Do Prices Fall Faster When Wal-Mart is Around?

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Do Prices Fall Faster when Wal-Mart is Around? The Effect of Competition and Reputation on Cost Pass-Through and Price Adjustment

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Abstract

This study analyzes Wal-Mart's pricing practices and its influence on competitors' input cost transmission. Previous attempts to analyze Wal-Mart's pricing strategy in the United States have been limited by the company's refusal to provide scanner data to third party research firms such as AC Nielsen. This is the first study to observe Wal-Mart's prices over an extended period of time. Using weekly-store level price data between 2001 and 2006 that government officials collected in 12 Mexican cities, I find that Wal-Mart adjusts its prices 1/3-3 times slower to wholesale price increases than other retailers and responds 5-7 times faster to wholesale price decreases than its competitors. This evidence is robust to the comparison of Wal-Mart to other hypermarkets that offer "every day low prices" and to potential endogeneity of Wal-Mart's location choices. All retailers respond asymmetrically to wholesale cost changes. However, retailers other than Wal-Mart respond twice as fast to wholesale price increases than to decreases, while Wal-Mart behaves in the opposite way. I find no evidence that proximity to a Wal-Mart supercenter or the level of competition affects the speed of price adjustment of retailers.

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1 Introduction

There is an ongoing debate about Wal-Mart's effect on the economy. Particularly, it is unclear what the corporation's pricing strategy is and how it influences its rivals' prices. Anecdotal evidence abounds, but previous research has not directly observed Wal-Mart's prices due to its refusal since July 2001 to allow third-party research firms such as ACNielsen and Information Resources, Inc. to collect prices in its stores. My study overcomes these data limitations by focusing on Mexico. Like in the U.S., Wal-Mart is the largest rival and employer in that country. Mexico is the second largest market for Wal-Mart after the United States.

This paper is part of a broader literature on price adjustment, which has been developed in industrial organization and macroeconomics. Macroeconomists are interested in price flexibility because it is relevant for monetary policy and business cycle fluctuations. Keynesian and New-Keynesian models rely on sticky prices. Previous research in industrial economics has focused on the asymmetry of price adjustment. Peltzman (2000) finds that prices tend to rise faster than they fall in several industries in response to cost changes. He also studies one particular supermarket chain, Dominick's, and does not find any asymmetries in price adjustments. Blinder et al. (1998) interview businesspeople in order to find out what their reasons for slow price adjustments are. The most common response (62 percent of all firms and 73 percent of retail firms) is that firms hold back on price changes, waiting for others to change prices first. Particularly, they state that they wait for their competitors to raise prices first, while they initiate price cuts. Empirical studies that analyze the relationship between price flexibility, competition, and price adjustment asymmetries are scarce. The main reason are data limitations. The ideal dataset requires time series for identical goods, information on competition and wholesale costs, and store-level disaggregation. Related research that focuses on multiple firms has centered on a few industries, notably gas stations and financial services.

This study analyzes Wal-Mart's pricing strategy in response to wholesale price changes and how it influences the price adjustment of other retailers. I begin with a descriptive analysis of the frequency, size, and synchronization of price changes at Wal-Mart and the retailers that compete with it. I present evidence that overall regular prices are more stable at Wal-Mart, although the frequency of price changes varies widely across products. I also show that Wal-Mart's price changes are of a smaller magnitude than those of its competitors. Another finding is that retailers that are closer to a Wal-Mart supercenter have a similar frequency of price changes as retailers that are farther away. The main empirical analysis focuses on the characterization of price adjustment speed at individual stores in response to cost shocks. I find that all retailers adjust their prices asymmetrically. Wal-Mart adjusts faster to wholesale price decreases than to wholesale price increases, while this asymmetry is reversed for other retailers. Wal-Mart stores adjust their prices 1/3-3 times slower to wholesale cost increases than other retailers and 5-7 times faster to wholesale cost decreases than its competitors. This is consistent with anecdotal evidence about Wal-Mart's relationship with its suppliers. Articles in the business press frequently state that Wal-Mart uses its bargaining power to exert pricing pressure on its suppliers, opposing fiercely to price increases and constantly demanding new price cuts, as the following example illustrates.

> The chief executive of a U.S. plastic-goods maker recently got the shock of his life. He had asked Wal-Mart Stores Inc., his biggest customer, to absorb a 5% to 7% price increase. The exec had good reason for the hike: The cost of resin, a key raw material in plastics, was going through the roof. Still, he didn't expect Wal-Mart, with its fearsome reputation for squeezing suppliers, to go along with the increase. Yet Wal-Mart allowed the supplier to lift its price for the first time in a decade. So should rivals and suppliers breathe a sigh of relief? A small one, perhaps, but only that. While Wal-Mart will be a bit more flexible in giving its suppliers a break, it will continue squeezing costs on many products, especially those it orders directly from manufacturers. Says Jay Fitzsimmons, Wal-Mart's senior vice-president for finance: "Prices will continue to go down, but not as fast." Indeed, the overall price on a typical basket of Wal-Mart goods is still likely

to fall this year. It just won't drop the 2.5% to 3% it did last year. [1]

I also study whether Wal-Mart's proximity and the overall level of competition influence the transmission of input price changes to retail prices. Wal-Mart's reputation for having the lowest prices could influence the signals about industry-wide costs that consumers receive when Wal-Mart changes its prices, and therefore influence competitors' prices. I do not find evidence for a clear relationship between distance to the closest Wal-Mart supercenter, competition, and the speed of input cost pass-through. I analyze whether price elasticity proxied by demographic characteristics influences stores' price adjustment strategy and do not find a clear relationship. The latter also serves as a robustness check confirming that Wal-Mart's response to wholesale cost changes is not driven by its endogenous location choices.

The remainder of the paper is organized as follows. Next, the theoretical and empirical literature on price flexibility and asymmetric price transmission is discussed. In section three, the data are presented. Section four describes Wal-Mart's and its competitors' pricing behavior. Section five studies Wal-Mart's input cost transmission and its effect on its rivals' price adjustment. The last section concludes.

[1] Business Week, February 16th 2004

2 Literature on Price Adjustment

2.1 Theoretical Literature on Price Change

This paper is related to the theoretical literature that links price rigidity and asymmetric price transmission of input prices to market structure. Akerlof and Yellen (1985) argue that a monopoly faces lower forgone profits if it fails to adjust prices in response to a cost shock than a Bertrand duopolist. Rotemberg and Saloner (1987) show that monopolies may be less likely to adjust prices in response to cost changes than firms in duopoly markets. Barro (1972) predicts greater frequency of price changes in markets with more competition because firms face more elastic demand. Levy (2007) reviews recent theoretical developments on price rigidity and flexibility. One of the most popular theories states that prices adjust slowly to cost changes because it is costly to change prices. Some proponents such as Rotemberg (1982) argue that the price adjustment costs are convex in the price change and therefore imply small price changes. Another view is that price changes imply a fixed cost every time, analogously to the cost of reprinting a menu. This "menu cost theory" was proposed by Mankiw (1985). Another theory is based on the idea that firms can use their inventories to buffer changes in prices. An implication is that firms that have lower inventory costs should have stickier prices. A coordination failure among firms could also lead to prices that adjust slowly to input cost changes. This idea implies that firms wait for their rivals to raise their prices first. In the absence of a price leader or collusive behavior, prices adjust slowly. This theory has been advanced by Cooper and John (1988) and Ball and Romer (1991). Other explanations on price rigidity include long-term contracts, pro-cyclical elasticity of demand, non-price market clearing, imperfect information about product characteristics, and on firms' conduct.

Cabral and Fishman (2006) develop a search theoretical model which predicts more frequent small price increases than small price decreases and more frequent large price decreases than large price increases. The intuition is that a price change by a consumer's regular vendor conveys information about industry-wide cost shocks if competing vendors' production costs are positively correlated. If the regular vendor increases its price, the consumer will interpret it as bad news about the entire industry and assume that competitor's prices have also increased. In the presence of search costs, a consumer would accept a moderate price increase rather than search. Therefore, sellers can increase prices moderately without losing consumers in response to cost increases. In the case of a price reduction at one firm, consumers will view it as "good news" about the entire industry because it carries the possibility of even greater price reductions at other firms. Hence, a moderate price decrease could encourage customers to search elsewhere in the hope of finding still greater bargains, which implies that a sellers' optimal response to moderate cost decreases is to keep prices unchanged. The same argument applies to large cost changes. If prices decline by a lot, consumers know that it is unlikely that further search will reveal even lower prices. This implies that large cost reductions can lead to large price reductions. Conversely, if search costs are not too high, a large price increase could trigger consumer search because there is the likelihood that competitors' prices have risen by substantially less. Therefore, large cost increases can result in only moderate price increases. This model can be applied to the retail industry with two assumptions. First, search costs will be higher the greater the distance between retailers. Second, if consumers expect Wal-Mart to have the lowest prices, this expectation should influence their search behavior depending on where they observe a price change (at Wal-Mart or at competing retailers) because a price change will convey different information about industry-wide costs.

