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Exchange Rates and Prices: Evidence from the 2015 Swiss Franc Appreciation*

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Abstract

We dissect the impact of a large and sudden exchange rate appreciation on Swiss border import prices, retail prices, and consumer expenditures on domestic and imported non-durable goods, following the removal of the EUR/CHF floor in January 2015. Cross-sectional variation in border price changes by currency of invoicing carries over to consumer prices and allocations, impacting retail prices of imports and competing domestic goods, as well as import expenditures. We provide measures of the sensitivity of retail import prices to border prices and the sensitivity of import shares to relative prices, which is higher when using retail prices than border prices.

JEL classification: F31, F41, L11
Keywords: Large exchange rate shocks, exchange rate pass-through, invoicing currency, expenditure switching, price-setting, nominal and real rigidities

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1 Introduction

In this paper we study how prices and consumer expenditures respond to exchange rate movements based on the large and sudden appreciation of the Swiss franc (CHF) on January 15, 2015. Using data on prices and invoicing currency at the border, as well as Nielsen "homescan" data on retail prices and purchases by Swiss households, we present a range of facts that shed light on the sources of incomplete exchange rate pass-through and the role of nominal rigidities in price adjustment, the extent of expenditure switching by households, and the allocative implications of invoicing currency in international trade. We also provide estimates of the sensitivities of retail prices to border prices and import shares to relative prices, which are important elasticities in open economy models.

The Swiss experience provides a unique setting to study the consequences of a large policy-driven change in the nominal exchange rate. On September 6, 2011, after a sharp appreciation of the Swiss franc, the Swiss National Bank (SNB) introduced a minimum exchange rate of 1.20 CHF per EUR. In late 2014 and early 2015, foreign developments such as anticipation of a large-scale quantitative easing program in the euro area raised the perceived cost of sustaining this policy (see e.g. SNB, 2015; Amador et al., 2020), prompting the SNB to unexpectedly abandon the minimum exchange rate on January 15, 2015.[1]

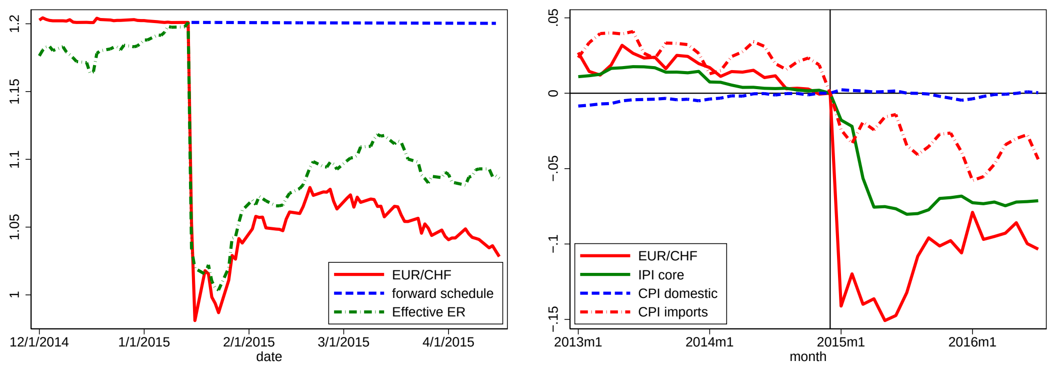
The subsequent appreciation episode is unique in a number of ways.[2] First, it followed a period of remarkable exchange rate stability, with the EUR/CHF exchange rate fluctuating in the range of 1.2–1.22 in the last six months before January 15, 2015. It is hence unlikely that the price dynamics we examine reflect adjustment lags due to prior exchange rate movements. Second, the exchange rate movement was large in magnitude relative to standard short-term exchange rate fluctuations in advanced economies, which have been a main focus of the literature.[3] EUR/CHF appreciated by more than 20% on the day of the policy change, 14.0% by the end of March relative to January 14, 14.7% by the end of June, and 10.6% by the

[1]The SNB had reiterated its commitment to the minimum exchange rate throughout late 2014, arguing as late as December 1 that it "remains the key instrument for ensuring appropriate monetary conditions" (see Jordan, 2014). Of 22 economists surveyed between January 9 and 14, 2015, none expected the SNB to get rid of its minimum rate during the course of 2015 (see Bloomberg, 2015). Forward rates the day before the appreciation show that investors expected a flat profile of the exchange rate, as illustrated in Panel (a) in Figure 1. Jermann (2017) argues that option prices before January 15 revealed a low probability of abandoning the exchange rate floor.

[2]A number of related papers also examine this episode. Bonadio et al. (2019) document the response of unit values at the border, Efing et al. (2016) examine the effects on the valuations of publicly listed Swiss firms, and Kaufmann and Renkin (2017, 2019) study the price and employment response of Swiss manufacturing firms and the response of export prices.

[3]There are many papers that resort to large devaluations in developing countries; see, for example, Burstein et al. (2005), Alessandria et al. (2010), Cravino and Levchenko (2017), and Gopinath and Neiman (2014). However, these episodes tend to be accompanied by other major macroeconomic developments that can confound the effects of exchange rate movements. Cavallo et al. (2015) use micro data on prices to show how a large monetary shock in a non-crisis context – Latvia's euro area accession – impacts international relative prices.

Figure 1: *The 2015 CHF appreciation*



(a) EUR/CHF and forward schedule (b) Official CPI and IPI

Notes: Panel (a) shows daily nominal EUR/CHF exchange rates and effective CHF nominal exchange rates (Switzerland's 59 main trading partners) between December 1, 2014 and April 30, 2015, and forward exchange rates on January 14, 2015 (overnight 1 week, 1, 2, and 3 months). Panel (b) shows monthly EUR/CHF nominal exchange rate, core import price index, and consumer price index for imports and for domestic goods and services, all relative to December 2014. Sources: Bank for International Settlements (2016), Swiss National Bank (2016), Datastream (2015).

end of December 2015 (see panel (a) in Figure 1).[4] The CPI-based bilateral real exchange rate followed a similar path to the EUR/CHF nominal exchange rate, as shown in Figure A.1 in the online appendix (referred to as appendix from here on). The real appreciation was prolonged, with the EUR/CHF real exchange rate returning to its December 2014 level only by the end of 2017. Third, the appreciation occurred against the backdrop of a stable Swiss economy — Table A.1 in the appendix shows that Swiss economic aggregates were remarkably stable in 2012-2016 — and reflected a policy response to foreign events.[5]

Following the 2015 CHF appreciation, there was a large decline in average import prices — more so at the border than at the consumer level — and a muted response in average prices of Swiss-produced goods (which we refer to interchangeably as domestic goods), as shown in panel (b) in Figure 1 using aggregate price indices from the SNB and the Swiss Federation Statistical Office (SFSO). To examine in more detail the response of these prices, as well as consumer expenditures, we combine several micro-level data sources, described in Section 2. Information on border prices and invoicing currency is from the good-level survey underlying the calculation of the official Swiss import price index. The transaction-level information on non-durable retail prices and expenditures is from the Swiss Nielsen homescan data, which we

[4]The Swiss franc appreciated less markedly against other currencies such as the yen or the pound sterling, as is evidenced by the effective exchange rate index shown in panel (a) in Figure 1.

[5]The price movements we focus on are unlikely to be the lagged result of safe-haven capital inflows while the minimum rate was in place. Foreign safe-haven demand for CHF was largely channelled through branches of foreign banks and invested in sight deposit accounts at the SNB (see e.g. Auer, 2015). Moreover, the CHF real exchange rate did not appreciate much in that period, and when it did in 2015, the growth rate of real GDP and real consumption fell slightly relative to 2014 (see Table A.1 in the appendix).

augment with data on the origin of the purchased goods. We exploit variation across product categories in currency of invoicing to trace the role of invoicing from border prices to retail prices and, further, to expenditure allocations.

We start our analysis in Section 3 by documenting the response of border prices in the aftermath of the appreciation and how this response varies across goods by invoicing currency. The decline in border prices was much larger for EUR-invoiced goods than for CHF-invoiced goods, even conditioning on non-zero price changes, consistent with findings in Gopinath et al. (2010) for border prices in the United States. However, estimated differences in conditional price changes attenuate over time and become statistically insignificant about one year after the CHF appreciation. These patterns are qualitatively consistent with models of endogenous invoicing (e.g. Gopinath et al., 2010). We perform simple accounting exercises to quantify the impact on border prices of hypothetical changes in the currency of invoicing from CHF to EUR and changes in the degree of nominal price stickiness. We conclude from these exercises that over short horizons (during which border price stickiness in the currency of invoicing is quantitatively relevant), counterfactual shifts in the currency of invoicing have larger effects on border prices than do counterfactual shifts in the degree of nominal price stickiness.

In Section 4 we examine the response of retail prices. After documenting in the homescan data a decline in the retail price of imports relative to Swiss-produced goods, we provide evidence that variation across goods in invoicing currency at the border has a sizable impact on retail price changes faced by consumers. According to our estimates, in the first two quarters after the appreciation, retail import prices in product categories that are (hypothetically) fully invoiced in foreign currency fell by roughly 7 percentage points more than in product categories (hypothetically) fully invoiced in CHF. While previous evidence on the role of invoicing currency is based on import and export price changes at the border (see e.g. Gopinath et al., 2010; Fitzgerald and Haller, 2014; Gopinath, 2016), our results establish that differences in border price changes associated with the currency of invoicing carry over to consumer prices.[6]

We estimate the sensitivity of import prices at the retail level with respect to changes in border prices, leveraging heterogeneity in border price changes induced by variation in pre-appreciation EUR invoicing shares. These estimates imply that, after two quarters, a 1 percentage point larger reduction in import prices at the border resulted in a roughly 0.55 percentage point larger price reduction for imported products at the retail level.[7]

[6]The invoicing currency and response of border and consumer prices to exchange rate movements is an important ingredient of optimal exchange rate policy (see e.g. Engel, 2003; Devereux and Engel, 2007; Egorov and Mukhin, 2020).

[7]Berger et al. (2012) use the micro price data underlying the official US import and consumer price indices of the US Bureau of Labor Statistics to match individual identical items at the border and retail levels, estimating the evolution of good-specific distribution shares. For related work studying pass-through at different layers of the distribution chain, see e.g. Nakamura and Zerom (2010) and Goldberg and Hellerstein (2013).

Even though the response of retail prices of Swiss-produced goods was on average very muted, we show that prices fell more in border product categories invoiced in EUR relative to those in CHF, conditioning on the expenditure share of competing imported goods in the same product category. Relatedly, prices of domestically produced goods fell by more in product categories with larger declines in retail prices of imported goods conditioning on import shares. We argue that, under a certain exclusion restriction, these observations point to the presence of pricing complementarities that imply that domestic producers react to changes in prices of competing imported retail products.[8]

We further examine the response of the extensive margin of adjustment of retail prices. We show that the average decline in retail import prices in 2015 was partly accounted for by an increase in the fraction of nominal price changes, which can in turn be decomposed into a large increase in the frequency of price reductions and a smaller decline in the fraction of price increases. We provide aggregate time series evidence as well as cross-product evidence exploiting variations in invoicing currency and in the magnitude of changes of border prices. Specifically, the increase in the frequency of price reductions was larger for imported products with a larger share of EUR invoicing and with larger price reductions at the border. That is, differences in border price changes associated with the currency of invoicing carry over to consumer prices not only for average changes but also for the extensive margin of price adjustment.[9]

Finally, in Section 5 we examine the extent of consumer expenditure switching in response to the appreciation. On average during the year following the appreciation, expenditure shares of imported goods rose by roughly 4% (or by 1 percentage point, from 0.26 to 0.27). Import shares rose substantially even at short horizons after the appreciation. Leveraging cross-sectional variation along the invoicing dimension, we show that expenditure shares on imported goods increased by more in product categories in which imports are invoiced in EUR than in those categories invoiced in CHF. Hence, differences in invoicing currency at the border matter also for consumer allocations.[10] To estimate the sensitivity of import expenditure shares with respect to changes in relative prices, we instrument import price

[8]These results complement evidence of strategic complementarities in Gopinath and Itskhoki (2011), Auer and Schoenle (2016), and Amiti et al. (2019), using retail price data and in the context of a well-identified exchange rate shock. Relatedly, Cavallo et al. (2020) and Flaaen et al. (2020) show that US domestic producers increased retail prices in response to the recent increase in US tariffs on competing Chinese imports.

[9]For related work documenting the role of the extensive margin of price adjustment in response to large aggregate shocks, see e.g. Gagnon (2009) in the context of Mexico's 1994 devaluation, Karadi and Reiff (2019) in the context of VAT changes in Hungary, and Gopinath et al. (2012) in the context of the trade collapse during the 2008 Great Recession.

[10]Differences in currency of invoicing at the border also carry over to allocations in the export side. In the context of the CHF appreciation, Auer et al. (2019) show that export growth in 2015 was larger in industries with higher EUR invoicing of export border prices. Cravino (2017) uses data on Chilean exports to estimate the differential response of exports to exchange rate shocks according to the invoicing currency of the transaction. Amiti et al. (2018) study the differential response of Belgian exports across heterogeneous firms within sectors.

changes across product categories using EUR invoicing shares at the border. Estimated price elasticities of import shares are close to 1 based on border-level measures of import prices, and much higher (ranging between 2 and 5) based on retail-level measures of import prices, but also less tightly estimated given large idiosyncratic movements in consumer prices. The large gap in estimated elasticities based on the measure of import prices is partly explained by lower exchange rate pass-through into retail prices compared with border prices.[11]

2 Data description

In this section we provide an overview of the border and retail data that we use in our analysis. We provide additional details in Appendix B. In the replication package we provide contact information to obtain the proprietary data.

2.1 Import prices at the border

We base the analysis of border prices on the microdata used by the SFSO to calculate the Swiss Import Price Index (Swiss Federal Statistical Office, 2016). The data are a survey-based panel of Swiss import prices similar to the US import price data studied in Gopinath and Rigobon (2008). The survey asks firms[12] to quote the price and invoicing currency of the goods accounting for the firm's highest volume of imports.[13] Since most consumer goods are surveyed on a quarterly basis, we focus on this time horizon. Surveys are carried out by the SFSO in the first two weeks of each quarter. In the exposition, we refer to the last pre-appreciation quarterly observations (first two weeks of January 2015) as 14Q4, and to the first post-appreciation quarterly observations (first two weeks of April 2015) as 15Q1. Since we observe weights by product categories only starting in December 2015 (after a major resampling of products), our baseline border price regressions are unweighted. For regressions that use the subset of categories matched to the retail data, we weight according to consumer expenditures.

[11]Our estimates based on retail prices are on the high range of elasticity estimates in the literature based on time-series variation and using border prices to measure import prices (see e.g. Feenstra et al., 2018, and references therein).

[12]The SFSO data contain an importing firm identifier, which we use in sensitivity analysis of border price pass-through. However, since we do not observe firm characteristics of Swiss importers or foreign exporters, we do not study the fundamentals that drive heterogeneous invoicing patterns as in e.g. Devereux et al. (2017) and Amiti et al. (2018).

[13]For each good invoiced in foreign currency, we have information on the price expressed in foreign currency and the price expressed in CHF. Given that for some observations there are large disparities between exchange rates implied by these two prices and official exchange rates (that are likely due to errors by contractors performing the conversion), we perform robustness exercises in which we convert foreign currency prices into CHF using official exchange rates.

Table 1: *Border data summary statistics*

	Number of observations	% CHF-invoiced	% EUR-invoiced	% USD-invoiced
2013	14,666	68.5	28.7	2.4
2014	14,789	65.8	31.3	2.4
2015	17,381	56.1	38.1	4.7
2016	17,976	51.5	42.0	5.2

Notes: This table shows the number of observations and the share of observations invoiced in CHF, EUR, and USD for various years in the non-commodity border price sample.

Table 1 displays, for the sample of non-commodity goods (commodities include agricultural products, coal, petroleum, metals, electricity and gas), the number of border price observations and the share of observations by currency of invoicing per year between 2013 and 2016. The share of observations invoiced in either CHF or EUR is close to 95% over the whole period, with CHF accounting for the highest share but falling over time.[14] USD invoicing is quite limited (the US accounted for 7% of Swiss goods imports in 2015).[15] In our baseline regressions, we exclude goods invoiced in foreign currency other than EUR because other currencies fluctuated vis-á-vis CHF and EUR before January 15, 2015.

The SFSO assigns imported goods to industries based on the industry of the importing firm using a classification similar to the 4-digit North American Industry Classification System (NAICS) code in the US. Our sample of non-commodity products covers 188 such product categories, of which 43 are consumer good categories that can be matched to retail categories as described below. For our analysis tracing currency of invoicing at the border to retail prices and expenditures, we calculate a pre-appreciation measure of invoicing intensity by border product category. We define the EUR invoicing share by product category as the fraction of border prices invoiced in EUR (relative to those invoiced in CHF or EUR) across all four quarters in 2014. In Table B.5 in the appendix we report the list of matched border product categories and retail product categories, as well as the EUR invoicing share of each category.

Given our prior that EUR invoicing shares by category are less tightly inferred for categories with a low number of border price observations, we exclude from our baseline analysis 6 (out of 43) border product categories for which we observe 7 or fewer border prices per quarter

[14] The rise over time in the share of EUR-invoiced goods is largely due to entry of new goods into the sample that are invoiced in EUR. For continuing products, the fraction that switches invoicing currency between quarters is very low, on average roughly 0.5% per quarter in 2015 (see Figure B.1 in the appendix).

[15] As reported in Table B.1 in the appendix, invoicing shares are very similar if we weight border product categories using NAICS two-digit weights in December 2015, which is the first period the SFSO reports weights. We note that Bonadio et al. (2019) and Federal Customs Administration (2015) report invoicing shares for imports based on more comprehensive customs data, allowing transactions to be weighted by import volume. In Federal Customs Administration (2015), import invoicing shares in 2014 are 31.6% for CHF, 54.9% for EUR, and 10.6% for USD.

on average in 2014.[16] Across the baseline sample of 37 border categories, the EUR invoicing share in 2014 varies between 0 and 0.74, with a median of 0.13 and a mean of 0.25.

2.2 Retail prices and expenditures

The analysis of retail prices and expenditures is based on Nielsen homescan data covering a demographically and regionally representative sample of around 3,000 households in Switzerland in the period January 2012 to June 2016 (Nielsen Switzerland, 2016). Participating households record purchases in supermarkets and drugstores, scanning goods such as food, non-food grocery items, health and beauty aids, and selected general merchandise. Individual products are classified into one of 256 product classes (which are narrower than border product categories) such as apple juice, shampoo, and toilet paper.[17]

In the raw data, an observation is a transaction including the household identifier, barcode (European Article Number, or EAN) of the product purchased, quantity purchased, price paid (net of good-specific discounts due to e.g. coupons), date of the shopping trip, and the name of the retailer. In the three months after the CHF appreciation, we observe on average 85 transactions per household. The data include 17 distinct retail stores. Since we do not observe the location of the retailer in a transaction, we assign it to one of 23 regions where the household lives (for more details, see appendix). We exclude purchases made in other countries via cross-border shopping.

We augment these data with information on the country of production of individual goods. Whereas EAN codes provide information on the country in which a product has been registered, in many instances this is not the country in which the product has actually been produced. However, that information is disclosed in the label of each product. We collect label information from codecheck.info, a Swiss health information portal with a large database of products sold in supermarkets, drug stores, and pharmacies (Codecheck, 2016). Coverage is not complete and notably excludes goods that are only occasionally sold in grocery stores, such as toys, clothing, or household electronics. We drop observations for which we do not

[16] The 6 categories we drop account for roughly 12% of retail expenditures on imported goods in 2014. In the sensitivity analysis, we consider a more restrictive sample that drops 9 categories with 8 or fewer observations per quarter, and a less restrictive sample that drops 2 categories with 4 or fewer observations per quarter. We also discuss which results are robust to keeping all border categories, including those with only 2 observations per quarter.

[17] In the Appendix we describe additional adjustments we make to the data, such as dropping newspapers, magazines, and non pre-packaged fresh fruits and vegetables products, and dropping transactions with errors in the entered price.

Table 2: *Nielsen data summary statistics*

Summary Statistics Nielsen Samples

	Non-balanced	Balanced yearly	Balanced monthly
No. of Imported Goods	4,545	2,682	937
No. of EU Imported Goods	4,134	2,362	794
No. of Domestic Goods	3,865	3,748	2,189
Expenditure share imports 2014	27	26	23
Expenditure share EU imports 2014	23	22	19
No. Product classes	233	217	172
No. Product classes (imports)	215	188	132
No. of Transactions - Imports	803,273	762,331	598,423
No. of Transactions - Domestic	2,396,208	2,390,273	2,106,375

Notes: The 'non-balanced' sample consists of EAN goods with information on country of origin (imports or domestic) that can be matched to border product categories with more than 7 border prices per quarter in 2014 (which we use in the baseline regressions). The 'balanced yearly' sample is a subsample of the first one that only includes goods observed each year between 2013 and 2015. The 'balanced monthly' sample is a subsample of the first one that only includes goods observed every month from mid-2013 to mid-2016. *No. of Imported Goods* and *Expenditure share imports* are, respectively, the number of imported goods and the expenditure share of imported goods in total expenditures in 2014. We report separately imports from the EU. *No. product classes* and *No. product classes imports* are the number of unique Nielsen product classes with positive expenditures on imports or domestic goods, and only on imports, respectively. *No. of transactions – imports* and *No. of transactions – domestic* are the number of underlying transactions at the household level over imports and domestic goods, respectively.

observe the country of origin.[18]

Table 2 provides basic summary statistics of the Nielsen data, for three different samples. The first sample (non-balanced) consists of goods with information on country of origin (imports or domestic) that can be matched to border product categories with more than seven border price observations per quarter in 2014. The second sample (balanced yearly) is a subsample of the first one that only includes goods observed each year between 2013 and 2015. The third sample (balanced monthly) is a subsample of the first one that only includes goods observed in each of the 18 months before and after the appreciation. We use the first and second samples in our analysis of expenditure allocations. We use the third sample in our analysis of retail prices. For each sample we provide the number of unique imported and domestic products, product classes, transactions, and import shares in 2014. The share of expenditures on imports relative to expenditures on all goods for which we observe country of

[18] We accessed codecheck.info between October 2015 and March 2016, searching for all goods in the Nielsen data. We also cross-checked the results from codecheck.info with information on websites of the various retailers. To get a sense of coverage, there are 5,444 unique goods in the Nielsen dataset that are observed in each of the 18 months before and after the appreciation. We found 3,481 of these goods on the web, accounting for 72% of all expenditures in this balanced sample of goods in 2014.

origin is 27% in the non-balanced sample (and 23% in the monthly balanced sample).[19] The import share is 23% in the non-balanced sample if we restrict the sample to goods imported from the European Union (EU). In our baseline results we include all imports because we do not observe the country of origin of imports in the border price data.

3 Exchange rate pass-through to border prices

In this section we report the impact of the 2015 CHF appreciation on border prices, first at the level of individual goods and then at the level of product categories. We then document the extent of price flexibility and exchange rate pass-through by currency of invoicing, conditioning and not conditioning on nominal price changes. Finally, we perform simple accounting exercises to quantify the impact on border prices of counterfactual shifts in invoicing from CHF to EUR and changes in the degree of nominal price stickiness.

3.1 Changes in average border prices by currency of invoicing

We first document the differential response of average changes in border prices by currency of invoicing after the CHF appreciation. We denote by p_{it}^{bor} the log of the border price (in CHF) of imported good i in quarter t. Keeping in mind our date convention, we refer to the period prior to the CHF appreciation as 14Q4. We consider panel regressions of the form

$$p_{it}^{bor} = \sum_{s \neq 14Q4} \beta_s \times \mathbb{I}_{s=t} \times EURinv_i + \alpha_t + \lambda_i + \varepsilon_{it}, \tag{1}$$

over the period $t = 13Q1, ..., 16Q2$, where $\mathbb{I}_{s=t}$ is the time period indicator function, $EURinv_i = 1$ $(= 0)$ if product i is invoiced in EUR (CHF) in quarter 14Q4, α_t is a time fixed effect, and λ_i is a product fixed effect.[20] Observations are equally weighted since we do not observe import values per product. Standard errors are clustered at the level of border product categories.

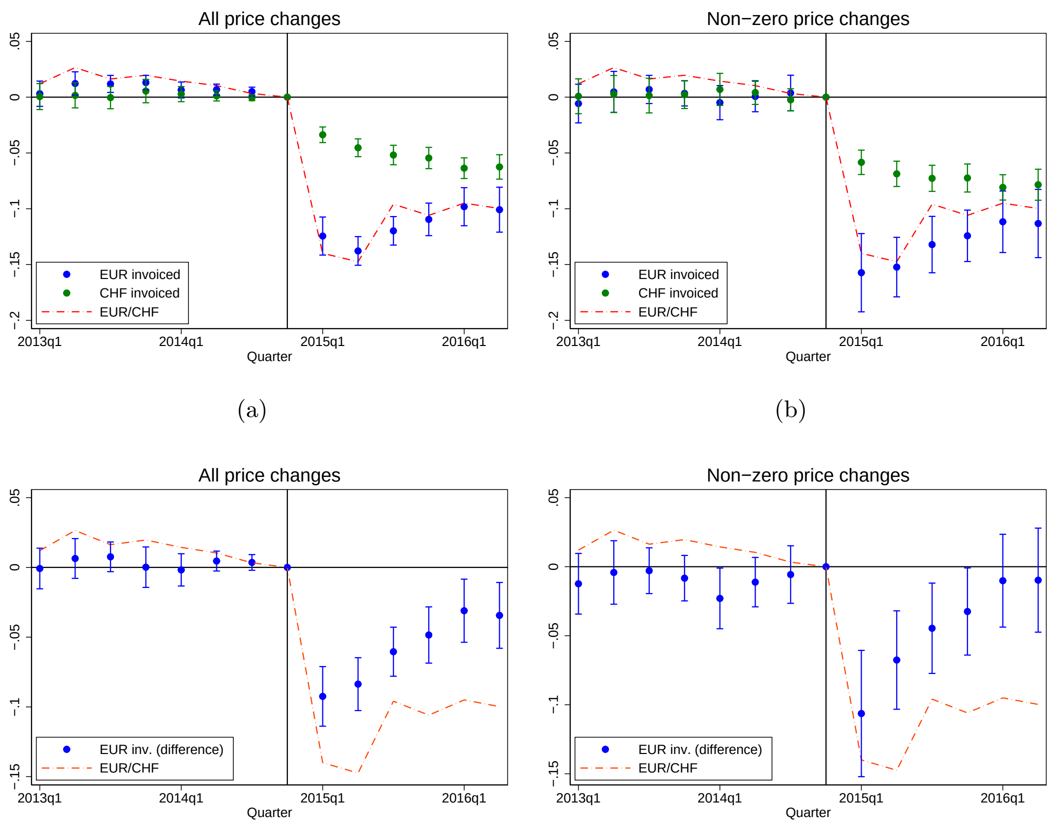
Panel (a) of Figure 2 displays estimates of α_t and $\alpha_t + \beta_t$ between 2013 and 2016, representing average cumulative changes, relative to 14Q14, in CHF-invoiced and EUR-invoiced border prices, respectively. CHF- and EUR-invoiced goods display similar price dynamics before

[19] For comparison purposes, the share of imports in total consumption reported in SFSO (2014) is 26.7% in 2014. Since services are mostly locally sourced, this means that the import share in our sample is lower than in overall consumption of goods.

[20] We consider a balanced panel of products with price data every quarter in the two-year period 13Q4-15Q3. We do not include 15Q4 in the balanced panel because the SFSO conducted a major re-sampling of products in December 2015. Moreover, for every quarter we exclude a small number of observations for which the currency of invoicing differs from 14Q4.

January 2015, a period of stability of the EUR/CHF exchange rate. In contrast, EUR-invoiced prices fall significantly relative to CHF-invoiced prices in the post-appreciation period. As summarized in the top rows of Table 3, the EUR appreciated by 14.0% in the first three months and by 14.7% in the first six months after December 2014. EUR-invoiced border prices fell by 12.4% and 13.8% in the first and second quarters, respectively (implying exchange rate pass-through rates of 89% and 94%, respectively). CHF-invoiced border prices fell by 3.4% and 4.5%, respectively, during the same time (implying pass-through rates of 24% and 31%, respectively).

Figure 2: *Border price changes by invoicing currency*



(a) (b) (c) (d)

Notes: This figure presents the EUR/CHF exchange rate and border price changes compared with 14Q4 based on estimates of equation (1). Panels (a) and (b) display average price changes by currency of invoicing, either all price changes (a) or non-zero price changes (b). Panels (c) and (d) show the difference in the average price change of EUR-invoiced goods and CHF-invoiced goods including time × category fixed effects, either all price changes or non-zero price changes. Whiskers indicate the bounds of a 95% confidence interval, calculated clustering at the level of border product category.

Average differences in price changes by currency of invoicing (i.e. β_t) fall over time from roughly 9% in 15Q1 to 5.5% in 15Q4, explained in part by a gradual decline in CHF-invoiced prices and in part by overshooting of the EUR/CHF and EUR-invoiced prices. Estimates of

Table 3: *Border and retail price changes and implied pass-through rates*

	Changes				Rates			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1) EUR/CHF	-14.0	-14.7	-9.6	-10.6				
2) All EUR inv.	-12.4	-13.8	-12.0	-11.0	88.9	93.5	124.9	103.4
3) Non-zero price changes	-15.7	-15.2	-13.2	-12.4	112.4	103.3	137.7	117.3
4) All CHF inv.	-3.4	-4.5	-5.2	-5.5	24.1	30.7	54.1	51.5
5) Non-zero price changes	-5.8	-6.9	-7.3	-7.2	41.7	46.6	75.8	68.4
6) Retail imports	-1.3	-2.9	-2.7	-3.9	9.3	19.4	28.6	36.6
7) Retail domest.	-0.3	-0.7	-0.4	-0.8	2.2	4.6	4.2	7.5

Notes: The left panel displays changes in CHF/EUR in each quarter of 2015 relative to 14Q4 (row 1) and average changes in various prices: EUR-invoiced border prices (row 2) and the subset with a non-zero price change (row 3), CHF-invoiced border prices (row 4) and the subset with a non-zero price change (row 5), and retail price changes of imported and domestic goods from the Nielsen data (rows 6 and 7) described in section 4. The right panel reports exchange rate pass-through % rates, calculated as ratios to row 1.

β_t are similar if we include time fixed effects or time × category fixed effects, as shown in panel (c) of Figure 2. Table C.2 in Appendix C.1 reports estimates and standard errors of β_t for each quarter after 14Q4, as well as the average effect in the first three quarters of 2015 calculated by imposing a single β over this time period. In Appendix C.1 we report a wide range of sensitivity analysis.

3.2 Invoicing and price changes across product categories

We next show that the differential response of border prices by invoicing currency that we document above helps explain part of the variation in average border price changes across product categories. We exploit this relationship when we match individual retail goods to product categories at the border.

We estimate

$$p_{gt}^{bor} - p_{g14Q4}^{bor} = \alpha_t + \beta_t \times EURshare_g + \varepsilon_{gt}, \tag{2}$$

where p_{gt}^{bor} denotes the simple average of border prices in border category g at time t (including prices in all invoicing currencies), $EURShare_g$ denotes the fraction of border prices in category g invoiced in EUR across all quarters of 2014, and α_t is a time fixed effect.

Table 4 reports estimates of β_t between 15Q1 and 16Q2 for different sets of product categories and weighting schemes. We consider the baseline dataset of non-commodity categories and the restricted set of consumer good categories that we match to our Nielsen data and that hence can be used in our retail price and expenditure analysis below. For the sample of Nielsen categories, we consider unweighted and weighted estimates (using 2014 consumer expenditures by category). In Appendix C.2 we report additional sensitivity analysis.

Table 4: *Border price changes and EUR invoicing intensity across border product categories*

	noncommodity	Nielsen unw.	Nielsen weighted
2015Q1	-0.067	-0.060	-0.110
	[0.019]	[0.038]	[0.029]
2015Q2	-0.080	-0.076	-0.135
	[0.018]	[0.030]	[0.033]
2015Q3	-0.053	-0.066	-0.107
	[0.022]	[0.027]	[0.036]
2015Q4	-0.031	-0.037	-0.042
	[0.025]	[0.024]	[0.026]
2016Q1	-0.016	-0.015	-0.008
	[0.028]	[0.029]	[0.029]
2016Q2	-0.011	-0.018	-0.023
	[0.028]	[0.030]	[0.030]
Observations	888	220	220
Adjusted R^2	0.22	0.27	0.48
Avg effect 15 Q1-Q3	-0.066	-0.067	-0.117
	[0.011]	[0.018]	[0.019]
Observations	544	128	128
Adjusted R^2	0.34	0.39	0.62
Border categories	150	32	32

Notes: This table displays estimates of β_t in equation (2) between 15Q1 and 16Q2 for different sets of product categories and weighting schemes. The first column uses all non-commodity product categories, while the second and third columns use the baseline sample of border categories in our retail price analysis. The first and second columns show results from unweighted regressions, whereas the third column weights according to Nielsen consumer expenditures in 2014. The upper panel shows estimates of β_t between 15Q1 and 16Q2. The bottom panel shows the average effect (imposing a common β_t) in 15Q1, 15Q2, and 15Q3. Estimates of (2) by quarter in 15Q1, 15Q2, and 15Q3 imply R^2 of 0.35, 0.4, and 0.29, respectively. Standard errors clustered by border category are shown in brackets.

Estimates of β_t are negative and highly significant in the first three quarters of 2015 (except in Q1 of the unweighted Nielsen border sample), indicating that border prices fall more, on average, in product categories with more EUR invoicing. Estimates of β_t in the first three quarters are largest in the weighted Nielsen sample, in spite of the low number of categories. The weighted Nielsen-based estimates imply that a category that is fully invoiced in EUR experiences in the first three quarters of 2015 a decline in border prices that is between 11% and 13.5% larger relative to a category that is fully invoiced in CHF. These differences are slightly larger than those based on individual product prices (that combine within and between category variation) reported in Table C.4 of the appendix. Variation across product categories in 2014 invoicing shares explains (in terms of R^2) between 29% and

40% of cumulative changes in border prices across Nielsen categories in each of the first three quarters of 2015. This relationship is much weaker starting in 15Q4, when the border price sample size declines due to product re-sampling by the SFSO.

Regression (2) constitutes the basis of the first stage in the 2SLS regressions we consider below. The results above anticipate that the first stage is strong in the first three quarters of 2015.

3.3 Price stickiness and border price changes

We begin by measuring the quarterly frequency of price changes and showing that for CHF-invoiced goods it increases substantially after the CHF appreciation. We then show that differences in border price changes by currency of invoicing persist when we condition on nominal price changes in the invoicing currency.

The top panel of Figure 3 displays, by invoicing currency, the fraction of products for which the price (in its currency of invoicing) in any quarter differs from the price in Q4 of the previous year.[21] For CHF-invoiced products, the fraction of products with a price change in 2014 (relative to Q4 of 2013) is roughly 41% in Q1 and 52% in Q2. These measures are similar in 2013. EUR-invoiced prices change less frequently.[22]

In 2015, after the CHF appreciation, there is a marked increase in the fraction of price changes for CHF-invoiced goods, even though prices are still far from fully flexible. The fraction of price changes (relative to Q4 of the previous year) rises from 41% in 14Q1 to 58% in 15Q1, from 52% in 14Q2 to 66% 15Q2, from 57% in 14Q3 to 71% in 15Q3, and from 61% in 14Q4 to 75% in 15Q4.[23] The bottom panel of Figure 3 shows that the increase in the fraction of price changes for CHF-invoiced goods is achieved through a large and long-lasting (i.e. not driven by temporary sales) increase in the fraction of price reductions and a small decline in the fraction of price increases (the latter is shown in Figure C.1 in the appendix). For EUR-invoiced products, the fraction of products with a price change or a price decrease does not change much in 2015.

