Supplier Responses to Walmart's Invasion in Mexico[1]

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June 2014

[1]We thank Andy Bernard, Jan De Loecker and the audiences at the 2008 LACEA Meetings, the 2009 NBER Spring Productivity Meeting, the 2009 Princeton Summer Trade Conference,and the 2012 CSFP IO and Development Workshop for comments and suggestions. Comments by two referees and the editor were particularly useful. We thankfully acknowledge support from the World Bank's Research Support Budget. The authors are grateful to Gerardo Leyva and Abigail Durán for granting us access to INEGI data at the offices of INEGI in Aguascalientes under the commitment of complying with the confidentiality requirements set by the Mexican Laws. Special thanks go to all INEGI employees who provided assistance and answered our questions, in particular to Gabriel Romero, Alejandro Cano, Araceli Martinez, Armando Arellanes, Ramon Sanchez, Otoniel Soto, Candido Aguilar, and Adriana Ramirez. We also wish to thank Thomas Withiam for his excellent work preparing the maps that appear in this paper, and Mauricio Varela for help with the data. The views expressed in the paper are those of the authors and should not be attributed to the World Bank, its Executive Directors or the countries they represent.

Abstract

This paper examines the effect of Walmart's entry into Mexico on Mexican manufacturers of consumer goods. Guided by firm interviews that suggested substantial heterogeneity across firms in how they responded to Walmart's entry, we develop a dynamic industry model in which firms decide whether to sell their products through Walmex (short for Walmart de Mexico), or use traditional retailers. Walmex provides access to a larger market, but it puts continuous pressure on its suppliers to improve their product's appeal, and it forces them to accept relatively low prices relative to product appeal. Simulations of the model show that the arrival of Walmex separates potential suppliers into two groups. Those with relatively high-appeal products choose Walmex as their retailer, whereas those with lower appeal products do not. For the industry as a whole, the model predicts that the associated market share reallocations, adjustments in innovative effort, and exit patterns increase productivity and the rate of innovation. These predictions accord well with the results from our firm interviews. The model's predictions are also supported by establishment-level panel data that characterize Mexican producers' domestic sales, investments, and productivity gains in states with differing levels of Walmex presence during the years 1994 to 2002.

1 Introduction

During the past two decades, China, Brazil, Mexico, Indonesia, India, and other emerging markets have opened up their retail sectors to foreign direct investment (FDI). Proponents of these policy reforms have typically viewed them as improving the efficiency of retailing, while detractors have viewed them as undermining local shopkeepers, destroying jobs, and forcing down wages for service sector workers.[1] But there is another important consequence of retail sector FDI that has received much less attention: it can induce structural changes in the domestic manufacturing industries that supply retailers with consumer goods.

This paper analyzes these upstream responses during Wal-Mart's "invasion" of Mexico. Inspired by the North American Free Trade Agreement and further attracted by Mexico's growing middle class, Walmart entered Mexico in 1991. By 2010 it was the country's largest employer, with roughly 175,000 workers.[2] As Wal-Mart de Mexico's (Walmex's) presence grew, it added a new retailing option for those producers with easy access to a Wal-Mart store or one of its distribution centers. However, it also changed the nature of product markets, inducing adjustments in prices, profits, market shares, and innovative efforts among upstream producers. And importantly, the implications of Wal-Mart's presence varied dramatically across firms, with those that began from relatively large market shares faring much better than others.

Our study begins with a synopsis of the Walmex business model, as described to us by Mexican manufacturers and industry experts during a series of interviews. The central message is that Walmex changed firms' retailing options by offering them access to a much larger customer base, while requiring

[1] For more details on the Indian reforms and protests, see the Financial Times reports on December 4 2011 "Singh under fire after retail plan delayed" and September 14 2012 "India reveals retail and aviation reforms." For a description of recent protests in China, see The Progressive, January 8, 2013, "Walmart Empire Clashes with China." Of course, similar concerns have long been voiced about the effects of Wal-Mart on retailers in the United States. Basker (2007) reviews the literature and Jia (2008) provides a rigorous structural analysis.

[2] An article of *The New York Times* published on April 21, 2012 suggests that part of Walmart's growth in Mexico may have been due to Walmart's use of bribery. While this would raise a number of important issues, the fact that the expansion occurred is all that matters for our purposes.

in exchange that they accept relatively low prices and make frequent product improvements. Even those firms that opted to stick with traditional retailers were affected because they faced heightened competition from their competitors who took up the Walmex offer, reducing their prices and expanding their customer base as they did so.

Next, given this characterization of Walmex's business practices, we develop an industrial evolution model that allows us to trace the effects of Walmex's presence through to the performance of upstream consumer goods suppliers. Building on the work of Ericson and Pakes (1995) and Weintraub et al. (2008), our model has heterogeneous producers deciding each period whether to retail through Walmex or traditional retailers. The model predicts that the Walmex option causes producers to self-select into two groups, with those offering the most popular products selling through Walmex and others rejecting Walmex's retailing offer. When this option becomes available, market shares shift from the low-appeal firms to the high-appeal firms, and while some of the Walmex suppliers invest more in product upgrading, the firms that continue with traditional retailers scale back their investments or shut down. Also, prices and mark-ups fall with the arrival of Walmex, especially for firms producing goods in the medium-appeal range.