A behavioral explanation for asymmetric prices is developed by Levy et al. (2005). They find support for more frequent small increases than small price decreases, but do not find any evidence for asymmetries with large price changes. They analyze scanner price data that cover 27 product categories over an eight-year period from Dominick's supermarket. They find that small price increases occur more frequently than small price decreases for price changes of up to about 10 cents, on average. To explain these findings, the authors extend the implications of the literature on rational inattention to individual price dynamics. Specifically, they argue that processing and reacting to price change information is a costly activity. Rational inattention implies that consumers may rationally choose to ignore and thus not to respond to small price changes, creating a “range of inattention” along the demand curve. This range of consumer inattention gives the retailers incentive for asymmetric price adjustment “in the small”. These incentives, however, disappear for large price changes, because large price changes are processed by consumers and therefore trigger their response.

2.2 Empirical literature on price changes

The empirical literature on the relationship between market structure and price rigidity has found predominantly that the frequency of price adjustments is lower in more concentrated markets. Hannan and Berger (1991) find that deposit interest rates at conventional banks are more rigid in concentrated markets. Carlton (1986) and Caucutt et al. (1999) also find that prices adjust more frequently if there is more competition. Arbatskaya and Baye analyze daily mortgage rates that are posted online and the frequency of price changes. They find that price rigidity depends on market structure, particularly that online mortgage rates are 30 to 40 percent more durable in concentrated markets. They also find downward price stickiness, rate adjustments in response to cost increases are twice the adjustments in response to cost decreases. Fisher and Konieczny (1995) find an opposite result, prices for monopolistic city newspapers are less rigid than the prices of oligopolistic newspapers. Bils and Klenow (2004) analyze the frequency of price changes for 350 categories of goods and services based on Bureau of Labor Statistics data from 1995 to 1997. They find that goods sold in more competitive markets, as measured by concentration ratios or wholesale markups, display more frequent price changes. This result disappears when they control for a good being energy related or being a fresh food.

Empirical literature that has tested the relationship between market power and asymmetric price transmission is scarce. Neuman and Sharpe (1992) find that banks in concentrated markets tend to be slower to increase interest rates on deposits in response to rising open market rates; and faster to lower interest rates on deposits in response to falling market interest rates. Borenstein et al. (1997) find that retail gasoline prices respond more quickly to increases than to decreases in crude oil. They analyze different explanations for this phenomenon and find more support for short run market power among retail gasoline sellers. Peltzman (2000) includes two proxies for market power in his study across industries, with conflicting results. Asymmetry increases as the number of competitors falls and asymmetry decreases with greater concentration measured as the Herfindahl- Hirschman index. Axarloglou (2007) finds a positive relationship between competition and synchronization of price adjustments using store-level transaction price data for books and CDs collected in two cities. Mueller and Sourav (2007) study Dominick's supermarket chain's scanner price data with a weekly frequency and do not find chain-wide asymmetric pricing. Weber and Anders (2007) study the relationship between market power and price flexibility in the retail markets for beef and pork from January 2000 to December 2001 in 207 retail outlets. They find that discount stores have more rigid prices. Owen and Trzepacz (2002) compare the pricing behavior of eight supermarkets across regions with and without item pricing laws, analyzing the importance of menu costs. They find that item pricing laws matter only for the firm which has an everyday low price strategy. The other firm in their study follows a HiLo strategy with frequent promotions and its pricing behavior is unaffected by the item pricing law. They also find that market characteristics such as age and income influenced the magnitude of price changes. Stores in markets with higher average ages implemented smaller price changes and stores in more affluent areas implemented smaller downward price changes. They study price changes in eight supermarkets that are part of two different chains in Upstate New York.

2.3 Literature on Wal-Mart and retail pricing

The following academic papers attempt to quantify Wal-Mart's effect on prices. Basker (2005) studies prices before and after Wal-Mart's entry, using quarterly average city prices for ten non-grocery goods in 165 U.S. cities from 1982 to 2002 from the American Chamber of Commerce Research Association (ACCRA). These prices are collected during the first week of every quarter in 5-10 non-identified retail establishments. She finds that prices are 12% lower after Wal-Mart's entry. Basker and Noel (2007) estimate the competitive price response to Wal-Mart's entry using store-level price data from ACCRA for 24 grocery products for four weeks (the first week of July 2001, July 2002, July 2003, and July 2004) in 175 U.S. cities. These data include a maximum of 10 stores in each city and the mean number of stores surveyed in each city is 5. Basker and Noel find that after Wal-Mart's entry, competitors' prices are 1-1.2% lower.

Hausman and Leibtag (2004) use AC Nielsen Consumer Panel data from 1998 to 2001 to estimate that supercenters' food prices are 4.5% lower than those of regular supermarkets. They do not focus particularly on Wal-Mart, but on supercenters in general. They analyze the prices of twenty grocery products[2] in six cities[3]. Research that analyzes the effect of Wal-mart's entry on price levels has to take into account that there is endogeneity in the entry decisions of Wal-Mart.

Empirical research on retail pricing across stores is limited. This is mainly due to data limitations. Scanner data have been used to study consumer choices, but not inter-store competition. Ellickson and Misra (2006) focus on retail stores' general pricing strategies, as they choose between featuring every day low prices (EDLP) or promotions. Their data are a survey that store managers answered in 1998 regarding their pricing strategies.

[2]apples, apple juice, bananas, bread, butter, cereal, chicken breast, coffee, cookies, eggs, ground beef, ham, ice cream, lettuce, milk, potatoes, soda, tomatoes, bottled water, and yogurt

[3]Atlanta, Baltimore/Washington, Chicago, Los Angeles, New York, and San Antonio

3 Data

3.1 Price Data

This study uses weekly store-level prices for 46 branded products from January 2001 to June 2006, collected by the Mexican Consumer Protection Agency. The data cover twelve cities: Mexico City, Guadalajara, Monterrey, Morelia, Merida, Oaxaca, Puebla, Queretaro, Tijuana, Toluca, Veracruz, and Villahermosa. Mexico City is a huge metropolitan area –19,331,365 people live in the Mexico City Meteropolitan Zone according to the 2005 Mexican Census– so that it actually corresponds to several cities. The maximum number of stores (it is an unbalanced panel) in the dataset is 646 in Mexico City, 44 in Morelia, 55 in Monterrey, 22 in Merida, 61 in Guadalajara, 29 in Oaxaca, 50 in Puebla, 44 in Queretaro, 60 in Tijuana, 29 in Toluca, 45 in Veracruz, and 31 in Villahermosa. The retail stores include international chains such as Wal-Mart and Carrefour, Mexican national chains, local chains, public chains, and independent stores. Two cities in the dataset do not have a Wal-Mart supercenter: Tijuana[4] and Oaxaca.

The goods are narrowly defined by packaging and brand and include groceries and drugstore products. A detailed list of the products is presented in table 1. Price data correspond to regular prices and are collected by Mexican public employees. The price collectors are advised to collect only regular

[4]Wal-Mart opened a supercenter in Tijuana on October 27th, 2006

prices, i.e. if the price tag on a shelf displays the regular price in black letters and the promotional price in red letters, the black price is registered. Therefore, this paper focuses on the change of regular prices, which are the everyday prices for retailers who engage in "Every day low pricing" and are the high prices for retailers who choose a high-low pricing strategy. The implications of focusing on regular prices will be further discussed.

3.2 Competition data

I measure competition in terms of the number of stores in a particular radius. In order to compute the number of stores, I use a yearly registry of all stores in Mexico, which includes their opening date. A law was passed in December 1996 which requires all businesses to register. Businesses are required to update their registration every year, facing a fine if they fail to do so. If a business closes, changes its address or its activities, it has to inform of such changes within two months. I use the registry data of the activity code which corresponds to "Retail commerce in supermarkets and self-service stores". Unfortunately, the registry is not that clean (some unrelated companies are listed under that category), so that I further restrict the stores to the ones that have the words "auto" (self-service) and/or "super" in their business description. The retailing literature measures competition in terms of a trade area, which is the geographic area from which a particular store draws its customers, based on travel time to store and store size. There are different rules of thumb to measure these trade areas. Given the subjective nature of any definition, I will try different specifications. First of all, I geocode all retail store addresses. I do this based on the zip code centroid of each retail store's zipcode. Second, I define a local market based on the distance between different stores. Previous approaches have used a 7-mile radius for the United States[5]. I use different radii: 1-mile and 3-miles. These radii are more appropriate for the Mexican context because fewer people own cars than in the United States and because of greater vehicular congestion. I then measure local competition in terms of the number of stores in a particular radius. The results are invariant to both measures, so that I discuss the implications of the number of competitors in a 3-mile radius in the empirical section. I also measure the distance to the nearest Wal-Mart supercenter for each store.

3.3 Demographic data

I use demographic data at the locality level from the 2005 Census in Mexico ("Conteo de Poblacion y Vivienda", INEGI). These data include information on household age and gender composition; goods that households own (refrigerator, TV, washing machine, and computer); educational background; information about public health and social benefits; and a description of the housing unit.

[5] Orhun(2006)

3.4 Wholesale cost data

I obtain wholesale prices from the Mexican Ministry of Economy, which collects daily prices in 45 wholesale markets across Mexico. These wholesale markets (centrales de abasto) supply convenience stores, supermarkets (defined as stores with 350 to 4000 square meters with at least three cash registers), kiosks, and traditional fairs. The Central de Abastos from Ciudad de Mexico operates approximately 40 percent[6] of the market for fruits, vegetables, grains, oil, fish, and meat.[7]

4 Description of Pricing Behavior

This section describes the frequency, size, and synchronization of price changes at Wal-Mart stores and other retailers.

