

The pass-through into import and consumer prices: New evidence from German micro data

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Abstract

This dissertation estimates the magnitude of cost pass-through rates at different levels and analyzes potential heterogeneity across countries, retailers and products. Its focus lies on Germany, which is one of the most active countries in international trade. My findings suggest that the exchange rate pass-through is generally incomplete, that is, exchange rate changes are not passed through one to one to German import prices. Exchange rate pass-through rates differ across German trading partners and are largest for German imports from non-European countries. In the further analysis of the apparel sector in Germany, I provide evidence that low- and high-income households differ in their choice of shopping stores. Apparel retailers, on the other hand, can be divided into high- and low-price retailers. The pass-through rate of import price changes is larger for low-price retailers and low-income households prefer shopping at these retailers. Consequently, the household specific pass-through rate is larger for low-income households. A theoretical model then provides one potential explanation for these observations which is bundling an otherwise homogeneous imported good with services. Following an import price shock, retailers who sell cheaper unbundled products change prices more than retailers who sell a higher-priced bundle of product and service. In a final step, I then distinguish the two retail formats supermarket and discounter and consider the German ground coffee market. Supermarkets generally have a higher price level, a broader product assortment and they change prices more often compared to discounters. Discounters, on the other hand, are characterized by longer price spells and a larger absolute price change for coffee products within the sample period. As a consequence, producer price changes are passed through at a higher degree to discount retailers' prices. The speed of price adjustment, however, does not show significant differences across retail formats.

1 Introduction

1.1 Research focus

The extent to which foreign cost shocks affect domestic prices is generally named cost pass-through. In this dissertation, I analyze the pass-through of cost changes to domestic prices in Germany at different levels and for different time periods. First, I consider how bilateral exchange rate changes affect German import prices. In a second step, I make use of a data set on household purchases and estimate the pass-through of import price changes to consumer prices for apparel products. Finally, I consider the German coffee market and use detailed product-level data to analyze the pass-through of coffee bean price changes into final consumer prices for ground coffee products across different retail formats and key accounts.

Recently, the discussion on pass-through rates regained new interest through a paper by Campa and Goldberg (2005). Campa and Goldberg analyzed exchange rate pass-through into import prices. They find that pass-through rates are generally incomplete and they report a considerable heterogeneity across countries. Their analysis uses effective exchange rates and import price indices and an investigation at this aggregated level tries to answer the question of producer versus local currency pricing and its implications for optimal monetary policy. Other studies then emphasized the possible microeconomic explanations for incomplete pass-through rates. For instance, Nakamura and Zerom (2010) or Corsetti and Dedola (2005) show that local distribution costs reduce pass-through rates. A related approach stems from the marketing literature. This literature generally uses product-level data and analyzes price reactions in retail stores. Here, one puzzle to be solved is the question why retail prices move so little in contrast to producer prices (Nakamura, 2008) and possible explanations include retailers' local cost components that are independent of producer prices (Nakamura and Zerom, 2010).

The aim of this dissertation is to estimate the magnitude of the pass-through rates and to analyze potential heterogeneity across countries, retailers and products. Its focus lies on Germany, which is one of the most active countries in international trade. For instance, in the years 2003 to 2008, Germany was ranked first worldwide in terms of its export value and from 2000 to 2008, it was ranked second with regard to its import value across all countries in the world. In 2008, Germany exported goods at a value of about

USD 1,446 billion and imported products for roughly USD 1,185 billion (see WTO online data base¹). Thus, foreign cost shocks, such as exchange rate or import price changes, have a considerable impact on the German economy. The question then is, whether these cost changes are passed through one to one or, if this is not the case, whether these incomplete pass-through rates are identical across countries, retailers and products.

This has important economic implications as a couple of recent reports emphasize an increasing trend in income inequality for Germany. For instance, in 2008, the OECD stated "... market income inequality (...) increased (...) rapidly in the case of Germany..."² the International Labor Organization (ILO) concludes, that Germany's increase in inequality is triggered by "...collapsing bottom wages..."³ and a recent report by the OECD (2011) shows that the Gini coefficient as a measure for inequality increased from 0.25 in the middle of the 1980s to 0.30 in the late 2000s in Germany. In the same time period, import prices for a number of consumer products dropped substantially. For instance, from 2000 to 2007, import prices for shoes were lowered by 30% and apparel product's prices decreased by 33%. In 2007, computers were 36% cheaper compared to 2000.⁴ In addition, prices for commodities such as coffee, cocoa or rice exhibit substantial variation over time. Recently, for instance, coffee prices fell by about 32% from their peak in the second quarter in 2011 to their value of USD 1.65 per pound in the first quarter 2012. Likewise, the price of cocoa decreased in the same period by about 34%. Sugar prices, finally, first increased in the first quarter 2011 by 15% and then dropped by 23% in the first quarter of 2012.⁵ All these price changes are generally assumed to affect retailers and households equally. If official inflation rates do not consider potentially different effects across countries and retailers appropriately, they might end up being biased. As a consequence, inequality measures based on real wage comparisons that generally use one official price level to adjust nominal wages, might not be appropriate.

My findings suggest that the exchange rate pass-through (ERPT) is generally incomplete, that is, exchange rate changes are not passed through one to one to import prices. ERPT rates differ across German trading partners and are largest for imports

¹<http://stat.wto.org/Home/WSDBHome.aspx?Language=E>.

²See OECD (2008), p.31.

³See ILO (2008), p.26.

⁴Author's calculation from Eurostat import data.

⁵Sources: International Coffee Organization, International Cocoa Organization and Public Ledger via Datastream.

stemming from non-European countries. I propose a definition of an appreciation or depreciation phase and I find that ERPT is considerably smaller in appreciation phases. In the further analysis, I estimate that pass-through rates for import price changes are not identical across retailers in the apparel sector. Retailers with a lower price level generally pass through import price changes to a higher degree. In addition, low and high-income households differ in their choice of shopping stores for apparel products and this results in differences in household-specific pass-through rates. Finally, I analyze the German retail market for ground coffee and I provide evidence that discount retailers pass through a larger share of producer price changes to final consumer prices than retailers of the supermarket format.

1.2 Research structure

The general structure of this dissertation is as follows. The ERPT into import prices is analyzed in more detail in the second chapter. The third chapter of this dissertation considers pass-through rates across retailers and households. The fourth chapter then analyzes differences in pass-through rates across the two retail formats supermarket and discounter. The final fifth chapter summarizes the results and concludes.

Chapter 2 focuses on German exchange rates towards 16 foreign currencies, such as the U.S. Dollar, the Chinese Yuan or the British Pound. I then add publicly available data on import prices from Eurostat. The chapter analyzes ERPT first for Germany as a whole and confirms an incomplete ERPT rate as found, for instance, in Gaulier et al. (2008). Estimating the pass-through rate with an increasing number of lagged differences of the exchange rate reveals that ERPT generally is a short-run phenomenon occurring within three months. Second, I disaggregate by trading partner and find considerable heterogeneity across countries. While German imports from European countries outside the Euro-zone generally exhibit zero pass-through, ERPT is incomplete for most of the imports from non-European countries. Then, I check for potential nonlinearities in ERPT rates. In particular, I construct an appreciation phase defined as starting with three consecutive months of appreciation and find a substantially smaller pass-through rate in these phases. In addition, I define large changes as being larger than one standard deviation above the average exchange rate change and approximate the quality of a product as deviations from the average unit value within a specified category. I find

no statistical support for the hypotheses of whether large exchange rate changes pass through differently or whether a product's quality determines the degree of pass-through. Research from this chapter has been published as: "Berner, Eike. 2010. Exchange rate pass-through: New evidence from German micro data. *International Economics*, 124(4), 75-100".

The third chapter is joint work with Laura Birg. Its analysis is based on a household data set provided to us by the GfK ("Gesellschaft für Konsumforschung"), a German market research institute. Comparable to studies such as Nakamura and Zerom (2010), we analyze the reaction of final consumer prices to import price changes. This data set refers to products as a category such as "men outerwear, trousers". The household data reveals some interesting patterns. For instance, neither do low- and high-income households go to identical retailers, nor do they spend identical shares of their expenditure at these different retailers. Low-income households prefer shopping at retailers that have a price level below the average over all retailers. These retailers, on the other hand, pass through import price changes to a higher degree. As a consequence, low-income household's prices react more to an import price change and, thus, their import price pass-through rate is higher compared to high-income households. One potential explanation for differences in pass-through rates are locally supplied services that drive a wedge between import prices and consumer prices. We then emphasize this mechanism in a theoretical model. Retailers that bundle the imported good with services charge higher prices. As a consequence, their prices react by less given a change in the import price.

In chapter 4, I then extend the analysis to the product level and analyze the pass-through of producer price changes to final consumer prices for ground coffee. This chapter is joint work with Janine Empen and, here, we also distinguish the two retail formats supermarket and discounter. The product level data in the fourth chapter was collected by Madakom, another German market research institute. This data was directly reported by the retailers to Madakom. Products are identified by the Universal Product Code, a unique identification number. We show that on average supermarkets have a broader product assortment, a higher price level and change prices more often compared to discounters. Discounters, on the other hand, are characterized by longer price spells and a larger absolute price change within the time span in our sample. Producer prices are approximated by publicly available green bean's prices. We find an incomplete pass-through of producer price changes to consumer prices across all retailers as, for instance, Bonnet

et al. (2011). Distinguishing retail formats then shows that discounters pass-through producer price changes to a higher degree compared to supermarkets. The retail strategy of discounters is based on providing low prices, reducing the interior decoration of the shopping outlets to a minimum and selling a clearly defined small range of products. Thus, the distinction of the two retail formats supermarket and discounter supports the explanation that local cost component determine pass-through rates. An analysis of the speed of price adjustments shows no significant difference across retail formats.

This dissertation, thus, provides evidence for an incomplete pass-through of cost shocks, approximated by exchange rate changes and import price changes, to domestic prices at different levels. It suggests that pass-through rates differ substantially depending on the aggregation level of the price data and the respective country and sector under consideration. Economies such as Germany which are intensively engaged in international trade are thus affected heavily by changes in international prices. These effects, however, are not evenly distributed across retailers and households. Instead, I find substantial differences.

2 Exchange rate pass-through into German import prices

Summary:⁶ This chapter examines exchange rate pass-through into German import unit values over the last 20 years. I find incomplete pass-through to be the predominant characteristic for German imports with an average rate of 41% over three months. This result holds when considering monthly 8-digit data, the most disaggregated German import data available. Furthermore, I distinguish 16 German trading partners and estimate substantial cross-country differences in the pass-through to import unit values. Imports coming from European countries generally exhibit statistically zero pass-through. By contrast, non-European trading partners are characterized by statistically significant incomplete pass-through rates. I also study whether there are differences in the pass-through rates for appreciations and depreciations, as well as for small and large exchange rate shocks. Moreover, I test for a negative correlation between the goods' quality and its pass-through rate.

⁶Research from this chapter has been published as: "Berner, Eike. 2010. Exchange rate pass-through: New evidence from German micro data. *International Economics*, 124(4), 75-100".

2.1 Introduction

This chapter uses highly disaggregated German data to study exchange rate pass-through (ERPT) into import unit values. I am particularly interested in potential differences in ERPT across goods and countries. Therefore, I consider German imported goods at the 8-digit level and distinguish between different trading partners. Additionally, I try to measure the impact of quality on ERPT and analyze whether there are differential effects for appreciations of the Euro compared to depreciations, as well as for small and large exchange rate shocks.

The pass-through of exchange rate shocks and trade shocks through the elimination or imposition of tariffs and non-tariff barriers has important economic effects.⁷ On a macroeconomic level, the extent of this pass-through is crucial for optimal monetary policy as it directly affects domestic prices and thus inflation rates (see, for instance, Devereux, 2001; McCarthy, 2007; or Engel, 2009). On a microeconomic level, the degree of pass-through determines how firms and households are affected by external shocks. This is especially true for Germany since its share of imports to total GDP increased in the last twenty years from 21% in 1991 to 32% in 2008.⁸

Surprisingly, there still is little empirical evidence regarding potentially different ERPT effects across trading partners and products. Studies focus either on one or two countries with their specific bilateral trade relation (Gosh and Rajan, 2009; Bergin and Feenstra, 2009), or on single countries and all their trading partners at once (Feinberg, 2000; Gust et al., 2010; Olivei, 2002; McCarthy, 2007). In the latter case, effective exchange rates are used which comprise several currencies. An aggregated view suppresses a lot of information and can lead to a sectoral estimation bias, as found by Mumtaz et al. (2006). There is also a large heterogeneity in the movements of exchange rates, as Figure 1 shows. For instance, in the last years the Euro experienced a substantial appreciation versus the Mexican Peso or the Indian Rupee. On the other hand, the German exchange rate versus the Czech Koruna depreciated strongly and it remained rather stable with respect to the Swiss Franc. By adding 16 different German trading partners - among others the United States, China and the United Kingdom - my analysis is, thus, useful to further distinguish country-specific pass-through rates into German import prices. A lot

⁷For the equivalent impact of these effects see, for example, Feenstra (1989).

⁸Values calculated with data from "Genesis Online", the publicly available online database of the German Federal Statistical Office.

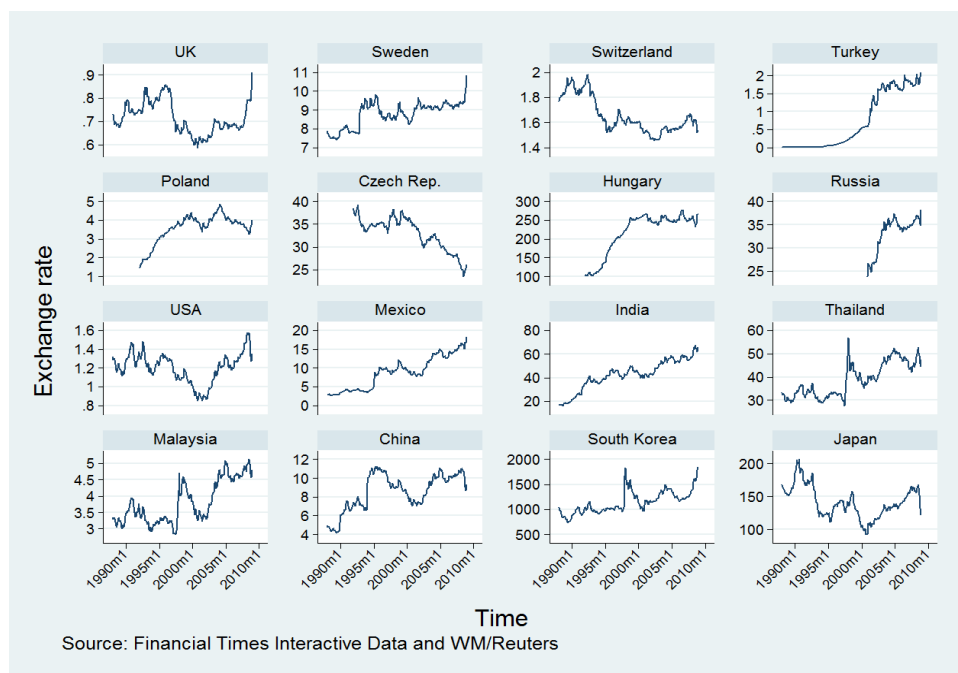


Figure 1: Exchange rates with respect to the Euro (Euro/foreign currency)

of studies analyze ERPT into price indices (see also Campa and Goldberg, 2005; Campa and Minguez, 2006; or Ihrig et al., 2006), while some consider more disaggregated sectors and price indices (Yang, 1997; Mumtaz et al., 2006; Francois et al., 2010). However, relatively few studies try to estimate ERPT into highly disaggregated unit values for a broader set of products (for instance, Gaulier et al., 2008, for 4-digit data and a large set of up to 100 countries; Auer and Chaney, 2009, for 10-digit U.S. import data; and Gopinath et al., 2010, for 10-digit U.S. data at the firm-level).⁹

This study is closely related to the work by Gaulier et al. (2008) and Gopinath et al. (2010). Gaulier et al. (2008) measure ERPT at an annual rate at the 4-digit level for about 100 countries, among which are Germany, the U.S., and Japan. While they find considerable cross-sectional heterogeneity, they do not consider potential differences concerning one destination and its several trading partners which this study does. Furthermore, their use of annual data limits the analysis to long-run pass-through rates. By

⁹Knetter (1989, 1993, 1997) also uses 7-digit data but estimates pass-through rates for a rather narrow set of up to 37 industries.

contrast, I apply monthly data and distinguish short and long-run pass-through rates. Gopinath et al. (2010) provide rich evidence on differences in ERPT concerning the currency in which U.S. imports are invoiced. Using monthly U.S. import data, they find that Dollar priced goods exhibit much lower ERPT rates compared to non-dollar priced goods. Additionally, they show substantial differences in ERPT rates regarding the specific U.S. trading partner. For instance, the average pass-through rate for German imports into the U.S. is 63% (17%) higher for dollar priced (non-dollar priced) goods compared to imports from the United Kingdom. I carry out a similar analysis using German data. In addition, I consider possible nonlinearities of ERPT stemming from appreciations and depreciations as well as large and small exchange rate movements.

The analysis is conducted as follows. Exchange rate pass-through into import unit values at the 8-digit level is calculated for the period January 1988 to December 2008. While other studies look at pass-through for Germany as a whole, one of the main contributions of this analysis is to extend it to 16 German trading partners separately. That is, it will be possible to measure the pass-through of, say, changes of the Yuan vis-à-vis the Euro for a selection of 8-digit products. The chosen partner countries cover on average 47% of German imports for these products. Given the fact that Euro-currency countries such as the Netherlands and France cannot be included, the countries in my sample cover a large share of relevant imports. I estimate pass-through with different time horizons to check the consistency of definitions of short and long-run pass through rates. I also test whether estimated ERPT rates differ for appreciation periods compared to depreciation periods, that is, whether ERPT to import unit values is uniform. Afterwards, I define "large" and "small" exchange rate changes and test whether unit values react equally to both types of exchange rate fluctuations. Finally, I make use of the highly disaggregated 8-digit data to consider product specific determinants. That is, I test for a negative correlation of the goods' quality and its exchange rate pass-through rate.

ERPT is incomplete with a rate of 41% in the short-run of three months when I use 8-digit level data in a pooled analysis. That is, a 10% increase in the exchange rate leads to a 4.1% decrease in the import unit value. These adjustments mainly occur within the short-run of three months. Further disaggregation by German trading partner shows substantial differences among countries. Imports coming from European countries generally exhibit statistically zero pass-through in the short as well as the long-run. By contrast, non-European trading partners are characterized by statistically significant

incomplete ERPT rates with full pass-through for imports from the U.S. and Mexico. This strongly suggests that local currency pricing for German imports from Europe prevails. Further disaggregating by product reveals large product heterogeneity, although I observe a low significance of the estimates.

I check whether the estimated ERPT rates differ for periods of appreciation. Appreciations, for instance, could refer only to periods where in all months an appreciation occurred. I estimate no significant difference, whether in the short or in the long-run. However, this result changes if I consider longer phases of appreciation. Then, ERPT is substantially lower in periods of appreciation and the order of magnitude is 49 to 83 *percentage points*. Additionally, large exchange rate changes indeed induce larger ERPT rates at a rate of about 2 percentage points. The point estimates are, however, not significantly different from zero. Finally, I do not find support for the Auer and Chaney prediction of a negative influence of quality on ERPT rates. In particular, my results point in the opposite direction: goods with higher quality are characterized by higher pass-through rates. The statistical evidence, however, is limited.

This chapter contributes to three strands of the pass-through literature.¹⁰ First, studies, such as Gaulier et al. (2008) or Auer and Chaney (2009), analyze pass-through with yearly data. The current study differs from these papers by considering pass-through at a disaggregated level and at a monthly frequency. It reveals strong variations in pass-through rates across products and country of origin. I show that pass-through is a short-run phenomenon and occurs within three months, which is in line with the findings of Gopinath et al. (2010).

Second, as outlined by Marazzi et al. (2005), little is known about whether ERPT really is a linear phenomenon. Dramatic decreases of exchange rates might influence a firm's costs more intensively. In the presence of standard menu costs of price changes, import prices could react differently depending on the size of the exchange rate change. This also includes the question of whether ERPT is uniform for appreciations and depreciations. Firms might tend to pass through cost increases at a different rate than cost-reducing effects of exchange rate fluctuations. My findings suggest that large exchange rate changes

¹⁰A comprehensive overview of how the empirical research questions on exchange rates and prices evolved is provided by Goldberg and Knetter (1997). They summarize that research started with trying to validate the law of one price. Then, ERPT, and pricing-to-market behavior of firms was investigated, generally based on the same empirical framework. Among other things, they conclude that incomplete pass-through can be interpreted as evidence for imperfect competition.

indeed are passed through to a larger extent than small changes.

Third, in a recent article Auer and Chaney (2009) set out a new theoretical framework that considers a good's quality as an explanation for pass-through. Their model predicts that lower quality goods are more sensitive to exchange rate movements than higher quality goods. Auer and Chaney empirically test this hypothesis with 10-digit US import data for 1991 to 2001. The empirical evidence supporting their theory, however, is statistically not significant. Applying the same methodology to German import unit values yields a comparable conclusion. I find no evidence for a negative correlation of quality and ERPT, whether in a pooled regression or on a by-country basis.

The rest of the chapter is organized as follows. In section 2, the estimation strategy is outlined and discussed. Section 3 describes the data and presents the empirical findings for ERPT into German import prices at an aggregated level, across countries, and for different non-uniform specifications. Section 4 concludes. The Appendix to this chapter provides details on the data used.

2.2 Estimation strategy

This section provides a brief discussion of the estimation strategy and the theoretical background that motivates the estimation equation.

If exporting firms increase prices by 1% following a 1% increase in the exchange rate, this is named complete exchange rate pass-through. However, there are several channels which might explain why firms will not adjust prices one-to-one. In a perfectly competitive market, a firm's price equals its marginal cost. If, however, the competitive environment is such that a firm is able to charge positive mark-ups over prices, it might choose to preserve its price in order to maintain or even increase its market share in a specific country. Since the work by Krugman (1986), this behavior is generally named "pricing-to-market". Second, additional local distribution or transportation costs an exporting firm has to bear may not be influenced by the exchange rate. This implies that the exchange rate pass-through is incomplete, even if the firm does not charge a positive mark-up. Third, the frequency of price adjustment determines pass-through as found by Gopinath and Itskhoki (2010). The more often prices are changed, the better a firm is able to adjust the price to any exogenous change. Additionally, classic menu costs might prevent the immediate change of prices and imply differences in pass-through rates in the

short- and long-run. Finally, a flexible production structure allows a firm to switch its source of imported inputs to countries where the exchange rate remained stable or even depreciated. Campa and Goldberg (2010) show that the use of imported inputs is indeed important and can account for up to 48% of the final price. All these channels not only give rise to incomplete exchange rate pass-through. They also imply that, besides the sectoral heterogeneity bias observed by Mumtatz et al. (2006), there might be country and product-level heterogeneities in pass-through rates.

According to Campa and Goldberg (2005) a useful starting point is the pricing decision of an exporting firm. For a given country, the import price of product j from its trading partner i , P_t^{ij} , can be written as export price, $P_t^{x,ij}$, multiplied with the inverse of the bilateral exchange rate¹¹, E_t^i , that is

$$P_t^{ij} = \frac{1}{E_t^i} P_t^{x,ij}. \quad (1)$$

Decomposing exporter prices into markup ($MKUP_t^{x,i}$) and marginal cost ($MC_t^{x,i}$) and taking the logarithm of all variables yields

$$\ln P_t^{ij} = \ln MKUP_t^{x,i} + \ln MC_t^{x,i} - \ln E_t^i. \quad (2)$$

Marginal costs of exporters are assumed to be increasing in the exporter's wage ($\ln W_t^{x,i}$) and the demand in the destination market ($\ln Y_t$).^{12,13} The logarithm of mark-ups on the other hand, is a function of fixed industry-specific conditions (ϕ) and the macroeconomic environment ($\Phi \ln E_t^i$) which is simply expressed as a function of the exchange rate. Therefore, the import price can be written as

$$\ln P_t^{ij} = \phi - (1 - \Phi) \ln E_t^i + c_0 \ln Y_t + c_1 \ln W_t^{x,i}. \quad (3)$$

The literature considers several transformations of (3).¹⁴ For the analysis of monthly 8-

¹¹Throughout the rest of my analysis exchange rates are expressed in quantity notation.

¹²That is, increasing marginal costs in the production for exporters are assumed.

