

Retailer Pass-Through and its Determinants Using Scanner Data*

Alexis Antoniadou[†] and Nicola Zaniboni
Georgetown University

First draft: July 2012
This version: July 2013

Abstract

We study exchange rate pass-through and its determinants using scanner data on about 85% of the fast moving consumer goods (FMCGs) sold by 1,041 outlets in the United Arab Emirates between January of 2005 and December of 2010. The data, reported at the barcode level at each outlet, are augmented with Country-of-Origin (COO) information that was collected from the products' labels.

Our main finding is that exchange rate pass-through varies more across retailers within regions than across regions, and in particular that pass-through increases with retailer market share. We also show that exchange rate pass-through is negatively correlated with product quality and with the elasticity of substitution of the product category. We interpret our main finding that pass-through increases with retailer size to strongly suggest that retailers exhibit heterogeneity in price-setting behavior.

JEL classification codes: D43, F40, F41, O53

Keywords: Exchange rate pass-through, Scanner data

*This research was made possible by support of an NPRP grant from the Qatar National Research Fund. We thank David Weinstein, Daniel Westbrook, Charles Engel, Ken West, Alan Blinder, Oleg Itskhoki and seminar participants at Princeton University, Columbia University, Georgetown University, University of Wisconsin-Madison, Bank of Canada and University of Bern for helpful comments. The statements made herein are solely the responsibility of the authors. All remaining errors are our own.

[†]Corresponding author. Address: School of Foreign Service in Qatar, Georgetown University, Education City, Doha, 23689, Qatar. E-mail: aa658@georgetown.edu

1 Introduction

We measure exchange rate pass-through into retail prices using micro data on prices and quantities for about 85% of the fast moving consumer goods (FMCGs) sold across hundreds of grocery stores in the United Arab Emirates (UAE) between January of 2006 and December of 2010.

A unique feature of the dataset is the availability of outlet-level information, which allows us to study variation in pass-through across retailers. Specifically, for each outlet and each period we have access to transactions data at the barcode level for thirty product categories, along with information on the outlet type, the region it belongs to, and whether the outlet is part of a chain.¹ Each outlet’s market share is also retrieved. The data, reported at the barcode level at a monthly or bi-monthly frequency, are augmented with Country-of-Origin (COO) information that is collected from the products’ labels.

Our main finding is that exchange rate pass-through varies more across retailers within regions than across regions, and in particular that pass-through increases with retailer market share. We first estimate aggregate pass-through to be around 20% after one year and find it to vary little across regions in the UAE.² We then estimate pass-through across retailers within regions and find it is highest for supermarkets and lowest for mini-markets, with groceries in between. To control for any differences in business models across types of outlets, we repeat the analysis only considering supermarkets. We estimate that exchange rate pass-through in supermarkets with high market share in a region is in most instances significantly larger than that of supermarkets with low market share within that same region.

We also show that exchange rate pass-through is negatively correlated with product quality and with the elasticity of substitution of the product category. To measure quality we

¹Transactions data refer to the total units of a particular item (barcode) sold within a particular period in a specific outlet and the price of the item in the particular store at the time (day) of the audit within that period. Outlet types offer a characterization of outlets based on size and function, such as supermarkets, groceries, mini-markets, cafeterias, and pharmacies.

²We discuss later in the paper how our aggregate findings are in line with existing estimates in the literature.

follow Auer and Chaney (2009) and use variation in price within specific product category-weight-package type triplet as evidence of variation in quality. We measure the elasticity of substitution for each product category in the sample using the methodology in Broda and Weinstein (2006). While product quality can be viewed as a proxy for markups, the elasticity is a proxy for the degree of product heterogeneity and substitutability of the available varieties within a product group. Product quality varies across products in a specific group, but the elasticity of substitution is constant within a group.

We interpret our main finding that pass-through increases with retailer size to strongly suggest that retailers exhibit heterogeneity in price-setting behavior. We argue that such heterogeneity can be accounted for by differences in local costs and/or markups across retailers. In particular, if large retailers charge lower markups and/or have lower costs, then exchange rate pass-through will be positively related to retailer market size.³ This happens because the lower the local costs (Corsetti and Dedola, 2005) or markups (Hellerstein, 2006) are, the higher the portion of the final price that depends on the exchange rate, which implies higher pass-through, all else equal.⁴

The alternative interpretation to our findings is that retailers' pricing behavior is irrelevant and that the observed heterogeneity in pass-through is solely a consequence of exporters' pricing behavior, when different retailers source from different manufacturers. However, the results are inconsistent with such an interpretation. Recent research has documented that larger (Atkeson and Burstein, 2008), more productive (Berman et al., 2012) firms, and firms that produce higher quality goods (Auer and Chaney, 2009, and Antoniadou, 2013a) vary their markups more in response to exchange rate shocks. As a result, these firms do more pricing to market and their exports exhibit a lower degree of pass-through. Reconciling these insights with our findings and with the assumption that retailers' pricing behavior exhibits

³Using scanner data across thousands of outlets in seven countries, Antoniadou (2013b) shows that prices for identical goods fall with retailer size. To match this and other stylized facts presented in that paper, Antoniadou builds a theory of retailers where local components (costs and markups) are lower for large retailers, which allows them to set lower prices and sell more varieties.

⁴Heterogeneity in the degree of price stickiness across retailers is also consistent with this story, if we interpret costs more broadly to include "menu costs" and argue the latter are lower for larger retailers.

no heterogeneity implies that large retailers (i.e. the ones that we document to exhibit a higher degree of pass-through) source from small, inefficient, low quality exporters, while small retailers source from large, efficient, and high quality exporters. We view this scenario as less likely than one where retailers play an independent role, in addition to exporters and wholesalers, in shaping incomplete pass-through into consumer prices.⁵

Retailers' heterogeneity in price-setting has received little attention in the literature.⁶ There are a few recent studies, however, that provide important insights on the determinants of incomplete pass-through into retail prices, by decomposing it into factors such as local distribution costs and markup adjustment at the wholesale and retail level. Using data on beer (Hellerstein, 2008; Goldberg and Hellerstein, 2011) and coffee (Nakamura and Zerom, 2010) products, these studies show that it is both local costs and markup adjustments (especially at the wholesale level) that explain most of the incomplete pass-through observed in these industries.⁷ But while these papers document the importance of local distribution components in explaining low pass-through into retail prices for very specific industries, they treat retailers as one homogeneous entity and thus do not explore whether differences in pricing behavior across retailers exist and how they may matter. Showing variation in pricing behavior across retailers is the main (and novel) contribution of this paper.⁸

Our evidence on the heterogeneity in pass-through across retailers has a couple of additional implications that need further investigation. First, differences in the structure of retail competition can affect the degree of exchange rate pass-through in an economy. For example, Frankel et al. (2012) argue that changes in the monetary environment that raise

⁵Large retailers sell more brands, more varieties per brand, and more units per variety per brand (see Antoniadou, 2013b). Since large retailers do more business with each brand than small retailers do, we cannot justify the assumption that large retailers source from small exporters. Moreover, if we assume that brand productivity relates to how many varieties a brand can sell to a retailer, then large retailers source from more productive brands (exporters), for these brands sell more varieties to large than to small retailers.

⁶An exception is Nakamura (2008). The author considers a variance decomposition on prices of 100 products (UPCs) sold across 7,000 groceries in 50 US states and finds that about 2/3 of the variation in prices is driven by retailers' chain-level effects.

⁷Burstein and Gopinath (2013) provide a very thorough review of recent empirical and theoretical work on exchange rate pass-through and its determinants.

⁸Hong and Li (2013) analyze how the vertical *and* horizontal structure of retail markets interact to affect pass-through, but do not look at retailer heterogeneity along the dimensions considered here.

real wages and change local retail costs have contributed to the observed decrease in pass-through in developing countries. We add to this observation by arguing that in addition to changes in the monetary environment, any changes in the structure of retail competition and in the distribution of retails can also affect local retail costs and markups, and thus contribute to changes in the degree of exchange rate pass-through. Furthermore, a possible shift in preferences toward high quality goods by consumers in developing countries during recent years may have also contributed to a lower degree of exchange rate pass-through.

Second, if costs and markups vary across retailers, as suggested by our results, and if these differences affect their pricing behavior, then treating retailers as an homogeneous group averages out relevant information, which in turn might result in biased inference on aggregate price dynamics.⁹ As argued in Nakamura (2008), studying the sources of retail-level variation in prices appears to be a crucial step for our more general understanding of these dynamics.

The rest of the paper is organized as follows: In Section 2 we describe the data in more detail. In Section 3 we establish the methodology used to measure exchange rate pass-through. In Section 4 we report aggregate estimates and discuss how micro-economic factors affect pass-through by focusing on retailer market share, product quality, and demand elasticity. We discuss and conclude in Section 5.

2 Data

We use micro data on more than 25,000 fast-moving consumer goods (FMCGs) sold across 1,041 outlets in the United Arab Emirates (UAE). The country, situated in the Arabian Gulf, has a currency peg to the US dollar and imports the majority of its consumptions goods.

The data are recorded at the scanner (barcode) level and come from Nielsen. They

⁹Carvalho (2006) analyzes producer behavior to argue that not accounting for heterogeneity in the degree of producers' price stickiness leads to significant under-estimation of the real effects of monetary policy. See also Carvalho and Nechio (2011) for open-economy implications. Both studies, however, ignore the behavior of retailers, which we think is important for understanding price stickiness. We address this issue in follow-up work.

cover sales in thirty product categories between 2006 and 2010.¹⁰ The dataset contains price and quantity information for all products sold by each outlet, along with information on the brand, manufacturer, weight, package type, and whether the item was part of a manufacturer’s promotion.¹¹ The frequency is monthly for some categories and bi-monthly for others. Because of the mixed frequency, we convert all monthly series to bi-monthly and use bi-monthly data in the analysis.¹² While quantities are based on total sales per period, prices are based on actual prices at the day of the audit. The exact day of the audit during the monthly or bi-monthly period varies by store and is not reported by Nielsen. Listed prices reflect the actual prices paid by the consumers. Often times, in advanced countries these two prices differs as consumers use promotional coupons. However, this is not an issue we face in our data. Customer loyalty programs providing consumers with coupons to be used on selected products did not exist in UAE during the period of this study. Carrefour, the largest retailer, launched the first such program of its kind in the UAE on April 12, 2012.

In addition to having information on each product (barcode) sold by each outlet, there is information on the location of each outlet, its type, and its chain code (if it belongs to a chain). Location covers three regions in the UAE: Dubai and Sharjah, Abu Dhabi and Al Ain, and Northern Emirates. Type classifies outlets as supermarkets, groceries, self-service, mini-markets, pharmacies, eateries, and convenience stores. The market share of each outlet can be retrieved since total sales by each outlet are known.

Descriptive statistics for the dataset are provided in Table 1. In 2010, 25,899 unique products were sold by 1,041 outlets in the UAE. Retailers sourced these products from 1,144 different manufacturers/distributors and these products belonged to 2,828 different brands.

¹⁰According to Nielsen, the data cover about 85% of all FMCGs’ sales in United Arab Emirates. The categories are: beans, blades, bullion, cereals, cheese, chewing gum, chocolate, cigarettes, cooking oil, carbonated soft drinks, deodorants, detergents, dish wash, energy drinks, fabric conditioners, insecticides, juices, liquid cordials, male grooming, milk, milk powder, powder soft drink, shampoo, skincare, skin cleansing, sun care, tea, toothbrush, toothpaste, water.

¹¹Includes price and non-price promotions. Examples of non-price promotions are promotion bundle, promotion free, promotion gift, promotion same, promotion unit, and promotion volume.

¹²We only consider odd months in the analysis: January, March, May, July, September, and November. For the series available at a monthly frequency, we just remove observations for the even months. For the series available at a bi-monthly frequency, we divide quantities in half and keep prices the same.