4.1 Do chains engage in uniform pricing?

The data contain several chain stores. A critical aspect for my empirical strategy is how retail chains take pricing decisions for their stores, particularly whether pricing decisions are being taken uniformly at the central office or locally by store managers. If there is an uniform pricing rule for a chain across stores and cities, distance to Wal-Mart or the level of competition

[6] Salcido (2003) "La Comercializacion de Alimentos en la Central de Abastos de Ciudad de Mexico"

[7] I also collect futures prices for Milk Class IV and Basic Formula Price (BFP) Milk from the Chicago Mercantile Exchange.

will not matter. There is little evidence for a uniform pricing rule in the retail literature. Hoch et al. (1995) analyze how demographic variables and competitive environment influence price elasticities across 83 stores of Dominick's in the Chicago area. They recommend that Dominick's refine its (regular) pricing strategy of three pricing zones. The zones are described as "The three DFF pricing zones are defined almost entirely by the extent of nearby competition. The lowest price zone is a warehouse-fighter zone, which is aimed at achieving closer parity to large EDLP warehouse operations." They find that 67% of store price elasticities can be explained by eleven variables, which are mainly demographic, and hence recommend local pricing that focuses more on demographic characteristics.

In order to analyze how prices vary across stores of a particular chain, I compute the coefficient of variation of prices across stores within a chain for each of the products in each of the weeks. The coefficient of variation is defined as the standard deviation divided by the mean, and hence allows comparison across goods. Summary statistics of the coefficients of variation of prices across stores for each product are presented in table 2. There is evidence against uniform pricing across stores of a particular chain and the coefficient of variation of prices across stores of a chain varies widely by product. The mean coefficient of variation across weeks and products is 4.04%. For Wal-Mart, the mean coefficient of variation across time and goods is 3.93%. I also study the share of stores that charges the modal price in each chain (see table 3). The average proportion of stores that charges the chain's modal price is 43.84%. This share is lowest for tuna (39.2%) and highest for vinegar (51.9%). These results provide evidence for non-uniform pricing within a chain and therefore justify analyzing how store-specific competition and demographics affect pricing strategies.

4.2 Are Regular Prices Lower At Wal-Mart?

It is commonly believed that Wal-Mart offers the lowest prices. I compare prices for all the goods, computing the store-level percentile rank for the price of each product in a given week and city. Wal-Mart's average percentile rank across weeks, stores, and products is 37.1%. Summary statistics for Wal-Mart's price percentile ranks are presented in table 4. Wal-Mart's prices are lower than the average, but are not consistently the lowest prices. The relatively cheapest product at Wal-Mart (out of the database) is ultra-pasteurized milk (percentile rank of 14%), and the relatively more expensive goods are napkins (percentile rank of 57%). This price dispersion at Wal-Mart stores implies that consumers who like shopping there, should still have incentives to search for low prices at other stores if the search costs are not excessive. Search costs will be lower the closer retailers are geographically, and hence, price competition (and adjustment) could be affected by the number of competitors in a given radius and the distance to the closest Wal-Mart supercenter.

4.3 How does the Frequency and Size of Price Changes at Wal-Mart Compare to other Retailers?

I study the stability of regular prices using survival analysis, defining "failures" in terms of price changes. A product-by-product analysis using the Cox proportional hazards model reveals that the regular prices of some goods change faster at Wal-Mart than at other retailers, while the prices of some goods change slower.[8] I test the following specifications for the hazard rate of the price change of product i in store j of firm k.

$$h(t|x_{ijk}) = h_0(t)exp(x_{ijk}\beta_x) \tag{1}$$

The hazard rate for the jth store is

$$h(t|x_{ijk}) = h_0(t)exp(x_{ijk}\beta_x) \tag{2}$$

where x is a dummy variable that takes the value 1 if the store is a Wal-Mart supercenter. The interpretation of the coefficients is the ratio of the hazards for a one-unit change in the corresponding covariate. Anecdotes about Wal-Mart's pricing behavior include that it tends to oppose suppliers' proposals of price increases. The book "The Wal-Mart Effect" tells how the executives of Bertolli Olive Oil attempted a price raise when the Euro exchange rate in-

[8]The Kaplan-Meier estimate for all pooled products shows that Wal-Mart's prices have a better "survival experience" than the prices from other stores, and hence that regular prices change slower at Wal-Mart. This also holds for a separate analysis of price increases and price decreases.

creased and it was a bad crop year for olive oil. Wal-Mart did not approve the price increase in spite of these cost increases. Other stories about Wal-Mart state that it requires its suppliers to offer a price cut every year. In order to analyze preliminarily whether there is any evidence for this asymmetric pricing behavior, I estimate the hazard ratio of a price increase and a price decrease separately. I therefore analyze the hazard ratio of a price change, a price increase, and a price decrease. Pooled across all goods, the hazard of a price increase is 3.1% lower at Wal-Mart than at the other stores, while the hazard of a price decrease is 7.7% lower at Wal-Mart. The results for all product-by-product Cox estimations are presented in tables 5 and 6. Most products (69.56%)have a lower hazard of a price change at Wal-Mart than at the other stores. The hazard of a price decrease is greater than the hazard of a price decrease for 73.91% of the products.

In order to analyze the size of price changes, I compute their absolute value in monetary terms (Mexican peso) for Wal-Mart stores and other stores. Summary statistics are presented in table 7. The average size of price changes is lower at Wal-Mart for each of the products. Therefore, a preliminary analysis shows that Wal-Mart changes its regular prices less frequently and that the price changes correspond to a lower monetary amount than those of other retailers. This suggests that Wal-Mart might not track wholesale prices that closely. I will analyze price adjustment in response to changes in wholesale costs in depth in section 5.

4.4 How is Proximity to Wal-Mart related to Price Changes?

I analyze how time until a price increase and decrease varies with the distance to the closest Wal-Mart and the number of competitors in a 3-mile radius (which include Wal-Mart) for stores in Mexico City. The analysis uses Cox proportional hazards model, which models the hazard rate for a price change of product i in store j of firm k is:

$$h(t|x_{ijk}) = h_0(t)exp(x_{ijk}\beta_x) \tag{3}$$

where x measures proximity to Wal-Mart of a particular store. A proportional Cox regression shows that increasing the distance to the closest Wal-Mart by a mile increases a store's hazard of a price increase or a price decrease by 0.001%. This outcome suggests that an endogenous location choice by Wal-Mart is not so likely. If this were the case, distance to Wal-Mart would proxy for other unobservable characteristics which influence stores' decisions to change their prices. I will include competition indicators and demographic variables to account for this in the next section. A modified Cox proportional hazards model includes both the minimum distance to a Wal-Mart supercenter and the number of competitors in the covariates x. As table 8 shows, one additional competitor in a 3-mile ratio decreases the hazard of a price decrease and the hazard of a price increase of a non-Wal-Mart retailer by 0.001%. Increasing the distance to the closest Wal-Mart by a mile increases the hazard of a price increase or a price decrease by the same amount.

5 Input-Output Transmission

This section analyzes how Wal-Mart adjusts its prices to input cost changes and how Wal-Mart's strategy affects the pass-through of other retailers. Anecdotal evidence states that Wal-Mart is continuously monitoring its suppliers' costs, demanding price cuts, and fiercely opposing price increases as the following example shows.

> One multinational supplier, who asked to remain anonymous, says Wal-Mart buyers in Mexico were "aggressive and abusive", pulling his product off shelves for several months last year when he objected to a deep price cut that would have wiped out his profits. Meanwhile, Danone yogurt disappeared from Wal-Mart's Mexican stores for several months in 2001. Suppliers and retail buyers say the French company had participated in a weekend sales promotion at a competing supermarket, but balked when Wal-Mart buyers demanded the same discount on a permanent basis. ... Eduardo Castro, president and chief operating officer of Wal-Mart de Mxico, says he cannot comment on specific cases, but he defends his company's tactics down to the last candy bar. "If we stop doing business with a supplier, it's because his costs

> don't allow him to sell at the prices we've established," Castro says. "The few cases I know about [involve] price increases that they haven't been able to justify."[9]

There is no prior systematic evidence of Wal-Mart's relationship with suppliers, given the secrecy that Wal-Mart is said to impose on them and the lack of price and wholesale data. This section estimates the pass-through of input costs to final prices at Wal-Mart stores and the competitive impact on other retailers. In order to estimate this, the ideal goods would exhibit large and frequent cost fluctuations and have a short shelf life. The products in the database with the shortest shelf-life are yoghurt, pasteurized milk, tortillas, and bread. An additional consideration for the ideal products are data availability of wholesale costs. The Mexican government collects daily price data with detailed product specifications in 45 wholesale markets for horticultural raw and processed goods, meat, and fish. Out of these goods, three products with the exact specifications in terms of brand and size are in my database: corn oil (1-liter bottle of "La Gloria"), mixed vegetable oil (1-liter bottle of "1-2-3"), and tuna in oil (174 gram can of "Dolores"). Although these goods are not perfect because they do not have the short shelf life mentioned above, they are still relevant because retailers try to optimize their inventories and minimize storage costs. The choice of these products understates the effect for perishable goods. The wholesale prices are collected for a box of 12 bottles of corn oil, a box of 12 bottles of vegetable mixed oil, and a

[9] Business Week, September 16th 2002

box of 48 tuna cans. The wholesale prices of mixed vegetable oil and corn oil are available on a weekly frequency and the wholesale prices of tuna in oil are collected twice a month. As already described, the wholesale markets ("centrales de abasto") in which the prices are collected supply convenience stores, supermarkets, and kiosks. Therefore, these wholesale prices are an approximation of the true economic marginal cost rather than an accounting measure that is driven by the retailers' inventory policies. Nevo and Hatzitaskos (2005) comment on the poor quality of the wholesale prices of Dominick's supermarket chain's database because they correspond to an average acquisition cost. Both Peltzman (2000) and Mueller and Ray (2007) use those data to study whether there are asymmetries in price adjustment. Neither Dominick's self-reported wholesale costs nor the wholesale costs that I use account for agreements between manufacturers and retailers such as coupons, so that the actual wholesale costs that the retailers face might be lower.