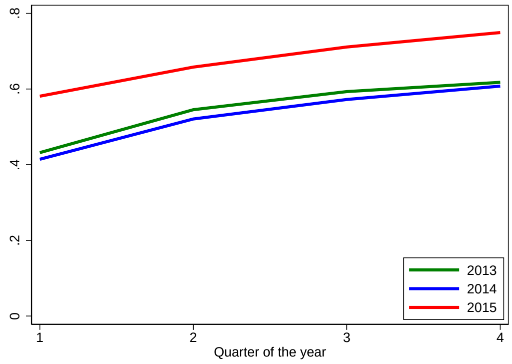
We next return to regression (1), conditioning on non-zero price changes as in Gopinath

[21] We exclude observations with price imputations due to product replacements, as well as observations in which the currency of invoicing differs from Q4 in the previous year.

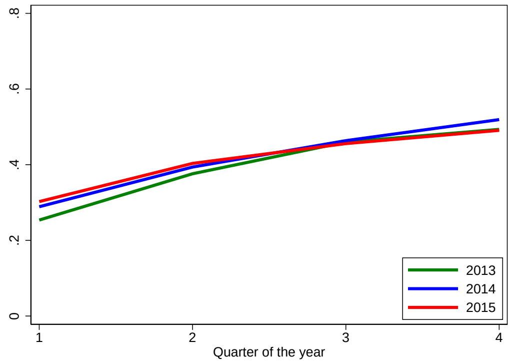
[22] The average fraction of price changes from one quarter to another when pooling all quarters between 2013 and 2015 is roughly 35% for CHF-invoiced goods and 25% for non-CHF invoiced goods. To put these numbers in perspective, the average monthly frequency of border price changes for differentiated imported and exported goods in the US reported in Table IV of Gopinath and Rigobon (2008) is roughly 0.15, implying a quarterly frequency of $1 - 0.85^3 = 0.39$ (assuming that the probability of a price change is independent across months).

[23] In Table C.10 in the appendix we additionally show that the degree of price flexibility is a characteristic that varies persistently across goods. For any given horizon, products for which price changed in 2013 (2014) are more likely to display a price change in 2014 (2015). The likelihood of a price change rises in 2015 irrespective of whether the price changed in previous years.

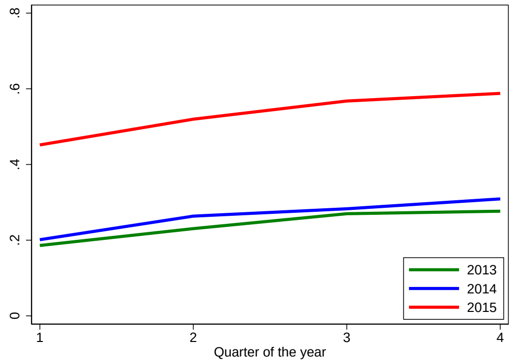
Figure 3: *Fraction of border price changes by currency of invoicing*



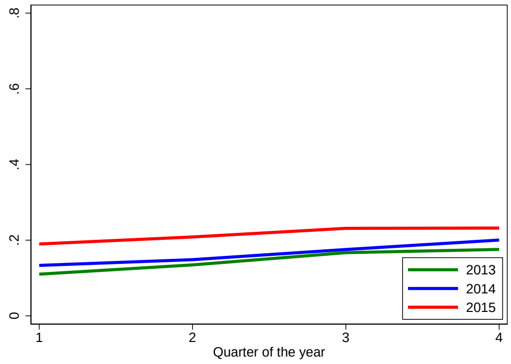
(a) Changes CHF-inv.



(b) Changes EUR-inv.



(c) Decreases CHF-inv.



(d) Decreases EUR-inv.

Notes: Panels (a) and (b) display for each quarterly horizon the fraction of products with changes in the price compared with Q4 of the previous year, for years 2013, 2014, and 2015, for CHF-invoiced goods (panel a) and EUR-invoiced goods (panel b). Panels (c) and (d) display, in a similar format, the fraction of price declines compared with Q4 of the previous year.

et al. (2010). Panel (b) of Figure 2 displays average cumulative price changes by currency of invoicing. CHF-invoiced prices in 2015 fall relative to 14Q4, by 5.8% in Q1, 6.9% in Q2, and 7.2% in Q3 and Q4 (exchange rate pass-through rates of 42% and 47% in Q1 and Q2, respectively, and roughly 70% in Q3 and Q4). Note the gradual decline in CHF-invoiced reset prices in spite of EUR/CHF overshooting. In contrast, EUR-invoiced prices (expressed in CHF) fall by slightly more than the EUR/CHF exchange rate (note, however, that standard errors are much larger due to smaller sample size).

Estimated differences in non-zero price changes by currency of invoicing (i.e. β_t) fall over time from 10% in Q1 to 5% in Q4. Allowing for time $\times$ category fixed effects, estimates of β_t (displayed in panel (c) of Figure 2 and in Table C.2) are as large initially but attenuate more rapidly over time and become insignificant in 2016. In sensitivity analysis in Appendix C, we show that, for certain sample choices, estimates of β_t become insignificant as early as

Q3 of 2015.

In Appendix C.1, we show that independently of invoicing, prices of commodities (excluded from our baseline analysis) change much more frequently than those of non-commodities. Moreover, differences in price changes by invoicing currency (including time × category fixed effects) are small and mostly insignificant. These results are consistent with the view that currency of invoicing is quantitatively relevant for price changes only for products with sticky prices in their currency of invoicing.

The fact that pass-through rates conditional on price changes are significantly smaller for CHF-invoiced products than for EUR-invoiced products, but only in the earlier quarters after the CHF appreciation, is qualitatively consistent with models of endogenous invoicing as in Gopinath et al. (2010). Specifically, in those models the choice of invoicing currency is determined by a discounted sum of future desired pass-through conditional on non-price adjustment. Hence, currency choice puts a higher weight on conditional pass-through rates in earlier periods after the exchange rate shock, which is precisely when estimated differences in conditional pass-through rates between invoicing currencies are larger in our data.[24]

3.4 Accounting-based counterfactuals

What would have been the average change in border prices had these been fully invoiced in CHF or in EUR? How do counterfactual changes in invoicing currency compare with counterfactual changes in the degree of price stickiness? We answer these questions by performing simple accounting exercises.

The average change in CHF-invoiced border prices in quarter t relative to 14Q4 is $p^{bor}_{Ct} = f_{Ct} \times s_{Ct}$, where f_{Ct} denotes the fraction of CHF-invoiced prices that change between 14Q4 and t, and s_{Ct} denotes the average size of these non-zero price changes (reset prices). The average change in EUR-invoiced border prices (expressed in CHF) is $p^{bor}_{Et} = f_{Et} \times s_{Et} + (1 - f_{Et}) \times e_t$, where f_{Et} denotes the fraction of EUR-invoiced prices that change (in EUR) between 14Q4 and t, s_{Et} denotes the average size of these non-zero price changes (expressed in CHF), and e_t denotes the EUR/CHF change in this time period. The average change in border prices including both invoicing currencies (roughly 2/3 CHF and 1/3 EUR) is $p^{bor}_t = 2/3 \times p^{bor}_{Ct} + 1/3 \times p^{bor}_{Et}$. Row 1 of Table 5 reports p^{bor}_{Ct}, p^{bor}_{Et}, and p^{bor}_t for the first and

[24] We leave for future research whether an endogenous currency choice model is quantitatively consistent with the profile of pass-through rates and the increase in the fraction of non-zero price changes we document for this large and unanticipated exchange rate shock.

last quarters of 2015 (quarters 2 and 3 are reported in Table C.12 in Appendix C.4).[25]

Rows 2 and 3 consider counterfactual degrees of price stickiness given actual average reset price changes by currency of invoicing. Specifically, row 2 ("All sticky") sets $f_{Ct} = f_{Et} = 0$, so that $p^{bor}_{Ct} = 0$ and $p^{bor}_{Et} = e_t$. Row 3 ("All flex") sets $f_{Ct} = f_{Et} = 1$ and actual s_{Ct} and s_{Et}, so that $p^{bor}_{Ct} = s_{Ct}$ and $p^{bor}_{Et} = s_{Et}$. In the "All flex" scenario we are assuming that, for products with unchanged price in 2015 (due to e.g. menu costs, information costs, or inattention) the price would change, if given the opportunity to do so, as much as observed reset prices in the data.[26] We do not take into account equilibrium changes in reset prices in each counterfactual scenario, as could be the case in the presence of pricing complementarities across price setters.

In 15Q1, the average decline in border prices is -4.7% under "All sticky" and -9.1% under "All flex". This implies that a counterfactual shift from "All sticky" to "All flex" would result in a 4.5 percentage point (pp) larger reduction in border prices in 15Q1 (row 4). To understand these results, note that if $s_{Ct} = 0$ and $s_{Et} = e_t$, a shift from "All sticky" to "All flex" would have no impact on average border price changes. In practice, reset prices fall by much less (but not zero) for CHF-invoiced than for EUR-invoiced goods, so changes in the degree of price flexibility have a limited impact on border price changes. The difference between CHF and EUR price changes, which is 14% under "All sticky", is as large as 9.9% under "All flex".

Rows 5 and 6 consider counterfactual invoicing choices. We assume that the degree of price stickiness is a characteristic of the invoicing currency, while the size of non-zero price changes (expressed in CHF) is a characteristic of the product and not of the invoicing currency, as in models in which invoicing currency choice on a product is shaped by its conditional pass-through rate. Specifically, in row 5 ("All CHF") we assume that EUR-invoiced goods are counterfactually invoiced in CHF, so that for these goods $p^{bor}_{Et} = f_{Ct} \times s_{Et}$. In row 6 ("All EUR") we assume that all CHF-invoiced goods are counterfactually invoiced in EUR, so that $p^{bor}_{Ct} = f_{Et} \times s_{Ct} + (1 - f_{Et}) \times e_t$. Note that if prices were fully flexible, then these counterfactual shifts in currency of invoicing would have no impact on average border price changes.

[25]The average change in EUR-invoiced prices, p^{bor}_{Et}, reported in Table 5 differs from that in Table 3 (by roughly 2.1 percentage points in 15Q1). This is due to sample differences (in our sticky price calculations we drop observations with price imputations arising from product replacement) and because we impose that for EUR-invoiced goods with zero price changes the change in price (expressed in CHF) is equal to the change in the EUR/CHF, e_t, which is not always the case in the raw data due to errors in exchange rate conversion. In Appendix C.4 we show that results do not vary much when using prices that are converted into CHF based on the official quarterly EUR/CHF rate. We also report sensitivity to using a smaller CHF invoicing share when calculating p^{bor}_t.

[26]In the appendix we provide suggestive evidence that the size of price changes in 2015 is independent of the degree of price flexibility in previous years. Specifically, in Table C.11 we show that the size of price changes in 2015 does not vary systematically across products with the likelihood of a price change in previous years (a measure of the product's price flexibility).

Table 5: *Counterfactual changes in border prices*

	15Q1			15Q4		
	CHF	EUR	2\3 CHF +1\3 EUR	CHF	EUR	2\3 CHF +1\3 EUR
1) Actual	-3.4	-14.5	-7.1	-5.4	-11.5	-7.4
2) All sticky	0.0	-14.0	-4.7	0.0	-10.6	-3.5
3) All flexible	-5.8	-15.7	-9.1	-7.2	-12.4	-9.0
4) All flex - all sticky			-4.5			-5.4
5) All CHF	-3.4	-9.1	-5.3	-5.4	-9.3	-6.7
6) All EUR	-11.5	-14.5	-12.5	-8.9	-11.5	-9.8
7) All EUR - all CHF			-7.2			-3.1

Notes: See main text for a description of each counterfactual. Quarters 2 and 3 are reported in the Appendix.

Evaluated at the degree of price flexibility in the data, the average decline in border prices in 15Q1 is -5.3% under "All CHF" and -12.5% under "All EUR". This implies that a counterfactual shift from "All CHF" to "All EUR" would result in a 7.2 pp larger reduction in border prices in 15Q1 (Row 7).[27]

Comparing rows 4 and 7, we observe that a shift in invoicing from "All CHF" to "All EUR" (given the observed degree of price stickiness) has a bigger impact on average border price changes than a shift from "All sticky" to "All flex" (given the observed fraction of goods by invoicing currency). This is also the case in 15Q2, as shown in Table C.12 in Appendix C.4. In contrast, in 15Q4 (as well as in 15Q3) a shift in invoicing has a smaller impact on average border prices than a shift in price flexibility. Currency of invoicing of border prices matters less over time because at longer time horizons border prices are more flexible and the EUR/CHF appreciation is smaller.

4 Retail price response

In this section we examine the response of Nielsen-based retail prices to the CHF appreciation. After reporting average changes in retail prices of imports and Swiss-produced goods, we examine how these changes vary in the cross-section by invoicing currency at the border and import penetration. We then estimate the sensitivity of retail import prices to border prices, and the sensitivity of Swiss-produced retail prices to import retail prices. Finally, we document changes in the extensive margin of price adjustment, first on average for imports

[27] If we assume that both the fraction and size of non-zero price changes is a characteristic of the currency choice and not of the product (in contrast to models of endogenous invoicing currency), then, $p^{bor}_{Et} = p^{bor}_{Ct}$ under "All CHF" and $p^{bor}_{Ct} = p^{bor}_{Et}$ under "All EUR". The impact of a shift from "All CHF" to "All EUR" is 11.1 pp in 15Q1, which is even larger than 7.2 pp under our baseline assumptions.

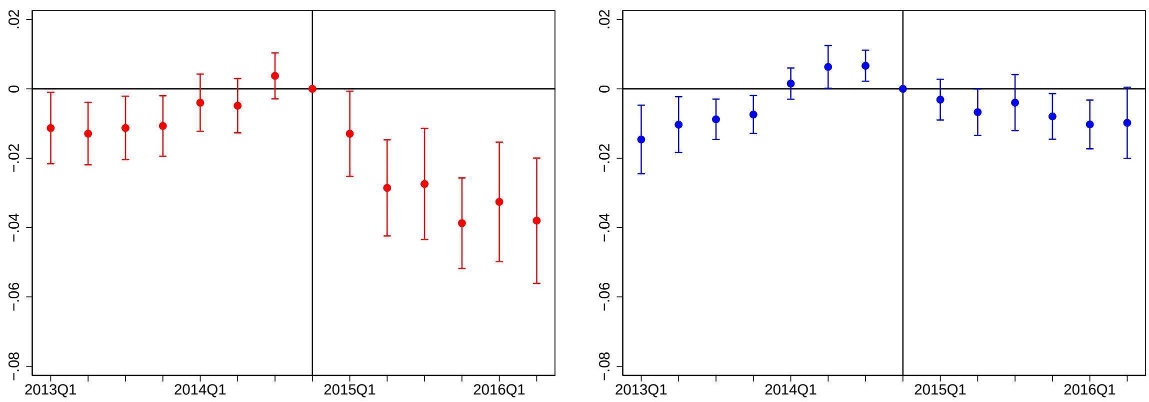
and Swiss-produced goods, and then across goods that vary in their currency of invoicing at the border.

We denote by P^{ret}_{irst} the retail price of product i (EAN) in region r, retailer s, and month t, averaged across households, weeks, and stores in triplet rst. We then average P^{ret}_{irst} across regions and retailers in month t to obtain a measure of the retail price of product i in month t, P^{ret}_{it}. To smooth out idiosyncratic product-level shocks or temporary price discounts, we construct quarterly log prices as a simple average of monthly log prices. We base our analysis on a balanced sample of goods sold in at least one store and retailer every month in the three-year period between June 2013 and May 2016.[28]

4.1 Average price changes for imports and Swiss-produced goods

Consistent with the official consumer price inflation estimates displayed in Figure 1, retail import prices in the Nielsen data fell in 2015 relative to Swiss-produced goods.

Figure 4: *Average retail price changes*



(a) Imports (b) Domestic

Notes: This figure displays time fixed effects (or cumulative average price changes) relative to 14Q4 of imports in panel (a) and Swiss-produced goods in panel (b), weighting goods by 2014 expenditures. Whiskers indicate the bounds of a 95% confidence interval, calculated clustering at the level of retail product class.

Figure 4 displays time fixed effects of log retail prices, p^{ret}_{it}, by quarter relative to 14Q4 (October 15, 2014 - January 14, 2015) for all imports and Swiss-produced goods, weighting individual goods by expenditures in 2014. There are no strong pre-trends in prices in the period 2013-14. Starting in 15Q1, there is a marked decrease in retail import prices while the

[28]In Appendix D.2, we report robustness of our invoicing on retail price regressions to calculating P^{ret}_{irst} by aggregating prices within rst using median or mode instead of average, and to calculating P^{ret}_{it} by aggregating prices P^{ret}_{irst} across regions and stores using median instead of average. We also report estimates using monthly rather than quarterly prices. Finally, we consider longer and shorter balanced samples.

response of Swiss-produced goods is more muted. As summarized in the bottom two rows of Table 3, the cumulative decline in retail import prices is 1.3% in 15Q1 and 3.8% in Q4. The implied exchange rate pass-through rate rises from 9% in 15Q1 to 36% at the end of the year. Swiss-produced retail prices fell by less than 1% cumulative in 2015 (i.e. the implied pass-through rate is less than 10%).[29]

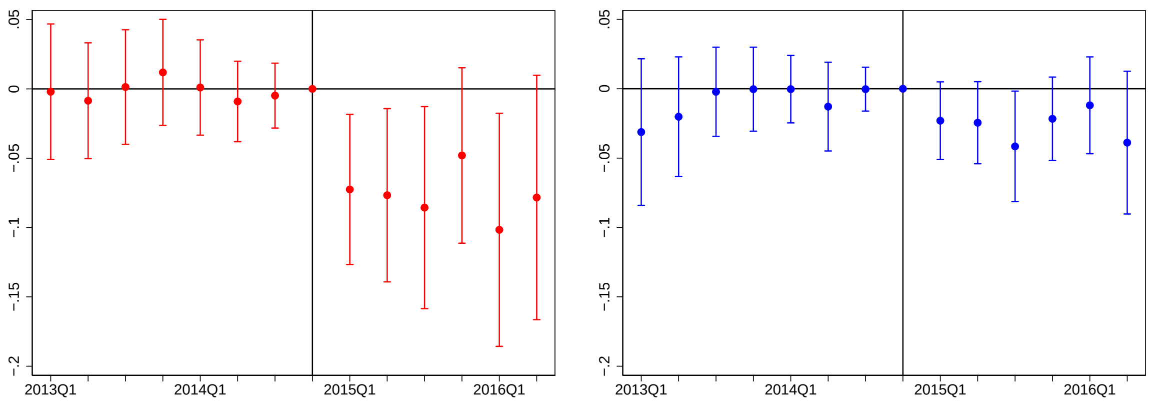
4.2 Currency of invoicing, border prices, and retail import prices

We document the differential response of retail prices according to the EUR invoicing share of the corresponding border product category. To do so, we consider panel regressions of the form

$$p_{it}^{ret} = \sum_{s \neq 14Q4} \beta_s \times \mathbb{I}_{s=t} \times EURShare_{g(i)} + \alpha_t + \lambda_i + \varepsilon_{it} \tag{3}$$

over the period $t = 13Q1, ..., 16Q2$, where $g(i)$ denotes the border category associated with retail product i, $EURshare_{g(i)}$ denotes the fraction of border prices in category $g(i)$ invoiced in EUR across all quarters in 2014, α_t is a time fixed effect, and λ_i is a product fixed effect. In all cross-sectional regressions using retail price data, observations are weighted by expenditures in 2014 and standard errors are clustered at the level of retail product classes.[30]

Figure 5: *Invoicing and retail prices*



Notes: This figure reports estimates of β_t from equation (3), for all imports (left panel) and Swiss-produced goods (right panel). The dependent variable is good log retail price by quarter. Independent variables include time dummies, time dummies interacted by EUR invoicing intensity in 2014 of the corresponding border category, and EAN fixed effects. Whiskers indicate the bounds of a 95% confidence interval, calculated clustering at the level of retail product class.

[29] Figure D.1 in the appendix shows similar (but more volatile) patterns based on monthly prices relative to December 2014. Figure D.2 in the appendix shows that import prices from the EU fell slightly more than prices of all imports.

[30] We cluster by retail product class because it is the level of variation of regressors in many of the regressions below. In the appendix we report for the main results specifications that cluster standard errors at the level of border product categories.

Figure 5 displays estimates of β_t for imported goods (left column) and Swiss-produced goods (right column). Table D.1 in the appendix reports estimates and standard errors by quarter, as well as the average effect (imposing a common β) in the first three quarters of 2015. For both imports and domestic goods, there are no significant pre-trends in the period 2013-14. For domestic goods, estimates of β_t in 2015-16 are negative but small and statistically insignificant. For imported goods, estimates of β_t are negative and much larger than for domestic goods, significant at the 1% level in 15Q1, at the 5% level in 15Q2, 15Q3, and 16Q1, and at the 10% level in 16Q2. For 15Q4, the estimate is negative but less tightly estimated. These estimates imply that retail prices decline by roughly 7.3 percentage points more in 15Q1 for goods belonging to border product categories that are (hypothetically) fully invoiced in EUR compared with goods in product categories (hypothetically) fully invoiced in CHF currencies. The estimated average effect in the period 15Q1-15Q3 is 7.8 pp. In Appendix D.2 we report extensive sensitivity analysis.

We next leverage cross-product variation in price changes and in invoicing currencies at the border to measure the sensitivity of retail prices of imported goods to changes in border prices in the corresponding border product category. Specifically, for every quarter in 2015 we consider the regression

$$p_{it}^{ret} - p_{i14Q4}^{ret} = \alpha_t + \beta_t \times \left(p_{g(i)t}^{bor} - p_{g(i)14Q4}^{bor}\right) + \varepsilon_{it}, \tag{4}$$

over imported goods i, where $p_{g(i)t}^{bor}$ denotes the simple average of border prices at time t in the border category associated with retail product i, $g(i)$, and β_t is the average sensitivity of retail prices to border prices across goods at time t. The rate of pass-through from border prices to retail prices, β_t, reflects a combination of changes in the cost of distribution services and changes in retail markups.

Given the concern that other drivers of retail prices in 2015 (such as category-specific demand shocks) may be correlated with border prices, we instrument border price changes in 2015 by the fraction of EUR-invoiced products in border category $g(i)$ in 2014, $EURShare_{g(i)}$. This instrument is valid if EUR invoicing shares by product category in 2014 are uncorrelated with other category-specific drivers of retail price changes in 2015 including (i) shocks to product demand or retail costs, and (ii) good-specific sensitivity of retail prices to border prices. Note that this restriction does not require that EUR invoicing shares in 2014 are uncorrelated with border price exchange rate pass-through in 2015 — in fact, our instrument builds on this correlation.[31]

[31] Wooldridge (1997) provides a detailed discussion of 2SLS in models with random coefficients (in our setting, variation in β_t across goods: $\beta_{g(i)t} = \beta_t + v_{g(i)t}$). In addition to the standard exclusion restriction, consistency of 2SLS requires that $v_{g(i)t}$ is conditionally mean independent with respect to $EURShare_{g(i)}$, and that the covariance between $v_{g(i)t}$ and $\left(p_{g(i)t}^{bor} - p_{g(i)14Q4}^{bor}\right)$ is conditionally independent with respect to $EURShare_{g(i)}$ (but this covariance need not be zero).

While we believe that this instrument somewhat alleviates endogeneity concerns, we cannot a priori rule out violations of the exclusion restriction. For example, one could build a model featuring variation in additive retail distribution costs across product categories in which, as in Corsetti and Dedola (2005), the level of retail distribution costs shapes border to retail price pass-through as well as desired exchange rate to border price pass-through. In this case, the exclusion restriction would be violated if the choice of invoicing between EUR and CHF in 2014 was endogenously determined by desired exchange rate pass-through, since product categories with higher retail distribution costs would feature lower border to retail price pass-through and more CHF invoicing.[32]

Table 6 reports OLS and 2SLS estimates of (4) for each quarter in 2015. Based on OLS, retail import prices fall by roughly 0.53 pp more in product categories with a 1 pp larger decline in border prices in 15Q1, and by 0.47 pp more in 15Q2. In the third and fourth quarters, the estimates are around 0.35, but less tightly estimated. The positive co-movement between border and retail import prices suggested by these OLS estimates is a feature of the data not only after January 2015 and, more importantly, does not establish a causal impact of border to retail import prices.[33]

Table 6: *Sensitivity of retail import prices to border prices*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta p^{bor}_{g(i)t}$	0.527	0.609	0.472	0.568	0.355	0.951	0.374	1.741
	[0.182]	[0.197]	[0.169]	[0.214]	[0.235]	[0.378]	[0.242]	[1.094]
Observations	937	937	937	937	937	937	937	937
F first stage		82.5		78.6		22.1		2.5
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table reports estimates of β_t from equation (4). The dependent variable is the cumulative change in the retail price of imported goods relative to 14Q4, $\Delta p^{ret}_{it} = p^{ret}_{it} - p^{ret}_{i14Q4}$. Under OLS, the independent variable is the change in the border price of the corresponding border category over the same time window, $\Delta p^{bor}_{g(i)t}$. Under 2SLS, the border price change is instrumented with EUR invoicing intensity in 2014 of the corresponding border category. Standard errors are clustered at the level of retail product class.

The first stage of the 2SLS is significant in the first three quarters of 2015 (see F-statistic reported in the bottom row), as revealed also by estimates of equation (2) displayed in Table 4. The estimated 2SLS estimates of β_t are 0.61 in 15Q1 and 0.57 in 15Q2 with standard errors of roughly 0.2. The point estimate in 15Q3 is 0.95 (with a standard error of 0.3) and the

[32] If distribution cost inputs and imported goods are combined in a Cobb-Douglas fashion (rather than additive), then the level of retail distribution costs shapes border to retail pass-through but not exchange rate to border price pass-through. So, in this case the exclusion restriction would not be violated.

[33] Estimating the OLS relationship between changes in border and retail import prices in each quarter of 2013 and 2014 (a period of EUR/CHF stability) relative to the fourth quarter of 2014 results in three quarters (out of a total of 7) with positive and significant coefficients. Moreover, all 2SLS estimates are close to zero and not statistically significant.

estimate in 15Q4 is insignificant.[34] In Appendix D.3 we report a range of sensitivity analysis.

4.3 Invoicing, import penetration, and retail prices of domestic goods

Whereas there is at most a weak relationship between changes in prices of Swiss-produced goods and the EUR invoicing share (see Figure 5 above), we next show that this relationship is stronger once we condition on the expenditure share of competing imported goods in the same product category. We argue that, under certain exclusion restrictions and in combination with estimates of co-movement between Swiss-produced and import retail prices, these results point to the presence of pricing complementarities between domestic and imported retail products (i.e. domestic producers react to changes in price of competing imported retail products).

We consider panel regressions of the form

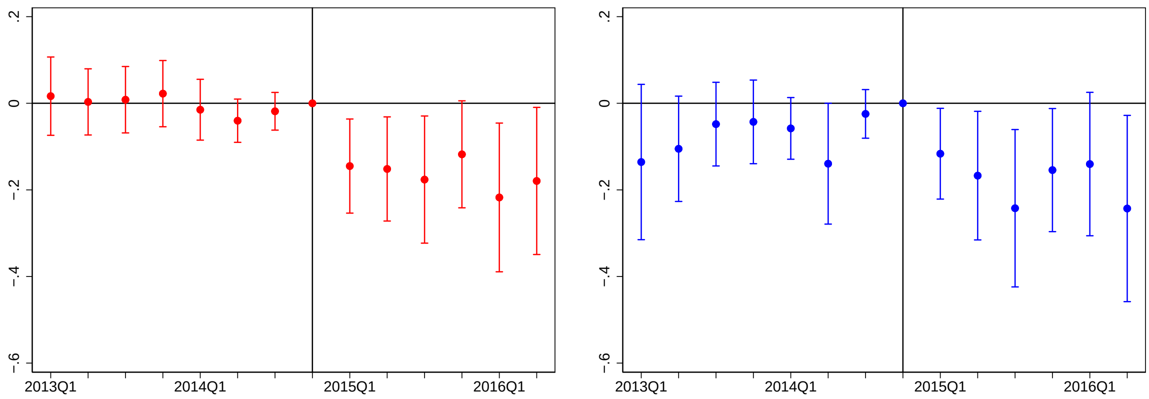
$$p_{it}^{ret} = \sum_{s \neq 14Q4} \mathbb{I}_{s=t} \times ImpShare_{g(i)} \times \left(\gamma_s + \beta_s \times EURShare_{g(i)}\right) + \alpha_t + \lambda_i + \varepsilon_{it}, \qquad (5)$$

for imported goods and domestic goods separately, where $ImpShare_{g(i)}$ denotes the import expenditure share in retail category $g(i)$ calculated over 2014. We include in the regression the interaction between import shares and EUR invoicing share because we expect a higher sensitivity of domestic prices to import prices in product categories with a large participation of imported products, as in the model of variable markups we consider in Appendix D.6.

Figure 6 presents estimates of β_t for imported goods (left panel) and Swiss-produced goods (right panel). Table D.17 in the appendix reports estimates and standard errors by quarter, as well as the average effect in the first three quarters of 2015. While estimates of β_t in 2013-14 are largely insignificant, they are negative and significant in 2015 not only for imports but also for Swiss-produced goods. Evaluated at the median import share of 23% across product categories, our point estimates imply that retail prices of domestically produced goods decline in 15Q1 (Q2 and Q3) relative to 14Q4 by 2.7 pp (3.8 and 5.6) more for goods in border product categories that are (hypothetically) fully invoiced in EUR compared with goods in product categories fully invoiced in CHF. In Appendix D.4 we report sensitivity analysis.

[34] 2SLS estimates throughout the cross-sectional regressions can be higher or lower than OLS estimates. On the one hand, measurement error in prices and invoicing shares can lead to attenuation bias, while on the other hand endogeneity can lead to upward biases in OLS estimates.

Figure 6: *Invoicing, import penetration, and retail prices*



Notes: This figure reports estimates of β_t from equation (5), for imports (left panel) and Swiss-produced goods (right panel). The dependent variable is log retail price by quarter. Independent variables include time dummies, time dummies interacted with import expenditure shares in 2014 of the corresponding product class, time dummies interacted with the product of import expenditures by product class and EUR invoicing intensity by border category in 2014, and EAN fixed effects. Whiskers indicate the bounds of a 95% confidence interval, calculated clustering at the level of border product category.

Motivated by these results, we aim to estimate the sensitivity of retail prices of Swiss-produced goods to changes in retail prices of imported goods in the same retail product category. For every quarter in 2015, we consider a regression of the form

$$p_{it}^{ret} - p_{i14Q4}^{ret} = \alpha_t + \beta_t \times ImpShare_{g(i)} \times \left(p_{g(i)t}^{retimp} - p_{g(i)14Q4}^{retimp}\right) + \varepsilon_{it}, \tag{6}$$

over Swiss-produced goods i, where $p_{g(i)t}^{retimp}$ denotes average retail price of imports in product class $g(i)$ (weighted by 2014 expenditures). The coefficient β_t captures the average sensitivity of retail prices of Swiss-produced goods to changes in retail prices of imported goods in the corresponding product category at time t.

OLS estimates of β_t, shown in Table 7, are positive in every quarter of 2015 with varying statistical significance, implying that prices of domestically produced goods fall by more in product categories with larger price reductions of retail prices of imported goods. This is not necessarily evidence of strategic complementarities in pricing between domestic and competing foreign products since domestic and import prices within a product category could also co-move due to correlated changes in demand or production costs.[35]

In the absence of direct measures of domestic marginal costs that we can use as a control,

[35] Since products in our sample consist mostly of non-durable final consumer goods such as shampoo, cheese, and mineral water, it is unlikely that domestically produced goods within a product category make intensive intermediate input use of imported goods in the same product category. However, domestically produced and imported goods within a product category may employ common inputs in production that induce a correlation in cost changes, as in Amiti et al. (2019).

Table 7: *Sensitivity of domestic retail prices to import retail prices*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ImpShare_{g(i)} \times \Delta p^{retimp}_{g(i)t}$	1.240	0.939	0.937	1.250	0.668	1.518	0.739	1.119
	[0.372]	[0.489]	[0.315]	[0.518]	[0.438]	[0.553]	[0.336]	[0.533]
Observations	1972	1972	1972	1972	1972	1972	1972	1972
F first stage		23.0		38.4		35.4		25.6
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table reports estimates of β_t from equation (6). The dependent variable is the cumulative change in the retail price of Swiss-produced goods relative to 14Q4, $\Delta p^{ret}_{it} = p^{ret}_{it} - p^{ret}_{i14Q4}$. Under OLS, the independent variable is the product of import expenditure share in 2014 and the change in retail import prices over the same time horizon for the corresponding product class, $ImpShare_{g(i)} \times \Delta p^{retimp}_{g(i)t}$. Under 2SLS, the import share-interacted change in retail import prices is instrumented by the import share-interacted EUR invoicing intensity in 2014 of the corresponding border category. Standard errors are clustered at the level of retail product class.

we address the endogeneity concern by instrumenting $ImpShare_{g(i)} \times \left(p^{retimp}_{g(i)t} - p^{retimp}_{g(i)14Q4}\right)$ by $ImpShare_{g(i)} \times EURshare_{g(i)}$, where these shares are calculated in 2014. The exclusion restriction, following the same logic as in the discussion after equation (4), is that the product of import share and EUR invoicing share by product category in 2014 is uncorrelated with other category-specific drivers of domestic retail price changes in 2015 including (i) shifts in product demand or in production costs, and (ii) good-specific sensitivity of domestic retail prices to import retail prices. This restriction does not require that EUR invoicing in 2014 is uncorrelated with border price exchange-rate pass-through in 2015.

Once again, we cannot a priori rule out violations of the exclusion restriction. However, the weaker relationship between EUR invoicing shares and domestic retail price changes in 2015, unless we interact it by import share of final goods in the corresponding category, casts some doubt on the hypothesis that Swiss-produced goods in EUR-invoiced categories use more imported inputs, which would violate the exclusion restriction.[36] Similarly, suppose that the exclusion restriction was violated because the sensitivity of domestic retail prices to import retail prices is higher in product categories with higher border price pass-through, which also shapes the choice of invoicing between EUR and CHF in 2014. Then we would expect a stronger relationship between EUR invoicing shares and domestic retail price changes in 2015, even without conditioning on import shares.

2SLS estimates of β_t, reported in Table 7, are positive with significance varying by quarter

[36] Figure D.5 in Appendix D.6 shows that there is very little Swiss value added contained in imports from the euro area, both for the aggregate of manufacturing industries and for the food, beverage, and tobacco industries (which are more closely related to the set of final consumption goods examined in this paper). These low shares speak against the possibility that marginal costs (and prices) of Swiss producers and foreign exporters are correlated due to local and foreign firms using identical Swiss inputs. Unfortunately, we do not have a good measure of the Swiss share of imported intermediate inputs by industry.

(10% in Q1, 5% in Q2 and Q4, and 1% in Q3). Based on Q2 and Q3 estimates, the decline in domestic prices is roughly 0.3 pp larger in product categories with the median import share and 1 pp larger decline in retail import prices. In Appendix D.5 we report a range of sensitivity analysis.

4.4 Invoicing and the extensive margin of retail prices

We next examine how the degree of retail price stickiness responded to the CHF appreciation. The decline in retail import prices in 2015 is partly accounted for by a large increase in the fraction of nominal price changes, which can itself be decomposed into an increase in the frequency of negative price changes and a decrease in the frequency of positive price changes. We first provide aggregate time series and then examine the cross-sectional relationship with currency of invoicing at the border.

