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Retailers and consumers. The pass-through of import price changes*

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Abstract

In this paper, we estimate pass-through rates of import price changes to retail prices across retailers and consumers for apparel purchases in Germany for the period of 2000 to 2007. We find that high-price retailers do not pass through changes in the import price. Pass-through rates for low-price retailers are 53% within 3 months. Consequently, pass-through rates for low-income households are 58%, significantly larger than those for high-income households. We then present one possible explanation for these observations in a theoretical model with endogenous vertical product differentiation due to bundling an ex-ante homogeneous import good with services. Following an import price change, retailers who sell a cheaper unbundled product change prices to a greater extent than retailers who sell a higher-priced bundle of product and service.

Key words: Import prices, Pass-through, Retailers, Households

JEL codes: D12, D31, F10

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1 Introduction

In this paper, we estimate pass-through rates of import price changes to retail prices across retailers and consumers for apparel purchases in Germany for the period of 2000 to 2007. On January 1st, 2005, the Multi Fibre Arrangement (MFA), which had imposed quotas for imports of clothing and textiles from developing countries, expired. The Agreement on Textiles and Clothing (ATC) guided a successive elimination of the import quotas for textile and clothing products over a 10 year transitional period (EU Commission, 2000). Francois et al. (2007) find that the ATC phase-out caused a 30.6% drop in producer prices in European countries from 1996 to 2004. In this period, German retail prices fell by about 13%. Francois and Woerz (2009) estimate that the trade cost equivalent of the quotas accounted for roughly 20% before the final phase-out in January 2005. Even though new quotas were implemented in 2005, we can observe a steady increase in apparel imports, especially from China, and a substantial decrease in import prices for Germany in the period of our observation. This raises the question, whether and to what extent these price changes are passed through by retailers to consumers.

There is a substantial literature on pass-through rates, mostly on the pass-through of exchange rate changes, see e.g. Burstein and Gopinath (2014) for an excellent survey.[1] Typically, these studies document incomplete pass-through rates, i.e. goods prices change by less than real exchange rates. Important factors in explaining incomplete pass-through rates include (but are not limited to) search frictions (Alessandria, 2004), frequency of price adjustment (Gopinath and Itskhoki, 2010), invoice currency choice (Fabling and Sanderson, 2015), market power and the degree of competition (Goldberg and Knetter, 1997; Amiti, Itskhoki, and Konings, 2014), product quality (Auer and Chaney, 2009, Chen and Juvenal, 2016), sourcing of foreign inputs (Goldberg and Campa, 2010; Hellerstein and Villas-Boas, 2010; Bernini and Tomasi, 2015) as well as market structure and the heterogeneity of firms (Raff and Schmitt, 2012, Berman et al., 2012, and Auer and Schoenle, 2016). Several studies emphasize the importance of the retail and distribution sector for variations in pass-through rates, e.g. Burstein et al. (2003), Francois et al. (2010), Corsetti and Dedola (2005). Among the papers most closely related to ours are Nakamura and Zerom (2010), and Hellerstein (2008) who emphasize the importance of markup adjustment and local cost. Nakamura and Zerom

[1] In this paper, we do not explicitly look at exchange rate pass-through. Exchange rate variation, however, is one of the sources of import price variation we see in the data. We cannot distinguish between different reasons of price variation. Accordingly, the obtained results on pass-through rates of import price changes cannot be compared directly to pass-through rates of exchange rate changes. However, we show that distribution cost and the degree of competition that explain incomplete exchange rate pass-through also explain incomplete import price pass-through.

(2010) estimate an incomplete pass-through to retail prices in the US coffee industry of 27%. They show that local costs account for 59% of incomplete pass-through. Hellerstein (2008), who investigates US beer prices, finds that retailer markup adjustments and local-cost components explain incomplete pass-through.

The two main contributions of this paper are as follows: First, we show that the pass-through of import price changes to retail prices is incomplete and differs across firms. We estimate that high price-retailers do not pass through changes in the import price. By contrast, low price-retailers show a pass-through rate of 53% within three months. Our paper builds upon the importance of local cost and the degree of competition as explanations for incomplete pass-through (see e.g. Nakamura & Zerom, 2010 and Hellerstein, 2008). We explain the degree of pass-through and the asymmetry in pass-through rates in a simple model with vertical product differentiation, where one firm bundles an ex-ante homogeneous good with a service. Offering the services is costly for firms and induces different price elasticities of demand, different markups and thus different exposure of firms to competition. Second, we show that pass-through rates also differ across income groups. The estimated pass-through rate of 58% for low-income households is significantly larger than those for high-income households. Low-income households prefer retailers with lower price levels that have higher pass-through rates, whereas high-income households buy from retailers with higher price levels that show lower pass-through rates. Consequently, we observe asymmetric real income effects of import price changes across consumers as a result of different consumption patterns.[2]

The rest of the paper is organized as follows: Section 2 introduces the data and provides stylized facts. In section 3, we present our estimation strategy and the empirical results. Section 4 introduces our theoretical model. Section 5 concludes.

2 Data And Stylized Facts

In this section we describe the data and provide stylized facts that motivate our analysis. We use the "Universalpanel" – monthly household consumption data provided by the "Gesellschaft für Konsumforschung" (GfK), a German market research institute. The data cover the period from January 2000 to December 2007 and has a total of 2,036,356 observations. This includes 11,934 households and 188 retailers. Participating households have to assign their purchases to 102 different categories (ranging from apparel products as well as electronic articles to housewares) and specify the price and the retailer

[2] Similarly, Han et al. 2016 show that the WTO accession of China had a pro-poor distributional effect.

for each purchased item. One observation consists of one reported product purchase by one household (k) at a retailer (r) at time (t). Additionally, household characteristics such as the net income and size as well as the buyer's age, profession, and education are reported. In this paper, we focus on the apparel categories only, since these categories exhibit high changes in import prices and a high import penetration. Our final sample contains 22 apparel categories. These include all apparel categories as classified by the GfK except two categories of "overcoats", for which data were only available for one year of observations. Overall, the final data include 829,320 observations for 11,613 households and 80 different retailers. Since apparel products are bought infrequently, we calculate monthly averages to guarantee sufficient observations. Data on German import unit values for apparel products are provided by Eurostat and cover the same period.[3] Our empirical approach is the following: First, the dependent variable is constructed as the monthly price of a retailer averaged over all household purchases. In a second step, the monthly average price for two household groups with high and low income is calculated for each retailer. We use this average price as dependent variable. Each of these variables is then regressed on changes in the import price in the apparel sector.

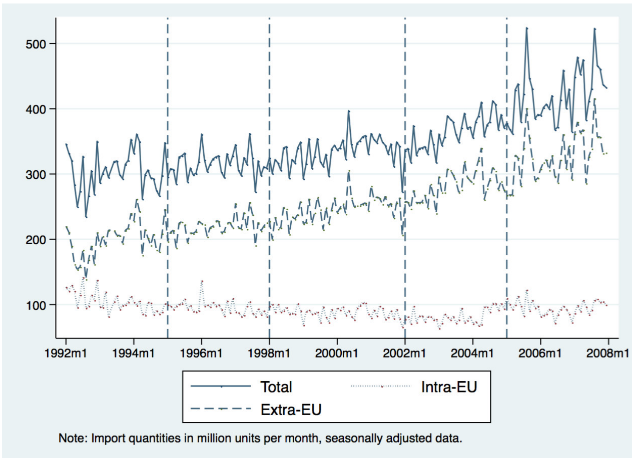

Figure 1: German clothing import quantities

Figure 1 shows German apparel import quantities separated by intra- and extra-EU trade over time. The vertical dashed lines mark the phase-out steps of the ATC. The

[3] Specifically, we consider all imports from outside the European Union in the combined nomenclature (CN) categories 61 (Articles of apparel and clothing accessories, knitted or crocheted) and 62 (Articles of apparel and clothing accessories, not knitted or crocheted), which report quantities and volumes. Prices are c.i.f. and in Euro. Accordingly, cost, insurance, and freight are covered, but not tariffs. Protection in the apparel sector, however, occurred mostly in the form of quotas – elimination of quotas should be directly reflected in import prices.

dotted line of imports from countries within the EU fluctuates around a relatively stable value of 100 million units per month. By contrast, we observe a steady increase in extra-EU imports following the final two steps of the ATC phase-out, even though quotas for Chinese textiles were re-introduced. By far, the majority of apparel imports comes from outside the EU.[4] It is exactly these countries that benefited from the ATC phase-out. Additionally, if we only consider extra-EU trade, the correlation between the seasonally adjusted import unit values and an overall average retail price is high with a value of 0.75 in contrast to a correlation of 0.28 for intra-EU trade. This suggests that imports from outside the EU play an important role for German apparel retailers. In the following, we will thus define import prices as the average unit value of all German extra-EU imports in the CN categories 61 and 62 in a month t. To compute the unit values, we use "supplementary units", which show the quantity traded in terms of pieces. As unit values are an approximation for prices, unit value per piece instead of ton or kilo seems to be a more reasonable approach for this approximation. Accordingly, all observations are provided in the same quantity unit. To compute unit values we aggregate the value of all apparel imports and divide by the number of pieces. In case the supplementary unit is missing, we delete the 8-digit apparel category from the computation of unit values. This, however, is only the case for less than 13% of all categories, which represent 8.5% of the total value of apparel imports.