We observe that some outlets are part of chains, with a total of 15 different chains listed in the dataset. To ensure that changes in pass-through are not driven by entry or exit of outlets in our sample over time, we only consider a balanced panel of outlets that existed in all periods during January 2006 and December 2010. This reduced the number of outlets to 431 but kept 96.6% of dollar sales since the majority of the outlets we drop are tiny stores.¹³

The Nielsen dataset is augmented with Country-of-Origin (COO) collected from the products' labels. A team of researchers, equipped with hand-held scanners, visited the largest hypermarket in UAE and recorded COO information for each product that was sold at the store at the time of the visit. To minimize errors and to collect information on products that were out of stock, the team was sent back to the same outlet for a second round of scanning. Any barcodes that appeared to originate from different countries during the two rounds of data collection were dropped. This occurred in less than 1% of the scanned products. Both rounds of data collection took place in 2011. Ideally, we would have liked to be able to scan all products in all stores. However, this was not feasible as it required permission from each store owner, which we did not have.

A total of 4,508 products were scanned in 2011. Either because many of these products did not exist in prior years, or they existed but were not sold at the particular outlet we visited, we were only able to match COO information with 2,905 products that were sold between 2006 and 2010.¹⁴ We then eliminated products coming from countries with currencies pegged to the US dollar, including other Gulf Cooperation Council (GCC) countries. In the end, we are left with 2,307 products.¹⁵

It is worth pointing out that the euro dominates foreign currency transactions in our

¹³Of the 431 outlets considered in the balanced panel, supermarkets, groceries, and mini-markets/self-service stores account for 10%, 30%, and 60%, respectively.

¹⁴The rate at which new products are introduced and old products are dropped is quite large. Our analysis shows that in a two-year period, product entry rates were between 40% and 90%, depending on the product category. To put this in perspective, using similar data for the US, Broda and Weinstein (2010) find that it takes four years to get 40% of new products.

¹⁵Of the 598 products that we dropped because of the dollar peg, 95% originated from Saudi Arabia. We also note that, by the end of the process, the COO-augmented sample has no observations for three of the categories, namely bullion, milk and tea.

sample. This can be seen from Figure 1, which shows countries of origin ranked by number of products and value of products sold in the UAE. More than half the products in our sample come from the Eurozone. In addition, three other EU countries, namely the UK, Poland, and Switzerland account for about 20%, whether measured by value or by number of products sold.

3 Methodology

We estimate exchange rate pass-through using a specification that is very standard in the empirical literature (see for example Gopinath et al. (2010) for a recent application). Specifically, we employ the following pooled regression:

$$\Delta p_{c,t} = \mu_c + \sum_{j=1}^k \beta_j \Delta e_{c,t-j} + \sum_{j=1}^k \alpha_j \Delta p_{c,t-j}^* + \sum_{j=1}^k \gamma_j \Delta y_{t-j} + u_{c,t} \quad (1)$$

where Δp_c is the average bi-monthly change in the (log) price of all products imported from country c , e_c is the bilateral exchange rate between UAE and country c (UAE Dirhams per unit of foreign currency), $\Delta p_{c,t}^*$ measures the bi-monthly change in the log price level in country c , and Δy measures bi-monthly changes in demand conditions in the UAE.

To obtain Δp_c we proceed in two steps: First, we compute the price P_{ic} as a *simple* average of the prices for each product i across all outlets. We use a simple average to ensure that sales promotions at an outlet - which are always accompanied by a substantial surge in the quantity sold at that particular outlet - do not drive changes in P_{ic} .¹⁶ In addition, we only consider a balanced panel of outlets that were audited in all periods in order to ensure that changes in average prices of each product are not driven by changes in outlet composition. Second, we compute Δp_c as the weighted average price change for all P_{ic} 's from country c . Weights are based on sales volumes of each product. We do this to minimize

¹⁶For robustness, we consider a more disaggregated definition of products, where we do not average prices of the same barcode across outlets. Results are not affected, as reported below.

measurement error that can arise when items with very low sales volume experience sharp price fluctuations and become more important in influencing average prices than the high-volume products with more stable prices.

Exchange rates come from the International Financial Statistics (IFS) database. For robustness, three alternative timing conventions are used: average daily exchange rates over the current bi-monthly period, average daily exchange rate over the previous bi-monthly period and exchange rates quoted at the last day of the previous period. We use the first convention for our baseline specification. As we show below, though, results are robust to these different conventions.

We use foreign CPI data to control for shifts in prices that are not driven by changes in exchange rates. Shifts in foreign prices affect marginal costs and, subsequently, they have potential effects on the prices of imported products. For the case of the Eurozone countries, we use country-specific CPI measures unless the product label states EU. In such cases, we use an EU-based CPI measure.¹⁷

To capture shifts in domestic demand conditions, we compute an output measure based on the value of total sales of FMCG products in our sample. Such measure is a much better proxy than conventional GDP for changes in demand of the products under study, for three main reasons: (i) measures of GDP in developing countries are not as accurate as measures in advanced economies, (ii) GDP changes in the UAE are mainly driven by changes in the price of oil and of natural gas and as a result, they do not reliably reflect changes in demand conditions, and (iii) the data are not available at a bi-monthly frequency. An advantage of the detailed dataset we have is that we can construct a market-specific measure of GDP that better tracks changes in the demand conditions for FMCGs.

The parameter of interest is $\beta(k) = \sum_{j=1}^k \tilde{\beta}_j$, where $\tilde{\beta}_j$ are the estimated coefficients from the regression specification above with k lags. $\beta(k)$ thus measures the cumulative percentage change in consumer prices in response to a one-percent change in exchange rates.

¹⁷For robustness, we re-ran the regressions using PPI data for the countries that such data are available (mainly EU). The results are almost identical and available upon request.

This represents the portion of the exchange rate change that is passed-through to prices after k bi-monthly periods. We are interested in the cumulative effect of exchange rates on retailer prices at different time horizons, so we estimate specification (1) varying the number of lags from 1 (two months) to 6 (one year) and computing the summation $\beta(k)$ each time. For example, to obtain the degree of exchange rate pass-through after 2 months, we run (1) using one lag and collect $\beta(1)$. For pass-through after one year, we run the regression using six lags and report $\beta(6)$. Notice that the number in parenthesis specifies both the number of lags used in the estimation and the number of coefficients added up in the summation.

4 Analysis

4.1 Aggregate Pass-Through

We start this section by presenting a measure of aggregate exchange rate pass-through on FMCGs in UAE. With all outlets pooled together, pass-through is estimated to be 20% after one year.¹⁸ The degree of aggregate pass-through over time, along with the 95% confidence intervals, is shown in Figure 2. Table 2 reports the estimates of the pass-through coefficients, along with the parameters for other relevant covariates. At all time horizons, pass-through is statistically different from zero. Moreover, we observe that pass-through is gradual, with about half of the response occurring within 6 months.¹⁹

This estimate falls in the mid-range of estimates obtained in related studies that use prices of traded goods at the dock and prices of aggregate baskets that include both traded and non-traded goods at the point of consumption. Using aggregate indices for *import* prices in OECD countries, Campa and Goldberg (2005) find evidence of partial, but relatively large

¹⁸Some papers measure the degree of exchange rate pass-through after a quarter, a period that is sometimes referred to as short-run. Our analysis shows that short run pass-through is about 3%, calculated as $\beta(1) + \beta(2)/2$.

¹⁹For robustness, we estimate equation (1) using alternative timing conventions for the exchange rates and a more disaggregated definition for the price series (as discussed above). Table 3 reports these variations on the baseline specification (which is also included, for comparison purposes, in column 1). These results are by and large robust to these variations.

pass-through after a year, with an average value of 64% across the sample of countries. Olivei (2002) and Marazzi and Sheets (2007) estimate lower (and declining) pass-through for US import prices. These studies find aggregate long run pass-through to be around 50% during the 1980s and 20% in the 1990s. Gopinath et al. (2010) use more recent US good-level data on prices at the dock and find comparable numbers. Pass-through into *consumer* prices is expected to be smaller, as other factors past the border contribute to making prices more unresponsive to exchange rate movements. Indeed, our benchmark retailer pass-through estimate of 20% is generally lower than the above values.²⁰ Studies that look at consumer price indexes for a selection of developed countries obtain pass-through estimates in the range of 0% to 17%, depending on the sample and specification considered, and in most cases statistically insignificant (e.g. Goldberg and Campa (2010), Ihrig et al. (2006)). These estimates of pass-through into consumer prices tend to be lower than those obtained here. However, as these indexes are based on baskets that contain a large portion of nontraded goods, pass-through is likely to be understated. While the aggregate specification is not the main focus of the paper, showing that our aggregate estimate using data from UAE does not differ from estimates obtained using data from advanced economies, shows that there is nothing particularly different about our data that may create concerns later on in the analysis.

Next, we show that there is little variation in pass-through across regions by running specification (1) for each region, separately. Again, we discard information on outlets by pooling them all together. The regression coefficients for each region are reported in Figure 3. We observe that exchange rate pass-through behavior across regions is very similar, both in the degree and in the evolution over time. Table A.1 reports point estimates and standard errors for the cumulative pass-through coefficients in the three regions, along with pairwise differences in pass-through and t-statistics for the differences (at all horizons).²¹ The results

²⁰For instance, our estimate is lower than most of the values in Campa and Goldberg (2005), which exhibit substantial cross-country variation around the reported average.

²¹In this instance and in subsequent analysis, we refrain from including confidence intervals in the figures to avoid cluttering. Appendix A has tables with significance tests for pass-through differences across all the

confirm the visual impression, as in most cases the differences are small and not statistically significant. This finding suggests that pricing to market is uniform across the country.²² However, as we show next, although there is little variation in pass-through *across* regions, there is substantial variation in pass-through across outlets *within* regions.

Because there is a large presence of Eurozone products in our dataset, we find it worthwhile to compare overall pass-through to Euro pass-through. That is, we use specification (1) to estimate pass-through for products originating from the Eurozone only. To control for compositional effects, stemming from the fact that supermarkets are more likely to carry European brands than groceries and mini-markets, we restrict the analysis to supermarket data. The results are reported in Figure 4. Comparing Figures 4 and 2, we find that Eurozone pass-through is higher. In the long run, pass-through for goods from the Eurozone is twice the size of overall pass-through, although there is considerable uncertainty around the point estimates.

While this finding deserves further investigation, two plausible explanations are worth mentioning. First, it may be the case that supermarkets that carry a larger share of Eurozone products also have a larger market share. We explore the relation between retailers' market share and pass-through in the next section and find that it is indeed positive. Second, we might be observing third currency pricing behavior. Exporters in countries with currencies that have been more volatile than the Euro during the 2006-2010 period (such as Poland and Turkey) may have chosen to set prices in US Dollars. Since the UAE Dinar is pegged to the US Dollar, exchange rate pass-through for the products originating from these countries is therefore expected to be substantially lower than pass-through for products from the Eurozone. For empirical evidence of Producer Currency Pricing behavior among Eurozone firms, see Antoniadou (2012).

various dimensions that we analyze throughout the paper.

²²To the extent that there is a difference, a higher pass-through in Dubai and Sharjah may be due to the fact that their population is mostly comprised of expats, who are more likely to stay in the region for shorter periods, whereas in the other two regions the population is mostly comprised of nationals. Retailers in these regions may be less willing to pass the burden of exchange rate movements to the consumers as they try to build loyalty with the local population.

Next, we turn to the main focus of this paper, and exploit the outlet-level information to make assessments about pass-through across outlets. We examine micro-economic factors that might determine the degree to which movements in the exchange rate affect the price that consumers pay for imported goods. Recent work has linked pricing to market/exchange pass-through to firm-level characteristics of exporters (see Berman et al., 2012 and Chatterjee et al., 2013). Our exercise is similar in spirit, but we look at retail prices in the importing countries and we are particularly interested in analyzing whether heterogeneity in retailer size has an impact on pass-through. The following factors are examined: (i) retailer market share, (ii) quality differentiation across products, used as proxy for markups, and (iii) product homogeneity within product categories as measured by the elasticity of substitution of each product category. The first is an outlet-specific attribute, the second is product-specific, and the third is category-specific.