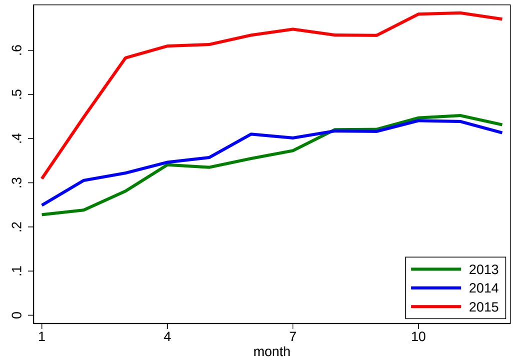
We do not construct a measure of price flexibility at the level of individual goods and stores because, at such a disaggregated level, our scanner data are very sparse over time. Instead, we aggregate prices for each good i, region r, retailer s, and month t according to the modal price across households, weeks, and stores within the quadruplet $irst$. We then calculate, for each good i, year $y = 13, 14, 15$, and monthly horizon $h = 1, ..., 12$, the fraction of region-retailer tuples for which the modal price in month h of year y differs from the modal price in December of the previous year. We denote this fraction by f_{iyh}. We further decompose the fraction of price changes into the fraction of increases (+) and decreases (-): $f_{iyh} = f^+_{iyh} + f^-_{iyh}$.[37]

The top row in Figure 7 displays the fraction of modal price changes f_{iyh} averaged across goods (weighting goods by expenditures in 2014) for imports (left panel) and Swiss-produced goods (right panel). For every monthly horizon in 2013 and 2014, the degree of price flexibility is similar for imported goods and for Swiss-produced goods. The fraction of price changes is roughly 20% at the one-month horizon in 2013 and in 2014. That is, modal prices change in roughly 20% of region/retailer pairs between December 2013 and January 2014 (and between December 2012 and January 2013). This fraction rises to roughly 40% at 12-horizons in 2013

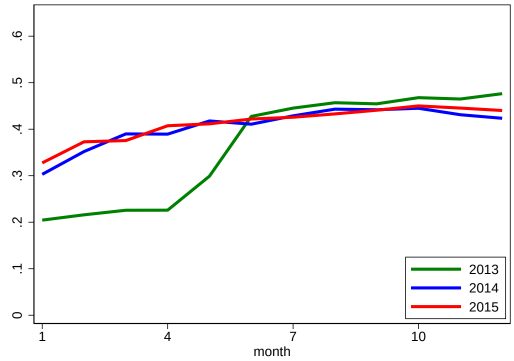
[37] More formally, let p_{irshy} denote the log of the modal price across households, weeks, and stores within region r, retailer s, month h, year y, and let p_{iyh} be the average of p_{irshy} over r, s pairs. Changes in log prices between December of year $y-1$ and month h of year y are $p_{iyh} - p_{iy-1,12} = f_{iyh} \times s_{iyh}$ where f_{iyh} is the fraction of r, s observations with non-zero price changes in this time period, and s_{iyh} is the average size of non-zero price changes. Note that, in the presence of temporary price changes, f_{iyh} does not need to increase monotonically over time. We can further decompose changes in prices as $p_{iyh} - p_{iy-1,12} = f^+_{iyh} \times s^+_{iyh} - f^-_{iyh} \times s^-_{iyh}$, where f^+_{iyh} (f^-_{iyh}) denotes the fraction of observations with a price increase (decrease) between month t and December of the previous year, and s^+_{iyh} (s^-_{iyh}) denotes the average size of these price increases (decreases).

and 2014.[38]

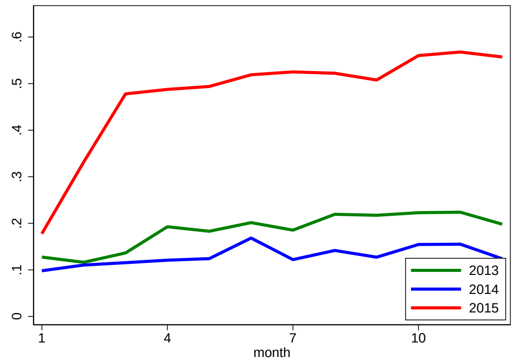
Figure 7: *Fraction of price changes compared with December of previous year*



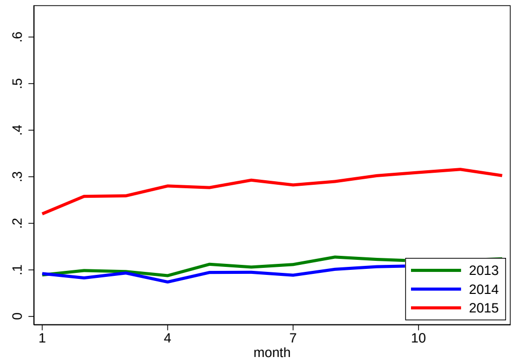
(a) Changes imports



(b) Changes domestic



(c) Decreases imports



(d) Decreases domestic

Notes: Panels (a) and (b) display the weighted average fraction of changes in modal prices relative to December of the previous year, f_{iyh}, for 1-12 month horizons. Panels (c) and (d) show the same statistic for price decreases, f^{-}_{iyh}. Panels (a) and (c) consider imported goods and panels (b) and (d) consider Swiss-produced goods.

In 2015, at every monthly horizon, the average fraction of modal price changes for imported goods rises significantly compared with 2013 and 2014. At the one-month horizon, the average f_{iyh} for imports rises from 20% in 2013-14 to 30% in 2015. At the 12-month horizon, it rises from 40% to 60%. In contrast, there is little change in the fraction of price changes by time horizon for Swiss-produced goods.

The increase in the fraction of price changes for imported goods following the January 2015

[38] Figure E.2 in Appendix E.1 displays the monthly fraction of price changes from one month to the other between 2013 and 2016. The fraction of price changes per month is on average roughly 0.2. Nakamura and Steinsson (2008) report that the average monthly fraction of price changes (inclusive of sales) in the US CPI is roughly 0.25 for all goods and for processed food goods, and 0.21 for household furnishings. The fraction of price changes is roughly half as large when sales are excluded, as is the case in our retail price data when we exclude temporary price reductions.

appreciation is almost completely driven by price reductions. The bottom row in Figure 7 shows that the average f^-_{iyh} rises from roughly 10% in 2013 and 2014 to roughly 40% in 2015 at either the one-, the two, or the three-month horizon. The fraction of price decreases at longer horizons is also much higher in 2015 than in 2013 or 2014. This suggests that the 2015 price reductions were not short-lived sales. Figure E.1 in the appendix shows that there was only a small decline in the fraction of price increases for imported goods.[39]

The evolution of retail price stickiness varies systematically across imported goods by currency of invoicing and price changes at the border. The impact of the appreciation on the extensive margin and especially on the fraction of price reductions was more pronounced in border product categories with higher EUR invoicing shares. For a given monthly horizon h, we consider panel regressions of the form

$$f^+_{iyh} \text{ or } f^-_{iyh} = \sum_{y'=13,15} \beta_{y'h} \times \mathbb{I}_{y'=y} \times EURShare_{g(i)} + \alpha_{yh} + \lambda_{ih} + \varepsilon_{iyh}. \tag{7}$$

The dependent variable is either the fraction of price increases or the fraction of price decreases by product. α_{yh} and λ_{ih} denote year and product fixed effects, respectively, that can vary by monthly horizon h.

Table 8 reports estimates of β_{13h} and β_{15h} for price decreases (-) and increases (+), separately for imports and Swiss-produced goods. We consider monthly horizons $h = 1, 2, 3$, since these horizons experience the largest changes in aggregate fractions of price changes. We report results for $h = 4, 5, 6$, as well as other sensitivity analysis in Appendix E.2.

Consider our estimates for 2015. For price reductions, estimates of β_{15h} are positive and significant at the 1% level in each of the horizons we consider. At the three-month horizon (between December and March), the fraction of price reductions is 57.4 percentage points higher in 2015 (compared with the same three-month horizon in 2014) for goods in product categories with border prices that are (hypothetically) fully EUR-invoiced compared with product categories fully invoiced in CHF. For price increases, estimates of β_{15h} are negative and significant at the 1% or 5% levels, depending on the monthly horizon. That is, the fraction of price increases fell by more in 2015 (compared with 2014) for imported goods in

[39] In Appendix E.1, we document that, accompanying the increase in the fraction of price reductions of imported goods, there was a significant decline in the absolute size of retail price reductions for imported goods in early 2015. We then show in Appendix E.4 that a simple Ss pricing can generate this seemingly puzzling negative co-movement between the change in the frequency of price adjustment and the change in the absolute size of price changes of imported goods. Specifically, in response to a decline in the CHF-denominated cost of imported goods, the absolute size of price reductions falls if new price changes (i.e. those that would not have occurred in the absence of the shock) are sufficiently small relative to the size of typical price reductions, which depends on the assumed distribution of idiosyncratic shocks.

Table 8: *Invoicing currency and the extensive margin of retail price changes*

	Decreases			Increases		
	(1) 1m	(2) 2m	(3) 3m	(4) 1m	(5) 2m	(6) 3m
Panel (a). Imported goods						
$EURShare \times \mathbb{I}13$	-0.031	0.048	-0.004	-0.105	-0.119	-0.291
	[0.068]	[0.058]	[0.098]	[0.078]	[0.112]	[0.121]
$EURShare \times \mathbb{I}15$	0.284	0.651	0.574	-0.267	-0.279	-0.363
	[0.095]	[0.169]	[0.181]	[0.106]	[0.126]	[0.109]
Observations	2537	2508	2506	2537	2508	2506
Unique products	884	881	877	884	881	877
Adjusted R^2	0.11	0.19	0.24	0.19	0.18	0.21
Panel (b). Domestic goods						
$EURShare \times \mathbb{I}13$	0.063	-0.065	-0.021	-0.031	-0.112	-0.272
	[0.057]	[0.029]	[0.036]	[0.179]	[0.202]	[0.228]
$EURShare \times \mathbb{I}15$	0.356	0.284	0.318	-0.255	-0.308	-0.472
	[0.278]	[0.292]	[0.298]	[0.218]	[0.260]	[0.290]
Observations	6223	6145	6121	6223	6145	6121
Unique products	2138	2125	2113	2138	2125	2113
Adjusted R^2	0.12	0.12	0.14	0.17	0.15	0.20

Notes: This table displays estimates of β_{13h} and β_{15h} in equation (7). Panel (a) reports estimates for imported goods, while (b) reports those for Swiss-produced goods. Columns (1)-(3) report estimates for price decreases. Columns (4)-(6) report estimates for price increases. Standard errors are clustered at the level of retail product class.

product categories with more EUR invoicing.[40]

For Swiss-produced goods, in contrast, estimates of β_{15h} are not significantly different from zero for either the fraction of price decreases or the fraction of price increases. Similarly, our estimates for 2013 are small and largely insignificant, suggesting that there are no pre-trends in the relationship between the fraction of price increases or decreases and currency of invoicing of border prices between 2013 and 2014.

We further show, in Appendix E.3, that the extensive margin of retail price adjustment for imported goods is strongly associated with changes in border prices in the corresponding

[40] Point estimates for price increases are lower in absolute terms than those for price decreases. For example, at the three-month horizon, $\beta_{15h} = 0.57$ for price decreases whereas $\beta_{15h} = -0.36$ for price increases. This is consistent with the fact, shown in Figure 7, that the overall fraction of price changes rose in 2015. In Table E.2 in the appendix we report estimates of equation (7) based on the overall fraction of price changes, $f_{iyh} = f^+_{iyh} + f^-_{iyh}$, as the dependent variable. Estimates of β_{15h} are positive, which is consistent with the fact that point estimates are higher in absolute terms for the fraction of price decreases than for the fraction of price increases, but only statistically significantly different from zero at the two-month horizon.

product category. Under both OLS and 2SLS (instrumenting border price changes by 2014 EUR invoicing shares in the corresponding border category), we show that categories with a larger border price reduction in 2015 display significantly more price decreases and fewer price increases.

5 Expenditure switching to imports

In this section we show that the changes in relative prices described above are associated with changes in retail expenditures on imported goods. We document the dynamics of the aggregate import share and then examine variation across individual goods.

5.1 Aggregate import share

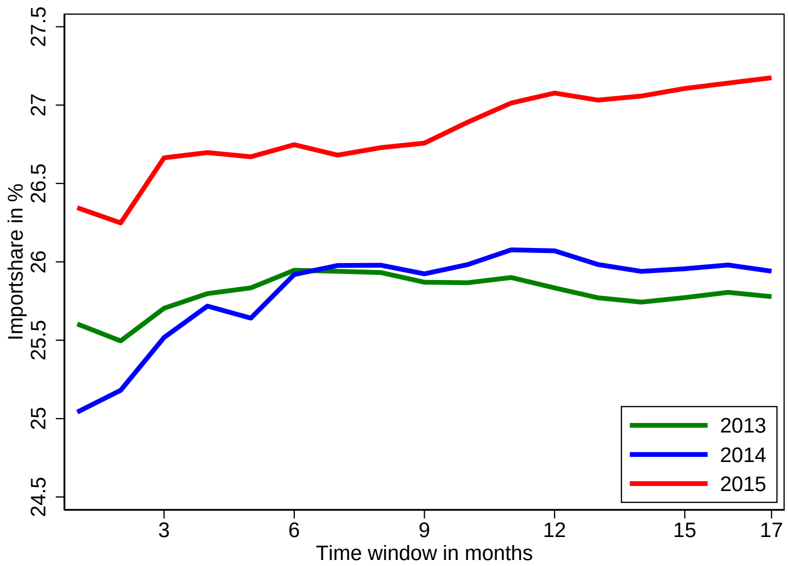
We denote the aggregate import share by S_{yh}, defined as the sum of expenditures on imports over $h = 1, ..., 17$ months starting in January of year $y = 2013, 14, 15$ relative to the sum of expenditures on imports and Swiss-produced goods over the same time horizon. We compare import shares across years over comparable time horizons, rather than comparing monthly or quarterly import shares relative to the last month or quarter of 2014, due to seasonalities of imports in our data.[41]

Figure 8 documents that aggregate import shares in 2014 are similar to those in 2013 for each time horizon. In 2015, there is a clear increase in import shares at each time horizon, even in the early months after the CHF appreciation. As shown in Table 9, the rise in the import share over different time horizons (corresponding to our quarterly price measures) ranges between 0.8 and 1.3 percentage points relative to the average between 2013 and 2014, or between 3.1 and 4.9 log percent differences. The increase in the import share is larger at longer time horizons.[42]

[41] We display in Appendix F.1 import shares by month. In constructing S_{yh}, our choice of the longest horizon, $h = 17$, is based on the latest month in the Nielsen dataset, May 2016. For $h > 12$ and $y = 14$, we include the first $(h - 12)$ months of the year rather than including post-appreciation months in 2015. Recall that in our baseline we consider products that can be matched to border product categories with more than 7 border prices per quarter in 2014. We report in the appendix results based on more and less restrictive product-category samples.

[42] As shown in Table A.1 in the appendix, while real imports of goods and services rose in 2015, the ratio of aggregate nominal imports to GDP fell (in contrast to the rise in the aggregate import share for non-durable consumer goods in our data). Blaum (2019) examines how the response of intermediate goods imports (which are not included in our data) to exchange rate movements may differ from that of final goods imports.

Figure 8: *Aggregate import share in total expenditures*



Notes: This figure reports the aggregate import share, S_{yh}, for years 2013, 2014, and 2015 and horizons $h = 3, 6, 9, 12, 15, 17$ months. The aggregate import share is the total sum of expenditures on imported goods over the corresponding monthly time horizon in the year divided by the sum of total expenditures (imports and Swiss-produced goods) over the same time period.

The increase in the aggregate import share is partly accounted for by an increase in import shares within product categories and partly by reallocation of expenditures across product categories. The within component, calculated by fixing the weights of individual product categories at the level of import expenditures in 2014 (reported in Table 9), is between 45% and 70% as large as the overall increase in the aggregate import share. The within component is quantitatively more important at longer time horizons.

How large are changes in aggregate import shares compared with changes in relative prices? We calculate the log change in relative prices as the log change in import prices minus the log change in prices across all goods (weighing imports and Swiss-produced goods by 2014 expenditures). For import prices we use changes in either border prices or retail prices, as described in the previous section. We then calculate the ratio of log differences in aggregate import shares with respect to log changes in relative prices by monthly time horizon in 2015.

As shown in Table 9, based on retail import prices, this ratio is 5.4 at the three-month horizon and ranges between 2.4 and 2.9 at horizons longer than three months. In contrast, based on border import prices this ratio ranges between 0.6 and 1. The ratio of import share changes relative to relative price changes is smaller based on border prices because retail import prices fell by much less and more gradually than border prices. This pattern is especially pronounced at the three-month horizon. The cross-sectional results that follow below display a similar

Table 9: *Aggregate expenditure switching*

	aggregate import share			agg import share, fixed category weights			ratio agg. import share diff / price diff	
			log diff			log diff	imp. price measure	
Monthly horizon	avg 13-14	15	15 vs 13-14	avg 13-14	15	15 vs 13-14	border	retail
3	25.6	26.7	4.0	25.8	26.2	1.8	-0.9	-5.4
6	25.9	26.8	3.1	26.1	26.5	1.7	-0.6	-2.6
9	25.9	26.8	3.3	26.0	26.5	2.0	-0.6	-2.4
12	26.0	27.1	4.3	25.9	26.6	2.6	-0.9	-2.7
15	25.9	27.1	4.7	25.9	26.7	3.1	-1.0	-2.9
17	25.9	27.2	4.9	25.9	26.8	3.4	-1.0	-2.9

Notes: This table reports import shares and their evolution over various monthly horizons. The first three columns report, in turn, the 2013-14 average import share, the 2015 average import share, and the log-percent difference between 2015 and 2013-14. The next three columns repeat the first three columns weighting product categories by import expenditures in 2014. The last two columns report the ratio of log changes in aggregate import shares (from column 3) with respect to changes in relative prices (obtained from Table 3).

pattern.

5.2 Changes in import shares and currency of invoicing at the border

We next analyze variation in import share changes across goods and relate these to invoicing currency. We then leverage this cross-sectional variation to provide an alternative measure of sensitivity of import shares to relative prices.

We first estimate the relationship between changes in expenditure shares on imported goods within product categories and pre-shock EUR invoicing in the corresponding border category.

For this, we define the share of expenditures on imported good i within its retail product class, S_{iyh}, as the sum of expenditures on good i over h months starting in January of year $y = 2013, 14, 15$ relative to the sum of expenditures on imports and Swiss-produced goods in retail product class $g(i)$ over the same time horizon. We consider panel regressions of the form

$$s_{iyh} = \sum_{y'=13,15} \beta_{y'h} \times \mathbb{I}_{y'=y} \times EURShare_{g(i)} + \alpha_{yh} + \lambda_{ih} + \varepsilon_{iyh}, \quad (8)$$

for monthly horizons $h = 3, 6, 9, 12, 15, 17$ and imported goods i, where $s_{iyh} = \log(S_{iyh})$. For each horizon, we consider a balanced sample of products for which s_{iyh} is observed in all three years 2013, 2014, and 2015.

We also consider a second version of equation (8) using import share-adjusted EUR invoicing shares, $\left(1 - ImpShare_{g(i)}\right) \times EURShare_{g(i)}$, both calculated in 2014. To understand this formulation, note from equation (9) below that for a given change in the price of imports, the magnitude of the change in the import price relative to the product category price is decreasing in the import share. In the limit, in a product category with import share equal to 1, relative import prices and import shares are constant over time. We use import share-adjusted EUR invoicing shares as an instrument in the 2SLS regression below. Finally, we consider a third specification in which, in addition to the interaction term, we also include $\left(1 - ImpShare_{g(i)}\right)$.

Table 10: *Expenditure switching and invoicing*

	(1) 3m	(2) 6m	(3) 9m	(4) 12m	(5) 15m	(6) 17m
Panel (a). EUR-invoicing share						
$EURShare \times \mathbb{I}13$	0.033	0.090	-0.008	0.024	0.036	0.037
	[0.056]	[0.052]	[0.063]	[0.047]	[0.051]	[0.054]
$EURShare \times \mathbb{I}15$	0.119	0.127	0.080	0.111	0.115	0.096
	[0.057]	[0.047]	[0.047]	[0.048]	[0.055]	[0.058]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (b). Interaction of import share with invoicing						
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	0.077	0.096	0.006	0.007	0.035	0.040
	[0.069]	[0.061]	[0.067]	[0.055]	[0.058]	[0.059]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.207	0.179	0.143	0.179	0.191	0.175
	[0.073]	[0.058]	[0.057]	[0.058]	[0.064]	[0.067]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (c). Import share and interaction of import share with invoicing						
$(1 - ImpShare) \times \mathbb{I}13$	0.063	-0.003	0.048	0.000	-0.001	0.000
	[0.060]	[0.057]	[0.063]	[0.039]	[0.042]	[0.045]
$(1 - ImpShare) \times \mathbb{I}15$	-0.033	-0.038	0.017	0.007	0.003	0.014
	[0.044]	[0.041]	[0.038]	[0.042]	[0.046]	[0.051]
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	0.007	0.099	-0.046	0.006	0.036	0.040
	[0.104]	[0.098]	[0.111]	[0.077]	[0.082]	[0.085]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.244	0.221	0.124	0.172	0.188	0.159
	[0.093]	[0.079]	[0.077]	[0.077]	[0.086]	[0.093]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Observations	6279	7068	7563	8046	8118	8160
Unique products	2093	2356	2521	2682	2706	2720

Notes: This table reports estimates of β_{13h} and β_{15h} from equation (8) for each monthly time horizon and specification. The dependent variable is the log of expenditure share of each imported good within retail product class. The independent variable is the EUR invoicing share (interacted with the 2013 or 2015 dummy) in the upper panel, the EUR invoicing share times domestic expenditure share in the middle panel, and the EUR invoicing share times domestic expenditure share and the domestic share on its own in the lower panel. Standard errors are clustered at the level of retail product class.

Table 10 presents estimates of β_{13h} and β_{15h} for each monthly time horizon and specification. Estimates of β_{13h} are small and largely insignificant across all specifications and time horizons, indicating no strong relationship between changes in import shares and EUR invoicing before 2015.

Estimates of β_{15h}, in contrast, are positive and statistically significant at most horizons and specifications. Our point estimates imply that the expenditure share of imported goods rises by roughly 12% more in (hypothetically) fully EUR-invoiced categories than in categories that are fully CHF-invoiced at three- and six-month horizons in 2015, significant at the 5% and 1% levels, respectively. If we consider the interaction term in the regression in the bottom two panels, estimates remain largely significant. Estimates using interacted invoicing shares imply that, evaluated at the median import share of 23% across product categories in 2014, the rise in expenditure shares of imported goods in fully EUR-invoiced categories relative to CHF-invoiced categories ranges between 13% and 18% at three- and six-month horizons in 2015. We report sensitivity analysis in Appendix F.2.

5.3 Sensitivity of import shares to relative prices

To measure the sensitivity of import expenditure shares to relative import prices within a product class, we consider the following regression

$$\Delta s_{i15h} = \alpha_h + \beta_h \times \left[\Delta p^{imp}_{i15h} - ImpShare_{g(i)14} \times \Delta p^{imp}_{g(i)15h} - (1 - ImpShare_{g(i)14}) \times \Delta p^{dom}_{g(i)15h}\right] + \varepsilon_{it}, \quad (9)$$

where for any variable x_{i15h}, $\Delta x_{i15h} = x_{i15h} - x_{i14h}$. We estimate this equation in the balanced sample of all imported goods i for $h = 3, 6, 9, 12$ and, in the appendix, also for $h = 15, 17$.

In order to examine the sensitivity of import shares to prices at different layers between the border and the retail levels, we consider three alternative measures of import prices, p^{imp}_{iyh} and category-level prices $p^{imp}_{g(i)yh}$. First, we use border prices of the corresponding border category, $p^{bor}_{g(i)yh}$, for both p^{imp}_{iyh} and $p^{imp}_{g(i)yh}$. Second, we use for both p^{imp}_{iyh} and $p^{imp}_{g(i)yh}$ a measure of retail import prices given by 'distribution services'-augmented border prices, $p^{bor+dis}_{g(i)yh}$.[43] Third, we use import retail prices, p^{ret}_{iyh}, for p^{imp}_{iyh} and then construct category-level prices, $p^{imp}_{g(i)yh}$, as the weighted average (using 2014 expenditures) of retail import prices within the corresponding retail product class.

We consider two alternative measures of domestic prices, $p^{dom}_{g(i)yh}$. First, we calculate a weighted average (using 2014 expenditures) of retail domestic prices within the corresponding product category. Second, we use an aggregate (as opposed to good-specific) price of domestic goods,

[43] Specifically, we assume that retail import prices p^{imp}_{iyh} and $p^{imp}_{g(i)yh}$ are weighted averages of border prices, $p^{bor}_{g(i)yh}$, and an aggregate price index of private services (Private Dienstleistungen) in the Swiss CPI. We assume a weight on border prices of 0.59 and on services of $(1 - 0.59)$, where 0.59 corresponds to the average sensitivity of retail import prices to border prices reported in Table 6 during 15Q1 and 15Q2.

given by the official CPI for Swiss-produced goods.[44] For each specification of equation (9), we report estimates of β_h based on each of the three measures of import prices and two measures of domestic prices, resulting in a total of six estimates for each time horizon.

Motivated by the findings in Section 5.2, we leverage heterogeneity in pre-shock import shares and EUR invoicing shares in border product category $g(i)$ as driver of heterogeneous responses of relative prices to the appreciation. We consider 2SLS estimations of equation (9) where the first stage relates import-adjusted EUR invoicing shares in 2014, $EURShare_{g(i)} \times \left(1 - ImpShare_{g(i)}\right)$, to relative price changes. The exclusion restriction, following the same logic as in the discussion after equation (4), is that import-adjusted EUR invoicing shares in 2014 are uncorrelated with other drivers of retail quantity changes in 2015 including (i) shifts in demand, and (ii) good-specific sensitivity of expenditures to prices. Once again, while we believe that this instrument somewhat alleviates endogeneity concerns, we cannot a priori rule out violations of the exclusion restriction.[45]

We report 2SLS estimates in Table 11. The first stage is highly significant, except for the specification using the combination of good-specific retail import prices and product category-specific retail domestic prices, for which F stats are around 6 at three-, six- or nine-month horizons. F stats are higher (close to or above 10) when weighting all observations equally (or when weighting observations equally within border product category) or when using modal prices to aggregate prices within regions, retailers, and weeks, as reported in Appendix F. For these alternative choices, point estimates of β_h are similar to our baseline.[46]

Estimates of β_h based on border prices as the measure of import prices are statistically significant at the 1% level and close to 1 at three-, six-, and nine-month horizons, implying that a 1% decline in the relative border price of imported goods is associated with an increase in import shares (within product categories) of around 1%. Point estimates at nine-month or higher horizons are slightly higher, close to 1.5. Point estimates are very similar under the two measures of domestic prices.

When we consider distribution-augmented border prices as the measure of import prices, the estimated sensitivity of import shares to relative import prices is higher than that based on

[44] A rationale for this second measure of domestic prices based on the CPI for Swiss-produced goods (Inlandgüter) is that retail domestic prices by product category are the sum of an aggregate component and measurement error. This second measure of domestic prices results in stronger first-stage power and point estimates that are within confidence bands of those based on the first measure.

[45] For example, one could build a model featuring endogenous invoicing currency choice that is based on desired pass-through by exporters, and where the latter is related to the demand elasticity at the retail level, which varies across product categories. Note, however, that in standard models of variable markups conditional pass-through is determined not by the demand elasticity level but by the curvature of the demand elasticity.

[46] We note that OLS estimates of β_h, reported in Table F.11 in the appendix, are close to zero and largely insignificant. As discussed in Feenstra et al. (2018), OLS estimates of the elasticity of substitution between domestic and imported goods may be downward biased due to measurement error in prices and endogeneity from demand shocks that are correlated with prices.

Table 11: *Sensitivity of import shares to relative prices*

	3m		6m		9m		12m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Border imp. price	-1.21	-1.12	-1.02	-0.98	-0.95	-0.87	-1.43	-1.27
	[0.45]	[0.41]	[0.34]	[0.33]	[0.39]	[0.35]	[0.47]	[0.42]
F first stage	126.7	237.6	123.7	243.2	85.4	183.9	59.6	142.6
Border +distr. imp. price	-2.27	-1.97	-1.89	-1.75	-1.87	-1.59	-2.90	-2.31
	[0.89]	[0.73]	[0.66]	[0.60]	[0.81]	[0.64]	[1.07]	[0.77]
F first stage	48.1	231.1	41.8	230.5	27.8	167.5	18.3	129.8
Retail imp. price	-5.10	-3.81	-4.23	-3.60	-3.81	-2.79	-5.84	-3.85
	[2.68]	[1.61]	[2.09]	[1.59]	[2.30]	[1.41]	[3.63]	[1.84]
F first stage	6.1	16.9	6.5	13.3	5.2	12.8	3.6	10.8
Observations	2092	2092	2352	2352	2517	2517	2677	2677
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table presents estimates of β_h in equation (9), as well as first stage F statistics. The dependent variable is the log change from 2014 to 2015 within a time horizon in the market share of good i in its retail product class, Δs_{i15h}. The independent variable is the log change in the price of imported good i relative to the product class price index, instrumented by import-adjusted EUR invoicing shares in 2014. To measure changes in prices of imported goods, panel (a) uses border prices, panel (b) adjusts border prices for changes in the official CPI for private services (assuming a weight on the latter of 41%), and panel c) uses retail prices of imported goods. To measure changes in domestic prices, odd-numbered columns use a weighted average of retail domestic prices within the corresponding product class, and even-numbered columns instead use the CPI for Swiss-produced goods. Standard errors are clustered at the level of retail product class. Results for 15 and 17 month horizons are reported in the Appendix.

border prices. At the three-, six-, and nine-month horizons, estimates of β_h are close to 2, with significance ranging between 1% and 5%. Estimates of β_h at longer horizons are close to 2.5 with significance between 1% and 5%. The degree of expenditure switching is higher because prices of private services, which we use to construct distribution-augmented border prices, fall by less than border prices.

Next, we consider good-specific retail prices as the measure of import prices. This measure of relative prices is closer to the measure one would use to estimate demand elasticities at the retail level, but implies more noisy estimates (and weaker first-stage F stats using product category-specific retail domestic prices) given the large degree of idiosyncratic movements in good-level prices. Point estimates of β_h are higher than those based on distribution-augmented border prices and subject to larger standard errors. The estimated sensitivities of import shares to relative prices within a product category range between 3.8 and 5.8 if we use good-specific domestic prices, with significance between 5% and 10% in the first nine-month or less horizons. If we use aggregate domestic prices, estimates sensitivities range between 2.7 and 3.7 — with lower standard errors and significance between 1% and 5% at 12-month horizons or less. The point estimates based on the two alternative measures of domestic prices are within the confidence intervals of each other. Finally, we note that point estimates are larger at the three-month horizon (consistent with the aggregate results in Table 9), but differences across time horizons are not statistically significant given large standard errors.

We report in Appendix F.3 additional sensitivity analysis of our 2SLS estimates. While the magnitude and significance of the estimates differs across specific time horizons and measures, the two main takeaways are quite robust. First, there is a significant degree of expenditure switching away from domestic goods and to imports, observed both on aggregate import shares and cross-sectional variation in import shares across individual goods. Second, in terms of magnitudes, the sensitivity of expenditure shares to changes in relative prices (instrumented by import-adjusted invoicing shares) is around one for the border-level measure of import prices, and at least twice as high for the retail-level measure of import prices. Import shares are more sensitive to relative prices at the retail level than at the border level due to a muted decline in retail prices compared with border prices.

6 Taking stock

In this paper, we provide a range of facts on how prices and expenditures of consumer goods in Switzerland responded to a unique exchange rate shock: the SNB's removal of the lower bound on the EUR/CHF exchange rate on January 15, 2015. This policy change happened against the backdrop of a stable macroeconomy and resulted in a large, unanticipated, and lasting appreciation of the Swiss franc. To investigate its impact, we examine border data on prices and invoicing, as well as household-level data on prices and expenditures of non-durable consumer goods. This allows us to link currency of invoicing to border prices, retail prices, and expenditure allocations at the consumer level.

We first document large differences in border price pass-through by invoicing currency in the first year after the appreciation, even when conditioning on non-zero price changes. However, differences dissipate at longer time horizons. These observations are consistent with models of endogenous invoicing based on desired pass-through at early time horizons. Via simple accounting exercises we argue that, given differences in desired pass-through across goods, counterfactual shifts in currency of invoicing at the border have a bigger impact on the aggregate rate of pass through than counterfactual changes in the degree of nominal price stickiness.

Second, we show that differences across border product categories in price changes by invoicing currency at the border carry over to consumer prices and allocations. Specifically, after the appreciation, EUR invoicing at the border is associated with: (i) larger reductions in retail prices of imported goods, (ii) larger increases (decreases) in the frequency of price decreases (increases) of imported goods, (iii) larger reductions in retail prices of Swiss-produced goods (in categories with substantial import competition), and (iv) larger increases in import shares in the corresponding product category.[47]

Third, leveraging the exchange rate shock and invoicing variation across product categories, we measure the sensitivity of retail import prices to border prices at roughly 50% after two quarters. We also measure the sensitivity of import shares to relative prices within product categories at roughly unity based on border import prices, and at least twice as high based on retail import prices. Elasticity estimates are higher using retail prices than using border prices because of the muted response of retail prices compared with border prices. A similar logic may apply for estimates of trade elasticities based on tariff variation.

Since we have limited our analysis to non-durable consumer expenditure data, we have not focused on the aggregate impact of the 2015 CHF appreciation on the Swiss economy. As shown in Table A.1 in the appendix, the growth rate of Swiss real GDP was lower in 2015 compared with 2013 and 2014, but other forces may have contributed to the observed aggregate fluctuations. The measures that we provide may help discipline key elasticities in general equilibrium models designed to perform counterfactuals on the macroeconomic impact of nominal exchange rate movements. The 2015 CHF appreciation episode may also be informative about additional margins of adjustment beyond consumer import expenditure switching, including cross-border shopping and import substitution at the level of intermediate goods.

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Online Appendix to "Exchange Rates and Prices: Evidence from the 2015 Swiss Franc Appreciation"

Raphael Auer, Ariel Burstein, and Sarah M. Lein

A Macroeconomic indicators

Table A.1: *Main macroeconomic indicators for Switzerland 2013–2016*

	2012	**2013**	**2014**	**2015**	**2016**
Real GDP growth	1.0%	1.9%	2.4%	1.3%	1.7%
Real consumption growth	2.3%	2.6%	1.3%	1.7%	1.4%
Real export growth	3.0%	-0.1%	5.2%	2.6%	6.5%
Real import growth	4.4%	1.4%	3.3%	3.0%	4.4%
Exports/GDP	52.5%	51.6%	52.7%	50.9%	52.8%
Imports/GDP	41.6%	41.8%	42.0%	39.5%	41.0%
Exports of goods/GDP	31.0%	30.3%	30.7%	29.5%	30.4%
Imports of goods/GDP	28.7%	28.4%	28.1%	25.7%	26.4%
Inflation rate	-0.7%	-0.2%	0.0%	-1.1%	-0.4%

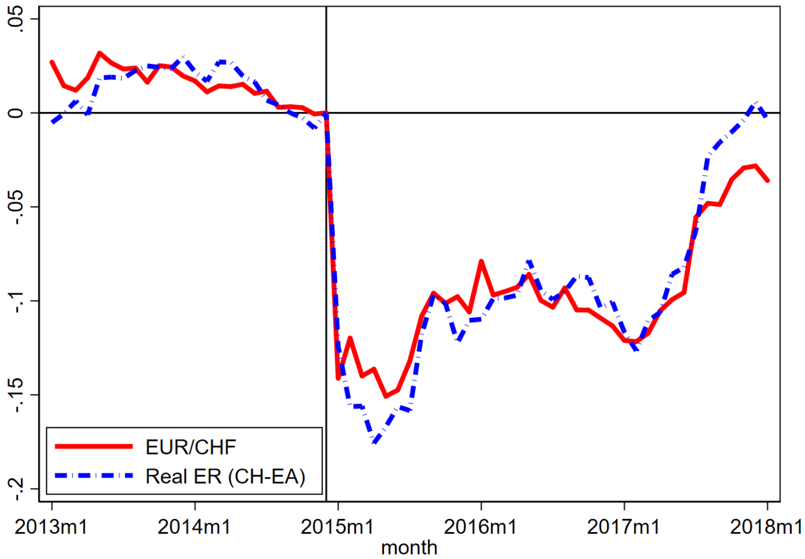
Sources: Quarterly GDP data (State Secretariat of Economic Affairs , 2020), inflation data from Swiss Federal Statistical Office (2020). Exports and imports include all goods and services, excluding "valuables" such as gold, which increase volatility significantly. In addition, we report exports and imports of goods excluding "valuables".

