrease													
θ	1												
θ	0.12	1											
Domestic GDP	0.23	0.90	1										
ρ	0.32	0.84	0.90	1									

Sample correlations Q2 1999–Q4 2011. Changes in macro variables accumulated since firm's last change in outcome in lower panel.

Table A.2: The transmission of the exchange rate to firm-level outcomes with different macro variables

	Exp. cost increase					Exp. cost decrease				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exchange rate e	-0.018 (0.002)***	-0.020 (0.002)***	-0.020 (0.002)***	-0.022 (0.002)***	-0.021 (0.002)***	0.021 (0.004)***	0.019 (0.003)***	0.017 (0.003)***	0.017 (0.003)***	0.018 (0.003)***
Log foreign GDP θ		0.992 (0.192)***	-2.677 (0.355)***	-0.459 (0.235)*	-2.907 (0.371)***		-1.894 (0.394)***	-3.753 (0.798)***	-4.275 (0.669)***	-3.841 (0.644)***
Log domestic GDP	2.806 (0.285)***		5.283 (0.501)***		4.638 (0.507)***	-0.979 (0.287)***		2.182 (0.576)***		-0.859 (0.536)
Domestic inflation p				0.052 (0.007)***	0.025 (0.006)***				0.070 (0.012)***	0.079 (0.013)***
Price	0.009 (0.008)	0.007 (0.008)	0.007 (0.008)	0.007 (0.008)	0.007 (0.008)	-0.011 (0.013)	-0.006 (0.013)	-0.011 (0.013)	-0.021 (0.013)	-0.020 (0.013)
Profit	0.035 (0.007)***	0.039 (0.007)***	0.037 (0.007)***	0.039 (0.007)***	0.037 (0.007)***	-0.047 (0.015)***	-0.044 (0.014)***	-0.043 (0.014)***	-0.039 (0.013)***	-0.039 (0.013)***
Capacity utilisation (%)	0.002 (3.62e-04)***	0.002 (3.65e-04)***	0.002 (3.61e-04)***	0.002 (3.57e-04)***	0.002 (3.58e-04)***	-4.22e-04 (0.001)	-1.69e-04 (0.001)	-2.72e-04 (0.001)	-2.56e-04 (0.001)	-2.26e-04 (0.001)
Scope	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	-2.34e-04 (0.001)	-2.25e-04 (0.001)	-3.45e-04 (0.001)	-0.001 (0.001)	-0.001 (0.001)
Domestic competition	0.013 (0.009)	0.011 (0.009)	0.014 (0.009)	0.012 (0.009)	0.014 (0.009)	-0.024 (0.016)	-0.023 (0.016)	-0.021 (0.016)	-0.023 (0.016)	-0.024 (0.016)
EU competition	-0.006 (0.008)	-0.009 (0.008)	-0.004 (0.008)	-0.008 (0.008)	-0.004 (0.008)	0.007 (0.015)	0.007 (0.015)	0.010 (0.015)	0.013 (0.015)	0.012 (0.015)
ROW competition	0.002 (0.007)	0.001 (0.007)	0.002 (0.007)	0.002 (0.007)	0.003 (0.007)	0.020 (0.014)	0.021 (0.014)	0.020 (0.014)	0.020 (0.014)	0.020 (0.014)
Demand constraints	-0.036 (0.010)***	-0.043 (0.010)***	-0.024 (0.009)**	-0.039 (0.010)***	-0.024 (0.009)***	0.007 (0.017)	0.013 (0.016)	0.028 (0.017)	0.029 (0.017)*	0.025 (0.017)
Employment constraints	0.049 (0.013)***	0.049 (0.013)***	0.053 (0.013)***	0.050 (0.013)***	0.053 (0.013)***	-0.029 (0.026)	-0.024 (0.025)	-0.022 (0.025)	-0.019 (0.026)	-0.019 (0.026)
Capacity constraints	0.009 (0.016)	0.009 (0.016)	0.011 (0.016)	0.010 (0.016)	0.011 (0.016)	-0.010 (0.030)	-0.006 (0.029)	-0.002 (0.029)	-0.003 (0.030)	-0.004 (0.030)
Other constraints	0.026 (0.011)**	0.025 (0.011)**	0.029 (0.011)**	0.027 (0.011)**	0.029 (0.011)***	0.007 (0.020)	0.006 (0.020)	0.009 (0.020)	0.017 (0.020)	0.016 (0.020)
Export share	0.026 (0.033)	0.028 (0.033)	0.025 (0.034)	0.026 (0.033)	0.024 (0.033)	-0.011 (0.069)	-0.011 (0.065)	-0.015 (0.065)	-0.015 (0.070)	-0.013 (0.071)
Obs.	26295	26295	26295	26295	26295	15373	15373	15373	15373	15373