4.2 Retailer Market Share

Retailer market share may affect exchange rate pass-through. One working hypothesis is that if large retailers charge lower markups and/or have lower costs (see Antoniadou, 2013b), then exchange rate pass-through will be positively related to retailer market size. This happens because the lower the local costs or markups are, the higher the portion of the final price that depends on the exchange rate, which, all else equal, implies higher pass-through.²³

We test this hypothesis by examining how exchange rate pass-through varies across outlet type. Outlets in our sample are supermarkets, groceries, mini-markets, self-services, pharmacies, convenience stores, cafeterias, and eateries. Table 4 provides the number of outlets and outlet types across the three regions in UAE. The majority of outlets are located in the Dubai and Sharjah region. While supermarkets in each region are few, they account for the majority of sales, as the high concentration ratios show. This can be seen clearly from Table 5, which reports sale shares of the three main outlet types in the UAE as a whole

²³An interesting issue, which we don't explore here, is whether cross-border pass-through is symmetric to a depreciation or an appreciation of the currency.

and by region. At about 88%, supermarkets' total share is much larger than groceries and self-service stores, which account for roughly 4% and 8% respectively. This is true for all three regions.²⁴ For the purpose of the analysis that follows, we will only focus on the three main outlet types, namely supermarkets, groceries, and self-service stores.

We run regression (1) for each outlet type. To account for changes in demand across regions, we replicate the analysis for each region. The results are presented in Figures 5 and 6. Two striking results stand out. Exchange rate pass-through is higher in supermarkets than in groceries and self-service stores, and within-variation in pass-through in each region is substantially higher than between-variation (see Figure 3).

The finding that exchange rate pass-through is higher for supermarkets than groceries and self-service stores suggests that market share is positively correlated with pass-through. However, there may be other differences across outlet types that affect pass-through without being related to market share. For example, the composition of imported goods can vary across outlet types, as well as management pricing behavior and clientele.

To control for such variation not linked to market share, we replicate the analysis focusing only on supermarkets. In each region, we allocate supermarkets into two bins based on their market share, with equal number of outlets in each bin.²⁵ We then estimate pass-through for each market share bin. Figures 7 and 8 reports these coefficients for the country and for each region, respectively. Again, we find that exchange rate pass-through is positively correlated with market share and that relation is robust across regions.

4.3 Quality

Next we investigate how product quality affects exchange rate pass-through. Following Auer and Chaney (2009), we use variation in price within specific product category-weight-

²⁴Shares are computed as fraction of observed sales, using the full sample. Outlet market shares and concentration ratios do not significantly change over the sample period. The numbers are very similar when we use the smaller COO-augmented sample.

²⁵In the country-wide analysis, outlets in the low-share bin have less than 1% market share in their region, while outlets in the high-share bin have from 1% to 12% share.

packaging type triplets as evidence of variation in quality. Examples of such triplets are water-0.33L-glass, water-0.33L-tins, and water-0.33L-pet. In total, 413 such triplets are considered. The deviation between the price of a product and the average price of all products within that same triplet is used to make inferences about quality.²⁶

We allocate products into three quality bins by sorting the price deviations and setting the 33rd and 67th percentile as the cutoff points. We then estimate pass-through for each bin. We run a regression across the entire country, and then for robustness, we repeat the analysis for each region. The national and regional results are presented in Figures 9 and 10, respectively. Exchange rate pass-through is high for low quality goods, but low for medium- and high-quality goods. The results suggest that a certain markup threshold exists, beyond which retailers are able to absorb most of the movement in the exchange rate.

While this study is among the first to confirm empirically this strong negative relation, possible channels by which product quality affects exchange rate pass-through have been discussed in previous work.²⁷ Bussiere and Peltonen (2008) emphasized the role of markups, while Auer and Chaney (2009) considered changes in the quality- and quantity- mix of goods produced and consumed in response to movements in exchange rates.

The results warrant a couple of comments. First, if globalization affects the share of quality goods produced and consumed and if it affects market concentration across wholesalers and retailers then one may expect that two sources of variation in pass-through across time and space may be variations in the average quality of the consumption basket and/or changes in cross-border market toughness.²⁸

²⁶Arguably, price may not always be a good proxy for quality. If a Perrier and a San Pellegrino 1-Liter, glass bottles of water both sell for a price premium over other goods, but Perrier sells 1,000 units per month, while San Pellegrino only sells 1, it can be deduced that consumers perceive Perrier as a product of higher quality than San Pellegrino. However, for the purpose of the analysis in this paper, what matters is the perception that suppliers have on the quality of their products as it determines the markups charged. So, if both products have high price, regardless of the quantity sold, we make the assumption here that both exhibit high markups. For a discussion on how quantity and price can be used to extract quality using constant markups, see Broda and Weinstein (2010) and Feenstra and Romalis (2012).

²⁷In a working paper, Auer et al. (2012) use European car data to show that pass-through is larger for low than for high quality cars.

²⁸For studies that link trade liberalization and quality, see Hummels and Klenow (2005), Verhoogen (2008), and Goldberg et al. (2012). For studies that consider how trade liberalization affects retailers, see

Second, our results confirm a hypothesis generated by two distinct literatures that link firm heterogeneity and pricing to market, on one hand, and firm heterogeneity and endogenous quality choice on the other hand. One set of studies documents that high-productivity exporters (Berman et al., 2012) and exporters with high market share (Atkeson and Burstein, 2008) absorb more exchange rate pass-through in their markups. Another set of studies, which endogenize quality choice (see Antoniadou, 2013a, Johnson, 2012, Baldwin and Harrigan, 2008), theorize that high-productivity firms have higher market shares and export higher-quality goods. By putting together the predictions of these two literatures, we can formulate the hypothesis that exchange rate pass-through must be lower for high-quality goods. This is because high-quality goods are produced by high-productivity firms that exhibit with high market shares and absorb more pass-through in their markups. Our analysis finds strong support for the aforementioned hypothesis.

4.4 Elasticity of Substitution

Our third exercise is motivated by the conjecture that product differentiation can have both a positive and negative effect on pass-through, as noted in Bussiere and Peltonen (2008). Since highly differentiated products command higher markups, exporters and retailers may use markups to absorb fluctuations in exchange rates. This notion suggests a negative relation between product differentiation and exchange rate pass-through. Yet, highly differentiated products are associated with high market power (less competition), which may encourage exporters and retailers to pass more of the fluctuations in exchange rates to the consumers. Hence, this channel suggests a positive relation between product differentiation and exchange rate pass-through. Overall, the impact of product differentiation on exchange rate pass-through is ambiguous.

Our interpretation of the discussion is that product differentiation has two dimensions: a product-specific dimension and a product-group (category) dimension.²⁹ The product-

Raff and Schmitt (2009).

²⁹Indeed, in models such as Melitz and Ottaviano (2008), and Antoniadou (2013a) there is a product-

specific dimension reflects product quality. As we showed in the previous section, our results confirm the prediction that higher quality (markup) goods exhibit lower pass-through.

The product-group dimension is captured by the elasticity of substitution of each product-group, which is constant within the group. For example, the juice and water product-groups have two different elasticities of substitution. These elasticities characterize the substitutability among products in a given category. In categories with high elasticity of substitution, there is more substitutability among products and hence, exporters and retailers have less desire to pass the extra cost to the consumers. In contrast, in categories with low elasticity of substitution, consumers are more likely to absorb most of the burden.

By realizing this very important but subtle point, we can now formulate a second hypothesis: exchange rate pass-through and the elasticity of substitution are negatively related.

To test this hypothesis, we first use the full sample to estimate the elasticity of substitution for each product category, employing a methodology proposed by Broda and Weinstein (2006) and Broda et al. (2006).³⁰ We then allocate the categories to three equally sized bins as shown in Table 6.³¹ The elasticity of substitution is the lowest in the Liquid Cordials, Suncare, and Blades categories, and the highest in the Chewing Gum, Power Soft Drinks, and Cigarettes categories. Finally, we run the pass-through regression for each bin.

The regression results by elasticity bin are reported in Figure 11 and confirm the hypothesis above. Exchange rate pass-through is the highest for the low elasticity bin, which suggests that the higher the degree of product heterogeneity within a particular product group, the higher the degree of exchange rate pass-through into consumer prices.

specific elasticity and an elasticity that characterizes the degree of product differentiation among all available varieties.

³⁰We would like to thank David Weinstein for sharing the code for the estimation of the elasticities.

³¹We recall that the COO-augmented sample only has data for 27 categories.

5 Discussion

We have documented substantial variation in the degree of exchange rate pass-through on imported consumer goods across retailers in the United Arab Emirates. Specifically, there is evidence that retailers with higher market share pass more of the movement in the exchange rate to the consumer, while retailers with small market shares end up passing less. Furthermore, we have documented that pass-through is lower for high-quality goods, and for product categories with high elasticity of substitution.

Our findings extend the literature on the determinants of exchange rate pass-through (as recently reviewed by Burstein and Gopinath, 2013) by documenting that substantial heterogeneity also exists at the level of the retailer. Because such heterogeneity is consistent with a model where retailers exhibit heterogeneity in pricing behavior due to differences in costs and/or markups (see Antoniadou, 2013b), extending traditional economic models to more carefully account for both manufacturers' and retailers' behavior, along with the vertical relation between the two, is essential for the understanding of price dynamics at both the micro and macro level.

The strength of the analysis comes from our ability to link prices and quantities of products sold across hundreds of outlets with country-of-origin information extracted from the product labels. In addition, the information is provided for thirty product categories that cover more than 85% of the fast moving consumer goods sold, at the highest level of disaggregation, and at the point of consumption. Importantly, the data include outlet-level information, which allows us to relate pass-through to retailers' characteristics. Finally, our data come from a developing country with a committed dollar peg, where we believe information on cross-border pass-through is most relevant. This is true more generally for economies where gross trade flows constitute a large portion of GDP.

To conclude, a few comments are in order regarding the United Arab Emirates. Studying exchange rate pass-through in the UAE is relevant, among other things, because gross trade

flows constitute a large portion of GDP and because of its dollar peg.³² At the same time, because of the peculiarity of the UAE, with its high GDP per capita and the preponderance of its energy sector, concerns might be raised about how much these findings can be generalized.

For starters, we are reassured by the observation that our findings on the elasticity of substitution and quality are broadly consistent with the intuition in models that are calibrated and estimated for advanced economies. More specifically, the vast majority of the population is made up by expatriates, whose origin is from developed and developing countries alike. Many of the retailing chains in the UAE, along with their management, are international. Moreover, we recall that we have excluded from our sample goods that are imported from other GCC countries, which have fixed exchange rates relative to the UAE. We then expect bundles of consumption goods and invoicing practices to be generally comparable to (or at least not systematically different from) those of other countries.³³

Finally, our analysis further explores variation *within* the UAE, across its regions. The latter display notable differences along several dimensions, including the degree of urbanization, infrastructure and demographics, from the “Western-like” Dubai to the more “traditional” Northern Emirates, where UAE citizens make up the majority of the population. Yet, our findings on aggregate pass-through and its potential determinants show remarkable robustness to regional differences. This seems to suggest that the basic insights are relatively general.

³²For countries committed to dollar pegs, the degree of exchange rate pass-through into consumer goods prices determines how much inflation these countries import from abroad whenever the US dollar depreciates relative to the currencies of trading partners. Fears of importing inflation make some policy makers, especially those in the Arabian Gulf, ponder a move away from the dollar peg.

³³As shown in section 2, a large portion of the FMCGs in our sample is imported from the Eurozone. We have anecdotal evidence from informal discussions with sourcing managers that pricing is predominantly in the currency of the producer.