B Data: supplemental information

The sources for the data used in this paper are as follows. Information on border prices and invoicing at the border is from the SFSO (see Swiss Federal Statistical Office (2016)). The homescan retail data is obtained from Nielsen Switzerland (see Nielsen Switzerland (2016)). In the readme file in the replication material we provide information on how to obtain these two proprietary datasets. We augment the Nielsen data with information on the location of the good's production obtained from codecheck.info, a consumer information portal (see Codecheck (2016)). Real and effective exchange rate data is from the Bank for International Settlement (see Bank for International Settlements (2016)). Nominal exchange rate data and data on official producer and consumer price indices are from the data portal of the Swiss National Bank (see Swiss National Bank (2016)). Forward rates for the EUR/CHF exchange rate are from Datastream (see Datastream (2015)).

This appendix provides additional information on the border and retail data complementing Section 2.

Figure A.1: *The 2015 CHF appreciation*



Notes: This red line is the EUR/CHF nominal exchange rate and the blue line is the EUR/CHF real exchange rate. Sources: Swiss National Bank (2016), Bank for International Settlements (2016).

B.1 Border price and invoicing data

Adjustments to the data The border price survey by the SFSO asks firms to quote price and invoicing currency of the good that typically accounts for the firm's highest volume of imports (larger firms are asked to quote prices for several goods). We make four types of adjustments to the prices in the data, where only the first and second apply to the subset of products matched to Nielsen categories. First, products may be replaced by newer or quality-adjusted versions over time. For many of these goods, the dataset includes the price of the new or quality-adjusted good and the one-month lagged price of the new good. Thus, for these goods we can calculate a price change during the month in which the product was replaced (we drop these price changes in our calculations of price stickiness and non-zero price changes). If the lagged price of the new good is unobserved, we drop the observation because we cannot construct a price change. Second, prices may not be observed in a given quarter due to survey non-responses. In this case, the SFSO raw data pulls forward observations from past survey responses in a specific quarter. We drop these observations (identifying them by an unchanged price both in CHF and the foreign currency). Third, we drop prices that show a price in foreign currency but no currency of invoicing information, or that are invoiced in foreign currency but show a zero price in foreign currency. Fourth, we make the following manual adjustments. i) one product has a break in the stated invoicing currency that is inconsistent with the constant foreign currency price and the CHF price showing only a small change in the price. We replace the apparently wrong invoicing currency entry (DKK) with

EUR (consistent with the exchange rate and stated as invoicing currency after the break). ii) we drop a product for which the foreign currency price randomly takes three very distinct values that are at times disconnected from the Swiss franc price. iii) for one product, the euro price changes from 159 to 572 for the first six months of 2014, without a corresponding change in the Swiss franc price. We pull forward the December 2013 foreign currency price of 159 euro for the next six months. iv) we changed prices for nine products with obvious digit errors in entered prices — instances in which the implied exchange rate (comparing CHF price and foreign exchange rate price) jumps within a price series by a factor of exactly 10, 100, or 1000.[A1]

One caveat with the border price data that we mention in footnote 13 of the main text regards the conversion of foreign-invoiced prices into CHF. The raw data for border prices and the invoicing information are entered manually by external contractors hired by the SFSO. The contractors enter the price both in CHF and in the invoiced currency. For prices invoiced in foreign currency, we must choose whether to use the price in CHF converted by the SFSO or the foreign price and the exchange rate used in the rest of our analysis to convert prices invoiced in foreign currency into CHF. In the former case, the implied exchange rates can deviate from the actual range of exchange rates prevailing during the two-week sampling period for two reasons. First, they deviate because of changes in the digits of the conversion rates used (i.e. fluctuations in the implied exchange rates by a factor of exactly 10, 100 or 1000), as mentioned in the previous paragraph. Second, the exchange rates used might not be the correct ones for the given sample period (for example, the exchange rate used to convert prices into CHF may not have been updated). The latter choice suffers from the problem that, for the case of product replacements of foreign-invoiced goods, the lagged prices of newly introduced goods are reported only in CHF (but neither the lagged price in foreign currency nor the lagged exchange rate that was used in the conversion is recorded). We can thus calculate a CHF price change only when taking the data and the implied exchange rates at face value. In our baseline estimates we use the raw prices in CHF and foreign currency (given the adjustments described in the previous paragraph), and thus rely on the exchange rate conversion made by the SFSO. In sensitivity analysis, we use foreign currency-invoiced prices and convert them using the exchange rate prevailing at the end of the quarter, and drop product replacements (we label this sensitivity “official EUR/CHF” in the text).

Non-commodity products in the border data are defined as products excluding the product categories “agricultural products”, “coals”, “petroleum and natural gas”, “petroleum products”, “basic metals, semi-finished products”, and “electricity, gas”.

Additional summary statistics on currency of invoicing

[A1] These digit errors are sometimes fixed by the SFSO when converting foreign-invoiced prices to CHF.

Table B.1: *Invoicing patterns in the full SFSO data weighting*

	% CHF-invoiced	% EUR-invoiced	% USD-invoiced
2013	66.8	28.9	3.5
2014	63.4	32.2	3.5
2015	54.9	38.3	5.5
2016	51.7	40.9	5.9

Notes: This table shows the share of import border prices invoiced in different currencies for various years, in the sample of non-commodity products, where border categories are weighted by December 2015 2-digit NAICS weights from the SFSO.

Table B.1 displays shares of border observations by currency of invoicing per year between 2013 and 2016 for the sample of non-commodity products, weighting border product categories by NAICS two-digit weights in December 2015, which is the first period the SFSO reports weights in our data. Invoicing shares are very similar to our unweighted shares reported in Table 1.

Table B.2 displays shares of observations by currency of invoicing per year between 2013 and 2016, as in Table 1, but including both non-commodities and commodities. Even though the share of commodities invoiced in CHF is higher than that of non-commodities, commodity prices tend to be more flexible, so currency of invoicing matters less. Specifically, in Figure C.2 we show that commodity prices change very frequently, and in Table C.8 we show that conditional pass-through does not vary significantly by invoicing currency.

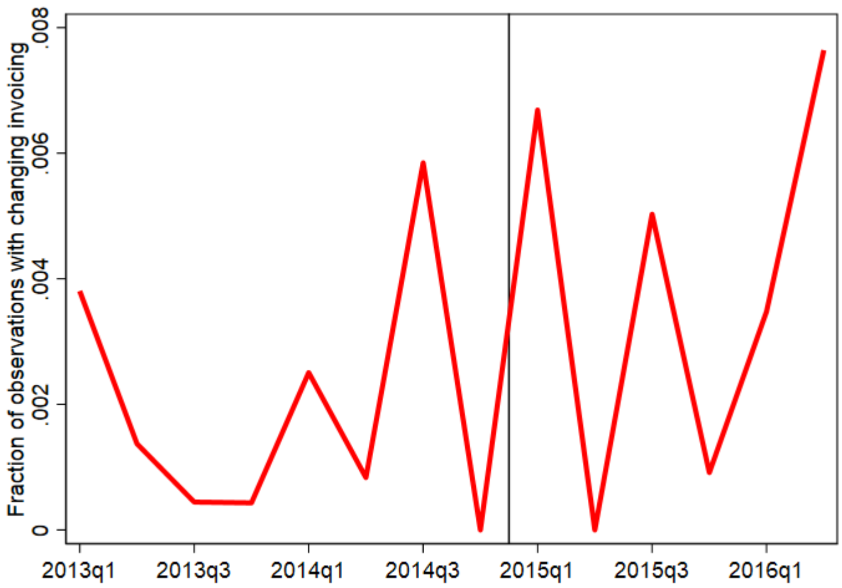
Table B.2: *Invoicing patterns in the full SFSO data (including commodities and non-commodities)*

	Number of observations	% CHF-invoiced	% EUR-invoiced	% USD-invoiced
2013	17,336	71.4	26.2	2.0
2014	17,417	69.1	28.4	2.1
2015	20,025	60.0	34.9	4.1
2016	20,595	55.9	38.4	4.6

Notes: This table shows the share of import border prices invoiced in different currencies for various years, in the sample that combines non-commodity and commodity products.

Figure B.1 shows that the fraction of observations switching invoicing currency between quarters is very low, on average roughly 0.5% per quarter in 2015. Hence, the rise over time in the share of EUR-invoiced goods displayed in Tables 1, B.1, and B.2 is largely due to the entry of new goods into the sample that are invoiced in EUR.

Figure B.1: *Invoicing currency switching (EUR and CHF only)*



Notes: This figure shows the fraction of border prices switching invoicing currency from CHF to EUR or vice versa between quarters, for the balanced sample of non-commodity products.

Table B.3 displays the number of imported products at the border in each year for various samples that we use in our analysis.

Table B.3: *Number of products per year for various samples in the border price data*

	Noncommodity		Nielsen (min0+)		Nielsen (baseline)	
	all	bal	all	bal	all	bal
2013	4,259	2,362	732	531	697	504
2014	4,414	2,394	796	534	758	507
2015	5,507	2,370	913	534	838	507
2016	5,113	2,046	832	488	764	461

Notes: Number of imported products at the border observed in each year for various samples. Columns 1, 3, and 5 consider the unbalanced sample ('all') including only CHF- and EUR-invoiced goods. Columns 2, 4, and 6 consider the balanced sample ('bal') observed every quarter in the period 13Q4-15Q3 and no change in invoicing currency. The balanced sample size falls in 2016 because the SFSO conducted a re-sampling of products in the import price index in December 2015. Columns 1 and 2 consider the non-commodity sample. Columns 3-6 consider the sample of products that we match to the Nielsen dataset without requiring a minimum number of border prices per quarter in 2014 (min0+). Columns 5 and 6 exclude border categories with seven or fewer border observations per quarter on average in 2014.

B.2 Nielsen retail data

We provide additional details that are not included in the main text.

One household in the sample represents roughly 1,000 households in the total population. The selection of panelists is based on the Swiss census conducted by the SFSO and excludes the Italian-speaking canton of Ticino. The sample of households fluctuates over time due to entry and exit. During the period January 2012 to June 2016, a total of 3,187 distinct household entries exist in the dataset.

The Nielsen data reports a "WEMF" region identifier by household. WEMF regions, defined by the media and advertisement research agency WEMF (Werbemedienforschungs AG), are geographically comparable, though not identical, to the 26 cantons of Switzerland. For a map of these regions, see `https://wemf.ch/de/downloads/gebietskarten/wemf-gebiete.pdf`.

In the Nielsen data, each transaction records the day of the purchase. We shift the date of the analysis by 14 days so that month 1 of 2015 starts on January 15, 2015.

We make the following adjustments to the Nielsen data. We drop newspapers and magazines, which have a separate article number coding scheme. We also exclude in-store EANs, except in cases where we can find the origin of such EANs via codecheck.info. The reason for doing so is that - as they can be assigned locally in a single retail store - the same in-store EAN can be used for different goods across retail stores, so no price comparison can be made unless we can find product-specific information (via codecheck.info). We also drop fresh fruits and vegetables products that are not pre-packaged. For those goods, the weight, volume or quantity is not recorded consistently so we cannot construct informative price series. Finally, we drop cross-border shopping transactions (instances in which a Swiss household purchases abroad).

We keep only transactions for which both price and quantity purchased are non-missing and positive, and remove clear price outliers via the following two-step procedure. First, we drop observations in which prices are equal to 1 and the natural logarithm of the price is 2 or below -2 (e.g. a factor of 7.4) the average log price for the same EAN in all other transactions, which may correspond to instances in which quantity and price have been switched. Second, we drop observations for which the natural logarithm of the price is 2 or below -2 the average log price for the same EAN paid in all other transactions.

To address inconsistencies over time in how goods are assigned to product categories, we use the modal entry for each EAN. We also merge the product classes "wheat beer", "lager beer", "strong beer" and "special beer" into the productclass "beer with alcohol".

In the sensitivity analysis, we further exclude from our regressions the top 1% of observations ranked by the dependent variable in the corresponding regression.

The use of coupons that offer a discount for specific goods is reflected in the Nielsen data as participating households are asked to enter the price paid net of any discount. Intensive use of coupons for a specific good in a specific retail outlet hence shows up as a temporary price change. We smooth out temporary price movements by using quarterly average prices in our baseline analysis. Vouchers or loyalty schemes that apply to the whole purchase, such as a lump-sum rebate voucher, are not reflected in the Nielsen data. For the time period we consider, consumers accumulated such vouchers at a rate of 1% of their purchase value. We are unaware of changes in the loyalty schemes after the 2015 appreciation.[A2] Selected goods may earn higher rewards in selected weeks. We do not have information on how important the purchase of these goods during those weeks is. However, this margin of price adjustment would only bias our results if good-specific rewards are disproportionately concentrated on imported goods and goods that are invoiced at the border in either EUR or CHF.

The homescan dataset we use does not include the universe of products sold by supermarkets. Entry and exit of products over time in these data reflects not only entry and exit of products in the marketplace, but also the fact that panelists do not buy the same set of goods over time even if these goods continue to be offered by retailers. We consider monthly and annual balanced panels constructed as described in the main text, and hence exclude seasonal items, products which supermarkets sell only occasionally, and newly entered goods. The ratio of expenditures on products in the monthly balanced sample relative to expenditures on products in the unbalanced sample in 2014 is 79% (70% for imports and 83% for domestic goods).

[A2] For example, for the case of Migros, vouchers are accumulated via loyalty cards offering a voucher of 5 CHF for every 500 CHF in purchases. For a description of these loyalty cards, see Jacob (2014), `https://www.aargauerzeitung.ch/wirtschaft/supercard-punkte-belasten-coop-bilanz-migros-macht-es-mit-cumulus-besser-128868942` and `https://livingingeneva.wordpress.com/2018/08/14/store-loyalty-cards-are-they-worth-the-hassle`.

Table B.4: *Nielsen data summary statistics for the 'min0+' sample*

Summary Statistics Nielsen Samples

	Non-balanced	Balanced yearly	Balanced monthly
No. of Imported Goods	5,032	3,010	1,045
No. of EU Imported Goods	4,544	2,634	883
No. of Domestic Goods	4,199	4,070	2,376
Expenditure share imports 2014	28	27	24
Expenditure share EU imports 2014	23	23	20
No. Product classes	274	256	205
No. Product classes (imports)	253	223	155
No. of Transactions - Imports	896,879	853,873	670,013
No. of Transactions - Domestic	2,593,829	2,586,708	2,278,048

Notes: This table reproduces Table 2 for the larger 'min0+' sample of products which does not drop categories with a small number of border price observations in 2014. The sum of imports and domestic products in the last column (3,421) is slightly lower than the number mentioned in footnote 18 (3,481) because some of the products with country of origin information could not be matched to border categories with invoicing information in 2014.

Recall that in our baseline analysis that combines border and retail data, we drop 6 (out of 43) border product categories (and the matched retail product categories) for which we observe 7 or fewer observations per quarter on average in 2014. We refer to this sample as 'min7+'. Table B.4 displays the same information as Table 2 but without dropping these product categories. We refer to this sample as 'min0+'.

When matching the Nielsen product categories with the border categories, we combine the border categories "game meat", "rabbit meat", "horse meat", and "mutton and lamb meat" to a category "other meat". We do so because the Nielsen data does not distinguish between these categories. For the same reason, we combine the border categories "draft beer", "bottled beer", and "canned beer" in one category "beer", and add the border category "fresh dairy products" to "other milk products" (which includes all dairy products other than cheese). Table B.5 reports the list of matched border product categories and retail product categories, as well as the EUR invoicing share of each category.

Table B.5: *List of matched border and retail product categories, and associated EUR-invoicing share in 2014*

Retail class	**Border category**	**EURShare**
Accessories grain proc.	Other grain mill products	0.11
Air refresher	Products for laundering, dishw. & cleaning	0.74
Alkali	Batteries and accumulators	0.11
Aperitif	Spirits	0.18
Appetizers	Other proc. fruits and vegetables	0.16
Apple juice	Fruit and vegetable juices	0.08
Aspic	Condiments and seasonings	0.40
Assorted tea	Tea	0.06
Bakery products - long shelf live	Bakery products	0.46
Bakery products - lose ware	Bakery products	0.46
Bakery products - snacks	Bakery products	0.46
Baking ingredient	Other grain mill products	0.11
Baking paper	Household & hygiene prod. from pulp & paper	0.33
Beef charcuterie	Meat products	0.44
Beer variegated	Beer	0.66
Beer with alc	Beer	0.66
Beer without alc	Beer	0.66
Bin bags	Household & hygiene prod. from pulp & paper	0.33
Black tea	Tea	0.06
Bouillon uncooked	Soups and broths	0.00
Bread products	Bakery products	0.46
Bread, loafes	Bakery products	0.46
Butter	Oils and fats (without margarine)	0.10
Candy	Confectioneries	0.00
Canned fish	Fish and fish products	0.33
Canned meat/poultry	Meat products	0.44
Cat food	Pet food	0.00
Cereals	Other grain mill products	0.11
Chewing gum	Confectioneries	0.00
Chicken charcuterie	Poultry meat	0.05
Chicken eggs	Eggs	0.50
Chicken meat	Poultry meat	0.05
Chips	Other proc. fruits and vegetables	0.16
Chocolate	Coffee and chocolate products	0.04
Chocolate bars	Coffee and chocolate products	0.04
Chocolate branches	Coffee and chocolate products	0.04
Chocolate dragees	Coffee and chocolate products	0.04
Chocolate marshmallow	Coffee and chocolate products	0.04
Chocolate other	Coffee and chocolate products	0.04
Chocolate pralines	Coffee and chocolate products	0.04
Chocolate/Cocoa powder	Coffee and chocolate products	0.04
Cider	Sparkling wine	0.11
Cleaning additive	Products for laundering, dishw. & cleaning	0.74

Cleaning agent	Products for laundering, dishw. & cleaning	0.74
Cleaning aids	Products for laundering, dishw. & cleaning	0.74
Cleansing tissue	Household & hygiene prod. from pulp & paper	0.33
Coffee beans	Coffee	0.11
Coffee complements	Coffee	0.11
Coffee filter	Household & hygiene prod. from pulp & paper	0.33
Convencience food	Convencience food	0.33
Convencience food at home	Convencience food	0.33
Cook set/Meal kits	Convencience food	0.33
Cooked convenience sauces	Soups and broths	0.00
Cookies	Bakery products	0.46
Cooking fat	Oils and fats (without margarine)	0.10
Cooking oil	Oils and fats (without margarine)	0.10
Cotton	Household & hygiene prod. from pulp & paper	0.33
Cotton pads	Household & hygiene prod. from pulp & paper	0.33
Cream	Other milk products	0.59
Cream cheese	Cheese	0.47
Crispy bread	Bakery products	0.46
Curd	Other milk products	0.59
Dessert products	Confectioneries	0.00
Desserts	Other milk products	0.59
DF Bakery products	Convencience food	0.33
DF Fish	Convencience food	0.33
DF Fruits	Convencience food	0.33
DF Ice cream	Convencience food	0.33
DF Meat	Convencience food	0.33
DF Pasta	Convencience food	0.33
DF Pizza	Convencience food	0.33
DF potatoes	Convencience food	0.33
DF Poultry	Convencience food	0.33
DF Vegetables/Mushrooms	Convencience food	0.33
Disposable bags	Household & hygiene prod. from pulp & paper	0.33
Dog food	Pet food	0.00
Dried soups	Condiments and seasonings	0.40
Dry Pasta	Pasta	0.00
Dry toilet paper	Household & hygiene prod. from pulp & paper	0.33
Fish	Fish and fish products	0.33
Flour	Other grain mill products	0.11
Foil	Household & hygiene prod. from pulp & paper	0.33
Foreign red wine	Red wine	0.10
Foreign wine rose	Red wine	0.10
Foreign wine white	White wine	0.14
Fruit gum	Confectioneries	0.00
Fruit juice	Fruit and vegetable juices	0.08
Fruit tins	Other proc. fruits and vegetables	0.16
Fruit/Nut mix	Other proc. fruits and vegetables	0.16
Fruits dried	Other proc. fruits and vegetables	0.16

Gellant	Starches and starch products	0.29
Grain/products	Other grain mill products	0.11
Hard cheese	Cheese	0.47
HB/pastries	Bakery products	0.46
Health medicine	Pharmac. specialities & other pharm. prod.	0.38
Herbal/fruit tea	Tea	0.06
Honey	Other foods	0.71
Horseradish	Condiments and seasonings	0.40
Ice-Tea	Soft drinks	0.00
Instant coffee	Coffee	0.11
Instant salad	Convencience food	0.33
Intimate	Body care products and perfumes	0.57
Jam	Other proc. fruits and vegetables	0.16
Ketchup	Condiments and seasonings	0.40
Lemon juice/concentrate	Fruit and vegetable juices	0.08
Liqueur	Spirits	0.18
Margarine	Other milk products	0.59
Mashed potatoes	Convencience food	0.33
Mayonnaise	Condiments and seasonings	0.40
Meat, beef	Other meat	0.11
Meat, veal	Other meat	0.11
Milk concentrate	Other milk products	0.59
Milk drinks	Other milk products	0.59
Milk fresh	Other milk products	0.59
Molasses	Homogenized and dietetic food	0.00
Mustard	Condiments and seasonings	0.40
Nectar	Fruit and vegetable juices	0.08
Nuts	Homogenized and dietetic food	0.00
Nuts/Nut mixes	Other foods	0.71
Olives	Other proc. fruits and vegetables	0.16
One-way diapers	Household & hygiene prod. from pulp & paper	0.33
Ordinary table wine red	Red wine	0.10
Ordinary table wine white	White wine	0.14
Other bakery products	Bakery products	0.46
Other charcuterie	Meat products	0.44
Other confectionery	Confectioneries	0.00
Other health care	Homogenized and dietetic food	0.00
Other household items	Household & hygiene prod. from pulp & paper	0.33
Other meat	Other meat	0.11
Other oral hygiene	Body care products and perfumes	0.57
Other pastries	Bakery products	0.46
Other pet food	Pet food	0.00
Other poultry	Poultry meat	0.05
Other sausage products	Meat products	0.44
Panty liners	Household & hygiene prod. from pulp & paper	0.33
Pasta	Pasta	0.00
Pasta products	Pasta	0.00

Pasta tins	Pasta	0.00
Pet food	Pet food	0.00
Pickled items	Other proc. fruits and vegetables	0.16
Pies (Wähen)	Bakery products	0.46
Pizza	Convencience food	0.33
Pork charcuterie	Pork meat	0.43
Pork meat	Pork meat	0.43
Pork sausage	Meat products	0.44
Portions	Tea	0.06
Power food	Homogenized and dietetic food	0.00
Processed cheese	Cheese	0.47
Razors	Small devices	0.22
Rice	Rice	0.00
Rtec	Other grain mill products	0.11
Rusk	Bakery products	0.46
Salad dressing uncooked	Condiments and seasonings	0.40
Salmon	Fish and fish products	0.33
Salt	Condiments and seasonings	0.40
sanitary napkins	Household & hygiene prod. from pulp & paper	0.33
Seafood	Fish and fish products	0.33
Seasoning	Condiments and seasonings	0.40
Semi hard	Cheese	0.47
Shopping help	Household & hygiene prod. from pulp & paper	0.33
Sirup	Soft drinks	0.00
Small bread	Bakery products	0.46
Snacks other	Other foods	0.71
Soda concentrate	Soft drinks	0.00
Soft cheese	Cheese	0.47
Sparkling water	Mineral water	0.00
Sparkling wine pure	Sparkling wine	0.11
Special products	Products for laundering, dishw. & cleaning	0.74
Sport/Energy drinks	Soft drinks	0.00
Starch products	Starches and starch products	0.29
Sticks	Household & hygiene prod. from pulp & paper	0.33
Still water	Mineral water	0.00
Styling	Body care products and perfumes	0.57
Sugar	Sugar	0.08
Swedish bread	Bakery products	0.46
Sweetened	Confectioneries	0.00
Sweetened water	Soft drinks	0.00
Sweeteners	Homogenized and dietetic food	0.00
Table deco	Household & hygiene prod. from pulp & paper	0.33
Table juice	Fruit and vegetable juices	0.08
Table vinegar	Condiments and seasonings	0.40
Tampons	Household & hygiene prod. from pulp & paper	0.33
Tinfoil	Tinfoil	0.67
Tofu/Soja	Other foods	0.71

Toilet stones	Products for laundering, dishw. & cleaning	0.74
Tomato puree	Condiments and seasonings	0.40
Toothbrushes	Body care products and perfumes	0.57
Tortillas/Tacos	Bakery products	0.46
Torts/Pies/Cake	Bakery products	0.46
uncooked seasoning	Condiments and seasonings	0.40
Unsweetend food supplements	Homogenized and dietetic food	0.00
Veal sausage	Meat products	0.44
Vegetable juice	Fruit and vegetable juices	0.08
Vegetable tins	Other proc. fruits and vegetables	0.16
Vegetables dried	Other proc. fruits and vegetables	0.16
Vegetables/Antipasti	Other proc. fruits and vegetables	0.16
Vitamines	Homogenized and dietetic food	0.00
Warm unc.	Condiments and seasonings	0.40
Wet soups uncooked	Condiments and seasonings	0.40
Wet wipes	Household & hygiene prod. from pulp & paper	0.33
Whisky	Spirits	0.18
White spirits	Spirits	0.18
Whole-grain cracker	Bakery products	0.46
Wine/Sparkling wine mix	Sparkling wine	0.11
Yoghurt	Other milk products	0.59

C Border prices: additional results

C.1 Regression (1) in subsections 3.1 and 3.3

We report tables with our baseline results and a wide range of sensitivity analysis. Specifically, we (i) include time × importing firm fixed effects (which implies similar point estimates as including × category fixed effects, but larger standard errors due to the small number of firms that report invoicing in both EUR and CHF),[A3] (ii) include non-CHF invoiced products in all currencies (not only EUR), (iii) restrict our sample to product categories that can be matched to our Nielsen retail product categories (and weighting border product categories based on Nielsen consumer expenditures in 2014), (iv) weight border categories by 2015 2-digit NAICS weights provided by the SFSO, (v) convert EUR-invoiced prices into CHF prices based on the official quarterly EUR/CHF rate rather than using CHF prices provided by the SFSO (which are subject to measurement error as discussed above), and (vi) consider the unbalanced sample. We also report pass-through rates adjusting EUR/CHF by changes in the euro area producer price index, which makes very little difference since inflation is very low in this period.

Table C.1: *Border and retail pass-through rates adjusted for euro area producer price index*

	Changes				Rates			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1) EUR/CHF	-14.6	-15.5	-10.3	-11.4				
2) All EUR inv.	-12.4	-13.8	-12.0	-11.0	85.5	88.6	116.8	96.4
3) Non-zero price changes	-15.7	-15.2	-13.2	-12.4	108.0	97.9	128.7	109.4
4) All CHF inv.	-3.4	-4.5	-5.2	-5.5	23.1	29.2	50.5	48.0
5) Non-zero price changes	-5.8	-6.9	-7.3	-7.2	40.1	44.2	70.9	63.8
6) Retail imports	-1.3	-2.9	-2.7	-3.9	8.9	18.4	26.7	34.1
7) Retail domest.	-0.3	-0.7	-0.4	-0.8	2.1	4.3	3.9	7.0

Notes: This table presents the same information as Table 3 in the main text, but in the calculations of pass-through rates adjusts the EUR/CHF change by the change in the producer price index in the euro area.

[A3] Our non-commodity sample includes a total of 616 unique importing firm indicators, and only 30 report prices in both EUR and CHF in any given quarter between 15Q1 and 16Q2. Conditional on non-zero price changes, our sample includes 475 importing firms and only 19 report prices in both EUR and CHF.

Table C.2: *Border price changes by invoicing currency, baseline sample*

	All			Non-zero		
	(1)	(2)	(3)	(4)	(5)	(6)
2015Q1	-0.091***	-0.092***	-0.086***	-0.099***	-0.106***	-0.094***
	[0.010]	[0.011]	[0.015]	[0.019]	[0.022]	[0.036]
2015Q2	-0.092***	-0.084***	-0.087***	-0.084***	-0.068***	-0.065*
	[0.008]	[0.009]	[0.020]	[0.014]	[0.017]	[0.036]
2015Q3	-0.068***	-0.060***	-0.063***	-0.059***	-0.045***	-0.053*
	[0.008]	[0.009]	[0.017]	[0.014]	[0.016]	[0.028]
2015Q4	-0.055***	-0.048***	-0.042*	-0.052***	-0.032**	-0.034
	[0.009]	[0.010]	[0.023]	[0.014]	[0.015]	[0.039]
2016Q1	-0.035***	-0.031***	-0.025	-0.031**	-0.010	-0.007
	[0.010]	[0.011]	[0.024]	[0.015]	[0.016]	[0.038]
2016Q2	-0.038***	-0.034***	-0.022	-0.035**	-0.010	0.013
	[0.011]	[0.012]	[0.030]	[0.016]	[0.018]	[0.043]
Observations	15424	15353	14478	10498	10403	9598
Adjusted R^2	0.13	0.21	0.45	0.13	0.22	0.46
Avg effect 15 Q1-Q3	0.084***	0.079***	0.079***	0.078***	0.069***	0.069**
	[0.007]	[0.009]	[0.016]	[0.015]	[0.017]	[0.030]
Adjusted R^2	0.23	0.32	0.54	0.22	0.32	0.54
Observations	9466	9414	8907	6425	6366	5892
Unique products	2394	2394	2394	2394	2394	2394
Quarter × category fixed effect	NO	YES	NO	NO	YES	NO
Quarter × firm fixed effect	NO	NO	YES	NO	NO	YES

Notes: The upper panel shows estimates of β_t in equation (1) for t=15Q1,...,16Q2, where β_t represents the difference in the average price change of EUR-invoiced goods and CHF-invoiced goods. The bottom panel shows the average effect (imposing common β_t) in 15Q1, 15Q2, and 15Q3. Columns 4-6 include only non-zero price changes. Columns 1 and 4 include time fixed effects. Columns 2 and 5 category × time fixed effects, and columns 3 and 6 importing firm × time fixed effects. Observations are not weighted. Standard errors are clustered by importing firm in columns 3 and 6 and by border product category in all other columns.

Table C.3: *Border price changes by invoicing currency, all non-CHF invoiced goods*

	All		Non-zero	
	(1)	(2)	(3)	(4)
2015Q1	-0.084***	-0.087***	-0.093***	-0.104***
	[0.009]	[0.010]	[0.019]	[0.021]
2015Q2	-0.086***	-0.080***	-0.078***	-0.067***
	[0.007]	[0.009]	[0.014]	[0.017]
2015Q3	-0.062***	-0.057***	-0.055***	-0.045***
	[0.007]	[0.008]	[0.013]	[0.015]
2015Q4	-0.046***	-0.043***	-0.043***	-0.032**
	[0.009]	[0.009]	[0.014]	[0.015]
2016Q1	-0.028***	-0.029***	-0.024	-0.012
	[0.010]	[0.011]	[0.016]	[0.016]
2016Q2	-0.034***	-0.033***	-0.030*	-0.012
	[0.011]	[0.011]	[0.016]	[0.018]
Observations	15783	15713	10674	10584
Adjusted R^2	0.12	0.20	0.12	0.22
Avg effect 15 Q1-Q3	0.078***	0.075***	0.073***	0.068***
	[0.007]	[0.008]	[0.014]	[0.016]
Adjusted R^2	0.22	0.30	0.21	0.32
Observations	9688	9636	6534	6477
Unique products	2449	2449	2449	2449
Border categories	150	150	149	149
Quarter × category fixed effects	NO	YES	NO	YES

Notes: This table repeats Table C.2 (excluding firm fixed effect specifications) but including border prices invoiced in all currencies (instead of only EUR- and CHF-invoiced prices).

Table C.4: *Border price changes by invoicing currency, Nielsen categories weighted by 2014 expenditures*

	All		Non-zero	
	(1)	(2)	(3)	(4)
2015Q1	-0.103***	-0.099***	-0.092***	-0.063***
	[0.013]	[0.012]	[0.025]	[0.020]
2015Q2	-0.094***	-0.081***	-0.064**	-0.036**
	[0.012]	[0.011]	[0.026]	[0.014]
2015Q3	-0.055***	-0.041**	-0.038	-0.021
	[0.019]	[0.016]	[0.040]	[0.036]
2015Q4	-0.070	-0.076	0.029	0.049
	[0.059]	[0.087]	[0.033]	[0.043]
2016Q1	-0.110*	-0.172**	-0.026*	-0.070**
	[0.058]	[0.069]	[0.015]	[0.031]
2016Q2	-0.123**	-0.202***	-0.032*	-0.086*
	[0.058]	[0.069]	[0.017]	[0.044]
Observations	3225	3224	2367	2359
Adjusted R^2	0.13	0.16	0.11	0.15
Avg effect 15 Q1-Q3	0.084***	0.073***	0.061**	0.036*
	[0.013]	[0.012]	[0.030]	[0.018]
Adjusted R^2	0.21	0.25	0.18	0.26
Observations	2028	2028	1464	1461
Unique products	507	507	507	507
Border categories	32	32	32	32
Quarter × category fixed effects	NO	YES	NO	YES

Notes: This table presents the same information as Table C.2 (excluding firm fixed effect specifications), but the sample is restricted to border categories matched to goods in the Nielsen retail data, excluding those with 7 or less border price observations per quarter on average in 2014 ('min7+' sample). Border categories are weighted by 2014 consumer expenditures, and observations within category are equally weighted.

Table C.5: *Border price changes by invoicing currency, baseline sample weighted by 2015 2-digit NAICS weights*

	All		Non-zero	
	(1)	(2)	(3)	(4)
2015Q1	-0.076***	-0.081***	-0.086***	-0.098***
	[0.013]	[0.011]	[0.022]	[0.022]
2015Q2	-0.086***	-0.079***	-0.079***	-0.063***
	[0.008]	[0.008]	[0.015]	[0.018]
2015Q3	-0.075***	-0.068***	-0.068***	-0.051***
	[0.008]	[0.009]	[0.013]	[0.016]
2015Q4	-0.056***	-0.052***	-0.047***	-0.024
	[0.009]	[0.010]	[0.017]	[0.022]
2016Q1	-0.037***	-0.038***	-0.028	-0.006
	[0.010]	[0.011]	[0.019]	[0.022]
2016Q2	-0.043***	-0.043***	-0.033	-0.012
	[0.013]	[0.013]	[0.023]	[0.028]
Observations	15414	15343	10488	10393
Adjusted R^2	0.13	0.21	0.12	0.22
Avg effect 15 Q1-Q3	0.079***	0.076***	0.077***	0.067***
	[0.008]	[0.007]	[0.015]	[0.016]
Adjusted R^2	0.22	0.33	0.22	0.34
Observations	9458	9406	6417	6358
Unique products	2392	2392	2392	2392
Quarter × category fixed effects	NO	YES	NO	YES

Notes: This table presents the same information as Table C.2 (excluding firm fixed effect specifications), but non-commodity border categories are weighted by December 2015 2-digit NAICS weights from the SFSO.