One explanation for incomplete pass-through of import prices into retail prices is local cost components including service costs. Services that some retailers offer are reflected in higher prices.[5] To construct a measure of the price level for each retailer, we first calculate $s_{rj} = p_{rj}/P_j$ over all periods, where p_{rj} is the average price of retailer r in GfK-category j and P_j is the average price in GfK-category j over all retailers. Weighting s_{rj} with the number of sales in a category yields $S_r = \sum s_{rj}\frac{c_j}{C}$, where c_j is the number of sales in category j and C is the total number of sales for a given retailer. A value of $S_r \geq 1$ characterizes a retailer who charges prices above average. These retailers are referred to as H-type retailers in the following. $S_r < 1$ implies a lower price level and we will refer to these as L-type retailers.

[4] Another implicit observation of Figure **1** is that these imports replaced German domestic production of apparel goods. As found in Braakmann and Wagner (2009) and Raff and Wagner (2010), German production dropped by about 50% from 2000 to 2006.

[5] We are well aware of the fact that other differences across retailers may be included in this measure. Retailers might sell different products within the same GfK-categories. Retailers with a more efficient distributional organization could charge a lower price to customers. The smaller the distance to production facilities, the faster a retailer may be able to react to changes in demand. This might be more important for seasonal clothing and to a lesser extent for basic items such as T-shirts.

The average prices for H- and L-type retailers reveal substantial differences, as Figure 2 shows. We focus on deviations from the mean of each variable.[6] The dashed line shows that the L-type retailer's average retail price follows very closely the import price, which is represented by the solid line. By contrast, the short-dashed line of H-type average retail prices seem to be much more isolated from the import price.

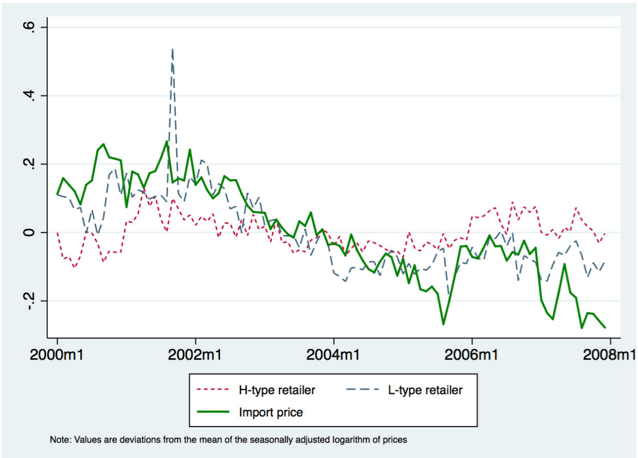

Figure 2: Import price and average price for H- and L-type retailers

Turning to Figure 3, which shows the relative retail price (p_H/p_L) as the solid line and the import price as the dashed line, we observe a strictly negative correlation. A decreasing import price is accompanied by a steady increase of the relative retail price (p_H/p_L). As we will show later, this is driven by a decrease of p_L.

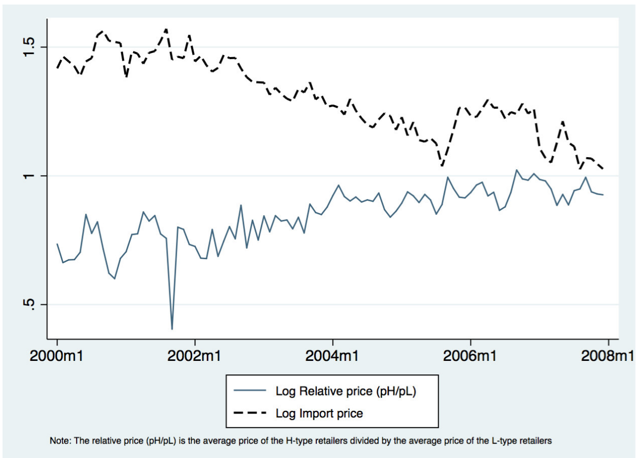

Figure 3: Import price and relative price of H- and L-type retailers

[6] Since the absolute difference between these prices is quite large, the deviations from the mean provide a much better view of the relative evolution of prices.

The GfK-data on household purchases provide 16 different income intervals and the size of the household. In order to calculate the per-capita income, we assume the mean of each interval as the household income and divide it by the scaled number of household members.[7]

The lowest quartile of the per-capita income distribution defines the low-income group and the highest quartile the high-income group. Table 1 provides some stylized facts on these household types. In our sample, low-income households have more children[8] with an average of 0.50 children per household, a lower education level of 5.5[9], and the number of persons in a household is larger with a mean of 2.58. The average per-capita income of a high-income household is Euro 2,111, more than three times higher than the income of low-income households. High-income households' total expenses are higher and they pay an average price of Euro 40.96 for apparel, compared to Euro 24.23 for a low-income household.

	Children	Size	Education	pc-Income	Av. price	Total exp.
Low-income	0.50	2.58	5.5	694	24.23	4,384,613
High-income	0.14	2.03	7.3	2,111	40.96	8,762,483

Table 1: Household sample information

Next, we look at retail outlets visited by households with different income. Table 2 shows the relative importance of a selection of retailers for the different types of households. Households with a low per-capita income spend a greater share of their income at L-type retailers.[10] For instance, KiK, a clothing discounter, has a low price level of 0.35. This is in line with this retailer's strict strategy of low prices with no advisory services for their customers. Low-income households spend 1.21% of their expenditure at KiK, a value more than five times larger than the share of 0.23% for high-income households. In other words, households obviously do not purchase their goods at the same shops with identical intensity. The correlation of the relative expenditure ratio and the price level measure is negative with a value of -0.47. That is, high values of the

[7] Household size needs to be scaled in order to adjust for the non-proportinal increase in needs with respect to household members. We use the OECD-modified scale of equivalence which applies a value of 1 for the first household member. Each additional person is assigned a value of 0.5 and each child under the age of 14 a value of 0.3. Nevertheless, our results hold qualitatively for different specifications of the equivalence scales as Appendix A.5 shows. For a review on equivalence scales, see for example De Vos and Zaidi (1997).

[8] According to the equivalence scales we use, children are defined as aged 14 or younger.

[9] The official GfK data ranks education from 2 "basic schooling without vocational training" in six steps to 9 "university/college degree".

[10] The share of units bought at each store is reported in Appendix A.1.

ratio variable indicate a more important role of these retailers for low-income households and these are correlated with low values of the price level measure. As retailers differ in their price levels, the same import price shock will have a different impact on final retail prices and, thus, households.

Retailer	Price level	Expenditure share Low income	High income	Ratio	Retailer information Sales volume	# of households	# of obs.
Alba Moda	1.81	0.08	0.24	0.36	39,233	169	531
Anson's / P&C	1.78	2.21	6.68	0.33	1,133,761	2,911	18,174
Breuninger	1.72	0.51	1.72	0.30	264,279	860	4,397
C & A	0.85	7.45	4.45	1.67	1,594,453	6,598	60,601
H & M	0.70	2.80	1.51	1.85	558,459	3,981	25,351
Karstadt	1.22	0.39	0.67	0.58	113,634	987	3,215
KiK	0.35	1.21	0.23	5.27	162,108	2,799	16,502
SinnLeffers	1.28	1.45	2.10	0.69	482,348	1,884	11,537
Orsay	0.76	0.44	0.16	2.84	77,287	1,015	3,061
Pimkie	0.81	0.27	0.10	2.74	48,492	748	2,059
Sportscheck	1.56	0.19	0.26	0.74	63,212	488	1,181
Takko	0.50	1.01	0.24	4.16	159,160	2,004	9,544
Zara	0.90	0.13	0.15	0.87	32,186	436	951

Table 2: Retailer information and household expenditure shares, selection of full sample

3 Empirical Strategy and Results

We interpret changes in the import unit value as a change in import prices and estimate how these changes affect retail prices. Generally, the data have three dimensions: household (k), retailer (r), and time (t). Since we focus on apparel products, which are not purchased as frequently as e.g. food, we do not obtain sufficient observations for each household at each retailer at each point in time. It is therefore not feasible to consider all dimensions at the same time. The same restriction applies to the GfK product categories. Moreover, our data do not include retailer specific information on the origin of imported apparel.[11] Therefore, we need to calculate the average price over all apparel categories. For this to be a valid approach, it is crucial that retailers should have a rather identical product portfolio, but do not specialize in selling only one or a few types of apparel. The data show that indeed all of the retailers are multi-product firms that sell products in many different apparel categories. In fact, 61 out of 80 retailers in our data