¹³This implicitly assumes that marginal costs are invariant to exchange rate fluctuations. However, if firms rely on imported inputs (see, for instance, Feenstra, 1998; Hummels et al., 2001) then exchange rate shocks affect a firm's cost. Hence, one cannot rule out the possibility that the estimated ERPT coefficient also captures the sensitivity of marginal costs to currency adjustments.

¹⁴See, for instance, Campa and Goldberg (2005) for nonstationary variables and no cointegration or Gosh and Rajan (2009) for a dynamic ordinary least square specification.

digit data I transform (3) according to Gopinath et al. (2010) into the general estimation equation

$$\begin{aligned} \Delta p_t^{ij} = & \sum_{k=0}^n \alpha_k^{ij} \Delta e_{t-k}^i + \sum_{h=1}^3 \beta_h^{ij} \Delta p_{t-h}^{ij} \\ & + \gamma_1^j trend^j + \gamma_2^{ij} fix^{ij} + \boldsymbol{\delta}' \mathbf{D} + \epsilon_t^{ij}. \end{aligned} \quad (4)$$

Here, Δp_t^{ij} denotes the first difference of the logarithm of the unit value of an 8-digit good j imported into Germany from country i at time t , e_t^i is the logarithm of the bilateral exchange rate between Germany and country i , and $trend^j$ is a product j -specific time trend. This time trend captures an average influence of time on product j , e.g., the average impact of worldwide technological shocks.¹⁵ fix^{ij} is a product-country fixed effect that captures, for instance, cost increases or changes in export legislation specific to product j and country i . Additionally, the vector \mathbf{D} covers a full set of fixed effects for the three dimensions of the data (time (fix_t), partner country (fix^i), and product (fix^j)) and other dummies.¹⁶ ϵ_t^{ij} is the error term. All but one exchange rate are nonstationary time series. In order to make the data stationary, I consider first differences in logarithms of the exchange rate and the import unit value. I refrain from using country-level variables, such as German GDP or the producer price index, to measure the influence of demand or exporter costs, respectively, and consider fixed effects instead. There are considerable differences in the variation of aggregate variables and 8-digit unit value data. This suggests that the use of fixed effects is more appropriate for the data.

I estimate (4) with monthly dummies in order to correct for seasonal influences and to preserve the time dimension of the data. The error terms might be correlated within a country but not across countries. Therefore, I cluster the data by trading partner to correct for the potential problem of contemporaneous correlation (confer, for instance, Moulton, 1990). The literature generally assumes pass-through to occur within a year after the initial exchange rate movement. Accordingly, I allow for $n = 11$ lags of the

¹⁵Although product-time fixed effects control for effects at any point in time, for reasons of data parsimony I chose the time trend specification.

¹⁶These include dummies for the German reunification in 1990, the beginning of the financial crisis in mid 2008, the introduction of the Euro, and the replacement of the Multifiber Arrangement starting in 1995.

exchange rate in equation (4). The short-run pass through is defined as occurring within the first three months. Long-run pass-through rates are the sum of the contemporaneous difference of the exchange rate and eight or eleven lags, respectively. This guarantees comparability with studies using quarterly or annual data. Three lagged terms of the difference of the unit value on the right hand side correct for autocorrelation in the sample. A crucial assumption in the ERPT literature is that a change in the exchange rate is considered as an exogenous shock.¹⁷ While this assumption may seem strong for macroeconomic import price indices, it is of less concern for detailed product data. A price change of a specific 8-digit product does not affect a country's exchange rate. Hence, my analysis is less sensitive to endogeneity problems. All regressions are weighted ordinary least square with weights based on the trade volume.¹⁸

2.3 Empirical evidence

2.3.1 Data

The monthly data in this analysis covers the period from January 1988 to December 2008 and is obtained from two different sources. I use data on import unit values from Eurostat, classified up to 8 digits by the combined nomenclature (CN).¹⁹ Mainly, I consider CNs covering textile and electronic categories for this study. These selected CNs provide a so-called supplementary unit which shows in numbers the quantity traded in this CN. This allows me to calculate unit values. To further increase the reliance of the data, I consider CNs that were traded for more than a minimal number of periods. Finally, CNs need to pass a threshold with respect to their variation which is described in the Appendix section A.2.

Due to data limitations I was not able to capture all non-Euro trade of Germany. However, the chosen 16 partner countries cover on average 47% of German imports for these products. Including imports from Euro-countries such as France or the Netherlands

¹⁷That is, they do not influence a firm's pricing decision and neither are exchange rates affected by firm pricing (see Gopinath et al., 2010).

¹⁸Similar to Gaulier et al. (2008), I use three-period weights, that is $w_t^{ij} = \frac{1}{3} \left(\frac{V_{t-1}^{ij}}{V_{t-1}} + \frac{V_t^{ij}}{V_t} + \frac{V_{t+1}^{ij}}{V_{t+1}} \right)$. Here, w_t^{ij} is the weight for product j from country i at time t . Total world trade at time t is $V_t = \sum_{i,j} V_t^{ij}$, the sum over the 16 German trading partners and all products. I chose three periods to minimize the influence of a relative high import volume in one month.

¹⁹For more details on data collection and its methodology confer Eurostat (2006).

increases this share to 93%. That is, my data covers a large share of relevant imports.

Data on bilateral exchange rates come from Financial Times Interactive Data and WM/Reuters and were extracted from Thomson Datastream. I calculated the arithmetic mean per month and used a Euro/US-Dollar exchange rate to convert all other currencies into Euro/foreign currency exchange rates over the entire sample period.

Checks on stationarity lead to the conclusion that the exchange rates are non-stationary, i.e. integrated of order one ($I(1)$). According to the results of Fisher’s unit-root test for unbalanced panels, unit values are stationary ($I(0)$). Hence, the existence of a cointegration relation between the exchange rates and the import unit values is not considered as being relevant.²⁰

At an 8-digit level, data on import unit values still exhibit significant variation. In what follows a crucial assumption is that an 8-digit CN is defined as a relatively homogeneous product. That is, changes in the unit value in this category will be interpreted as price changes of this product.²¹ Therefore, there is no need to further construct a price index and variables are considered as log differences due to their nonstationary characteristic. In order to estimate an average ERPT rate into German import prices, I run a pooled regression on equation (4) and use each country-CN combination as the panel variable. Thus, the coefficients α_k do not have a country or product dimension. Then, I estimate (4) by country and product. Accordingly, country-specific ERPT rates (α_k^i) are estimates for each country i , and product-specific pass-through rates are α_k^j .

2.3.2 Exchange rate pass-through to import unit values

Table 1 shows the results for a pooled regression with different specifications. Estimates are sensitive to the weighting scheme, but to a much less extent to the number of included fixed effects. In the short-run, defined as the first difference of the exchange rate and two lags, a statistically significant incomplete ERPT is estimated at a rate of about 41%, as

²⁰For a more detailed overview of the unit-root tests see the Appendix section A.3.

²¹There is another caveat. Any change inside an 8-digit-level in the relative quantity of imported goods is not observable. To illustrate this point think of two goods x and y belonging to the hypothetical CN 10000001. The combined imported quantity of x and y be 10 units. 6 of these units are y goods priced at 10, 4 are x goods with a price of 5. Thus, in the data I observe a quantity of 10 and a value of 80 for this CN. This yields an unit value of 8. The next period Germany still imports 10 units in this CN, 5 y goods and 5 x goods, and prices remain constant. I now would calculate a decreased unit value of 7.5 which is totally due to changes in quantity but not in prices. Since it is not possible to control for this effect, I assume that it can be neglected in the sense that an 8-digit-CN represents one final good.

can be seen in the lower part of the table for the weighted regressions. In other words, a 10% increase in the exchange rate leads to a 4.1% decrease in the import unit value.²² The long-run includes eight lags of the exchange rate and the pass-through increases only slightly to 43% – 46%. If I consider eleven lags of the exchange rate as the long-run pass-through, Table 1 shows a substantial decrease of the pass-through rate for all specifications, for instance down to 34% in column 4. That is, pass-through is sensitive to the number of lags included in its definition. In order to define short and long-run effects more precisely, I therefore estimate equation (4) and increase the number of lags stepwise to $n = 20$. The respective cumulative ERPT is presented in Figure 2 and it reveals that ERPT is predominantly a short-run phenomenon with little adjustments after the first three months. It also justifies the definition of long-run as occurring within nine months which is equivalent to a period of three quarters. These results are close to the findings of Campa and Goldberg (2005), who estimated ERPT to be 34% in the short-run and 42% in the long-run for manufactured goods using quarterly data up to 2003. Other studies found larger ERPT rates. Gaulier et al. (2008) report a median long-run pass-through of 68% for Germany, Warmedinger (2004) obtains 56%, and Campa and Minguez (2006) present 76%. Nevertheless, these studies cover a different set of industries. For instance, reducing Campa and Minguez' (2006) data to a comparable set of industries decreases their ERPT to 66%.

Now, I further disaggregate by country and run a regression of equation (4) for each country. This eliminates the geographical dimension of the data and shows whether there are country-specific differences in German import pass-through rates. As Table 2 shows, the mean of ERPT rates over all countries is 42% in the short-run. However, there is considerable variation between countries. Imports coming from European countries, such as Sweden, Poland, or the Czech Republic, exhibit statistically zero pass-through in the short as well as the long-run with the exception of Hungarian imports. All of these countries are close to Euro-currency states and also small economies relative to Germany. By contrast, non-European trading partners are characterized by statistically significant incomplete ERPT rates with complete pass-through rates for imports from the U.S., Mexico, and South Korea. This strongly suggests that local currency pricing is prevalent for German imports from Europe. In the long-run, pass-through increases to a

²²Note, that exchange rates are used in quantity notation. Thus, estimated ERPT coefficients will be negative numbers and a coefficient closer to zero represents a decline in the pass-through rate.

Variables	1	2	3	4	5	6	7
	Dependent variable: Δ_t Unit value						
Δ_t Exchange rate	0.006 (0.019)	-0.035 (0.025)	-0.056 (0.039)	-0.103*** (0.028)	-0.107*** (0.028)	-0.104*** (0.028)	-0.107*** (0.028)
Δ_{t-1} Exchange rate	-0.198*** (0.047)	-0.168*** (0.036)	-0.165*** (0.046)	-0.173*** (0.036)	-0.175*** (0.037)	-0.173*** (0.037)	-0.176*** (0.038)
Δ_{t-2} Exchange rate	-0.137* (0.066)	-0.152** (0.063)	-0.100 (0.064)	-0.129** (0.058)	-0.134** (0.060)	-0.130** (0.058)	-0.134** (0.060)
Δ_{t-1} Unit value	-0.648*** (0.016)	-0.565*** (0.031)	-0.649*** (0.015)	-0.571*** (0.029)	-0.573*** (0.029)	-0.573*** (0.029)	-0.575*** (0.029)
Product-, country-, and time fixed effects	no	no	yes	yes	yes	yes	yes
Product-specific time trend	no	no	no	no	yes	no	yes
Product-country fixed effect	no	no	no	no	no	yes	yes
Weighted by trade volume	no	yes	no	yes	yes	yes	yes
Observations	217,215	214,651	217,215	214,651	214,651	214,651	214,651
Adj. R2	0.305	0.255	0.305	0.261	0.261	0.260	0.260
Root MSE	0.351	0.186	0.352	0.185	0.185	0.185	0.185
Short-run ERPT	-0.329	-0.355	-0.321	-0.405	-0.416	-0.407	-0.417
Prob > F	0.008	0.018	0.007	0.000	0.002	0.001	0.002
Long-run (8 lags) ^a ERPT	-0.512	-0.380	-0.594	-0.425	-0.461	-0.426	-0.462
Prob > F	0.009	0.001	0.017	0.001	0.000	0.000	0.000
Long-run (11 lags) ^a ERPT	-0.405	-0.359	-0.457	-0.338	-0.389	-0.340	-0.390
Prob > F	0.077	0.005	0.001	0.001	0.002	0.001	0.002

(Weighted) ordinary least square regression, standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

All regressions are clustered by trading partner. ^aSum of the coefficients of 8 and 11 lagged exchange rates, respectively.

All regressions include: dummies for the financial crisis, Germany's reunification, the introduction of the Euro and the replacement of the Multi Fibre Arrangement.

Table 1: Exchange rate pass-through in the short and long-run

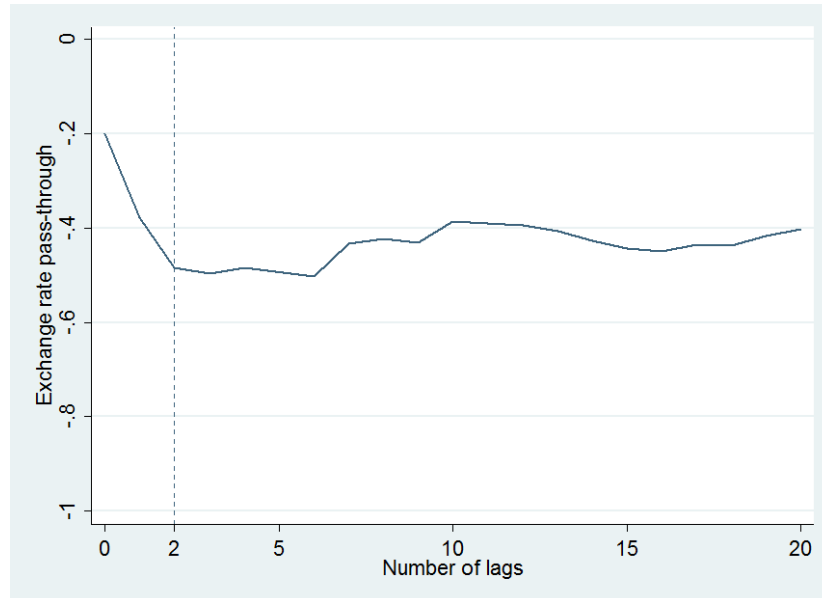


Figure 2: Exchange rate pass-through with different number of lags

mean across countries of 72% after 9 month and 93% after a year. The aforementioned observed drop in pass-through rates in the pooled regression when including 11 instead of 8 lags seems to be driven by the European countries. All other countries show a steady increase of pass-through rates with an increasing number of lags.

In order to estimate pass-through rates by products I now focus on 8-digit goods regardless of where they were imported from. In other words, I drop the country dimension and estimate α_k^j for each product j . At this high level of disaggregation only a small fraction of the estimated coefficients are statistically significant from zero. For the significant estimates I obtain a much higher density around the complete pass-through rate of -1 . Nevertheless, a fraction of estimates lies outside this interval, is not statistically different from zero, and even some coefficients exceeding -2 or $+2$ are obtained. Other studies present comparable results, for instance Auer and Chaney (2009), who report pass-through into U.S. import unit values at the 6-digit level within a similar interval of -2.5 to $+2.5$. This seems to be due to the variation in disaggregated unit value data and does not seem to be a German phenomenon.

What explains such a spread? A possible explanation is that 8-digit-levels do not describe a specific good in all cases. This would contradict my basic assumption and

	1	2	3	4	5	6	7	8
	UK	Sweden	Switzerland	Turkey	Poland	Czech Rep.	Hungary	Russia
Variables								
	Dependent variable: Δ_t Unit value							
Δ_t Exchange rate	-0.104 (0.104)	0.048 (0.305)	-0.756** (0.344)	-0.031 (0.023)	0.140* (0.073)	-0.536*** (0.142)	0.277*** (0.086)	1.469** (0.576)
Δ_{t-1} Exchange rate	-0.008 (0.111)	-0.577* (0.315)	-0.056 (0.351)	-0.026 (0.025)	-0.123* (0.074)	0.016 (0.141)	0.044 (0.087)	-0.227 (0.596)
Δ_{t-2} Exchange rate	-0.187* (0.111)	0.022 (0.316)	-0.238 (0.373)	0.036 (0.025)	-0.125 (0.077)	0.149 (0.137)	0.001 (0.093)	-1.019* (0.610)
Δ_{t-1} Unit value	-0.627*** (0.008)	-0.701*** (0.017)	-0.695*** (0.009)	-0.516*** (0.007)	-0.534*** (0.006)	-0.611*** (0.008)	-0.531*** (0.008)	-0.778*** (0.029)
Observations	14,674	3,397	12,082	22,451	23,463	15,322	15,833	1,202
Adj. R2	0.285	0.353	0.329	0.232	0.249	0.272	0.224	0.389
F-Statistic	31.8	26.02	25.99	26.36	23.97	20.97	18.35	9.813
Root MSE	0.189	0.223	0.321	0.143	0.203	0.204	0.153	0.236
Short-run ERPT	-0.299	-0.508	-1.050	-0.022	-0.109	-0.371	0.322	0.223
Prob > F	0.058	0.252	0.055	0.512	0.329	0.084	0.010	0.804
Long-run (8) ^a ERPT	0.001	-0.906	-0.763	-0.174	-0.530	-0.580	0.788	-0.527
Prob > F	0.997	0.247	0.443	0.004	0.018	0.099	0.000	0.732
Long-run (11) ^a ERPT	0.546	-0.850	-2.179	-0.115	-0.323	-0.519	0.542	-1.595
Prob > F	0.055	0.332	0.070	0.086	0.212	0.239	0.026	0.326

Weighted ordinary least square regression, standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

All regressions include: product fixed effects, a product specific time trend, dummies for the financial crisis,

Germany's reunification, the introduction of the Euro and the replacement of the Multi Fibre Arrangement.

^aSum of the coefficients of 8 and 11 lagged exchange rates, respectively.

Table 2: Exchange rate pass-through estimates by country (first part)

	9	10	11	12	13	14	15	16
	USA	Mexico	India	Thailand	Malaysia	China	S. Korea	Japan
Dependent variable: Δ_t Unit value								
Δ_t Exchange rate	-0.267*** (0.083)	-0.365** (0.149)	-0.222*** (0.067)	0.040 (0.078)	-0.053 (0.140)	-0.042 (0.031)	-0.039 (0.071)	-0.019 (0.054)
Δ_{t-1} Exchange rate	-0.286*** (0.087)	0.053 (0.144)	-0.087 (0.069)	-0.254*** (0.080)	-0.353** (0.143)	-0.273*** (0.032)	-0.206*** (0.078)	-0.181*** (0.057)
Δ_{t-2} Exchange rate	-0.549*** (0.089)	-0.762*** (0.145)	-0.077 (0.070)	-0.026 (0.080)	-0.392*** (0.145)	-0.182*** (0.032)	-0.152* (0.079)	-0.231*** (0.057)
Δ_{t-1} Unit value	-0.673*** (0.007)	-0.655*** (0.042)	-0.541*** (0.009)	-0.529*** (0.010)	-0.676*** (0.015)	-0.504*** (0.005)	-0.579*** (0.011)	-0.637*** (0.008)
Observations	17,967	627	11,297	10,512	4,107	38,503	8,021	15,193
Adj. R2	0.328	0.312	0.271	0.229	0.335	0.221	0.258	0.289
F-Statistic	41.89	8.118	28.22	22.13	26.83	27.07	24.64	35.33
Root MSE	0.233	0.140	0.170	0.221	0.221	0.197	0.198	0.159
Short-run ERPT	-1.102	-1.074	-0.385	-0.240	-0.797	-0.498	-0.397	-0.431
Prob > F	0.000	0.000	0.000	0.031	0.000	0.000	0.000	0.000
Long-run (8) ^a ERPT	-1.004	-2.082	-0.607	-0.503	-2.258	-0.800	-1.070	-0.440
Prob > F	0.000	0.000	0.001	0.016	0.000	0.000	0.000	0.002
Long-run (11) ^a ERPT	-1.683	-2.158	-0.680	-0.742	-2.498	-0.951	-1.172	-0.510
Prob > F	0.000	0.000	0.002	0.006	0.000	0.000	0.000	0.001

Weighted ordinary least square regression, standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
All regressions include: product fixed effects, a product specific time trend, dummies for the financial crisis, Germany's reunification, the introduction of the Euro and the replacement of the Multi Fibre Arrangement.
^aSum of the coefficients of 8 and 11 lagged exchange rates, respectively.

Exchange rate pass-through estimates by country (second part)

implies that quantity effects and other unobservable determinants of goods are persistent in the data. As outlined above, this critique cannot be negated unless real product data is used. On the other hand, the proposed theoretical model underlying the estimation equation may not be appropriate for such disaggregated data. Although I include a full set of fixed effects in the estimation equation, other forces that influence prices may not be captured by this specification, for example competition effects in the transportation sector or within an industry. Additionally, Hellerstein's (2008) findings suggest that the strategic behavior of firms is another important channel to be considered. Hence, firm-level information on how they adjust their mark-ups and to which extent they are willing to bear some part of the costs seems to be crucial to understand and measure pass-through at this disaggregated level.

In summary, I obtain strong statistical evidence for incomplete pass-through occurring within three months in a pooled analysis. Refining by country and product reveals large heterogeneity. There are substantial differences in ERPT rates for German import unit values across Germany's trading partners. All but one European countries exhibit zero ERPT while non-European countries exhibit statistically significant incomplete ERPT rates.

2.3.3 Nonlinearities of exchange rate pass-through rates

The literature generally considers ERPT to be a linear phenomenon. In this section, I first test whether German import unit values react similarly when differences in the direction and size of exchange rate movements are taken into account. I consider appreciations compared to depreciations and define small and large changes of an exchange rate. Second, following the idea of Auer and Chaney (2009), I analyze whether a product's quality determines the degree of pass-through.

Appreciation and large exchange rate change effects Generally, ERPT is estimated with first-differences specifications which implicitly assume appreciations and depreciations to influence prices equally, and neither is the actual size of exchange rate changes considered. Early work on this topic by Knetter (1994) did not show significant differences for 7-digit data on German and Japanese exports. By contrast, Webber's (2000) study on countries across the Asia-Pacific region finds asymmetric behavior for

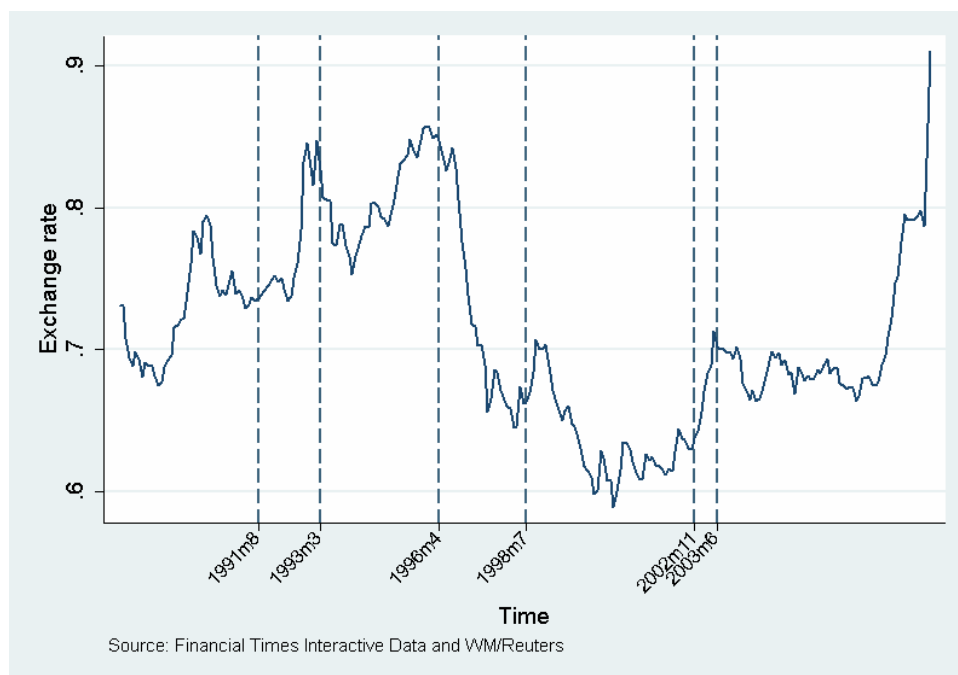


Figure 3: Exchange rate (Euro/Pound) with periods of appreciation and depreciation

six out of seven countries. Khundrakam (2007) confirms this result for India. Theoretically, there are good reasons to think of differential effects. Consider again the classic menu costs of price changes. Confronted with a slight devaluation of a currency an importer should not change his prices as long as the cost for changing is higher than his expected income increase through higher prices. On the other hand, periods of substantial appreciation of a currency might be induced by an overall economic upswing. As this process takes time, firms could anticipate the appreciation and hedge against the consequences. As a consequence, the pass-through of these changes could be smaller. Additionally, firms with market power pass through cost increases at a higher rate than cost-reducing effects of exchange rate fluctuations.