Table C.6: *Border price changes by invoicing currency, unbalanced sample*

	All		Non-zero	
	(1)	(2)	(3)	(4)
2015Q1	-0.093***	-0.098***	-0.097***	-0.098***
	[0.009]	[0.009]	[0.017]	[0.017]
2015Q2	-0.095***	-0.087***	-0.084***	-0.063***
	[0.007]	[0.008]	[0.014]	[0.015]
2015Q3	-0.067***	-0.059***	-0.057***	-0.040***
	[0.007]	[0.007]	[0.012]	[0.013]
2015Q4	-0.054***	-0.043***	-0.048***	-0.020
	[0.008]	[0.009]	[0.013]	[0.015]
2016Q1	-0.033***	-0.031***	-0.026**	-0.010
	[0.008]	[0.009]	[0.013]	[0.013]
2016Q2	-0.036***	-0.032***	-0.029**	-0.010
	[0.009]	[0.010]	[0.014]	[0.014]
Observations	19531	19475	13155	13071
Adjusted R^2	0.15	0.23	0.14	0.24
Avg effect 15 Q1-Q3	0.086***	0.082***	0.078***	0.064***
	[0.007]	[0.007]	[0.013]	[0.014]
Adjusted R^2	0.26	0.34	0.24	0.34
Observations	12426	12386	8316	8265
Unique products	3406	3406	3406	3406
Border categories	152	152	151	151
Quarter × category fixed effects	NO	YES	NO	YES

Notes: This table repeats Table C.2 (excluding firm fixed effect specifications) but based on the non-balanced sample of border prices.

Table C.7: *Border price changes by invoicing currency, EUR-invoiced prices converted using official EUR/CHF*

	All		Non-zero	
	(1)	(2)	(3)	(4)
2015Q1	-0.115***	-0.114***	-0.122***	-0.125***
	[0.008]	[0.009]	[0.018]	[0.021]
2015Q2	-0.108***	-0.098***	-0.098***	-0.081***
	[0.007]	[0.009]	[0.014]	[0.017]
2015Q3	-0.047***	-0.042***	-0.035**	-0.025
	[0.008]	[0.009]	[0.014]	[0.016]
2015Q4	-0.055***	-0.050***	-0.052***	-0.034**
	[0.009]	[0.010]	[0.013]	[0.016]
2016Q1	-0.034***	-0.031***	-0.032**	-0.011
	[0.010]	[0.011]	[0.016]	[0.017]
2016Q2	-0.040***	-0.036***	-0.037**	-0.011
	[0.011]	[0.011]	[0.016]	[0.019]
Observations	15355	15284	10464	10366
Adjusted R^2	0.15	0.22	0.13	0.22
Avg effect 15 Q1-Q3	0.090***	0.085***	0.080***	0.071***
	[0.007]	[0.009]	[0.015]	[0.017]
Adjusted R^2	0.26	0.32	0.22	0.32
Observations	9417	9365	6401	6340
Unique products	2376	2376	2376	2376
Border categories	150	150	149	149
Quarter × category fixed effects	NO	YES	NO	YES

Notes: This table repeats Table C.2 (excluding firm fixed effect specifications) but converting EUR-invoiced prices into CHF prices based on the official quarterly EUR/CHF rate rather than using CHF prices provided by the SFSO.

Table C.8: *Border price changes by invoicing currency, commodity sample*

	All		Non-zero	
	(1)	(2)	(3)	(4)
2015Q1	-0.086***	-0.026**	-0.081**	-0.021**
	[0.028]	[0.010]	[0.031]	[0.008]
2015Q2	-0.083*	-0.005	-0.079*	-0.006
	[0.041]	[0.013]	[0.044]	[0.015]
2015Q3	-0.037	0.026**	-0.036	0.026**
	[0.023]	[0.011]	[0.025]	[0.011]
2015Q4	-0.036*	0.004	-0.028	0.008
	[0.021]	[0.018]	[0.019]	[0.017]
2016Q1	-0.029	0.017	-0.019	0.021
	[0.025]	[0.018]	[0.025]	[0.017]
2016Q2	-0.044*	0.005	-0.037	0.008
	[0.025]	[0.009]	[0.025]	[0.009]
Observations	4031	4007	3802	3773
Adjusted R^2	0.15	0.42	0.15	0.43
Avg effect 15 Q1-Q3	0.068**	0.002	0.064*	-0.001
	[0.030]	[0.011]	[0.033]	[0.011]
Adjusted R^2	0.09	0.38	0.09	0.39
Observations	2340	2328	2197	2182
Unique products	588	588	588	588
Border categories	29	29	29	29
Quarter × category fixed effects	NO	YES	NO	YES

Notes: This table repeats Table C.2 (excluding firm fixed effect specifications) but based on the commodity sample of products.

C.2 Regression (2) in subsection 3.2

We report estimates of regression (2) when using the quarterly EUR/CHF exchange rate from the SNB to convert EUR-invoiced prices into prices in CHF.

Table C.9: *Border price changes and EUR invoicing intensity across border product categories, EUR-invoiced prices converted using official EUR/CHF*

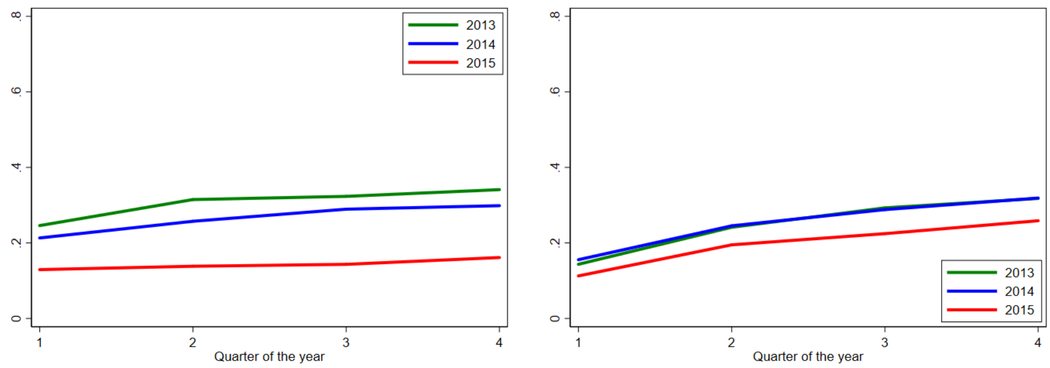
	noncommodity	Nielsen unw.	Nielsen weighted
2015Q1	-0.099***	-0.096***	-0.115***
	[0.015]	[0.025]	[0.029]
2015Q2	-0.096***	-0.101***	-0.146***
	[0.018]	[0.027]	[0.033]
2015Q3	-0.024	-0.046*	-0.104***
	[0.022]	[0.026]	[0.036]
2015Q4	-0.025	-0.032	-0.041
	[0.026]	[0.023]	[0.026]
2016Q1	-0.009	-0.009	-0.005
	[0.030]	[0.028]	[0.029]
2016Q2	-0.009	-0.017	-0.022
	[0.030]	[0.030]	[0.030]
Observations	888	220	220
Adjusted R^2	0.23	0.31	0.49
Avg effect 15 Q1-Q3	-0.073***	-0.081***	-0.122***
	[0.011]	[0.015]	[0.019]
Observations	544	128	128
Adjusted R^2	0.36	0.45	0.63
Unique categories	136	32	32
Border categories	150	32	32

Notes: This table repeats Table 4 but converting EUR-invoiced prices into CHF prices based on the official quarterly EUR/CHF rate rather than using CHF prices provided by the SFSO.

C.3 Price stickiness in subsection 3.3

We present additional results for the border price stickiness analysis in subsection 3.3. We show the fraction of border price increases and the fraction of border price changes for commodities, since the baseline includes only non-commodities. Furthermore, we consider additional regressions on the frequency and size of price changes.

Figure C.1: *Fraction of border price increases by currency of invoicing in the baseline sample*

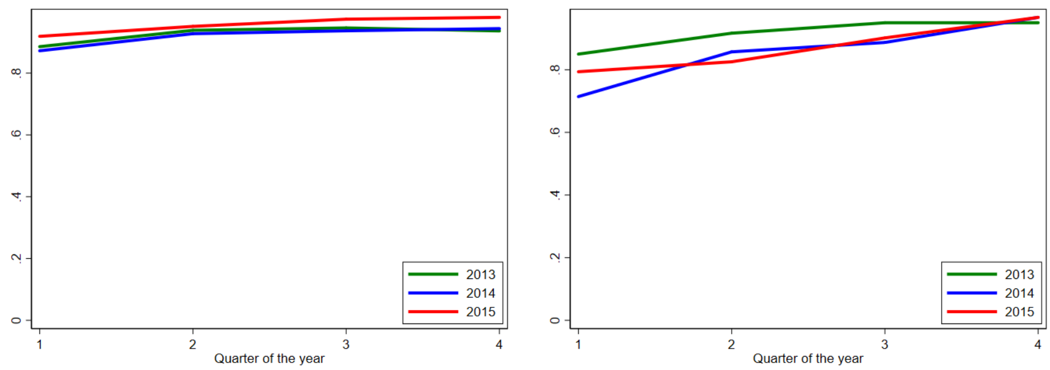


(a) Increases CHF-inv.

(b) Increases EUR-inv.

Notes: This figure reports the fraction of products with increases in the invoicing price compared with Q4 of the previous year, in the same format as Figure 3.

Figure C.2: *Fraction of border price changes by currency of invoicing in the commodities sample*



(a) Changes CHF-inv.

(b) Changes EUR-inv.

Notes: This figure reports the fraction of products with changes in the invoicing price compared with Q4 of the previous year in the sample of commodity products, in the same format as Figure 3.

Additional regressions on the frequency and size of border price changes

We consider regressions of the form:

$$f_{iyh} = \mathbb{I}_{y=14} \times (\alpha_{14} + \beta_{14} f_{iy-1h}) + \mathbb{I}_{y=15} \times (\alpha_{15} + \beta_{15} f_{iy-1h}) + \varepsilon_{iyh} \quad \text{(A1)}$$

where f_{iyh} is equal to 1 if the price of product i changes between Q4 of year $y-1$ and quarter h of year y, and 0 otherwise. We include $y = 14, 15$ and $h = 1, ..., 4$. Results are reported in Table C.10.

Table C.10: *Fraction of price changes given previous year price change*

CHF invoiced	(1) 1Q	(2) 2Q	(3) 3Q	(4) 4Q
α_{14}	0.218***	0.266***	0.262***	0.272***
	[0.014]	[0.017]	[0.018]	[0.019]
β_{14}	0.447***	0.458***	0.516***	0.534***
	[0.023]	[0.023]	[0.023]	[0.023]
α_{15}	0.442***	0.483***	0.517***	0.542***
	[0.016]	[0.018]	[0.019]	[0.021]
β_{15}	0.339***	0.343***	0.345***	0.338***
	[0.022]	[0.022]	[0.022]	[0.023]
Observations	3275	3223	3149	3032
R^2	0.59	0.67	0.72	0.75
Wald $\alpha_{14} = \alpha_{15}$	0.000	0.000	0.000	0.000
Wald $\alpha_{14} + \beta_{14} = \alpha_{15} + \beta_{15}$	0.000	0.000	0.000	0.000

EUR invoiced	(1) 1Q	(2) 2Q	(3) 3Q	(4) 4Q
α_{14}	0.201***	0.258***	0.259***	0.314***
	[0.021]	[0.026]	[0.028]	[0.031]
β_{14}	0.396***	0.382***	0.430***	0.407***
	[0.050]	[0.045]	[0.043]	[0.044]
α_{15}	0.218***	0.299***	0.308***	0.340***
	[0.020]	[0.025]	[0.026]	[0.031]
β_{15}	0.321***	0.279***	0.331***	0.312***
	[0.045]	[0.042]	[0.040]	[0.045]
Observations	1039	1014	1003	892
R^2	0.384	0.467	0.535	0.568
Wald $\alpha_{14} = \alpha_{15}$	0.567	0.252	0.207	0.543
Wald $\alpha_{14} + \beta_{14} = \alpha_{15} + \beta_{15}$	0.327	0.204	0.244	0.114

Notes: Estimates of regression (A1) for CHF-invoiced goods (top panel) and EUR-invoiced goods (bottom panel). The last two rows report the p-values of Wald tests. Observations are unweighted and standard errors are clustered at the level of border product categories.

According to the estimates in Table C.10, for every horizon, $\beta_{14} > 0$ and $\beta_{15} > 0$ for both CHF-invoiced goods and EUR-invoiced goods. That is, for each quarterly horizon, products for which prices in the invoicing currency changed in 2013 (relative to 4Q of the previous year) are more likely to display a price change in 2014 (relative to 4Q of the previous year). Similarly, products for which the price changed in 2014 are more likely to display a price change in 2015. Moreover, for CHF-invoiced goods, we have $\alpha_{15} > \alpha_{14}$, and $\alpha_{15} + \beta_{15} > \alpha_{14} + \beta_{14}$. That is, for each horizon, the likelihood of a CHF-invoiced price change rises in 2015 irrespective of whether the price did change in the previous year. In contrast, there is no statistically significant change in the likelihood of a price change for EUR-invoiced goods (see Wald tests at the bottom of the table).

We next consider regressions of the form:

$$s_{iyh} = \mathbb{I}_{y=14} \times (\alpha_{14} + \beta_{14} f_{iy-1h}) + \mathbb{I}_{y=15} \times (\alpha_{15} + \beta_{15} f_{iy-1h}) + \varepsilon_{iyh} \tag{A2}$$

where s_{iyh} is equal to absolute value of the log price change if the price of product i changes between Q4 of year $y-1$ and quarter h of year y. We include $y = 14, 15$ and $h = 1, ..., 4$. Results are reported in Table C.11.

We see that α_{14} is close to zero (no trends in price changes before 15Q1) and $\alpha_{15} < 0$ (on average, non-zero price changes become negative in 2015 since the fraction of price reductions fell as of 15Q1). More importantly, β_{14} and β_{15} are roughly zero. That is, the size of non-zero price changes does not differ systematically between more and less flexible price goods. We use this result to motivate our assumption, in our counterfactuals, that the size of non-zero price changes does not vary systematically across products with the likelihood of a price change in previous year (a measure of the product's price flexibility).

Table C.11: *Size of nonzero price changes for goods that changed price in previous year*

CHF invoiced	(1) 1Q	(2) 2Q	(3) 3Q	(4) 4Q
α_{14}	-0.010	-0.005	0.004	0.007
	[0.007]	[0.008]	[0.009]	[0.009]
β_{14}	0.011	0.005	-0.010	-0.011
	[0.008]	[0.009]	[0.010]	[0.010]
α_{15}	-0.061***	-0.072***	-0.081***	-0.076***
	[0.004]	[0.005]	[0.006]	[0.006]
β_{15}	0.005	0.005	0.012*	0.004
	[0.006]	[0.007]	[0.007]	[0.008]
Observations	1645	1907	2028	2052
R^2	0.19	0.19	0.20	0.19
Wald $\alpha_{14} = \alpha_{15}$	0.000	0.000	0.000	0.000
Wald $\alpha_{14} + \beta_{14} = \alpha_{15} + \beta_{15}$	0.000	0.000	0.000	0.000

EUR invoiced	(1) 1Q	(2) 2Q	(3) 3Q	(4) 4Q
α_{14}	0.014**	0.011	0.019	0.032**
	[0.006]	[0.013]	[0.012]	[0.014]
β_{14}	-0.026**	-0.004	0.000	-0.019
	[0.011]	[0.016]	[0.014]	[0.016]
α_{15}	-0.029***	-0.010	-0.001	-0.015
	[0.010]	[0.011]	[0.012]	[0.012]
β_{15}	-0.006	-0.009	-0.009	0.003
	[0.016]	[0.014]	[0.015]	[0.015]
Observations	315	409	459	448
R^2	0.08	0.02	0.02	0.03
Wald $\alpha_{14} = \alpha_{15}$	0.000	0.227	0.234	0.010
Wald $\alpha_{14} + \beta_{14} = \alpha_{15} + \beta_{15}$	0.116	0.052	0.015	0.024

Notes: Estimates of regression (A2) for CHF-invoiced goods (top panel) and EUR-invoiced goods (bottom panel). The last two rows report the p-value of Wald tests. Observations are unweighted and standard errors are clustered at the level of border product categories.

C.4 Counterfactuals in subsection 3.4

We present additional information for the counterfactuals in subsection 3.4. We first show the results for all quarters of 2015 (the main text reports only the first and the fourth quarter). We then report results when we assume that average changes in border prices are calculated using a lower CHF invoicing share than the one we assume in our baseline. Finally, we report results based on EUR-invoiced prices converted using the quarterly EUR/CHF exchange rate from the SNB.

Table C.12: *Baseline counterfactual results for all quarters*

	15Q1			15Q2		
	CHF	EUR	2\3 CHF +1\3 EUR	CHF	EUR	2\3 CHF +1\3 EUR
1) Actual	-3.4	-14.5	-7.1	-4.5	-14.9	-8.0
2) All sticky	0.0	-14.0	-4.7	0.0	-14.7	-4.9
3) All flexible	-5.8	-15.7	-9.1	-6.9	-15.2	-9.7
4) All flex - all sticky			-4.5			-4.7
5) All CHF	-3.4	-9.1	-5.3	-4.5	-10.0	-6.4
6) All EUR	-11.5	-14.5	-12.5	-11.6	-14.9	-12.7
7) All EUR - all CHF			-7.2			-6.3

	15Q3			15Q4		
	CHF	EUR	2\3 CHF +1\3 EUR	CHF	EUR	2\3 CHF +1\3 EUR
1) Actual	-5.2	-11.2	-7.2	-5.4	-11.5	-7.4
2) All sticky	0.0	-9.6	-3.2	0.0	-10.6	-3.5
3) All flexible	-7.3	-13.2	-9.3	-7.2	-12.4	-9.0
4) All flex - all sticky			-6.1			-5.4
5) All CHF	-5.2	-9.4	-6.6	-5.4	-9.3	-6.7
6) All EUR	-8.5	-11.2	-9.4	-8.9	-11.5	-9.8
7) All EUR - all CHF			-2.9			-3.1

Notes: See main text for a description of each counterfactual.

Recall that we calculate changes in border prices as a weighted average of changes in CHF-invoiced border prices and changes in EUR-invoiced border prices. In our baseline, we assume a CHF invoicing share of 2/3, obtained from the SFSO data. We now consider a lower CHF invoicing share of 32%, as reported in Federal Customs Administration (2015).

In 15Q1, the average change in border prices due to a shift from "All sticky" to "All flex" is -3% and the average change in border prices due a shift in invoicing from "All CHF" to

"All EUR" is −6.3%. In 15Q2, these statistics are −2.5% and −5.6%, respectively. In 15Q3, these statistics are −4.8% and −2.3%, respectively. In 15Q4, these statistics are −3.6% and −2.6%, respectively. While these differences are smaller than our baseline, we still obtain the result that in the first two quarters of 2015, a shift in invoicing from "All CHF" to "All EUR" has a bigger impact on average changes in border prices than a shift from "All sticky" to "All flex".

Table C.13: *Counterfactuals for all for quarters, EUR-invoiced prices converted using official EUR/CHF*

	15Q1			15Q2		
	CHF	EUR	2\3 CHF +1\3 EUR	CHF	EUR	2\3 CHF +1\3 EUR
1) Actual	-3.4	-15.2	-7.3	-4.5	-15.5	-8.2
2) All sticky	0.0	-14.0	-4.7	0.0	-14.7	-4.9
3) All flexible	-5.8	-18.0	-9.9	-6.9	-16.7	-10.2
4) All flex - all sticky			-5.2			-5.2
5) All CHF	-3.4	-10.5	-5.7	-4.5	-11.0	-6.7
6) All EUR	-11.5	-15.2	-12.8	-11.6	-15.5	-12.9
7) All EUR - all CHF			-7.0			-6.2
	15Q3			**15Q4**		
	CHF	EUR	2\3 CHF +1\3 EUR	CHF	EUR	2\3 CHF +1\3 EUR
1) Actual	-5.2	-10.1	-6.8	-5.4	-11.5	-7.5
2) All sticky	0.0	-9.6	-3.2	0.0	-10.6	-3.5
3) All flexible	-7.3	-10.8	-8.4	-7.2	-12.5	-9.0
4) All flex - all sticky			-5.2			-5.5
5) All CHF	-5.2	-7.7	-6.0	-5.4	-9.3	-6.7
6) All EUR	-8.5	-10.1	-9.1	-8.9	-11.5	-9.8
7) All EUR - all CHF			-3.1			-3.1

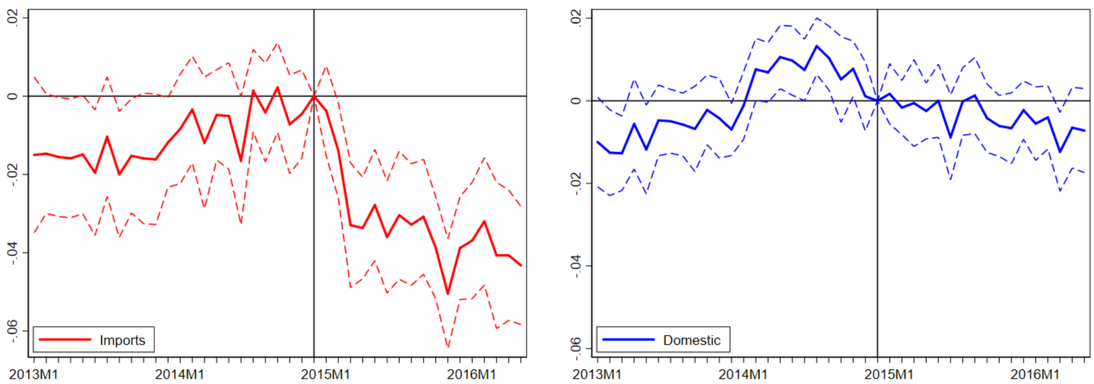
Notes: Same as Table C.12 but using EUR-invoiced prices converted by the end of quarter EUR/CHF rate.

D Retail prices: additional results

D.1 Cumulative average price changes in subsection 4.1

We present additional figures for the average price changes reported in subsection 4.1 in the main text. We show average retail price changes at a monthly frequency, average prices changes for EU imports only (rather than all imports in our baseline analysis), and average price changes including all product categories (rather than dropping categories with 7 or less border prices per quarter in 2014).

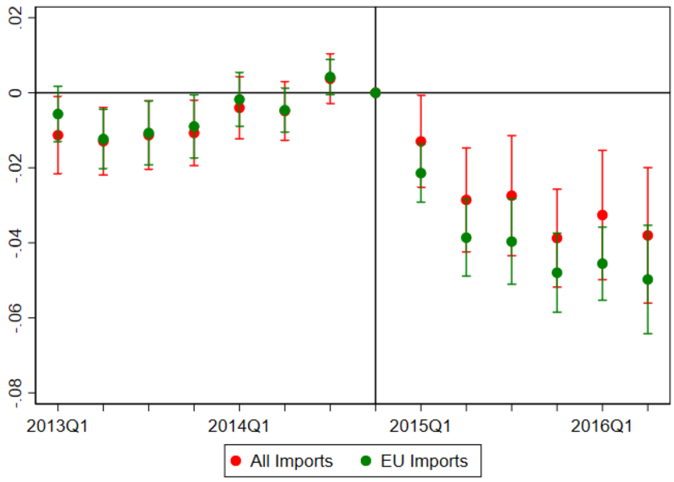
Figure D.1: *Average retail price changes, monthly*



(a) Imports (b) Domestic

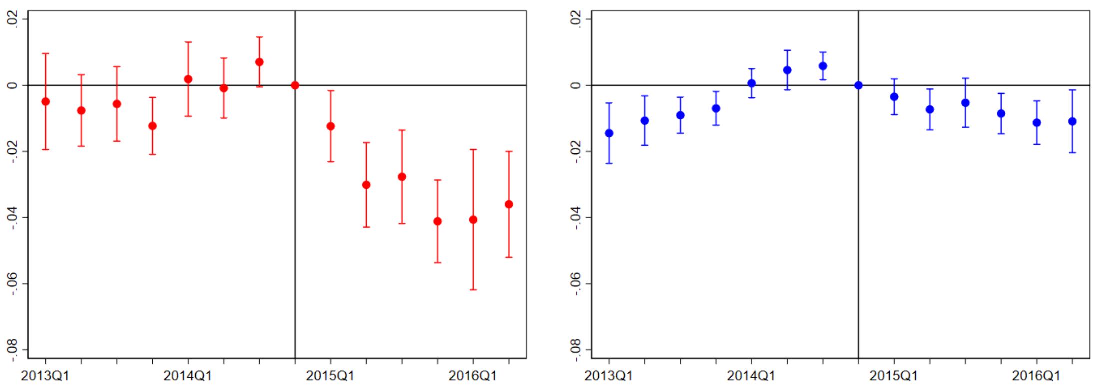
Notes: The solid lines display monthly time fixed effects (or cumulative average price changes) relative to 14Q4 of imports in panel (a) and Swiss-produced goods in panel (b), weighting goods by 2014 Nielsen expenditures and using the baseline sample clustering at the level of retail product class. Dashed lines present the upper and lower bound of a 95% confidence interval for each coefficient estimate. Standard errors are clustered at the level of retail product class.

Figure D.2: *Average retail price changes with EU imports*



Notes: This figure repeats Figure 4 including only imports from the EU (green), compared with all imports baseline (red).

Figure D.3: *Average retail price changes, all border categories*



(a) Imports

(b) Domestic

Notes: This figure repeats Figure 4, but based on the 'min0+' sample of product categories (that is, including all product categories rather than dropping product categories with 7 or less border prices per quarter in 2014).

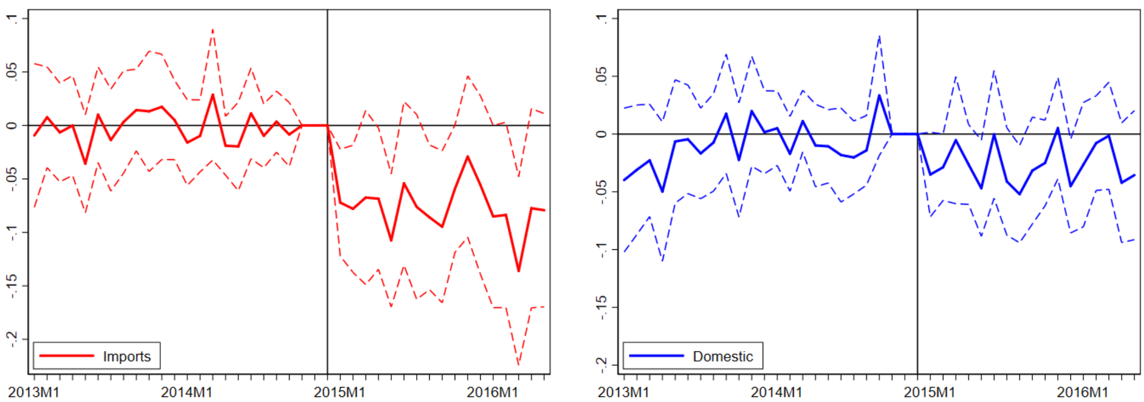
D.2 Regression (3) in subsection 4.2

We report various sensitivities for the estimated relationship between invoicing and retail price responses during the first three quarters of 2015 given in equation (3) in subsection 4.2. We first show the table form of the regression coefficients reported graphically in the main text (we also report estimates at the monthly level). We then consider (i) different weighting schemes (weighting all observations equally or weighting observations equally within border product category) and clustering (border categories), (ii) alternative restrictions in terms of minimum number of quarterly invoicing observations per border product category, (iii) different balanced samples, (iv) alternative aggregations of prices over weeks, regions and stores, (v) different baseline periods (December 2014, average in 2014, and monthly estimates), vi) all non-CHF foreign currency invoiced observations (rather than only EUR), imports from the EU (rather than all imports), and (vii) trimming the dependent variable to exclude very large price changes.

We note that, as we include additional border categories that have a low number of border price observations, estimates of β_t tend to be smaller. If we consider all border product categories (including categories with only 2 or 4 quarterly observations), the estimate of β_t in 15Q1 is -0.049 rather than -0.073 in our baseline, and the average effect in 15Q1-15Q3 is -0.043 (10% significance) rather than -0.078 (5% significance).

We also note that if we restrict our sample to imports from the EU, the magnitude and significance of our estimates is diminished (the average effect in 15Q1-15Q3 is -0.044 (5% significance). In our baseline we include all imports because we do not observe country of origin in our border price data.

Figure D.4: *Invoicing and retail prices, monthly*



(a) Imports

(b) Domestic

Notes: This figure repeats 4 but based on monthly rather than quarterly fixed effects. The solid lines display monthly time fixed effects relative to 14Q4. Dashed lines depict 95% confidence intervals.

Table D.1: *Invoicing and retail prices*

	(1) Imports	(2) Domestic
2015Q1	-0.073***	-0.023
	[0.027]	[0.014]
2015Q2	-0.077**	-0.024
	[0.032]	[0.015]
2015Q3	-0.086**	-0.042**
	[0.037]	[0.020]
2015Q4	-0.048	-0.022
	[0.032]	[0.015]
2016Q1	-0.102**	-0.012
	[0.042]	[0.018]
2016Q2	-0.078*	-0.039
	[0.045]	[0.026]
Adjusted R^2	0.40	0.42
Observations	13113	30643
Avg effect 15 Q1-Q3	-0.078**	-0.030*
	[0.031]	[0.015]
Adjusted R^2	0.547	0.479
Observations	3748	8756
Unique products	937	2189
Retail classes	132	151
Border categories	32	34

Notes: This table reports estimates of β_t from equation (3) for t=15Q1,...,16Q2. The dependent variable is the cumulative change in the price compared with 14Q4. The independent variables include time dummies and time dummies interacted with the 2014 invoicing share. The left column displays results for imported goods, and the right column those for Swiss-produced goods. The bottom panel shows the average effect (imposing common β_t) in 15Q1, 15Q2, and 15Q3. Observations are weighted by 2014 Nielsen expenditures. Standard errors are clustered at the level of retail product class.

Table D.2: *Invoicing and retail prices, alternative weighting and clustering*

	Unweighted		Weights border cat.		Cluster border cat.	
	(1) imports	(2) domestic	(3) imports	(4) domestic	(5) imports	(6) domestic
2015Q1	-0.062***	-0.015	-0.071***	-0.015	-0.073**	-0.023*
	[0.021]	[0.010]	[0.023]	[0.010]	[0.030]	[0.012]
2015Q2	-0.060**	-0.019	-0.081***	-0.013	-0.077**	-0.024
	[0.029]	[0.015]	[0.028]	[0.011]	[0.035]	[0.015]
2015Q3	-0.063*	-0.029	-0.081**	-0.021	-0.086**	-0.042**
	[0.033]	[0.019]	[0.035]	[0.015]	[0.041]	[0.019]
2015Q4	-0.047*	-0.022	-0.060*	-0.012	-0.048	-0.022
	[0.028]	[0.019]	[0.031]	[0.013]	[0.036]	[0.016]
2016Q1	-0.075**	-0.012	-0.089**	-0.003	-0.102**	-0.012
	[0.035]	[0.018]	[0.040]	[0.014]	[0.045]	[0.017]
2016Q2	-0.078**	-0.029	-0.092**	-0.020	-0.078	-0.039
	[0.035]	[0.020]	[0.040]	[0.019]	[0.048]	[0.024]
Adjusted R^2	0.40	0.42	0.40	0.43	0.40	0.42
Observations	13113	30643	13113	30643	13113	30643
Avg effect 15 Q1-Q3	-0.061**	-0.021	-0.078***	-0.016	-0.078**	-0.030**
	[0.027]	[0.014]	[0.028]	[0.011]	[0.035]	[0.014]
Adjusted R^2	0.51	0.44	0.52	0.45	0.55	0.48
Observations	3748	8756	3748	8756	3748	8756
Unique products	937	2189	937	2189	937	2189
Retail classes	132	151	132	151	132	151
Border categories	32	34	32	34	32	34

Notes: This table repeats Table D.1, but with different weights and/or using different clustering. Columns (1) and (2) weight all observations equally, (3) and (4) weight by border product categories based on 2014 Nielsen expenditures (observations are equally weighted within border category), and (5) and (6) cluster by border product categories and weight by 2014 Nielsen expenditures as in the baseline.

Table D.3: *Invoicing and retail prices, alternative border category samples*

	Min 8+		Min 4+		All (Min0+)	
	(1) imports	(2) domestic	(3) imports	(4) domestic	(5) imports	(6) domestic
2015Q1	-0.055***	-0.022	-0.059**	-0.023	-0.049**	-0.017
	[0.020]	[0.015]	[0.028]	[0.014]	[0.024]	[0.013]
2015Q2	-0.061**	-0.022	-0.063**	-0.024	-0.041	-0.018
	[0.027]	[0.015]	[0.031]	[0.015]	[0.030]	[0.014]
2015Q3	-0.067**	-0.042**	-0.069*	-0.041**	-0.052	-0.031
	[0.030]	[0.021]	[0.036]	[0.020]	[0.032]	[0.019]
2015Q4	-0.027	-0.019	-0.036	-0.021	-0.016	-0.014
	[0.024]	[0.016]	[0.031]	[0.015]	[0.030]	[0.014]
2016Q1	-0.076***	-0.009	-0.085**	-0.012	-0.029	-0.004
	[0.024]	[0.018]	[0.041]	[0.017]	[0.054]	[0.017]
2016Q2	-0.053	-0.037	-0.059	-0.038	-0.051	-0.026
	[0.034]	[0.027]	[0.044]	[0.026]	[0.037]	[0.025]
Adjusted R^2	0.42	0.43	0.39	0.42	0.39	0.42
Observations	11801	29229	13925	31385	14623	33259
Avg effect 15 Q1-Q3	-0.061**	-0.028*	-0.064**	-0.029*	-0.047*	-0.022
	[0.025]	[0.015]	[0.031]	[0.015]	[0.028]	[0.014]
Adjusted R^2	0.53	0.47	0.54	0.48	0.54	0.47
Observations	3372	8352	3980	8968	4180	9504
Unique products	843	2088	995	2242	1045	2376
Retail classes	119	137	150	171	155	177
Border categories	29	31	36	38	38	40

Notes: This table repeats Table D.1 for alternative samples according to the minimum number of border price observations per quarter in 2014. Columns (1) and (2) include only product classes matched to border categories with more than 8 border observations, (3) and (4) include only border categories with more than 4 border observations, (5) and (6) include all border categories.

Table D.4: *Invoicing and retail prices, alternative sample balancing periods*

	(1) Balanced from Jan 2013	(2) Balanced from Jan 2014
2015Q1	-0.073***	-0.069**
	[0.028]	[0.027]
2015Q2	-0.077**	-0.068**
	[0.032]	[0.031]
2015Q3	-0.088**	-0.075**
	[0.037]	[0.036]
2015Q4	-0.049	-0.043
	[0.032]	[0.031]
2016Q1	-0.103**	-0.097**
	[0.043]	[0.041]
2016Q2	-0.079*	-0.074*
	[0.045]	[0.044]
Adjusted R^2	0.40	0.39
Observations	12726	13690
Avg effect 15 Q1-Q3	-0.079**	-0.071**
	[0.032]	[0.031]
Adjusted R^2	0.55	0.54
Observations	3636	3924
Unique products	909	981
Retail classes	132	135
Border categories	32	32

Notes: This table repeats Table D.1 for alternative samples. The baseline regression uses a balanced sample of goods observed each month from June 2013 to May 2016. Column (1) considers a balanced sample of goods from January 2013 to May 2016, while column (2) considers a balanced sample from January 2014 to May 2016.