[11] This information is not publicly available through business reports or firm homepages. Especially the clothing sector is affected by consumers' perception of the working conditions in their production plants. In Germany, public television and organizations such as the "Clean Clothes Campaign" (www.cleanclothes.org) try to provide information on working conditions to consumers. Thus, a lot of retailers are not willing to reveal their exact import sources.

show sales in all 22 apparel categories. The mean number of apparel categories that the 80 retailers sell is 21.42. Accordingly, it seems valid to assume that all retailers have the same type of products in their portfolio.[12] Showing that products within the apparel categories are identical across retailers is more challenging. Our data set does not allow us to distinguish apparel beyond its category (e.g. in terms of quality). Available anecdotal evidence, however, suggests that our assumption is not unreasonable. Evidence from a television report, for instance, shows that jeans production in China is identical for high and low-price jeans.[13] Further evidence comes from other sectors, such as the food sector, where identical items are sold under different (high and low price) brands. To exclude the possibility that differences in the country of origin, e.g. differences in currency pass-through, drive the results, we estimate pass-through rates only with the price for Chinese imports as a robustness check. The ranking of the pass-through rates remains identical.[14]

The import price is calculated at the 2-digit level in order to match the aggregation level of the household data. Therefore, our empirical approach is the following: First, the dependent variable is constructed as the monthly price of a retailer r averaged over all household purchases (p_t^r). Then, the monthly average price of each of the two household groups of high and low income is calculated for each retailer and we use this average price as dependent variable ($p_t^{h,r}$). Each of these variables is regressed on changes in the import price in the apparel sector (p_t^i).

3.1 Retailers

We consider a regression equation that is motivated by several other pass-through studies (see, e.g., Campa and Goldberg, 2005, 2006; Gopinath and Itskhoki, 2010):

$$p_t^r = p_t^i + \mathbf{D'} + \varepsilon_t^r, \tag{1}$$

where p_t^r is the product price of retailer r, p_t^i, are import unit values and all prices are monthly averages. D is a vector of additional control variables, ε_t^r is the error term, and the subscript t refers to time. For the purpose of this study, we rewrite equation (1) in first differences and add two lagged values of the import unit value to account for the

[12] We additionally perform a robustness check with heterogeneous portfolios and thus heterogeneous import prices across retailer. Result remain qualitatively unchanged.

[13] See http://www.ndr.de/fernsehen/sendungen/45_min/hintergrund/bluejeans101.html.

[14] We also run regressions with Eurostat's intra-EU-unit values as an explanatory variable and our results remain qualitatively unchanged.

stepwise adjustment to cost changes.[15] This yields the following estimation equation:

$$\Delta p_t^r = \sum_{j=0}^{2} \alpha_j \Delta p_{t-j}^i + \sum_{j=0}^{2} \beta_j \left(\Delta p_{t-j}^i * low\right) + \gamma_{low} low + \boldsymbol{\gamma}'\mathbf{D} + \varepsilon_t^r, \tag{2}$$

where the definition of the variables is the same as in (1). We add an interaction term of the import unit value and the dummy variable *low*, which equals 1 if the retailer has a price level lower than 1. That is, the total impact of a change of the import unit value on the average price of an L-type retailer equals $\sum_{j=0}^{2} \left(\alpha_j + \beta_j\right)$. The control variables captured by the vector D include the number of households, the retailers' revenue, dummies for retailers and ATC phase-out stages, monthly dummies, and a time trend measure.

We now discuss some econometric issues that affect all regressions and all dependent variables. In our analysis, the import price is the average monthly unit value of all extra-EU imports of Germany within the 2-digit sectors 61 and 62 that report quantities and volumes. Relative to the global apparel economy, the German market is small and import prices are thus considered as given. Therefore, endogeneity of the import unit value is of lesser concern for our study.[16] The error terms of the regressions might be serially correlated. Hence, we report results for the Prais-Winsten estimator and include a lagged dependent variable in another specification. We tested all variables for the existence of unit-roots. The import unit value is integrated of order one (I(1)). We also performed Fisher's panel unit-root test for the average price of retailer r and for the average price of household type h at retailer r, respectively. The null hypothesis that all series are non-stationary is rejected.[17] Therefore, all variables are in first differences to remove the non-stationarity of the import price. Generally, all variables are separately seasonally adjusted using monthly dummies. Also, the error terms might be correlated within a retailer, but not across retailers; so we cluster the data by retailer to correct for the potential problem of contemporaneous correlation (see Moulton, 1990).

Table 3 summarizes the regression results for equation (2). Except for column 1, all regressions include the interaction term. The regressions differ with respect to the

[15] With the adpotion of two lagged values we thus refer to the short-run pass-through. We refrain from including more lagged values in order to reduce the size of our estimation equation. This is supported by studies as Gopinath and Itskhoki (2010), who show for the US that the main part of pass-through occurs in the short run.

[16] We do not think that endogeneity stemming from global shocks that affect import and retail prices likewise is a problem. The major part of German imports originates in less developed economies, making this a reasonable assumption. However, we included a time trend to capture any remaing effects.

[17] We thus do not consider the existence of a cointegration relation among these variables as relevant. See Appendix A.2 for unit-root tests.

estimator (3, 4, and 8) and whether we add a lagged value of the dependent variable (5). In (6) we use the original data and seasonally adjust it by inserting monthly dummy variables in the regression and (7) uses levels of all variables. In the basic regression, we confirm the incomplete pass-through of import price changes into retail prices of about 24%. Distinguishing between retailers, the estimation results point to zero pass-through for H-type retailers. By contrast, the average price of L-type retailers changes by about 0.53 percent given a 1 percent change in the import price. Accordingly, there is a significant difference in pass-through rates across retailers. For all but one regression, L-type retailer prices are affected significantly more by a change in the import unit value. The recent decline in import prices that we showed in Figure 3 is passed through to a greater extent for L-type retailers.[18]

As a robustness check we repeat the estimation with heterogeneous import prices across retailers. For all specifications the pass-through for L-type retailers remains positive and significant. Coefficients for H-type retailers are now positive and significant for four out of eight specifications, but the pass-through rates are lower than those of their L-type counterpart. The results and a more detailed description (including potential data problems with this approach) can be found in Appendix A.4.

The differences in price levels between H-type and L-type retailers point towards product differentiation in the apparel market. Accordingly, retailers may face different price elasticities of demand depending on their customers. We utilize this potential mechanism for different pass-through rates in our theoretical explanation, where we model product differentiation by retailers bundling an ex-ante homogeneous good with a service.

Retailers might differ with respect to which country they import apparel from. In order to consider this possibility, we regress the average price of retailer r on intra-EU import prices. If H-type retailers provide higher quality products, which in turn are more likely to be manufactured within the European Union, we would expect a positive correlation with the intra-EU import price. However, this is not the case. The estimation results for these regressions always show a higher pass-through rate for L-type retailers.[19] In addition, the coefficients are generally not statistically significant from zero, which again points to the importance of extra-EU imports in the apparel retailing sector. We then run the same regression only with the price for Chinese imports as explanatory variable. To assume that imports from one country are homogeneous seems to be a less

[18] Note that the R2 in our estimation is relatively low for some specification, as there are several (with our data) unobservable factors at retailer level that drive retail price changes (e.g. local cost, demand etc.). This is a common phenomenon in the pass-through literature.

[19] This can be seen in Appendix A.5.

	1	2	3	4	5	6	7	8
Estimator	OLS	OLS	FE[2]	RE[3]	OLS	OLS	OLS	PW[4]
	Dependent variable: Average price of retailer r (Δp_t^r)							
All	0.240							
All: Prob > F	0.067							
H-type retailer		-0.138	-0.150	-0.150	-0.293	0.288	0.173*	-0.181
H: Prob > F		0.410	0.379	0.379	0.165	0.086	0.010	0.298
L-type retailer		0.545*	0.530*	0.530*	0.638*	0.263	0.669*	0.447*
L: Prob > F		0.005	0.006	0.005	0.007	0.086	0.000	0.010
Included:								
ATC dummy			yes	yes	yes	yes	yes	yes
Retailer dummies			yes	yes	yes	yes	yes	yes
Interaction term[1]		yes	yes	yes	yes	yes	yes	yes
Δp_{t-1}^r					yes			
Time trend		yes	yes	yes	yes	yes	yes	yes
Monthly Dummies						yes		
Levels							yes	
Observations	6,469	6,469	6,469	6,469	6,452	6,506	6,573	6,469
Number of retailers	80	80	80	80	80	80	80	80
Adj. R2	0.001	0.002	0.002	0.004	0.252	0.030	0.885	-0.008
F-Statistic	1.916		3.794					
Root MSE	0.339	0.339			0.293	0.318	0.252	0.294

*Statistically significant at the 5%-level. The full results can be found in Appendix A.3.

[1] Columns 2-8 include an interaction term of the dummy variable "low" (=1 if L-type retailer) and Δp_{t-j}^i.

[2] Retailer fixed effects. [3] Random effects. [4] Prais-Winsten estimator.