	Price increase					Price decrease				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exchange rate e	-0.003 (0.001)**	-0.004 (0.002)**	-0.005 (0.002)***	-0.005 (0.002)***	-0.005 (0.002)***	0.009 (0.002)***	0.007 (0.002)***	0.008 (0.002)***	0.008 (0.002)***	0.009 (0.002)***
Log foreign GDP θ		0.247 (0.124)**	-0.831 (0.345)**	-0.207 (0.149)	-0.834 (0.345)**		-2.166 (0.423)***	-0.696 (0.297)**	-1.503 (0.339)***	-0.702 (0.298)**
Log domestic GDP	0.571 (0.219)***		1.376 (0.518)***		1.176 (0.478)**	-2.410 (0.458)***		-1.828 (0.427)***		-1.471 (0.428)***
Domestic inflation p				0.014 (0.006)**	0.005 (0.004)				-0.022 (0.006)***	-0.010 (0.005)*
Exp. cost	0.106 (0.037)***	0.112 (0.037)***	0.107 (0.037)***	0.104 (0.036)***	0.104 (0.037)***	-0.061 (0.013)***	-0.062 (0.013)***	-0.060 (0.013)***	-0.060 (0.013)***	-0.060 (0.013)***
Profit	0.019 (0.008)**	0.019 (0.008)**	0.019 (0.008)**	0.019 (0.008)**	0.019 (0.008)**	-0.067 (0.014)***	-0.068 (0.014)***	-0.066 (0.014)***	-0.066 (0.014)***	-0.066 (0.014)***
Capacity utilisation (%)	0.001 (4.27e-04)***	0.001 (4.39e-04)***	0.001 (4.31e-04)***	0.001 (4.26e-04)***	0.001 (4.28e-04)***	-0.002 (3.82e-04)***	-0.002 (3.92e-04)***	-0.002 (3.80e-04)***	-0.002 (3.82e-04)***	-0.002 (3.78e-04)***
Scope	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	-0.002 (0.001)*	-0.002 (0.001)*	-0.002 (0.001)*	-0.002 (0.001)*	-0.002 (0.001)*
Domestic competition	0.024 (0.011)**	0.025 (0.011)**	0.025 (0.011)**	0.024 (0.010)**	0.025 (0.011)**	-0.048 (0.013)***	-0.047 (0.013)***	-0.048 (0.012)***	-0.047 (0.012)***	-0.047 (0.012)***
EU competition	-0.003 (0.006)	-0.003 (0.006)	-0.002 (0.006)	-0.002 (0.006)	-0.001 (0.006)	0.002 (0.009)	0.004 (0.009)	0.002 (0.009)	0.003 (0.009)	0.002 (0.009)
ROW competition	-0.005 (0.006)	-0.005 (0.006)	-0.005 (0.006)	-0.005 (0.005)	-0.005 (0.006)	0.013 (0.009)	0.013 (0.009)	0.013 (0.009)	0.013 (0.009)	0.013 (0.009)
Demand constraints	-0.052 (0.020)**	-0.056 (0.021)***	-0.047 (0.019)**	-0.050 (0.020)**	-0.046 (0.019)**	0.047 (0.013)***	0.058 (0.015)***	0.049 (0.013)***	0.053 (0.014)***	0.049 (0.013)***
Employment constraints	0.009 (0.010)	0.008 (0.010)	0.010 (0.010)	0.009 (0.010)	0.010 (0.010)	-0.066 (0.019)***	-0.061 (0.019)***	-0.064 (0.019)***	-0.061 (0.019)***	-0.063 (0.019)***
Capacity constraints	0.020 (0.013)	0.020 (0.013)	0.021 (0.013)	0.020 (0.012)	0.021 (0.013)	-0.005 (0.018)	0.001 (0.018)	-0.003 (0.018)	-0.001 (0.018)	-0.003 (0.018)
Other constraints	0.010 (0.009)	0.010 (0.009)	0.011 (0.009)	0.010 (0.009)	0.011 (0.009)	-0.013 (0.012)	-0.009 (0.012)	-0.012 (0.012)	-0.011 (0.012)	-0.013 (0.012)
Export share	0.033 (0.018)*	0.034 (0.018)*	0.032 (0.018)*	0.033 (0.017)*	0.032 (0.018)*	-0.008 (0.033)	-0.012 (0.033)	-0.009 (0.033)	-0.009 (0.033)	-0.008 (0.033)
Obs.	18055	18055	18055	18055	18055	19556	19556	19556	19556	19556