First, I check whether the estimated ERPT rates differ for periods of appreciation. Given my definition of short-run and long-run pass-through rates, several specifications are possible. Appreciations, for instance, could refer only to periods where in all months an appreciation occurred. By contrast, I assume that a general appreciating trend is decisive. I define an appreciation phase as a phase that starts with at least three successive

months of appreciations and where there are no more than two consecutive depreciations. Thus, if over a longer time period an exchange rate appreciates, all months within this period are considered as an appreciation period. I use a dummy variable which is "1" in this case. This definition seems reasonable, as the following example of the Euro and the British Pound indicates. By this definition the exchange rate of the Euro with respect to the British Pound is characterized by a total of 9 appreciation periods. Figure 3 shows three examples for this criterion. From August 1991 to March 1993 the Euro appreciated compared to the Pound. By contrast, all the periods from April 1996 to July 1998 are classified as belonging to a depreciation phase, although not every single month is characterized by a depreciation. Finally, from November 2002 to June 2003 there is a period of consecutive appreciations.

Furthermore, for each country I define an exchange rate change of greater than one standard deviation above or below the mean of all changes over time as a "large change". That is, I calculated the mean and standard deviation of each exchange rate. If any monthly growth rate of the exchange rate exceeds a value of more than one standard deviation above or below the mean, this change is considered a "large change". All others changes are referred to as a "small change". This should shed some light on the question whether import prices react uniformly. These nonlinearities are generated as dummy variables and incorporated in the estimation equation as an interaction with the exchange rate. In order to be consistent with the definition of short and long-run pass-through, I include the interaction term as the sum of lagged values. Equation (4) then reads

$$\begin{aligned} \Delta p_t^{ij} = & \sum_{k=0}^{12} \alpha_k \Delta e_{t-k}^i + \sum_{k=0}^{12} \theta_k \Delta \ln e_{t-k}^i * Dummy + \mu Dummy \\ & + \sum_{h=1}^3 \beta_h \Delta p_{t-h}^{ij} + \gamma_1^j trend^j + \gamma_2^{ij} fix^{ij} + \boldsymbol{\delta}' \mathbf{D} + \epsilon_t^{ij} \end{aligned} \quad (5)$$

where the definition of the variables is the same as above. The variable *Dummy* equals 1 if there is an appreciation or a large change. I perform a weighted least square regression and restrict coefficients to be equal across trading partners and products. If appreciations or large changes of the exchange rate imply a higher pass-through rate, the respective short and long-run sum of θ_k should be negative.

Table 3 provides the results of a pooled analysis for different specifications. $\Delta_t NL$ is a synonym for the first difference of the respective interaction effects and the squared exchange rate variable ($\Delta_{t-1} NL$ stands for the lagged first difference, accordingly). In columns 1 and 2 I test whether an appreciation leads to a significantly different ERPT rate.

Column 1 shows the results when I interact with all positive monthly growth rates of the exchange rate. The sum of the interaction terms is statistically not different from zero, whether in the short or in the long-run. However, this result changes if I apply the above described criterion to discern periods of appreciation. As column 2 shows, ERPT is substantially lower in periods of appreciation and the order of magnitude is 49 to 83 *percentage points*.²³ The coefficients are statistically significant in the long-run at the 10%-level. Appreciations of the Euro represent cost reducing effects for the importers. If these effects were passed through at a substantially lower rate than other changes, this would be a strong indicator for market power of the importers.

The interaction terms in column 3 and 4 suggest that large exchange rate changes indeed induce larger ERPT rates at a rate of about 2 percentage points. These results are, however, not significantly different from zero. Apart from column 2, the estimated ERPT rates in the short and long-run are in line with the reference estimation in column 5.

Exchange rate pass-through and quality There are a lot of product-specific features that influence pass-through rates. However, the adjustment of a firm's mark-up or changes in the input composition of production require additional firm-level data which is hard to obtain. By contrast, the available unit value data may be used to approximate the quality of products. The model of Auer and Chaney (2009) predicts pass-through to depend negatively on quality. In their model, an appreciation of, e.g., the Euro allows households in the Euro-zone to increase consumption of an international numéraire good. This raises domestic wages in the numéraire sector and all other sectors and thus marginal costs of European firms. Faced with a fixed cost of exporting, this wage increase forces the exit of the lowest quality firms that were exporting before. On average,

²³These results are robust to alternative definitions. In particular, whether I define appreciation phases as a phase that starts with at least two or four successive months of appreciations, respectively, does not qualitatively change the result.

Variables	Appreciation effect		Large changes		5 Reference estimation
	1	2	3	4	
	$\Delta_t E > 0$	Appreciation phase Dependent variable: Δ_t Unit value	<i>Mean</i> \pm <i>sd</i>	$\Delta_t E^2$	
Δ_t Exchange rate	-0.084 (0.125)	-0.136 (0.142)	-0.025 (0.064)	-0.136*** (0.030)	-0.107*** (0.028)
Δ_{t-1} Exchange rate	-0.204*** (0.046)	-0.242** (0.102)	-0.185*** (0.037)	-0.168*** (0.031)	-0.176*** (0.038)
Δ_{t-2} Exchange rate	-0.171 (0.100)	-0.398*** (0.110)	-0.170*** (0.047)	-0.110* (0.057)	-0.134** (0.060)
$\Delta_t NL$	-0.044 (0.124)	0.062 (0.138)	-0.100 (0.070)	0.008* (0.004)	
$\Delta_{t-1} NL$	0.035 (0.080)	0.096 (0.129)	0.023 (0.068)	-0.003 (0.003)	
$\Delta_{t-2} NL$	0.090 (0.080)	0.334** (0.129)	0.054 (0.056)	-0.008 (0.007)	
Δ_{t-1} Unit value	-0.576*** (0.029)	-0.576*** (0.028)	-0.576*** (0.029)	-0.576*** (0.029)	-0.575*** (0.029)
Observations	214,651	214,651	214,651	214,651	214,651
Adj. R2	0.260	0.261	0.261	0.260	0.260
Root MSE	0.185	0.185	0.185	0.185	0.185
F-Test					
Interactions (joined)	12.670	6.650	17.09	15.38	
Prob > F	0.000	0.000	0.000	0.000	
NL Short-run	0.082	0.491	-0.023	-0.006	
Prob > F	0.694	0.141	0.891	0.780	
Short-run ERPT	-0.459	-0.777	-0.381	-0.414	-0.417
Prob > F	0.015	0.017	0.000	0.001	0.002
NL Long-run (8) ^a	0.155	0.828	0.220	-0.027	
Prob > F	0.464	0.065	0.125	0.189	
Long-run (8) ^a ERPT	-0.564	-1.067	-0.511	-0.443	-0.462
Prob > F	0.014	0.024	0.000	0.001	0.000
NL Long-run (11) ^a	0.177	0.706	0.001	-0.027	
Prob > F	0.324	0.082	0.993	0.151	
Long-run (11) ^a ERPT	-0.503	-0.887	-0.365	-0.372	-0.390
Prob > F	0.003	0.032	0.000	0.001	0.002

Weighted ordinary least square regression, standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
All regressions include: product fixed effects, a product specific time trend, dummies for the financial crisis, Germany's reunification, the introduction of the Euro and the replacement of the Multi Fibre Arrangement.
Note: Variable NL is a synonym for the respective interaction effects and the squared exchange rate variable.
^aSum of the coefficients of 8 and 11 lagged exchange rates, respectively.

Table 3: Appreciations and large change effects on ERPT

quality valuation of consumers and prices go up. Since firms have identical technology, this cost shock leads all firms to reduce their production and prices increase once more. Firms at the exporting threshold are affected more by the first effect, and prices for lower quality products move almost equally with the exchange rate. On the other hand, high quality goods are solely influenced by the second effect. Thus, they predict lower quality products to be more sensitive to exchange rate movements than higher quality products.

Besides their explanation, there is another quite straightforward possibility to interpret this correlation. In a market with perfect competition and homogeneous goods, producers are not able to charge positive mark-ups over prices. Consequently, any cost shock needs to be transferred to buyers and ERPT will be complete. The higher the quality of a product, the more differentiated a good might be and the harder it seems to assume perfect competition. That is, the higher the quality of goods the lower might be the competition in this market. Any differences in ERPT across products or sectors could thus be interpreted as an indicator for market power of firms, i.e. imperfect competition.²⁴ This section empirically tests the hypothesis that lower quality goods are characterized by higher pass-through rates compared to higher quality goods.

Since no official measure of quality is covered by the data, it needs to be approximated in some way. Auer and Chaney (2009) suggest to consider differences across unit values within specified sectors. Across all countries, the data allow me to define 99 sectors at the 4-digit-level denoted by Ω . Within each sector Ω , differences in the unit values of corresponding 8-digit-products j are assumed to reflect differences in quality of otherwise comparable goods. Consider as an example the sector 6201²⁵ with the subcategories 62011100²⁶ and 62011210.²⁷ The first category covers coats made out of wool while the latter includes coats made from cotton. I assume that this is a difference in quality of relatively similar products.

²⁴Note, however, that imperfect competition does not necessarily imply incomplete ERPT. In particular, a model with Dixit-Stiglitz monopolistic competition generates constant mark-ups, no pricing-to-market and therefore complete ERPT. I thank an anonymous referee for pointing this out.

²⁵With the official description: "Men's or boy's overcoats, car coats, capes, cloaks, anoraks, incl. ski jackets, windcheaters, wind-jackets and similar articles (excl. knitted or crocheted, suits, ensembles, jackets, blazers, and trousers)".

²⁶With the official description: "Men's or boy's overcoats, car coats, capes, cloaks, anoraks, incl. ski jackets, windcheaters, wind-jackets and similar articles of wool or fine animal hair".

²⁷With the official description: "Men's or boy's overcoats, car coats, capes, cloaks, anoraks, incl. ski jackets, windcheaters, wind-jackets and similar articles of cotton, of a weight per garment of $\leq 1\text{kg}$ ".

Unit values are normalized by standard deviations from the mean of a sector in order to make results comparable across sectors. That is, I calculate

$$Q_t^{ij} = \frac{p_{t-1}^{ij} - E_{t-1} [p_{t-1}^{ij} | j \in \Omega]}{\sigma_{t-1} [p_{t-1}^{ij} | j \in \Omega]} \quad (6)$$

for each good j from each country i at time t . I then extend equation (4) by this quality measure (Q_t^{ij}) and a sum of lagged interaction terms of quality and the exchange rate ($\Delta e_t^i * Q_t^{ij}$), which yields

$$\begin{aligned} \Delta p_t^{ij} = & \sum_{k=0}^{12} \alpha_k \Delta e_{t-k}^i + \sum_{k=0}^{12} \theta_k \Delta e_t^i * Q_t^{ij} + \mu Q_t^{ij} \\ & + \sum_{h=1}^3 \beta_h \Delta p_{t-h}^{ij} + \gamma_1^j trend^j + \gamma_2^{ij} fix^{ij} + \boldsymbol{\delta}' \mathbf{D} + \epsilon_t^{ij}. \end{aligned} \quad (7)$$

Finally, I run a regression of equation (7) for each 4-digit sector Ω separately and on the pooled data. Since unit values are normalized, a sum of estimated coefficient θ_k larger than zero implies that lower quality goods have a higher ERPT in sector Ω . Table 4 summarizes the results for the 99 sectors in the data and for a pooled regression. In column one, the estimated coefficients of the exchange rate variable ($\alpha_k(\Omega)$) have a median of -0.351 over all sectors Ω . The estimated influence of the interaction term ($\theta_k(\Omega)$) has a median of -0.102 in the short-run. That is, a good with a quality two standard deviations below (above) the mean of its sector has a short-run ERPT of -0.147^{28} (-0.555). This difference vanishes in the long-run. The pooled analysis provides a comparable picture. The effect of quality is significant at the 10%-level and reduces the short-run pass-through rate for lower quality goods. These results exactly point in the opposite direction of the Auer and Chaney prediction and, thus, do not support the hypothesis of a negative effect of quality on ERPT rates.

²⁸For a good two standard deviations *below* the mean of its sector I therefore *subtract* the median of the interaction term. Thus I calculate $-0.351 - 2 * (-0.102) = -0.147$.

	1	2
	All sectors ^b	Pooled
	Median	Regression
Short-run		
Exchange rate * Quality	-0.102	-0.108
Prob > F		0.053
ERPT	-0.351	-0.356
Prob > F		0.000
Long-run (8) ^c		
Exchange rate * Quality	0.059	-0.068
Prob > F		0.293
ERPT	-0.712	-0.837
Prob > F		0.000

Weighted ordinary least square regression.
^bNumber of sectors: 99.
^cSum of the coefficients of 8 lags.

Table 4: Exchange rate pass-through and quality

2.4 Conclusion

Until recently, exchange rate pass-through has been analyzed mainly at an aggregated level. Although the microeconometrics of ERPT have increasingly gained in importance, few studies analyze the bilateral exchange rate relations for one country and a set of its specific trading partners. This study tries to bridge this gap for Germany and presents broad empirical evidence for incomplete pass-through into monthly German import data at the 8-digit-level. In a pooled analysis I estimate ERPT to be incomplete at a rate of about 41% in the short run of three months and 46% in the long run of 9 months. I find that ERPT differs substantially across German trading partners as well as across products, being highest and complete for goods imported from the US and Mexico. The European countries generally exhibit zero pass-through, strongly indicating local currency pricing with respect to the German market.

Additionally, I test whether ERPT is linear with respect to the size and direction of exchange rate movements. My findings suggest that appreciations of the Euro are passed through to a much lesser extent than depreciations. Large changes of the bilateral exchange rates are passed through by about 2 percentage points more with the point estimates being not significantly different from zero. Following Auer and Chaney (2009), I also test for a negative correlation of the ERPT and the relative quality of a product,

but do not find empirical support for their theory. In effect, my results point in the opposite direction of higher quality goods having higher pass-through rates.

3 Retailers and consumers: The pass-through of import price changes

Summary:²⁹ In this chapter, we estimate pass-through rates of import price changes across retailers and consumers. We estimate that high-price retailers do not pass through changes in the import price. By contrast, the pass-through for low-price retailers is 53% within 3 months. We show that, conditional on income, households differ with respect to their shopping outlets and the prices they pay. Consequently, pass-through rates for low-income households are 58%, significantly larger than those for high-income households. We then present one explanation for these observations in a theoretical model with vertical product differentiation due to bundling an otherwise homogeneous imported good with services. Following an import price shock, retailers who sell cheaper unbundled products change prices more than retailers who sell a higher-priced bundle of product and service.

²⁹This chapter is based on a paper that is joint work with Laura Birg.

3.1 Introduction

In this chapter, we estimate pass-through rates of import price changes across retailers and consumers. We combine a data set by the GfK (Gesellschaft für Konsumforschung), a German market research institute, on households' apparel purchases with Eurostat data on apparel import prices. We provide evidence that the aggregate pass-through of import price changes to consumer prices is incomplete. That is, a 1% change in the import price leads to a less than 1% change of the consumer price. In addition, pass-through rates differ across retailers. We estimate that high-price retailers do not pass through changes in the import price. By contrast, import price changes are passed through to low-price retailers at a rate of 53% within three months. We show that low- and high-income households differ in their expenditure shares across different retailers and they do not pay identical prices for apparel products. This implies that consumer price effects of changes in import prices differ across households. Consequently, estimated pass-through rates for low-income households are with 58% significantly larger than those for high-income households.

We then provide a simple theoretical model to explain this empirical finding. Retailers have the possibility to offer a service in addition to the imported good. Services include shop assistants providing advice to customers and retail environmental factors such as ambience (see for instance Grewal and Baker, 1994). The local cost for providing the service adds to the import price. This form of product differentiation causes final consumer prices to differ. Consumers are heterogeneous with respect to their willingness to pay for this extra service and services are preferably consumed by high-income households. Following a shock to the import price, the retailer who sells the good without a service changes final consumer prices by more than the retailer who sells a bundle of product and service. Consumers with a lower willingness to pay for services purchase from the former retailers and are thus affected more by import shocks.

The apparel sector provides a suitable framework for our analysis, as on January 1st, 2005, the Agreement on Textiles and Clothing (ATC), which imposed quotas for imports of clothing and textiles from developing countries, expired.³⁰ This dramatically

³⁰The ATC had dominated international trade in clothing and textile products by imposing quotas for imports from developing countries for decades. The progressive integration into normal GATT rules, that is, the successive elimination of the respective import quotas for textile and clothing products, had proceeded over a 10 year transitional period (EU Commission, 2000). But it was in fact the final step

boosted especially imports from China. On the other hand, a current article in a German business magazine (*Wirtschaftswoche*, 2011) reports an increase in wages of Chinese workers. This brought the steady decrease of prices of China's textile products to a stop and thus triggered their recent export price increase. This raises the question, whether these price changes for German apparel imports are passed through to consumers and to what extent. Benefits to or disadvantages for consumers may be distributed unequally. Consumer behavior, such as store choice, may determine to what extent savings accrue or - in the case of cost increases - spending increases.

The general trade effects of the phasing-out of the ATC have been studied amongst others by Nordas (2004), Francois et al. (2007), and Francois and Woerz (2009). Francois et al. (2007) investigate the implications of the ATC phase-out for 15 European Union member states. They find that producer prices reacted similarly across countries and dropped by over 30% from 1996 to 2004. German consumer prices fell by about 13% in this period. In addition, consumer prices exhibit substantial variation across countries that is mainly driven by differences in the structure of retail markets.³¹

There is also a substantial literature on the pass-through of foreign cost shocks, mostly approximated by exchange rate changes, to domestic prices, see e.g. Burstein et al. (2003), Campa and Goldberg (2006, 2010), or Francois et al. (2010).³² Typically, these studies document incomplete pass-through rates, i.e. goods prices change by less than real exchange rates between the respective countries. The degree of incomplete pass-through differs across countries. Empirical studies, though, suggest that about one fifth of an import price change is passed through into consumer prices.³³ This raises the question why the pass-through rate is so small. Recent studies using micro data try

that brought the massive liberalization. In the EU, which is the world's largest importer of textile and clothing products together with the United States, 94% of all clothing constraints had not been removed before January 2005 (see Nordas, 2004).

³¹Furthermore, Francois and Woerz (2009) estimate the trade cost equivalent of the ATC quotas and show that these still accounted for roughly 20% before the final phase-out in January 2005. This indicates that it was indeed the last step in 2005 that brought most of the trade liberalization.

³²Burstein et al. (2003) as well as Campa and Goldberg (2006, 2010) explicitly consider distribution expenditure which add to import prices and can account for a large part of the final price. This channel dampens the pass-through of external shocks to consumer prices. Francois et al. (2010) provide an analysis for 12 EU member states and show significant heterogeneity in pass-through rates to consumers depending on the market structure in the distribution sector.

³³For the U.S., this rate is between 7 and 25%, and for Germany it is 21%, see Campa and Goldberg (2010), Nakamura and Zerom (2010), and Hellerstein (2008).

to provide explanations for this phenomenon and identify the exact components that yield incomplete pass-through rates. Potentially important factors include (but are not limited to) markup adjustment, local distribution costs, barriers to and frequency of price adjustment, the degree of competition and a product's quality (see Nakamura and Zerom, 2010; Hellerstein, 2008; Gopinath and Itskhoki, 2010; Goldberg and Knetter, 1997; Alessandria, 2004; or Auer and Chaney, 2009).³⁴

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 our are Nakamura and Zerom (2010) and Hellerstein (2008). Nakamura and Zerom (2010) estimate an incomplete pass-through to consumer prices in the US coffee industry of 27%. They suggest that local cost and markup adjustments are important factors in causing incomplete pass-through rates: Local costs account for 59% of incomplete pass-through. Also Hellerstein (2008), who investigates US beer prices, finds that retailer markup adjustments and local-cost components each account for one half of the incomplete pass-through. In sum, these studies emphasize that local costs dampen price reactions to any external shock that hits the economy simply because a smaller ratio of the final price is affected. This is exactly the mechanism that induces different pass-through rates in our theoretical model. Nakamura and Zerom as well as Hellerstein focus on pass-through rates for retailers. By contrast,

³⁴Gopinath and Itskhoki (2010) show that the higher is the frequency of price adjustments, the larger is a product's pass-through rate. Goldberg and Knetter (1997) suggest that incomplete pass-through rates are a consequence of imperfect competition. A significant portion of the price response can be attributed to destination-specific changes in markups, that is, to third-degree price discrimination, which requires a certain degree of market power. Alessandria (2004) links incomplete pass-through rates to search frictions. Firms set optimal prices by taking the consumers' threat of switching the supplier into account. This decreases the pass-through rate for importing firms. Auer and Chaney (2009) link pass-through rates to a product's quality. Based on a model of quality pricing under perfect competition they predict import prices of low-quality goods being more sensitive to exchange rate changes and a shift in the composition of exports towards the high-quality good. Testing these predictions for U.S. import data, they find only weak empirical evidence for this.

For a discussion of how the market structure and the heterogeneity of firms affects the pass-through rates see, for instance, Raff and Schmitt (2011), Campos (2009), Garetto (2012), or Berman et al. (2009). Raff and Schmitt (2011) suggest that the degree of pass-through is underestimated, if the retail market structure is ignored. Campos (2009) argues that the extensive margin has a low impact on the degree of pass-through, but as prices charged by new entrants are higher, the degree of pass-through is reduced by the entry of new firms. Berman et al. (2009) find for French firm level data that following a depreciation, high-performance firms increase markups significantly more and increase less their export volume relative to firms with low productivity. With fixed costs for exporting, only the high productivity firms export and this selection effect can partly explain the observed low aggregate pass-through rates.

we use the fact that our data consists of household purchases to provide further evidence for different pass-through rates not only across retailers but also across households of different income.

Our analysis is structured as follows: To begin with, we show the evolution of import prices and final consumer prices of apparel products. We provide evidence that households with different income differ in their choice of shopping stores. These stores, on the other hand, differ in their price level and we distinguish high- and low-price retailers. As retailers do not pass through import price changes at an identical rate, the effects for households differ as well. In other words, pass-through rates of import price changes are heterogeneous across retailers and households.

Generally, our data has the three dimensions: household (k), retailer (r) and time (t). However, as 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. Instead, 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. In a second step, the monthly average price for the two household groups with high and low income is calculated for each retailer and 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.

We estimate that high-price retailers (H-type retailers in the following) do not pass through changes in the import unit value. By contrast, import unit value changes are passed through to the prices of L-type retailers, which have a low price level, at a rate of 53% within three months. The relative price (p_H/p_L) responds with an increase of 0.46 – 0.63% given a one percent increase in the import price. Turning to households, we estimate that the pass-through of import price changes to the average prices paid by low-income households is 58% which is significantly higher than for high-income consumers. This is consistent with rich households shopping more frequently in high-price stores that are less affected by trade-induced changes in the import price of apparel products.

We then emphasize the role of one possible explanation for price differences and different pass-through rates of retailers: locally supplied services. We consider the impact of a change in import prices in a theoretical model with a heterogeneous demand side and vertical product differentiation based on Shaked and Sutton (1982). Two firms sell

an identical imported product, but one firm bundles the good with a service, inducing product differentiation. Given an identical change in import prices, the retail price of the firm offering additional services changes less in relative terms.

This chapter contributes to two strands of the literature. First, we provide further evidence for the incomplete pass-through of import price changes to domestic prices. This is in line with several other studies as, for instance, Campa and Goldberg (2006, 2010) or Francois et al. (2010). More importantly, we explicitly consider local distribution costs which we interpret as additional services offered with an otherwise identical good. The heterogeneity of retailers has been shown amongst others by Raff and Schmitt (2011). In this study, the firm heterogeneity with respect to the supply of services provides one possible explanation for differences in pass-through rates. Second, we add to the pass-through literature a new aspect: Household income. The shopping behavior of low- and high-income households differs with respect to the type of retailers they go to. Retailers differ in their price level and pass-through rates. Low-income households prefer retailers with a lower price level that have higher pass-through rates. In sum, this leads to different pass-through rates depending on a household's income.

The rest of the chapter is organized as follows: Section 2 provides stylized facts of the data where we show the shopping behavior of households and the average prices of retailers. In section 3, we discuss our estimation strategy and the estimation results. Section 4 then presents our theoretical model and its predictions for a decrease in import prices and section 5 concludes.