Table 3: Pass-through into average prices for L- and H-type retailers

strong assumption. But again, the ranking of the pass-through rates remains identical.

3.2 Consumers

In this section, we focus on low- and high-income households and examine whether they are affected differently by changes in the import unit value. First, we calculate average monthly prices paid by low- and high-income households at each retailer r in our sample. We then regress these average prices on changes in the import price.

In line with the estimation equation in section (3.1), $p_t^{h,r}$ is the average price of purchases of household type h ($h = 1, 2$) at retailer r at time t, p_t^i are import unit values and all prices are monthly averages. D is a vector of additional control variables, including household income, a time trend measure, and retailer fixed effects and $\varepsilon_t^{h,r}$ is the error term. Again, we use first differences and add two lagged values of the import unit value. This yields the estimation equation

$$\Delta p_t^{h,r} = \sum_{j=0}^{2} \alpha_j \Delta p_{t-j}^i + \sum_{j=0}^{2} \beta_j \left(\Delta p_{t-j}^i * low\right) + \gamma_{low} low + \boldsymbol{\gamma}'\mathbf{D} + \varepsilon_t^{h,r}. \tag{3}$$

We add an interaction term of the import price and the dummy variable low, which equals 1 for households with low income. That is, the total average impact of a change in the import unit value on a low-income household equals $\sum_{j=0}^{2} \left(\alpha_j + \beta_j\right)$. If changes in the import price p_t^i lead to unequal effects on the household price $p_t^{h,r}$, we would expect β_j to be statistically different from zero. More specifically, $\beta_j > 0$ implies that households with a lower per-capita income are affected to a greater extent by changes in the import price. Table 4 summarizes our results for different specifications. About 58% of a change in the import price is passed through into average prices of a low-income household. These results are statistically significant for all specifications.[20] By contrast, in all specifications high-income households are affected less and the coefficients are never significantly different from zero.

Summarizing the results from Table 3 and 4, we observe that pass-through rates of import price changes across households can be explained by two factors. First, the purchasing behavior differs by household type: High- and low-income households do not shop at the same stores with the same intensity. Total spending and the relative impor-

[20] To rule out the possibility that the results are simply driven by differences in the consumption pattern, where low-income households (with more children) spend a higher share of apparel purchases on children's apparel, we delete all categories of children's apparel ("baby apparel" and "kids apparel") from the data and repeat the estimation with the remaining categories as a robustness check. The results are almost unchanged and are available upon request.

	1	2	3	4	5	6	7	8
Dependent variable: Average price of household group h at retailer r $\left(\Delta p_t^{h,r}\right)$								
Estimator	OLS	OLS	OLS	PW[1]	OLS	OLS	FE[2]	RE[3]
High income	0.232	0.199	0.199	0.193	0.275	0.275	0.284	0.278
H: Prob > F	0.328	0.337	0.210	0.249	0.200	0.105	0.188	0.195
Low income	0.612*	0.512*	0.512*	0.396*	0.576*	0.576*	0.578*	0.580*
L: Prob > F	0.010	0.013	0.001	0.018	0.007	0.000	0.007	0.007
Included:								
$\Delta p_{t-1}^{h,r}$		yes	yes		yes	yes	yes	yes
Time trend				yes	yes	yes	yes	yes
Retailer fixed effects				yes	yes	yes	yes	yes
Observations	10,594	10,594	10,594	10,594	10,594	10,594	10,594	11,051
Number of groups	141	141	141	141	141	141	141	141
Adj. R2	0.021	0.254	0.254	0.033	0.250	0.250	0.245	0.251
F-Statistic	13.52	191.1	190.2	5.021	39.38		189.5	
Root MSE	0.487	0.425	0.425	0.426	0.427	0.427		

*Statistically significant at the 5%-level. The full results can be found in Appendix A.6.

[1] Prais-Winsten, [2] Fixed effects [3] Random effects

Table 4: Pass-through into average prices of high- and low-income households

tance of retailers measured by a household's expenditure share differ across households. Second, retailers differ in their price levels. They also differ in their pass-through rates, which in turn implies different pass-through rates for low- and high-income households. Therefore, it is crucial to consider the role of retailers to correctly analyze trade effects on retail prices when households are heterogeneous with respect to income and differ in consumption patterns.

4 Endogenous Product Differentiation and Pass-Through of Import Prices

In the following section, we provide a theoretical explanation for our observation that pass-through rates differ across retailers and consumers. In our model, firms sell ex-ante identical imported products, but have the possibility to sell an additional local service together with a good. We interpret service in a broad sense. Services may include store service (e.g. returns, exchanges or after-sale service) and sales service (e.g. helpful and knowledgeable shop assistants and prompt attention) (Bishop Gagliano and Hathcote, 1994). Also retail store factors such as design and ambience (see for instance Grewal and Baker, 1994), a better brand image or a more central location with better accessibility may be interpreted as a service. For firms, bundling the product with a service creates ex-post product differentiation. We show that firms always choose to differentiate, i.e. one firm offers a service and the other not, in Appendix A.7. This form of ex-post product differentiation results in different price elasticities of demand for both firms, different markups, and thus also creates an asymmetry in the elasticity of retail prices with respect to the import price. The cost for providing the service further enhances this effect. Given a change in the import price, relative changes in the retail price are lower for the firm offering the bundle of good and service. The addition of the service thus dampens the pass-through of import price changes, regardless of its direction. As a consequence, if households differ in their willingness to pay for such services, they are not affected identically by trade shocks.[21]

To show this, we apply a simple model, following Shaked and Sutton (1982), in which

[21] Furthermore, especially in the clothing sector, brands and the importance of a brand's image also determine prices. We do not have information on brands. However, we think that this is not a major concern and we assume that service and brand image can be used interchangeably. The basic part of a T-shirt sold by a well-known brand is the imported good. Commercials and other marketing activities that establish the brand image are not produced abroad. Instead, they are supplied locally. That is, this works in the same way as our definition of services. Retailers who offer this T-shirt thus sell a bundle of the basic shirt and some additional local service. As a consequence, prices of this retailer will be higher compared to retailers selling a "no-name" brand.

two retailers sell a homogeneous imported good, but may bundle the good with a service to differentiate products.

4.1 The Model

Consider a market with two retailers, each distributing an ex-ante identical good with a constant import price p^i. Both firms have the possibility to offer the product with a service. We show in Appendix A.7 that firms always choose to differentiate their products, i.e. one firm offers a service and the other not. Let us denote the bundle of the good and the additional service and the firm offering it as b and let us denote the good without the service and the firm selling it as u.

Consumers obtain a higher utility from the bundle of good and service, which is captured by a premium $\delta > 1$ in consumer valuation. As explained above, store service, sales service or a more central location may be examples for such a service. Consumers differ with respect to their gross valuation θ, which is uniformly distributed on the unit interval. Each consumer demands either one or zero units of the most preferred good. The utility derived from no purchase is zero, while a consumer who buys one unit of the good obtains a net utility of

$$U(\theta, \delta, p_j) = \begin{cases} \delta\theta - p_b^r & if\ j = b \\ \theta - p_u^r & if\ j = u \end{cases} \tag{4}$$

where $\delta > 1$ reflects the additional utility obtained from the service, p_b^r is the final price of the bundled good and p_u^r is the price of the unbundled good. For $\delta = 1$, the bundled and unbundled good would be considered perfect substitutes. The higher the gross valuation θ, the higher is the willingness to pay for the service. The consumer heterogeneity can be interpreted as differences in willingness to pay for an additional local service or differences in income.[22]

The marginal consumer who is indifferent between purchasing the bundled and unbundled good has the gross valuation $\theta^* = \frac{p_b^r - p_u^r}{\delta - 1}$. The marginal consumer who is indifferent between purchasing the unbundled good and not buying at all has the valuation $\theta^{**} = p_u^r$.

Hence, demand for the bundled good and the unbundled good respectively is given

[22] Note that θ can also be interpreted as the marginal rate of substitution between income and quality (see Tirole, 1988). A consistent interpretation with our empiricial observation is that higher θ corresponds to higher income for a household.

as

$$q_b = 1 - \frac{p_b^r - p_u^r}{\delta - 1},\ q_u = \frac{p_b^r - p_u^r}{\delta - 1} - p_u^r. \tag{5}$$

The marginal cost of distributing the good is c for both firms, which is normalized to zero. In addition, firm b incurs marginal cost w for offering the service, e.g. salary for shop assistants or higher rents for more central stores. We analyze the following two-stage game: In the first stage, firms choose whether to bundle the good with the service or to sell only the good, see Appendix A.7. In the second stage, firms compete in prices.

Firms' profits are given as

$$\pi_b = \left(p_b^r - p^i - w\right)\left(1 - \frac{p_b^r - p_u^r}{\delta - 1}\right),\ \pi_u = \left(p_u^r - p^i\right)\left(\frac{p_b^r - p_u^r}{\delta - 1} - p_u^r\right). \tag{6}$$

Equilibrium prices are

$$p_b^r = \frac{3p^i\delta + 2w\delta + 2\delta\left(\delta - 1\right)}{4\delta - 1},\ p_u^r = \frac{p^i\left(1 + 2\delta\right) + w + \left(\delta - 1\right)}{4\delta - 1}. \tag{7}$$

Prices are strategic complements. Thus, although only firm b offers the service, also the price of firm u, p_u^r, increases in service costs w.