Table A.2: (continued)

	Profit increase					Profit decrease				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Exchange rate e	-0.012 (0.002)***	-0.011 (0.002)***	-0.010 (0.002)***	-0.008 (0.002)***	-0.008 (0.001)***	0.009 (0.001)***	0.007 (0.001)***	0.008 (0.001)***	0.006 (0.001)***	0.007 (0.001)***
Log foreign GDP θ		0.653 (0.205)***	0.969 (0.359)***	1.621 (0.278)***	1.018 (0.368)***		-3.061 (0.185)***	-1.910 (0.329)***	-3.545 (0.229)***	-1.842 (0.322)***
Log domestic GDP	0.440 (0.217)**		-0.411 (0.379)		1.145 (0.472)**	-2.920 (0.180)***		-1.346 (0.323)***		-2.731 (0.374)***
Domestic inflation p				-0.033 (0.006)***	-0.043 (0.008)***				0.017 (0.005)***	0.039 (0.006)***
Exp. cost	0.026 (0.009)***	0.025 (0.009)***	0.025 (0.009)***	0.027 (0.009)***	0.026 (0.009)***	-0.028 (0.007)***	-0.029 (0.007)***	-0.027 (0.007)***	-0.030 (0.007)***	-0.028 (0.007)***
Price	0.056 (0.011)***	0.057 (0.011)***	0.057 (0.011)***	0.058 (0.011)***	0.058 (0.011)***	-0.086 (0.008)***	-0.087 (0.008)***	-0.085 (0.008)***	-0.090 (0.008)***	-0.089 (0.008)***
Capacity utilisation (%)	-3.16e-04 (0.001)	-3.40e-04 (0.001)	-3.43e-04 (0.001)	-4.50e-04 (0.001)	-4.80e-04 (0.001)	-0.002 (3.68e-04)***	-0.002 (3.61e-04)***	-0.002 (3.65e-04)***	-0.002 (3.61e-04)***	-0.002 (3.66e-04)***
Scope	4.61e-04 (0.001)	4.59e-04 (0.001)	4.64e-04 (0.001)	0.001 (0.001)	0.001 (0.001)	-0.001 (0.001)*	-0.001 (0.001)*	-0.001 (0.001)*	-0.002 (0.001)*	-0.002 (0.001)*
Domestic competition	0.106 (0.013)***	0.105 (0.014)***	0.105 (0.014)***	0.104 (0.012)***	0.105 (0.012)***	-0.078 (0.009)***	-0.076 (0.009)***	-0.076 (0.009)***	-0.076 (0.009)***	-0.077 (0.009)***
EU competition	0.027 (0.011)**	0.027 (0.011)**	0.026 (0.011)**	0.025 (0.011)**	0.026 (0.011)**	0.005 (0.009)	0.007 (0.009)	0.006 (0.009)	0.008 (0.009)	0.006 (0.009)
ROW competition	-0.008 (0.010)	-0.008 (0.010)	-0.008 (0.010)	-0.009 (0.010)	-0.009 (0.010)	0.006 (0.008)	0.007 (0.008)	0.007 (0.008)	0.007 (0.008)	0.006 (0.008)
Demand constraints	-0.041 (0.013)***	-0.044 (0.013)***	-0.046 (0.013)***	-0.047 (0.013)***	-0.043 (0.013)***	0.083 (0.009)***	0.095 (0.010)***	0.088 (0.010)***	0.098 (0.010)***	0.089 (0.010)***
Employment constraints	0.058 (0.017)***	0.057 (0.017)***	0.057 (0.017)***	0.055 (0.017)***	0.056 (0.017)***	-0.061 (0.015)***	-0.054 (0.015)***	-0.056 (0.015)***	-0.053 (0.016)***	-0.056 (0.015)***
Capacity constraints	0.053 (0.020)***	0.053 (0.020)***	0.052 (0.020)**	0.051 (0.020)**	0.053 (0.020)***	-0.005 (0.019)	0.003 (0.019)	0.000 (0.019)	0.005 (0.019)	0.001 (0.019)
Other constraints	0.042 (0.016)***	0.041 (0.016)***	0.040 (0.016)**	0.039 (0.016)**	0.040 (0.016)**	-0.003 (0.012)	0.001 (0.012)	-0.001 (0.012)	0.003 (0.012)	0.001 (0.012)
Export share	0.042 (0.038)	0.043 (0.037)	0.043 (0.037)	0.043 (0.038)	0.041 (0.039)	0.062 (0.035)*	0.060 (0.036)*	0.060 (0.036)*	0.060 (0.036)	0.060 (0.036)*
Obs.	20800	20800	20800	20800	20800	25632	25632	25632	25632	25632