References

- [1] Antoniadou, A. (2012), “Local versus producer currency pricing: Evidence from disaggregated data”, *International Economic Review* 53(4), 1229-1241.
- [2] ----- (2013a), “Heterogeneous firms, quality, and trade”, FREIT Working Paper.
- [3] ----- (2013b), “Six Facts About Retailers”, Georgetown University Working Paper.
- [4] Atkeson, A. and A. Burstein (2008), “Pricing to market, trade costs, and international relative prices”, *American Economic Review* 98(5): 1999-2031.
- [5] Auer, R. and T. Chaney (2009), “Exchange rate pass-through in a competitive model of pricing-to-market”, *Journal of Money, Credit, and Banking* 41(1): 151-175.
- [6] Auer, R., Chaney, T. and P. Saure (2012), “Quality Pricing-to-Market”, Federal Reserve Bank of Dallas Working Paper #125.
- [7] Baldwin, R. and J. Harrigan (2011), “Zeros, quality and space: trade theory and trade evidence”, *American Economic Journal Microeconomics* 3(2): 60-88.
- [8] Berman, N., Martin, P. and T. Mayer (2012), “How do different exporters react to exchange rate changes”, *Quarterly Journal of Economics* 127: 437-492.
- [9] Broda, C. and D. Weinstein (2006), “Globalization and the gains from variety”, *Quarterly Journal of Economics* 121(2): 541-585.
- [10] ----- (2010), “Product creation and destruction: evidence and price implications”, *American Economic Review* 100(3): 691-723.
- [11] Broda, C., Greenfield, J. and D. Weinstein (2006), “From groundnuts to globalization: A structural estimate of trade and growth”, NBER Working Paper #12512.

- [12] Burstein, A. and G. Gopinath (2013), “International prices and exchange rates”, Forthcoming *Handbook of International Economics*, Vol. IV.
- [13] Bussiere, M. and T. Peltonen (2008), “Exchange rate pass-through in the global economy: The role of emerging market economies”, ECB Working Paper series #951.
- [14] Campa, J.M. and L.S. Goldberg (2005), “Exchange rate pass-through into import prices”, *Review of Economics and Statistics* 87(4): 679-690.
- [15] Carvalho, C. (2006), “Heterogeneity in price stickiness and the real effects of monetary shocks”, *The B.E. Journal of Macroeconomics* 6(1): 1-58.
- [16] Carvalho, C. and F. Nechio (2011), “Aggregation and the PPP puzzle in a sticky-price model”, *American Economic Review* 101(6): 2391-2424.
- [17] Chatterjee, A., Dix-Carneiro R. and J. Vichyanond (2013), “Multi-product firms and exchange rate fluctuations”, *American Economic Journal: Economic Policy* 5(2): 77-110.
- [18] Choudri, E., Faruquee, H., and D. Hakura (2005) “Explaining exchange rate pass-through in different prices”, *Journal of International Economics* 65(2), 349-374.
- [19] Corsetti, G. and L. Dedola (2005), “A macroeconomic model of international price discrimination”, *Journal of International Economics* 67: 129-155.
- [20] Feenstra, R., J. Gagnon, and M. Knetter (1996), “Market shares and exchange rate pass-through in world automobile trade”, *Journal of International Economics* 40: 187-207.
- [21] Frankel, J., Parsley, D. and S. Wei (2012), “Slow pass-through around the world: A new import for developing countries?”, *Open Economies Review* 23(2): 213-251.

- [22] Goldberg, L. and J. Campa (2010), “The sensitivity of the CPI to exchange rates: Distribution margins, imported inputs and trade exposure”, *Review of Economics and Statistics* 92(2): 392-407.
- [23] ----- (2011), “A structural approach to identifying the sources of local-currency price stability”, Working paper.
- [24] Goldberg, P., Khandelwal A., Pavcnik, N. and P. Topalova (2012), “Multi-product firms and product turnover in the developing world: Evidence from India”, *Review of Economics and Statistics* 92(4): 1042-1049.
- [25] Gopinath, G., Itskhoki, O. and R. Rigobon (2010), “Currency choice and exchange rate pass-through”, *American Economic Review* 100(1): 304-336.
- [26] Hellerstein, R. (2008), “Who bears the cost of a change in the exchange rate? Pass-through accounting for the case of beer”, *Journal of International Economics* 76: 14-32.
- [27] Hong, G.H. and N. Li (2013), “Market structure and cost pass-through in retail”, Working Paper.
- [28] Hummels D. and P. J. Klenow (2005), “The variety and quality of a nation’s exports”, *American Economic Review* 95(3): 704-723.
- [29] Ihrig, J., Marazzi, M. and A. Rothenberg (2006), “Exchange-rate pass-through in the G-7 countries”, International Finance Discussion Papers #851, Federal Reserve Board.
- [30] Johnson, R. (2012) “Trade and prices with heterogeneous firms”, *Journal of International Economics* 86(1): 43-56.
- [31] Marazzi, M. and N. Sheets (2007), “Declining exchange rate pass-through to U.S. import prices: The potential role of global factors”, *Journal of International Money and Finance* 26: 924-947.

- [32] Melitz, M. and G. Ottaviano (2008), “Market size, trade, and productivity”, *Review of Economic Studies* 75: 295-316.
- [33] Nakamura, E. (2008), “Pass-through in retail and wholesale”, *American Economic Review P&P* 98(2): 430-437.
- [34] Nakamura, E. and D. Zerom (2010), “Accounting for incomplete pass-through”, *Review of Economic Studies* 77: 1192-1230.
- [35] Raff, H. and N. Schmitt (2009), “Imports, pass-through, and the structure of retail markets”, CESifo Working Paper #2817.
- [36] Verhoogen, E. (2008), “Trade, quality upgrading and wage inequality in the Mexican manufacturing sector”, *Quarterly Journal of Economics* 123(2): 489-530.

Table 1: Descriptive statistics for the United Arab Emirates

Year	Products	Categories	Brands	Manufacturers	Outlets	Chains	Regions
2006	25,462	30	3,158	974	840	12	3
2007	24,360	30	2,949	946	912	14	3
2008	23,908	30	2,820	976	915	14	3
2009	23,988	30	2,756	1,002	1,031	15	3
2010	25,889	29	2,828	1,144	1,042	15	3

Table 2: Baseline aggregate pass-through regression

Horizon, in months (k)	2 (1)	4 (2)	6 (3)	8 (4)	10 (5)	12 (6)
$\sum_{j=1}^k \Delta e_{t-j}$	0.025*** (0.011)	0.045*** (0.015)	0.104*** (0.017)	0.148*** (0.022)	0.175*** (0.032)	0.202*** (0.045)
$\sum_{j=1}^k \Delta p_{t-j}^*$	0.153*** (0.040)	0.148*** (0.044)	0.108*** (0.051)	0.022 (0.066)	0.070 (0.105)	0.085 (0.137)
$\sum_{j=1}^k \Delta y_{t-j}$	0.039*** (0.004)	0.041*** (0.005)	0.037*** (0.006)	0.045*** (0.007)	0.065*** (0.010)	0.029* (0.017)
R^2	0.18	0.17	0.15	0.14	0.13	0.12
$N_{observations}$	788	753	718	684	650	616

Notes: Estimates from specification (1). Robust standard errors in brackets. ***, **, * denote significance at the 1%, 5% and 10% level, respectively.

Table 3: Robustness for aggregate pass-through

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
<i>Month</i>												
2	0.02	0.02	0.03	0.03	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.01
4	0.04	0.05	0.06	0.06	0.05	0.05	0.02	0.03	0.02	0.04	0.03	0.04
6	0.10	0.10	0.14	0.13	0.13	0.12	0.05	0.08	0.08	0.12	0.07	0.10
8	0.15	0.15	0.15	0.14	0.15	0.14	0.10	0.13	0.11	0.14	0.10	0.13
10	0.17	0.17	0.18	0.15	0.18	0.15	0.15	0.17	0.17	0.15	0.14	0.15
12	0.20	0.18	0.14	0.13	0.16	0.14	0.19	0.18	0.21	0.17	0.19	0.17
<i>Supermarkets only</i>	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
<i>Exchange Rate</i>												
Average t	*	*					*	*				
Average (t-1)			*	*					*	*		
End period					*	*					*	*
<i>Disaggregated</i>	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES

Notes: The main entries are the cumulative pass-through coefficients $\sum_{j=1}^k \beta_j$ as in specification (1). We consider three timing conventions for the exchange rate ((i) the average daily value in the current month, (ii) the average daily value in the previous month and (iii) the end-of-period value for the the previous month. The *Disaggregated* version considers the price of each product-outlet combination as a separate data entry (i.e. it doesn't compute the average price for a given product across outlets)

Table 4: Outlet information by region

Region	All	Number of outlets per region by outlet type				Mkt Concentration Ratio	
		Supermarkets	Groceries	Self-Service	Other*	Top-4	Top-8
Dubai - Sharjah	599	50	129	36	384	0.72	0.92
Abu Dhabi - Al Ain	277	25	135	21	96	0.83	0.89
Northern Emirates	165	10	67	6	82	0.87	0.90
Total UAE	1,041	85	331	63	562	0.28	0.45

* Includes cafeterias, eateries, pharmacies and convenience stores

Table 5: Outlet sales shares by region

Region	% of observed sales, by outlet type		
	Supermarkets	Groceries	Self-Service
Dubai - Sharjah	90.5	3.8	5.6
Abu Dhabi - Al Ain	84.8	3.7	11.4
Northern Emirates	87.3	5.3	7.3
UAE	88.9	3.9	7.9

Table 6: Elasticities of substitution by product category

Group	Category	Elasticity
i. Low		
	Liquid cordials	4.13
	Suncare	4.88
	Blades	5.80
	Skin cleansing	6.88
	Milk powder	8.65
	Male grooming	9.89
	Skincare	10.92
	Toothbrush	12.61
	Cooking oil	13.60
ii. Medium		
	Toothpaste	14.01
	Deodorant	19.75
	Water	20.85
	Csd	21.14
	Juices	23.19
	Shampoo	23.80
	Energy drinks	24.11
	Cereals	24.37
	Fabric conditioner	25.10
iii. High		
	Beans	25.53
	Chocolate	25.93
	Insecticides	32.91
	Detergents	35.33
	Cheese	35.70
	Dishwash	38.55
	Powder soft drink	39.92
	Chewing gum	86.80
	Cigarettes	131.50

Notes: For more information regarding the methodology used to estimate elasticities, see Broda and Weinstein (2006) and Broda et al. (2006)