3.2 Stylized facts

In this section, we describe the data and provide stylized facts that motivate our theoretical model. We use monthly data on clothing purchases from the "Gesellschaft für Konsumforschung" (GfK), a German market research institute, and its "Universalpanel" for the period January 2000 to December 2007. In this panel, participating households have to assign all their purchases to roughly 100 categories ranging from apparel products as well as electronic articles to housewares and specify the price and the retailer for each item. We focus on the 24 apparel categories, such as "trousers, men outerwear". Household characteristics, such as the buyer's age, his/her profession and education, and a household's net income and size, are reported as well. Data on German import unit

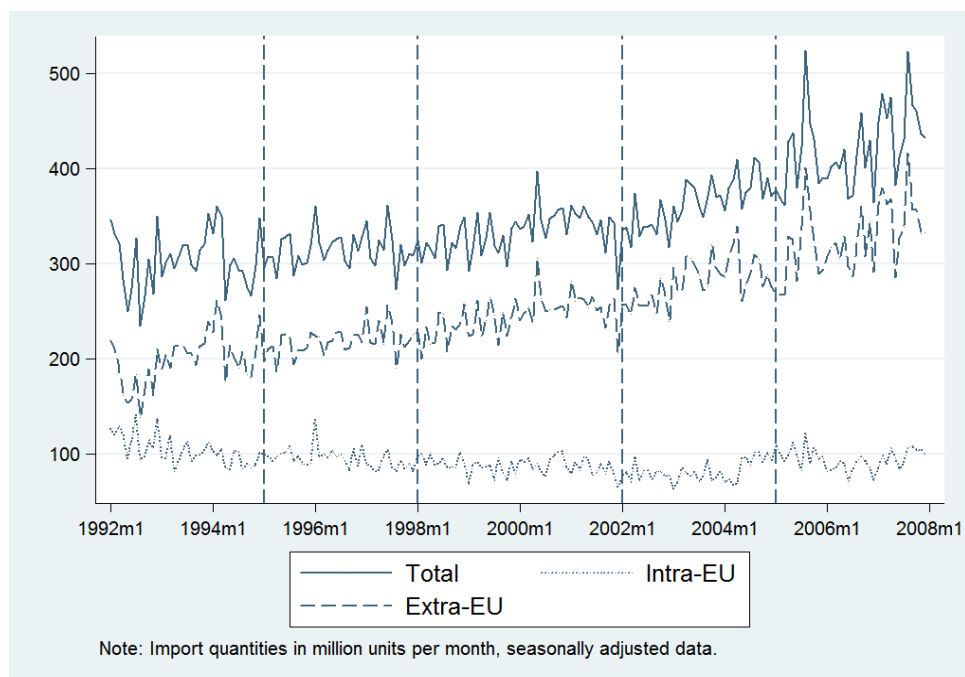


Figure 4: German clothing import quantities

values for apparel products are provided by Eurostat and cover the same period.³⁵

First, we show the impact of the ATC phase-out on German imports in the clothing sector. Figure 4 shows German import quantities separated by intra- and extra-EU trade. The vertical dashed lines mark the respective phase-out steps of the ATC. The 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, represented by the dashed line, following step three of the ATC phase-out by about one third. A spike in imported quantity occurs right after the final integration in January 2005, even exceeding 400 million units in some months. So by far, the major part of apparel imports comes from outside the EU.³⁶ It is exactly these countries that

³⁵Specifically, 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.

³⁶Another implicit observation of Figure 4 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.

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 consumer price is high with a value of 0.75 in contrast to a correlation factor 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 .

One explanation for incomplete pass-through of import prices into consumer prices are local cost components including service costs. Services that some retailers offer are reflected in their higher prices. To this end, we 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. Summing s_{rj} over all n categories and dividing by the number of categories yields $S_r = \sum s_{rj}/n$, our measure of the average price level of each retailer r . A value of $S_r \geq 1$ characterizes a retailer who charges prices above average. These retailers are regarded as H-type retailers in the following. $S_r < 1$ implies a relatively lower price level, respectively, and we will refer to these as L-type retailers. We are well aware of the fact that other differences across retailers are included in this measure. Retailers might sell different products within the same GfK-categories. Differences in the distribution channel e.g. will imply that retailers with more efficient distributional organization can charge a lower price to customers. The smaller the distance to production facilities, the faster a retailer is 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. If countries differ in their ability to produce high quality products, retailers offering higher quality could choose exactly these countries for sourcing their inputs. Products manufactured in Italy might have different quality requirements compared to goods from Bangladesh.

The data do not say anything about where the retailers source their goods. There are, however, at least three remarks to be made here. First, 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. Thus, a lot of retailers are not willing to reveal their exact import sources.³⁷

³⁷In Germany, public television and organizations such as the "Clean Clothes Campaign" (www.cleanclothes.org) try to provide information on working conditions to consumers. For

Second, in 2008, the import share of Chinese clothing was about 30%. Including Turkey and Bangladesh increases this share to about 50%.³⁸ Given these amounts, it seems reasonable to assume that almost all retailers will source at least part of their goods from these countries.³⁹ Finally, we also run regressions with Eurostat’s intra-EU-unit values as an explanatory variable and our results remain qualitatively unchanged. But regardless of where the price differences stem from, for the interpretation of the empirical results the crucial assumption is that the imported goods are identical across retailers. In this way, we are able to interpret the effect of an import price change on retailers with different price levels.

The average prices for H- and L-type retailers reveal substantial differences, as Figure 5 shows. We focus on deviations from the mean of each variable.⁴⁰ The solid line shows that the L-type retailer’s average price follows very closely the import price, which is represented by the dotted line. By contrast, the dashed line of H-type average prices seems to be much more isolated from the import price. Turning to Figure 6, which shows the relative price (p_H/p_L) as the dashed line and the import price as a dotted line, we observe a strictly negative correlation. A decreasing import price is accompanied by a steady increase of the relative price (p_H/p_L). As we will show later, this is driven by a decrease of p_L .

The GfK-data on household purchases provides 16 different income intervals and the size of the household. In order to calculate the per-capita income, we assume the mean of the respective interval as the household income and divide it by the scaled number of household members.⁴¹ The lowest quartile of the per-capita income distribution defines

instance, in 2008, reports were made about poor working conditions and physical punishment in factories supplying H&M or KiK (CCC, 2008; or <http://www.swr.de/report/-/id=233454/nid=233454/did=4039780/80hm8d/index.html>). Such reports might heavily worsen the public image of these firms.

³⁸Data published by the German Federal Statistical Office on its official website (see GENESIS online, Table 51000-0007).

³⁹Another German television report provides more anecdotal evidence on the production of blue jeans (http://www.ndr.de/fernsehen/sendungen/45_min/hintergrund/bluejeans101.html). The authors conclude that regardless of the final consumer price category of the jeans working conditions are identical for Chinese workers. In other words, regardless if a jeans sells for 10€ or 150€, its production still takes place in China.

⁴⁰Since 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.

⁴¹Household size needs to be scaled in order to adjust for the non proportional increase in needs with respect to household members. We use the OECD-modified scale of equivalence which applies a value of 1

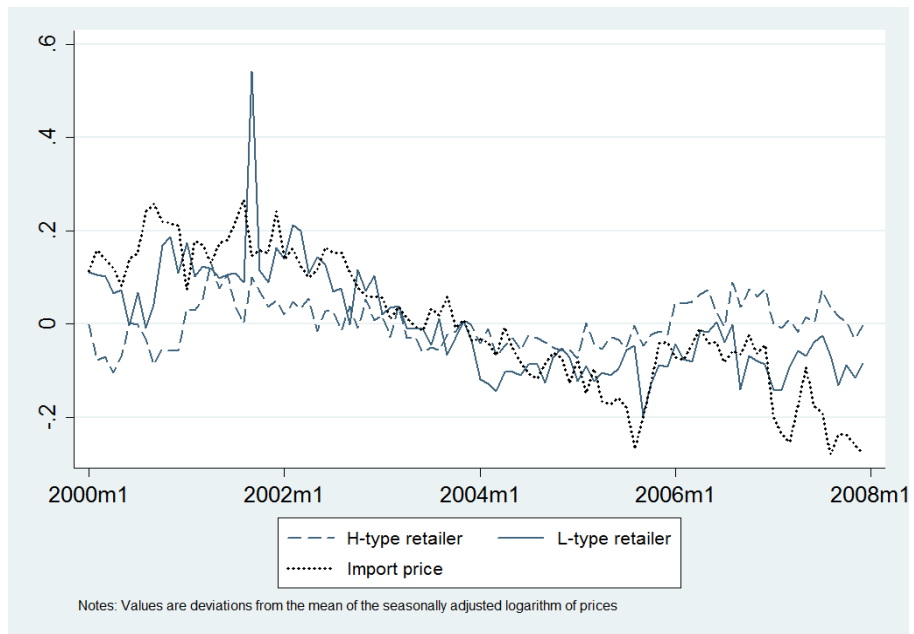


Figure 5: Import price and average prices for H- and L-type retailers

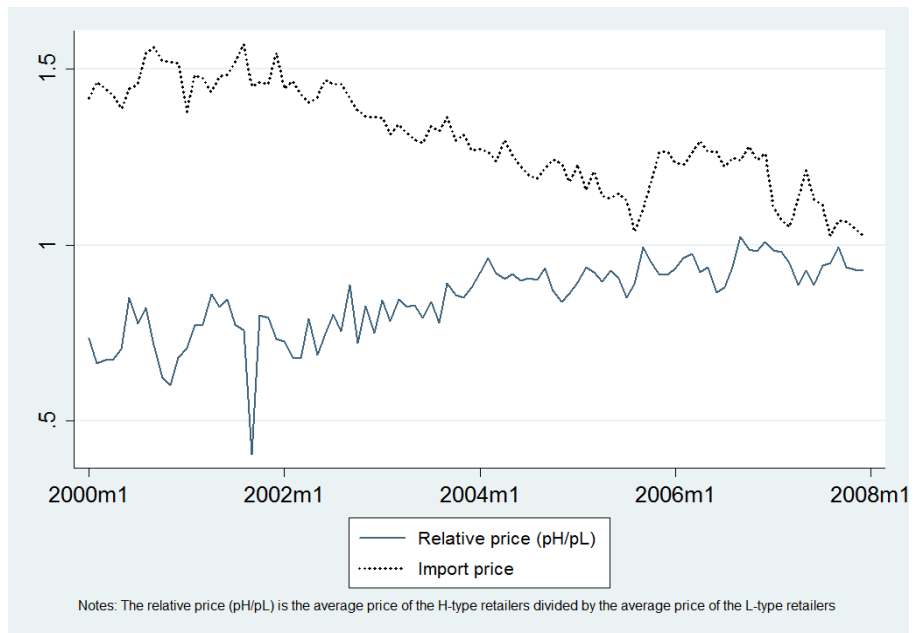


Figure 6: Import price and relative price of H- and L-type retailers

	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 5: Household sample information

the low-income group and the highest quartile the high-income group, respectively. Table 5 provides some stylized facts on these household types. In our sample, low-income households have more children⁴² with an average of 0.50 children per household, a lower education level of 5.5⁴³, 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 twice that of the low-income household. Their 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.

Next, we look at retail outlets visited by households with different income. Table 6 shows the relative importance of a selection of retailers for the different types of households. Households with a low per-capita income purchase relatively more goods and spend a greater share of their income in L-type retailers.⁴⁴ KiK, for instance, 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 0.23% for high-income households. In other words, households obviously do not purchase their goods in 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 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 different impacts on the final consumer prices of retailers and, thus, households.

for the first household member. Each additional person is assigned a value of 0.5, each child under the age of 14 a value of 0.3, respectively. Nevertheless, our results hold qualitatively for different specifications of the equivalence scales as Table B.5 in the Appendix shows. For a review on equivalence scales, see for example De Vos and Zaidi (1997).

⁴²According to the equivalence scales we use, children are defined as aged 14 or younger.

⁴³The official GfK data ranks education from 2 "basic schooling without vocational training" in six steps to 9 "university/college degree".

⁴⁴The share of units bought at each store is reported in the Appendix in Table B.1.

Retailer	Price level	Expenditure share			Retailer information		
		Low income	High income	Ratio	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 6: Retailer information and household expenditure shares, selection of full sample

3.3 Empirical strategy and results

We interpret changes in the import unit value as a change in import prices and estimate how these changes affect the prices of retailers and households. Generally, the data has the three dimensions: household (k), retailer (r) and time (t). Since we focus on apparel products that 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. We do not have sufficient observations for each household or retailer to distinguish different categories in the empirical analysis. Instead, we need to calculate the average price over all apparel categories. Consequently, 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). We then calculate the relative price $(p_H/p_L)_t$. In a final step, 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).

3.3.1 Retailers

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

$$p_t^r = p_t^i + \mathbf{D}' + \varepsilon_t^r, \quad (8)$$

where p_t^r is the product price of retailer r , p_t^i are import unit values and all prices are monthly averages. \mathbf{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 (8) in first differences and consider the logarithm of the prices. We add two lagged values of the import unit value to account for the stepwise adjustment to cost changes.⁴⁵ This yields the following estimation equation:

$$\Delta p_t^r = \sum_{j=0}^2 \alpha_j \Delta p_{t-j}^i + \sum_{j=0}^2 \beta_j (\Delta p_{t-j}^i * low) + \gamma_{low} low + \boldsymbol{\gamma}' \mathbf{D} + \varepsilon_t^r, \quad (9)$$

where the definition of the variables is the same as in (8). That is, Δp_t^r and Δp_t^i are the first difference of the logarithm of the price at retailer r and of the import price, respectively. 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 smaller 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 $\sum_{j=0}^2 (\alpha_j + \beta_j)$. Other variables influencing retailer prices, such as dummy variables for the respective stages of the ATC phase-out or a time trend, are captured by the vector \mathbf{D} .

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

⁴⁵With the adaption 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 et al. (2010), which show for the US that the main part of pass-through occurs in the first two quarters after an exchange rate with little further adjustments.

of lesser concern for our study.⁴⁶ The error terms of the regressions might be serially correlated. Hence, we consider this and report results for the Prais-Winsten estimator and in another specification included a lagged dependent variable. 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 nonstationary is rejected.⁴⁷ Therefore, all variables are in first differences to remove the nonstationarity of the import price.⁴⁸ 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 7 summarizes the results of regressions of equation (9). Except for column 1, all regressions include the interaction term. The regressions differ with respect to the added fixed effects (3), the estimator (4, 5, and 9), and whether we add a lagged value of the dependent variable (6). In (7) we use the original data and seasonally adjust it by inserting monthly dummy variables in the regression and (8) uses levels of all variables. In the basic regression, we confirm the incomplete pass-through of import price changes into consumer prices of about 24%. Distinguishing between retailers, the estimation results point to no price changes 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. Compared to the incomplete pass-through of L-type retailers, the results would be interpreted as zero pass-through of import price changes for H-type retailers. While this is a little surprising, we do not want to emphasize the exact value of the coefficients given the characteristic of the data. Nonetheless, as is clear from Table 7, there is a significant difference across types of retailers. For all but one regression, L-type retailer’s prices are affected significantly more by a change of the import unit value. The recent decline in import prices that we showed in Figure 6 is passed through to a much higher level for L-type retailers.

Retailers might differ with respect to the country where they import from. In order

⁴⁶We 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 remaining effects.

⁴⁷We thus do not consider the existence of a cointegration relation among these variables as relevant.

⁴⁸Confer the Appendix section B.3 for more detailed results.

	1	2 ¹	3	4	5	6	7	8	9 ²
	basic	interact	add FE	FE	RE	lagged	monthly	levels	PW-est.
				est.	est.	dep.var.	dummies		
	Dependent variable: Average price of retailer r (Δp_t^r)								
Observations	6,469	6,469	6,469	6,469	6,469	6,452	6,506	6,573	6,469
Adj. R2	0.001	0.002	-0.010	0.002	0.004	0.252	0.030	0.885	-0.008
F-Statistic	1.916			3.794					
Root MSE	0.339	0.339	0.341			0.293	0.318	0.252	0.294
All	0.240								
All: Prob > F	0.067								
H-type retailer		-0.138	-0.150	-0.150	-0.150	-0.293	0.288	0.173*	-0.181
H: Prob > F		0.410	0.382	0.379	0.379	0.165	0.086	0.010	0.298
L-type retailer		0.545*	0.530*	0.530*	0.530*	0.638*	0.263	0.669*	0.447*
L: Prob > F		0.005	0.007	0.006	0.005	0.007	0.086	0.000	0.010
Number of retailers				80	80				

*Statistically significant at the 5%-level.

¹Columns 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 7: Pass-through into average prices for L- and H-type retailers

	1	2 ¹	3	4 ¹	5 ²
	Δ	Δ	<i>Levels</i>	<i>Levels</i>	<i>PW – est.</i>
	Dependent variable: (H-type price / L-type price), $\Delta(p_H/p_L)_t$				
Variables ³					
Δp_t^{import}	0.153 (0.193)	0.143 (0.193)	0.103 (0.180)	0.122 (0.165)	0.139 (0.194)
Δp_{t-1}^{import}	-0.516* (0.219)	-0.451* (0.149)	-0.560* (0.227)	-0.588* (0.228)	-0.521* (0.194)
Δp_{t-2}^{import}	-0.099 (0.138)	-0.321 (0.164)	-0.143 (0.104)	0.089 (0.106)	-0.067 (0.155)
$(p_1/p_2)_{t-1}$		-0.453* (0.166)		0.366* (0.134)	
Constant			1.634* (0.073)	1.031* (0.221)	
Observations	93	93	94	94	93
Adj. R2	0.094	0.273	0.616	0.665	0.112
F-Statistic	2.123	3.318	45.470	49.970	3.287
Root MSE	0.075	0.067	0.066	0.062	0.067
Cumulative effect	-0.463	-0.629*	-0.600*	-0.376*	-0.448*
Prob > F	0.103	0.023	0.000	0.000	0.032

*Statistically significant at the 5%-level. Robust standard errors in parentheses.
¹ Columns 2 and 4: added lagged dependent variable. ² Prais-Winsten estimator.
³ Variables in differences and levels, respectively.

Table 8: Relative price of H- and L-type retailers and the import price

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, as can be seen in Table B.4 in the Appendix. 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 with only the price for Chinese imports as explanatory variable. To assume that imports from one country are homogeneous seems to be a less strong assumption. But again, the ranking of the pass-through rates remains identical.

Now we calculate the average price of all H- and L-type retailers in order to obtain the relative price $(p_H/p_L)_t$ for each period t . Figure 6 shows a clear negative correlation. That is, a decrease of import prices, instrumented by the import unit value, should lead

to an increase of (p_H/p_L) . We therefore regress $\Delta(p_H/p_L)$ on import price changes. Table 8 provides the estimation results. The lagged first-difference of the import unit value is statistically significant and has a value between -0.52 to -0.45 . More importantly, the cumulative effect of the first three lags, although not statistically significant in every case, confirms the predicted negative correlation. The corresponding increase in the relative price (p_H/p_L) is thus driven by a decrease of p_L .

3.3.2 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, respectively, 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 3.3.1, $p_t^{h,r}$ is the average price of purchases of household type h ($h = 1, 2$) at retailer r , p_t^i are import unit values and all prices are monthly averages. \mathbf{D} is a vector of additional control variables, $\varepsilon_t^{h,r}$ is the error term, and the subscript t refers to time. Again, we use first differences, consider the logarithm of the prices, and add two lagged values of the import unit value. This yields the estimation equation

$$\Delta p_t^{h,r} = \sum_{j=0}^2 \alpha_j \Delta p_{t-j}^i + \sum_{j=0}^2 \beta_j (\Delta p_{t-j}^i * low) + \gamma_{low} low + \boldsymbol{\gamma}' \mathbf{D} + \varepsilon_t^{h,r}. \quad (10)$$

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 $\sum_{j=0}^2 (\alpha_j + \beta_j)$. 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 more by changes in the import price. Table 9 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. 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 7 and 9, we observe that pass-through rates of

	1	2	3	4	5	6	7	8
Dependent variable: Average price of household group h at retailer r ($\Delta p_t^{h,r}$)								
Observations	10,594	10,594	10,594	10,594	10,594	10,594	10,594	11,051
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		
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
Number of groups							141	141
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		
Estimator	OLS	OLS	OLS	PW ¹	OLS	OLS	FE ²	RE ³

*Statistically significant at the 5%-level.
¹Prais-Winsten, ²Fixed effects, ³Random effects

Table 9: Pass-through into average prices of high- and low-income households

import price changes across households can be explained by two things. 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 importance 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 consumer prices when households are heterogeneous with respect to income. In the next section, we provide a theoretical model that explains this effect.

3.4 The Model

Theoretically, several potential explanations for differences in prices and pass-through rates across retailers emerge, for instance, markup adjustment, frequency of price adjustment, and local distribution costs.⁴⁹ As pointed out before, retailers also might sell different products, but this channel is not necessary for explaining differences in pass-through rates. In our model, we stress another important factor: An additional local service sold together with a good. This involves, for example, shop assistants providing advice to customers or retail environmental factors such as ambience. If two firms offer homogeneous imported products, then bundling this product with services is a means to differentiate the product from the competitor's product. The cost for providing the service adds to the import price and this form of product differentiation causes final consumer prices to differ. Given a shock to the import price, relative consumer price reactions are smaller for the bundle of good and service. The addition of the service thus dampens any shock to the import price, 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.⁵⁰

⁴⁹Also, the degree of competition in the two market segments may drive differences in prices and pass-through rates. But firms being able to sustain price differences implies a different willingness to pay for specific goods and hence certain degree of product differentiation. Thus, differences in the degree of competition cannot explain differences in the prices by itself, but only in combination with differences on the demand side.

⁵⁰Furthermore, 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

To make this point, we apply a simple model, following Shaked and Sutton (1982), in which two retailers sell a homogeneous imported good, but bundling the good with a service constitutes a form of product differentiation. Consider a market with two retailers, each distributing a simple good with a constant import price p^i . Both firms have the possibility to offer the product with a service. We will show that firms will always choose to differentiate their products, i.e. one firm will offer 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 δ in consumer valuation. Also, a lower brand image of the retailer distributing the good without a service may contribute to a lower quality perception of the unbundled good, but this is not necessary for the results derived from the model.

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

$$U(\theta, \delta, p_j) = \begin{cases} \delta\theta - p_b^r & \text{if } j = b \\ \theta - p_u^r & \text{if } j = u \\ 0 & \text{otherwise,} \end{cases} \quad (11)$$

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 are considered perfect substitutes. A consumer with a positive net utility of the good will choose the most preferred version of the good by trading off perceived quality against the price. The higher the gross valuation θ , the higher 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.⁵¹

a T-shirt of, say, "Adidas" is the T-shirt itself and this is produced abroad. Commercials and other marketing activities that establish the brand image of "Adidas" are not produced abroad. Instead, they are supplied locally. That is, this works exactly in the same way as our definition of services. Retailers who offer "Adidas" T-shirts thus sell a bundle of the basic shirt and some additional local service. As a consequence, prices in this retailer will be higher compared to retailers selling a "no-name" brand.

⁵¹Note that θ can also be interpreted as the marginal rate of substitution between income and quality (see Tirole, 1988). A consistent interpretation with our empirical observation is that higher θ corresponds

The marginal consumer indifferent between purchasing the bundled and unbundled good has gross valuation θ^* , which is given by

$$\delta\theta^* - p_b^r = \theta^* - p_u^r \Leftrightarrow \theta^* = \frac{p_b^r - p_u^r}{\delta - 1}. \quad (12)$$

The marginal consumer indifferent between purchasing the unbundled good and not buying has valuation θ^{**} , which is given by

$$\theta^{**} - p_u^r = 0 \Leftrightarrow \theta^{**} = p_u^r. \quad (13)$$

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

$$q_b = 1 - \frac{p_b^r - p_u^r}{\delta - 1}, \quad q_u = \frac{p_b^r - p_u^r}{\delta - 1} - p_u^r. \quad (14)$$

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 together with the good. 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. In the second stage, firms compete in prices.

Firms' profits are given as

$$\pi_b = (p_b^r - p^i - w) \left(1 - \frac{p_b^r - p_u^r}{\delta - 1}\right), \quad \pi_u = (p_u^r - p^i) \left(\frac{p_b^r - p_u^r}{\delta - 1} - p_u^r\right). \quad (15)$$

Starting with the second stage, equilibrium prices are

$$p_b^r = \frac{3p^i\delta + 2w\delta + 2\delta(\delta - 1)}{4\delta - 1}, \quad p_u^r = \frac{p^i(1 + 2\delta) + w + (\delta - 1)}{4\delta - 1}. \quad (16)$$

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

$$q_b = \frac{(2\delta - p^i)(\delta - 1) - w(2\delta - 1)}{(4\delta - 1)(\delta - 1)}, \quad q_u = \frac{\delta((1 - 2p^i)(\delta - 1) + w)}{(4\delta - 1)(\delta - 1)}, \quad (17)$$

to higher income for a household.

and profits are

$$\begin{aligned}\pi_b &= \frac{(2\delta(\delta-1) - w(2\delta-1) - p^i(\delta-1))^2}{(\delta-1)(4\delta-1)^2}, \\ \pi_u &= \frac{\delta((\delta-1) - 2p^i(\delta-1) + w)^2}{(\delta-1)(4\delta-1)^2},\end{aligned}\tag{18}$$

with $\pi_b > \pi_u$, if $w < (\sqrt{\delta} - 1)(p^i + \sqrt{\delta})$. 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.