Finally, we use plant-level panel data to estimate reduced-form regressions that link Walmex's presence in the state to local industrial structure. Our analysis identifies the effects of Walmex's presence on upstream producers by contrasting the responses of two types of manufacturing industries: perishable goods industries, which rely heavily on proximity to their retailers, and industries that supply other types of consumer goods. We do so because we do not observe whether a given plant sells its product through Walmex or not. Our industrial evolution model implies that upstream firms of different sizes adjust differently to the availability of a Walmex retailing option, so we look for the predicted size-specific adjustment patterns among perishable goods producers versus others.[3] To

[3] More precisely, our model predicts that firms' adjustments to the presence of Walmex depend upon the popularity of their product. Since product popularity is unobservable, we proxy this variable with sales, which are monotonically

deal with the endogeneity of Walmex's geographic expansion patterns, we allow for arbitrary state-time specific shocks that might have made Walmart's expansion in a given year into one state more attractive than into another state. The plant-level results generally support the predictions of our industrial evolution model.

Our paper is related to several literatures. First, it is complementary to recent work on Walmart in the United States. Basker (2005a) shows that Wal-Mart's entry into U.S. regions is associated with lower retail prices, while Basker (2005b) finds mixed evidence on its effect on job creation. Using a model of strategic competition to analyze market share reallocation between two major chains—Walmart and K-mart—and a fringe of smaller retailers, Jia (2008) finds that Walmart is largely responsible for the demise of small discount retailers. Holmes (2011) examines the dynamic pattern of store openings in the U.S. to estimate Walmart's implied gain from establishing stores near to each other.

Second, by proposing a new industrial evolution model we contribute to a growing literature on industry dynamics (Ackerberg, Benkard, Berry, and Pakes, 2007, provide an overview). While the data necessary for estimating the structural parameters of the model are unavailable to us, our analysis is motivated by our firm interviews and corroborated by reduced-form evidence. Consequently, there is an unusually high level of external validation for our modeling strategy.

Third, our analysis speaks to the effects of FDI on host country producers. Earlier studies have measured the rate at which learning spillovers accrue to domestic firms (see Keller 2010, Gorg and Greenaway 2004) and explored vertical links to upstream firms (Javorcik 2004). A subset of these studies has focussed, like us, on multinational retail chains (including Walmart), arguing that their investments have raised regional exports in China (Head, Jing, and Swenson 2011) and increased the productivity of food suppliers in Romania (Javorcik and Li 2013). By grounding our analysis in a

related to product popularity in our model.

dynamic structural model, this paper goes some way towards characterizing a specific mechanism for this class of productivity effects.

Finally, our results on induced quality upgrading relate to a large class of models in which heterogeneous firms respond idiosyncratically to a change in the economic environment. While heterogeneous quality upgrading has been emphasized in the context of exporting (Yeaple 2005, Bustos 2007, Constantini and Melitz 2008, Verhoogen 2008, Lileeva and Trefler 2010), our analysis indicates that the structure of vertical relationships between firms might be just as important as a trigger for induced quality change.

The remainder of the paper is as follows. Section 2 provides background on Walmart's entry into the Mexican retail market. Section 3 introduces the basic trade-off that suppliers contemplating selling through Walmart face, embeds this trade-off in an industrial evolution model, and characterizes the implications for industries that produce consumer goods. Regression results are presented in section 4, while section 5 summarizes the results and offers conclusions.

2 Walmart in Mexico: Background and Identification of its Effect

2.1 Business Practices

The basic facts of Walmart's Mexican operations are well known. The company entered in 1991 through a joint venture with Cifra, a major Mexican retailer. From the start, Walmart experienced high rates of sustained sales growth. In 1997 Walmart became majority owner of the joint venture and changed its name to Walmart de Mexico (Walmex). By the year 2001 Walmex accounted for nearly half of the Mexican retail market, and Walmex has been Mexico's largest private employer since 2003.

To better understand the implications of this process for individual firms that might contemplate becoming a Walmart supplier, we conducted two series of interviews with Mexican firms and industry experts. The first of these took place in the year 2005 and the second was held in 2007. The focus in the 2005 interviews was on firms in the soaps, detergents and surfactants industry, while firms in a broader set of industries were included in the second set of interviews. Both produced consistent results and serve to motivate the model we present in the following section. Some results of the first round of interviews are also discussed in Javorcik, Keller, and Tybout (2008).

Our approach followed broadly the interview-based case-study methodology recommended by Yin (2002). We identified the firms to be interviewed through internet searches, consultations with industry associations, and visits to supermarkets. Moreover, the results of the 2005 interviews guided our approach for the 2007 round. In total, we had face-to-face meetings with executives of ten firms. Importantly, one of the meetings in the year 2007 was with several of Walmex' executives. We also talked to two members of industry associations as well as various employees of Mexico's national statistical office (Instituto Nacional de Estadística y Geografía) to cross-check what we had heard. Additional detail on our interview methodology is given in Appendix 1.

The new business practices that Walmex introduced into the Mexican retailing sector included improvements in warehousing, distribution, inventory management, and logistics, many of which had been introduced before in its U.S. stores (see Basker 2007). For example, by the early 2000s, Walmex was still the only retail chain in Mexico that had its own centralized distribution system (Tegel 2003). While we learned in the interviews that other Mexican retail chains have to some extent followed suit and introduced similar changes, Walmex has remained the technological leader in terms of retail practices in Mexico. In particular, by the year 2007 Walmex was still the only retailer that used computerized tracking of sales and inventories, allowing it to provide daily sales and inventory figures at the level of individual stores.