Table D.5: *Invoicing and retail prices, alternative aggregations of transaction-level prices to price series*

	(1) Median within rst	(2) Mode within rst	(3) Median within it
2015Q1	-0.068**	-0.065**	-0.068**
	[0.027]	[0.025]	[0.027]
2015Q2	-0.073**	-0.074**	-0.065**
	[0.031]	[0.031]	[0.031]
2015Q3	-0.082**	-0.081**	-0.078**
	[0.036]	[0.035]	[0.036]
2015Q4	-0.044	-0.045	-0.043
	[0.033]	[0.032]	[0.032]
2016Q1	-0.101**	-0.098**	-0.092**
	[0.043]	[0.041]	[0.043]
2016Q2	-0.080*	-0.080*	-0.066
	[0.044]	[0.043]	[0.045]
Adjusted R^2	0.40	0.38	0.40
Observations	13113	13113	13113
Avg effect 15 Q1-Q3	-0.074**	-0.073**	-0.070**
	[0.031]	[0.030]	[0.031]
Adjusted R^2	0.54	0.54	0.52
Observations	3748	3748	3748
Unique products	937	937	937
Retail classes	132	132	132
Border categories	32	32	32

Notes: This table repeats Table D.1 for alternative aggregations of transaction-level prices to EAN-specific price series. In the baseline, we average P^{ret}_{irst} across households, weeks, and stores in triplet rst. We then average P^{ret}_{irst} across regions and retailers in month t to obtain a measure of the retail price of product i in month t, P^{ret}_{it}. Here, in column (1), we take the median across households, weeks, and stores in triplet rst and then average P^{ret}_{irst} across regions and retailers in month t to obtain a measure of the retail price of product i in month t, P^{ret}_{it}. In column (2), we take the mode across households, weeks, and stores in triplet rst and then average P^{ret}_{irst} across regions and retailers in month t to obtain a measure of the retail price of product i in month t, P^{ret}_{it}. In column (3), we average P^{ret}_{irst} across households, weeks, and stores in triplet rst. We then take the median of P^{ret}_{irst} across regions and retailers in month t to obtain a measure of the retail price of product i in month t, P^{ret}_{it}.

Table D.6: *Invoicing and retail prices, alternative base periods for price changes*

	(1) Rel. to Dec 2014	(2) Rel. to average 2014
2015Q1	-0.059**	-0.069***
	[0.027]	[0.025]
2015Q2	-0.063**	-0.073**
	[0.029]	[0.030]
2015Q3	-0.072**	-0.082**
	[0.034]	[0.035]
2015Q4	-0.034	-0.045
	[0.027]	[0.031]
2016Q1	-0.088**	-0.098**
	[0.039]	[0.041]
2016Q2	-0.065*	-0.075*
	[0.038]	[0.044]
Adjusted R^2	0.03	0.40
Observations	13113	13113
Avg effect 15 Q1-Q3	-0.065**	-0.075**
	[0.029]	[0.029]
Adjusted R^2	0.05	0.62
Observations	3748	6559
Unique products	937	937
Retail classes	132	132
Border categories	32	32

Notes: This table repeats Table D.1 for different base periods (the base period in our baseline is 14Q4): December 2014 in column (1) and average 2014 price in column (2).

Table D.7: *Invoicing and retail prices, other sensitivities*

	(1) All currencies	(3) EU imports	(2) Trim
2015Q1	-0.074**	-0.042**	-0.065***
	[0.029]	[0.017]	[0.024]
2015Q2	-0.077**	-0.044*	-0.067**
	[0.034]	[0.025]	[0.029]
2015Q3	-0.086**	-0.046*	-0.083**
	[0.040]	[0.027]	[0.035]
2015Q4	-0.050	-0.016	-0.042
	[0.034]	[0.026]	[0.031]
2016Q1	-0.106**	-0.054**	-0.094**
	[0.046]	[0.024]	[0.040]
2016Q2	-0.085*	-0.034	-0.083**
	[0.045]	[0.034]	[0.038]
Adjusted R^2	0.40	0.42	0.40
Observations	13113	11111	12996
Avg effect 15 Q1-Q3	-0.079**	-0.044**	-0.073**
	[0.034]	[0.022]	[0.030]
Adjusted R^2	0.55	0.51	0.52
Observations	3748	3176	3719
Unique products	937	794	935
Retail classes	132	129	132
Border categories	32	32	32

Notes: This table repeats Table D.1 with two different adjustments to the baseline. In column (1) we include in border invoicing shares products that are invoiced in non-EUR foreign currencies (as compared with the baseline, where we include only EUR and CHF). In column (2) we trim the dependent variable by excluding the 1% largest changes in absolute values from the regression. In column (3) we include only imports from EU countries.

D.3 Regression (4) in subsection 4.2

We consider sensitivity analysis to using (i) different weighting schemes, clustering, and trimming, (ii) different border category samples, (iii) alternative price aggregations, (iv) EUR-invoiced border prices obtained by using the official EUR/CHF exchange rate, and (v) EU imports. In all cases, the 2SLS estimates of β_t remain significant, range between 0.48 and 0.60 (or roughly 0.35 if we restrict the sample to EU imports) in the first two quarters of 2015.

Table D.8: *Sensitivity of retail import prices to border prices, unweighted*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ border price	0.469***	0.551***	0.444***	0.475**	0.410**	0.789**	0.451**	2.149
	[0.151]	[0.166]	[0.136]	[0.207]	[0.181]	[0.371]	[0.204]	[1.438]
Observations	937	937	937	937	937	937	937	937
F first stage		90.8		77.0		18.1		1.9
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 6, but weighting all observations equally.

Table D.9: *Sensitivity of retail import prices to border prices, border category weights*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ border price	0.497***	0.598***	0.489***	0.599***	0.461**	0.901***	0.496**	2.178*
	[0.156]	[0.167]	[0.145]	[0.183]	[0.208]	[0.344]	[0.235]	[1.190]
Observations	937	937	937	937	937	937	937	937
F first stage		101.8		92.3		25.3		2.9
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 6, but weighting border product categories by 2014 expenditures (and weighting observations equally within category).

Table D.10: *Sensitivity of retail import prices to border prices, standard errors clustered by border category*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ border price	0.527**	0.609***	0.472**	0.568**	0.355	0.951*	0.374	1.741
	[0.193]	[0.203]	[0.177]	[0.234]	[0.265]	[0.500]	[0.269]	[1.782]
Observations	937	937	937	937	937	937	937	937
F first stage		35.5		30.1		7.0		1.0
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 6, but clustering standard errors by border product category.

Table D.11: *Sensitivity of retail import prices to border prices, Min 8+*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta p^{bor}_{g(i)t}$	0.386***	0.499***	0.357***	0.463**	0.165	0.825**	0.098	1.242
	[0.121]	[0.169]	[0.130]	[0.202]	[0.174]	[0.386]	[0.150]	[1.263]
Observations	843	843	843	843	843	843	843	843
F first stage		64.1		59.5		15.7		1.8
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 6, but including only product classes matched to border categories with more than 8 border observations per quarter in 2014.

Table D.12: *Sensitivity of retail import prices to border prices, Min 4+*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta p^{bor}_{g(i)t}$	0.500***	0.511**	0.440***	0.486**	0.363	0.822**	0.399*	2.501
	[0.180]	[0.209]	[0.163]	[0.218]	[0.231]	[0.387]	[0.212]	[2.546]
Observations	995	995	995	995	995	995	995	995
F first stage		87.4		82.4		21.7		0.6
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 6, but including only product classes matched to border categories with more than 4 border observations per quarter in 2014.

Table D.13: *Sensitivity of retail import prices to border prices, alternative aggregations of transaction-level prices to price series*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta p^{bor}_{g(i)t}$	0.475***	0.546***	0.482***	0.549***	0.366*	0.900**	0.379	1.645
	[0.162]	[0.180]	[0.167]	[0.208]	[0.212]	[0.353]	[0.245]	[1.074]
Observations	937	937	937	937	937	937	937	937
F first stage		82.5		78.6		22.1		2.5
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 6 with an alternative aggregation of retail prices. Here we take the mode (instead of the mean as in the baseline) across households, weeks, and stores in triplet rst and then average P^{ret}_{irst} across regions and retailers in month t to obtain a measure of the retail price of product i in month t, P^{ret}_{it}.

Table D.14: *Sensitivity of retail import prices to border prices, official exchange rate*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta p^{bor}_{g(i)t}$	0.530***	0.586***	0.452***	0.526***	0.365	0.988**	0.382	1.801
	[0.186]	[0.191]	[0.163]	[0.199]	[0.236]	[0.394]	[0.243]	[1.146]
Observations	937	937	937	937	937	937	937	937
F first stage		98.4		94.2		20.1		2.3
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 6, but converting EUR-invoiced prices into CHF prices based on the official quarterly EUR/CHF rate rather than using CHF prices provided by the SFSO.

Table D.15: *Sensitivity of retail import prices to border prices, trimming largest price changes*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta p^{bor}_{g(i)t}$	0.472***	0.507***	0.451***	0.479**	0.338	0.923**	0.358	1.499
	[0.147]	[0.165]	[0.146]	[0.196]	[0.223]	[0.362]	[0.232]	[0.984]
Observations	928	928	928	928	928	928	928	928
F first stage		83.3		78.6		22.2		2.5
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 6, but trimming the 1% largest absolute value of retail price changes.

Table D.16: *Sensitivity of retail import prices (EU only) to border prices*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Δ border price	0.325***	0.375***	0.316***	0.343*	0.231	0.511*	0.340*	0.614
	[0.105]	[0.144]	[0.115]	[0.186]	[0.151]	[0.297]	[0.173]	[0.925]
Observations	794	794	794	794	794	794	794	794
F first stage		80.4		72.6		24.1		2.4
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table reports estimates of β_t from equation (4). The dependent variable is the cumulative change in the retail price of imported goods (EU imports only) relative to 14Q4, $\Delta p_{it}^{ret} = p_{it}^{ret} - p_{i14Q4}^{ret}$. Under OLS, the independent variable is the change in the border price of the corresponding border category over the same time window, $\Delta p_{g(i)t}^{bor}$. Under 2SLS, the border price change is instrumented with EUR invoicing intensity in 2014 of the corresponding border category. Standard errors are clustered at the level of retail product class.

D.4 Regression (5) in subsection 4.3

We consider sensitivity analysis to using different weighting schemes, clustering, trimming, and border category samples.

Table D.17: *Invoicing, import penetration, and retail prices*

	Baseline		Min 8+		Min 4+		All (Min0+)	
	(1) imports	(2) domestic	(3) imports	(4) domestic	(5) imports	(6) domestic	(7) imports	(8) domestic
2015Q1	-0.145***	-0.116**	-0.108***	-0.089**	-0.105*	-0.101**	-0.089*	-0.062
	[0.055]	[0.053]	[0.040]	[0.042]	[0.058]	[0.049]	[0.052]	[0.048]
2015Q2	-0.152**	-0.167**	-0.118**	-0.128**	-0.113*	-0.143**	-0.075	-0.104
	[0.061]	[0.075]	[0.049]	[0.060]	[0.061]	[0.069]	[0.060]	[0.063]
2015Q3	-0.176**	-0.242***	-0.139**	-0.238***	-0.127*	-0.215**	-0.100	-0.145*
	[0.074]	[0.092]	[0.057]	[0.090]	[0.075]	[0.085]	[0.067]	[0.082]
2015Q4	-0.118*	-0.154**	-0.084*	-0.124**	-0.083	-0.130**	-0.046	-0.084
	[0.062]	[0.072]	[0.044]	[0.063]	[0.059]	[0.066]	[0.059]	[0.064]
2016Q1	-0.217**	-0.140*	-0.167***	-0.108	-0.166*	-0.125*	-0.069	-0.068
	[0.087]	[0.084]	[0.047]	[0.069]	[0.086]	[0.075]	[0.105]	[0.073]
2016Q2	-0.179**	-0.243**	-0.138**	-0.223*	-0.121	-0.216**	-0.108	-0.131
	[0.086]	[0.109]	[0.056]	[0.119]	[0.087]	[0.100]	[0.076]	[0.099]
Adjusted R^2	0.40	0.42	0.43	0.43	0.40	0.42	0.39	0.41
Observations	13113	29691	11801	28319	13925	30363	14623	32237
Avg effect 15 Q1-Q3								
ImpShare	0.034	0.045*	0.021	0.031*	0.032	0.042	0.027	0.018
	[0.024]	[0.027]	[0.020]	[0.018]	[0.023]	[0.027]	[0.022]	[0.026]
ImpShare × *EURShare*	-0.158**	-0.175***	-0.122**	-0.152***	-0.115*	-0.153**	-0.088	-0.103*
	[0.062]	[0.067]	[0.047]	[0.053]	[0.064]	[0.062]	[0.059]	[0.060]
Adjusted R^2	0.55	0.49	0.53	0.48	0.54	0.48	0.54	0.48
Observations	3748	8484	3372	8092	3980	8676	4180	9212
Unique products	937	2121	843	2023	995	2169	1045	2303
Retail classes	132	151	119	137	150	171	155	177
Border categories	32	34	29	31	36	38	38	40

Notes: This table reports estimates of β_t from equation (5), for imports (odd-numbered columns) and Swiss-produced goods (even-numbered columns). Standard errors are clustered at the level of retail product class. Columns (1) and (2) include only border categories with 7 or more border observations in 14Q4 (baseline), columns (3) and (4) include only product classes matched to border categories with more than 8 border observations, (5) and (6) include only border categories with more than 4 border observations, and (7) and (8) include all border categories.

Table D.18: *Invoicing, import penetration, and retail prices; alternative weighting and clustering*

	Unweighted		Weight cat BFS		Cluster BFS	
	(1) imports	(2) domestic	(3) imports	(4) domestic	(5) imports	(6) domestic
2015Q1	-0.127***	-0.062*	-0.147***	-0.066*	-0.145**	-0.116**
	[0.045]	[0.036]	[0.049]	[0.036]	[0.055]	[0.053]
2015Q2	-0.123**	-0.092**	-0.160***	-0.080**	-0.152**	-0.167**
	[0.057]	[0.043]	[0.056]	[0.040]	[0.064]	[0.079]
2015Q3	-0.135*	-0.131**	-0.167**	-0.124**	-0.176**	-0.242**
	[0.069]	[0.063]	[0.075]	[0.056]	[0.078]	[0.096]
2015Q4	-0.114*	-0.092*	-0.142**	-0.070	-0.118*	-0.154**
	[0.058]	[0.050]	[0.064]	[0.046]	[0.067]	[0.073]
2016Q1	-0.162**	-0.080	-0.187**	-0.063	-0.217**	-0.140
	[0.075]	[0.060]	[0.086]	[0.058]	[0.089]	[0.089]
2016Q2	-0.171**	-0.154**	-0.200**	-0.131*	-0.179**	-0.243**
	[0.072]	[0.072]	[0.081]	[0.070]	[0.087]	[0.107]
Adjusted R^2	0.41	0.41	0.41	0.42	0.40	0.42
Observations	13113	29691	13113	29691	13113	29691
Avg effect 15 Q1-Q3						
$ImpShare$	0.028	0.009	0.032	0.013	0.034	0.045
	[0.021]	[0.019]	[0.022]	[0.018]	[0.024]	[0.027]
$ImpShare \times EURShare\mathbb{I}t$	-0.128**	-0.095**	-0.158***	-0.090**	-0.158**	-0.175**
	[0.055]	[0.042]	[0.059]	[0.039]	[0.065]	[0.070]
Adjusted R^2	0.51	0.45	0.52	0.45	0.55	0.49
Observations	3748	8484	3748	8484	3748	8484
Unique products	937	2121	937	2121	937	2121
Retail classes	132	151	132	151	132	151
Border categories	32	34	32	34	32	34

Notes: This table repeats columns (1) and (2) of Table D.17, but with different weights and/or using different clustering. Columns (1) and (2) weight all observations equally, (3) and (4) weight by border product categories based on 2014 Nielsen expenditures (observations are equally weighted within border category), and (5) and (6) cluster by border product categories and weight by 2014 Nielsen expenditures as in the baseline.

Table D.19: *Invoicing, import penetration, and retail prices; trimming largest price changes*

	(1) imports	(2) domestic
2015Q1	-0.132***	-0.092**
	[0.049]	[0.043]
2015Q2	-0.133**	-0.122**
	[0.055]	[0.061]
2015Q3	-0.168**	-0.197**
	[0.071]	[0.081]
2015Q4	-0.110*	-0.125**
	[0.060]	[0.061]
2016Q1	-0.209**	-0.107
	[0.082]	[0.070]
2016Q2	-0.181**	-0.242**
	[0.079]	[0.108]
Adjusted R^2	0.41	0.39
Observations	12996	29439
Avg effect 15 Q1-Q3		
$ImpShare$	0.032	0.033*
	[0.022]	[0.018]
$ImpShare \times EURShare$	-0.147**	-0.138**
	[0.059]	[0.054]
Adjusted R^2	0.52	0.44
Observations	3719	8419
Unique products	935	2114
Retail classes	132	151
Border categories	32	34

Notes: This table repeats columns (1) and (2) of Table D.17, but trimming the 1% largest absolute value of retail price changes.

D.5 Regression (6) in subsection 4.3

We report sensitivity analysis to using our different border category samples and alternative weighting schemes, clustering, and trimming.

Table D.20: *Sensitivity of domestic retail prices to import retail prices, unweighted*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ImpS \times \Delta$ imppr retPC	0.935***	0.695**	0.691***	0.974***	0.768***	1.209***	0.750***	0.980**
	[0.290]	[0.329]	[0.244]	[0.368]	[0.276]	[0.436]	[0.231]	[0.438]
Observations	1972	1972	1972	1972	1972	1972	1972	1972
F first stage		16.2		19.9		21.8		18.0
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 7, but weighting all observations equally.

Table D.21: *Sensitivity of domestic retail prices to import retail prices, border category weights*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ImpS \times \Delta$ imppr retPC	0.994***	0.641**	0.668***	0.732***	0.766***	0.983***	0.629***	0.705**
	[0.278]	[0.293]	[0.220]	[0.259]	[0.246]	[0.326]	[0.226]	[0.343]
Observations	1972	1972	1972	1972	1972	1972	1972	1972
F first stage		24.4		36.9		36.7		18.4
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 7, but weighting by border product categories based on 2014 Nielsen expenditures (observations are equally weighted within border category).

Table D.22: *Sensitivity of domestic retail prices to import retail prices, cluster border categories*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ImpS \times \Delta$ imppr retPC	1.240***	0.939**	0.937***	1.250***	0.668	1.518***	0.739**	1.119**
	[0.398]	[0.474]	[0.324]	[0.470]	[0.457]	[0.540]	[0.344]	[0.461]
Observations	1972	1972	1972	1972	1972	1972	1972	1972
F first stage		22.0		31.2		30.5		19.1
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 7, but standard errors are clustered by border product categories.

Table D.23: *Sensitivity of domestic retail prices to import retail prices, Min 8+*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ImpShare_{g(i)} \times \Delta p^{retimp}_{g(i)t}$	0.982**	0.870*	0.699***	1.177**	0.366	1.480***	0.543	1.054*
	[0.422]	[0.514]	[0.255]	[0.525]	[0.430]	[0.569]	[0.328]	[0.543]
Observations	1883	1883	1883	1883	1883	1883	1883	1883
F first stage		22.7		39.4		36.5		26.6
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 7, but including only product classes matched to border categories with more than 8 border observations.

Table D.24: *Sensitivity of domestic retail prices to import retail prices, Min 4+*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ImpShare_{g(i)} \times \Delta p^{retimp}_{g(i)t}$	1.194***	1.087*	0.943***	1.380**	0.681	1.772***	0.765**	1.148**
	[0.356]	[0.605]	[0.302]	[0.563]	[0.421]	[0.656]	[0.327]	[0.562]
Observations	2013	2013	2013	2013	2013	2013	2013	2013
F first stage		5.4		12.8		10.8		13.2
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 7, but including only product classes matched to border categories with more than 4 border observations.

Table D.25: *Sensitivity of domestic retail prices to import retail prices, trimming largest price changes*

	1Q		2Q		3Q		4Q	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$ImpShare_{g(i)} \times \Delta p^{retimp}_{g(i)t}$	1.028***	0.761	0.757***	1.103**	0.359	1.269**	0.595**	1.007*
	[0.277]	[0.489]	[0.241]	[0.537]	[0.379]	[0.561]	[0.288]	[0.546]
Observations	1956	1956	1955	1955	1952	1952	1952	1952
F first stage		23.3		37.4		35.3		24.8
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table 7, but trimming the 1% largest absolute value of domestic retail price changes.

D.6 Simple model of pricing complementarities

Here we consider a simple flexible price model with variable markups, following Gopinath et al. (2010) and Burstein and Gopinath (2014), to motivate the reduced-form regression (6).

Consider product i in product category g. Suppose that the log price change Δp_{ig} can be expressed, up to a first-order approximation, as

$$\Delta p_{ig} = \frac{1}{1+\Gamma_{ig}}\Delta c_{ig} + \frac{\Gamma_{ig}}{1+\Gamma_{ig}}\Delta p_g, \tag{A3}$$

where Δc_{ig} denotes the log change in marginal cost, Γ_{ig} denotes the markup elasticity, and Δp_g denotes the log change in the aggregate price index in product category g, which we assume is given by $\Delta p_g = \sum_i S_{ig}\Delta p_{ig}$ where S_{ig} denotes expenditure share of product i in g.

We now assume that all domestic firms in g have a common markup elasticity Γ_g^{dom}.[A4] Aggregating equation (A3) across all domestic products, the expenditure-weighted average of domestic prices in g, denoted by Δp_g^{dom}, is

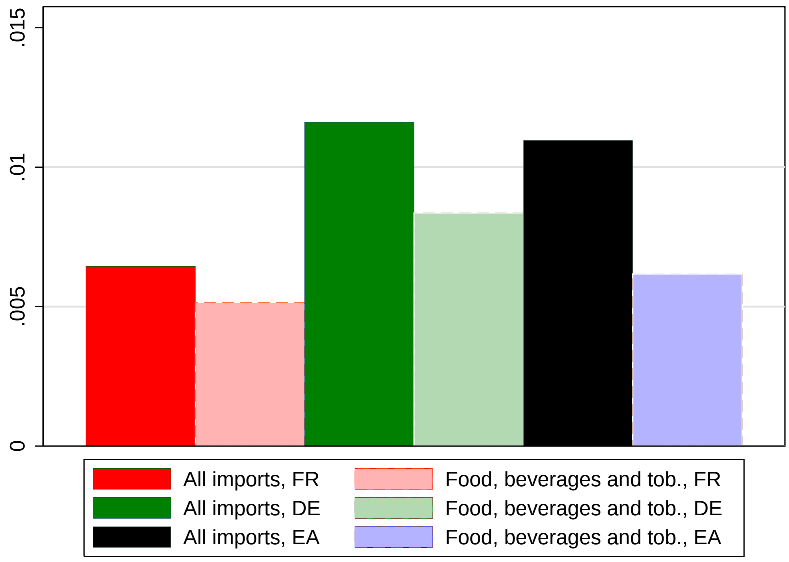
$$\Delta p_g^{dom} = \frac{1}{1+ImpShare_g \times \Gamma_g^{dom}}\Delta c_g^{dom} + \frac{ImpShare_g \times \Gamma_g^{dom}}{1+ImpShare_g \times \Gamma_g^{dom}}\Delta p_g^{imp}. \tag{A4}$$

Here, Δc_g^{dom} denotes the expenditure-weighted average of domestic marginal cost changes in g, Δp_g^{imp} denotes the expenditure-weighted average of import price changes in g, and $ImpShare_g$ denotes the expenditure share on imported products in g.

While in equation (A4) and regression equation (6) the term in the right-hand-side multiplying the change in import retail prices, Δp_g^{imp}, is increasing in $ImpShare_g$, these two specifications are different so the estimated coefficients cannot be directly interpreted in terms of model structural parameters. Moreover, since changes in domestic marginal costs Δc_g^{dom} are unobservable to us, the error term in equation (6) could be correlated with Δp_g^{imp} if changes in import prices are correlated with changes in domestic costs. This motivates the use of an instrument discussed in the main text.

[A4] Due to its partial coverage of consumer expenditures, our homescan data is not well-suited to estimate the dependance of Γ_{ig}^{dom} on product characteristics such as market share, as in Amiti et al. (2019).

Figure D.5: *Swiss value added share in imports from France, Germany, and the euro area*



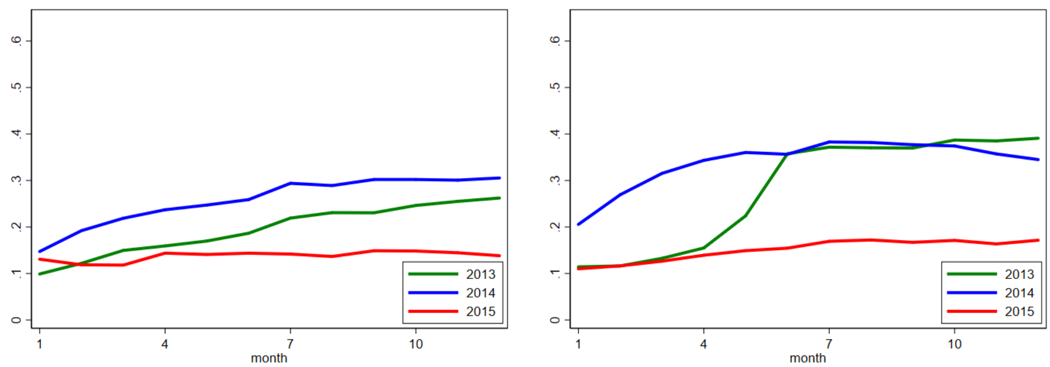
Notes: This figure displays the 2011 fraction of value added originating from Switzerland for French (red), German (green), or Euro area (blue) exports to Switzerland. This statistic is shown for either total exports (dark color bars, solid outline) or the food, beverage, and tobacco sector only (light color bars, dashed outline). For example, the number 0.006 in the left-most bar means that for every 100 CHF worth of French exports to Switzerland, 0.6 CHF worth of Swiss labor and other Swiss factors of production were ultimately used. Data is from the OECD's Trade in Value Added (TiVA) statistic, which only covers data until 2011 (origin of value added in gross imports; https://stats.oecd.org, accessed on 23.08.2018).

E Retail price stickiness: additional results

E.1 Aggregate statistics in subsection 4.4

We report additional results for subsection 4.4. We show the cumulative fraction of price increases, average frequency of monthly price changes (not cumulative as in the main text), and the average size of monthly price changes using different weighting schemes. We also compare the size of price changes in our data with other studies in the literature, and discuss additional robustness checks.

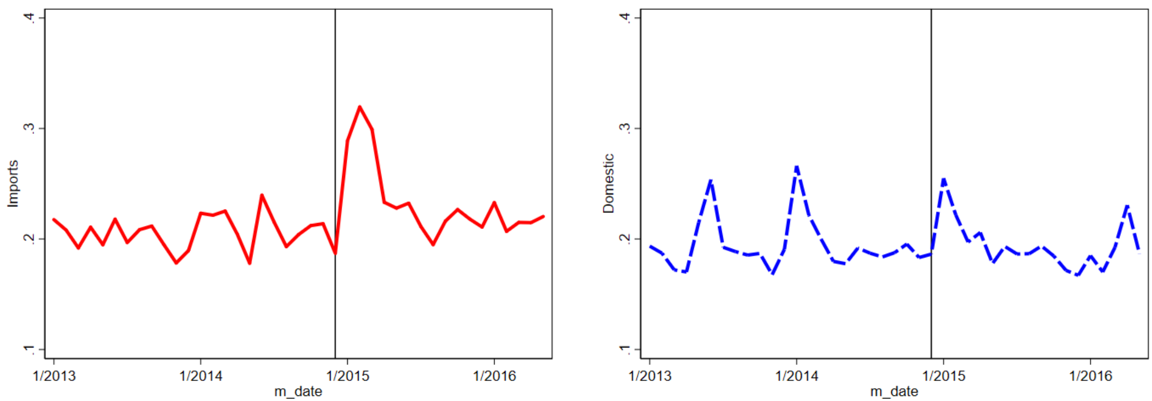
Figure E.1: *Fraction of price increases compared with December of previous year.*



(a) Increases imports (b) Increases domestic

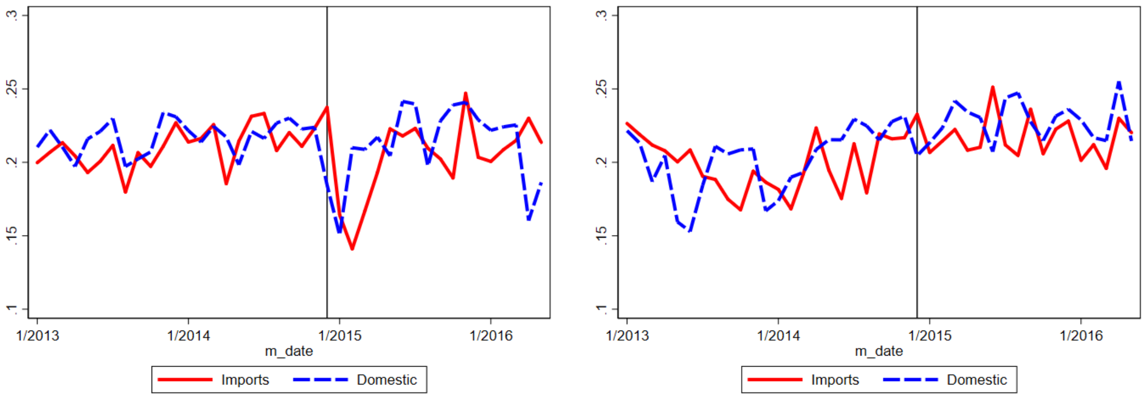
Notes: This figure presents a version of Figure 7 for price increases only. Panels (a) and (b) display the weighted average fraction of increases in modal prices relative to December of the previous year, f^+_{iyh}, for 1-12 month horizons of imported and Swiss-produced goods, respectively.

Figure E.2: *Average frequency of monthly price changes*



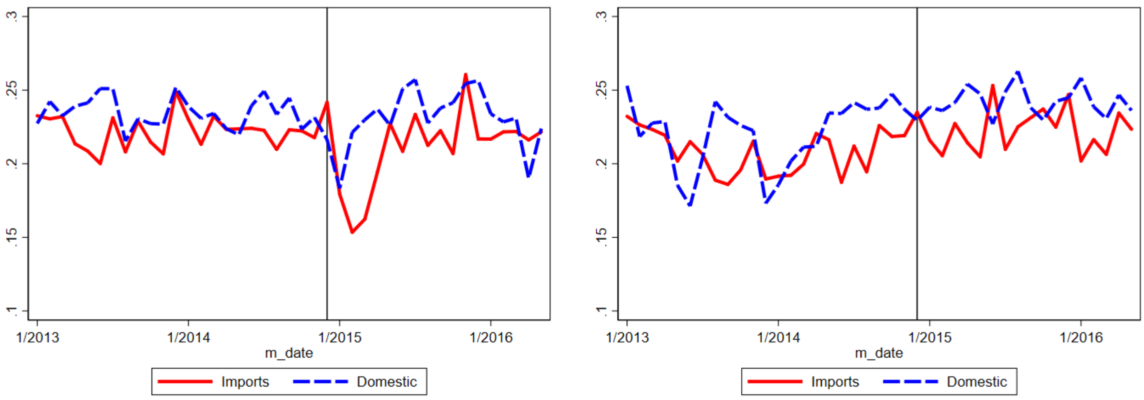
Notes: This figure displays the fraction of changes in the modal price from one month to the other between Jan 2013 and May 2016. Panel (a) considers imported goods and panel (b) considers Swiss-produced goods. Products are weighted by their 2014 expenditure share (as in the baseline retail regressions).

Figure E.3: *Average size of monthly price changes, weighted by expenditures per product*



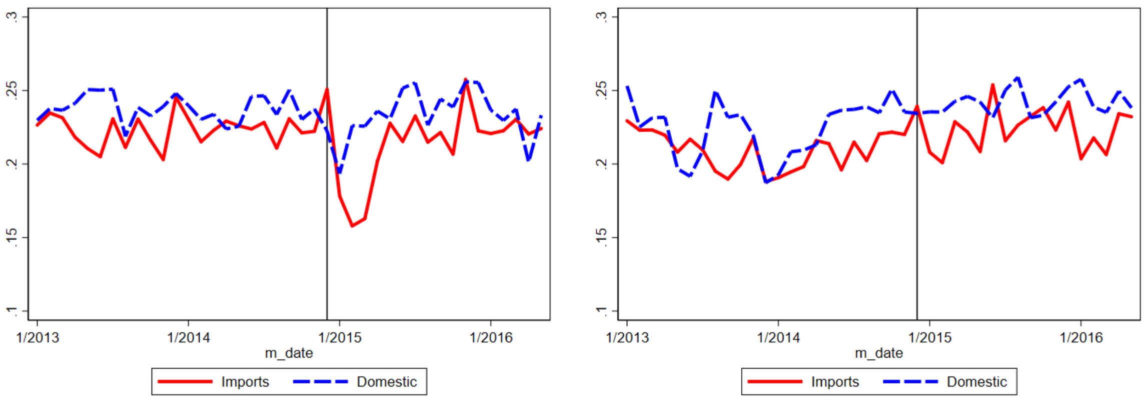
Notes: This figure displays the sizes of price changes in the modal price from one month to the other between Jan 2013 and May 2016. Panel (a) considers the size of price decreases and panel (b) considers the size of price increases. Weights are by individual product based on 2014 Nielsen expenditures.

Figure E.4: *Average size of monthly price changes, weighted by border category expenditures*



Notes: This figure repeats Figure E.3, but weighting by border product categories based on 2014 Nielsen expenditures (observations are equally weighted within border category).

Figure E.5: *Average size of monthly price changes, unweighted*



Notes: This figure repeats Figure E.3, but weighting all observations equally.

Note to figure E.3-E.5 The average absolute size of price changes is larger than the average size of price changes for unprocessed food (around 15%) and processed food (around 8%) reported for Europe in Dhyne et al. (2006) or for the US in Nakamura and Steinsson (2008). However, the reported average size of price changes is in line with price-setting statistics in European homescan data reported in Beck and Lein (2019), who argue that using modal prices per product (as in Eichenbaum et al. (2014)) results in a higher size of price changes because many small price changes are erratic and the modal price is more robust to measurement error. Eichenbaum et al. (2014) show in their scanner level data that the median size of price adjustments increases from 10% to 30% after taking measurement error into consideration.

In an earlier draft, we reported that the central facts on the evolution of the fraction and size of retail price changes of imported goods are largely robust to a number of changes relative to our baseline procedure. First, we exclude temporary price changes due to temporary price reductions based on a simple v-shaped sales filter (i.e. price changes in month t that are exactly offset in month $t+1$).[A5] Second, we standardize price changes at the region and product-level to reduce the role of underlying heterogeneity across goods, as discussed in Alvarez et al. (2016). Third, we split goods into those with sticky prices prior to 2015 and those that changed prices frequently prior to 2015. Fourth, we separate firms with one or two goods from firms with more than two goods. Fifth, we split goods into those with high or low market share prior to 2015 within their respective product category. Finally, we include only the two largest retailers (Coop and Migros).

[A5]The frequency of temporary price reductions dropped slightly after January 2015 while the frequency of regular price reductions rose.

E.2 Regression (7) in subsection 4.4

We report additional results for the regressions in subsection 4.4. In particular, we consider additional estimation horizons, all price changes instead of only decreases, different weighting schemes, clustering, and border category samples.