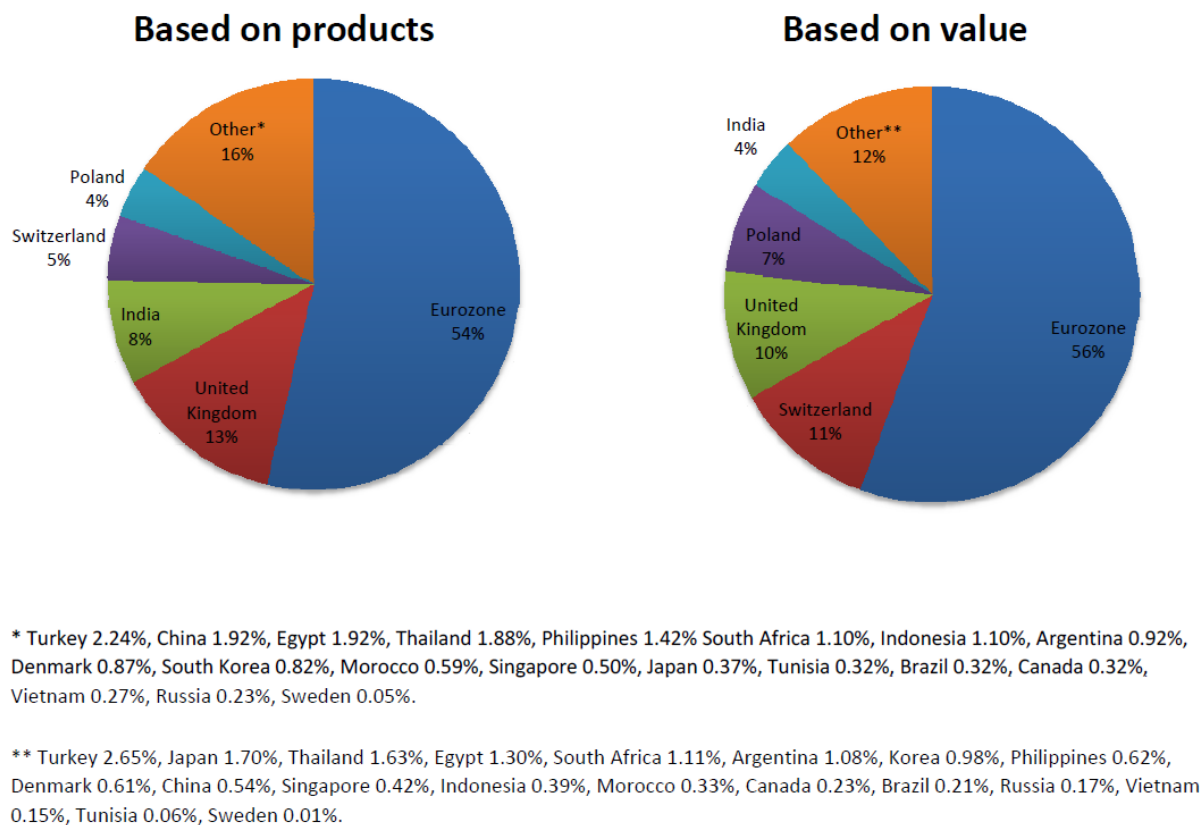


Figure 1: Country of origin information (based on 2010 data)

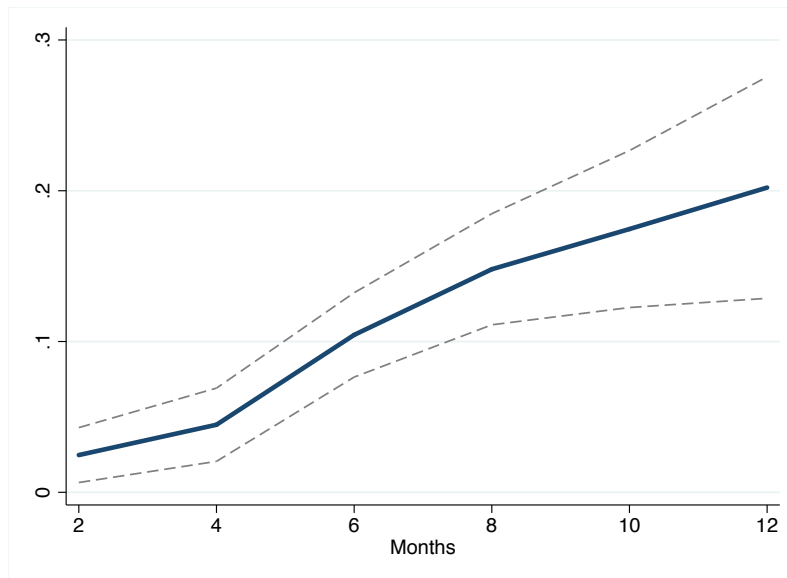


Figure 2: Aggregate exchange rate pass-through in UAE

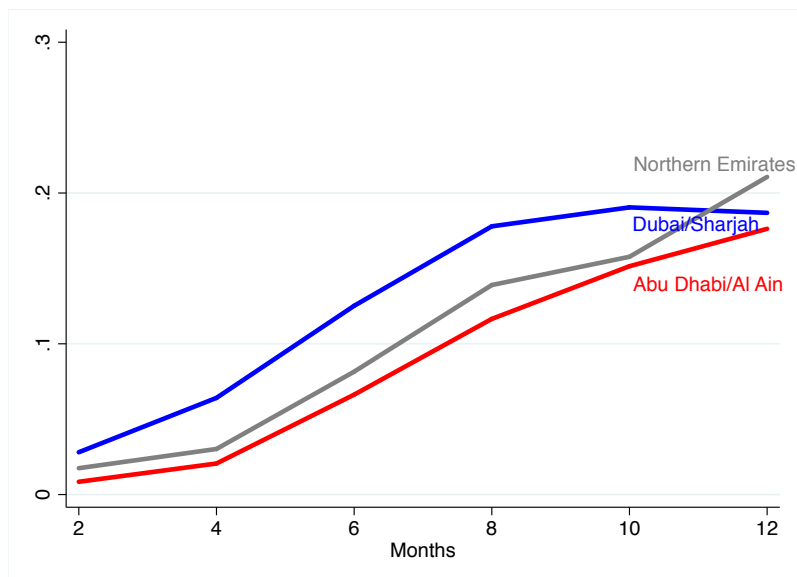


Figure 3: Exchange rate pass-through by region

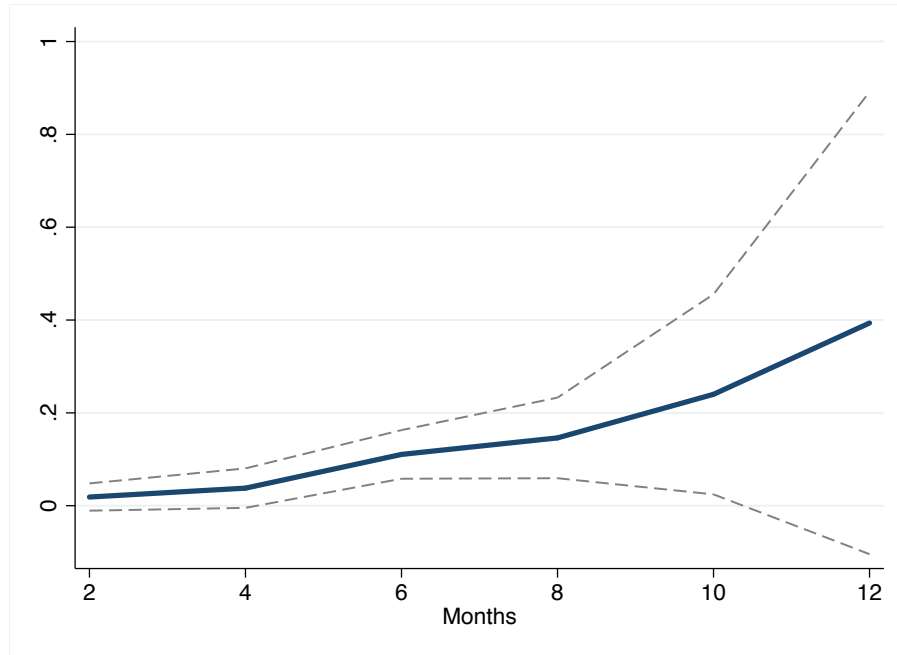


Figure 4: Euro pass-through to UAE
Notes: This figure uses supermarket data only

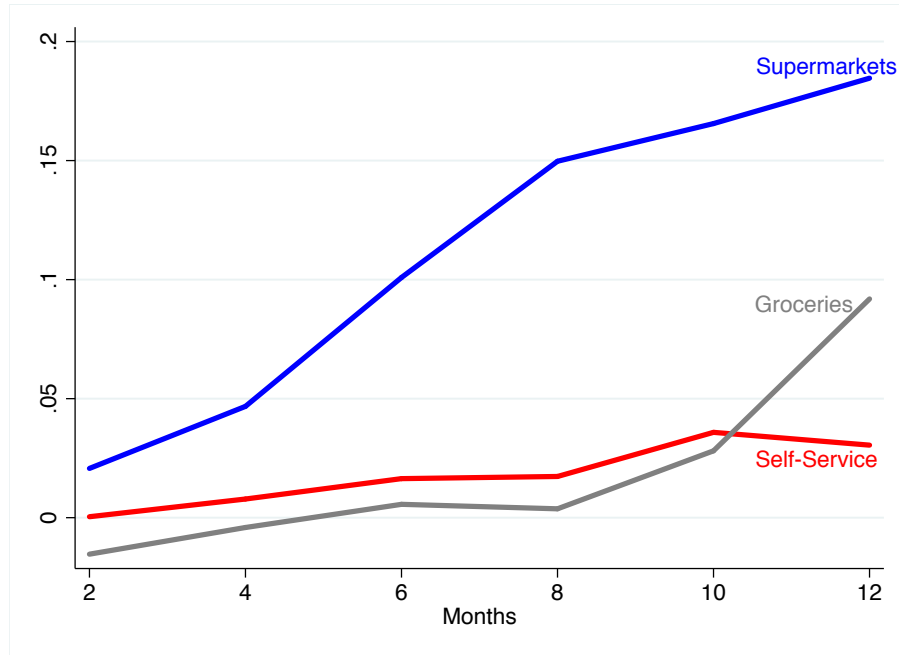
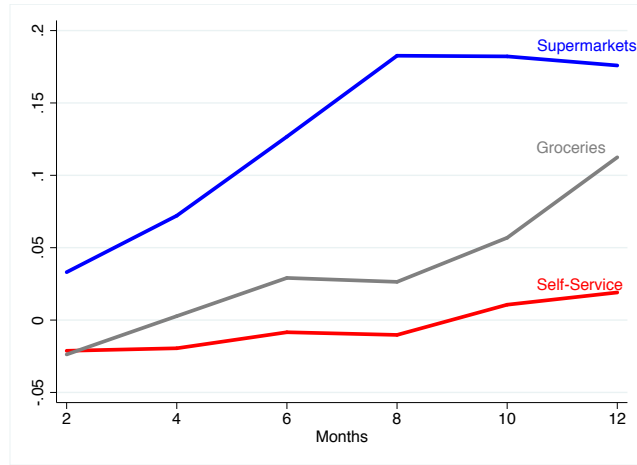
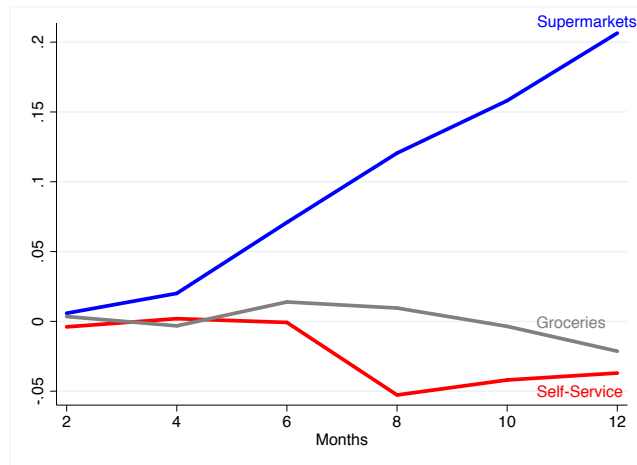


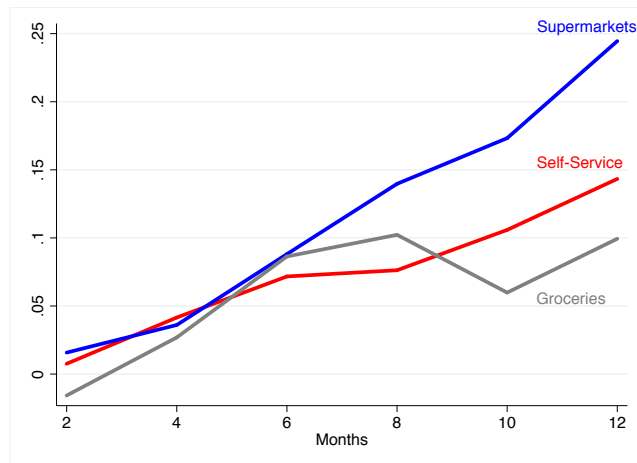
Figure 5: Exchange rate pass-through by outlet type, UAE