Turning to stage 1, Table 10 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	$\frac{\delta((\delta-1) - 2p^i(\delta-1) + w)^2}{(\delta-1)(4\delta-1)^2},$ $\frac{(2\delta(\delta-1) - w(2\delta-1) - p^i(\delta-1))^2}{(\delta-1)(4\delta-1)^2}$
bundling good and service	$\frac{(2\delta(\delta-1) - w(2\delta-1) - p^i(\delta-1))^2}{(\delta-1)(4\delta-1)^2},$ $\frac{\delta((\delta-1) - 2p^i(\delta-1) + w)^2}{(\delta-1)(4\delta-1)^2}$	0, 0

Table 10: 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.

3.4.1 Pass-through of import price changes

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

$$\begin{aligned}\eta_{p_b, p^i} &= \frac{\partial p_b^r}{\partial p^i} \frac{p^i}{p_b^r} = \frac{3p^i}{3p^i + 2w + 2(\delta - 1)} > 0, \\ \eta_{p_u, p^i} &= \frac{\partial p_u^r}{\partial p^i} \frac{p^i}{p_u^r} = \frac{p^i(1 + 2\delta)}{p^i(1 + 2\delta) + w + (\delta - 1)} > 0.\end{aligned}\quad (19)$$

Consequently, a decrease of the import price results in retail price decreases for both firms. 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 consumer prices is higher for firm u , which is driven by the higher import price share for the unbundled good ($p^i/p_b^r < p^i/p_u^r$).

The price decreases relatively more for firm u : $\left(\frac{\partial p_b^r/\partial p^i}{p_b^r} < \frac{\partial p_u^r/\partial p^i}{p_u^r}\right)$. The derivative of the relative price (p_b^r/p_u^r) with respect to p^i is negative:

$$\frac{\partial (p_b^r/p_u^r)}{\partial p^i} = -\frac{\delta(4\delta - 1)(w + \delta - 1)}{(p^i(1 + 2\delta) + w + (\delta - 1))^2} < 0.\quad (20)$$

Decreasing import prices thus induce a larger proportional decrease of p_u^r relative to p_b^r , which results in an increase of (p_b^r/p_u^r) . That is exactly what we observe in the data: H-type retailers pass through import price changes to a lesser extent than L-type retailers, resulting in a decrease of the relative price.

3.4.2 Change in the valuation of the service

Consumers may assign different values to an additional service for different products. Advice by a shop assistant may be valued differently depending on the frequency with which a good is purchased or whether the fit of the product is of particular importance. For instance, suits are generally purchased less often than T-shirts and shop assistants might provide better help when it comes to the fit. In general, the valuation of the service determines only the magnitude of price effects, qualitative changes are independent of it. In particular, an increase of the valuation factor δ amounts to the bundled and unbundled

becoming more remote substitutes. This results in an increase of the price for the bundle:

$$\frac{\partial p_b^r}{\partial \delta} = \frac{2(1 - 2\delta + 4\delta^2) - 2w - 3p^i}{(4\delta - 1)^2} > 0, \quad (21)$$

while the price for the unbundled good increases (decreases) if w is relatively small (high):

$$\begin{aligned} \frac{\partial p_u^r}{\partial \delta} &= \frac{3(1 - 2p^i) - 4w}{(4\delta - 1)^2} > 0 \\ \text{if } w &< \frac{3}{4}(1 - 2p^i). \end{aligned} \quad (22)$$

The valuation of the service also determines the magnitude of changes in prices and markups following a cost shock. When bundled and unbundled good are remote substitutes, i.e. the consumer valuation factor δ is high, a decrease of the import price results in lower consumer price reductions (the price elasticities in equation (19) both decrease in δ). Nevertheless, the pass-through remains lower for the firm offering the bundle of product and service.

3.5 Conclusion

A substantial literature analyzes the role of local costs in explaining incomplete pass-through of import price shocks to consumer prices. In this chapter, we explicitly consider the price level of retailers and emphasize differences across retailers and households. We show that households purchase at different shopping outlets and do not pay identical prices for apparel products. We estimate that H-type retailers, which have a high price level, do not pass through changes in the import price. By contrast, import price changes are passed through to L-type retailers at a rate of 53% within three months. The relative price (p_H/p_L) responds with an increase of 0.46 – 0.63% given a one percent increase in import prices. As a consequence, the pass-through into consumer prices depends on the shopping behavior of households. We show how this behavior differs across households and thus leads to differential impacts of trade shocks. Trade induced changes in the import price are passed through to low-income households at a rate of 58%. By contrast, high-income households have a pass-through rate that is statistically not different from zero.

We then provide a theoretical model that is consistent with these observations. The model features a heterogeneous demand side and vertical product differentiation stemming from the possibility to bundle an identical imported good with services. This generates heterogeneous effects across retailers with respect to a change in import prices. Retailers who bundle a good with services pass through import price changes to a lesser extent. In addition, the ranking of the pass-through rates is independent of the valuation of the service, which might be different for specific products such as T-shirts or suits.

Our results thus point into the direction that price effects of changes in international trade barriers do not affect all households equally. Thus, in periods of price decreases, such as the ATC phase-out we consider, low-income households benefit relatively more. However, they may also be hurt more intensively by periods of import price increases.

4 Pass-through of producer price changes in different retail formats

Summary:⁵² In this chapter, we use product-level data for Germany to estimate the pass-through of producer price changes to final consumer prices. In particular, we are interested in different reactions across retail formats concerning the size and the speed of retail price adjustments. Therefore, we distinguish between two retail formats: discounters and supermarkets. We analyze the German ground coffee market and show that supermarkets have a higher price level and change their prices more often compared with discounters. We find that discount retailers pass through 37% of a producer price change, significantly more than the 23% for supermarkets. However, this does not result in differences in the speed of price adjustments across retail formats.

⁵²This chapter is based on a paper that is joint work with Janine Empen.

4.1 Introduction

In this chapter, we use product-level data for Germany to estimate the pass-through rate of producer price changes to final consumer prices. The degree to which a change in the producer price is reflected in a corresponding change in the consumer price is defined as the pass-through rate. In particular, we are interested in different reactions across retail formats concerning the size and the speed of price adjustments. Therefore, we distinguish between two retail formats, discounters and supermarkets, and analyze the German ground coffee market in the years 2000 to 2001.

The literature provides substantial evidence for incomplete pass-through of cost shocks, such as import or producer price changes, into consumer prices across countries and sectors (Campa and Goldberg, 2005, 2010). While the estimated coefficients differ in size across countries, for Germany, Campa and Goldberg (2010) estimate it to be around 21%. In other words, a 10% decrease in producer prices leads to a 2.1% decrease in consumer prices. This leaves a considerable part of the price change that is not passed through and needs to be explained. Using detailed product data, some sources for incomplete pass-through rates have been determined. The most important ones are the frequency of price adjustment (Gopinath and Itskhoki, 2010), mark-up adjustments by firms (Hellerstein, 2008), local distribution costs (Nakamura and Zerom, 2010), and the type of pricing contract between the manufacturer and the retailer (Bonnet et al. 2011). Especially local cost components can explain up to 50% of the incomplete pass-through of cost shocks to final consumer prices (Nakamura and Zerom, 2010; or Hellerstein, 2008).

The current study considers retailers that obtain their products from producers. Then, they add their own local costs and set their retail price for consumers.⁵³ We emphasize one crucial part of local cost components that retailers have to cover. That is, we consider retailers differing in the amount of additional services they supply. In the food retailing sector, possible services can be additional shop assistants, a broader product assortment, more cash points in order to reduce the waiting time for customers, or a sales area that is more ample. Indeed, service quality of retailers is frequently stated as influencing consumers' choices of their shopping stores (see, for instance, Tang et al., 2001; Gijsbrechts et al., 2008; Cleeren et al., 2010).⁵⁴ All these factors add to the producer price and are

⁵³In this study, the retail price is the price the consumer has to pay. So the terms "retail price" and "consumer price" have identical meanings.

⁵⁴Tang et al. (2001) consider service quality as "fixed benefit of shopping", Gijsbrechts et al. (2008)

locally supplied. Thus, they drive a wedge between the final consumer price of a retailer and the producer price. As a consequence, a 10% change of the producer price will imply a change of less than 10% of the consumer price, which is generally named incomplete pass-through. In Germany, the two dominant retail formats in the grocery market are supermarkets and discounters. These two retail formats pursue different strategies to attract customers. In contrast to supermarkets, the concept of discounters can be summarized as providing low prices, reducing the interior decoration of the shopping outlets to a minimum and serving a clearly defined small number of products (GfK, 2008; or Cleeren et al., 2010). In this chapter, we think of these factors as services. If such services are attached to an otherwise identical product, the final consumer price is higher. An identical change in the producer price is thus passed through to consumer prices differently, depending on the degree of services provided by supermarkets and discounters.

The discounter phenomenon originated in Germany and, here, discounters increased their market share from about 32% in 2001 up to 43% in 2007 (GfK, 2008). Discounters have become an important part of the grocery sector in other countries as well. In the last years, the number of discount stores in Europe has increased by approximately 30% to reach a number of 45,000 in 2010. Discounters now have market shares in the grocery sector ranging from 10% in Belgium, 19% in Austria to about 35% in Norway (see Planet Retail, 2006, as cited in Cleeren et al., 2010). These examples illustrate the importance of analyzing the effect of discounters on prices and price changes, and Germany provides the adequate environment for such a study.

We employ a data set of the Madakom GmbH, a former market research institute in Germany, at the Universal Product Code (UPC)-level for a sample of German retailers covering the years 2000 and 2001. We consider the category of ground coffee so we can use raw coffee bean prices as approximation of producer prices. Ground coffee is an appropriate category as it provides a relatively homogeneous product and the main ingredient, raw coffee beans, is internationally traded, not produced in Germany and thus needs to be imported by all producers. We first show that prices and the frequency of price changes differ across retailers. We assume that services, such as additional shop assistants or a broader product assortment, induce these price differences. For example, in the first week in the year 2000 a 500gr package of “Jacobs Krönung Mild” was sold

name it “fixed in-store benefits”, and Cleeren et al. (2010) see it as one possibility for supermarkets to differentiate themselves from discounters.

for DM 7.49 at a discounter belonging to the key account Edeka and for DM 7.99 at a supermarket of Rewe's retail network, another large German key account. Thus, this difference of DM 0.50 is attributed to the costs of additional services occurring in the supermarket. Then, we estimate to which degree changes in the producer price are passed through to consumer prices in different retail formats. In addition, we apply an error correction model to check whether the speed of price adjustments is identical for discounters and supermarkets.

Supermarket retailers have a broader product assortment, a higher price level and change prices more often compared to discounters. We then show that the pass-through of producer price changes to final consumer prices is incomplete and differs across retail formats. Stores belonging to the discount retail format have a significantly larger pass-through rate of 37% compared to 23% for supermarkets. In addition, we provide evidence that the speed with which producer price changes are transmitted into consumer prices does not differ significantly across retail formats. Differences in pass-through rates across retail formats are important in the ongoing debate on inequality and the prices paid by low-income households (see, e.g. Broda et al., 2009; Leibtag and Kaufmann, 2003). A recent study by the German market research institute GfK (2008) shows that in Germany low-income households, such as students, unemployed people or young families from the working class, have much higher expenditure shares at discounters. If the prices of these discount retailers include a lower amount of local cost components such as services, the pass-through rates of producer price changes are higher. As a consequence, low-income households are affected relatively more by price changes. This setting intensifies existing price differences and needs to be taken into account when measuring price differences and inequality. Broda et al. (2009) present a similar finding for the US. Finally, we provide evidence that the frequency of price adjustments differs across retail formats. This is essential for the discussion on nominal price rigidities, which is an important topic in macroeconomics (see, for instance, Eichenbaum et al., 2011). Due to their retail concept discount retailers change prices less often compared to supermarkets. So the presence of discount retailers affects the price rigidity at the consumer level.

Closely related papers to ours are Bonnet et al. (2011) and Leibtag et al. (2007). Bonnet et al. (2011) employ the same data set as this study but differ in two major aspects. First, they aggregate the data and do not use the UPC-level. More precisely, they define a product as one brand (e.g. Melitta) sold at one key account (e.g. Rewe).

By contrast, we make use of the UPC-level and define products by UPC-codes and consider the specific store that sells this product. Second, they use a structural model. In a reduced form Bonnet et al. (2011) estimate a pass-through rate of about 18%, comparable to the 25% we obtain if we do not distinguish between retail formats. In their structural model, however, the pass-through rates increase to about 50 to 60%. The structural model allows them to consider the effects of non-linear pricing strategies and two-part tariffs between wholesalers and retailers on pass-through. They conclude that pass-through rates increase, for instance, with resale price maintenance by 10% by reducing the double-marginalization problem. While their structural model provides valuable insights, it cannot be estimated with the number of products we obtain at the UPC-level. Therefore, we apply the reduced form approach and also highlight the role of different retail formats. In addition, we also analyze whether retailers differ in the speed of price adjustment. Leibtag et al. (2007) focus on the ground coffee sector in the US at the commodity, wholesale and retail price level. Using quarterly data from 2000 to 2004, they estimate pass-through to be 22% after six quarters for wholesale and retail prices. We carry out a similar analysis for Germany but consider a much more disaggregated level - we use weekly data. This is of particular importance when analyzing retail data, as promotional sales frequently occur on a weekly basis (von Cramon-Taubadel et al., 2006). Furthermore, our panel variable is more disaggregated: a single good sold in a specific store in one week. In contrast to Leibtag et al. (2007), we do not have wholesale prices at our disposal. Instead, we chose ground coffee as the product category for which approximations of the producer price can be made using the price of raw coffee beans.

Our contribution to the literature is twofold: First, studies on cost pass-through such as Bonnet et al. (2011), Leibtag et al. (2007), Nakamura (2008), Kim and Cotterill (2008), and Berck et al. (2009) perform their analysis without considering discount retail formats.⁵⁵ We differ from these papers in that we carry out the analysis at a more

⁵⁵Nakamura (2008) employs a wide U.S. sample of products on the UPC-level. She finds that 65% of price variation is common within one key account and concludes that the pass-through of manufacturer costs changes to retail prices is not the most important explanation for price variability. Kim and Cotterill (2008) find that cost pass-through rates for processed cheese are lower under collusion compared to Nash-Bertrand price competition. Berck et al. (2009) analyze the pass-through of corn, wheat and gasoline prices to retail prices of chicken and cereals in the U.S. for 2003-2005. They find significant differences in the pass-through rates depending on sales. The estimated pass-through rates are 17% for corn price changes and 30% for feed price changes to the net price of chicken. These estimates are about 50% larger compared to the ones using gross shelf prices. This again indicates the importance of accounting for

disaggregated level, as we are able to distinguish a single product at a single store. We show the substantial price and pass-through rate differences for discounters compared to supermarkets.⁵⁶ Second, we add to the growing literature on the interaction of discounters and supermarkets (for example, Cleeren et al., 2010; Gijsbrechts et al., 2008; González-Benito et al., 2005).⁵⁷ These studies generally consider the intensity of competition between discounters and supermarkets. Our study, however, considers one of the consequences of this competition, i.e. price adjustment. Fiercer competition among supermarkets would suggest that they adjust prices faster and to a higher degree. We show the contrary. Discounters are the ones that react more given a change in the producer price. We attribute that to additional services provided in supermarkets that reduce the price decreasing effect of lower producer prices. However, the speed of price adjustment does not differ significantly across retail formats.

The remaining chapter is structured as follows: In the next section, we present our data in greater detail and deduce some stylized facts on retail chains and their average prices. Section 3 first presents the results on the magnitude of pass-through rates and then on the speed of price adjustment. The results as well as their potential limitations are addressed in section 4. Finally, section 5 concludes.

sales.

⁵⁶There also exist studies on a more aggregated level, such as Bettendorf and Verboven (2000), who use price indices for their analysis. The authors study the Dutch market and find incomplete pass-through of the price of green beans to consumer prices. They conclude that costs other than coffee beans, such as labor costs and packaging costs are the dominant reasons for incomplete pass-through. Since additional service costs include, for instance, wages their finding supports our line of reasoning that these service costs induce incomplete pass-through rates.

⁵⁷Cleeren et al. (2010) classify competition within a format as intraformat competition and competition between supermarkets and discounters as interformat competition. They find it to be intense in both dimensions but fiercer among supermarkets. The appearance of discounters only affects a supermarket's profitability from two discount stores onwards. Gijsbrechts et al. (2008) provide an alternative explanation for multiple stop grocery shopping. Consumers not only take into account price differences but also other shopping benefits, including "in-store benefits" such as a store's service level. González-Benito et al. (2005) find higher intra- compared to interformat competition, too. They derive a two-step consumer shopping decision. First, it is based on the retail format and in a second step on the specific store, e.g. a consumer decides to shop at a discounter and then chooses to go to Penny.

4.2 Data and stylized facts

In this section, we start with a short description of the ground coffee market in Germany. Then, based upon a thorough introduction of the data at hand, we will show basic characteristics of the prices observed across retail formats, particularly, to what extent prices were altered during the period under observation and how long prices remained unchanged.

4.2.1 German ground coffee market

When a consumer buys a package of coffee at a retailer, it generally has passed through the two production steps growing and roasting (Richardson and Stähler, 2007). Coffee beans are grown in the southern hemisphere and the four major producers of coffee in 2000 to 2001 are Brazil, Vietnam, Colombia, and Indonesia.⁵⁸ These coffee beans are internationally traded and the two largest importing countries in 2000 are the U.S. and Germany, with about 24 million and 14 million imported 60kg bags, respectively. This implies a market share of 16% for Germany.⁵⁹ The second production step is roasting the coffee beans. The German roasting market is dominated by a few firms, with Jacobs and Tchibo/Eduscho⁶⁰ having the highest market shares in 1999 of 27% and 24%, respectively (Liening, 2000, as cited in Koerner, 2002). Finally, the roasted coffee is sold to retailers and then to consumers.⁶¹ In Germany, average coffee consumption was about 6.79kg per capita in 2010.⁶²

While there are a couple of other factors determining the price of ground coffee, such as wages or transportation costs, Draganska and Klapper (2007) pointed out, that green beans are the major force for driving marginal costs. We follow their reasoning and thus assume that green bean prices approximate producer prices, and we abstract from other potential factors that might influence producer prices.

⁵⁸Source: ICO (a), online database.

⁵⁹Source: ICO (b), online database.

⁶⁰The producers Tchibo and Eduscho merged in 1997 but still their products are sold with the two distinct brand names. We, thus, follow other studies of the German ground coffee market (Draganska and Klapper, 2007; Bonnet et al., 2011) and consider these brands as being different.

⁶¹Note, that some firms, for instance Tchibo, use partly own stores to sell their coffee (see, for example, Feuerstein, 2002), which reduces the dependence of roasting firms on retailers. However, the data does not cover sales for these stores, so we are not able to analyze potential price differences at own stores and other retailers.

⁶²Source: ICO (c), online database.



Figure 7: Adjusted price (in DM/pound) of raw green beans

4.2.2 Data set and data processing

In order to show how producer price changes are passed through to consumer prices, we need to adjust green bean prices carefully. More precisely, we use the composite daily price in cents per pound of raw green beans obtained from the International Coffee Organization (ICO) via Datastream. We then follow Draganska and Klapper (2007) and adjust this price with the Dollar-Deutsche Mark exchange rate, deduct a 15% loss in volume due to roasting of the raw beans and add the German coffee tax of DM 2.16 per pound.⁶³ As can be seen from Figure 7, despite the large fraction of taxes, we observe a substantial decrease in the adjusted price of raw green beans from over DM 4 in the first weeks of 2000 to roughly DM 3.20 in late 2001. So, within two years the approximated producer price is reduced by roughly 20% and the question is to what extent and how rapidly these cost savings were passed through to final consumer prices.

Consumer prices at the UPC-level were collected by the Madakom GmbH on a weekly

⁶³Throughout the analysis we keep the notation of Deutsche Mark (DM). Recall, however, that in 2000 and 2001 the exchange rate between DM and Euro was fixed at 1.9558 DM/Euro.

basis from 2000 to 2001 in 200 retail stores located throughout Germany, the world’s second largest coffee market (Koerner, 2002). Within this sample, we concentrate on the five biggest key accounts in our sample: Edeka, Markant, Metro, Rewe, and Tengelmann.⁶⁴ These key accounts capture about 93% of the sales in our data. Besides Rewe, all these key accounts maintain supermarket and discount stores. Edeka, for instance, has stores named Edeka that represent the supermarket segment. Netto, on the other hand, is the name of Edeka’s discounter stores.⁶⁵ On the brand side, we focus on Tchibo, Eduscho, Melitta, Jacobs, Onko, Dallmayr, and Idee. Altogether, these brands account for about 88% of all sales in each key account. As shown by Bonnet et al. (2011), the interaction of producers or wholesalers and retailers influences the pricing strategies, but this is not the focus of the current study. Therefore, the producer price for all these brands is identical and is approximated by the adjusted green beans price. Nevertheless, we include brand dummies in our empirical analysis to take into account brand-specific effects on the pass-through rate and the speed of price adjustment.

In the following, we restrict our data set to packages of 500gr. With a share of 81% of the sales, this packaging type is by far the most common one on the German market. It also enables us to focus on ground coffee only, and we have thus not included other products, such as instant coffee or espresso, which are sold in smaller packages and differ substantially in terms of prices.

Promotional activities, such as price discounts, are frequently used at the retail level. According to the often applied definition of Hosken and Reiffen (2004), promotional prices are “temporary reductions in retail prices that are unrelated to cost changes” (p.145). In other words, we need to define a real or regular price and its deviations in order to exclude

⁶⁴Unfortunately, ALDI and Lidl, with 4200 and 2900 stores, respectively, in 2007 the largest discounters in Germany (GfK, 2008), are not included in our data set. We share this shortcoming with all other studies (e.g. Bonnet et al., 2011; Draganska et al., 2010). However, this is not a major concern. As ALDI and Lidl generally do not sell branded products but rather own or no-name brands, we would not be able to compare identical products across different key accounts.

⁶⁵This restriction is important. Price differences across retailers might stem from other factors as well. Models with heterogeneous retailers imply price differences which are based on productivity differences (Raff and Schmitt, 2011). Retailers that distribute products more efficiently will have lower costs. Compared to single retailers these efficiency gains are more pronounced for larger retail chains as they invest more in technology (Basker, 2007; Foster et al., 2006; or Doms et al., 2004). However, in this study we only consider supermarkets and discounters which are actually part of a larger key accounts such as Rewe or Tengelmann and do not include single shop retailers. Thus, the effect of single store retailers does not influence our results.

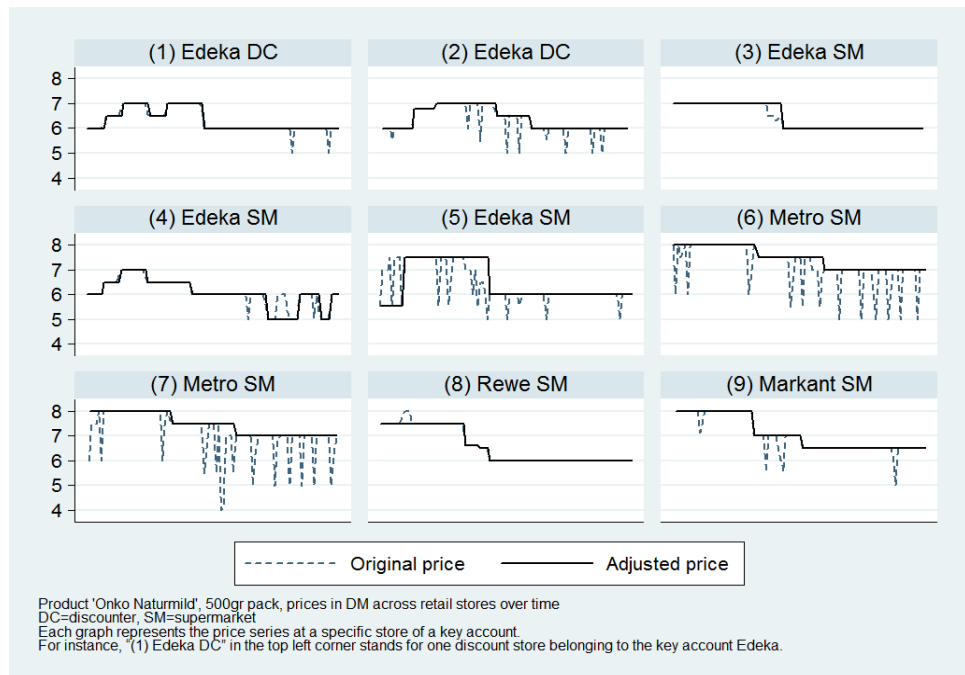


Figure 8: Original and adjusted retail prices for a selection of stores

promotional prices from the analysis.⁶⁶ We define regular prices as prices not having been altered for four consecutive weeks. Promotional prices are price reductions exceeding 5%. Promotional prices can only last for four weeks, otherwise we define them as long-term price reductions. We obtain our adjusted price series by replacing promotional prices by the regular prices that were valid the week before the item was on sale.