Table E.1: *Invoicing currency and the extensive margin of retail price changes, horizons 4-6 months*

	(1) 4m-	(2) 5m-	(3) 6m-	(4) 4m+	(5) 5m+	(6) 6m+
Panel (a). Imports						
$EURShare \times \mathbb{I}13$	-0.297***	-0.116	-0.075	-0.275*	-0.165	-0.152
	[0.101]	[0.114]	[0.139]	[0.140]	[0.132]	[0.179]
$EURShare \times \mathbb{I}15$	0.386**	0.378**	0.571***	-0.380***	-0.340***	-0.474***
	[0.157]	[0.149]	[0.140]	[0.139]	[0.127]	[0.129]
Observations	2499	2497	2441	2499	2497	2441
Unique products	886	873	869	886	873	869
Adjusted R^2	0.26	0.28	0.27	0.22	0.17	0.16
Panel (b). Domestic						
$EURShare \times \mathbb{I}13$	-0.028	-0.052	-0.072	-0.193	-0.064	0.219
	[0.041]	[0.051]	[0.049]	[0.222]	[0.174]	[0.139]
$EURShare \times \mathbb{I}15$	0.247	0.319	0.197	-0.419	-0.449	-0.320
	[0.267]	[0.281]	[0.276]	[0.273]	[0.292]	[0.286]
Observations	6088	6126	5983	6088	6126	5983
Unique products	2104	2110	2083	2104	2110	2083
Adjusted R^2	0.15	0.16	0.15	0.19	0.21	0.25

Notes: This table repeats Table 8 for 4, 5 and 6 month horizons.

Table E.2: *Invoicing currency and the extensive margin of retail price changes, all changes*

	Imports			Domestic		
	(1)	(2)	(3)	(4)	(5)	(6)
	1m	2m	3m	1m	2m	3m
$EURShare \times \mathbb{I}13$	-0.136	-0.071	-0.294*	0.033	-0.177	-0.293
	[0.118]	[0.122]	[0.156]	[0.191]	[0.194]	[0.236]
$EURShare \times \mathbb{I}15$	0.018	0.372**	0.211	0.100	-0.024	-0.154
	[0.134]	[0.173]	[0.141]	[0.095]	[0.097]	[0.112]
Observations	2537	2508	2506	6223	6145	6121
Unique products	884	881	877	2138	2125	2113
Adjusted R^2	0.17	0.22	0.23	0.32	0.28	0.29

Notes: This table repeats Table 8, but for all price changes (that is, without separating price increases and decreases here).

Table E.3: *Invoicing currency and the extensive margin of retail price changes, unweighted*

Imported goods	(1)	(2)	(3)	(4)	(5)	(6)
	1m-	2m-	3m-	1m+	2m+	3m+
$EURShare \times \mathbb{I}13$	-0.089	0.033	-0.042	-0.083	-0.044	-0.182*
	[0.082]	[0.055]	[0.079]	[0.059]	[0.095]	[0.107]
$EURShare \times \mathbb{I}15$	0.281***	0.515***	0.394**	-0.263**	-0.233**	-0.257***
	[0.084]	[0.117]	[0.158]	[0.102]	[0.092]	[0.084]
Observations	2537	2508	2506	2537	2508	2506
Unique products	884	881	877	884	881	877
Adjusted R^2	0.10	0.18	0.22	0.14	0.15	0.17
Swiss-produced goods	(1)	(2)	(3)	(4)	(5)	(6)
	1m-	2m-	3m-	1m+	2m+	3m+
$EURShare \times \mathbb{I}13$	0.039	-0.005	-0.017	-0.176*	-0.222*	-0.307**
	[0.048]	[0.033]	[0.034]	[0.097]	[0.122]	[0.129]
$EURShare \times \mathbb{I}15$	0.184	0.128	0.158	-0.212*	-0.262*	-0.376**
	[0.121]	[0.116]	[0.142]	[0.114]	[0.140]	[0.153]
Observations	6223	6145	6121	6223	6145	6121
Unique products	2138	2125	2113	2138	2125	2113
Adjusted R^2	0.15	0.08	0.12	0.19	0.15	0.17

Notes: This table repeats Table 8, but weighting all observations equally.

Table E.4: *Invoicing currency and the extensive margin of retail price changes, border category weights*

Imported goods	(1) 1m-	(2) 2m-	(3) 3m-	(4) 1m+	(5) 2m+	(6) 3m+
$EURShare \times \mathbb{I}13$	-0.031	0.019	-0.031	-0.095	-0.086	-0.255**
	[0.069]	[0.058]	[0.074]	[0.064]	[0.093]	[0.098]
$EURShare \times \mathbb{I}15$	0.349***	0.596***	0.504***	-0.251***	-0.247***	-0.291***
	[0.087]	[0.122]	[0.157]	[0.088]	[0.093]	[0.084]
Observations	2537	2508	2506	2537	2508	2506
Unique products	884	881	877	884	881	877
Adjusted R^2	0.11	0.19	0.24	0.16	0.17	0.19
Swiss-produced goods	(1) 1m-	(2) 2m-	(3) 3m-	(4) 1m+	(5) 2m+	(6) 3m+
$EURShare \times \mathbb{I}13$	0.038	0.003	0.019	-0.172	-0.229	-0.326*
	[0.042]	[0.030]	[0.035]	[0.141]	[0.151]	[0.165]
$EURShare \times \mathbb{I}15$	0.160	0.094	0.119	-0.171	-0.232	-0.318*
	[0.148]	[0.145]	[0.166]	[0.147]	[0.170]	[0.186]
Observations	6223	6145	6121	6223	6145	6121
Unique products	2138	2125	2113	2138	2125	2113
Adjusted R^2	0.12	0.08	0.10	0.18	0.15	0.17

Notes: This table repeats Table 8, but weighting by border product categories based on 2014 Nielsen expenditures (observations are equally weighted within border category).

Table E.5: *Invoicing currency and the extensive margin of retail price changes, cluster by border category*

Imported goods	(1) 1m-	(2) 2m-	(3) 3m-	(4) 1m+	(5) 2m+	(6) 3m+
$EURShare \times \mathbb{I}13$	-0.031	0.048	-0.004	-0.105	-0.119	-0.291
	[0.072]	[0.059]	[0.094]	[0.083]	[0.153]	[0.172]
$EURShare \times \mathbb{I}15$	0.284***	0.651***	0.574**	-0.267***	-0.279*	-0.363**
	[0.099]	[0.204]	[0.262]	[0.092]	[0.142]	[0.137]
Observations	2537	2508	2506	2537	2508	2506
Unique products	884	881	877	884	881	877
Adjusted R^2	0.11	0.19	0.24	0.19	0.18	0.21
Swiss-produced goods	(1) 1m-	(2) 2m-	(3) 3m-	(4) 1m+	(5) 2m+	(6) 3m+
$EURShare \times \mathbb{I}13$	0.063	-0.065**	-0.021	-0.031	-0.112	-0.272
	[0.060]	[0.029]	[0.035]	[0.190]	[0.194]	[0.206]
$EURShare \times \mathbb{I}15$	0.356	0.284	0.318	-0.255	-0.308	-0.472*
	[0.268]	[0.292]	[0.268]	[0.208]	[0.249]	[0.247]
Observations	6223	6145	6121	6223	6145	6121
Unique products	2138	2125	2113	2138	2125	2113
Adjusted R^2	0.12	0.12	0.14	0.17	0.15	0.20

Notes: This table repeats Table 8, but clustering standard errors by border product category.

Table E.6: *Invoicing currency and the extensive margin of retail price changes, Min 8+*

Imported goods	(1) 1m-	(2) 2m-	(3) 3m-	(4) 1m+	(5) 2m+	(6) 3m+
$EURShare \times \mathbb{I}13$	0.008	0.007	0.040	-0.105	-0.097	-0.230*
	[0.074]	[0.072]	[0.128]	[0.097]	[0.129]	[0.138]
$EURShare \times \mathbb{I}15$	0.294***	0.680***	0.631***	-0.179*	-0.165	-0.259**
	[0.110]	[0.201]	[0.186]	[0.103]	[0.144]	[0.111]
Observations	2095	2073	2085	2095	2073	2085
Unique products	726	724	726	726	724	726
Adjusted R^2	0.12	0.20	0.27	0.18	0.15	0.18
Swiss-produced goods	(1) 1m-	(2) 2m-	(3) 3m-	(4) 1m+	(5) 2m+	(6) 3m+
$EURShare \times \mathbb{I}13$	0.021	-0.085**	-0.015	0.005	-0.041	-0.209
	[0.044]	[0.033]	[0.041]	[0.219]	[0.257]	[0.285]
$EURShare \times \mathbb{I}15$	0.342	0.256	0.376	-0.235	-0.249	-0.439
	[0.324]	[0.342]	[0.348]	[0.255]	[0.321]	[0.356]
Observations	5312	5254	5238	5312	5254	5238
Unique products	1826	1816	1807	1826	1816	1807
Adjusted R^2	0.14	0.12	0.12	0.15	0.14	0.18

Notes: This table repeats Table 8, but including only product classes matched to border categories with more than 8 border observations.

Table E.7: *Invoicing currency and the extensive margin of retail price changes, Min 4+*

Imported goods	(1) 1m-	(2) 2m-	(3) 3m-	(4) 1m+	(5) 2m+	(6) 3m+
$EURShare \times \mathbb{I}13$	-0.040	0.030	0.006	-0.083	-0.092	-0.211*
	[0.063]	[0.055]	[0.092]	[0.071]	[0.101]	[0.120]
$EURShare \times \mathbb{I}15$	0.235**	0.554***	0.509***	-0.187*	-0.190	-0.289***
	[0.092]	[0.162]	[0.171]	[0.108]	[0.129]	[0.110]
Observations	2698	2658	2657	2698	2658	2657
Unique products	941	935	930	941	935	930
Adjusted R^2	0.13	0.17	0.23	0.18	0.18	0.22
Swiss-produced goods	(1) 1m-	(2) 2m-	(3) 3m-	(4) 1m+	(5) 2m+	(6) 3m+
$EURShare \times \mathbb{I}13$	0.064	-0.063**	-0.018	-0.026	-0.106	-0.263
	[0.056]	[0.029]	[0.035]	[0.177]	[0.200]	[0.225]
$EURShare \times \mathbb{I}15$	0.346	0.283	0.319	-0.239	-0.292	-0.455
	[0.274]	[0.287]	[0.292]	[0.216]	[0.257]	[0.286]
Observations	6366	6283	6263	6366	6283	6263
Unique products	2187	2173	2162	2187	2173	2162
Adjusted R^2	0.12	0.11	0.13	0.16	0.15	0.20

Notes: This table repeats Table 8, but including only product classes matched to border categories with more than 4 border observations.

E.3 Regression retail frequency on border prices in subsection 4.4

The extensive margin of price adjustment responds significantly to changes in border prices in the corresponding product category. To show this, we consider regressions relating changes between 2014 and 2015 in the fraction of price changes (either increases or decreases) across individual goods to changes in border prices at the category level. We estimate

$$\left(f^{+}_{i15h} - f^{+}_{i14h}\right) \text{ or } \left(f^{-}_{i15h} - f^{-}_{i14h}\right) = \alpha_h + \beta_h \times \left(p^{bor}_{g(i)15Q1} - p^{bor}_{g(i)14Q4}\right) + \varepsilon_{it}, \quad \text{(A5)}$$

over imported goods i for monthly horizons $h = 1, 2, 3$. We consider OLS estimates as well as 2SLS estimates in which we instrument average changes in border prices, $\left(p^{bor}_{g(i)15Q1} - p^{bor}_{g(i)14Q4}\right)$, by the fraction of EUR-invoiced products in border category $g(i)$ in 2014. This instrumentation addresses endogeneity concerns and is subject to similar exclusion restrictions as those discussed in the context of regression (4).

Table E.8: *Border prices and the extensive margin of retail price changes*

	1m		2m		3m	
Decreases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$	-1.049*	-2.260***	-4.341***	-5.317***	-4.493***	-4.688***
	[0.607]	[0.782]	[1.001]	[1.335]	[1.166]	[1.210]
Observations	807	807	799	799	799	799
F first stage		87.6		85.3		84.1
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS
	1m		2m		3m	
Increases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$	1.525***	2.163***	2.120***	2.213**	2.456***	3.022***
	[0.552]	[0.840]	[0.612]	[0.943]	[0.631]	[0.735]
Observations	807	807	799	799	799	799
F first stage		87.6		85.3		84.1
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table displays coefficient estimates of β_h in Equation A5. Panel (a) reports estimates for the fraction of price decreases, and panel (b) for the fraction of price increases.

Table E.8 displays estimates of β_t for price decreases (upper panel) and price increases (lower panel). The increase in the fraction of price reductions is more pronounced for imported goods with larger border price reductions. According to our 2SLS estimates, the increase in the fraction of retail price reductions in the first quarter of 2015 (relative to that fraction of price reductions in the first quarter of 2014) is 0.47 larger for goods in product categories with a 10 percentage point larger decline in border prices. Similarly, the decline in the fraction of price increases is more pronounced for goods with larger border price reductions. The reduction in the fraction of retail price increases in the first quarter of 2015 (relative to the fraction of price increases in the first quarter of 2014) is roughly 0.3 larger for imported goods in product categories with a 10 percentage point larger decline in border prices. Almost all 2SLS estimates (as well as OLS estimates at 2- and 3-month horizons) are significant at the 1% level.

Table E.9: *Border prices and the extensive margin of retail price changes, unweighted*

	1m		2m		3m	
Decreases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$	-1.222***	-2.321***	-3.315***	-4.448***	-3.640***	-3.512***
	[0.445]	[0.711]	[0.724]	[0.974]	[0.924]	[1.173]
Observations	807	807	799	799	799	799
F first stage		98.9		91.2		93.3
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS

	1m		2m		3m	
Increases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$order price	1.213***	2.209**	1.462***	1.868**	2.026***	2.338***
	[0.427]	[0.916]	[0.438]	[0.785]	[0.457]	[0.647]
Observations	807	807	799	799	799	799
F first stage		98.9		91.2		93.3
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table E.8, but weighting all observations equally.

Table E.10: *Border prices and the extensive margin of retail price changes, border category weights*

	1m		2m		3m	
Decreases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$	-1.242**	-2.770***	-3.885***	-4.840***	-3.799***	-4.177***
	[0.492]	[0.747]	[0.708]	[0.954]	[0.964]	[1.078]
Observations	807	807	799	799	799	799
F first stage		105.9		99.6		101.5
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS

	1m		2m		3m	
Increases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$	1.375***	2.032***	1.628***	1.860**	2.163***	2.486***
	[0.414]	[0.716]	[0.457]	[0.731]	[0.496]	[0.560]
Observations	807	807	799	799	799	799
F first stage		105.9		99.6		101.5
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table E.8, but weighting by border product categories based on 2014 Nielsen expenditures (observations are equally weighted within border category).

Table E.11: *Border prices and the extensive margin of retail price changes, cluster by border category*

	1m		2m		3m	
Decreases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$	-1.049	-2.260***	-4.341***	-5.317***	-4.493***	-4.688***
	[0.707]	[0.775]	[1.139]	[1.401]	[1.506]	[1.697]
Observations	807	807	799	799	799	799
F first stage		38.8		37.9		38.3
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS

	1m		2m		3m	
Increases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$	1.525***	2.163***	2.120***	2.213**	2.456***	3.022***
	[0.490]	[0.734]	[0.607]	[1.010]	[0.769]	[0.852]
Observations	807	807	799	799	799	799
F first stage		38.8		37.9		38.3
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table E.8, but clustering standard errors by border product category.

Table E.12: *Border prices and the extensive margin of retail price changes, Min 8+*

	1m		2m		3m	
Decreases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$	-0.927	-2.592**	-4.881***	-6.031***	-4.963***	-5.575***
	[0.739]	[1.058]	[1.219]	[1.784]	[1.405]	[1.385]
Observations	669	669	660	660	666	666
F first stage		53.9		53.5		52.2
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS

	1m		2m		3m	
Increases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$	1.131*	1.624*	1.663**	1.395	1.871***	2.340***
	[0.574]	[0.931]	[0.696]	[1.227]	[0.667]	[0.855]
Observations	669	669	660	660	666	666
F first stage		53.9		53.5		52.2
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table E.8, but including only product classes matched to border categories with more than 8 border observations.

Table E.13: *Border prices and the extensive margin of retail price changes, Min 4+*

	1m		2m		3m	
Decreases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$	-1.012*	-1.932**	-3.937***	-4.659***	-4.291***	-4.332***
	[0.591]	[0.763]	[0.998]	[1.310]	[1.150]	[1.187]
Observations	858	858	845	845	846	846
F first stage		91.4		88.3		86.9
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS

	1m		2m		3m	
Increases	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta p^{bor}_{g(i)t}$	1.318**	1.560*	1.753***	1.508	2.241***	2.473***
	[0.556]	[0.869]	[0.648]	[1.035]	[0.639]	[0.796]
Observations	858	858	845	845	846	846
F first stage		91.4		88.3		86.9
Estimation	OLS	2SLS	OLS	2SLS	OLS	2SLS

Notes: This table repeats Table E.8, but including only product classes matched to border categories with more than 4 border observations.

E.4 Explaining the decline in the size of price reductions

In subsection E.1 we showed that in early 2015, accompanying the increase in the fraction of price reductions of imported goods there was a significant decline in the absolute size of retail price reductions for imported goods. We now show that a simple Ss pricing can generate this seemingly puzzling negative co-movement between the change in the frequency of price adjustment and the change in the absolute size of price changes of imported goods. Specifically, in response to a decline in the CHF-denominated cost of imported goods, the absolute size of price reductions falls if new price changes (i.e. those that would not have occurred in the absence of the shock) are sufficiently small relative to the size of typical price reductions. This is the case under the form of selection in Ss pricing models with idiosyncratic shocks that give rise to a fat-tailed distribution of price changes, as in Gertler and Leahy (2008) and Midrigan (2011).

Consider the following pricing rule for goods produced abroad and imported into Switzerland. Firm i's desired or reset price denominated in CHF is denoted (in logs) by p^*_{it}. We assume that $p^*_{it} = c + w_t + z_{it}$, where c is a constant, w_t is the aggregate component of marginal costs (production and local costs) measured in CHF, and z_{it} is the idiosyncratic component of marginal costs. An appreciation of the CHF reduces w_t for imported goods.

Following Gertler and Leahy (2008) and Midrigan (2011), we allow for the possibility that changes in the idiosyncratic component of marginal costs arrive infrequently according to a Poisson process. Specifically, $z_{it} - z_{it-1} = \varepsilon_{it}$ where

$$\varepsilon_{it} = \begin{cases} 0 & \text{with prob } 1-\lambda \\ N(0,\sigma) & \text{with prob } \lambda. \end{cases}$$

We assume that single-product firms change their price to p^*_{it} if the price gap (i.e. the difference between the actual log price, p_{it}, and the desired log price, p^*_{it}) exceeds y.[A6] This implies that the actual log price evolves according to

$$p_{it} = \begin{cases} p_{it-1} & \text{if } |p_{it-1} - p^*_{it}| < y \\ p^*_{it} & \text{if } |p_{it-1} - p^*_{it}| \geq y. \end{cases}$$

This policy function allows us to provide a simple characterization of how the average absolute size of price changes responds to an aggregate cost shock. Consider first the pre-shock steady-state, in which the aggregate component of costs w_t is constant over time. Every period a fraction f of firms reduce their price by an average size of $s \geq y$, a fraction f raise

[A6] Alvarez and Lippi (2014) derive this Ss pricing rule in a menu cost model under the assumption that marginal cost shocks follow a random walk process and desired markups are constant.

their price by the same average size s, while the remaining fraction of firms $1-2f$ leave their price unchanged. Consider now the response of prices after a one-time permanent decline in w_t of size $\Delta > 0$. The fraction of firms reducing their prices increases from f to f'. Of these f' firms reducing their price after the shock, f would have reduced their price even if $\Delta = 0$ and they will do so by an average size equal to $s + \Delta$. Hence, for this subset of firms, the average price reduction grows by Δ relative to the pre-shock equilibrium.[A7] A fraction $f' - f$ of firms, which would have either increased or left their price unchanged if $\Delta = 0$, now reduce their price by $\tilde{s}$. Putting these two pieces together, the change in the average size of price reductions is

$$s' - s = \frac{f}{f'}\Delta + \frac{f' - f}{f'}\left(\tilde{s} - s\right). \tag{A6}$$

The first term in equation (A6) contributes to increasing the average size of price reductions. The second term in equation (A6) contributes to decreasing the average size of price reductions if new price changes are on average small relative to pre-shock price changes ($\tilde{s} < s$). The average size of price reductions falls if the second term in equation (A6) is large and negative because there is a large increase in the fraction of price reductions and these new price reductions are small compared with pre-shock price reductions.[A8] We next illustrate in a calibrated version of this simple pricing model that if shocks arrive frequently ($\lambda = 1$), the first term in the right-hand side of equation (A6) dominates, and the average size of prices reductions rises. We then show that this result can be overturned if λ is sufficiently small, in which case $\tilde{s}$ is low relative to s and the second term in the right-hand side of equation (A6) dominates.

To calibrate the model, we set the time period to a month. For any given value of λ, we choose σ and y to target the following pre-shock equilibrium moments: (i) fraction of prices changing (increasing or decreasing) every month = 0.21, and (ii) average absolute size of price changes = 0.22. We consider two alternative values for the shock arrival probability λ: 1 (which we refer to as Gaussian) and 0.3 (which we refer to as Poisson). In order to match our two calibration targets, the Poisson specification requires thinner Ss bands y and more volatile cost shocks σ.[A9] As discussed in Midrigan (2011), the Poisson specification gives rise

[A7] In the presence of expected CHF overshooting (as observed in Figure 1) or strategic complementarities, the desired price may fall by less than Δ. Our qualitative results below are unchanged when we consider a smaller decline in desired prices, parameterized as a smaller value of Δ.

[A8] If we make the length of the time interval sufficiently short (reducing σ correspondingly) then price reductions before the shock are of size y (so that $s = y$) and new price changes after the shock are no smaller than y (so that $\tilde{s} \geq s$), implying $s' > s$. Therefore, a necessary condition for $s' < s$ is that the time interval is sufficiently long such that there is a non-degenerate distribution of price changes greater than y.

[A9] With $\lambda = 1$, we set $\sigma = 0.105$ and $y = 0.16$. With $\lambda = 0.3$, we set $\sigma = 0.21$ and $y = 0.08$. To assess the role of λ, we considered two alternative parameterizations. First, if we fix y and σ at their Gaussian-calibration levels and set $\lambda = 0.3$, the average size of price reductions falls after the CHF appreciation. Second, if we fix y and σ at their Poisson-calibration levels and set $\lambda = 1$, then the average size of price reductions rises after the CHF appreciation.

to a more Leptokurtic distribution of cost changes (the kurtosis of price changes is 2.2 with $\lambda = 0.3$ and 1.3 with $\lambda = 1$).

Starting in the pre-shock steady state distribution of price gaps in which $w_t = 0$, we consider a one-time 3.2% permanent reduction in the aggregate component of marginal cost for imported goods at the retail level, that is, $w_t = \Delta = -0.032$ for $t \geq 0$. This choice of Δ corresponds to the average decline of border prices three months after the CHF appreciation (6.4% averaging CHF and EUR-invoiced border price changes in Table 3) times 0.5 (which assumes a distribution share of 50%).

Both model specifications imply a reduction in the fraction of price increases, a rise in the fraction of prices decreases, and a small reduction in the size of price increases, as observed in the data on retail prices of imported goods reviewed above. However, while the model with Gaussian shocks implies an increase in the size of price reductions (from 0.22 to 0.23), the model with Poisson shocks implies a drop in the size of price reductions (from 0.22 to 0.20).

We can understand these results using equation (A6). Both specifications of the model are calibrated to the same pre-shock frequency and absolute size of price adjustment, f and s. Both specifications produce roughly the same increase in the frequency of price reductions, f'. The key difference between the two specifications is in terms of the absolute size of new price reductions: $\tilde{s} = 0.17$ with Gaussian shocks and $\tilde{s} = 0.09$ with Poisson shocks. With Poisson shocks, more firms are subject to small cost shocks, which only reduce their price in response to the aggregate cost reduction. This shift in the composition of price changes toward small values reduces the average size of price reductions. With Poisson shocks, the average size of large price reductions (those larger than 15%) increases after the shock, as well as the fraction of firms with small price reductions (those smaller than 15%).

If we consider a larger reduction in border prices (i.e. a larger value of Δ), the increase in the frequency of price reductions and the reduction in the average size of price reductions are both larger. This is consistent with the empirical results reported in subsection 4.4: larger reductions in border prices (or foreign-currency invoiced border prices) lead to more frequent but smaller price reductions.[A10]

Finally, we discuss the implications of the model for average (zero and non-zero) price changes. Denoting the average price change after k months by p_k, $p_1 = -0.022$, $p_3 = -0.031$, and $p_6 = -0.032$ with Gaussian shocks ($\lambda = 1$), and $p_1 = -0.013$, $p_3 = -0.023$, and $p_6 = -0.029$ with Poisson shocks ($\lambda = 0.3$). As discussed in detail in Midrigan (2011), the model with

[A10]We considered two alternative model specifications which can produce a more Leptokurtic distribution of price changes: one with multi-product firms, as in Midrigan (2011), and one in which every period the Ss band y is zero (i.e. zero menu costs) with a certain probability, as in the Calvoplus model of Nakamura and Steinsson (2010). When parameterized with Gaussian shocks ($\lambda = 1$), the average size of price reductions implied by these alternative model specifications increases in response to a decline in aggregate costs, as in the single-product model with Gaussian shocks.

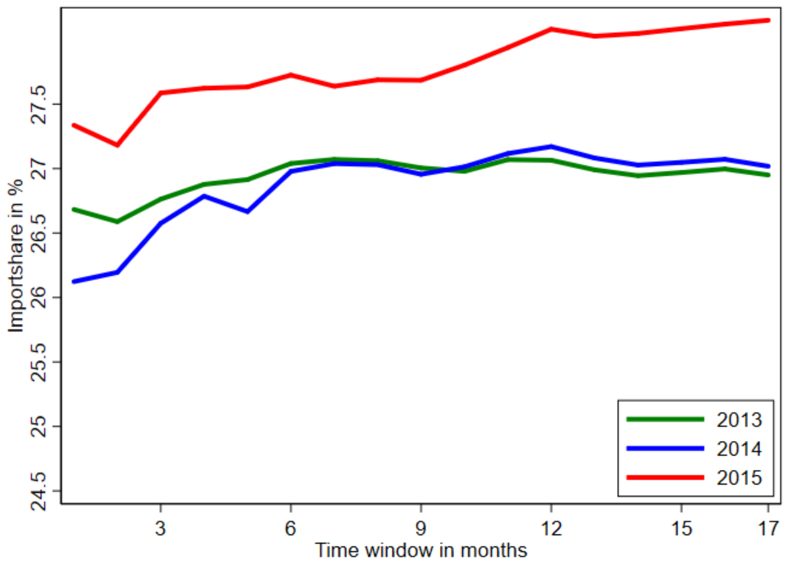
Poisson shocks implies a smaller reduction in prices, on average, because of a weaker "selection effect" in the set of firms changing price. What we showed is that this selection effect also has very different implications for the direction of the intensive margin of price changes in response to an aggregate cost shock.

F Expenditure switching: additional results

F.1 Aggregate import shares in subsection 5.1

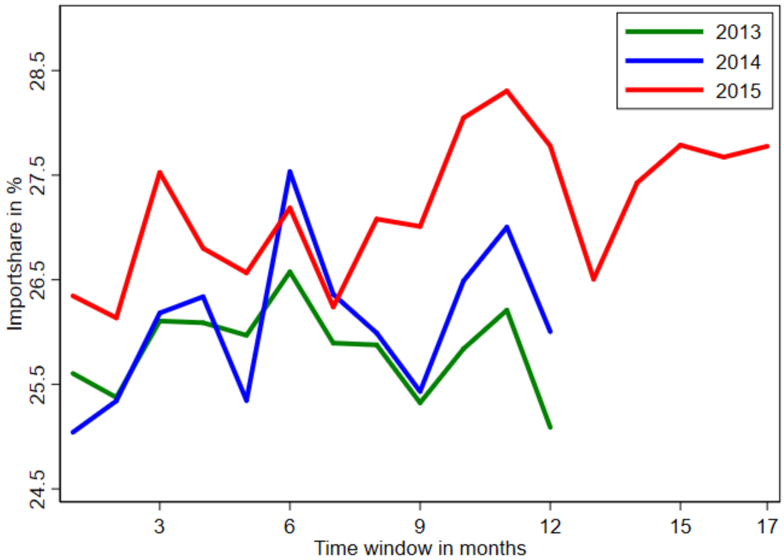
We provide additional graphs for aggregate import shares. We consider the full set of product classes (sample Min0+) rather than dropping product categories with 7 or less border prices per quarter in 2014), monthly shares (not cumulative by horizon), and using only EU imports.

Figure F.1: *Aggregate import share in total expenditures*



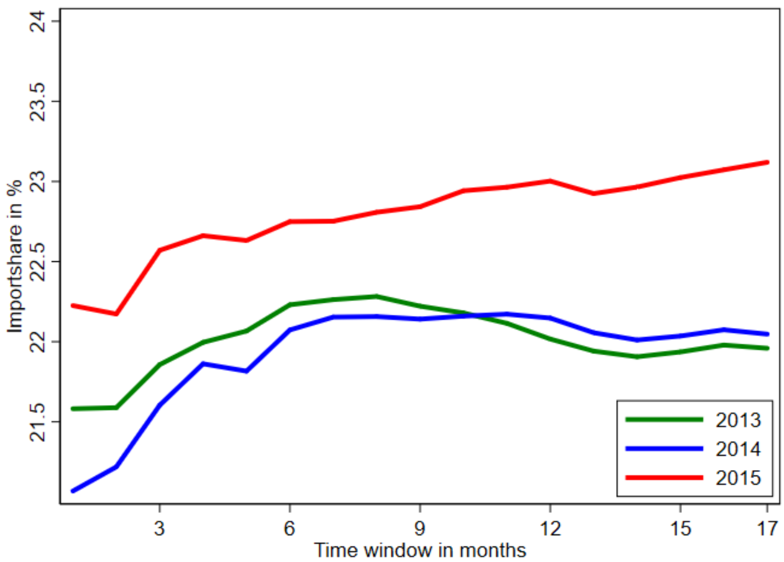
Notes: This figure repeats Figure 8, but in the sample Min0+ that includes all product categories (rather than dropping product categories with 7 or less border prices per quarter in 2014).

Figure F.2: *Aggregate import share in total expenditures not accumulated*



Notes: This figure repeats Figure 8, but does not accumulate expenditures over time for each horizon.

Figure F.3: *Aggregate EU import share in total expenditures*



Notes: This figure repeats Figure 8, but including only EU imports in the numerator.

F.2 Regression (8) in subsection 5.2

We consider sensitivity analysis to using different weighting schemes, clustering, trimming, balanced sample, EU imports, and border category samples. Note that, in contrast to our results on prices and invoicing, as we include more border categories, estimates become stronger. Moreover, results are not very sensitive to including EU imports only.

Table F.1: *Expenditure switching and invoicing, unweighted*

	(1) 3m	(2) 6m	(3) 9m	(4) 12m	(5) 15m	(6) 17m
Panel (a). EUR-invoicing share						
$EURShare \times \mathbb{I}13$	-0.117	0.005	-0.029	0.067	0.082	0.092
	[0.082]	[0.075]	[0.075]	[0.073]	[0.073]	[0.070]
$EURShare \times \mathbb{I}15$	0.051	0.220***	0.155**	0.223***	0.197**	0.143
	[0.071]	[0.065]	[0.071]	[0.076]	[0.082]	[0.092]
Adjusted R^2	0.90	0.91	0.91	0.91	0.90	0.90
Panel (b). Interaction of import share with invoicing						
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	-0.062	-0.001	-0.060	0.036	0.084	0.105
	[0.092]	[0.096]	[0.092]	[0.093]	[0.090]	[0.086]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.191**	0.372***	0.278***	0.321***	0.301***	0.296**
	[0.089]	[0.085]	[0.093]	[0.091]	[0.104]	[0.119]
Adjusted R^2	0.90	0.91	0.91	0.91	0.90	0.90
Panel (c). Import share and interaction of import share with invoicing						
$(1 - ImpShare) \times \mathbb{I}13$	0.093	-0.020	0.018	-0.024	-0.029	-0.042
	[0.071]	[0.069]	[0.091]	[0.090]	[0.089]	[0.091]
$(1 - ImpShare) \times \mathbb{I}15$	0.104	0.008	0.106	0.036	0.081	0.128
	[0.064]	[0.067]	[0.069]	[0.097]	[0.104]	[0.117]
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	-0.154	0.020	-0.078	0.060	0.113	0.148
	[0.130]	[0.127]	[0.147]	[0.147]	[0.145]	[0.143]
$EURShare \times (1 - ImpShare)\mathbb{I}15$	0.087	0.364***	0.170	0.284*	0.219	0.165
	[0.112]	[0.115]	[0.125]	[0.156]	[0.165]	[0.190]
Adjusted R^2	0.90	0.91	0.91	0.91	0.90	0.90
Observations	6279	7068	7563	8046	8118	8160
Unique products	2093	2356	2521	2682	2706	2720

Notes: This table repeats Table 10, but weighting all observations equally.

Table F.2: *Expenditure switching and invoicing, border category weights*

	(1) 3m	(2) 6m	(3) 9m	(4) 12m	(5) 15m	(6) 17m
Panel (a). EUR-invoicing share						
$EURShare \times \mathbb{I}13$	-0.123	-0.021	-0.012	0.089	0.100	0.117*
	[0.079]	[0.072]	[0.073]	[0.076]	[0.072]	[0.070]
$EURShare \times \mathbb{I}15$	0.074	0.214***	0.178**	0.244***	0.215**	0.173*
	[0.072]	[0.072]	[0.085]	[0.084]	[0.088]	[0.098]
Adjusted R^2	0.90	0.91	0.91	0.91	0.90	0.90
Panel (b). Interaction of import share with invoicing						
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	-0.048	-0.019	-0.059	0.033	0.082	0.096
	[0.087]	[0.094]	[0.088]	[0.093]	[0.084]	[0.080]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.228***	0.368***	0.305***	0.343***	0.330***	0.307**
	[0.086]	[0.097]	[0.113]	[0.102]	[0.115]	[0.138]
Adjusted R^2	0.90	0.91	0.91	0.91	0.90	0.90
Panel (c). Import share and interaction of import share with invoicing						
$(1 - ImpShare) \times \mathbb{I}13$	0.107	-0.007	-0.019	-0.069	-0.066	-0.083
	[0.071]	[0.070]	[0.087]	[0.090]	[0.087]	[0.090]
$(1 - ImpShare) \times \mathbb{I}15$	0.078	0.022	0.126*	0.061	0.108	0.135
	[0.061]	[0.068]	[0.075]	[0.094]	[0.099]	[0.109]
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	-0.159	-0.012	-0.039	0.104	0.150	0.181
	[0.128]	[0.117]	[0.135]	[0.143]	[0.134]	[0.131]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.147	0.345***	0.175	0.280*	0.219	0.167
	[0.108]	[0.125]	[0.147]	[0.156]	[0.165]	[0.191]
Adjusted R^2	0.90	0.91	0.91	0.91	0.90	0.90
Observations	6279	7065	7560	8043	8115	8157
Unique products	2093	2355	2520	2681	2705	2719

Notes: This table repeats Table 10, but weighting by border product categories based on 2014 Nielsen expenditures (observations are equally weighted within border category).