Equilibrium quantities are

$$q_b = \frac{\left(2\delta - p^i\right)\left(\delta - 1\right) - w\left(2\delta - 1\right)}{\left(4\delta - 1\right)\left(\delta - 1\right)},\ q_u = \frac{\delta\left(\left(1 - 2p^i\right)\left(\delta - 1\right) + w\right)}{\left(4\delta - 1\right)\left(\delta - 1\right)}, \tag{8}$$

and profits are

$$\begin{aligned}\pi_b &= \frac{\left(2\delta\left(\delta - 1\right) - w\left(2\delta - 1\right) - p^i\left(\delta - 1\right)\right)^2}{\left(\delta - 1\right)\left(4\delta - 1\right)^2},\\ \pi_u &= \frac{\delta\left(\left(\delta - 1\right) - 2p^i\left(\delta - 1\right) + w\right)^2}{\left(\delta - 1\right)\left(4\delta - 1\right)^2},\end{aligned} \tag{9}$$

with $\pi_b > \pi_u$, if $w < \left(\sqrt{\delta} - 1\right)\left(p^i + \sqrt{\delta}\right)$.[23] That is, if the cost for providing the service is sufficiently low, the profit is higher for the firm bundling the good with the service.

[23] See Appendix A.8 for absolute and relative markups.

4.2 Pass-Through of Import Price Changes

Now consider the effect of a decrease in the import price. The elasticity of retail prices with respect to the import price is positive for both firms:

$$\begin{aligned} \eta_{p_b,p^i} &= \frac{\partial p_b^r}{\partial p^i}\frac{p^i}{p_b^r} = \frac{3p^i}{3p^i + 2w + 2(\delta - 1)} > 0, \\ \eta_{p_u,p^i} &= \frac{\partial p_u^r}{\partial p^i}\frac{p^i}{p_u^r} = \frac{p^i(1+2\delta)}{p^i(1+2\delta) + w + (\delta - 1)} > 0. \end{aligned} \tag{10}$$

Consequently, a decrease of the import price results in retail price decreases for both firms. The elasticity of retail prices with respect to the import price is smaller than one. In absolute terms, the import price-elasticity is higher for the unbundled good as $\eta_{p_b,p^i} < \eta_{p_u,p^i}$. In other words, the pass-through of import price changes to retail prices is higher for firm u, which is driven by the higher import price share for the unbundled good $\left(p^i/p_b^r < p^i/p_u^r\right)$. Ex-post product differentiation from bundling the good with the service results in different exposure to competition for both firms: The price elasticity of demand is lower for firm b, and both absolute and relative markups are higher for firm b as compared to firm u (see Appendix A.8). Even if the additional service was offered at no cost ($w = 0$), the import price-elasticity would be higher for the unbundled good. However, the cost of providing the service enhances the difference in import price-elasticities: The cost of providing the service lowers import price-elasticities of both firms, but the effect on the import price-elasticity of firm b is higher than for firm u. The price decreases relatively more for firm u: $\left(\frac{\partial p_b^r/\partial p^i}{p_b^r} < \frac{\partial p_u^r/\partial p^i}{p_u^r}\right)$. This implies that households with a low θ who buy the unbundled good benefit over-proportionally from an import price decrease.[24]

These implications of the model are consistent with the data: Consumers choose either a high price retailer or a low price retailer depending on their willingness to pay, which is determined by income. In our model, the retailers who bundle their good with a service are the high price retailers. We find that the aggregate pass-through of import price changes to retail prices is incomplete. High-price retailers do not pass through changes in the import price. By contrast, L-retailers pass through import price changes at a rate of 53% within three months. This results in a decrease of the relative price, as Figure 3 shows. We also observe that the estimated pass-through rates for low-income households are 58% and thus significantly larger than those for high-income households.

While our model is consistent with the empirical observations, there are alternative

[24] See Appendix A.9 for a detailed discussion of welfare effects.

explanations for why pass-through rates might differ across high price retailers and low price retailers. For instance, high price retailer might import different products (e.g. of better quality) than low price retailers. Different price elasticities for different goods, e.g. because of different intensities in competition, may then explain different pass-through rates across high- and low-price retailers. Another potential source of heterogeneity in pass-through rates across retailers may be the sourcing from different countries, when import prices change differently across countries.

5 Conclusion

In this paper, we study pass-through rates of import price changes across retailers and households. We estimate that high price-retailers do not pass through changes in the import price. By contrast, low-price retailers show a pass-through rate of 53% within three months. The pass-through into retail prices depends on the shopping behavior of households: Import price changes are passed through to low-income households at a rate of 58%. High-income households have a pass-through rate that is not statistically different from zero.

We then provide a possible explanation for these observations with the help of a simple model with a heterogeneous demand side and endogenous vertical product differentiation stemming from the possibility to bundle a homogeneous imported good with services. This generates heterogeneous pass-through rates across retailers and households following a change in the import price. Retailers who bundle a good with a service pass through import price changes to a lesser extent. Consequently, the purchase of a service by high-income households isolates them from price changes.

This paper sheds light on the link between trade and real income inequality. Whereas traditional trade models explain how real income changes due to changes in real factor prices, assuming that households have homothetic preferences and consume the same bundle of goods, we show a different channel that has not received much attention in the literature. We can show that households with different income buy from different retailers with different pass-through rates and experience different real income effects.

Our results suggest that heterogeneous pass-through rates constitute a link between trade and inequality. Trade liberalization and the corresponding decrease in import prices, for instance during the ATC phase-out, may reduce within-country inequality. As import price decreases are passed-through to low-income households to a greater extent, low-income households will experience a gain in real income. By contrast, trade barriers and rising import prices tend to harm low-income households relatively more.

That is, through the channel of heterogeneous pass-through rates, trade barriers may increase within-country inequality.

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6 Appendix

A.1 Share of Items purchased at a Retailer

Table 5 shows the number of items a household group bought at a specific retailer. For instance, for Anson's / P&C it reveals that 1.12% of all items of the low-income households were bought at this retailer and 3.85% of all items of the high-income household. This corresponds to a price level of Anson's / P&C of 1.78, a value indicating a high-price retailer.

Retailer	Price level	Item share low income	Item share high income	Ratio
Alba Moda	1.81	0.04	0.11	0.36
Anson's / P&C	1.78	1.12	3.85	0.29
Breuninger	1.72	0.27	1.04	0.26
C & A	0.85	7.69	6.50	1.18
H & M	0.70	3.43	2.56	1.34
Karstadt	1.22	0.32	0.70	0.45
KiK	0.35	3.17	0.96	3.31
SinnLeffers	1.28	1.01	1.77	0.57
Orsay	0.76	0.48	0.23	2.03
Pimkie	0.81	0.29	0.16	1.79
Sportscheck	1.56	0.11	0.18	0.59
Takko	0.50	1.58	0.61	2.61
Zara	0.90	0.11	0.16	0.69

Table 5: Share of items bought at a specific retailer, selection of full sample

A.2 Unit-Root Tests

We tested for unit-roots with the Augmented-Dickey-Fuller test (ADF-test). The number of included lags has been chosen according to the Akaike information criterion provided by Stata. The results for the import price are given in Table 6. The import price is tested to be integrated of order one. Average prices for each retailer r (p_t^r) and average prices of household type h at retailer r $\left(p_t^{h,r}\right)$ are tested with Fisher's unit-root test for unbalanced panels using both, the ADF and the Phillips-Perron test. As Table 7 indicates, the null hypothesis that all series are non-stationary is clearly rejected.