Interviewees mentioned a number of advantages to becoming a supplier of Walmex. First, Walmex gives its suppliers access to a larger population of consumers than they could have reached through traditional retailers. Second, Walmex pays the agreed upon amount on time, while other supermarket chains are often late with payments or subtract arbitrary fees. This not only limits the uncertainty Walmex suppliers face, it allows them to leverage Walmex's creditworthiness by selling commercial trade receivables in exchange for working capital ("factoring"). Finally, Walmex suppliers face relatively low distribution costs. These low costs derive partly from Walmex's large customer base, which allows firms to spread their fixed delivery costs over large sales volumes. But they also derive from Walmex's business practices. For example, the requirement that delivery drivers show up only at pre-specified appointment times and carry standard identification cards reduces congestion frictions.

Against these benefits, potential Walmex suppliers must weigh the costs of playing by Walmex's rules. According to our interviewees, Walmex tries to appropriate a significant share of the distribution-related cost savings it generates for suppliers by demanding low prices (called "logistics discount"), and by gradually reducing the prices it offers to suppliers whose products lose popularity.[4] Further, in order to comply with Walmex's various delivery rules, its suppliers often need to make complementary investments in office technologies and computerized tracking systems. Other costs are induced by Walmex's requirement that shipments arrive on shrink-wrapped standardized palettes with corner protectors.

Whether firms are helped or hurt by the arrival of Walmex, their investments in innovation are likely to be affected for several reasons. First, since Walmex suppliers have access to a relatively large customer base, they face relatively strong Schumpeterian incentives to pursue product or process innovations. By the same logic, those firms that opt out of Walmex are likely to back off of investments in innovation as they lose market share to their Walmex-based competitors. Second, as mentioned above, some firms that choose to deal with Walmex must upgrade their office technologies and tracking systems to do so. Finally, Schumpeterian motives and mandatory investments aside, Walmex suppliers may wish to improve their products in order to relax the pricing constraints they face at the bargaining

[4] Walmex policy of "everyday low prices" is estimated to have led to lower average prices by about 14 percent in Mexico (Tegel 2003).

table (Javorcik, Keller, and Tybout, 2008).

2.2 Differential effects of the Walmex expansion

The timing and extent of Walmex's local presence has varied by region. Figures 1-4 show Walmex's expansion across the thirty-two Mexican states between 1993 and 2007, with darker shading indicating a higher population density. The figures also distinguish four different Walmex store formats, and indicate the location of Walmex distribution centers. Walmex's expansion strategy in Mexico clearly differed from Walmart's strategy in the United States, where it gradually radiated out from Bentonville, Arkansas (Holmes, 2011). Although it began in the highly populated central areas, reflecting the existing locations of its joint venture partner (Cifra), it quickly planted stores in the far North-West as well as in the South-East (Figure 2).

In the empirical work of section 4 below, a key assumption is that the local presence of Walmex stores improves suppliers' access to Walmex. Despite the fact that distribution centers allow producers to distribute their products to Walmex stores nationwide, this assumption is justified for several reasons. First, even if all producers had equal access to Walmex retailers, only those producers with local Walmex stores would feel the competitive pressures of these stores vis a vis traditional retailers in their state. Second, each distribution center specializes in terms of product type–dry goods, clothing, and perishables, including frozen goods. Thus, while some producers are near a suitable distribution center, other are not. Finally, according to our interviewees, Walmex prefers to source many perishables goods locally rather than channeling them through distribution centers. A recent report indicates that 89% of all fruits and vegetables sold by Walmart in Mexico are purchased directly from Mexican farmers, most of them locally (Walmart 2010). This allows it to save on cold chain distribution costs and, according to some interviewees, helps it build ties with the local community. Indeed, since perishable goods producers should be particularly sensitive to local Walmex presence, we single them out to contrast with other types of producers in our regressions.[5]

3 A Model of Walmex's Upstream Industry

In the previous section we reviewed a supplier's costs and benefits of retailing through Walmex in some detail. Drawing on Pakes and McGuire (1994), Pakes and Ericson (1995), and Weintraub, Benkard and van Roy (2008), we now develop an industrial evolution model that captures the key trade-off: suppliers who choose Walmex over traditional retailers reach a larger customer base in exchange for price caps that depend upon their product's appeal. The model characterizes supplying firms' retailer choices, pricing decisions, investments in product quality improvements, and entry/exit decisions.

3.1 Model Structure

The structure of our model is similar to Weintraub et al.'s (2008), with the additional feature that firms choose how to retail their products. Specifically, forward-looking, risk-neutral firms make optimal decisions as they compete against each other in an infinite-horizon dynamic game. Time is measured in discrete increments, and within each period the following sequence of events occurs:

1. Taking into consideration its scrap value, its current product quality, and other firms' product qualities, each incumbent firm decides whether to continue operating or shut down. Those that do not shut down also decide how much to invest in quality improvement.

2. Each potential entrant calculates the present value of the profit stream from a new firm, takes stock of sunk entry costs, and decides whether to become a producer next period.

[5] We also note from Figures 1 to 4 that the establishment of distribution centers has generally followed, not led, the opening of local stores. Given this timing it is more plausible that local store openings trigger the beginning of a producer's retailing relationship with Walmart, rather than the placement of a distribution center. At the same time, a nearby distribution center might reinforce the bond between Walmex and its suppliers.