Table F.3: *Expenditure switching and invoicing, standard errors clustered by border category*

	(1) 3m	(2) 6m	(3) 9m	(4) 12m	(5) 15m	(6) 17m
Panel (a). EUR-invoicing share						
$EURShare \times \mathbb{I}13$	0.033	0.090**	-0.008	0.024	0.036	0.037
	[0.064]	[0.043]	[0.053]	[0.042]	[0.047]	[0.048]
$EURShare \times \mathbb{I}15$	0.119***	0.127***	0.080**	0.111**	0.115**	0.096**
	[0.041]	[0.035]	[0.038]	[0.042]	[0.045]	[0.047]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (b). Interaction of import share with invoicing						
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	0.077	0.096*	0.006	0.007	0.035	0.040
	[0.071]	[0.052]	[0.066]	[0.060]	[0.064]	[0.063]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.207***	0.179***	0.143***	0.179***	0.191***	0.175***
	[0.051]	[0.041]	[0.049]	[0.054]	[0.058]	[0.056]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (c). Import share and interaction of import share with invoicing						
$(1 - ImpShare) \times \mathbb{I}13$	0.063	-0.003	0.048	0.000	-0.001	0.000
	[0.063]	[0.055]	[0.063]	[0.038]	[0.038]	[0.040]
$(1 - ImpShare) \times \mathbb{I}15$	-0.033	-0.038	0.017	0.007	0.003	0.014
	[0.036]	[0.039]	[0.034]	[0.038]	[0.039]	[0.044]
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	0.007	0.099	-0.046	0.006	0.036	0.040
	[0.116]	[0.088]	[0.107]	[0.072]	[0.077]	[0.077]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.244***	0.221***	0.124**	0.172***	0.188***	0.159**
	[0.066]	[0.056]	[0.058]	[0.063]	[0.062]	[0.067]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Observations	6279	7068	7563	8046	8118	8160
Unique products	2093	2356	2521	2682	2706	2720

Notes: This table repeats Table 10, but clustering standard errors by border product category.

Table F.4: *Expenditure switching and invoicing, Min 8+*

	(1) 3m	(2) 6m	(3) 9m	(4) 12m	(5) 15m	(6) 17m
Panel (a). EUR-invoicing share						
$EURShare \times \mathbb{I}13$	0.047	0.057	-0.016	0.035	0.049	0.046
	[0.067]	[0.054]	[0.071]	[0.052]	[0.056]	[0.058]
$EURShare \times \mathbb{I}15$	0.145**	0.115**	0.054	0.082*	0.088*	0.070
	[0.057]	[0.047]	[0.046]	[0.047]	[0.052]	[0.054]
Adjusted R^2	0.94	0.95	0.95	0.94	0.94	0.94
Panel (b). Interaction of import share with invoicing						
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	0.091	0.060	0.001	0.012	0.044	0.046
	[0.075]	[0.060]	[0.071]	[0.058]	[0.060]	[0.061]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.230***	0.163***	0.119**	0.151***	0.166***	0.151**
	[0.073]	[0.057]	[0.055]	[0.057]	[0.061]	[0.063]
Adjusted R^2	0.94	0.95	0.95	0.94	0.94	0.94
Panel (c). Import share and interaction of import share with invoicing						
$(1 - ImpShare) \times \mathbb{I}13$	0.044	0.009	0.059	-0.005	-0.007	-0.003
	[0.068]	[0.054]	[0.067]	[0.040]	[0.044]	[0.046]
$(1 - ImpShare) \times \mathbb{I}15$	-0.042	-0.025	0.031	0.018	0.007	0.017
	[0.044]	[0.043]	[0.038]	[0.042]	[0.047]	[0.053]
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	0.042	0.049	-0.065	0.018	0.052	0.050
	[0.119]	[0.094]	[0.119]	[0.080]	[0.085]	[0.087]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.277***	0.192**	0.085	0.131*	0.158*	0.132
	[0.091]	[0.077]	[0.072]	[0.074]	[0.081]	[0.088]
Adjusted R^2	0.94	0.95	0.95	0.94	0.94	0.94
Observations	5394	6075	6504	6912	6975	7011
Unique products	1798	2025	2168	2304	2325	2337

Notes: This table repeats Table 10, but including only product classes matched to border categories with more than 8 border observations per quarter in 2014.

Table F.5: *Expenditure switching and invoicing, Min 4+*

	(1) 3m	(2) 6m	(3) 9m	(4) 12m	(5) 15m	(6) 17m
Panel (a). EUR-invoicing share						
$EURShare \times \mathbb{I}13$	0.022	0.081*	-0.007	0.013	0.024	0.026
	[0.052]	[0.048]	[0.055]	[0.043]	[0.046]	[0.048]
$EURShare \times \mathbb{I}15$	0.117**	0.123***	0.078*	0.101**	0.102**	0.088*
	[0.054]	[0.043]	[0.042]	[0.043]	[0.049]	[0.052]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (b). Interaction of import share with invoicing						
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	0.087	0.113*	0.024	0.012	0.041	0.047
	[0.067]	[0.059]	[0.065]	[0.053]	[0.056]	[0.057]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.206***	0.175***	0.142***	0.178***	0.185***	0.171***
	[0.072]	[0.055]	[0.054]	[0.055]	[0.062]	[0.065]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (c). Import share and interaction of import share with invoicing						
$(1 - ImpShare) \times \mathbb{I}13$	0.092	0.033	0.069	0.017	0.016	0.018
	[0.057]	[0.055]	[0.059]	[0.037]	[0.040]	[0.042]
$(1 - ImpShare) \times \mathbb{I}15$	-0.024	-0.042	0.012	0.010	0.002	0.012
	[0.046]	[0.039]	[0.037]	[0.040]	[0.043]	[0.048]
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	-0.013	0.077	-0.051	-0.006	0.024	0.027
	[0.098]	[0.092]	[0.104]	[0.073]	[0.078]	[0.080]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.232**	0.221***	0.129*	0.167**	0.183**	0.158*
	[0.091]	[0.075]	[0.073]	[0.073]	[0.082]	[0.089]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Observations	6777	7647	8178	8691	8769	8820
Unique products	2259	2549	2726	2897	2923	2940

Notes: This table repeats Table 10, but including only product classes matched to border categories with more than 4 border observations per quarter in 2014.

Table F.6: *Expenditure switching and invoicing, Min 0+*

	(1) 3m	(2) 6m	(3) 9m	(4) 12m	(5) 15m	(6) 17m
Panel (a). EUR-invoicing share						
$EURShare \times \mathbb{I}13$	0.002	0.062	-0.023	-0.001	0.008	0.007
	[0.048]	[0.044]	[0.052]	[0.040]	[0.044]	[0.046]
$EURShare \times \mathbb{I}15$	0.114**	0.125***	0.090**	0.104***	0.103**	0.092*
	[0.050]	[0.039]	[0.039]	[0.039]	[0.045]	[0.047]
Adjusted R^2	0.93	0.94	0.94	0.94	0.94	0.93
Panel (b). Interaction of import share with invoicing						
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	0.057	0.095*	0.006	-0.001	0.023	0.028
	[0.065]	[0.056]	[0.062]	[0.050]	[0.054]	[0.055]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.202***	0.182***	0.156***	0.184***	0.189***	0.178***
	[0.068]	[0.052]	[0.051]	[0.051]	[0.057]	[0.060]
Adjusted R^2	0.93	0.94	0.94	0.94	0.94	0.93
Panel (c). Import share and interaction of import share with invoicing						
$(1 - ImpShare) \times \mathbb{I}13$	0.091*	0.036	0.072	0.019	0.019	0.023
	[0.054]	[0.051]	[0.055]	[0.035]	[0.039]	[0.041]
$(1 - ImpShare) \times \mathbb{I}15$	-0.031	-0.048	-0.002	-0.001	-0.007	0.002
	[0.045]	[0.038]	[0.036]	[0.039]	[0.042]	[0.047]
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	-0.037	0.057	-0.068	-0.021	0.003	0.004
	[0.089]	[0.082]	[0.095]	[0.068]	[0.074]	[0.076]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.234***	0.232***	0.158**	0.185***	0.196**	0.176**
	[0.085]	[0.070]	[0.068]	[0.067]	[0.076]	[0.081]
Adjusted R^2	0.93	0.94	0.94	0.94	0.94	0.93
Observations	7041	7962	8508	9030	9114	9171
Unique products	2347	2654	2836	3010	3038	3057

Notes: This table repeats Table 10, but including all product categories (rather than dropping product categories with 7 or less border prices per quarter in 2014).

Table F.7: *Expenditure switching and invoicing, trimming largest expenditure changes*

	(1) 3m	(2) 6m	(3) 9m	(4) 12m	(5) 15m	(6) 17m
Panel (a). EUR-invoicing share						
$EURShare \times \mathbb{I}13$	0.023	0.094*	-0.010	0.025	0.034	0.034
	[0.055]	[0.052]	[0.063]	[0.046]	[0.051]	[0.053]
$EURShare \times \mathbb{I}15$	0.114**	0.127***	0.080*	0.110**	0.114**	0.096
	[0.056]	[0.047]	[0.048]	[0.048]	[0.056]	[0.059]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (b). Interaction of import share with invoicing						
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	0.061	0.102*	0.006	0.014	0.036	0.041
	[0.068]	[0.060]	[0.068]	[0.055]	[0.057]	[0.058]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.200***	0.179***	0.145**	0.183***	0.196***	0.179***
	[0.072]	[0.059]	[0.058]	[0.059]	[0.066]	[0.068]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (c). Import share and interaction of import share with invoicing						
$(1 - ImpShare) \times \mathbb{I}13$	0.068	-0.003	0.052	0.006	0.004	0.005
	[0.060]	[0.057]	[0.063]	[0.038]	[0.042]	[0.044]
$(1 - ImpShare) \times \mathbb{I}15$	-0.029	-0.037	0.018	0.011	0.007	0.019
	[0.043]	[0.041]	[0.038]	[0.041]	[0.046]	[0.051]
$EURShare \times (1 - ImpShare) \times \mathbb{I}13$	-0.013	0.105	-0.050	0.008	0.032	0.035
	[0.102]	[0.097]	[0.112]	[0.075]	[0.080]	[0.082]
$EURShare \times (1 - ImpShare) \times \mathbb{I}15$	0.231**	0.219***	0.125	0.171**	0.188**	0.158*
	[0.092]	[0.079]	[0.077]	[0.078]	[0.088]	[0.095]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Observations	6209	6985	7472	7955	8021	8068
Unique products	2080	2337	2502	2667	2688	2708

Notes: This table repeats Table 10, but trimming the dependent variable by excluding the 1% largest changes in absolute values from the regression.

Table F.8: *Expenditure switching and invoicing, 2014-2015 balanced sample*

	(1) 3m	(2) 6m	(3) 9m	(4) 12m	(5) 15m	(6) 17m
Panel (a). EUR-invoicing share						
$EURShare \times \mathbb{I}13$	0.034	0.072	-0.014	0.014	0.024	0.024
	[0.061]	[0.051]	[0.062]	[0.046]	[0.051]	[0.054]
$EURShare \times \mathbb{I}15$	0.122**	0.092*	0.068	0.090**	0.092*	0.072
	[0.058]	[0.047]	[0.044]	[0.044]	[0.050]	[0.054]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (b). Interaction of import share with invoicing						
$(1 - CHFShare)(1 - ImpShare) \times \mathbb{I}13$	0.079	0.096	0.006	0.000	0.028	0.031
	[0.074]	[0.060]	[0.066]	[0.054]	[0.057]	[0.058]
$(1 - CHFShare)(1 - ImpShare) \times \mathbb{I}15$	0.212***	0.180***	0.142***	0.167***	0.176***	0.156**
	[0.076]	[0.057]	[0.054]	[0.053]	[0.059]	[0.065]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (c). Import share and interaction of import share with invoicing						
$(1 - ImpShare) \times \mathbb{I}13$	0.060	0.012	0.052	0.011	0.010	0.010
	[0.060]	[0.054]	[0.060]	[0.037]	[0.042]	[0.044]
$(1 - ImpShare) \times \mathbb{I}15$	-0.039	-0.010	0.025	0.028	0.024	0.035
	[0.051]	[0.044]	[0.039]	[0.041]	[0.046]	[0.051]
$(1 - CHFShare)(1 - ImpShare) \times \mathbb{I}13$	0.013	0.084	-0.051	-0.012	0.017	0.019
	[0.107]	[0.095]	[0.109]	[0.076]	[0.082]	[0.084]
$(1 - CHFShare)(1 - ImpShare)\mathbb{I}15$	0.255***	0.191**	0.115	0.136*	0.150*	0.117
	[0.097]	[0.081]	[0.074]	[0.073]	[0.082]	[0.092]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Observations	6803	7702	8329	8844	8928	8994
Unique products	2355	2673	2904	3081	3111	3137

Notes: This table repeats Table 10, but based on balanced samples that, for any given monthly horizon, only include goods observed in both 2014 and 2015.

Table F.9: *Expenditure switching and invoicing, EU imports*

	(1) 3m	(2) 6m	(3) 9m	(4) 12m	(5) 15m	(6) 17m
Panel (a). EUR-invoicing share						
$EURShare \times \mathbb{I}13$	0.060	0.114**	0.005	0.051	0.067	0.066
	[0.061]	[0.054]	[0.066]	[0.052]	[0.056]	[0.058]
$EURShare \times \mathbb{I}15$	0.128**	0.134**	0.089*	0.132**	0.142**	0.123*
	[0.062]	[0.052]	[0.052]	[0.053]	[0.060]	[0.063]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (b). Interaction of import share with invoicing						
$(1 - CHFShare)(1 - ImpShare) \times \mathbb{I}13$	0.124*	0.111*	0.007	0.022	0.061	0.062
	[0.073]	[0.066]	[0.072]	[0.061]	[0.063]	[0.064]
$(1 - CHFShare)(1 - ImpShare) \times \mathbb{I}15$	0.239***	0.191***	0.154**	0.211***	0.235***	0.217***
	[0.078]	[0.063]	[0.061]	[0.063]	[0.070]	[0.073]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Panel (c). Import share and interaction of import share with invoicing						
$(1 - ImpShare) \times \mathbb{I}13$	0.075	-0.006	0.035	-0.030	-0.025	-0.023
	[0.059]	[0.052]	[0.058]	[0.049]	[0.053]	[0.055]
$(1 - ImpShare) \times \mathbb{I}15$	-0.011	-0.022	0.011	-0.015	-0.008	0.009
	[0.045]	[0.043]	[0.042]	[0.049]	[0.051]	[0.054]
$(1 - CHFShare)(1 - ImpShare) \times \mathbb{I}13$	0.050	0.117	-0.027	0.052	0.086	0.085
	[0.098]	[0.090]	[0.103]	[0.087]	[0.091]	[0.093]
$(1 - CHFShare)(1 - ImpShare)\mathbb{I}15$	0.251***	0.213***	0.143*	0.226**	0.243**	0.208**
	[0.094]	[0.081]	[0.082]	[0.088]	[0.095]	[0.099]
Adjusted R^2	0.93	0.94	0.94	0.94	0.93	0.93
Observations	5448	6168	6627	7086	7158	7200
Unique products	1816	2056	2209	2362	2386	2400

Notes: This table repeats Table 10, considering only EU imports (shares are calculated including non-EU imports in the denominator).

F.3 Regression (9) in subsection 5.3

We first report the results of Table 11 also for the 15-month and the 17-month horizon. We then report OLS estimates, as well as sensitivity analysis to using different weighting schemes, clustering, trimming, price aggregations, balanced sample, converting EUR-invoiced prices into CHF using the quarterly EUR/CHF exchange rate, and using EU imports only. We report all these robustness tests for horizons up to 17 months.

Table F.10: *Sensitivity of import shares to relative prices, incl. 15 months and 17 months horizon*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. border imp. price	-1.21***	-1.12***	-1.02***	-0.98***	-0.95**	-0.87**	-1.43***	-1.27***	-1.65***	-1.46***	-1.58**	-1.39**
	[0.45]	[0.41]	[0.34]	[0.33]	[0.39]	[0.35]	[0.47]	[0.42]	[0.57]	[0.51]	[0.63]	[0.57]
F first stage	126.7	237.6	123.7	243.2	85.4	183.9	59.6	142.6	48.2	117.6	42.8	106.3
Rel. bor.+distr. imp. price	-2.27**	-1.97***	-1.89***	-1.75***	-1.87**	-1.59**	-2.90***	-2.31***	-3.41**	-2.68***	-3.33**	-2.58**
	[0.89]	[0.73]	[0.66]	[0.60]	[0.81]	[0.64]	[1.07]	[0.77]	[1.34]	[0.95]	[1.48]	[1.06]
F first stage	48.1	231.1	41.8	230.5	27.8	167.5	18.3	129.8	14.2	105.1	12.1	93.1
Rel. retail imp. price	-5.10*	-3.81**	-4.23**	-3.60**	-3.81*	-2.79**	-5.84	-3.85**	-5.26*	-3.69**	-4.77*	-3.36*
	[2.68]	[1.61]	[2.09]	[1.59]	[2.30]	[1.41]	[3.63]	[1.84]	[2.98]	[1.79]	[2.84]	[1.77]
F first stage	6.1	16.9	6.5	13.3	5.2	12.8	3.6	10.8	4.9	11.9	4.7	11.7
Observations	2092	2092	2352	2352	2517	2517	2677	2677	2701	2701	2714	2714
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table repeats Table 11 including the 15 months and the 17 months horizon.

Table F.11: *Sensitivity of import shares to relative prices, OLS estimates*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. border imp. price	-0.24	-0.40	-0.24	-0.38	-0.28	-0.51	-0.39	-0.61	-0.29	-0.44	-0.25	-0.32
	[0.36]	[0.33]	[0.29]	[0.28]	[0.29]	[0.32]	[0.33]	[0.39]	[0.39]	[0.45]	[0.41]	[0.48]
Rel. bor.+distr. imp. price	-0.17	-0.69	-0.21	-0.67	-0.20	-0.88	-0.33	-1.05	-0.23	-0.73	-0.23	-0.48
	[0.57]	[0.58]	[0.42]	[0.50]	[0.39]	[0.58]	[0.41]	[0.71]	[0.47]	[0.83]	[0.50]	[0.88]
Rel. retail imp. price	0.40**	0.37*	0.38*	0.37	0.36	0.34	0.09	0.08	0.15	0.15	0.18	0.19
	[0.20]	[0.19]	[0.23]	[0.22]	[0.23]	[0.23]	[0.26]	[0.25]	[0.27]	[0.26]	[0.28]	[0.27]
Observations	2092	2092	2352	2352	2517	2517	2677	2677	2701	2701	2714	2714
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table shows the OLS specifications corresponding to each of the 2SLS estimations of Table 11. Also the results for the 15 months and the 17 months horizon are displayed.

Table F.12: *Sensitivity of import shares to relative prices, unweighted*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. border imp. price	-1.11**	-1.11**	-2.13***	-2.23***	-1.88***	-1.91***	-2.65***	-2.65***	-2.77**	-2.74***	-2.84**	-2.81**
	[0.52]	[0.52]	[0.56]	[0.55]	[0.69]	[0.66]	[0.92]	[0.81]	[1.12]	[0.97]	[1.36]	[1.20]
F first stage	166.7	248.4	122.9	226.6	83.3	142.4	59.9	102.4	46.7	84.6	41.0	74.9
Rel. bor.+distr. imp. price	-1.96**	-1.96**	-3.68***	-4.00***	-3.39**	-3.49***	-4.84**	-4.85***	-5.18**	-5.10***	-5.40*	-5.29**
	[0.94]	[0.92]	[1.07]	[0.99]	[1.37]	[1.21]	[1.93]	[1.49]	[2.41]	[1.82]	[2.95]	[2.28]
F first stage	74.8	239.9	46.9	211.9	35.7	126.8	25.7	90.8	19.0	73.5	16.2	63.3
Rel. retail imp. price	-3.46*	-3.45*	-5.46***	-6.19***	-4.52**	-4.70**	-6.92*	-6.94**	-6.47*	-6.35**	-5.61	-5.48*
	[1.85]	[1.81]	[1.99]	[2.11]	[2.19]	[1.99]	[3.63]	[2.92]	[3.70]	[2.92]	[3.70]	[3.13]
F first stage	10.5	11.8	13.2	14.5	11.3	16.1	6.7	9.5	6.3	9.2	7.0	9.8
Observations	2092	2092	2352	2352	2517	2517	2677	2677	2701	2701	2714	2714
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table repeats Table 11, but weighting all observations equally. Also the results for the 15 months and the 17 months horizon are displayed.

Table F.13: *Sensitivity of import shares to relative prices, border category weights*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. border imp. price	-1.27**	-1.22***	-2.03***	-2.02***	-1.94**	-1.88***	-2.60***	-2.48***	-2.73**	-2.60***	-2.62*	-2.49**
	[0.50]	[0.47]	[0.58]	[0.56]	[0.77]	[0.70]	[0.90]	[0.77]	[1.08]	[0.93]	[1.35]	[1.18]
F first stage	183.8	298.4	156.5	282.3	107.0	195.7	77.3	145.1	61.7	120.5	54.9	109.6
Rel. bor.+distr. imp. price	-2.32**	-2.15***	-3.64***	-3.60***	-3.59**	-3.41***	-4.89**	-4.50***	-5.25**	-4.76***	-5.10*	-4.61**
	[0.93]	[0.82]	[1.13]	[0.99]	[1.55]	[1.27]	[1.93]	[1.40]	[2.34]	[1.71]	[2.91]	[2.20]
F first stage	81.6	288.0	61.2	264.5	44.0	176.7	31.3	131.0	24.1	106.8	20.9	95.0
Rel. retail imp. price	-4.05**	-3.58**	-5.16**	-5.09***	-4.73*	-4.41**	-7.02*	-6.23**	-6.59*	-5.84**	-5.04	-4.57*
	[1.96]	[1.54]	[2.00]	[1.80]	[2.42]	[1.97]	[3.74]	[2.62]	[3.66]	[2.61]	[3.49]	[2.76]
F first stage	8.2	12.4	14.5	18.7	12.4	18.5	6.6	10.8	6.4	10.6	7.7	12.2
Observations	2092	2092	2351	2351	2516	2516	2676	2676	2700	2700	2713	2713
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table repeats Table 11, but weighting by border product categories based on 2014 Nielsen expenditures (observations are equally weighted within border category). Also the results for the 15 months and the 17 months horizon are displayed.

Table F.14: *Sensitivity of import shares to relative prices, cluster border categories*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. border imp. price	-1.21***	-1.12***	-1.02***	-0.98***	-0.95***	-0.87***	-1.43***	-1.27***	-1.65***	-1.46***	-1.58***	-1.39***
	[0.36]	[0.33]	[0.28]	[0.28]	[0.33]	[0.29]	[0.44]	[0.37]	[0.53]	[0.44]	[0.56]	[0.48]
F first stage	79.9	94.3	88.3	89.5	51.8	59.1	34.5	44.9	28.7	38.3	26.2	35.0
Rel. bor.+distr. imp. price	-2.27***	-1.97***	-1.89***	-1.75***	-1.87***	-1.59***	-2.90***	-2.31***	-3.41***	-2.68***	-3.33**	-2.58***
	[0.71]	[0.57]	[0.56]	[0.50]	[0.71]	[0.51]	[1.06]	[0.66]	[1.31]	[0.82]	[1.39]	[0.90]
F first stage	41.4	90.2	39.6	81.9	23.3	51.3	14.4	39.0	11.4	32.6	10.1	29.1
Rel. retail imp. price	-5.10**	-3.81***	-4.23**	-3.60***	-3.81*	-2.79**	-5.84	-3.85**	-5.26*	-3.69**	-4.77*	-3.36**
	[2.49]	[1.37]	[1.75]	[1.25]	[2.21]	[1.23]	[3.61]	[1.74]	[2.87]	[1.62]	[2.49]	[1.48]
F first stage	6.3	19.4	7.6	15.3	6.3	15.3	4.7	12.5	6.4	14.0	6.5	13.6
Observations	2092	2092	2352	2352	2517	2517	2677	2677	2701	2701	2714	2714
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table repeats Table 11, but clustering standard errors by border product categories. Also the results for the 15 months and the 17 months horizon are displayed.

Table F.15: *Sensitivity of import shares to relative prices, Min 8+*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. border imp. price	-1.25***	-1.24***	-0.86***	-0.89***	-0.73**	-0.74**	-1.10***	-1.09***	-1.29**	-1.27**	-1.22**	-1.21**
	[0.42]	[0.42]	[0.31]	[0.33]	[0.34]	[0.34]	[0.42]	[0.42]	[0.50]	[0.49]	[0.54]	[0.54]
F first stage	177.1	177.6	203.5	185.3	134.7	145.6	92.4	114.0	76.0	94.4	68.4	85.9
Rel. bor.+distr. imp. price	-2.24***	-2.20***	-1.50***	-1.61***	-1.34**	-1.35**	-2.05**	-1.99***	-2.42**	-2.36**	-2.32**	-2.28**
	[0.77]	[0.75]	[0.54]	[0.60]	[0.63]	[0.63]	[0.80]	[0.77]	[0.96]	[0.92]	[1.06]	[1.02]
F first stage	108.2	173.9	103.5	177.6	77.2	134.0	50.6	104.4	41.0	84.9	35.7	75.8
Rel. retail imp. price	-4.92**	-4.71**	-3.17**	-3.72**	-2.56	-2.59*	-3.93*	-3.73*	-3.76*	-3.63**	-3.42*	-3.33*
	[2.33]	[1.93]	[1.48]	[1.80]	[1.56]	[1.47]	[2.36]	[1.98]	[2.12]	[1.83]	[2.06]	[1.80]
F first stage	7.4	14.2	9.5	11.0	7.6	12.3	5.3	10.1	6.5	12.0	6.2	11.5
Observations	1797	1797	2021	2021	2164	2164	2299	2299	2320	2320	2332	2332
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table repeats Table 11, but including only product classes matched to border categories with more than 8 border observations. Also the results for the 15 months and the 17 months horizon are displayed.

Table F.16: *Sensitivity of import shares to relative prices, Min 4+*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. border imp. price	-1.20***	-1.12***	-1.00***	-0.97***	-0.96**	-0.88**	-1.44***	-1.28***	-1.63***	-1.45***	-1.58**	-1.40**
	[0.44]	[0.41]	[0.33]	[0.32]	[0.38]	[0.34]	[0.46]	[0.41]	[0.56]	[0.51]	[0.62]	[0.56]
F first stage	135.6	250.3	130.2	248.8	88.6	187.5	60.6	140.2	48.6	113.9	42.6	101.6
Rel. bor.+distr. imp. price	-2.25***	-1.97***	-1.86***	-1.74***	-1.87**	-1.60**	-2.90***	-2.33***	-3.35***	-2.66***	-3.33**	-2.61**
	[0.86]	[0.72]	[0.64]	[0.58]	[0.78]	[0.62]	[1.04]	[0.75]	[1.30]	[0.94]	[1.45]	[1.05]
F first stage	52.0	244.5	44.7	237.2	29.5	172.0	19.2	128.2	14.8	102.2	12.4	89.2
Rel. retail imp. price	-5.29*	-3.97**	-4.34**	-3.74**	-4.06*	-2.97**	-6.18	-4.08**	-5.41*	-3.82**	-5.00*	-3.52*
	[2.73]	[1.66]	[2.12]	[1.64]	[2.43]	[1.47]	[3.86]	[1.94]	[3.07]	[1.85]	[2.98]	[1.85]
F first stage	6.2	16.7	6.5	12.8	5.0	12.1	3.5	10.2	4.7	11.3	4.5	11.0
Observations	2258	2258	2545	2545	2722	2722	2892	2892	2918	2918	2934	2934
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table repeats Table 11, but including only product classes matched to border categories with more than 4 border observations. Also the results for the 15 months and the 17 months horizon are displayed.

Table F.17: *Sensitivity of import shares to relative prices, alternative aggregations of transaction-level prices to price series*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. retail imp. price	-4.92**	-3.71**	-4.07**	-3.51**	-3.61*	-2.68**	-5.83	-3.76**	-5.30*	-3.62**	-4.73*	-3.28*
	[2.47]	[1.55]	[1.94]	[1.55]	[2.10]	[1.34]	[3.56]	[1.78]	[2.97]	[1.74]	[2.78]	[1.72]
F first stage	7.3	19.5	7.8	14.7	6.2	14.7	3.9	12.0	5.0	12.9	5.0	12.6
Observations	2092	2092	2352	2352	2517	2517	2677	2677	2701	2701	2714	2714
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table repeats Table 11 with an alternative aggregation of retail prices, taking the mode (instead of the mean as in the baseline) across households, weeks, and stores in triplet rst and then average P^{ret}_{irst} across regions and retailers in month t to obtain a measure of the retail price of product i in month t, P^{ret}_{it}. Also the results for the 15 months and the 17 months horizon are displayed.

Table F.18: *Sensitivity of import shares to relative prices, official exchange rate*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. border imp. price	-1.18***	-1.09***	-0.98***	-0.94***	-0.93**	-0.85**	-1.40***	-1.24***	-1.62***	-1.43***	-1.55**	-1.36**
	[0.44]	[0.40]	[0.33]	[0.32]	[0.38]	[0.34]	[0.46]	[0.41]	[0.56]	[0.50]	[0.62]	[0.56]
F first stage	133.7	261.8	135.2	273.6	90.5	196.6	62.6	150.0	50.3	122.5	44.6	110.6
Rel. bor.+distr. imp. price	-2.21**	-1.93***	-1.81***	-1.68***	-1.81**	-1.54**	-2.82***	-2.26***	-3.33**	-2.62***	-3.25**	-2.53**
	[0.86]	[0.71]	[0.63]	[0.57]	[0.78]	[0.63]	[1.03]	[0.75]	[1.29]	[0.93]	[1.43]	[1.04]
F first stage	50.5	255.8	45.6	261.0	29.6	179.8	19.3	136.9	14.9	109.9	12.7	97.3
Rel. retail imp. price	-5.10*	-3.81**	-4.23**	-3.60**	-3.81*	-2.80**	-5.84	-3.85**	-5.26*	-3.69**	-4.77*	-3.36*
	[2.67]	[1.61]	[2.09]	[1.59]	[2.30]	[1.41]	[3.63]	[1.84]	[2.98]	[1.79]	[2.84]	[1.77]
F first stage	6.1	16.9	6.5	13.3	5.2	12.8	3.6	10.8	4.9	11.9	4.7	11.7
Observations	2092	2092	2352	2352	2517	2517	2677	2677	2701	2701	2714	2714
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table repeats Table 11, but converting EUR-invoiced prices into CHF prices based on the official quarterly EUR/CHF rate rather than using CHF prices provided by the SFSO. Also the results for the 15 months and the 17 months horizon are displayed.

Table F.19: *Sensitivity of import shares to relative prices, trimming largest expenditure changes*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. border imp. price	-0.95**	-0.88**	-0.85***	-0.82***	-0.78**	-0.71**	-1.15***	-1.02***	-1.32***	-1.16***	-1.32**	-1.16**
	[0.43]	[0.40]	[0.31]	[0.31]	[0.34]	[0.31]	[0.41]	[0.37]	[0.50]	[0.44]	[0.55]	[0.49]
F first stage	126.5	234.9	124.0	241.2	85.4	182.4	59.7	141.4	48.3	116.5	42.8	105.1
Rel. bor.+distr. imp. price	-1.78**	-1.55**	-1.58***	-1.47***	-1.52**	-1.29**	-2.34**	-1.86***	-2.73**	-2.14***	-2.79**	-2.15**
	[0.83]	[0.70]	[0.59]	[0.55]	[0.70]	[0.57]	[0.93]	[0.67]	[1.15]	[0.82]	[1.28]	[0.93]
F first stage	48.2	228.6	42.0	228.6	27.9	166.1	18.4	128.6	14.3	104.1	12.1	92.0
Rel. retail imp. price	-4.23*	-3.12**	-3.75*	-3.16**	-3.30	-2.39*	-5.15	-3.29*	-4.51	-3.10*	-4.28	-2.95*
	[2.54]	[1.56]	[1.98]	[1.53]	[2.13]	[1.32]	[3.61]	[1.73]	[2.86]	[1.65]	[2.77]	[1.67]
F first stage	5.4	16.2	5.8	12.3	4.7	12.0	3.1	9.9	4.3	11.1	4.2	10.5
Observations	2073	2073	2329	2329	2492	2492	2651	2651	2674	2674	2687	2687
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table repeats Table 11, but trimming the dependent variable by excluding the 1% largest changes in absolute values from the regression. Also the results for the 15 months and the 17 months horizon are displayed.

Table F.20: *Sensitivity of import shares to relative prices, 2014-2015 balanced sample*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. border imp. price	-1.23***	-1.14***	-1.02***	-0.98***	-0.94**	-0.86**	-1.31***	-1.17***	-1.49***	-1.33***	-1.38**	-1.23**
	[0.47]	[0.43]	[0.34]	[0.34]	[0.38]	[0.34]	[0.44]	[0.39]	[0.53]	[0.47]	[0.61]	[0.55]
F first stage	130.1	237.3	126.3	242.8	86.4	183.6	61.6	145.9	50.2	120.5	44.6	109.1
Rel. bor.+distr. imp. price	-2.30**	-2.01***	-1.88***	-1.76***	-1.82**	-1.57**	-2.62***	-2.13***	-3.05**	-2.45***	-2.88**	-2.28**
	[0.91]	[0.77]	[0.66]	[0.60]	[0.78]	[0.62]	[0.98]	[0.72]	[1.21]	[0.88]	[1.39]	[1.03]
F first stage	50.8	231.2	44.0	230.7	29.3	167.5	19.6	132.7	15.3	107.6	13.1	95.5
Rel. retail imp. price	-5.72*	-4.22**	-4.12**	-3.57**	-3.73*	-2.81**	-5.29*	-3.61**	-4.72*	-3.41**	-4.10*	-2.98*
	[2.99]	[1.80]	[1.91]	[1.48]	[2.13]	[1.34]	[3.16]	[1.68]	[2.56]	[1.59]	[2.46]	[1.61]
F first stage	5.6	16.0	7.3	15.3	5.7	13.7	4.0	11.6	5.4	13.0	5.3	12.9
Observations	2353	2353	2666	2666	2900	2900	3076	3076	3106	3106	3131	3131
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table repeats Table 11, but based on balanced samples that, for any given monthly horizon, only include goods observed in both 2014 and 2015. Also the results for the 15 months and the 17 months horizon are displayed.

Table F.21: *Sensitivity of import shares to relative prices, EU imports only*

	3m		6m		9m		12m		15m		17m	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Rel. border imp. price	-1.44***	-1.35***	-1.11***	-1.09***	-1.02**	-0.96**	-1.66***	-1.54***	-2.00***	-1.85***	-1.94***	-1.79***
	[0.49]	[0.46]	[0.36]	[0.37]	[0.41]	[0.38]	[0.52]	[0.48]	[0.64]	[0.58]	[0.70]	[0.64]
F first stage	157.3	204.8	170.8	207.7	120.5	159.3	81.8	121.7	64.2	99.6	56.4	89.5
Rel. bor.+distr. imp. price	-2.64***	-2.35***	-1.98***	-1.94***	-1.91**	-1.73**	-3.17***	-2.75***	-3.88***	-3.35***	-3.81**	-3.27***
	[0.92]	[0.80]	[0.66]	[0.65]	[0.79]	[0.69]	[1.05]	[0.85]	[1.34]	[1.06]	[1.49]	[1.18]
F first stage	74.6	202.8	70.2	201.5	55.1	149.2	36.3	113.5	27.5	91.5	23.3	80.8
Rel. retail imp. price	-6.62*	-5.05**	-4.97**	-4.68**	-4.43	-3.56**	-7.52	-5.53**	-7.15*	-5.53**	-6.74	-5.22**
	[3.54]	[2.14]	[2.53]	[2.23]	[2.71]	[1.82]	[4.99]	[2.75]	[4.28]	[2.60]	[4.26]	[2.58]
F first stage	4.9	12.3	5.7	8.8	4.4	8.6	2.8	6.7	3.7	7.9	3.3	7.6
Observations	1811	1811	2049	2049	2205	2205	2358	2358	2382	2382	2395	2395
Aggreg. dom. price	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

Notes: This table repeats Table 11, but includes only EU imports. Also the results for the 15 months and the 17 months horizon are displayed.

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