Variable	no. of lags$^+$	test statistic	cr. Values 1%	cr. Values 5%	cr. Values 10%	order of integration
Import price	5	-0.140	-3.524	-2.898	-2.584	I(1)

$^+$according to Akaike information criteria in Stata

Table 6: Unit-root test

	ADF-Test		Phillips-Perron Test		# of
	p-value	test statistic	p-value	test statistic	panels
Av. price of retailer r (p_t^r)	0	1,961	0	3,890	80
Av. price of household type h at retailer r $\left(p_t^{h,r}\right)$	0	4,316	0	7,450	141

Table 7: Panel unit-root test

A.3 Full Model – Retailers

	1	2	3	4	5	6	7	8
Estimator	OLS	OLS	FE[2]	RE[3]	OLS	OLS	OLS	PW[4]
	Dependent variable: Average price of retailer r (Δp_t^r)							
All	0.240							
All: Prob > F	0.067							
H-type retailer		-0.138	-0.150	-0.150	-0.293	0.288	0.173*	-0.181
H: Prob > F		0.410	0.379	0.379	0.165	0.086	0.010	0.298
L-type retailer		0.545*	0.530*	0.530*	0.638*	0.263	0.669*	0.447*
L: Prob > F		0.005	0.006	0.005	0.007	0.086	0.000	0.010
Δp_t^i	-0.098	-0.022	-0.028	-0.028	-0.084	-0.088	0.105	-0.075
	(0.083)	(0.108)	(0.109)	(0.109)	(0.109)	(0.110)	(0.090)	(0.113)
Δp_{t-1}^i	0.200	-0.108	-0.112	-0.112	-0.135	0.142	-0.061	-0.105
	(0.102)	(0.114)	(0.114)	(0.115)	(0.099)	(0.122)	(0.112)	(0.118)
Δp_{t-2}^i	0.138	-0.007	-0.010	-0.010	-0.074	0.234*	0.128	-0.000
	(0.102)	(0.149)	(0.150)	(0.151)	(0.137)	(0.116)	(0.099)	(0.132)
$\Delta p_t^i * low$		-0.148	-0.149	-0.149	-0.120	-0.055	-0.163	-0.124
		(0.164)	(0.163)	(0.164)	(0.152)	(0.115)	(0.144)	(0.161)
$\Delta p_{t-1}^i * low$		0.568*	0.567*	0.567*	0.500*	0.131	0.565*	0.610*
		(0.186)	(0.187)	(0.188)	(0.163)	(0.145)	(0.181)	(0.201)
$\Delta p_{t-2}^i * low$		0.262	0.262	0.262	0.550*	-0.101	0.094	0.142
		(0.203)	(0.203)	(0.205)	(0.207)	(0.113)	(0.134)	(0.177)
Low		0.002		0.007*	0.016*	0.034*	-2.997*	0.010*
		(0.002)		(0.002)	(0.002)	(0.001)	(0.123)	(0.001)
# Customers		0.000		-0.000	-0.000*	-0.000*	0.000*	-0.000
		(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Revenue		0.000		0.000	0.000*	0.000*	-0.000*	-0.000
		(0.000)		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant			0.008	0.004			3.559*	
			(0.012)	(0.012)			(0.100)	
...								

Table 8: Pass-through into average prices for L- and H-type retailers

	1	2	3	4	5	6	7	8
Estimator	**OLS**	**OLS**	**FE**[2]	**RE**[3]	**OLS**	**OLS**	**OLS**	**PW**[4]
	Dependent variable: Average price of retailer r (Δp_t^r)							
...								
Included:								
ATC dummy			yes	yes	yes	yes	yes	yes
Retailer dummies			yes	yes	yes	yes	yes	yes
Interaction term[1]		yes	yes	yes	yes	yes	yes	yes
Δp_{t-1}^r					yes			
Time trend		yes	yes	yes	yes	yes	yes	yes
Monthly Dummies						yes		
Levels							yes	
Observations	6,469	6,469	6,469	6,469	6,452	6,506	6,573	6,469
Number of retailers	80	80	80	80	80	80	80	80
Adj. R2	0.001	0.002	0.002	0.004	0.252	0.030	0.885	-0.008
F-Statistic	1.916		3.794					
Root MSE	0.339	0.339			0.293	0.318	0.252	0.294

*Statistically significant at the 5%-level.

Standard errors (in parentheses) are robust and clustered by retailers, except in (1)

[1]Columns 2-8 include an interaction term of the dummy variable "low" (=1 if L-type retailer) and Δp_{t-j}^i.

[2]Retailer fixed effects. [3]Random effects. [4]Prais-Winsten estimator

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able 8 cont.: Pass-through into average prices for L- and H-type retailers

A.4 Robustness Check: Heterogeneous Import Prices

To map import data with GfK data, we first create a correspondence table between the two classifications. The quotient of the aggregated number of apparel import values and quantities for every GfK category allows us to compute the import unit value for every GfK category as before. The monthly varying retailer specific import unit value is then determined by $imp_{rt} = \sum_{j=1}^{22} imp_j \frac{c_{rj}}{C_r}$, where the import unit value imp of retailer r at time t is the sum of the import unit value of GfK category j weighted by the number of retailer sales c in category j over the total number of retailer sales C. The estimation is identical to (2) except that the import unit values are now retailer specific. The results are presented in Table 9. The coefficients for L-type retailers remain positive and significant. Coefficients for H-type retailers are now positive and significant in four specifications, but pass-through rates of H-type retailers are lower than for their L-type counterpart.

For various data reasons the results have to be regarded with some caution. First, the trade data provided by Eurostat (classified in CN) and the household consumption data provided by the GfK use different apparel classifications. There is no correspondence table that maps both categories such that mapping has to take place "by hand", where a CN category is mapped into a GfK category according to its name. The definitions and descriptions of the categories are, however, rather different for some categories such that mapping is somewhat arbitrary. Second, this approach would lead to a decrease of observations. After cleaning the data for missing links between trade and consumption data, our sample is reduced to 733,600 observations. Given that we have 80 retailers in 96 time periods, we end up with an average of slightly less than 100 observations per retailer and time period. This, third, would make the import unit value for a retailer very prone to changes in consumption patterns. If incidentally consumers at a given retailer buy for instance mainly overcoats in one month and mainly swimwear in another month from the same retailer, we would see a huge change in the import unit value simply because of consumption changes and not because the import price changed.

	1	2	3	4	5	6	7	8
Estimator	OLS	OLS	FE[2]	RE[3]	OLS	OLS	OLS	PW[4]
	Dependent variable: Average price of retailer r (Δp_t^r)							
All	0.222							
All: Prob > F	0.000							
H-type retailer		0.129	0.129	0.129	0.276*	0.238*	0.228*	0.167*
H: Prob > F		0.097	0.098	0.098	0.003	0.001	0.015	0.024
L-type retailer		0.265*	0.266*	0.266*	0.354*	0.307*	0.348*	0.272*
L: Prob > F		0.000	0.000	0.000	0.000	0.000	0.000	0.000
Included:								
ATC dummy			yes	yes	yes	yes	yes	yes
Retailer dummies			yes	yes	yes	yes	yes	yes
Interaction term[1]		yes	yes	yes	yes	yes	yes	yes
Δp_{t-1}^r					yes			
Time trend		yes	yes	yes	yes	yes	yes	yes
Monthly dummies						yes		
Levels							yes	
Observations	6,458	6,458	6,458	6,458	6,441	6,496	6,564	6,458
Number of retailers	80	80	80	80	80	80	80	80
Adj. R2	0.048	0.049	0.049	0.051	0.284	0.127	0.892	0.041
F-Statistic	23.97							
Root MSE	0.328	0.328			0.285	0.299	0.245	0.285

*Statistically significant at the 5%-level.

[1]Columns 2-8 include an interaction term of the dummy variable "low" (=1 if L-type retailer) and Δp_{t-j}^i.

[2]Retailer fixed effects. [3]Random effects. [4]Prais-Winsten estimator.

Table 9: Heterogeneous import prices

A.5 Robustness Check: Intra-EU Import Prices

Table 11 presents the results for intra-EU import prices. Although the effects are statistically significant only for the regression in levels the qualitative results that L-type retailers have a higher pass-through rate compared to H-type retailers holds for all specifications. In order to calculate the adjusted per-capita income we used the OECD-modified equivalence scale. According to the website of the OECD85, these scales assign a value of 1 for the first person of a household. Each additional adult is given a value of 0.5, and each child 0.3. Here, we also apply two other scales. First, the "OECD equivalence scale" that gives a value of 0.7 for each additional adult and 0.5 for each child. Second, we use the "Square root scale" that is simply the square root of the household's size. As Table 10 shows, our results do not seem to be sensitive to the chosen equivalence scale. Using the "OECD equivalence scale" or the "Square root scale" slightly increases the pass-through rates to about 60 – 67%. Nevertheless, over all specifications the pass-through rates for low-income households are significantly higher than for high-income households.

	1	2	3	4	5	6	7	8
Estimator	OLS	OLS	OLS	PW[1]	OLS	OLS	FE[2]	RE[3]
(1) OECD equivalence scale								
High income	0.370	0.373	0.373*	0.283	0.425	0.425*	0.424	0.416
H: Prob > F	0.130	0.078	0.023	0.099	0.054	0.011	0.055	0.059
Low income	0.657*	0.571*	0.571*	0.419*	0.614*	0.614*	0.607*	0.607*
L: Prob > F	0.007	0.007	0.000	0.014	0.005	0.000	0.006	0.006
(2) Square root scale								
High income	0.406	0.383	0.383*	0.357*	0.397	0.397*	0.409	0.409
H: Prob > F	0.082	0.061	0.021	0.032	0.061	0.023	0.055	0.054
Low income	0.672*	0.571*	0.571*	0.507*	0.579*	0.579*	0.592*	0.591*
L: Prob > F	0.004	0.005	0.000	0.002	0.006	0.000	0.005	0.005
(3) OECD-modified scale (used in Section 3)								
High income	0.232	0.199	0.199	0.193	0.275	0.275	0.284	0.278
H: Prob > F	0.328	0.337	0.210	0.249	0.200	0.105	0.188	0.195
Low income	0.612*	0.512*	0.512*	0.396*	0.576*	0.576*	0.578*	0.580*
L: Prob > F	0.010	0.013	0.001	0.018	0.007	0.000	0.007	0.007
Included:								
$\Delta p_{t-1}^{h,r}$		yes	yes		yes	yes	yes	yes
Time trend				yes	yes	yes	yes	yes
Retailer fixed effects				yes	yes	yes	yes	yes
Clustered by retailer			yes			yes		

*Statistically significant at the 5%-level.