3. Each incumbent firm decides whether to use Walmex as its retailer or deal with traditional retailers, given Walmex's take-it-or-leave-it price offer and minimum quality requirements.

4. Incumbent firms compete in the spot market and generate their current period operating profits. Those that are selling through Walmex must offer their goods at Walmex's dictated prices or less; others are free to choose any price.

5. The outcomes of firms' investments in quality improvements are realized, and the industry takes on a new state.

6. The next period begins.

3.1.1 The profit function

To develop firms' profit functions, we begin with a logit demand system that allows for a retailer effect. Let $\mathbf{I}_t$ denote the set of incumbent firms in period t, each of which produces a single, differentiated product. Also let firm j's product have quality or appeal level ξ_{jt} relative to goods outside the industry of interest,[6] and (suppressing time subscripts) express the net indirect utility of product j for the i^{th} consumer as:

$$\begin{aligned} U_{ij} &= \theta_1 \ln(\xi_j) + \beta_w w_j + \theta_2 \ln(Y - P_j) + \epsilon_{ij} \qquad (1) \\ &\stackrel{def}{=} \overline{U}_j + \epsilon_{ij}. \end{aligned}$$

Here $\beta_w > 0$ measures the extra appeal of product j when it is available at Walmex, w_j is a dummy variable that takes a value of unity if producer j sells through Walmex, Y is the (exogenous) expenditure level of a typical household, and ϵ_{ij} is a Type I extreme value disturbance that picks up

[6] Quality in this model is simply an index of product demand, controlling for price. So ξ_{jt} may be thought of as responding to investments in either advertising or product improvements.

unobserved idiosyncratic features of consumer i.

The assumption that $\beta_w > 0$ captures the advantages of shopping at Walmex from the perspective of Mexican consumers. As discussed in ANTAD (2003), these consumers consider hygiene, low prices and variety to be key considerations when deciding where to shop. Relative to most traditional stores, Walmart offers a preferable option in all of these dimensions. Further, especially in large cities where congestion is a major problem, the opportunity to access a large variety of products in the same place is important. Finally, β_w also serves as a reduced-form way to capture the positive effects of Walmex on suppliers' profits, due especially to low delivery costs and dependable payments for goods sold.[7]

Assuming that each consumer purchases a single unit of the product that gives her the highest indirect utility, and letting the mass of consumers be measured by M, it is well known that (1) implies the total demand for product j is

$$Q_j^D = M \cdot h_j$$

where:

$$h_j = h(j|\mathbf{w}, \mathbf{P}, \boldsymbol{\xi}) = \frac{\exp\left[\overline{U}_j\right]}{\sum_\ell \exp\left[\overline{U}_\ell\right] + 1}, \tag{2}$$

$\mathbf{w} = \{w_j | j \in \mathbf{I}\}$, $\mathbf{P} = \{P_j | j \in \mathbf{I}\}$, and $\boldsymbol{\xi} = \{\xi_j | j \in \mathbf{I}\}$. Note that this formulation implies each supplier either sells through traditional retailers or through Walmex, but not both. While this is not entirely realistic, it will be close to the truth in markets where local retailers and Walmex are both present, since the latter will underprice the former and capture most of the market for the products it carries.

Several additional assumptions keep the model tractable. First, firms differ in terms of their

[7] Holmes (2011) also uses a logit specification, but for several reasons, he assumes that shopping at Wal-Mart is less appealing than shopping at local alternatives, particularly in densely populated areas. First, his model is designed to characterize Wal-Mart's profits rather than those of its suppliers, so he is not trying to capture the scale economies in reaching customers that Wal-Mart suppliers enjoy. Second, since he is interested in estimating his demand system, he is controlling for the region-specific demographic characteristics that make Walmex relatively popular in Mexico.

product appeal, but not in terms of their marginal costs (hereafter denoted C).[8] Second, Walmex's maximum price offer to any supplier j—hereafter denoted $\overline{P}_j$—depends upon ξ_j according to:

$$\overline{P}_j = P_0 + \theta_3 \ln(\xi_j),\ \theta_3 > 0. \tag{3}$$

This specification implies that the improvements in product appeal ease Walmex's price ceiling, while reductions in appeal relative to the outside good force firms to cut their prices, as discussed in section 2 above. Third, in addition to the pricing constraint (3), we assume that Walmex imposes a minimum appeal standard on all its suppliers: $\xi_j \geq \overline{\xi}\ \forall j \in \mathbf{W}^1$, where $\mathbf{W}^1 = \{j | w_j = 1, j \in \mathbf{I}\}$ is the set of suppliers who do business with Walmex. Finally, we assume there are no sunk costs associated with starting or stopping a Walmex relationship. This implies that suppliers choose their retailers period by period without worrying about the implications of their current choices for their future retailing options.