Figure 8 provides an example for the product “Onko Naturmild, 500gr” across retailers and formats. Each of the nine graphs represents the price series at a specific store of a key account. For instance, “(1) Edeka DC” in the top left corner stands for one discount store belonging to the key account Edeka. The brighter dashed line shows the original price series including all discounts. The black solid line represents the adjusted “regular” price at a store. We see that promotional activities are seldom used in discount stores in contrast to supermarkets. Furthermore, the adjusted prices are relatively stable and do change less frequently. For instance, as we see in the bottom right corner of Figure

⁶⁶Retailers might use price discounts strategically in response to a producer price change. We further discuss this aspect in section 4.4.

8, “(9) Markant SM” a supermarket store of the key account “Markant” changes prices twelve times in the original price series.⁶⁷ If we calculate the regular price, this reduces to two adjustments of the regular price. In addition, we observe that promotional price reductions do not need to be uniform across stores of the same retail format of one key account. For instance, “(4) Edeka SM” and “(5) Edeka SM” are both supermarket stores of the key account Edeka. The original price moves almost one to one with the adjusted price in the store represented by “(4) Edeka SM”. By contrast, the original price series shown in the store “(5) Edeka SM” exhibits several price promotions that are filtered out for the adjusted price series. One possible explanation for differences in promotional price reductions and price levels for retail stores of the same format within the same key account might be the geographical location of a retailer. Our data set includes a variable that defines a relatively heterogeneous geographical region.⁶⁸ However, it covers only a small number of retailers within the same region. For instance, about 63% of all observations belong to stores that share a region with two or fewer other retail stores. Therefore, we do not focus on price differences within one region. In the empirical analysis, however, we account for this and include regional dummies.

4.2.3 Stylized facts of price formation across retail formats

First, we turn to the description of prices observed in the data set. In order to describe retail prices over time, we distinguish between two major characteristics: current price levels and price movements.

Table 11 shows that the average price, the sales area and the number of products sold by discounters are smaller compared to supermarkets. For instance, the discounters operated by Edeka have an average price of DM 7.15 per 500gr package of coffee, sell 25 different UPCs for ground coffee, the average store is equipped with two cash points, and its sales area is $437m^2$ large. Edeka’s supermarkets, on the other hand, charge higher prices, DM 7.80 on average, and with 56 UPCs they offer a broader set of products. In

⁶⁷Note that a promotional price reduction is counted twice as a price change. First, when the price is reduced to its promotional level, and second, when the price switches back to its old price level. Counting promotional price reductions as one price change still results in six price changes in this example.

⁶⁸That is cities (e.g. Freiburg) as well as districts (e.g. Unterfranken) and federal states (e.g. Thüringen) are included in one variable. So in some cases we know that retail stores are located within the same city. In other cases, however, this variable only tells us that retailers are located within the same federal state.

Key account	Format	all prices	Average of				UPCs	Number of	
			prices no PA*	sales area	cash points	stores		obs.	
Edeka	DC	7.15	7.20	437	2.0	25	5	8,851	
	SM	7.80	8.01	793	2.8	56	24	73,112	
Markant	DC	6.15	6.18	250	4.0	9	1	581	
	SM	8.09	8.31	807	3.4	51	8	21,967	
Metro	DC	6.94	7.05	500	2.0	15	1	1,117	
	SM	7.76	7.96	1,092	4.2	50	9	28,662	
Rewe	SM	7.77	7.83	863	3.3	43	12	30,368	
Tengelmann	DC	6.59	6.67	587	2.9	21	16	20,403	
	SM	8.01	8.20	831	3.3	52	24	58,370	
Others	DC	7.08	7.10	583	3.0	31	5	7,491	
	SM	7.98	8.11	947	3.6	55	14	37,779	
All	DC	6.82	6.89	544	2.8	23	28	38,443	
	SM	7.90	8.07	867	3.3	52	91	250,258	
Average	All	7.75	7.91	791	3.2	45			

*PA = promotional activity
DC = Discounter, SM = Supermarket

Table 11: Average prices, sales area, number of cash points, UPCs, stores, and observations

addition, if we calculate the average price for ground coffee products excluding sales with promotional prices such as a price discount, the gap between prices across retail formats increases. Comparing columns 3 and 4, we see that discounter prices only slightly increase by DM 0.05 in the case of Edeka in contrast to its supermarkets' prices that are raised by DM 0.21. Overall, supermarkets price their coffee products DM 1.08 higher than discounters and the price gap increases, if the promotional prices are excluded.

Table 12 shows the evolution of the average prices and their differences. The producer price of coffee dropped by 17.6%, from DM 3.97 in the first quarter of 2000 to DM 3.27 in the last quarter of 2001. In the same period, final consumer prices were reduced by less

- on average by 3.8 %. The reduction differs substantially across retailers. Discounters generally lowered prices by more. For Tengelmann, for instance, prices in the discounter section dropped on average from DM 6.85 to DM 6.50, implying a decrease by 5.1% relative to 0.7% in its supermarket section, and for Edeka it is 4.7% relative to 3.8%. The last two columns of Table 12 indicate that in all key accounts the relative difference between prices paid at supermarkets compared to discounters increased. In the first quarter of 2000 prices at discounters were on average 13.7% lower. In the last quarter of 2001, this gap increased to 15.3%. Besides the producer price, final consumer prices include markups, transportation costs, and additional local cost components such as services. Given a price decrease of the producer price, the share of other components in the consumer price rises, pronouncing existing price differences. The observed increasing gap between prices paid at discounters relative to supermarkets thus supports the argument that consumer prices at supermarkets include other cost components to a higher degree compared to discounters.

Besides the actual price level, the frequency of price adjustments is another important channel for price transmissions (Gopinath and Itskhoki, 2010). Table 13 shows that discounters change prices less often than supermarkets. Here, we calculated the average number of price changes and the duration of a price spell in each store with and without promotional activities. On average Edeka's discounter section has 8.2 price changes per product within the time period of our sample. Its supermarkets exhibit 12.4 price changes. Not surprisingly, if we exclude changes due to promotional activities, the numbers decrease substantially to 2.1 and 2.4, respectively, for Edeka. In other words, if a product was sold in a store in each week within the two years covered by our data, its price has been changed only 2.1 times, slightly more than once a year.⁶⁹ Stores belonging to the discounter section of the key account Tengelmann change prices 2.7 times and thus more often than supermarket stores of the same key account that have a frequency of

⁶⁹These values generally fit into other studies' findings. Nakamura and Steinsson (2008) report that excluding promotional activities the duration of consumer prices in the U.S. is in between 8 to 11 months. For France, Baudry et al. (2004) find average price durations for food of 5 months and prices being less often changed in discounters. The same pattern holds for Italy, with an average price duration of 5 month for unprocessed food goods and larger retailers changing prices more often (Veronese et al., 2005). For Germany, Hoffmann and Kurz-Kim (2006) find a much longer duration and large heterogeneity for processed food ranging from 6 to up to 48 months. The discrepancy to our results might be explained in that we focus on one product group only, coffee, while the other studies consider a wider range of goods. The large heterogeneity across goods found by Hoffmann and Kurz-Kim (2006) supports this view.

Consumer Prices						
Key account	Format	Average price			Relative price difference DC vs. SM	
		1. quarter 2000	4. quarter 2001		1. quarter 2000	4. quarter 2001
Edeka	DC	7.42	7.07	-4.7%	-9.1%	-9.9%
	SM	8.15	7.85	-3.8%		
Markant	DC	6.22	5.98	-3.9%	-25.4%	-26.9%
	SM	8.33	8.17	-1.9%		
Metro	DC	7.71	6.66	-13.7%	-4.2%	-15.4%
	SM	8.04	7.86	-2.2%		
Rewe	SM	7.95	7.60	-4.4%		
Tengelmann	DC	6.85	6.50	-5.1%	-17.0%	-20.7%
	SM	8.26	8.20	-0.7%		
Others	DC	7.16	6.95	-3.0%	-12.2%	-11.0%
	SM	8.16	7.81	-4.4%		
All	DC	7.04	6.72	-4.5%	-13.7%	-15.3%
	SM	8.16	7.93	-2.8%		
Average	All	7.87	7.58	-3.8%		
Producer Price						
Adj. price of coffee beans [†]		3.97	3.27	-17.6%		

DC = Discounter, SM = Supermarket
[†]including tax and adjusted for exchange rates and losses due to roasting

Table 12: Average prices and relative price differences over time

Key account	Format	Average number of price changes		Average duration of a price spell		Obs. indicating PA*	
		incl. PA*	excl. PA*	incl. PA*	excl. PA*	total	ratio
Edeka	DC	8.2	2.1	7.7	18.9	300	0.16
	SM	12.4	2.4	4.0	11.5	874	0.29
Markant	DC	6.1	2.2	9.1	18.3	49	0.08
	SM	12.0	2.1	4.2	12.9	714	0.25
Metro	DC	1.2	0.9	33.8	26.8	340	0.30
	SM	16.3	2.8	3.7	12.5	789	0.24
Rewe	SM	10.0	2.9	5.4	11.9	537	0.20
Tengelmann	DC	9.3	2.7	6.0	12.8	313	0.25
	SM	6.9	1.4	5.9	15.6	537	0.22
Others	DC	4.5	1.8	9.0	15.8	191	0.13
	SM	10.6	2.2	4.2	11.6	666	0.25
All	DC	7.7	2.3	7.0	14.8	280	0.21
	SM	10.7	2.2	4.5	12.6	686	0.25
Average	All	10.4	2.2	4.7	12.9	591	0.24

*PA = promotional activity
DC = Discounter, SM = Supermarket

Table 13: Average number of price changes and duration of price spells per store

1.4. This also holds for Markant but the pattern is reversed for Edeka and Metro. On average across retail formats, discounters change prices less often than supermarkets, if we include promotional price changes. Given that supermarkets generally pursue a more distinct Hi-Lo pricing strategy⁷⁰, excluding promotional prices results in an almost equal number of price changes across the two retail formats.

However, the duration of unchanged prices is generally larger for discounter stores, even if price promotions are accounted for. In the case of Edeka it is 18.9 consecutive observations for discounters compared to 11.5 for supermarkets, if we exclude price changes due to promotional activities. The last column of Table 13 shows the ratio of all observations indicating any promotional activity per store. We see that promotional activities

⁷⁰A retailer pursuing a Hi-Lo pricing strategy has relatively high regular prices but frequently uses promotional discounts to lower its retail prices (see, for instance, Popkowski et al., 2004).

are intensively used by supermarkets but rather seldom occur for discounters in the key accounts Edeka and Markant. An average store of Edeka’s discounter format has 16% of its observations indicating some promotional activity in contrast to 29% for the average supermarket.⁷¹

Based on the stylized facts presented above, there are two competing hypotheses as to why pass-through rates of producer price changes might be higher or lower in discounters and supermarkets. Table 11 shows that discounters carry fewer products, have smaller sales areas, and fewer cash points. Table 12 and Table 13 indicate that discounters offer lower prices and prices hold for a longer time period. Given a producer price change, two effects emerge. First, supermarket’s higher final consumer prices contain a local cost component such as costs for a larger product assortment range that should reduce the pass-through rate. On the other hand, supermarkets seem to change prices more often, even though we adjusted for promotional price changes, compared to discounters, which try to maintain the same price for a longer time. For the U.S., Gopinath and Itskhoki (2010) report that the frequency of price adjustment is positively correlated to the pass-through rate. So, this second effect should increase the pass-through rate for supermarkets. Depending on which effect dominates, pass-through rates of producer price changes can be larger or smaller for discounters. We analyze this empirically in the next section.

4.3 Empirical analysis

Retail pass-through can be characterized with respect to two dimensions: the size of the pass-through rate and the speed of the price adjustment following a producer price change. In a first step, we estimate pass-through rates with a reduced form approach. Then, we analyze the speed of price adjustments with an error correction model (ECM). Both dimensions of pass-through will be evaluated with regard to the effects of retail

⁷¹One outlier in Table 13 is Metro’s discounter section. Not only is the duration of prices higher than in any other format, it also decreases when we exclude promotional activities. In the data several of its prices are indicated as being sold in combination with a promotional activity although the price remains unchanged. Of these promotional activities, a high percentage is “display” and not price reductions. “Display” is unrelated to price reductions. So this marketing instrument simply shows products at an exposed place to increase sales. Furthermore, although the observations are marked as belonging to the discounter format we are not aware of any discounter in the Metro network. Therefore, we exclude these observations from our empirical analysis.

format. While other studies on pass-through generally apply either the reduced form approach or an ECM, we think that performing both approaches is valuable. A reduced form approach estimates how much the consumer price changes given a decrease in the producer price. The ECM, by contrast, determines empirically how fast the producer price change is passed through to the consumer price. Furthermore, in the ECM a long-term adjustment rate can only be assessed if a cointegration relationship exists. Whether or not two variables are cointegrated also depends on the time horizon. So one possible reason as to why some retail price series do not show a cointegrated relationship with the producer price can be attributed to the restricted time period of two years in our data set. Therefore, we adopt both approaches in our analysis.

4.3.1 Pass-through estimation

As described in the previous section, we use consumer price data for the German ground coffee sector and approximate producer prices using the adjusted price of raw green beans. We use an estimation equation motivated by several other pass-through studies (e.g. Campa and Goldberg, 2005; Gopinath and Itskhoki, 2010). More precisely, we estimate

$$\Delta p_{jt}^r = \sum_{i=0}^5 \alpha_i \Delta p_{t-i}^w + \sum_{i=0}^5 \beta_i (\Delta p_{t-i}^w * DC) + \gamma_{DC} DC + \boldsymbol{\gamma}' \mathbf{D} + \varepsilon_{jt}^r. \quad (23)$$

Here, Δp_{jt}^r is the first difference of the logarithm of the price of product j at retail store r at time t , Δp_{t-i}^w denotes the first difference of the logarithm of the producer price, which is identical across retailers. The dummy variable DC equals 1 if retail store r is classified as a discounter. We add five lags in order to account for a possibly slow adjustment of final consumer prices.⁷² We performed unit-root tests for all variables.⁷³ The producer price is a nonstationary time series. We therefore write our estimation equation in first differences. The total pass-through of producer price changes for a supermarket is, thus, given by $\sum_{i=0}^5 \alpha_i$ and for a discounter it amounts to $\sum_{i=0}^5 (\alpha_i + \beta_i)$. If $\sum \beta_i > 0$, then the pass-through rate is larger for discounters. Additional control variables are, for instance, regional dummies, retailer and brand fixed effects, and a dummy variable for the location

⁷²We estimated the pass-through rates for 1 up to 11 lags, respectively. As the main part of the adjustment occurred up to the fifth lag we included five lagged values in our regressions.

⁷³Results are presented in the Appendix in Table C.1 and Table C.2.

of a store in cities exceeding 100,000 inhabitants. These variables are included in the vector \mathbf{D} , and ε_{jt}^r represents the error term. Store, key account, and brand fixed effects control for time invariant characteristics such as the location of a store or different pricing strategies for a key account or brand. Brand-key account fixed effects take into account specific arrangements or differences in market power in price negotiations between a brand producer and a specific key account. As illustrated in the example in Figure 8 above, the weekly scanner data for the time period under observation does not show any obvious sign of a seasonal pattern. However, there might be an impact of some weeks due to holidays or other time specific influences, but these should most reasonably be considered as uniform across products. So we decided to include weekly dummies in our regression and do not seasonally adjust each price series.

Table 14 summarizes our results. In the first two columns we exclude the interaction term in order to calculate an average pass-through rate across all retailers. The remaining specifications differ with respect to whether we include additional fixed effects (3 and 4), cluster the error terms by key account (5) or by key account and its specific format (6) or if we use different estimators (7 and 8). The rows “All” and “Supermarket” then show the cumulative effect of the α_i ’s, the row “Discounter” gives the cumulative effect of the α_i ’s and β_i ’s. The respective columns below provide the result of an F-test of the joint significance of the coefficients.⁷⁴

Column 2 shows that for all retailers together the pass-through of producer price changes to final consumer prices is incomplete and the sum of the α_i ’s amounts to 0.25. In other words, a 10% decrease of the producer price leads to a corresponding decrease of the consumer price of 2.5%, implying a pass-through rate of 25%. The F-test shows that these coefficients are jointly significantly different from zero. If we distinguish retail formats, we see in columns 3 to 8 that supermarkets pass through 23% compared to 37% for discounters. The sum of the β_i ’s amounts to about 0.14 and captures the influence from the interaction of the producer price and the retailer being a discounter. Thus, discount retailers pass through a significantly larger fraction of producer price changes to their final consumer prices. Changing the estimator, clustering the error term, adding more fixed effects to capture brand or store specific effects does not alter the coefficients. The fixed effects for the key accounts and brands do not show any consistent differences

⁷⁴More detailed results on the respective coefficients are presented in the Appendix in Table C.3.

Dependent variable	1	2	3	4	5	6	7	8
	Price of product j at retail store r (Δp_{jt}^r)							
Observations	55,437	55,437	55,437	55,437	55,437	55,437	55,437	55,437
Adj. R2	0.002	0.015	0.016	0.016	0.016	0.016	0.016	0.018
F-Statistic	3.42	7.23	7.49	6.55				
Root MSE	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
All	0.125*	0.254*						
All: Prob > F	0.000	0.000						
Supermarket								
($\sum \alpha_i$)			0.226*	0.227*	0.227	0.227	0.225	0.226*
SM: Prob > F			0.000	0.000	0.060	0.051	0.051	0.019
Discounter								
($\sum \alpha_i + \beta_i$)			0.374*	0.374*	0.374*	0.374*	0.374*	0.374*
DC: Prob > F			0.000	0.000	0.009	0.002	0.002	0.000
Interactions								
F-Test (joined)			13.1	13.1	13.2	173.2	169	1038.2
Prob > F			0.000	0.000	0.014	0.000	0.000	0.000
# of groups							712	712
Included:								
regional dummies	yes	yes	yes	yes	yes	yes	yes	yes
weekly dummies		yes	yes	yes	yes	yes	yes	yes
Fixed effects								
key account		yes	yes	yes	yes	yes		yes
brand		yes	yes	yes	yes	yes		yes
store		yes	yes	yes	yes	yes		yes
key account-brand				yes	yes	yes		
clustered					yes#	yes/	yes/	yes/
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	FE	RE
#clustered by key account								
/clustered by key account and its specific format (discounter and supermarket)								
$p < 0.05$, SM = Supermarket, DC = Discounter								

Table 14: Pass-through estimation by retail format

across key accounts or brands and neither does the dummy variable for cities exceeding 100,000 inhabitants.

We also performed several other robustness checks.⁷⁵ In particular, the magnitude of our results seems to be sensitive to the seasonal adjustment method applied. If we seasonally adjust each price series separately with weekly time dummies (column 1), we do not measure a significant pass-through rate for discounters. Nevertheless, their point estimate is still larger compared with supermarkets. On the other hand, if we do not seasonally adjust at all (column 2), the pass-through rate of the discounters is significantly larger again and amounts to about 23%. As pointed out before, though, the individual price series do not show a seasonal pattern, so we decided to include weekly dummies to capture seasonal influences. Adding a full set of monthly time dummies (column 3), increases the magnitude of pass-through rates to 33% for supermarkets and 47% for discounters but does not affect the ranking. Incorporating a lagged value of the dependent variable (column 4) leaves our results unaltered. If we exclude all price series that do not have any price change within our time period (column 5 thus excludes 47 out of the total of 712 price series), the results again remain almost unchanged: Discounters still pass-through a higher percentage than supermarkets. We also checked whether our adjustment of the coffee price affects the results (column 6). While the magnitude of the pass-through rate seems to be sensitive to this adjustment, the ranking is not. In our final check, we perform the regression in levels and include a lagged value of the dependent variable to correct for autocorrelation in the error terms (column 7). We obtain the same picture: Supermarket prices react less to changes in the producer price compared to discounters.

4.3.2 Speed of retail price adjustments

We investigate the speed of price adjustments in two steps: First, we estimate an error correction model (ECM) to obtain the adjustment coefficients. How fast do retailers respond to producer price changes? Second, we carry out an auxiliary regression to determine which parameters influence the speed of the retail pass-through. Here, the effect of the specific retail format on the speed of price adjustments is of particular interest.

⁷⁵Results are presented in the Appendix in Table C.4.

Fitting an error correction model, in turn, involves four steps. First, we evaluate the nonstationarity of the price. If the price series are integrated of order one ($= I(1)$), we can proceed to the second step, which is to estimate the long-run relationship to obtain the residuals. Third, we test whether the residuals are stationary, implying that a cointegration relationship exists (Engle and Granger, 1987). Finally, we estimate the ECM. The data set contains 712 different retail price series, thus, steps one through four have to be repeated 712 times. Out of all retail price series, 47 do not contain any price changes. Consequently, these price series are not $I(1)$. All but four of the remaining retail price series, as well as the producer price are $I(1)$. A cointegrated relationship exists in 50% of the price series. The non-cointegrated retail price series show only minor or no price changes. Thus, they do not share a cointegrated relationship with the producer price. Finally, the coefficients are estimated using the equation

$$\Delta p_{jt}^r = \delta + \lambda_j^r ec m_{j,t-1} + \sum_{i=0}^5 \alpha_{ij}^r \Delta p_{t-i}^w + \varepsilon_{jt}^r. \quad (24)$$

As in the previous analysis, Δp_{jt}^r denotes the first difference of the logarithm of the retail price of retailer r for product j in period t , Δp_{t-i}^w is the first difference of the logarithm of the producer price. If no cointegrated relationship exists, equation (24) is estimated without the long-term adjustment ($\lambda_j^r ec m_{j,t-1}$) (Bahmani-Oskooee and Payesteh, 1993), in order to obtain the contemporaneous price adjustments.⁷⁶

Two coefficients are of particular interest, the long-term adaption to distortions of the equilibrium (λ_j^r) and the short term or contemporaneous reactions (α_{ij}^r).⁷⁷ The short-term reactions α_{ij}^r are predominantly insignificant (94%), indicating that there is almost no significant reaction of retail price changes to changes of the producer price within the same week and 4 weeks following the change of the producer price. The long-term reaction on the other hand is significant on a 5% significance level in 86% of the cointegrated price series. On average, the estimated λ_j^r 's from the cointegrated price series equal -0.206. In other words, in all following weeks the distortions between the producer and the retail prices are reduced by 20.6%.

Next, we consider whether the speed of price adjustment differs with respect to retail

⁷⁶We tested for asymmetric price transmission. Those effects were statistically insignificant.

⁷⁷In line with equation (23), five lags of the producer price are included in the model.

	Supermarkets	Discounters	Total
Cointegration	310 (53 %)	46 (35 %)	356
No Cointegration	272 (47 %)	84 (65 %)	356
Total	582	130	712

Table 15: Existence of cointegration by retail format

formats. As a long term price adjustment process can only be assessed if a cointegrated relationship exists and equals zero if there is no such relationship, we first analyze whether the existence of a cointegration is influenced by the retail format. As shown in Table 15, out of 582 price series originating from a supermarket, 310 price series are cointegrated with the producer price series. The share of cointegrated price series is higher for the supermarkets than for the discounters.