Marginal effects at sample means from panel fixed-effects logit regressions (Q2 1999–Q4 2011) including seasonal dummies and a dummy for changes in VAT. The dependent variable is a dummy for an increase/decrease in the outcome (expected costs of intermediate goods and raw material, selling price, profit). Changes in macro variables accumulated since firm's last change in outcome. Standard errors in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.3: The transmission of the exchange rate to firm-level outcomes with one lag

	Exp. cost		Price		Profit	
	Inc.	Dec.	Inc.	Dec.	Inc.	Dec.
	(1)	(2)	(3)	(4)	(5)	(6)
Exchange rate e	-0.011 (0.002)***	0.025 (0.008)***	-0.002 (0.002)	0.017 (0.004)***	-0.004 (0.003)	0.008 (0.002)***
Log foreign GDP ϑ	5.869 (0.986)***	-11.562 (3.216)***	-1.150 (0.575)**	-1.593 (0.648)**	9.008 (1.475)***	-9.844 (0.743)***
Domestic inflation ρ	0.122 (0.019)***	-0.074 (0.024)***	0.030 (0.012)**	-0.027 (0.010)***	0.016 (0.010)*	-0.018 (0.008)**
Exp. cost			0.102 (0.038)***	-0.075 (0.017)***	0.025 (0.009)***	-0.033 (0.007)***
Price	0.012 (0.007)*	-0.035 (0.015)**			0.059 (0.013)***	-0.108 (0.010)***
Profit	0.031 (0.007)***	-0.021 (0.012)*	0.019 (0.008)**	-0.080 (0.018)***		
Capacity utilisation (in %)	0.002 (3.63e-04)***	-0.001 (0.001)**	0.001 (4.64e-04)***	-0.002 (4.90e-04)***	2.61e-04 (4.46e-04)	-0.003 (3.26e-04)***
Scope	0.001 (0.001)	2.85e-05 (0.001)	0.001 (0.001)	-0.002 (0.001)**	0.001 (0.001)	-0.002 (0.001)**
Domestic competition	0.009 (0.008)	-0.021 (0.015)	0.023 (0.011)**	-0.047 (0.013)***	0.092 (0.017)***	-0.076 (0.010)***
EU competition	-0.007 (0.007)	0.009 (0.014)	-0.002 (0.006)	0.007 (0.009)	0.023 (0.011)**	0.009 (0.009)
ROW competition	0.003 (0.006)	0.022 (0.014)	-0.004 (0.005)	0.013 (0.009)	-0.009 (0.009)	0.008 (0.008)
Demand constraints	-0.036 (0.010)***	0.042 (0.020)**	-0.047 (0.019)**	0.069 (0.018)***	-0.043 (0.014)***	0.119 (0.012)***
Employment constraints	0.041 (0.013)***	-0.019 (0.023)	0.010 (0.009)	-0.076 (0.022)***	0.050 (0.017)***	-0.056 (0.016)***
Capacity constraints	0.010 (0.014)	0.019 (0.027)	0.020 (0.012)	4.70e-04 (0.018)	0.042 (0.019)**	0.007 (0.019)
Other constraints	0.018 (0.010)*	0.025 (0.019)	0.011 (0.009)	-0.008 (0.012)	0.035 (0.015)**	0.012 (0.012)
Export share (1-4)	0.012 (0.030)	-0.010 (0.056)	0.029 (0.017)*	-0.010 (0.036)	0.041 (0.032)	0.065 (0.039)*
Obs.	26295	15373	18055	19556	20800	25632

Marginal effects at sample means from panel fixed-effects logit regressions (Q2 1999-Q4 2011) including seasonal dummies and a dummy for changes in VAT. The dependent variable is a dummy for an increase/decrease in the outcome (expected costs of intermediate goods and raw material, sales price, profit). Changes in macro variables lagged by one quarter. Standard errors in parentheses (***) $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.