Generalizing Berry (1994), the Walmex-constrained Bertrand-Nash price vector $\mathbf{P}(\mathbf{w}) = \{P_j(\mathbf{w})\}_{j \in \mathbf{I}}$ solves the system of pricing equations:

$$P_j = \begin{cases} C + \frac{Y + \theta_2 C(1-h_j)}{1+\theta_2(1-h_j)} & w_j = 0 \\ \min\left(\overline{P}_j, C + \frac{Y + \theta_2 C(1-h_j)}{1+\theta_2(1-h_j)}\right) & w_j = 1 \end{cases}, \tag{4}$$

where h_j is the share function (2) evaluated at $(\mathbf{w}, \mathbf{P}(\mathbf{w}),\ \boldsymbol{\xi})$. The associated profits for the j^{th} non-*Walmex* firm are

$$\pi_j(w_j = 0 | \mathbf{w}_{-j}, \boldsymbol{\xi}) = [P_j(\mathbf{w}) - C] \cdot h_j \cdot M$$

[8] Investments in cost reduction respond to the same Schumpeterian forces that drive investments in product quality/appeal. While we shut them down in our model, we will look for them in the econometric analysis that follows.

where $\mathbf{w}_{-j}= (w_1, w_2, ..., w_{j-1}, w_{j+1,}.., w_N)$ collects the retailing decisions of all firms *except* firm j.[9] Analogously, if firm j were to switch from traditional retailers to Walmex, and all other firms were to stick with their initial retailing choices, j would earn operating profits:

$$\pi_j(w_j = 1|\mathbf{w}_{-j}, \boldsymbol{\xi}) = \left[P_j(\mathbf{w}') - C\right] \cdot h'_j \cdot M$$

where $\mathbf{w}' = \{w_1, w_2, ..., w_{j-1}, 1, w_{j+1,}.., w_N\}$ and h'_j is the share function (2) evaluated at $(\mathbf{w}', \mathbf{P}(\mathbf{w}'),$ $\boldsymbol{\xi})$. Firms' retailer choices are Nash equilibria so, given the choices of other supplier firms, no firm will wish to adjust its choice of retailer. Thus in all equilibria:

$$\begin{aligned}
[\pi_j(w_j &= 1|\mathbf{w}_{-j}, \boldsymbol{\xi}) - \pi_j(w_j = 0|\mathbf{w}_{-j}, \boldsymbol{\xi})] \cdot w_j \\
+[\pi_j(w_j &= 0|\mathbf{w}_{-j}, \boldsymbol{\xi}) - \pi_j(w_j = 1|\mathbf{w}_{-j}, \boldsymbol{\xi})] \cdot (1 - w_j) \geq 0 \ \ \forall\, j.
\end{aligned}$$

Equilibria may exist in which w is nonmonotonic in ξ. However, we limit our attention to equilibria in which all firms above some appeal threshold sell their product through Walmex, and all firms below that threshold sell their product through traditional retailers. Doing so allows us to establish a mapping from $\boldsymbol{\xi}$ to $\mathbf{w}$, and to thereby express the profits of all incumbent firms as a function of the vector $\boldsymbol{\xi}$ alone. Hereafter we will express the profits for firm j when the industry is in state $\boldsymbol{\xi}$ as $\pi^*\left(\xi_j, \boldsymbol{\xi}_{-j}\right)$, where $\boldsymbol{\xi}_{-j}$ gives the product appeal levels for all incumbent firms except $j's$. (Thus $\boldsymbol{\xi} = \xi_j \cup \boldsymbol{\xi}_{-j}$.)

3.1.2 The dynamic problem

Although current period retailing decisions do not affect future period earnings, there are two features of our model that make it forward-looking. First, entry and exit are not frictionless. When entre-

[9] In principle, the j^{th} Walmex supplier might want to price at less than the ceiling $\overline{P}_j$. We check that no Walmex supplier does better at a price below its ceiling in each equilibrium we calculate.

preneurs create new firms, they incur sunk start-up costs (hereafter ϕ_e), and when they shut down their firms they receive their scrap value (hereafter $\phi_s < \phi_e$). Their entry and exit decisions thus involve comparisons of expected future profit streams with entry costs and scrap values, respectively. Second, each firm's product appeal (ξ) evolves over time, and the processes that these indices follow are dependent upon firms' R&D expenditures.

Define r_j to be the current level of R&D undertaken by the j^{th} producer in order to influence its product appeal next period, hereafter denoted ξ_j'. Further, assume that for any firm j, all realizations on ξ_j are elements of a discrete ordered set $\{\xi^1, ..., \xi^K\}$, $\xi^i < \xi^{i+1}\ \forall i \in I^+$, that ξ_j moves at most one position in the ordered set per period, and that ξ_j is measured relative to the appeal of goods outside the industry. Then, if R&D efforts are successful with probability $\frac{ar_j}{1+ar_j}$, and if outside goods improve one step in appeal with exogenous probability δ, firm j's product appeal evolves according to:

$$\begin{aligned}
\Pr\left[\xi_j' = \xi^{i+1} | \xi_j = \xi^i\right] &= \tfrac{ar_j}{1+ar_j} \cdot (1-\delta) \\
\Pr\left[\xi_j' = \xi^{i} | \xi_j = \xi^i\right] &= \left(1 - \tfrac{ar_j}{1+ar_j}\right)(1-\delta) + \tfrac{ar_j}{1+ar_j}\delta \\
\Pr\left[\xi_j' = \xi^{i-1} | \xi_j = \xi^i\right] &= \left(1 - \tfrac{ar_j}{1+ar_j}\right)\delta
\end{aligned} \tag{5}$$