(a) Dubai - Sharjah



(b) Abu Dhabi - Al Ain



(c) Northern Emirates

Figure 6: Exchange rate pass-through by outlet type, Regional

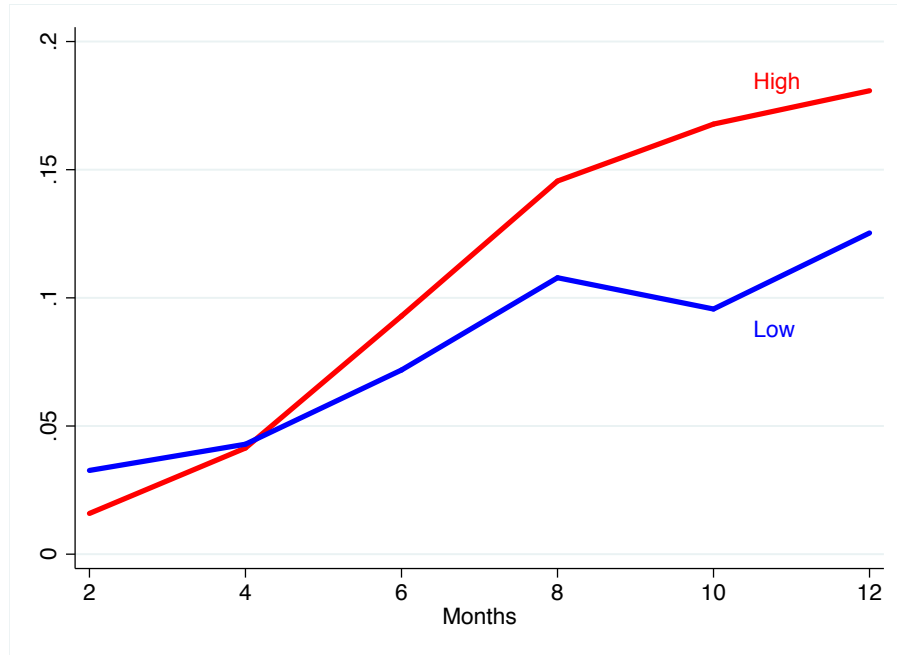
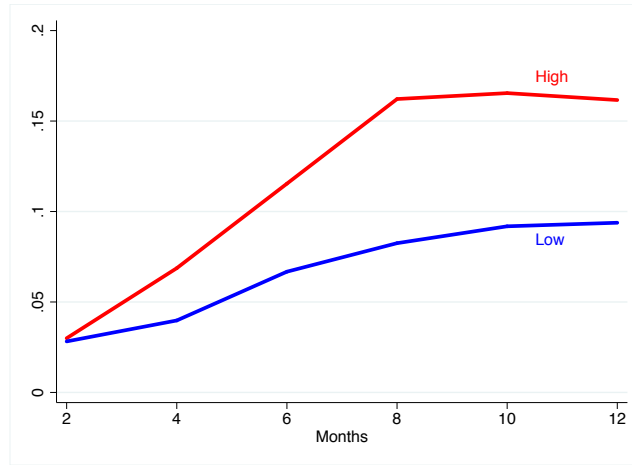
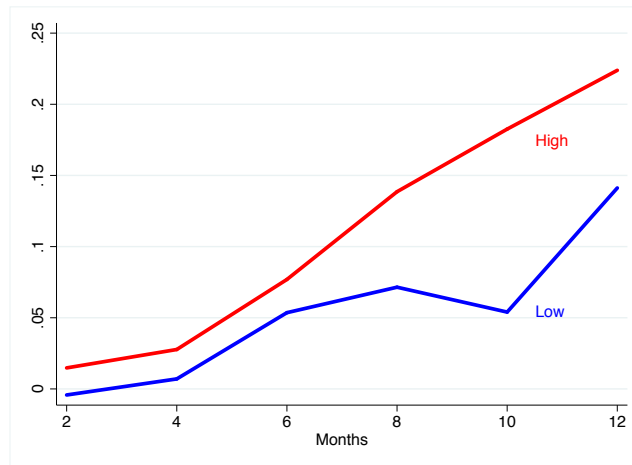


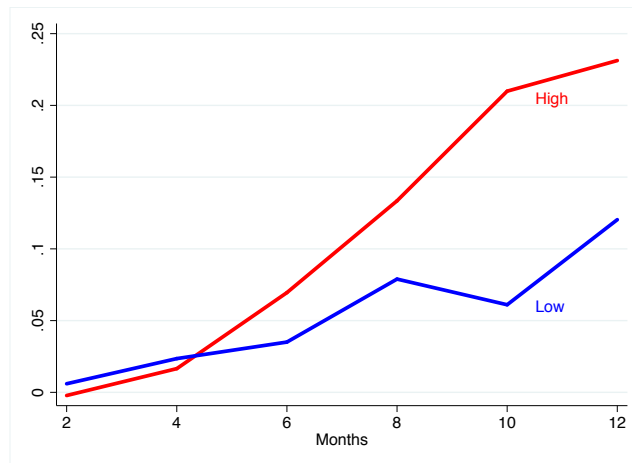
Figure 7: Exchange rate pass-through by supermarket market share, UAE



(a) Dubai - Sharjah



(b) Abu Dhabi - Al Ain



(c) Northern Emirates

Figure 8: Exchange rate pass-through by supermarket market share, Regional

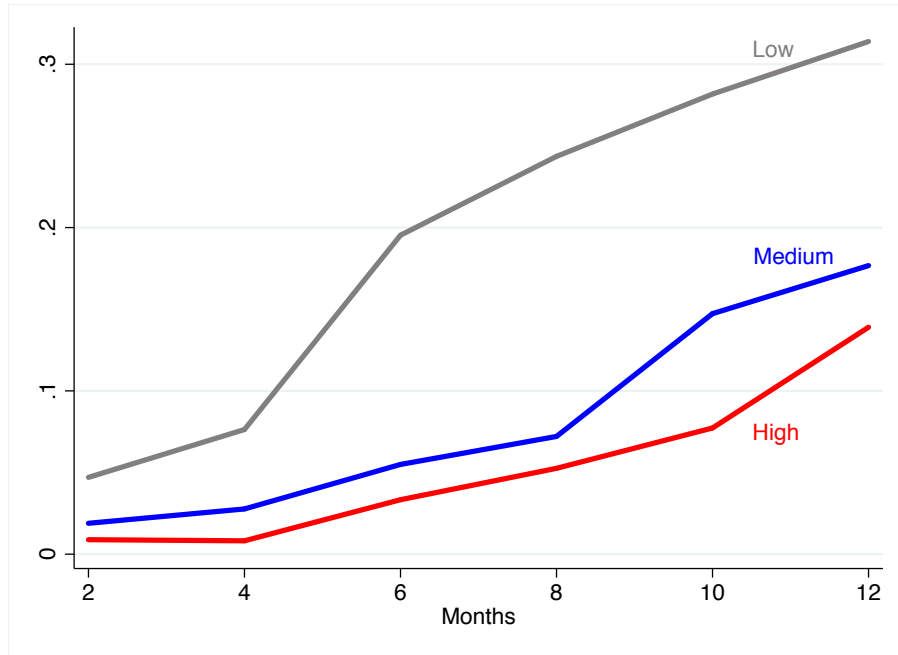
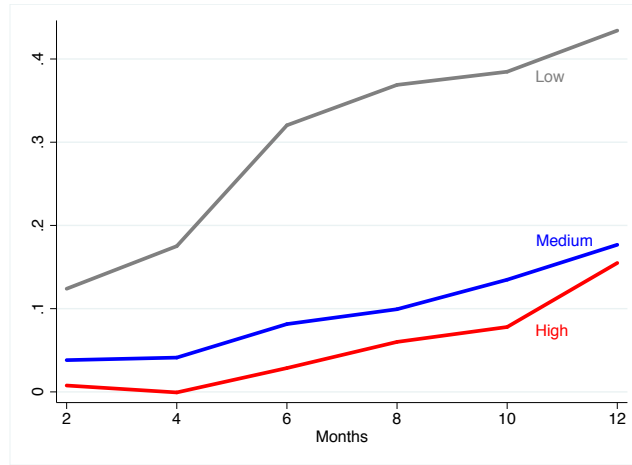
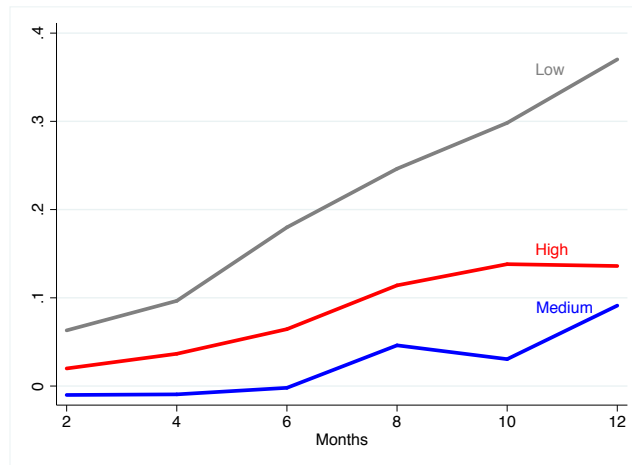


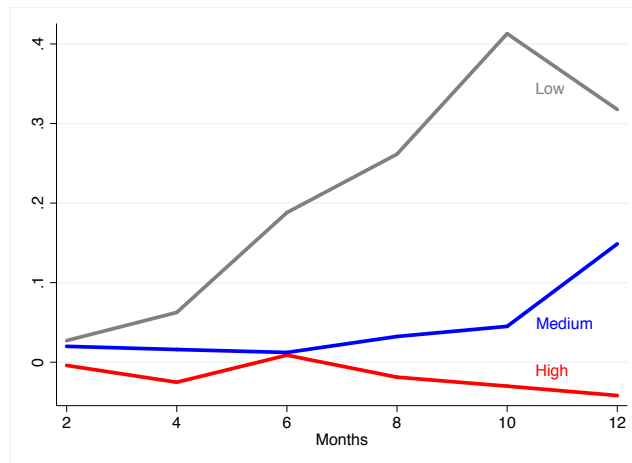
Figure 9: Exchange rate pass-through and product quality, UAE