If a cointegrated relationship exists, we can evaluate the speed of adjustment. The lower are the estimated coefficients, the quicker is the adjustment process. Histograms of the estimated parameters by retail format are depicted in Figure 9. The estimated coefficients are both skewed to the left and the parameters for the supermarkets are even more skewed. However, the average observed parameters are -0.21 for the discounters and -0.20 for the supermarkets, meaning that each week following a change in the producer price, retail prices are adjusted by 21% in discounters and by 20% in supermarkets. In order to determine whether the retail format significantly influences the speed of price adjustment, we carry out an auxiliary regression given in equation (25). In only half of the price series can a cointegrated relationship be determined; otherwise the long term adoption rate equals 0. Thus, we adopt a Tobit model with an upper bound at zero. The model can be expressed in terms of the latent, non-observable variable λ_j^{r*} (see Baum, 2006):

$$\begin{aligned}
\lambda_j^{r*} = & \rho + \theta * \text{discounter} + \sum_{c=2}^5 \delta_c * \text{key account}_i + \sum_{b=2}^7 \tau_b * \text{BRAND}_i \\
& + \sigma_1 * \text{big city} + \sigma_2 * \text{medium city}
\end{aligned} \tag{25}$$

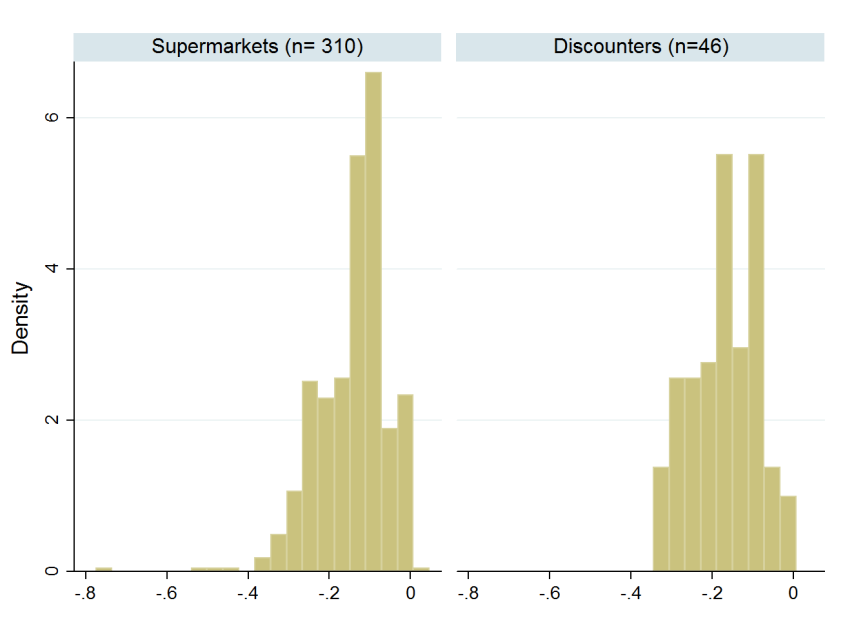


Figure 9: Histogram of the long-term adjustment parameters by retail format

$$\lambda_j^{r*} = \begin{cases} 0 & \text{if } \lambda_j^{r*} \geq 0 \\ \lambda_j^{r*} & \text{if } \lambda_j^{r*} < 0 \end{cases} .$$

The parameter of interest is θ . If it is statistically significant, we can conclude that the speed of price adjustments varies across retail formats. To single out this effect from other effects that potentially influence the speed of price adjustments, we include further variables. Levy et al. (1998) analyze the actual workflows of the price adjustment process in different key accounts. The authors find evidence for varying speeds of price adjustments across retailers. Thus, we introduce key account dummies to the model. In addition, we add brand dummies as the different manufacturers might react with varying speeds. In our case with a predominantly decreasing producer price, for example, the retail prices of brands produced by manufacturers holding large inventories might be adjusted more slowly. Furthermore, we also include dummies for retail stores located in cities exceeding 100,000 inhabitants (“big city”) and in cities with at least 20,000 to 100,000 inhabitants (“medium cities”). Retailers located in areas with less than 20,000 inhabitants (“small cities”) serve as reference category to avoid the dummy variable trap.

Tobit – Model	
Discounter	-0.016
Base: Tchibo	
Eduscho	0.003
Melitta	-0.060*
Jacobs	0.028*
Onko	0.012
Dallmayr	0.042*
Idee	-0.016
Base: Edeka	
Markant	-0.018
Metro	-0.002
Rewe	-0.013
Tengelmann	-0.030*
Base: Small city	
Big city	0.013*
Medium city	0.023*
Constant	-0.158*
Regional Dummies	Yes
N	712
* $p < 0.05$	

Table 16: Parameters influencing the speed of price adjustment

Here the intuition is that the larger the city, the more retailers are located within a certain area. Thus, the pressure to adjust prices might be higher in these areas.

The results are presented in Table 16. The negative sign of the coefficient θ suggests that discounters adjust prices faster than supermarkets. However, the effect is statistically insignificant. The speed of price adjustment is much more influenced by brands and key accounts. Although we approximate producer prices by the identical adjusted green beans prices, we observe differences across producers. For example, the positive coefficient of the variable for the brand Eduscho indicates that price series of Eduscho UPCs are generally adjusted more slowly than price series stemming from the brand Tchibo. Retail prices of coffee packages of the brand Melitta react the most rapidly to producer price changes: On average, price series observed from Melitta adjust 6.0% quicker compared to the

predicted price adjustment process of Tchibo's products. The effects of the affiliation to a key account are in general less pronounced compared to the brand effects, only the key account Tengelmann shows a significantly quicker reaction compared with Edeka. Retailers located in urban surroundings adjust their consumer prices significantly more slowly than other retailers.

4.4 Discussion

Our results are generally in line with previous studies on the pass-through of producer price changes but underline how important it is to account for retail formats. Bonnet et al. (2011) point out that the relationship between producers and retailers matters. Using the identical data set, we show that a distinction between retail formats also affects the pass-through rates. Broda et al. (2009) demonstrate that about one third of the price differences between low- and high-income households are explained by the choice of the store. High-income households prefer stores with a nicer ambiance and better service that charge higher prices. In Germany, households with a relatively low income purchase relatively more at discount retailers (GfK, 2008). Our data covers a period of price decreases. Periods of increasing producer prices, however, would reduce the price differences between different income groups due to the higher pass-through rate for discounters.

In this chapter, we analyze the effect of producer price changes for ground coffee. However, the implications of our study go beyond that and are important for measuring the magnitude of other imported goods' prices on domestic consumer prices, too. For instance, producer prices for coffee fell by about 32% from their peak in the second quarter in 2011 to their value of USD 1.65 per pound in the first quarter 2012. Likewise, the price of cocoa decreased in the same period by about 34%. Sugar prices, finally, first increased in the first quarter 2011 by 15% and then dropped by 23% in the first quarter of 2012.⁷⁸ The retail format specific pass-through rates of these producer price changes can thus affect the price differences across income groups.

The concept of discount retailers originates in Germany. For that reason we chose this market for the empirical study. In many countries, however, discounters are only

⁷⁸Sources: International Coffee Organization, International Cocoa Organization, and Public Ledger via Datastream.

starting to expand their activities and the consequences of a larger discounter presence will become visible. For instance, in October 2005, ALDI opened its first affiliate in Switzerland. A recent study by the Swiss Institute for Retail Management (Weber and Rudolph, 2011) exhibits that within three years the percentage of managers expecting intensified price competition rose from 59% in 2008 to 89% in 2011. Based on our findings of increased price pass-through by discount stores, increased price competition can be expected if more discount stores enter the market. Furthermore, the distinction between retail formats in empirical analyses should be carefully considered in markets in which discounters intensify their activity.

The degree of competition among supermarkets and discounters is part of a lively debate among researchers (Cleeren et al., 2010). While we do not directly consider competition among retailers, we do observe that the frequency of price adjustment, as one implication of competition, differs across retail formats. Discounters pursue a strategy of rarely using promotional activities such as price discounts compared to supermarkets. Instead, they try to maintain lower prices and hold prices constant for a longer time. Consequently, one potential limitation of our findings is that we excluded promotional prices because in the literature on price promotions, these are defined as being unrelated to cost changes (Hosken and Reiffen, 2004). However, it could be the case that supermarkets, which generally pursue a Hi-Lo pricing strategy in Germany, use price promotions strategically to react to producer price changes. Translated to our setting of falling producer prices that could imply that supermarkets might have reacted to the falling producer price by promoting ground coffee products more frequently or offering higher discounts and thus lowering their average price.

Figure 10 depicts the average number of promoted items per week and supermarket. On average, a supermarket in our sample carries 16 distinct ground coffee products and promotes averaged over both years each week 2.33 items. Figure 10 shows that the average number of items on sale varies over time. The promotional frequency increases slightly, and comparing the two years shows that in 2001 on average 2.49 items were on sale and in 2000 only 2.16. Thus, the promotional frequency increased by 0.33 items per week. Or expressed differently, in 2001 each retailer offered an additional sale on one out of 16 items every three weeks compared to 2000.

Figure 11 shows that also the average promotional discount increased over time and was particularly high in weeks 40 to 60, when producer prices decreased significantly.

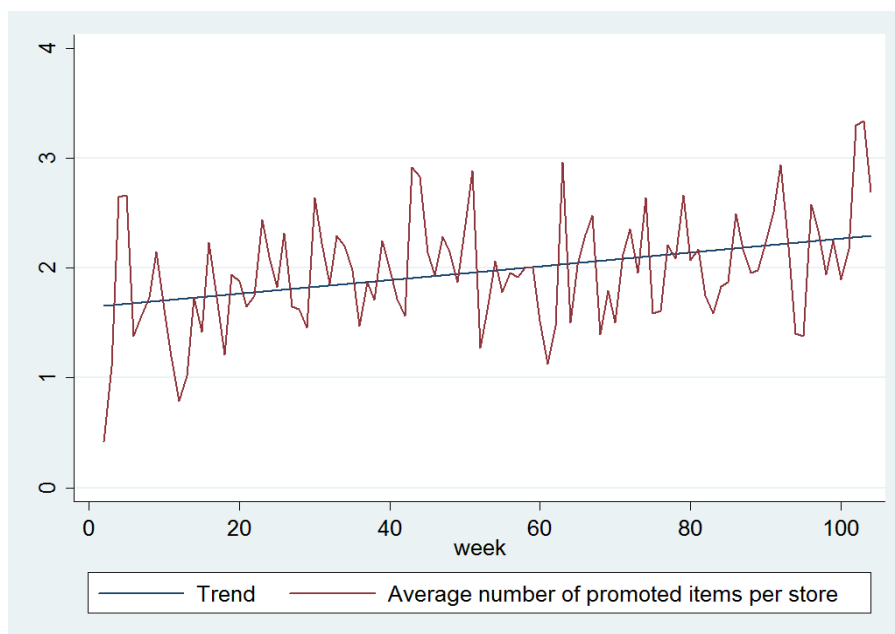


Figure 10: Average number of price promotions per week and supermarket, 2000-2001

Overall, the average promotional discount in the supermarket equals 16.2%. In 2000, it is 15.2% comparing to 17.2% in 2001. It becomes evident that supermarkets also elevated the average discount by 2%. Carrying out paired t-tests for the weekly average number of promotions and the respective average discounts shows that both are significantly higher in 2001 compared to 2000 ($p - value < 0.001$). Taken both effects together, supermarkets decreased their overall average prices by intensified promotional activity. The question is whether the increased promotional activity can compensate for lower price adjustments of falling producer prices. Again comparing 2000 and 2001, a rough calculation shows that considering the increased promotional activity in 2001 leads to a pass-through rate of 32% instead of 25%.⁷⁹ This is still considerably smaller compared to the pass-through rate of the discount retailers (37%), but provides some evidence that retailers use price

⁷⁹The average regular price for 500gr coffee is DM 7.93 in 2000 and DM 7.67 in 2001, and thus falls by 3%. The producer price for coffee decreased by 12%, which implies a pass through-rate of approximately 25%. An additional discount of 2% in 2001 relates to an additional nominal discount of DM 0.15. This discount is on average additionally applied to 2.49 out of 16 items, thus the average price decreased by DM 0.02. Thus, also considering the increased promotional activity, the average price was DM 7.65 in 2001. Calculating the percentage decrease from 2000 to 2001 leads to a pass-through rate of 32%.

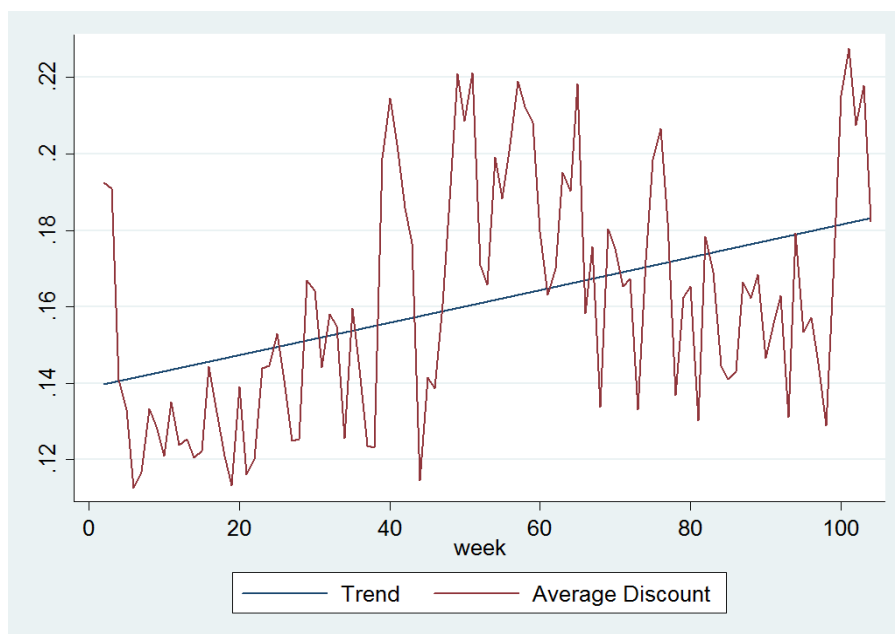


Figure 11: Average promotional discount per week and supermarket, 2000-2001

promotions strategically.

However, supermarkets and discounters offer a large variety of products and the promotional pricing strategy for one product is not independent of other products' prices. That is, price discounts on coffee products do not need to be correlated to producer price changes. Instead, they might be used to generally attract customers to a retail store (Hosken and Reiffen, 2004). Since our data set only covers coffee products, we are not able to observe the full promotional pricing strategy of a retailer. Therefore, we decided to follow the literature and considered the regular price of products in our main analysis.

4.5 Conclusion

The current chapter studies the pass-through of producer price changes into consumer prices at the product-store level and explicitly distinguishes discount and supermarket retail formats. While the literature on retail competition starts to analyze the impact of these specific retail formats, pass-through studies generally have neglected this aspect. We demonstrate that the differences in the two retail strategies are reflected in lower average

prices, a longer duration of price spells and less frequent price changes for discounters. Estimating a reduced-form pass-through model, we find that discounters pass through 37% of producer price changes, a rate significantly higher compared to supermarkets' 23%. We attribute the difference in pass-through rates to additional service costs. These are part of the final consumer prices and are much higher in the case of supermarkets. In addition, service costs provide one explanation as to why local costs components affect pass-through rates. We do not find evidence for differences in the speed of price adjustments across retail formats.

Our study provides further evidence that consumer price reactions to an identical producer price change differ across retailers. Pass-through studies using more aggregated data are not able to capture these differences across retail formats. Furthermore, as has been shown in other surveys, households differing in income do not purchase their goods with the same intensity across stores (GfK, 2008; Broda et al., 2009). Retail discounters are much more frequently visited by lower income households. This, in turn, implies that pass-through rates are higher for households purchasing more intensively at discount retailers. That is, in times of producer price decreases they benefit relatively more. This intensifies existing price differences and needs to be taken into account when measuring price differences and inequality. Whether or not discounters also increase their prices relatively more given a producer price increase is an important question but unfortunately beyond the possibilities of this analysis. We only observe a period of decreasing producer prices. So it might be the case that discounters keep their prices stable and take a cut in their mark-ups if producer prices rise. Finally, we present evidence that the frequency of price adjustments differs across retail formats. In the food retail sector, price rigidities depend on the retail strategy. Prices at discount retailers are more rigid compared to prices at supermarket retailers.

We chose ground coffee to be able to directly compare our results to previous studies on pass-through using the same data set that did not account for retail formats. However, Richards et al. (2010) argue that the level of pass-through of input cost changes depends upon the level of product differentiation. The higher the degree of differentiation is, the lower is the expected degree of pass-through. Thus, a natural step for future research would be to validate our results for additional product categories.

5 Conclusion

5.1 Summary of results

This dissertation estimates the magnitude of the pass-through rates and analyzes potential heterogeneity across countries, retailers and products. Its focus lies on Germany, which is one of the most active countries in international trade. My findings suggest that there is indeed a lot of heterogeneity. In chapter 2, I find that in a pooled regression the exchange rate pass-through to import prices is incomplete for German imports at a rate of 41% in the short run of three months and 46% in the long run of nine months. This finding suppresses a lot of variance across the different German trading partners. Exchange rate pass-through rates are largest for German imports from non-European countries, such as the U.S. and China. By contrast, European countries generally exhibit statistically zero pass-through. Defining an appreciation phase as starting with three consecutive months of appreciation, I find a substantially smaller pass-through rate in these phases. Small and large exchange rate shocks and a product's quality do not statistically influence the magnitude of the pass-through rates.

Chapter 3 then considers the German apparel sector and uses a data set on household purchases and import prices. The chapter is based on a paper which is joint work with Laura Birg. Retailers differ in their price level and we estimate that high-price retailers do not pass through changes in the import prices. By contrast, the pass-through for low-price retailers is 53% within three months. Low-income households are attracted relatively more by retailers with a lower price level and they spend a larger share of their expenditure at these stores. Consequently, pass-through rates for low-income households are 58%, significantly larger than those for high-income households. We then explain these observations in a theoretical model with vertical product differentiation due to bundling an otherwise homogeneous imported good with services. Following an import price shock, retailers who sell cheaper unbundled products change prices more than retailers who sell a higher-priced bundle of product and service. Consumers might assign different values to an additional service for different products but this does not affect our results.

In chapter 4, which is joint work with Janine Empen, we use product-level data for the German ground coffee sector to estimate the pass-through of producer price changes

to final consumer prices. We distinguish the two retail formats discount retailers and supermarket retailers. We show that supermarkets have a broader product assortment, a higher price level and change prices more often compared to discounters. We find that discount retailers pass through 37% of a producer price change, significantly more than the 23% for supermarkets. However, this does not result in differences in the speed of price adjustments across retail formats.

5.2 Policy implications and future research

The increase in international trade makes countries much more susceptible to price changes of traded goods, which is especially the case for the German economy. The underlying motivation of this dissertation is the question to what extent these price changes affect the domestic economy and whether the price changes affect all retailers and consumer equally. My analysis emphasizes that there is a substantial heterogeneity of the pass-through rates of these price changes across countries, retailers and consumers. Its general implication for research is to properly account for this heterogeneity in order to measure the exact impact of any foreign price change. Chapter 2 showed that for the exchange rate pass-through literature this implies that studies using more disaggregated data are better able to measure this heterogeneity. It also suggests that the trend of an exchange rate is relevant for data at a monthly frequency. That is, not a single appreciation from one month to the next matters but whether there is a underlying appreciation phase going on. To my knowledge, this has received little attention in the literature and thus should be considered in future studies on ERPT.

Furthermore, chapters 3 and 4 revealed that retailers also play an important role for the magnitude of the pass-through rates. Besides other explanations the retail strategy affects the pass-through rate. That is, if a retailer decides to supply additional services to its customers this generally reduces its pass-through rate.

Chapter 3 considers apparel products but there is, of course, a much wider range of products that could be taken into account. The basic idea is that the final consumer price consists of a bundle of retailer service costs and the original product price. If products in other sectors are also sold as a bundle pass-through rates will differ as well. This has direct consequences for the discussion on income inequality. Chapter 3 emphasizes that import price changes do not affect all households equally. Instead, the importance of a

household's store choice and this store's retail strategy need to be taken into account. In our sample, import price pass-through rates for low-income households are larger. In times of decreasing import prices, this benefits low-income households by more and implies a decreasing effect on the frequently stated increase in income inequality for Germany.

In chapter 4, we focus on one product group, ground coffee, but another important aspect of retail pass-through is the pricing strategy of retailers across products. As shown by Hosken and Reiffen (2004), retailers' pricing strategies and promotional activities are not independent across products. Supermarkets sell a broad range of 10,000 or more products, and even discounters sell up to 2,000 different products (Geldmacher et al., 2011) and customers typically purchase several articles on one shopping trip. Thus, a number of potential explanations for a wide range of possible pass-through rates arises. For instance, if a product is relatively popular or has a price that customers are well aware of due to frequent purchases, retailers might not change that product's price even if there is a substantial producer price change.⁸⁰ The simple reason is to not deter potential consumers. Alternatively, products that are rarely purchased or where the demand elasticity is low might be characterized by more than complete pass-through rates in order to offset other products' constant price levels. These are just a few examples for potential interactions within a retailer and across products that potentially influence the pass-through rates of specific products. Thus, future research should consider this and try to obtain a comprehensive data set of a retailer's product assortment.

Chapter 4 also revealed the importance of considering promotional activities of retailers appropriately. If product data is used, a weekly frequency of the data should be used in the retailing sector as most of the promotional discounts occur at weekly frequencies. Monthly or even quarterly data will most likely end up in average prices that makes it difficult to exclude promotional discounts.

In summary, there are several sources that influence the extent of the pass-through rates of foreign price changes. These price changes, on the other hand, affect the domestic inflation rate. Thus, inflation rates need to be constructed that explicitly take into account the differential effect of import prices on households with different income and shopping patterns. This, however, is difficult to do. Household information in combina-

⁸⁰Such products are generally named "loss leader", see, for instance, DeGraba (2006).

tion with retail prices is readily available through market research institutes and their scanner data sets. It becomes more difficult, however, to obtain the required producer prices or import prices and, more importantly, to match all these data sets properly. Nonetheless, one conclusion of my research is that there is indeed evidence for different pass-through rates across households with low and high income. Thus, future research should try to consider a wider range of products and to test whether different pass-through rates within a sector and across households are a general phenomenon and not restricted to the data set I used.

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Appendix

A Appendix to Chapter 2

A.1 Data

Data on import unit values from January 1988 to December 2008 comes from Eurostat and is published as "Intra- and extra-EU trade data". According to the combined nomenclature (CN), it covers trade at an 8-digit level.⁸⁴ In order to reduce the complexity, some threshold for the declaration of imports and exports exist. For example, transactions with a value less than Euro 200 may be summarized to one reported product code for Intra-EU trade. In the case of Extra-EU trade, transactions with value less than Euro 1000 or weight less than one ton do not have to be provided. Since 2002 all member states have to adjust their data for these omitted transactions. Generally, roughly 1% of trade is not captured due to this threshold. The statistical values of imported goods are c.i.f. (cost, insurance, and freight) which are collected in the respective national currency. Eurostat's publication is in multiples of euros. In addition to import values, the CNs selected for this study provide a so-called supplementary unit which shows the quantity traded in this CN 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. This reduces the number of available CNs. To further increase the reliance of the data, I only consider CNs that were traded for more than a minimum time period. In particular, the duration of a trade relation with Germany covered by the data differs by country. For instance, imports from Poland start in January 1992 which yields a total of 204 periods. I then keep all CNs that are traded for at least 154 (= maximum time coverage minus 50) periods. Finally, CNs need to pass a threshold with respect to their variation described in the next section. This should further support the approximation of prices with unit values.

Data on bilateral exchange rates come from Financial Times Interactive Data and WM/Reuters and were extracted from Thomson Datastream at a daily rate. I calculate the arithmetic mean per month and use a Euro/US-Dollar exchange rate to convert the

⁸⁴An example is 61041300 "Women's or girl's suits of synthetic fibres, knitted or crocheted (excl. ski overalls and swimwear)".

other currencies into Euro/foreign currency exchange rates over the entire sample period.

Generally, my data captures the period from January 1988 to December 2008. However, for some countries, e.g., Russia or Poland, I do not have an exchange rate over the entire sample period. One shortcoming of the Eurostat CN system is that it does not explicitly differentiate between consumer goods and industrial goods. Descriptions for CNs covering textile and electronic categories seem most appropriate to exclude industrial goods. Therefore, the analysis is mainly restricted to these CNs. Furthermore, concordance tables offered by the Statistical Office to classify industry and consumption purposes were integrated, but still this caveat needs to be kept in mind.

A.2 CN selection criterion

CNs are selected according to their dispersion. Following the methodology outlined in WTO, UNCTAD and ITC (2007), the interquartile range ratio (*IRR*) and Bowley's skewness coefficient (*BSC*) are useful instruments. I calculate the mean and quartiles ($Q_i, i \in 1, 2, 3$) of the unit value of each CN in each country over time. The *IRR* then is $IRR = Q_1/Q_3$. The smaller the *IRR* the higher is the variation in this CN. In order to check whether the median of this CN is well located, I calculate the *BSC* according to $BSC = ((Q_3 - Q_2) - (Q_2 - Q_1)) / (Q_3 - Q_2)$. The closer to zero the *BSC* is, the closer is the mean of this CN to the exact middle of the interquartile range. CNs satisfying $IRR > 0.5$ and $-0.5 < BSC < 0.5$ are considered as stable and properly centered. In other words, the less volatile an 8-digit CN and the more centered the median, the more likely it is that this CN represents a relatively homogeneous product. This constraint reduces the total of different CNs from 753 to 487.