We now summarize the dynamic optimization problem that firms solve. At the beginning of each period, each incumbent firm takes stock of its current product appeal and the product appeal of all of its rivals. It then decides whether to continue operating or shut down. If it continues operating, it also chooses an R&D level, r, and a retailing strategy, w. To characterize these decisions, let the state of the industry be summarized by $\mathbf{s} = (s_1, s_2, ..., s_K)$, where s_i is the number of firms that are currently at the i^{th} appeal level. Similarly, let $\mathbf{s}_{-j}$ be the same vector, except in that it leaves firm j out of the count.[10] Then firm j chooses its R&D level to solve:

[10] This vector contains the same information as $\boldsymbol{\xi}_{-j}$, but it is smaller dimension, and it does not track individual firms through time. Since firms need only keep track of the state of the industry, and not of the individual shocks to their various competitiors, it is better suited for analysis of the dynamic equilibrium.

$$V\left(\xi_{j,},\mathbf{s}_{-j}\right)=\max\left[\phi_s,\max_{r_j}\left\{\pi^*\left(\xi_{j,},\mathbf{s}_{-j}\right)-c_r\cdot r+\beta E_{\Omega_j}\left[V.\left(\xi'_{j,},\mathbf{s}'_{-j}\right)\right]\right\}\right] \tag{6}$$

Here c_r is the unit cost of R&D, β is the one period discount factor, and the expectation operator is based on firm j's beliefs about the transition density for the industry state, excluding itself: $\Omega_j\left(\mathbf{s}'_{-j}|\mathbf{s}_{-j}\right)$. This perceived transition density in turn reflects firm j's perceptions of the policy functions that other firms in the industry use to make their exit or entry decisions and to choose their R&D spending levels.

Finally, there is a large pool of potential entrants who stand ready to create new firms. They do so when the expected profit stream covers their entry costs, ϕ_e, so the mass of entrants each period is just large enough to drive the net expected profit stream for the marginal entrant to zero, except in the corner case where even a single entrant expects negative net returns. New entrants start with some relatively modest product appeal, ξ_e.

3.1.3 Equilibrium

The industry is in dynamic equilibrium when all firms correctly solve their optimization problems and their beliefs about industrial evolution patterns (as characterized by $\Omega(\cdot)$) are consistent with the realized Markov process for industry states. Several methods for identifying this kind of equilibrium are available; we rely on the approach developed by Weintraub et al. (2008).[11]

The basic idea is the following. So long as the number of incumbent firms is fairly large, the industry state is insensitive to the idiosyncratic outcomes of R&D investments by individual firms. And since there are no other shocks in the model, each firm's optimal behavior is approximated by its behavior under the assumption that $\mathbf{s}_{-j}$ is time-invariant and $\Omega_j\left(\mathbf{s}'_{-j}|\mathbf{s}_{-j}\right)$ is a degenerate

[11] The main challenge is to deal with the fact that the number of possible industry states s is very large, and number of transition probabilities summarized by $\Omega_j\left(\mathbf{s}'_{-j}|\mathbf{s}_{-j}\right)$ is the square of this very large number. Ackerberg et al. (forthcoming) provide a useful discussion of solution techniques in the context of dynamic model estimation.

distribution. The associated equilibrium concept is called an "oblivious equilibrium" by Weintraub et al. (2008) to highlight the assumption that firms ignore the variations in $\mathbf{s}_{-j}$ due to idiosyncratic product appeal shocks.

3.1.4 Implications

To estimate the parameters of our model would require information on firm-level retailing decisions, with and without a Walmex option. Unfortunately, such data are unavailable. We therefore proceed by finding parameter values that generate plausible size distributions of suppliers, entry and exit patterns, R&D patterns, and firm mark-ups; see Table 1.[12] Then, by comparing simulated equilibria under several scenarios, we characterize the likely effects of the Walmex invasion on Mexican producers of consumer goods. Finally, in section 4 we confirm the relevance of these possible effects using micro data on the changes in industrial structures that have occurred in states where Walmex's presence has grown.

3.2 Model Simulations

Adapting Weintraub et al's (2010) code to accommodate endogenous retailer choice, we first solve our model under the "base case" parameterization reported in Table 1.[13] Next we re-solve the model under the assumption that Walmex does nothing to increase the customer base of its suppliers ($\beta_w = 0$), which naturally leads all firms to remain with traditional retailers. Third, we examine the effects of a smaller Walmex effect on the customer base relative to the base case ($\beta_w = 0.5$ instead of $\beta_w = 1$). Finally we simulate the effects of an alternative pricing policy under which Walmex dictates that $\overline{P}_j$ rises more gradually with respect to product quality ($\theta_3 = 0.3$ instead of $\theta_3 = 0.4$).[14]

[12] In particular, given these parameters for the model the cumulative market share of the largest firms increases by about six percentage points with every firm that is added. This is also true for the average industry in our sample.

[13] For details on the equilibrium concept and solution algorithm, the reader is referred to Weintraub et al. (2008).

[14] By focusing on the long-run equilibria without and with Walmex, we leave the analysis of transitional dynamics to future work.