In addition to the wholesale prices described above, I collect milk futures prices from the Chicago Mercantile Exchange to proxy for wholesale prices of pasteurized milk and yoghurt. I use the Milk Class IV and Basic Formula Price (BFP) milk prices.

I ask the following questions. How does the price of a one liter corn oil bottle at a specific store respond to a change in corn oil's wholesale price? Is the response asymmetric for corn oil wholesale price increases and decreases?

Is price adjustment to input costs shocks different at Wal-Mart than at other stores? How do retailers' responses to cost shocks depend on proximity to Wal-Mart, overall competition, and consumer characteristics?

The empirical specifications used in prior research on price adjustment are reviewed in Meyer and Cramon-Taubadel (2004). First, the following equation is estimated:

$$p_{it}^{ret} = \alpha + \beta_1 p_t^{who} + \eta x_{it} + \delta t + \mu_t \tag{4}$$

where p_{it}^{ret} is the retail price in store i in week t, p_t^{who} is the wholesale price in week t, x_{it} is a vector of store fixed effects, and t is a time trend (week number). This equation can be regarded as an estimate of the long-run equilibrium relationship between retail and wholesale prices. The coefficients for equation 5 for each of the products are reported in table 9. Vegetable mixed oil has the best fit, the retail price is explained by 93.7% of the wholesale price. A coefficient of 1 would be expected in the long run if it were exactly the same product and if retailing exhibited constant returns to scale and were perfectly competitive.[10]

[10] The estimated relationship between dairy retail and wholesale prices from this equation is very low (below 5%). This could be due to two factors. First, milk futures prices are a rough measure of yoghurt and ultrapasteurized milk because they refer to a different physical product. Second, milk futures prices trade in much greater units than the retail dairy products. Unfortunately, the Mexican government only began collecting wholesale prices for milk in 2007. Therefore, I exclude dairy products from my analysis.

Second, a lagged adjustment model, an error correction model, or a combination of both is estimated. The combined model has the following form:

$$\Delta p_{it}^{ret} = \alpha + \sum_{j=1}^{K}(\beta_j^+ D^+ \Delta p_{t-j+1}^{who}) + \sum_{j=1}^{L}(\beta_j^- D^- \Delta p_{t-j+1}^{who}) + \phi ECT_{t-1} \tag{5}$$

where $\Delta p_{it}^{ret} = p_t^{ret} - p_{t-1}^{ret}$ for store i in week t, D^+ and D^- are dummy variables with: $D^+ = 1$ if $p_t^{who} \geq p_{t-1}^{who}$ and $D^+ = 0$ otherwise; $D^- = 1$ if $p_t^{who} < p_{t-1}^{who}$ and $D^- = 0$ otherwise. The error correction term ECT_{t-1} is the one-period lagged residual from equation 5.

For the three products that I focus on (corn oil, vegetable mixed oil, and tuna in oil) the error correction term is so strong that it wipes out the effect of the lagged adjustment coefficients (see table 10). The following error correction model does not contain the lagged terms:

$$\Delta p_{it}^{ret} = \alpha + \phi ECT_{t-1} + \delta t \tag{6}$$

The fit for this model is presented in table 11. In order to be able to test whether there are any asymmetries in price adjustment, I differentiate among positive and negative values of the error correction term.

$$\Delta p_{it}^{ret} = \alpha + \phi^{+} ECT_{t-1}^{+} + \phi^{-} ECT_{t-1}^{-} + \delta t \tag{7}$$

where ECT^{+} and ECT^{-} are positive and negative deviations from the long-run equilibrium respectively. The interpretation of the coefficients is as follows. A positive value of the error correction term implies that the observed retail price is higher than the equilibrium retail price that is determined by the wholesale price. Therefore, a positive value of the error correction term means that the retail price would be expected to adjust downwards. A negative value of the error correction term has the opposite interpretation, it implies that retail prices would be expected to increase. The expected sign for the coefficient of both positive and negative values of the error correction terms is negative, as it implies a stable price relationship.

In order to analyze whether Wal-Mart stores adjust their prices to wholesale cost changes in a different way than other retailers, I include an interaction term.

$$\Delta p_{it}^{ret} = \alpha + \phi^{+} ECT_{t-1}^{+} + \phi^{-} ECT_{t-1}^{+} + \lambda^{+} W \times ECT_{t-1}^{+} + \lambda^{-} W \times ECT_{t-1}^{-} \tag{8}$$

where W is a dummy variable that takes the value 1 for Wal-Mart stores. The results of this specification are presented in table 13. The errors are clustered by time, specifically by week. Both Wal-Mart stores and non-Wal-

Mart stores respond asymmetrically to wholesale price changes, but with the opposite sign. Wal-Mart stores adjust their prices faster to wholesale price decreases than to wholesale price increases, while this relationship is reversed for non-Wal-Mart stores. Analyzing overall price adjustment without taking asymmetries into account confounds the results (table 12), as overall prices for corn oil adjust faster at Wal-Mart and prices of tuna adjust slower. As table 13 shows, at non-Wal-Mart stores the retail price of mixed vegetable oil adjusts upward by almost double the percentage of the error correction term that it adjusts downward in one week (24% versus 13%). For corn oil, this difference is even larger (17% versus 7%). Regarding tuna, the coefficient for an upward price adjustment of non-Wal-Mart stores is not statistically significant, and the price adjusts downward by 20% of the error correction term in one week. At Wal-Mart stores, the price of mixed vegetable oil adjusts downward almost seven times faster in one week than at other retailers and it adjusts upward one third slower than at other retailers. The price of corn oil adjusts downward more than five times faster at Wal-Mart stores than at other retailers and the interaction effect for the upward adjustment coefficient is not statistically significant. The price of tuna adjusts three times slower upward at Wal-Mart stores and the coefficient for the downward interaction effect is not statistically significant. Summarizing, all three coefficients on Wal-Mart's positive interaction term are negative, suggesting faster downward price adjustment at Wal-Mart stores. The two coefficients on Wal-Mart's negative interaction term that are statistically significant are positive, suggesting that prices at Wal-Mart stores adjust slower upwards.

The following analysis centers on whether Wal-Mart influences other retailers' price adjustment speed. The coordination failure hypothesis states that prices adjust slowly because firms wait for other firms to initiate price changes. This failure could be alleviated by a price leader or by collusive behavior. Wal-Mart seems to be a good candidate for a price leader given its size and reputation. Other models state that if search costs are not excessive, consumers will shop around if their regular retailer changes its prices. Wal-Mart's reputation for squeezing suppliers and passing all savings on to their consumers could lead consumers to think that they will infer whether costs have changed industry-wide by comparing prices at Wal-Mart supercenters. Search costs should be lower the closer a Wal-Mart supercenter to consumers' regular store is. The specification below analyzes the influence of Wal-Mart's proximity on price adjustment by non-Wal-Mart retailers:

$$\Delta p_{it}^{out} = \alpha + \phi^{+} ECT_{t-1}^{+} + \phi^{-} ECT_{t-1}^{+} + \lambda^{+} mindist_i \times ECT_{t-1}^{+} + \lambda^{-} mindist_i \times ECT_{t-1}^{-} \tag{9}$$

where *mindist* measures the distance for each store to the closest Wal-Mart supercenter. Stores that are one mile closer to a Wal-Mart supercenter adjust their corn oil prices 0.9% faster downward and 0.4% slower upward. Retailers that are one mile closer to a Wal-Mart store adjust their vegetable oil prices 0.4% slower downward. Hence, I do not find a clear relationship between proximity to Wal-Mart and the speed of price adjustment.

Firms' incentives to rapidly adjust prices could also depend on the level of competition. Search costs for lower prices depend on travel costs between stores. Hence, I measure competition as the number of stores in a 3-mile radius[11]. The number of stores includes Wal-Mart supercenters. The following specification tests the importance of competition on the speed of price adjustment:

$$\Delta p_{it}^{out} = \alpha + \phi^{+} ECT_{t-1}^{+} + \phi^{-} ECT_{t-1}^{+} + \lambda^{+} comp_i \times ECT_{t-1}^{+} + \lambda^{-} comp_i \times ECT_{t-1}^{-} \tag{10}$$

where $comp_i$ is the number of competitors for store i in a 3-mile radius. The results for this specification are presented in table 15. Stores with an additional competitor within 3 miles adjust their corn oil prices 0.2% slower downward and 0.1% slower upward. Retailers with an additional competitor in a 3-mile radius adjust the price of mixed vegetable oil 0.1% faster upward. The other coefficients are neither statistically nor economically significant. Therefore, I do not find support for theories that link the speed of price adjustment to the level of competition.