A.3 Unit-root test for stationarity

I 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 exchange rates are given in Table A.1. All exchange rates are tested to be integrated of order one with the exception of the Polish Złoty. Import unit values, on the other hand, are tested with Fisher's unit-root test for unbalanced panels using both, the ADF and the Phillips-Perron test. As Table A.2 indicates, the

null hypothesis that all unit value series are nonstationary is clearly rejected.

Country	no. of lags ^a	test statistic	cr. values			order of integration
			1%	5%	10%	
UK	4	-1.009	-3.461	-2.88	-2.57	I(1)
Sweden	5	-1.225	-3.461	-2.88	-2.57	I(1)
Switzerland	2	-2.145	-3.488	-2.88	-2.567	I(1)
Turkey	3	-2.702	-3.461	-2.88	-2.57	I(1)
Poland	3	-3.482	-3.476	-2.883	-2.573	I(0)
Czech Rep.	2	-0.427	-3.48	-2.884	-2.574	I(1)
Hungary	3	-2.953	-3.476	-2.883	-2.573	I(1)
Russia	3	-1.896	-3.518	-2.895	-2.582	I(1)
USA	3	-1.737	-3.461	-2.88	-2.57	I(1)
Mexico	2	-0.926	-3.46	-2.88	-2.57	I(1)
India	3	-2.222	-3.461	-2.88	-2.57	I(1)
Thailand	9	-1.563	-3.463	-2.881	-2.571	I(1)
Malaysia	3	-1.472	-3.461	-2.88	-2.57	I(1)
China	3	-2.176	-3.461	-2.88	-2.57	I(1)
South Korea	3	-1.331	-3.461	-2.88	-2.57	I(1)
Japan	2	-1.901	-3.46	-2.88	-2.57	I(1)

^achosen according to Akaike information criteria in Stata

Table A.1: ADF-Tests on stationarity

Country	ADF-Test		Phillips-Perron Test	
	p-value	test statistic	p-value	test-statistic
UK	0	3715.815	0	6466.508
Sweden	0	1038.557	0	1748.656
Switzerland	0	3502.664	0	6945.135
Turkey	0	5163.857	0	9004.582
Poland	0	5066.479	0	9368.225
Czech Republic	0	3277.219	0	6828.678
Hungary	0	3489.939	0	6950.986
Russia	0	469.5029	0	1060.843
USA	0	4847.172	0	8128.96
Mexico	0	114.4351	0	344.5228
India	0	2464.346	0	4313.462
Thailand	0	2415.629	0	4142.424
Malaysia	0	1029.745	0	2055.048
China	0	6827.915	0	12693.25
South Korea	0	1905.395	0	3229.822
Japan	0	2998.916	0	5603.54

Table A.2: Import unit values: Unit-root tests on stationarity

A.4 Country information

Additional information on the trade volume and exchange rates used in this study are given in Table A.3. In the reference year 2008 the selected countries cover on average 47% of the total import value over all CNs. This amount is explained by the restriction to specific CNs as well as by the exclusion of all other EU countries belonging to the Euro-currency zone, e.g. France, the Netherlands and Italy. Including all Euro-currency countries increases the share to 93%. However, as unit values are an approximation of prices I constrain the data twice. First, CNs that are traded over a time period of less than the maximum time range minus 50 periods are not considered. Second, as mentioned above, the *IRR* and *BSC* are applied, which reduces the number of CNs. In so doing I reduce the data to a set of relatively stable and continuing observations which should provide a more reliable approximation of prices.

German Trading Partner	Exchange rate		Year: 2008, (volume in 1000€)		
	Mean	St. Dev.	Volume	Trade Share	No. of CNs
UK	0.716	0.069	1522,720	9.52%	65
Sweden	8.780	0.654	292,623	1.83%	18
Switzerland	1.568	0.055	951,628	5.95%	83
Turkey	0.710	0.772	1,108,947	6.93%	106
Poland	3.560	0.765	630,582	3.94%	134
Czech Rep.	32.646	3.443	854,812	5.34%	101
Hungary	216.217	55.049	1,860,906	11.64%	98
Russia	33.205	3.688	28,128	0.18%	27
USA	1.202	0.157	1,043,973	6.53%	75
Mexico	8.773	4.265	519,615	3.25%	4
India	42.532	12.388	709,392	4.44%	57
Thailand	38.851	7.239	156,862	0.98%	53
Malaysia	3.809	0.643	106,295	0.66%	22
China	8.567	1.943	5,372,396	33.59%	173
South Korea	1145.853	221.379	118,856	0.74%	36
Japan	141.774	24.003	715,036	4.47%	50
Total:			15,722,541	100.00%	

Notes:
Selected countries cover on average 47% of German imports over all CNs.
Including imports from Euro-countries increases this share to 93%.

Table A.3: Import volume and share by country

B Appendix to Chapter 3

B.1 Data

The "Gesellschaft für Konsumforschung" (GfK) granted access to its "Universalpanel". The data set covers the time from January 2000 to December 2007 and has a total of 2,036,356 observations. This includes 11,934 unique households and 188 retailers. Household characteristics, such as the buyer's age, his/her profession and education, and a household's net income and size, are reported as well. In this panel, participating households have to assign all their purchases to 102 categories ranging from apparel products as well as electronic articles to housewares and specify the price and the retailer for each item. We focus on the 24 apparel categories, such as "trousers, men outerwear". This results in a subset of the data with 837,791 observations, containing 11,615 households and 169 retailers. One observation consists of one product purchased by a household at a store. For instance, if household A buys one T-shirt and a pair of jeans at retailer B at November 5th, then this gives us two observations for household A, one for the T-shirt and one for the jeans. Although the exact date of the purchase is given, we calculated monthly averages since there are not sufficient observations per household for a more disaggregated time dimension. Households do get paid indirectly for participation. That is, they collect bonus points for each week they participate regardless of the number of transmitted purchases. These bonus points then can be exchanged into some reward, for instance, an electric shaver.

Data on import unit values from January 2000 to December 2007 comes from Eurostat and is published as "Intra- and extra-EU trade data" as described in section A.1. Here, we restrict the analysis to the apparel sector and hence consider the 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. The regression analysis in chapter 3 considers all imports from outside the European Union (extra-EU). For a robustness check in the Appendix, we also use data on imports within the European Union (intra-EU) in the same categories.

B.2 Share of items purchased at a retailer

Table B.1 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		Ratio
		low income	high income	
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 B.1: Share of items bought at a specific retailer, selection of full sample

B.3 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 B.2. The import price is tested to be integrated of order one. Average prices for each retailer r (p_t^r) and average price of household type h at retailer r ($p_t^{h,r}$) are tested with Fisher's unit-root test for unbalanced panels using both, the ADF and the Phillips-Perron test. As Table B.3 indicates, the null hypothesis that all series are nonstationary is clearly rejected.

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

⁺according to Akaike information criteria in Stata

Table B.2: Unit-root test

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

Table B.3: Panel unit-root test

B.4 Robustness checks

In Table 7, we used extra-EU import price and regressed them on the average price of retailer r . Here, we use intra-EU import prices instead. Table B.4 presents the results. 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, respectively. 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, respectively. Second, we use the "Square root scale" that is simply the square root of the household's size. As Table B.5 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, throughout all specifications low-income household's pass-through rates are significantly higher compared to high-income households.

⁸⁵<http://www.oecd.org/dataoecd/61/52/35411111.pdf>.

	1	2 ¹	3	4	5	6	7	8	9 ²
basic	interact	add FE	FE	FE	RE	lagged	monthly	in levels	Prais-
			est.	est.	est.	dep. var.	dummies		Winsten
									est.
	Dependent variable: Average price of retailer r (Δp_t^r)								
Observations	6,469	6,469	6,469	6,469	6,469	6,452	6,506	6,573	6,469
Adj. R2	0.000	0.003	-0.009	0.003	0.005	0.252	0.031	0.883	-0.008
F-Statistic	1.288			2.256					
Root MSE	0.339	0.338	0.340			0.293	0.317	0.255	0.293
All	0.088								
All: Prob > F	0.551								
H-type retailer		-0.033	-0.035	-0.035	-0.035	-0.215	0.104	0.241*	0.025
H: Prob > F		0.844	0.836	0.835	0.835	0.275	0.499	0.010	0.863
L-type retailer		0.204	0.205	0.205	0.205	0.398	-0.019	0.392*	0.166
L: Prob > F		0.388	0.390	0.387	0.387	0.176	0.904	0.000	0.405
Number of retailers				80	80				

*Statistically significant at the 5%-level.

¹Columns 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 B.4: Pass-through into average prices for L- and H-type retailers, Intra-EU import prices.

	1	2	3	4	5	6	7	8
(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 chapter 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	yes	yes	yes
Estimator	OLS	OLS	OLS	PW ¹	OLS	OLS	FE ²	RE ³

*Statistically significant at the 5%-level.
¹Prais-Winsten, ²Fixed effects, ³Random effects

Table B.5: Pass-through into average prices of high and low-income households. Alternative equivalence scales.

B.5 Markups

Absolute markups for both firms are

$$\begin{aligned}\mu_b &= p_b^r - p^i - w = \frac{2\delta(\delta-1) - p^i(\delta-1) - w(2\delta-1)}{4\delta-1}, \\ \mu_u &= p_u^r - p^i = \frac{\delta-1 - 2p^i(\delta-1) + w}{4\delta-1},\end{aligned}\quad (26)$$

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

Relative markups are

$$\begin{aligned}\frac{\mu_b}{p_b^r} &= \frac{p_b^r - p^i - w}{p_b^r} = \frac{2\delta(\delta-1) - p^i(\delta-1) - w(2\delta-1)}{3p^i\delta + 2w\delta + 2\delta(\delta-1)}, \\ \frac{\mu_u}{p_u^r} &= \frac{p_u^r - p^i}{p_u^r} = \frac{(\delta-1) - 2p^i(\delta-1) + w}{p^i(1+2\delta) + w + (\delta-1)}.\end{aligned}\quad (27)$$

with $\frac{\mu_b}{p_b^r} > \frac{\mu_u}{p_u^r}$, if $w < \frac{1}{2}(1 - 2p^i - \delta + \sqrt{(\delta-1)^2 + 4p^i\delta(p^i + 2(\delta-1))})$. 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:

$$\frac{\partial\mu_b}{\partial p^i} = -\frac{\delta-1}{4\delta-1} < 0, \quad \frac{\partial\mu_u}{\partial p^i} = -2\frac{\delta-1}{4\delta-1} < 0. \quad (28)$$

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

$$\begin{aligned}\frac{\partial(\mu_b/p_b^r)}{\partial p^i} &= -\frac{(4\delta-1)(2(\delta-1)-w)}{\delta(3p^i+2w+2(\delta-1))^2}, \\ \frac{\partial(\mu_u/p_u^r)}{\partial p^i} &= -\frac{(4\delta-1)(w+(\delta-1))}{(p^i(1+2\delta)+w+(\delta-1))^2}.\end{aligned}\quad (29)$$

The change of relative markup is higher for firm 2, if the import price is sufficiently low:

$$\left| \frac{\partial(\mu_b/p_b^r)}{\partial p^i} \right| < \left| \frac{\partial(\mu_u/p_u^r)}{\partial p^i} \right| \text{ if } p^i < p^{i*}$$

$$\text{and } p^{i*} = \frac{2(\delta-1)^3 + (4\delta-1)\sqrt{-\delta(w+\delta-1)^3(w-2\delta+2)+w(10\delta-1)(\delta-1)+w^2(8\delta+1)}}{(\delta-1)(2-\delta+8\delta^2)-w(13\delta+4\delta^2+1)}.$$

B.6 Welfare analysis

Here, we investigate the welfare implications of a decrease of the import price for firms and consumers. Decreasing prices increase the total quantity sold:

$$\begin{aligned}\frac{\partial q_b}{\partial p^i} &= -\frac{1}{4\delta - 1} < 0 \\ \frac{\partial q_u}{\partial p^i} &= -\frac{2\delta}{4\delta - 1} < 0.\end{aligned}\quad (30)$$

Of this additional market size, i.e. quantity sold, firm u gains more than firm b as $\partial q_b/\partial p^i < \partial q_u/\partial p^i$. 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. On the other hand, firm u is also more vulnerable to import price increases.

For both firms, a decreasing import price increases profits:

$$\begin{aligned}\frac{\partial \pi_b}{\partial p^i} &= -\frac{2(2\delta(\delta - 1) - w(2\delta - 1) - p^i(\delta - 1))}{(4\delta - 1)^2}, \\ \frac{\partial \pi_u}{\partial p^i} &= -\frac{4(\delta - 1)\delta((\delta - 1) - 2p^i(\delta - 1) + w)}{(\delta - 1)(4\delta - 1)^2}.\end{aligned}\quad (31)$$

The profit for firm b increases by more if $w < p^i(\delta - 1)$. 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 ($\tilde{\cdot}$), the increase in consumers surplus is given as:

$$\Delta CS = \left(\int_{\tilde{\theta}^*}^1 (\delta\theta - \tilde{p}_b^r) d\theta - \int_{\tilde{\theta}^{**}}^{\tilde{\theta}^*} (\theta - \tilde{p}_u^r) d\theta \right) - \left(\int_{\theta^*}^1 (\delta\theta - p_b^r) d\theta - \int_{\theta^{**}}^{\theta^*} (\theta - p_u^r) d\theta \right) > 0, \quad (32)$$

which can be decomposed into four effects:

$$\Delta CS = \underbrace{\int_{\theta^*}^1 (p_b^r - \tilde{p}_b^r) d\theta}_I + \underbrace{\int_{\tilde{\theta}^*}^{\theta^*} (\delta\theta - \tilde{p}_b^r - (\theta - p_u^r)) d\theta}_{II} + \underbrace{\int_{\theta^{**}}^{\tilde{\theta}^*} (p_u^r - \tilde{p}_u^r) d\theta}_{III} + \underbrace{\int_{\tilde{\theta}^{**}}^{\theta^{**}} (\theta - \tilde{p}_u^r) d\theta}_{IV}. \quad (33)$$

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 of 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. $\tilde{p}_b^r = p_b - (\partial p_b^r / \partial p^i)$ and $\tilde{p}_u^r = p_u^r - (\partial p_u^r / \partial p^i)$, the change in consumer surplus for these four subgroups of consumers is given respectively as:

$$\begin{aligned} \int_{\theta^*}^1 (p_b - \tilde{p}_b^r) d\theta &= \frac{3\delta((2\delta - p^i)(\delta - 1) - w(2\delta - 1))}{(4\delta - 1)^2(\delta - 1)} \\ \int_{\tilde{\theta}^*}^{\theta^*} (\delta\theta - \tilde{p}_b^r - (\theta - p_u^r)) d\theta &= \frac{(5\delta + 1)}{2(4\delta - 1)^2} \\ \int_{\theta^{**}}^{\tilde{\theta}^*} (p_u^r - \tilde{p}_u^r) d\theta &= \frac{(2\delta + 1)(1 + \delta(w + (\delta - 2) - 2p^i(\delta - 1)))}{(4\delta - 1)^2(\delta - 1)} \text{ and} \\ \int_{\tilde{\theta}^{**}}^{\theta^{**}} (\theta - \tilde{p}_u^r) d\theta &= \frac{((w + \delta)(2\delta - 1) + p^i(\delta - 1) + 2)^2}{2(4\delta - 1)^2}. \end{aligned} \quad (34)$$

Comparing 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:

$$\int_{\theta^*}^1 (p_b^r - \tilde{p}_b^r) d\theta > \int_{\tilde{\theta}^*}^{\theta^*} (\delta\theta - \tilde{p}_b - (\theta - p_u)) d\theta + \int_{\theta^{**}}^{\tilde{\theta}^*} (p_u - \tilde{p}_u) d\theta$$

$$\text{if } p^i > \frac{4w\delta(4\delta - 1) + 1 - \delta(\delta(8\delta - 11) + 4)}{2\delta(4\delta - 1)(\delta - 1)}. \quad (35)$$

If the import price is relatively 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.

C Appendix to Chapter 4

C.1 Unit-root test

We tested the adjusted price series for coffee for the existence of a unit-root using the Dickey-Fuller test. We included three lags and a trend and Table C.1 indicates that the null hypothesis of nonstationarity cannot be rejected. The retail price series were tested with Fisher's unit-root test for unbalanced panels. In this case, the null-hypothesis is nonstationarity for all series which clearly is rejected as shown in Table C.2. Due to the nonstationarity of the coffee price series we generally apply first differences of the variables in our regressions.

Variable	no. of lags*	test statistic	cr. values			order of integration
			1%	5%	10%	
Adj. coffee price	3	-2.2	-4.04	-3.45	-3.15	I(1)

*according to information criteria in Stata

Table C.1: Unit-root test

Variable	ADF-Test		Phillips-Perron		order of integration
	p-value	Inv. Chi-squared	p-value	Inv. Chi-squared	
Retail price*	0.00	3332	0.00	3288	I(0)

*Number of panels: 712

Table C.2: Panel-unit root test

C.2 Additional regression results

Dependent variable	1	2	3	4	5	6	7	8
	Δp_{jt}^r							
Δp_t^w	0.060*	0.02	0.026	0.026	0.026	0.026	0.027	0.026
	(0.009)	(0.013)	(0.014)	(0.014)	(0.026)	(0.026)	(0.026)	(0.026)
Δp_{t-1}^w	0.013	0.077*	0.092*	0.093*	0.093*	0.093*	0.092*	0.092*
	(0.009)	(0.014)	(0.015)	(0.015)	(0.016)	(0.014)	(0.014)	(0.014)
Δp_{t-2}^w	0.060*	0.066*	0.043*	0.043*	0.043	0.043*	0.043*	0.043*
	(0.009)	(0.015)	(0.015)	(0.015)	(0.016)	(0.014)	(0.014)	(0.014)
Δp_{t-3}^w	0.000	0.040*	0.048*	0.048*	0.048	0.048	0.048	0.048
	(0.009)	(0.014)	(0.015)	(0.015)	(0.035)	(0.037)	(0.037)	(0.037)
Δp_{t-4}^w	0.022*	0.061*	0.050*	0.050*	0.05	0.05	0.05	0.05
	(0.009)	(0.014)	(0.014)	(0.014)	(0.036)	(0.031)	(0.031)	(0.031)
Δp_{t-5}^w	-0.030*	-0.011	-0.034*	-0.034*	-0.034	-0.034	-0.035	-0.034
	(0.009)	(0.013)	(0.014)	(0.014)	(0.067)	(0.062)	(0.062)	(0.063)
$\Delta p_t^w * DC$			-0.031	-0.031	-0.031	-0.031	-0.031	-0.031
			(0.023)	(0.023)	(0.046)	(0.040)	(0.040)	(0.040)
$\Delta p_{t-1}^w * DC$			-0.075*	-0.075*	-0.075*	-0.075*	-0.075*	-0.075*
			(0.022)	(0.022)	(0.022)	(0.030)	(0.030)	(0.031)
$\Delta p_{t-2}^w * DC$			0.112*	0.111*	0.111	0.111	0.112	0.112
			(0.023)	(0.023)	(0.070)	(0.064)	(0.064)	(0.064)
$\Delta p_{t-3}^w * DC$			-0.041	-0.041	-0.041	-0.041	-0.041	-0.041
			(0.023)	(0.023)	(0.044)	(0.048)	(0.048)	(0.048)
$\Delta p_{t-4}^w * DC$			0.061*	0.061*	0.061	0.061	0.062	0.061
			(0.022)	(0.022)	(0.068)	(0.075)	(0.075)	(0.075)
$\Delta p_{t-5}^w * DC$			0.121*	0.121*	0.121*	0.121*	0.122*	0.121*
			(0.023)	(0.023)	(0.031)	(0.031)	(0.031)	(0.031)
Observations	55,437	55,437	55,437	55,437	55,437	55,437	55,437	55,437
Adj. R2	0.002	0.015	0.016	0.016	0.016	0.016	0.016	0.018
F-Statistic	3.42	7.23	7.49	6.55				
Root MSE	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
All	0.125*	0.254*						
All: Prob > F	0.000	0.000						

Supermarket

$(\sum \alpha_i)$	0.226*	0.227*	0.227	0.227	0.225	0.226*
SM: Prob > F	0.000	0.000	0.06	0.051	0.051	0.019
Discounter						
$(\sum \alpha_i + \beta_i)$	0.374*	0.374*	0.374*	0.374*	0.374*	0.374*
DC: Prob > F	0.000	0.000	0.009	0.002	0.002	0.000
Interactions						
F-Test (joined)	13.1	13.1	13.2	173.2	169	1038.2
Prob > F	0.000	0.000	0.014	0.000	0.000	0.000
# of groups					712	712

Included:

regional dummies	yes	yes	yes	yes	yes	yes	yes	yes
weekly dummies		yes	yes	yes	yes	yes	yes	yes

Fixed effects

key account		yes	yes	yes	yes	yes		yes
brand		yes	yes	yes	yes	yes		yes
store		yes	yes	yes	yes	yes		yes
key account-brand				yes	yes	yes		
clustered					yes [#]	yes [/]	yes [/]	yes [/]
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	FE	RE

[#]clustered by key account

[/]clustered by key account and its specific format (discounter and supermarket)

* $p < 0.05$, SM = Supermarket, DC = Discounter

Table C.3: Detailed regression results for Table 14

Variation	1 Each price series seas. adj.	2 No seas. adj.	3 Add monthly time dummies	4 Include $\Delta p_{j,t-1}^r$	5 Drop price series w/o changes	6 Unadj. coffee price	7 Levels & $p_{j,t-1}^r$
Dependent variable	Price of product j at retail store r (Δp_{jt}^r)						$(p_{j,t-1}^r)$
Observations	55,437	55,437	55,437	55,437	51,625	55,437	57,685
Adj. R2	0.002	0.002	0.02	0.016	0.017	0.016	0.968
Root MSE	0.021	0.024	0.024	0.024	0.025	0.024	0.025
Supermarket ($\sum \alpha_i$)	0.130*	0.096	0.326*	0.227	0.244*	0.093*	0.024*
SM: Prob > F	0.002	0.174	0.018	0.051	0.046	0.047	0.001
Discounter ($\sum \alpha_i + \beta_i$)	0.158	0.226*	0.474*	0.374*	0.387*	0.137*	0.033*
DC: Prob > F	0.130	0.000	0.014	0.002	0.002	0.001	0.000
Interactions							
F-Test (joined)	125.0	57.7	74.9	172.5	201.9	247.5	1031
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Included:							
regional dummies	yes	yes	yes	yes	yes	yes	yes
weekly dummies			yes	yes	yes	yes	yes
Fixed effects							
key account	yes	yes	yes	yes	yes	yes	yes
brand	yes	yes	yes	yes	yes	yes	yes
store	yes	yes	yes	yes	yes	yes	yes
key account-brand	yes	yes	yes	yes	yes	yes	yes
clustered	yes/	yes/	yes/	yes/	yes/	yes/	yes/
Estimator	OLS	OLS	OLS	OLS	OLS	OLS	OLS
/clustered by key account and its specific format (discounter and supermarket)							
* $p < 0.05$, SM = Supermarket, DC = Discounter							

Table C.4: Pass-through estimates: Robustness checks

Eidesstattliche Erklärung

Ich erkläre hiermit an Eides Statt, dass ich meine Doktorarbeit mit dem Titel „*The pass-through into import and consumer prices: New evidence from German micro data*“ selbständig und ohne fremde Hilfe angefertigt habe und dass ich alle von anderen Autoren wörtlich übernommenen Stellen, wie auch die sich an die Gedanken anderer Autoren eng anlehnenden Ausführungen meiner Arbeit, besonders gekennzeichnet und die Quellen nach den mir angegebenen Richtlinien zitiert habe .

Ich versichere an Eides Statt, dass ich mich an keiner anderen Fakultät einer Doktorprüfung unterzogen habe. Meine Prüfung zum Diplom-Volkswirt habe ich an der Julius-Maximilians-Universität zu Würzburg abgeschlossen.

Kiel, 30. April 2012

(Eike Berner)

Hilfsmittel

Die Bearbeitung aller Datensätze und die Regressionsanalysen in dieser Doktorarbeit erfolgten mit dem Statistikprogramm Stata in den Versionen 9.2 und 11.2.

Das vorliegende Dokument habe ich mit den Programmen Scientific Workplace 5.5 und Microsoft Word erstellt.

Kiel, 30. April 2012

(Eike Berner)

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