(a) Dubai - Sharjah



(b) Abu Dhabi - Al Ain



(c) Northern Emirates

Figure 10: Exchange rate pass-through and product quality, Regional

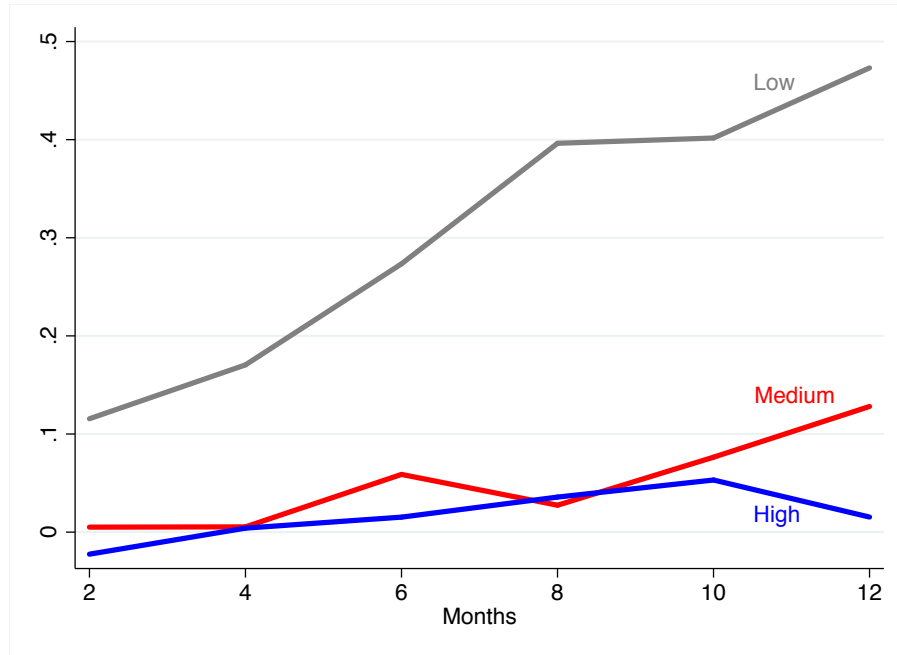
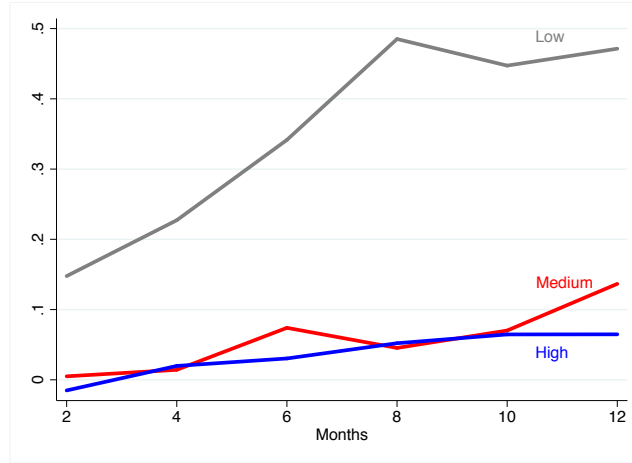
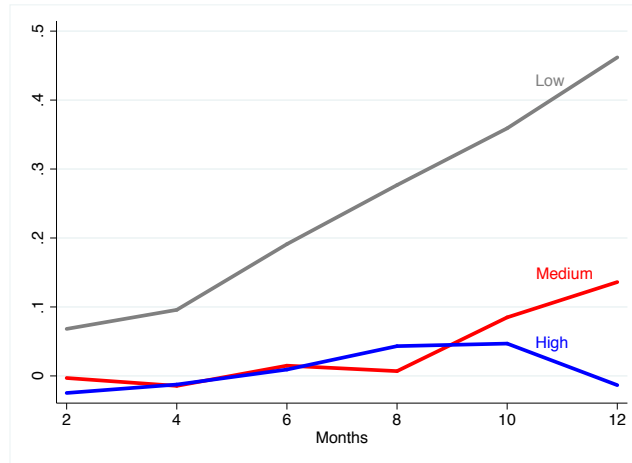


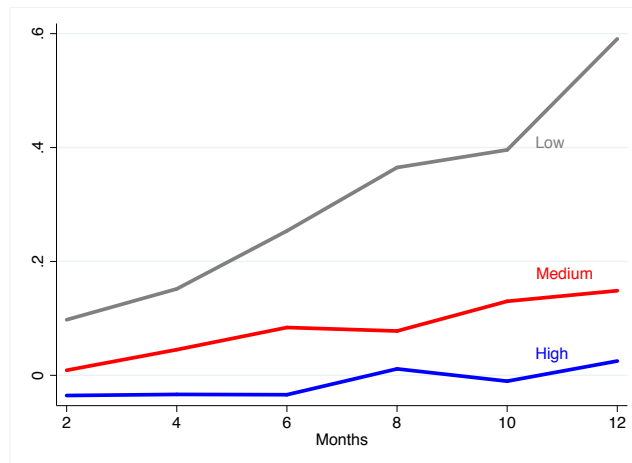
Figure 11: Exchange rate pass-through and elasticity of substitution of FMCG category, UAE



(a) Dubai - Sharjah



(b) Abu Dhabi - Al Ain



(c) Northern Emirates

Figure 12: Exchange rate pass-through and elasticity of substitution of FMCG category, Regional

A Additional tables

Table A.1: Aggregate pass-through regressions by region

Horizon (Months)	(1) Abu Dhabi/Al Ain				(2) Dubai/Sharjah				(3) Northern Emirates				Differences					
	β_1	$se(\beta_1)$	R^2	N	β_2	$se(\beta_2)$	R^2	N	β_3	$se(\beta_3)$	R^2	N	$\beta_2 - \beta_1$	$t - stat$	$\beta_3 - \beta_1$	$t - stat$	$\beta_3 - \beta_2$	$t - stat$
2	0.01	0.01	0.13	784	0.03	0.01	0.23	786	0.02	0.01	0.19	781	0.02	1.23	0.01	0.60	-0.01	-0.62
4	0.02	0.01	0.12	749	0.06	0.02	0.22	751	0.03	0.02	0.18	746	0.04	2.05	0.01	0.49	-0.03	-1.48
6	0.07	0.01	0.11	714	0.13	0.02	0.20	716	0.08	0.02	0.16	712	0.06	2.40	0.02	0.67	-0.04	-1.65
8	0.12	0.02	0.10	680	0.18	0.03	0.18	682	0.14	0.02	0.15	678	0.06	1.92	0.02	0.75	-0.04	-1.13
10	0.15	0.03	0.09	646	0.19	0.04	0.17	648	0.16	0.03	0.14	644	0.04	0.87	0.01	0.15	-0.03	-0.67
12	0.18	0.04	0.09	612	0.19	0.05	0.16	614	0.21	0.05	0.13	610	0.01	0.17	0.03	0.57	0.02	0.35

Notes: See Figure 3. The β entries are the estimated cumulative pass-through coefficients $\beta(k)$ (see main text). Each row represents a different time horizon, and k is the number of bi-monthly lags in the regression associated to this horizon. The subscripts identify the different groups (regions).

Table A.2: Pass-through regressions by outlet channel, UAE and regional

Horizon (Months)	(1) Groceries				(2) Self-Service				(3) Supermarkets				Difference					
	β_1	$se(\beta_1)$	R^2	N	β_2	$se(\beta_2)$	R^2	N	β_3	$se(\beta_3)$	R^2	N	$\beta_2 - \beta_1$	$t - stat$	$\beta_3 - \beta_1$	$t - stat$	$\beta_3 - \beta_2$	$t - stat$
UAE																		
2	-0.02	0.02	0.24	671	0.00	0.01	0.12	763	0.02	0.01	0.15	784	0.02	0.77	0.04	1.76	0.02	1.39
4	0.00	0.02	0.23	641	0.01	0.01	0.11	730	0.05	0.01	0.14	749	0.01	0.47	0.05	1.97	0.04	2.08
6	0.01	0.03	0.21	608	0.02	0.02	0.10	698	0.10	0.02	0.12	714	0.01	0.35	0.10	3.06	0.08	3.88
8	0.00	0.04	0.19	577	0.02	0.02	0.10	665	0.15	0.02	0.11	680	0.01	0.32	0.15	3.45	0.13	4.55
10	0.03	0.05	0.18	546	0.04	0.03	0.09	632	0.17	0.03	0.10	646	0.01	0.14	0.14	2.39	0.13	3.24
12	0.09	0.06	0.16	515	0.03	0.04	0.08	599	0.18	0.04	0.10	612	-0.06	-0.81	0.09	1.22	0.15	2.79
Dubai/Sharjah																		
2	-0.02	0.02	0.27	628	-0.02	0.01	0.15	725	0.03	0.01	0.19	783	0.00	0.11	0.06	2.50	0.05	3.24
4	0.00	0.02	0.25	600	-0.02	0.02	0.14	693	0.07	0.02	0.18	748	-0.02	-0.78	0.07	2.43	0.09	4.26
6	0.03	0.03	0.22	569	-0.01	0.02	0.12	660	0.13	0.02	0.16	713	-0.04	-1.09	0.10	2.85	0.14	5.39
8	0.03	0.04	0.20	540	-0.01	0.02	0.12	628	0.18	0.02	0.14	679	-0.04	-0.78	0.16	3.39	0.19	5.82
10	0.06	0.05	0.19	512	0.01	0.03	0.11	596	0.18	0.03	0.13	645	-0.05	-0.74	0.13	2.01	0.17	3.78
12	0.11	0.07	0.17	482	0.02	0.04	0.10	564	0.18	0.04	0.12	611	-0.09	-1.13	0.06	0.76	0.16	2.54
Abu Dhabi/Al Ain																		
2	0.00	0.02	0.27	602	0.00	0.01	0.20	727	0.01	0.01	0.16	783	-0.01	-0.29	0.00	0.10	0.01	0.56
4	0.00	0.03	0.24	572	0.00	0.02	0.18	695	0.02	0.01	0.14	748	0.01	0.16	0.02	0.79	0.02	0.81
6	0.01	0.03	0.22	542	0.00	0.02	0.17	662	0.07	0.02	0.13	713	-0.01	-0.38	0.06	1.59	0.07	2.69
8	0.01	0.04	0.19	514	-0.05	0.03	0.16	629	0.12	0.02	0.12	679	-0.06	-1.18	0.11	2.25	0.17	4.84
10	0.00	0.06	0.18	488	-0.04	0.04	0.15	598	0.16	0.03	0.11	645	-0.04	-0.53	0.16	2.39	0.20	4.06
12	-0.02	0.08	0.16	461	-0.04	0.06	0.14	565	0.21	0.04	0.11	611	-0.02	-0.17	0.23	2.60	0.24	3.53
Northern Emirates																		
2	-0.02	0.03	0.37	555	0.01	0.02	0.27	695	0.02	0.01	0.16	779	0.02	0.72	0.03	1.07	0.01	0.41
4	0.03	0.03	0.34	528	0.04	0.02	0.26	664	0.04	0.01	0.15	744	0.01	0.37	0.01	0.25	-0.01	-0.21
6	0.09	0.04	0.30	501	0.07	0.03	0.25	632	0.09	0.02	0.14	710	-0.01	-0.30	0.00	0.04	0.02	0.54
8	0.10	0.06	0.27	476	0.08	0.04	0.23	600	0.14	0.02	0.13	676	-0.03	-0.39	0.04	0.63	0.06	1.53
10	0.06	0.07	0.23	450	0.11	0.05	0.22	568	0.17	0.03	0.12	642	0.05	0.54	0.11	1.49	0.07	1.15
12	0.10	0.09	0.22	426	0.14	0.07	0.21	539	0.24	0.04	0.11	608	0.04	0.40	0.15	1.49	0.10	1.28

Notes: See Figures 5 and 6. The β entries are the estimated cumulative pass-through coefficients $\beta(k)$ (see main text). Each row represents a different time horizon, and k is the number of bi-monthly lags in the regression associated to this horizon. The subscripts identify the different groups (outlet channels).