[11]An alternative specification with a 1-mile radius has similar results.

5.1 Discussion

This section reviews how robust the aforementioned results are. First, concern could arise because retailers follow different pricing strategies, using either an "every day low prices" or a "high-low prices" approach. The data contain list regular prices, so that the low promotional prices are excluded. In order to analyze the robustness of the results, I study whether Wal-Mart's pricing strategy is different from that of other every day low price retailers, restricting the sample to hypercenters. The results are robust to this specification (see table 16), Wal-Mart stores adjust their prices downward faster than other supercenters and adjust their prices upward slower than other hypercenters in response to wholesale cost changes. Other supercenters exhibit a reverse asymmetry in price adjustment for corn oil and vegetable oil than Wal-Mart, adjusting their prices faster upward than downward.

A second empirical challenge is that retailers engage in multi-product pricing. Ideally, I would like to study a representative basket of goods. There is multi-market contact in terms of the product market and the geographic market. Price changes across each chain's stores and price changes across product categories are not independent. I study isolated goods instead of focusing on a basket of representative goods or an entire product category. A related concern is which products are staple goods for consumers of a particular market. The question arises whether the products that I use for the input cost transmission analysis are goods for which demand elasticity is average and whether it varies across consumers' characteristics. The description of pricing practices in section four illustrates that those particular products change their prices with an approximately average frequency and that they tend to have a price distribution at Wal-Mart stores that is close to the average. In addition, it is not obvious that those products are consumed in a greater proportion by households with certain demographic characteristics, as would have been the case if for example baby food had been included in the analysis. I analyze the influence of demographic characteristics on price adjustment in order to address this concern and to account for potential endogeneity of Wal-Mart's locations. If Wal-Mart's stores are located in areas where people who buy corn oil, vegetable oil, and tuna have a different price elasticity than consumers from other neighborhoods, the results about Wal-Mart's input cost transmission would be confounded. Using demographic data at the locality level for Mexico City, I study whether stores' price adjustment is driven by consumer characteristics. Hoch et al. (1995) find that households with higher income are less price sensitive. In order to proxy for income differences, I include an interaction effect in the error correction model that measures the proportion of households in each store's neighborhood that owns a refrigerator and a personal computer. In addition to proxying for income, a higher proportion of refrigerators could indicate higher search costs for consumers. Analogous to Sorenson's (2002) who studies how frequency of purchase influences pharmaceuticals' price dispersion, frequency of grocery shopping will depend on storage capabilities by households, which are determined by the ownership of a refrigerator and storage space. Singh et al. (2006) show that households with an infant (or a pet) are more likely to shop at Wal-Mart stores. I include an interaction term that accounts for the proportion of households with small children (up to four years old) in each store's neighborhood. The results are presented in table 17. There is not a strong pattern of statistical consistency for any of the three demographic variables. However, all six of the coefficient estimates are negative, and one is significant, for refrigerator ownership, suggesting faster price adjustment (both upwards and downwards) when a greater share of the population owns a refrigerator. Five of the six coefficient estimates are negative, and two are significant, for percentage of households with small children, also suggesting faster price adjustment in both directions for stores that are located in neighborhoods with more small children. Demographic characteristics do not account for the asymmetric response to wholesale price cost changes that Wal-Mart stores exhibit. Hence, there is no evidence that the results of Wal-Mart's input-cost transmission are driven by its endogenous location choices.

6 Conclusion

How should the findings that Wal-Mart adjusts its prices faster downward than its competitors and slower upward than its rivals be interpreted? The classical discussion about Wal-Mart is summarized in the following article from the New York Times on Mexican retailers.

> According to Carlos N. Lukac, managing director of the Mexico City office of the Bain and Company consulting firm: About 3 percentage points of Wal-Mart's price advantage comes from its negotiations with suppliers, he said, adding that Wal-Mart's "distribution costs are more efficient by orders of magnitude." "I am fed up with hearing about Wal-Mart's efficiencies and logistics," said Santiago Garca, president of Comercial Mexicana's hypermarket group, pointing to numbers on Wal-Mart's balance sheet to show where the two companies' operating costs are comparable. "The reality is that their efficiency is in the volumes they have and the way they squeeze suppliers."[12]

Wal-Mart has been credited for having more efficient distribution systems than other retailers, which would imply less inventories. Therefore, it would be expected to have less sticky prices, but overall (without taking asymmmetries into account) Wal-Mart does not adjust its prices faster than its competitors as shown in table 12. The findings of an asymmetry in the speed of price adjustment towards lower prices is consistent with anecdotal evidence of Wal-Mart taking advantage of its scale when bargaining with suppliers. An alternative explanation is that Wal-Mart passes all savings on to its consumers through an every-day-low pricing strategy, rather than temporal price

[12] "Mexican retailers unite against Wal-Mart", New York Times, July 9, 2004

promotions. In order to test this effect, I restrict the analysis to all every-day-low-price retailers. Wal-Mart adjusts its prices faster downward than other hypermarkets and slower upward than they do. Another alternative explanation is that Wal-Mart's contracts with suppliers have different length than those of other retailers, but this would not account for the asymmetry in Wal-Mart's response to wholesale cost changes.

To summarize, this study is the first to directly observe Wal-Mart's pricing practices and its influence on other retailers' input cost transmission over an extended period of time. I analyze the importance of market power and competition on the speed of input cost transmission using weekly store-level retail prices in 12 Mexican cities from 2001 to 2006. Although this study focuses on a small number of goods, it uses economically relevant wholesale cost data, which are a better estimate of the true replacement cost than self-reported wholesale costs by retailers that have been used in previous research. The overall findings are that Wal-Mart adjusts its prices 1/3-3 times slower to wholesale price increases than other retailers and responds 5-7 times faster to wholesale price decreases than its competitors. This evidence is robust to the comparison of Wal-Mart to other hypermarkets that offer "every day low prices". Demographic variables in stores' neighborhoods which proxy for income and propensity for shopping at Wal-Mart do not explain Wal-Mart's asymmetric price response, although prices tend to adjust faster in both directions in stores that are located in neighborhoods with more refrigerators and more small children. The results therefore support anecdotal evidence that Wal-Mart exerts pricing pressure on its suppliers. All retailers respond asymmetrically to wholesale cost changes. However, retailers other than Wal-Mart respond twice as fast to wholesale price increases than to decreases, while Wal-Mart behaves in the opposite way. I do not find support for theoretical models that link search costs and market structure to the speed of price adjustment. Neither proximity to a Wal-Mart supercenter nor the number of competitors in a 3-mile radius affect the speed of price adjustment of retailers.

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Table 1: List of products

Good	Brand	Packaging and Specification
Corn Flour	Maseca	1 kg. package
Corn Tortilla	Milpa Real	500 gr. bag
Bread	Bimbo	680 gr. package (white sliced bread)
Bread	Wonder	680 gr. package (white sliced bread)
Cookies	Gamesa	1kg. box (marias)
Pasta for Soup	La Moderna	200 gr. package (long pasta)
Sugar Cereal (Zucaritas)	Kellogg's	510 gr. box
Evaporated Milk	Carnation (Nestle)	410 gr. can (part skim)
Condensed Milk	La Lechera (Nestle)	100 gr. can
Yoghurt	Yoplait	150 gr. cup (strawberry)
Pasteurized Milk	Alpura 2000	1 lt. box (part skim)
Corn Oil	La Gloria	1 lt. bottle
Mixed Vegetable Oil	1-2-3	1 lt. bottle
Canola Oil	Capullo	1 lt. bottle
Lard	Inca	1 kg. package
Tuna	Dolores	174 gr. can (in oil)
Peaches	La Costena	820 gr. can (halves)
Corn	Del Monte	225 gr. can (grain)
Chiles	La Costena	220 gr. can (red jalapenos)
Tomato Puree	Del Fuerte	1 kg. box
Peas	Del Fuerte	225 gr. can
Baby Food	Gerber	113 gr. jar (2nd stage, blended food)
Jam	Mc Cormick	270 gr. jar (strawberry)
Sugar	S/M	2 kg. plastic bag (brown)
Instant Coffee	Nescafe Dolca	100 gr. jar
Instant Coffee	Nescafe Dolca	200 gr. jar
Salt	La Fina	1 kg. bag
Salt	La Fina	1kg. container
English Sauce	Worcestershire Crosse	145 ml. bottle
Hot Sauce	Bufalo	150 gr. bottle (classic)
Vinegar	Clemente Jacques	1 lt. bottle (white)
Cocoa	Choco Milk	400 gr. bag
Cocoa	Choco Milk	400 gr. can
Chocolate	Abuelita	540 gr. package (6 tablets)
Bleach	Cloralex	950 ml bottle
Laundry Detergent	Foca	1 kg. bag (powder)
Soap	Zote	400 gr. bar
Floor Cleaner	Maestro Limpio	1 lt. bottle (multi-use pine)
Floor Cleaner	Pinol	1 lt. bottle (multi-use pine)
Laundry Softener	Vel Rosita	1 lt. bottle (liquid)
Hand Cream	Hinds	420 ml. bottle (normal skin)
Deodorant	Mum	65 ml. roll-on
Facial Soap	Zest	150 gr. bar
Shampoo	Caprice Naturals	900 ml. bottle
Napkins	LYS	250 units package
Napkins	Petalo	250 units package