[1]Prais-Winsten, [2]Fixed effects, [3]Random effects

Table 10: Pass-through into average prices of high and low-income households. Alternative equivalance scales.

	1	2[1]	3	4	5	6	7	8[2]
Estimator	OLS	OLS	FE	RE	OLS	OLS	OLS	PW-est.
	Dependent variable: Average price of retailer r (Δp_t^r)							
All	0.088							
All: Prob > F	0.551							
H-type retailer		-0.033	-0.035	-0.035	-0.215	0.104	0.241*	0.025
H: Prob > F		0.844	0.835	0.835	0.275	0.499	0.010	0.863
L-type retailer		0.204	0.205	0.205	0.398	-0.019	0.392*	0.166
L: Prob > F		0.388	0.387	0.387	0.176	0.904	0.000	0.405
Included:								
ATC dummy			yes	yes	yes	yes	yes	yes
Retailer dummies			yes	yes	yes	yes	yes	yes
Interaction term[1]		yes	yes	yes	yes	yes	yes	yes
Δp_{t-1}^r					yes			
Time trend		yes	yes	yes	yes	yes	yes	yes
Monthly dummies						yes		
Levels							yes	
Observations	6,469	6,469	6,469	6,469	6,452	6,506	6,573	6,469
Number of retailers	80	80	80	80	80	80	80	80
Adj. R2	0.000	0.003	0.003	0.005	0.252	0.031	0.883	-0.008
F-Statistic	1.288							
Root MSE	0.339	0.338			0.293	0.317	0.255	0.293

*Statistically significant at the 5%-level.

[1] Columns 2-9 include an interaction term of the dummy variable "low" (=1 if L-type retailer) and Δp_{t-j}^i.

[2] Prais-Winsten estimator.

Table 11: Pass-through into average prices for L- and H-type retailers, Intra-EU import prices

A.6 Full Model – Consumers

	1	2	3	4	5	6	7	8
Dependent variable: Average price of household group h at retailer r $\left(\Delta p_t^{h,r}\right)$								
Estimator	OLS	OLS	OLS	PW[1]	OLS	OLS	FE[2]	RE[3]
High income	0.232	0.199	0.199	0.193	0.275	0.275	0.284	0.278
H: Prob > F	0.328	0.337	0.210	0.249	0.200	0.105	0.188	0.195
Low income	0.612*	0.512*	0.512*	0.396*	0.576*	0.576*	0.578*	0.580*
L: Prob > F	0.010	0.013	0.001	0.018	0.007	0.000	0.007	0.007
Δp_t^i	-0.092	-0.076	-0.076	-0.085	-0.088	-0.088	-0.086	-0.089
	(0.128)	(0.112)	(0.122)	(0.115)	(0.112)	(0.123)	(0.113)	(0.112)
Δp_{t-1}^i	0.259	0.145	0.145	0.195	0.170	0.170	0.173	0.171
	(0.132)	(0.116)	(0.116)	(0.123)	(0.117)	(0.120)	(0.118)	(0.118)
Δp_{t-2}^i	0.065	0.129	0.129	0.084	0.193	0.193*	0.197	0.196
	(0.118)	(0.103)	(0.086)	(0.113)	(0.111)	(0.096)	(0.111)	(0.111)
$\Delta p_t^i * low$	0.167	-0.032	-0.032	-0.042	-0.036	-0.036	-0.037	-0.036
	(0.122)	(0.107)	(0.105)	(0.117)	(0.107)	(0.106)	(0.107)	(0.107)
$\Delta p_{t-1}^i * low$	0.005	0.140	0.140	0.185	0.137	0.137	0.134	0.137
	(0.129)	(0.113)	(0.121)	(0.140)	(0.113)	(0.121)	(0.113)	(0.113)
$\Delta p_{t-2}^i * low$	0.209	0.205	0.205	0.060	0.200	0.200	0.197	0.200
	(0.121)	(0.106)	(0.106)	(0.116)	(0.106)	(0.107)	(0.106)	(0.106)
Income	0.001	0.004	0.004	0.001	-0.000	-0.000		-0.000
	(0.009)	(0.008)	(0.003)	(0.006)	(0.008)	(0.003)		(0.008)
Constant							0.039*	0.012
							(0.018)	(0.049)
...								

Table 12: Pass-through into average prices of high- and low-income households

	1	2	3	4	5	6	7	8
Dependent variable: Average price of household group h at retailer r $\left(\Delta p_t^{h,r}\right)$								
Estimator	**OLS**	**OLS**	**OLS**	**PW**[1]	**OLS**	**OLS**	**FE**[2]	**RE**[3]
...								
Included:								
$\Delta p_{t-1}^{h,r}$		yes	yes		yes	yes	yes	yes
Time trend				yes	yes	yes	yes	yes
Retailer fixed effects				yes	yes	yes	yes	yes
Observations	10,594	10,594	10,594	10,594	10,594	10,594	10,594	11,051
Number of groups	141	141	141	141	141	141	141	141
Adj. R2	0.021	0.254	0.254	0.033	0.250	0.250	0.245	0.251
F-Statistic	13.52	191.1	190.2	5.021	39.38		189.5	
Root MSE	0.487	0.425	0.425	0.426	0.427	0.427		

*Statistically significant at the 5%-level, robust standard errors in parentheses.

Standard errors (in parantheses) are robust and clustered by retailers in (6)

[1]Prais-Winsten, [2]Fixed effects [3]Random effects

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able 12 cont.: Pass-through into average prices of high- and low-income households

A.7 Stage 1: Bundling Choice

Turning to stage 1, Table 13 shows profits for both firms, conditional on the simultaneous choice whether to bundle the good with a service or to offer only the good.

Firm 1, 2	offering only the good, no service	bundling good and service
offering only the good, no service	0, 0	$\frac{\delta\left((\delta-1)-2p^i(\delta-1)+w\right)^2}{(\delta-1)(4\delta-1)^2}$, $\frac{\left(2\delta(\delta-1)-w(2\delta-1)-p^i(\delta-1)\right)^2}{(\delta-1)(4\delta-1)^2}$
bundling good and service	$\frac{\left(2\delta(\delta-1)-w(2\delta-1)-p^i(\delta-1)\right)^2}{(\delta-1)(4\delta-1)^2}$, $\frac{\delta\left((\delta-1)-2p^i(\delta-1)+w\right)^2}{(\delta-1)(4\delta-1)^2}$	0, 0

Table 13: Firm profits in a simultaneous game

Nash equilibria are (no service, service) and (service, no service). That is, in equilibrium, firms will differentiate, one firm will bundle the good with a service, the other one will offer only the good. In other words, the point that exactly one firm is offering a service is not an exogenous assumption, but an endogenous result of the model. If firms decide sequentially, the first mover will choose to provide a service along with the good, if $w < (\sqrt{\delta} - 1)(p^i + \sqrt{\delta})$. The second mover then will choose to offer only the good.

A.8 Absolute and Relative Markups

Absolute markups for both firms are:

$$\begin{aligned} \mu_b &= p_b^r - p^i - w = \frac{2\delta\,(\delta-1) - p^i\,(\delta-1) - w\,(2\delta-1)}{4\delta-1}, \\ \mu_u &= p_u^r - p^i = \frac{\delta - 1 - 2p^i\,(\delta-1) + w}{4\delta-1}, \end{aligned} \tag{11}$$

with $\mu_b > \mu_u$, if $w < \frac{(\delta-1)(2\delta-1)+p^i(\delta-1)}{2\delta}$.

Relative markups are:

$$\begin{aligned} \frac{\mu_b}{p_b^r} &= \frac{p_b^r - p^i - w}{p_b^r} = \frac{2\delta\,(\delta-1) - p^i\,(\delta-1) - w\,(2\delta-1)}{3p^i\delta + 2w\delta + 2\delta\,(\delta-1)}, \\ \frac{\mu_u}{p_u^r} &= \frac{p_u^r - p^i}{p_u^r} = \frac{(\delta-1) - 2p^i\,(\delta-1) + w}{p^i\,(1+2\delta) + w + (\delta-1)}. \end{aligned} \tag{12}$$

with $\frac{\mu_b}{p_b^r} > \frac{\mu_u}{p_u^r}$, if $w < \frac{1}{2}(1 - 2p^i - \delta + \sqrt{(\delta-1)^2 + 4p^i\delta\left(p^i + 2\left(\delta - 1\right)\right)})$. That is, if the cost for providing the service is sufficiently low, both relative and absolute markups are higher for the firm selling the bundle of the good and the service.