Simulation results for the "base case," "no Walmex" case, and small market boost" case are reported in Figure 5a. Each quadrant in this figure depicts one variable as a function "firm quality" (or, appeal) under the three cases of interest. Quality cutoffs separating firms that choose Walmex ($w_j = 1$) from those that don't are marked with boxes on the horizontal axes for the "base case" and "small market boost" simulations.[15] Consider pricing effects first. When the option to sell through Walmex is offered to potential suppliers, the lower quality firms decline to do so, including some firms with quality above the minimum level acceptable to Walmex. Accordingly, these firms continue to price around 2.4, maintaining a large mark-up over their marginal cost of 1.5 (quadrant 1).[16] But those producers above a certain quality threshold find they do best to accept Walmex's terms, and those just above that threshold take a large price cut in consequence. This is particularly true in the base case, where the payoff in terms of an expanded customer base is relatively attractive (quadrant 3).

Both the customer base effect and the price rule cause firms that opt for Walmex to increase their market shares. This leaves relatively little room for non-Walmex firms, so the producers with relatively low profits and/or high scrap values do best to exit. This reduces the number of firms at all quality levels except the highest (quadrant 2). Finally, suppliers that opt into Walmex must keep innovating to keep their price ceilings from falling, and, given their larger market shares, they face heightened Schumpeterian incentives to innovate. For both reasons, firms at the top end of the quality spectrum exhibit more innovative effort when the Walmex option is present, and the remaining firms have incentives to scale back their innovative efforts or shut them down entirely (quadrant 4).

[15] Recall that we are focusing on equilbria characterized by a simple cutoff rule in terms of appeal of which plant sells through Walmex and which does not.

[16] The lack of price sensitivity to quality reflects the fact that even high-appeal firms have small market shares, so changes in their product appeal does not lead to large changes in their market power.

Table 1: Parameters used for Simulation

Parameter	Parameter governs:	base case	no Walmex	low boost	low quality premium
C	Marginal costs	1.5	1.5	1.5	1.5
m	Market size	100	100	100	100
Y	Consumer income	6	6	6	6
β_w	Walmex customer base boost	1.0	**0.0**	**0.5**	1.0
$\overline{\xi}$	Minimum Walmex appeal	2.0	2.0	2.0	2.0
θ_1	Quality coefficient	2	2	2	2
θ_2	Price coefficient	4	4	4	4
θ_3	Product appeal-price relationship	0.4	0.4	0.4	**0.3**
a	Investment function parameter	0.8	0.8	0.8	0.8
δ	Innovation probability, outside good	2	2	2	2
κ	Entry cost	35	35	35	35
$E(\phi_s)$	Average scrap value	10	10	10	10

It is noteworthy that the firms with product quality just high enough to induce them to work with Walmex are not better off in the Walmex equilibrium than in the no-Walmex equilibrium. (Profits are not depicted in our graphs.) To the contrary, many would have preferred that Walmex had never become an option for anyone. However, once the option is there, competition from suppliers who accept its terms causes these firms to do worse with traditional retailers than if they do if they cut their prices and tap into Walmex's large consumer base.

Our final experiment is to ask how a flatter pricing schedule (3) would have affected the equilibrium. Figure 5b reproduces the same "base case" and "no Walmex" as Figure 5a, but compares them to a scenario in which the slope of the price ceiling schedule with respect to log quality is $\theta_3 = 0.3$ rather than $\theta_3 = 0.4$. Since this has the effect of making Walmex less appealing to potential suppliers, the adjustments in industrial structure are similar to those we observed for a reduction in the market size boost (Figure 5a). However, this policy has the effect of eliciting a particularly strong increase in innovative effort among the largest firms (quadrant 4), which in turn increases their market dominance (quadrant 3).

We now ask whether our model's characterization of supplier reactions to Walmex is consistent with the evidence from Mexican manufacturing firms during Walmex' expansion in Mexico.

4 Regression analysis

4.1 Data sources and definitions

Mexican Producer data Our analysis is based on establishment-level data from the Encuesta Industrial Anual (EIA) and the Encuesta Industrial Mensual (EIM) administered by the Instituto Nacional de Estadística y Geografía (INEGI) in Mexico. The EIA is an annual industrial survey that covers about 85 percent of Mexican industrial output, with the exception of "maquiladoras." The EIA was started in 1963 and then expanded in subsequent years, with the last expansion taking place in 1994 after the 1993 census. In our analysis, we use the information for the 1993-2002 period. The unit of observation is a plant described as *"the manufacturing establishment where the production takes place".*[17] Each plant is classified by industry (*clase*) on the basis of its principal product. Classifications are based on the 6-digit level Mexican System of Classification for Productive Activities (CMAP).

Our sample includes 6,408 establishments spread across 205 classes of activity. Of these plants, 4,915, or 76%, are observed in all years.[18] In each of the selected 205 *clases,* the survey samples the largest firms until the coverage reaches 85% of the sectoral output. In sectors with fewer than 20 plants, all entities are surveyed. Plants with more than 100 employees are always included in the sample. In addition to standard plant-level data, the EIA survey includes details of plant-level activities associated with production upgrading, such as investment in physical assets and R&D expenditures. It also allows us to gauge the quality of inputs by tracking plants' average wages and their reliance on imported

[17] In the following, we occasionally use the term firm instead of establishment (or plant). It should be kept in mind however that several establishments can be part of the same firm.

[18] The sample size decreases over time as firms exit and entry is not perfectly captured in the data.

intermediate goods.[19] These features of the dataset makes it particularly suitable for examining the question at hand.

Some variables of interest require plant-level price deflators, and these are not collected by the EIA. Accordingly, we merge the EIA panel with monthly information on values and physical quantities supplied, plant by plant and, for multi-product establishments, product by product.[20] These data comes from the *Encuesta Industrial Mensual* (EIM), a survey of the plants in the EIA collected by INEGI to monitor short-term industry dynamics.