Table 2: Chains do not engage in uniform pricing: Summary statistics for coefficient of variation within a chain for each product's price every week

Good	Mean Coeff. of Variation	Std.Dev.	N
Corn flour	0.041	0.051	85,519
Tortilla	0.027	0.040	74,996
Bread (Bimbo)	0.027	0.023	101,462
Bread (Wonder)	0.035	0.036	74,876
Pasta for soup	0.049	0.055	109,419
Cookies	0.043	0.037	83,203
Sugar cereal	0.031	0.030	87,260
Tuna	0.048	0.053	73,154
Evaporated milk	0.032	0.051	91,370
Condensed milk	0.032	0.054	84,042
Yoghurt	0.050	0.048	93,840
Pasteurized milk	0.036	0.150	103,458
Corn oil	0.037	0.036	82,346
Mixed oil	0.035	0.029	100,979
Canola oil	0.036	0.029	115,879
Lard	0.038	0.046	88,623
Corn	0.043	0.044	86,896
Chiles	0.071	0.058	110,483
Tomato puree	0.040	0.052	81,205
Peas	0.072	0.083	87,667
Baby food	0.041	0.049	110,028
Jam	0.040	0.042	96,626
Peaches	0.040	0.036	78,546
Sugar	0.025	0.035	73,199
Instant coffee	0.021	0.028	100,367
Instant coffee	0.018	0.022	98,908
Salt	0.058	0.059	85,904
Salt	0.039	0.045	82,062
Worcestershire sauce	0.033	0.042	70,645
Hot sauce	0.037	0.056	91,763
Vinegar	0.023	0.039	73,061
Cocoa	0.047	0.045	92,543
Cocoa	0.041	0.034	95,795
Chocolate	0.043	0.035	96,754
Bleach	0.057	0.059	108,168
Laundry detergent	0.033	0.038	103,970
Soap	0.040	0.040	108,181
Floor cleaner	0.041	0.037	95,217
Floor cleaner	0.053	0.042	109,386
Laundry softener	0.034	0.034	97,082
Hand cream	0.037	0.037	72,235
Deodorant	0.051	0.049	82,647
Facial soap	0.035	0.035	88,454
Shampoo	0.041	0.038	95,869
Napkins	0.040	0.043	65,550
Napkins	0.041	0.039	88,402

Table 3: Chains do not engage in uniform pricing: Summary statistics for share of stores within a chain that charge the chain's modal price

Good	Mean Share of Modal Price	Std.Dev.	N
Corn flour	0.441	0.292	82,707
Tortilla	0.474	0.283	70,247
Bread (Bimbo)	0.453	0.286	93,827
Bread (Wonder)	0.461	0.289	68,332
Pasta for soup	0.425	0.282	104,236
Cookies	0.408	0.281	78,027
Sugar cereal	0.444	0.287	82,083
Tuna	0.392	0.292	68,719
Evaporated milk	0.434	0.293	89,014
Condensed milk	0.473	0.296	79,472
Yoghurt	0.426	0.273	88,651
Pasteurized milk	0.462	0.279	98,694
Corn oil	0.438	0.277	73,024
Mixed oil	0.394	0.293	92,895
Canola oil	0.401	0.294	106,749
Lard	0.459	0.291	83,973
Corn	0.453	0.284	81,281
Chiles	0.399	0.280	105,185
Tomato puree	0.451	0.284	75,710
Peas	0.476	0.282	81,835
Baby food	0.409	0.280	104,699
Jam	0.440	0.299	91,413
Peaches	0.414	0.271	72,632
Sugar	0.445	0.281	69,402
Instant coffee	0.485	0.297	88,194
Instant coffee	0.483	0.294	86,038
Salt	0.432	0.293	78,287
Salt	0.483	0.298	73,600
Worcestershire sauce	0.477	0.301	68,126
Hot sauce	0.461	0.293	87,770
Vinegar	0.519	0.296	69,994
Cocoa	0.409	0.286	85,190
Cocoa	0.427	0.289	88,238
Chocolate	0.420	0.290	91,780
Bleach	0.407	0.287	104,528
Laundry detergent	0.423	0.300	99,832
Soap	0.427	0.289	103,171
Floor cleaner	0.423	0.290	87,201
Floor cleaner	0.392	0.288	101,034
Laundry softener	0.431	0.294	91,814
Hand cream	0.461	0.287	66,652
Deodorant	0.451	0.28	76,503
Facial soap	0.458	0.295	83,995
Shampoo	0.421	0.289	90,846
Napkins	0.470	0.292	59,758
Napkins	0.432	0.290	81,764

Table 4: Wal-Mart's price distribution: Percentile Rank Summary Statistics

Good	Mean Percentile Rank	Std.Dev.	N
Baby food	40.6	17.5	6,937
Tuna	29.4	21.2	4,225
Sugar	42.0	27.9	6,138
Bleach	34.3	20.5	6,931
Peas	48.8	25.2	6,725
Chiles	35.8	22.7	6,884
Chocolate	41.9	21.7	6,415
Hand cream	40.2	17.6	5,260
Deodorant	41.2	19.0	6,512
Laundry detergent	33.1	18.3	6,963
Peaches	36.2	19.8	6,549
Corn	45.4	19.2	6,610
Cookies	42.5	22.0	6,431
Corn flour	38.9	18.5	6,546
Sugar cereal	34.1	15.8	6,784
Soup	32.2	23.4	6,660
Facial soap	30.2	18.7	5,090
Condensed milk	37.9	15.6	5,916
Evaporated milk	14.8	16.6	4,823
Ultrapasteurized milk	14.0	12.4	6,857
Lard	45.3	19.3	6,647
Jam	39.8	20.0	6,965
Pasta for soup	46.6	19.0	6,869
Tomato puree	36.1	18.9	6,857
Worcestershire sauce	20.3	13.3	6,498
Hot sauce	41.4	13.8	6,490
Shampoo	32.2	20.3	6,926
Laundry softener	36.5	17.0	6,860
Corn tortilla	35.7	16.2	6,086
Vinegar	32.3	17.0	6,795
Yoghurt	30.5	17.9	6,975
Corn oil	38.7	20.8	6,672
Mixed vegetable oil	31.7	21.1	5,136
Canola oil	39.1	22.0	6,969
Instant coffee (100 gr.)	35.1	27.5	6,490
Instant coffee (200 gr.)	33.9	27.1	6,295
Bread (Bimbo)	46.6	17.3	6,709
Bread (Wonder)	41.3	18.5	5,639
Salt (bag)	40.0	22.5	6,102
Salt (box)	33.4	19.3	5,965
Napkins (LYS)	40.3	20.0	206
Napkins (Petalo)	57.2	20.1	6,628
Cocoa (bag)	41.5	20.7	6,639
Cocoa (can)	36.7	20.8	6,741
Floor cleaner (Maestro)	38.6	17.9	5,648
Floor cleaner (Pinol)	37.8	20.8	6,855

Table 5: Frequency of price changes at Wal-Mart and other retailers: Cox Proportional Hazards Model, reporting coefficient for hazard ratio of Wal-Mart dummy, Part 1

Product	Hazard ratio of price change	Hazard ratio of price decrease	Hazard ratio of price increase	N
Corn flour	0.902***	0.904**	0.901**	82,707
	(0.031)	(0.045)	(0.042)	
Corn tortilla	1.687***	1.828***	1.568***	70,247
	(0.052)	(0.081)	(0.068)	
Bread (Bimbo)	0.962	0.955	0.967	93,827
	(0.030)	(0.046)	(0.040)	
Bread (Wonder)	1.088***	1.164***	1.030	68,332
	(0.036)	(0.056)	(0.046)	
Pasta for soup	0.893***	0.952***	0.838***	104,236
	(0.028)	(0.041)	(0.037)	
Cookies	1.217***	1.232***	1.204***	78,027
	(0.031)	(0.046)	(0.043)	
Sugar Cereal	0.879***	0.869***	0.887***	82,083
	(0.030)	(0.044)	(0.041)	
Tuna	0.984	0.944	1.018	68,719
	(0.036)	(0.052)	(0.051)	
Evaporated milk	0.690***	0.581***	0.782***	89,014
	(0.028)	(0.038)	(0.041)	
Condensed milk	0.882***	0.759***	0.97	79,472
	(0.039)	(0.055)	(0.053)	
Yoghurt	1.170***	1.193***	1.146***	88,651
	(0.031)	(0.044)	(0.043)	
Pasteurized milk	0.452***	0.353***	0.524***	98,694
	(0.026)	(0.036)	(0.037)	
Corn oil	1.066**	1.043	1.088**	73,024
	(0.030)	(0.042)	(0.042)	
Mixed oil	0.988	1.014	0.965	92,895
	(0.029)	(0.042)	(0.039)	
Canola oil	0.892***	0.892***	0.892***	106,749
	(0.023)	(0.033)	(0.032)	
Lard	1.126***	1.147***	1.110**	83,973
	(0.037)	(0.056)	(0.050)	
Corn	1.582***	1.676***	1.501***	81,281
	(0.046)	(0.070)	(0.061)	
Chiles	0.922***	0.926**	0.918**	105,185
	(0.025)	(0.036)	(0.035)	
Tomato puree	1.175***	1.226***	1.130***	75,710
	(0.038)	(0.057)	(0.051)	
Peas	1.295***	1.307***	1.285***	81,835
	(0.042)	(0.061)	(0.057)	
Baby food	1.035	1.032	1.037	104,699
	(0.026)	(0.038)	(0.036)	
Jam	0.730***	0.713***	0.744***	91,413
	(0.028)	(0.040)	(0.038)	
Peaches	1.412***	1.418***	1.406***	72,632
	(0.035)	(0.050)	(0.049)	