Following a decrease of the import price, absolute markups increase for both firms:

$$\frac{\partial \mu_b}{\partial p^i} = -\frac{\delta - 1}{4\delta - 1} < 0, \ \frac{\partial \mu_u}{\partial p^i} = -2\frac{\delta - 1}{4\delta - 1} < 0. \tag{13}$$

The absolute markup increases by more for firm 2:$\left|\frac{\partial \mu_b}{\partial p^i}\right| < \left|\frac{\partial \mu_u}{\partial p^i}\right|$. Also, the relative markup increases for both firms:

$$\begin{aligned} \frac{\partial \frac{\mu_b}{p_b^r}}{\partial p^i} &= -\frac{\left(4\delta - 1\right)\left(2\left(\delta - 1\right) - w\right)}{\delta\left(3p^i + 2w + 2\left(\delta - 1\right)\right)^2}, \\ \frac{\partial \frac{\mu_u}{p_u^r}}{\partial p^i} &= -\frac{\left(4\delta - 1\right)\left(w + \left(\delta - 1\right)\right)}{\left(p^i\left(1 + 2\delta\right) + w + \left(\delta - 1\right)\right)^2}. \end{aligned} \tag{14}$$

The change of relative markup is higher for firm 2, if the import price is sufficiently low: $\left|\frac{\partial \frac{\mu_b}{p_b^r}}{\partial p^i}\right| < \left|\frac{\partial \frac{\mu_u}{p_u^r}}{\partial p^i}\right|$ if $p^i < p^{i*} = \frac{2(\delta-1)^3 + (4\delta-1)\sqrt{-\delta(w+\delta-1)^3(w-2\delta+2)} + w(10\delta-1)(\delta-1) + w^2(8\delta+1)}{(\delta-1)\left(2-\delta+8\delta^2\right) - w\left(13\delta+4\delta^2+1\right)}$.

A.9 Welfare Analysis

This subsection investigates the welfare implications of a decrease of the import price.

Decreasing prices increase the total quantity sold:

$$\frac{\partial q_b}{\partial p^i} = -\frac{1}{4\delta - 1} < 0, \ \frac{\partial q_u}{\partial p^i} = -\frac{2\delta}{4\delta - 1} < 0.$$

Firm u gains more than firm b of this additional market size, i.e. quantity sold, as $\frac{\partial q_b}{\partial p^i} < \frac{\partial q_u}{\partial p^i}$. The firm offering the good without a service is more exposed to changes in the import price. A decrease of the import price induces a higher price decrease and a higher quantity increase.

For both firms, a decreasing import price increases profits:

$$\begin{aligned} \frac{\partial \pi_b}{\partial p^i} &= -\frac{2\left(2\delta\left(\delta - 1\right) - w\left(2\delta - 1\right) - p^i\left(\delta - 1\right)\right)}{\left(4\delta - 1\right)^2}, \\ \frac{\partial \pi_u}{\partial p^i} &= -\frac{4\left(\delta - 1\right)\delta\left(\left(\delta - 1\right) - 2p^i\left(\delta - 1\right) + w\right)}{\left(\delta - 1\right)\left(4\delta - 1\right)^2}. \end{aligned} \tag{15}$$

The profit for firm b increases by more if $w < p^i\left(\delta - 1\right)$. Whether import price decreases induce higher profit changes for firm b or firm u, depends on the cost of providing the service. If the service cost is relatively small, firm b gains more from import price decreases in terms of profit. If the service cost is relatively high, firm u increases its profit by more.

For consumers, a decrease of the import price is associated with lower prices for both the bundle of good and service and the unbundled good. In addition, both quantities sold increase, implying that some consumers change from the unbundled to the bundled good and some consumers with a low gross valuation θ who did not buy before now purchase the unbundled good.

Denoting variables after the change in the import price by a tilde (˜), the increase in consumers surplus is given by:

$$\Delta CS = \left(\int\limits_{\widetilde{\theta}^*}^{1} (\delta\theta - \widetilde{p}_b^r) d\theta - \int\limits_{\widetilde{\theta}^{**}}^{\widetilde{\theta}^*} (\theta - \widetilde{p}_u^r)\, d\theta \right) - \left(\int\limits_{\theta^*}^{1} (\delta\theta - p_b^r) d\theta - \int\limits_{\theta^{**}}^{\theta^*} (\theta - p_u^r)\, d\theta \right) > 0, \tag{16}$$

which can be decomposed into four effects:

$$\Delta CS = \underbrace{\int\limits_{\theta^*}^{1} (p_b^r - \widetilde{p}_b^r) d\theta}_{I} + \underbrace{\int\limits_{\widetilde{\theta}^*}^{\theta^*} (\delta\theta - \widetilde{p}_b^r - (\theta - p_u^r))\, d\theta}_{II} + \underbrace{\int\limits_{\theta^{**}}^{\widetilde{\theta}^*} (p_u^r - \widetilde{p}_u^r)\, d\theta}_{III} + \underbrace{\int\limits_{\widetilde{\theta}^{**}}^{\theta^{**}} (\theta - \widetilde{p}_u^r)\, d\theta}_{IV}. \tag{17}$$

Part I of the decomposition exhibits the change in consumer surplus for those consumers who bought b before the change of the import price and now pay a lower price for it. Part II indicates the change in consumer surplus for the consumers who switch from u to b, providing them with a higher gross utility. The price of b after the change of the import price may be still higher than the price of u before, but net utility is higher by a revealed preference argument. Part III exhibits the change in utility for those consumers who continue to buy u, but pay a lower price for it. Part IV indicates the change in consumer surplus for the consumers who did not buy before, but are now able to afford u.

For a marginal decrease of the import price, i.e. $\widetilde{p}_b^r = p_b - \frac{\partial p_b^r}{\partial p^i}$ and $\widetilde{p}_u^r = p_u^r - \frac{\partial p_u^r}{\partial p^i}$, the change in consumer surplus for these four subgroups of consumers is given respectively as:

$$\begin{aligned}
&\int_{\theta^*}^{1}(p_b-\widetilde{p}_b^r)d\theta = \frac{3\delta\left(\left(2\delta-p^i\right)(\delta-1)-w\,(2\delta-1)\right)}{(4\delta-1)^2\,(\delta-1)},\\
&\int_{\widetilde{\theta}^*}^{\theta^*}\left(\delta\theta-\widetilde{p}_b^r-(\theta-p_u^r)\right)d\theta = \frac{(5\delta+1)}{2\,(4\delta-1)^2},\\
&\int_{\theta^{**}}^{\widetilde{\theta}^*}\left(p_u^r-\widetilde{p}_u^r\right)d\theta = \frac{(2\delta+1)\left(1+\delta\left(w+(\delta-2)-2p^i\,(\delta-1)\right)\right)}{(4\delta-1)^2\,(\delta-1)},\ \text{and}\\
&\int_{\widetilde{\theta}^{**}}^{\theta^{**}}\left(\theta-\widetilde{p}_u^r\right)d\theta = \frac{\left((w+\delta)\,(2\delta-1)+p^i\,(\delta-1)+2\right)^2}{2\,(4\delta-1)^2}.
\end{aligned} \tag{18}$$

Comparing the consumer surplus for the consumers who bought b before the change in the import price (Part I) and for the consumers who bought u before (Part II and III), the initial size of the import price determines which group of the consumers gains more from a decrease of the import price:

$$\begin{aligned}
\int_{\theta^*}^{1}(p_b^r-\widetilde{p}_b^r)d\theta &> \int_{\widetilde{\theta}^*}^{\theta^*}\left(\delta\theta-\widetilde{p}_b-(\theta-p_u)\right)d\theta+\int_{\theta^{**}}^{\widetilde{\theta}^*}\left(p_u-\widetilde{p}_u\right)d\theta,\\
\text{if } p^i &> \frac{4w\delta\,(4\delta-1)+1-\delta\,(\delta\,(8\delta-11)+4)}{2\delta\,(4\delta-1)\,(\delta-1)}.
\end{aligned} \tag{19}$$

If the import price is sufficiently high, the increase of consumer surplus is higher for consumers who bought the bundle before. That is, the effect from the price decrease of b exceeds the effect from a higher gross utility and a price decrease of u for the consumers who bought the unbundled good before. As a consequence, although the pass-through rate is higher for u, consumers buying b can gain more from import price decreases in terms of consumer surplus. Vice versa, if the import price is sufficiently low, the increase of consumer surplus for consumers who bought the unbundled good before outweighs the increase of consumer surplus for consumers who bought the bundle before.

In addition to price changes, two other effects induce welfare changes: First, some consumers switch from the unbundled good to the bundle in case of price decreases (and vice versa for price increases). These consumers experience additional utility from the consumption of the service (or less utility from waiving the service.) Second, some consumers who could not buy the good before can afford the good in case of price decreases (or can no longer afford the good in case of price increases).