Table A.3: Pass-through regressions by supermarket share, UAE and regional

Horizon (Months)	(1) High mkt share				(2) Low mkt share				Difference	
	β_1	$se(\beta_1)$	R^2	N	β_2	$se(\beta_2)$	R^2	N	$\beta_2 - \beta_1$	$t - stat$
UAE										
2	0.02	0.01	0.14	784	0.03	0.01	0.15	773	0.02	1.15
4	0.04	0.01	0.14	749	0.04	0.01	0.14	740	0.00	0.08
6	0.09	0.01	0.11	714	0.07	0.02	0.13	707	-0.02	-0.94
8	0.15	0.02	0.10	680	0.11	0.02	0.12	674	-0.04	-1.27
10	0.17	0.03	0.10	646	0.10	0.03	0.11	641	-0.07	-1.78
12	0.18	0.04	0.09	612	0.13	0.04	0.10	608	-0.06	-0.99
Dubai/Sharjah										
2	0.03	0.01	0.18	783	0.03	0.01	0.18	771	0.00	-0.11
4	0.07	0.01	0.17	748	0.04	0.02	0.17	738	-0.03	-1.36
6	0.12	0.02	0.14	713	0.07	0.02	0.16	705	-0.05	-1.96
8	0.16	0.02	0.13	679	0.08	0.02	0.15	672	-0.08	-2.43
10	0.17	0.03	0.12	645	0.09	0.03	0.13	639	-0.07	-1.64
12	0.16	0.04	0.11	611	0.09	0.05	0.13	606	-0.07	-1.10
Abu Dhabi/Al Ain										
2	0.01	0.01	0.15	783	0.00	0.01	0.18	773	-0.02	-1.22
4	0.03	0.01	0.14	748	0.01	0.01	0.16	740	-0.02	-1.04
6	0.08	0.02	0.12	713	0.05	0.02	0.14	707	-0.02	-1.01
8	0.14	0.02	0.11	679	0.07	0.02	0.14	674	-0.07	-2.16
10	0.18	0.03	0.10	645	0.05	0.03	0.13	641	-0.13	-2.97
12	0.22	0.04	0.10	611	0.14	0.05	0.12	608	-0.08	-1.38
Northern Emirates										
2	0.00	0.01	0.19	777	0.01	0.01	0.18	735	0.01	0.48
4	0.02	0.02	0.18	742	0.02	0.02	0.17	702	0.01	0.31
6	0.07	0.02	0.15	708	0.04	0.02	0.16	669	-0.03	-1.32
8	0.13	0.02	0.14	674	0.08	0.03	0.15	637	-0.05	-1.57
10	0.21	0.03	0.13	641	0.06	0.04	0.13	606	-0.15	-3.16
12	0.23	0.04	0.12	607	0.12	0.05	0.13	574	-0.11	-1.69

Notes: See Figures 7 and 8. The β entries are the estimated cumulative pass-through coefficients $\beta(k)$ (see main text). Each row represents a different time horizon, and k is the number of bi-monthly lags in the regression associated to this horizon. The subscripts identify the different groups (market share bins).

Table A.4: Pass-through regressions by product quality, UAE and regional

Horizon (Months)	(1) High quality				(2) Low quality				(3) Medium quality				Difference							
	β_1	$se(\beta_1)$	R^2	N	β_2	$se(\beta_2)$	R^2	N	β_3	$se(\beta_3)$	R^2	N	$\beta_2 - \beta_1$	$t - stat$	$\beta_3 - \beta_1$	$t - stat$	$\beta_3 - \beta_2$	$t - stat$		
UAE																				
2	0.01	0.01	0.10	502	0.05	0.02	0.23	547	0.02	0.01	0.04	482	0.04	1.75	0.01	0.68	-0.03	-1.39		
4	0.01	0.02	0.09	480	0.08	0.03	0.22	521	0.03	0.01	0.04	460	0.07	2.21	0.02	0.95	-0.05	-1.72		
6	0.03	0.02	0.09	458	0.20	0.03	0.17	495	0.05	0.01	0.03	437	0.16	4.68	0.02	0.88	-0.14	-4.50		
8	0.05	0.03	0.09	437	0.24	0.03	0.17	469	0.07	0.02	0.03	415	0.19	4.33	0.02	0.60	-0.17	-4.33		
10	0.08	0.04	0.08	415	0.28	0.05	0.16	443	0.15	0.02	0.03	392	0.20	3.44	0.07	1.56	-0.13	-2.56		
12	0.14	0.05	0.07	393	0.31	0.06	0.16	417	0.18	0.04	0.02	370	0.17	2.06	0.04	0.58	-0.14	-1.86		
Dubai/Sharjah																				
2	0.01	0.01	0.13	487	0.12	0.02	0.34	543	0.04	0.01	0.05	471	0.12	4.40	0.03	1.77	-0.09	-3.52		
4	0.00	0.02	0.12	465	0.18	0.03	0.33	517	0.04	0.01	0.05	448	0.18	4.71	0.04	1.73	-0.13	-3.91		
6	0.03	0.02	0.12	444	0.32	0.03	0.25	491	0.08	0.02	0.04	425	0.29	7.12	0.05	1.82	-0.24	-6.51		
8	0.06	0.03	0.11	423	0.37	0.04	0.24	465	0.10	0.02	0.04	404	0.31	5.93	0.04	1.03	-0.27	-5.78		
10	0.08	0.04	0.10	401	0.38	0.06	0.22	439	0.13	0.03	0.03	382	0.31	4.33	0.06	1.09	-0.25	-3.99		
12	0.15	0.07	0.09	379	0.43	0.08	0.22	413	0.18	0.04	0.03	360	0.28	2.75	0.02	0.28	-0.26	-2.94		
Abu Dhabi/Al Ain																				
2	0.02	0.01	0.11	480	0.06	0.02	0.16	488	-0.01	0.01	0.06	449	0.04	1.97	-0.03	-1.64	-0.07	-3.47		
4	0.04	0.02	0.11	458	0.10	0.02	0.14	465	-0.01	0.02	0.06	427	0.06	2.03	-0.05	-1.84	-0.11	-3.73		
6	0.06	0.02	0.10	436	0.18	0.03	0.12	442	0.00	0.02	0.06	406	0.12	3.31	-0.07	-2.21	-0.18	-5.40		
8	0.11	0.03	0.09	414	0.25	0.03	0.11	419	0.05	0.03	0.05	385	0.13	3.01	-0.07	-1.71	-0.20	-4.79		
10	0.14	0.04	0.08	393	0.30	0.04	0.10	397	0.03	0.04	0.05	363	0.16	2.67	-0.11	-1.93	-0.27	-4.63		
12	0.14	0.06	0.07	371	0.37	0.06	0.10	375	0.09	0.05	0.05	342	0.23	2.75	-0.04	-0.56	-0.28	-3.45		
Northern Emirates																				
2	0.00	0.02	0.13	421	0.03	0.03	0.31	465	0.02	0.01	0.06	394	0.03	1.04	0.02	1.17	-0.01	-0.25		
4	-0.03	0.02	0.12	400	0.06	0.03	0.29	441	0.02	0.02	0.06	375	0.09	2.18	0.04	1.45	-0.05	-1.17		
6	0.01	0.02	0.11	380	0.19	0.04	0.22	418	0.01	0.02	0.05	356	0.18	3.95	0.00	0.10	-0.18	-3.88		
8	-0.02	0.03	0.10	360	0.26	0.05	0.21	396	0.03	0.03	0.05	337	0.28	4.85	0.05	1.07	-0.23	-3.95		
10	-0.03	0.05	0.09	340	0.41	0.06	0.19	375	0.05	0.05	0.05	318	0.44	5.78	0.08	1.11	-0.37	-4.90		
12	-0.04	0.07	0.08	319	0.32	0.08	0.18	353	0.15	0.06	0.04	299	0.36	3.36	0.19	2.03	-0.17	-1.65		

Notes: See Figures 9 and 10. The β entries are the estimated cumulative pass-through coefficients $\beta(k)$ (see main text). Each row represents a different time horizon, and k is the number of bi-monthly lags in the regression associated to this horizon. The subscripts identify the different groups (quality bins).

Table A.5: Pass-through regressions by category elasticity of substitution, UAE and regional

Horizon (Months)	(1) High elasticity				(2) Low elasticity				(3) Medium elasticity				Difference					
	β_1	$se(\beta_1)$	R^2	N	β_2	$se(\beta_2)$	R^2	N	β_3	$se(\beta_3)$	R^2	N	$\beta_2 - \beta_1$	$t - stat$	$\beta_3 - \beta_1$	$t - stat$	$\beta_3 - \beta_2$	$t - stat$
UAE																		
2	-0.02	0.01	0.12	532	0.12	0.02	0.23	492	0.01	0.02	0.21	608	0.14	5.99	0.03	1.27	-0.11	-4.35
4	0.00	0.02	0.11	509	0.17	0.02	0.21	470	0.01	0.02	0.20	580	0.17	5.55	0.00	0.04	-0.17	-4.85
6	0.02	0.02	0.10	486	0.27	0.03	0.17	449	0.06	0.03	0.19	552	0.26	7.77	0.04	1.26	-0.21	-5.52
8	0.04	0.03	0.09	463	0.40	0.03	0.15	428	0.03	0.04	0.17	525	0.36	8.36	-0.01	-0.18	-0.37	-7.24
10	0.05	0.04	0.09	440	0.40	0.05	0.14	407	0.08	0.05	0.17	498	0.35	5.57	0.02	0.37	-0.33	-4.59
12	0.02	0.05	0.08	417	0.47	0.07	0.13	386	0.13	0.07	0.16	471	0.46	5.17	0.11	1.26	-0.35	-3.44
Dubai/Sharjah																		
2	-0.02	0.01	0.14	532	0.15	0.02	0.33	491	0.00	0.02	0.27	606	0.16	6.09	0.02	0.83	-0.14	-4.75
4	0.02	0.02	0.12	509	0.23	0.03	0.31	469	0.01	0.03	0.26	578	0.21	5.96	-0.01	-0.17	-0.21	-5.30
6	0.03	0.02	0.11	486	0.34	0.03	0.25	448	0.07	0.03	0.24	550	0.31	8.03	0.04	1.12	-0.27	-5.81
8	0.05	0.03	0.10	463	0.49	0.04	0.23	427	0.05	0.04	0.23	523	0.43	8.63	-0.01	-0.13	-0.44	-7.28
10	0.06	0.04	0.10	440	0.45	0.06	0.21	406	0.07	0.06	0.22	496	0.38	5.23	0.01	0.08	-0.38	-4.45
12	0.06	0.06	0.09	417	0.47	0.09	0.20	385	0.14	0.08	0.21	469	0.41	3.95	0.07	0.72	-0.33	-2.78
Abu Dhabi/Al Ain																		
2	-0.04	0.02	0.20	530	0.10	0.02	0.32	470	0.01	0.02	0.26	597	0.13	4.68	0.04	1.70	-0.09	-2.97
4	-0.03	0.02	0.19	507	0.15	0.03	0.29	448	0.05	0.03	0.24	569	0.19	5.02	0.08	2.29	-0.11	-2.70
6	-0.03	0.03	0.17	484	0.25	0.03	0.25	428	0.08	0.03	0.23	543	0.29	6.96	0.12	2.88	-0.17	-3.71
8	0.01	0.03	0.16	461	0.36	0.04	0.22	407	0.08	0.04	0.22	516	0.35	6.58	0.07	1.22	-0.29	-4.76
10	-0.01	0.05	0.14	438	0.40	0.06	0.20	386	0.13	0.06	0.20	489	0.41	5.17	0.14	1.86	-0.27	-3.15
12	0.03	0.07	0.13	415	0.59	0.09	0.18	366	0.15	0.08	0.19	462	0.57	5.01	0.12	1.19	-0.44	-3.72
Northern Emirates																		
2	-0.04	0.02	0.20	530	0.10	0.02	0.32	470	0.01	0.02	0.26	597	0.13	4.68	0.04	1.70	-0.09	-2.97
4	-0.03	0.02	0.19	507	0.15	0.03	0.29	448	0.05	0.03	0.24	569	0.19	5.02	0.08	2.29	-0.11	-2.70
6	-0.03	0.03	0.17	484	0.25	0.03	0.25	428	0.08	0.03	0.23	543	0.29	6.96	0.12	2.88	-0.17	-3.71
8	0.01	0.03	0.16	461	0.36	0.04	0.22	407	0.08	0.04	0.22	516	0.35	6.58	0.07	1.22	-0.29	-4.76
10	-0.01	0.05	0.14	438	0.40	0.06	0.20	386	0.13	0.06	0.20	489	0.41	5.17	0.14	1.86	-0.27	-3.15
12	0.03	0.07	0.13	415	0.59	0.09	0.18	366	0.15	0.08	0.19	462	0.57	5.01	0.12	1.19	-0.44	-3.72

Notes: See Table 6 and Figures 11 and 12. The β entries are the estimated cumulative pass-through coefficients $\beta(k)$ (see main text). Each row represents a different time horizon, and k is the number of bi-monthly lags in the regression associated to this horizon. The subscripts identify the different groups (elasticity bins).