Standard errors in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6: Frequency of price changes at Wal-Mart and other retailers: Cox Proportional Hazards Model, reporting coefficient for hazard ratio of Wal-Mart dummy, Part 2

Product	Hazard ratio of price change	Hazard ratio of price decrease	Hazard ratio of price increase	N
Sugar	1.149***	1.225***	1.082*	69,402
	(0.033)	(0.051)	(0.044)	
Instant coffee (small)	0.720***	0.739***	0.706***	88,194
	(0.032)	(0.049)	(0.042)	
Instant coffee (medium)	0.945	0.934	0.953	86,038
	(0.039)	(0.058)	(0.052)	
Salt	1.008	1.040	0.979	78,287
	(0.035)	(0.052)	(0.049)	
Salt	1.111	1.126	1.097	73,600
	(0.042)	(0.061)	(0.058)	
English sauce	0.946	0.894*	0.986	68,126
	(0.038)	(0.055)	(0.051)	
Hot sauce	0.593***	0.617***	0.571***	87,770
	(0.026)	(0.039)	(0.036)	
Vinegar	0.767***	0.775***	0.760***	69,994
	(0.034)	(0.050)	(0.048)	
Cocoa	1.113***	1.150***	1.077**	85,190
	(0.030)	(0.043)	(0.041)	
Cocoa	0.914***	0.917**	0.911**	88,238
	(0.026)	(0.037)	(0.036)	
Chocolate	0.865***	0.884***	0.849***	91,780
	(0.027)	(0.041)	(0.037)	
Bleach	0.849***	0.885***	0.814***	104,528
	(0.024)	(0.035)	(0.033)	
Laundry detergent	0.916***	1.004	0.834***	99,832
	(0.027)	(0.041)	(0.036)	
Soap	1.052*	1.081*	1.025	103,171
	(0.030)	(0.044)	(0.041)	
Floor cleaner	0.817***	0.832***	0.802***	87,201
	(0.026)	(0.037)	(0.036)	
Floor cleaner	0.828***	0.838***	0.819***	101,034
	(0.022)	(0.032)	(0.031)	
Laundry softener	1.016	1.022	1.011	91,814
	(0.031)	(0.046)	(0.043)	
Hand cream	0.873***	0.868***	0.877**	66,652
	(0.033)	(0.047)	(0.047)	
Deodorant	0.758***	0.748***	0.769***	76,503
	(0.028)	(0.0404)	(0.040)	
Facial soap	0.753***	0.800***	0.711***	83,995
	(0.031)	(0.047)	(0.042)	
Shampoo	1.032	1.069*	0.998	90,846
	(0.027)	(0.040)	(0.037)	
Napkins	0.574***	0.591***	0.556***	59,758
	(0.067)	(0.095)	(0.093)	
Napkins	0.999	0.959	1.035	81,764
	(0.030)	(0.043)	(0.043)	

Standard errors in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 7: Size of price changes: Summary statistics of absolute value of price changes for Wal-Mart and non-Wal-Mart stores (in Mexican pesos)

	Wal-Mart stores		**Non-Wal-Mart stores**	
	Mean of absolute value of price change	SD	Mean of absolute value of price change	SD
Corn flour	0.157	0.291	0.248	0.905
Corn tortilla	0.088	0.201	0.180	0.643
Bread (Bimbo)	0.273	0.558	0.360	0.720
Bread (Wonder)	0.320	0.659	0.402	0.774
Pasta for soup	0.075	0.164	0.151	0.248
Cookies	0.552	1.417	0.673	1.277
Sugar Cereal	0.560	1.205	0.811	1.985
Tuna	0.152	0.292	0.341	0.777
Evaporated milk	0.164	0.313	0.287	0.997
Condensed milk	0.143	0.612	0.274	1.340
Yoghurt	0.120	0.201	0.206	0.631
Pasteurized milk	0.124	0.226	0.482	4.707
Corn oil	0.301	0.684	0.413	0.886
Mixed oil	0.240	0.482	0.369	0.602
Canola oil	0.295	0.667	0.497	0.859
Lard	0.364	0.811	0.532	1.185
Corn	0.150	0.368	0.245	0.526
Chiles	0.156	0.302	0.254	0.459
Tomato puree	0.262	0.503	0.499	2.327
Peas	0.208	0.413	0.313	1.678
Baby food	0.212	0.391	0.233	0.721
Jam	0.207	0.607	0.482	0.983
Peaches	0.501	0.901	0.666	1.330
Sugar	0.265	0.616	0.413	0.900
Instant coffee (small)	0.238	0.679	0.485	1.295
Instant coffee (medium)	0.379	1.056	0.648	1.530
Salt	0.137	0.309	0.205	0.527
Salt	0.144	0.372	0.281	0.610
English sauce	0.23	0.719	0.456	1.115
Hot sauce	0.111	0.42	0.243	0.882
Vinegar	0.199	0.55	0.314	1.345
Cocoa	0.586	1.094	0.756	1.672
Cocoa	0.573	1.181	0.745	1.476
Chocolate	0.790	1.537	0.988	1.796
Bleach	0.188	0.498	0.384	1.674
Laundry detergent	0.261	0.576	0.548	1.424
Soap	0.113	0.210	0.221	0.509
Floor cleaner	0.372	0.844	0.593	1.016
Floor cleaner	0.325	0.711	0.622	1.121
Laundry softener	0.519	1.461	0.822	1.571
Hand cream	1.038	2.028	1.328	2.619
Deodorant	0.725	1.251	0.907	1.666
Facial soap	0.186	0.316	0.250	0.461
Shampoo	0.495	0.925	0.862	1.699
Napkins	0.423	0.845	0.365	0.934
Napkins	0.347	0.751	0.494	0.989

Table 8: Influence of proximity to Wal-Mart and level of competition on hazard of price changes by a non-Wal-Mart retailer, proportional Cox hazards model

	Hazard ratio of price increase	Hazard ratio of price decrease
Distance to closest Wal-Mart	0.998887***	0.998743***
	(0.000046)	(0.000049)
Number of competitors in 3-mile radius	0.999710***	0.999573***
	(0.000027)	(0.000028)
N	3,525,267	3,525,267

Standard errors in parenthesis.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 9: Long-run equilibrium retail-wholesale price relationship, Dependent variable is difference of retail price of each product

	Mixed Veg. Oil	Corn oil	Tuna	UHT Milk	Yoghurt
Wholesale price	0.9366***	0.5465***	0.5883***	0.0400***	0.0091***
	(0.0051)	(0.048)	(0.0097)	0.00219	(0.0006)
Time trend	0.0026***	0.0105***	0.0017***	0.0074***	−0.0020***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0000)
Constant	1.2054***	5.7973***	3.0169**	6.8892***	3.7791***
	(0.0365)	(0.0468)	(0.0451)	(0.0308)	(0.0079)
N	74,789	47,080	30,792	82,064	73,919

Store fixed effects are included.
Robust standard errors clustered by week in parenthesis
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 10: Error correction model with lagged adjustment, Dependent variable is difference of retail price of each product

	Mixed Vegetable oil	Corn oil	Tuna
△ Wholesale price (0) +	−0.0024	0.1367***	−0.0370
	(0.0677)	(0.0446)	(0.0230)
△ Wholesale price (-1) +	−0.0462	−0.0118	−0.0740**
	(0.0670)	(0.0306)	(0.0350)
△ Wholesale price (-2) +	−0.1086	0.0227	−0.0684
	(0.1148)	(0.0307)	(0.0424)
△ Wholesale price (-3) +	−0.0381	−0.0004	−0.0501*
	(0.0538)	(0.0262)	(0.0303)
△ Wholesale price (-4) +	0.0439	0.05016*	−0.0378
	(0.1358)	(0.0270)	(0.0300)
△ Wholesale price (-5) +	−0.0941	0.0490	−0.0930***
	(0.0605)	(0.0455)	(0.0269)
△ Wholesale price (-6) +	−0.0542	0.0156	0.0145
	(0.0757)	(0.0279)	(0.0359)
△ Wholesale price (0) −	−0.0693	−0.0354	0.1459***
	(0.1371)	(0.0995)	(0.0193)
△ Wholesale price (-1) −	−0.1727	−0.0003	−0.0360
	(0.1089)	(0.0542)	(0.0466)
△ Wholesale price (-2) −	−0.1684	−0.0196	−0.0343*
	(0.1398)	(0.0938)	(0.0193)
△ Wholesale price (-3) −	−0.1730	0.0078	−0.0243
	(0.1266)	(0.0805)	(0.0252)
△ Wholesale price (-4) −	−0.0577	−0.0994	0.0459
	(0.0871)	(0.0684)	(0.0386)
△ Wholesale price (-5) −	0.0095	−0.0301	0.0245
	(0.1336)	(0.0442)	(0.0359)
△Wholesale price (-6) −	−0.2414*	0.0625	0.0569***
	(0.1440)	(0.0584)	(0.0138)
Error correction term	−0.2005***	−0.1041***	−0.1288***
	(0.0088)	(0.0090)	(0.0078
Time trend	−0.0002***	−0.0001	0.0002***
	(0.0001)	(0.0001)	0.0001
Intercept	0.0343***	−0.0191	−0.0194***
	(0.0101)	(0.0159)	0.0068
N	30,114	15,213	18,115
R^2	0.1063	0.0531	0.0679

Robust standard errors clustered by time in parenthesis
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 11: Error correction model without lagged adjustment, Dependent variable is difference of retail price of each product

	Mixed Vegetable oil	Corn oil	Tuna
Error correction term	-0.1674^{***}	-0.1031^{***}	-0.1258^{***}
	(0.0068)	(0.0020)	(0.0075)
Time trend	-0.0001^{***}	-0.0001^{***}	0.0001
	(0.0000)	(0.0000)	(0.0001)
Constant	0.0344^{***}	0.0158^{***}	0.0027
	(0.0062)	(0.0048)	(0.0079)
N	74,789	47,080	53,130
R-square	0.087	0.052	0.032

Robust standard errors clustered by time in parenthesis
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 12: Wal-Mart's error correction model without asymmetry, Dependent variable is difference of retail price of each product

	Mixed Veg. Oil	Corn oil	Tuna
Error correction term	-0.1679^{***}	-0.0987^{***}	-0.1282^{***}
	(0.0066)	(0.0021)	(0.0077)
Wal-Mart dummy $\times$ ECT	0.0131	-0.1125^{***}	0.0486^{**}
	(0.0225)	(0.0104)	0.0194
Time trend	-0.0002^{***}	-0.0001^{***}	0.0001
	(0.0000)	(0.0000)	(0.0001)
Constant	0.0347^{***}	0.0128^{***}	0.0039
	(0.0061)	(0.0048)	(0.0080)
N	74,789	47,080	53,130

Robust standard errors clustered by time in parenthesis
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 13: Wal-Mart's asymmetric price adjustment is different, error correction model where the dependent variable is difference in retail price of each product

	Mixed Veg. Oil	Corn oil	Tuna
Error correction term +	-0.1280^{***}	-0.0647^{***}	-0.1993^{***}
	(0.0073)	(0.0116)	(0.0167)
Wal-Mart × ECT +	-0.6463^{***}	-0.2849^{***}	-0.0706
	(0.1502)	(0.0686)	(0.0867)
Error correction term −	-0.2361^{***}	-0.1734^{***}	-0.0150
	(0.0146)	(0.0132)	(0.0190)
Wal-Mart × ECT −	0.0735^{***}	-0.0348	0.0307^{*}
	(0.0178)	(0.0326)	(0.0159)
Time trend	-0.0002^{***}	-0.0001	0.0001
	(0.0000)	(0.0001)	(0.0001)
Constant	0.0033^{***}	-0.0348^{***}	0.0543^{***}
	(0.0071)	(0.0120)	(0.0126)
N	74,789	47,080	24,023

Robust standard errors clustered by time in parenthesis

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

ECT + refers to a positive value of the error correction term or downward price adjustment; ECT − refers to a negative value of the error correction term or upward price adjustment

Table 14: Influence of proximity to Wal-Mart on price adjustment speed, error correction model where dependent variable is difference of retail price of each product

	Mixed Veg. Oil	Corn oil	Tuna
Error correction term +	-0.1349^{***}	-0.0564^{***}	-0.1929^{***}
	(0.00793)	(0.0032)	(0.0149)
Distance to closest Wal-Mart × ECT +	0.0005^{***}	-0.0005^{***}	-0.0008
	(0.0001)	(0.0001)	(0.0006)
Error correction term −	-0.2318^{***}	-0.1865^{***}	-0.0069
	(0.0154)	(0.0053)	(0.0181)
Distance to closest Wal-Mart × ECT −	0.0000	0.0007^{***}	-0.0005
	(0.0001)	(0.0001)	(0.0003)
Time trend	-0.0002^{***}	-0.0002^{***}	0.0001
	(0.0000)	(0.0000)	(0.0001)
Constant	0.0023	-0.0378^{***}	0.0539^{***}
	(0.0073)	(0.0061)	(0.0128)
N	72,632	41,664	23,332

Robust standard errors clustered by time in parenthesis

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

ECT + refers to a positive value of the error correction term or downward price adjustment; ECT − refers to a negative value of the error correction term or upward price adjustment

Table 15: Influence of level of competition on price adjustment speed, error correction model, dependent variable is difference of retail price of each product

	Mixed Veg. Oil	Corn oil	Tuna
Error correction term +	-0.1150^{***}	-0.0883^{***}	-0.1816^{***}
	(0.0127)	(0.0046)	0.0297
Number of competitors in 3-mile radius × ECT +	-0.0001	0.0002^{***}	-0.0002
	(0.0001)	(0.0000)	0.0002
Error correction term −	-0.2052^{***}	-0.1857^{***}	-0.0159
	(0.01630)	(0.0075)	0.0225
Number of competitors in 3-mile radius × ECT -	-0.0002^{***}	0.0001^{***}	0.0001
	(0.0001)	(0.0001)	(0.0001)
Time trend	-0.0002^{***}	-0.0002^{***}	0.0001
	(0.0000)	(0.0000)	(0.0001)
Constant	0.0034	-0.0373^{***}	0.0551^{***}
	(0.0072)	(0.0057)	(0.01289)
N	74,201	46,608	23,759

Robust standard errors clustered by time in parenthesis

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

ECT + refers to a positive value of the error correction term or downward price adjustment; ECT − refers to a negative value of the error correction term or upward price adjustment

Table 16: Wal-Mart's price adjustment compared to other hypermarkets, error correction model, dependent variable is difference of retail price of each product

	Mixed Vegetable oil	Corn oil	Tuna
Error correction term +	-0.3085^{***}	-0.1697^{***}	-0.2981^{***}
	(0.0708)	(0.0083)	(0.0877)
Wal-Mart dummy × ECT +	-0.4551^{***}	-0.2328^{***}	0.0004
	(0.1479)	(0.0274)	(0.1143)
Error correction term −	-0.3266^{***}	-0.2337^{***}	-0.1434^{***}
	(0.0375)	(0.0184)	(0.0666)
Wal-Mart dummy × ECT −	0.1429^{***}	0.0690^{***}	0.2019^{***}
	(0.0323)	(0.0200)	(0.0453)
Time trend	0.0001^{***}	-0.0004^{***}	-0.0003
	(0.0001)	(0.0001)	(0.0002)
Constant	-0.0531	0.0634^{***}	0.1144^{***}
	(0.0143)	(0.0129)	(0.4912)
N	11,787	9,694	3,818

Robust standard errors clustered by time in parenthesis
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
ECT + refers to a positive value of the error correction term or downward price adjustment;
ECT − refers to a negative value of the error correction term or upward price adjustment

Table 17: Influence of store's neighborhood's demographics on price adjustment speed, error correction model with dependent variable as difference of retail price of each product

	Mixed Vegetable oil	Corn oil	Tuna
Error correction term +	-0.14651^{***}	0.01344^{***}	-0.13161^{***}
	(0.02966)	(0.06901)	(0.02949)
ECT + × % of households with a refrigerator	-0.05120	-0.07303	-0.00358
	(0.03943)	(0.05947)	(0.05552)
ECT + × % of households that owns a PC	0.06550	0.05437	-0.08411
	(0.06513)	(0.06985)	(0.08581)
ECT + × % of households with small children	0.24880	-0.16396	-0.66307^{**}
	(0.26133)	(0.35845)	(0.27653)
Error correction term −	-0.28016^{***}	-0.08883	0.07886^{***}
	(0.04256)	(0.02746)	(0.02917)
ECT − × % of households with a refrigerator	-0.05558	-0.04619	-0.08137^{***}
	(0.03787)	(0.03715)	(0.03526)
ECT − × % of households that owns a PC	0.12701^{**}	-0.08684	0.039081
	(0.05929)	(0.06603)	(0.060596)
ECT − × % of households with small children	-0.00189	-0.57964^{***}	-0.23436
	(0.25505)	(0.21044)	(0.18711)
Time trend	-0.00189^{***}	-0.00097	0.00011
	(0.00053)	(0.00099)	(0.00008)
Intercept	0.01103	-0.06744^{***}	0.05942^{***}
	(0.00904)	(0.01376)	(0.01203)
N	53,170	28,140	15,351
Testing for joint significance of all demographic interaction terms			
F statistic	1.15	2.86	4.15
Prob($F > F_c$)	0.3339	0.0105	0.0008

Robust standard errors clustered by time in parenthesis
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$
ECT + refers to a positive value of the error correction term or downward price adjustment; ECT − refers to a negative value of the error correction term or upward price adjustment