More precisely, after annualizing the EIM variables and merging them with the EIA for the period 1994-2002, we impute establishment-level time series on prices, quantities, and total factor productivites (TFP). The price indices are Tornqvist aggregations of unit values across each establishment's main product lines. (Since these indices reflect heterogeneous product mixes, we normalize each establishment-level price to a value of 100 in the base period.) The quantity series are establishment level nominal production series from the EIA, deflated by our output price deflators.[21] Finally, the TFP series are calculated using this quantity series in combination with establishment-level series on employment, real capital stocks and real intermediate input purchases from the EIA. Here again we deal with heterogeneous products by normalizing all TFP series to 100 in the base period, effectively converting these series to cumulative rates of growth.

[19] All firm variables are reported in thousands of pesos.

[20] The EIM contains information on 3,396 unique product categories (*clases*). Each category contains a list of products, which was developed in 1993 and remained unchanged during the entire period under observation. For instance, the *clase* of *distilled alcoholic beverages* (identified by the CMAP code 313014) lists 13 products: gin, vodka, whisky, fruit liquors, coffee liquors, liquor "habanero", "rompope", prepared cocktails, cocktails (made from agave, brandy, rum, table wine), alcohol extract for liquor preparation. The *clase* of *small electrical appliances* contains 29 products, including vacuum cleaners, coffee makers, toasters, toaster ovens, 110 volt heaters and 220 volt heaters (within each group of heaters the classification distinguishes between heaters of different sizes: less than 25 liters, 25-60 liters, 60-120 liters, more than 60 liters). These examples illustrate the narrowness of product definitions and the richness of micro-level information available in this dataset.

[21] Our multilateral TFP index is calculated using the formula developed by Caves, Christensen, and Diewert (1982), and also used by Aw, Chen and Roberts (2001).

Retailer data We combine the micro data on Mexican producers with panel data on the presence of retailers in each Mexican state. Generally, there is less data on the retailers than on the upstream producers, largely a result of the fact that the mandatory EIM and EIA surveys conducted by INEGI do not cover the retailing sector. First, we employ information provided to us by Walmex on the number of Walmex stores in each state. (These data underly Figures 1 to 4 above.) In addition, we exploit state-specific information on the number of retail stores and their floorspace, distinguishing Walmex from other retailers. This information comes from the annual reports of the industry association (*Asociacion Nacional Tiendas de Autoservicio y Departamentales*, ANTAD).

Our preferred measure of state-specific retailer presence is floor space. While some of the floor space figures have been estimated, this variable is superior to a store count in that it captures the major size differences across retail outlets.[22] The estimated floor space figures match up very well with the variation in the number of retail stores across states that is publicly available.

We now discuss our empirical strategy.

4.2 Empirical strategy

Using the data described above, we wish to determine whether the dynamic model in section 3 gives a good description of producers' reactions to the presence of Walmex. To recap, the key predictions are: firms with sufficiently popular products should begin retailing through Walmex when the option arises, increasing sales, investing more in innovation, and (if the price ceiling is binding) reducing prices as they do so. Firms with less popular products should stick with traditional retailers, and given the heightened competition that Walmex brings, they should lose sales relative to Walmex suppliers while

[22] Information on Walmex floor space is available for the years 1995 to 2001 from ANTAD, with the exception of 1998, which is linearly interpolated from the 1997 and 1999 values. To estimate Walmex floor space for the years 1993 and 1994 we use the number of Walmex stores by state and assume stores and floor space are proportional using the average floor space to stores ratio across all years. We estimate Walmex floor space for 2002 using the 2001/2000 trend, and non-Walmex floor space for 1993 and 1994 using the 1997/94 and 1998/95 growth trends, respectively. In the calculation of Walmex floor space, all four of its store formats–Supercenters, Bodegas Aurrera, Sam's, and Superamas–are treated separately.

backing off of investments in innovation and letting their prices rise relative to their larger competitors.

To connect these predictions with observable variables, we first need a means to sort firms by product appeal, ξ. According to our model, this variable is monotonically related to firms' sales in any equilibrium, so we sort our sample of Mexican suppliers into product appeal quartiles $q \in \{1, 2, 3, 4\}$ based on their sales in the initial sample year. Quartile cut-offs are specific to firms' 4-digit industries, and to avoid simultaneity problems, we do not let quartile assignments vary over time for a given establishment.

Next we need a means to compare firms with Walmex access to those without it. As noted in the Introduction, information on which firms retail through Walmex is not available to us. But as argued in section 2 above, access to Walmex depends upon a firm's product type and its geographic proximity to Walmex stores. In particular, the producers that should be most sensitive to a close-by Walmex store are suppliers of the kinds of perishable goods carried by Walmex, like frozen food. Accordingly, we define the indicator variable PG_j^i to take a value of unity if the i^{th} plant in state j supplies this kind of perishable good. Then we interact this dummy with Walmex's current share of retail floor space in state j, s_{jt}, to obtain our period-t measure of the strength of the Walmex effect for producer i: $PG_j^i \times s_{jt}$.[23] While perishables should show the most sensitivity to Walmex proximity, other producers of Walmex-type consumer goods should be affected too. Accordingly, we also consider the interaction variable $WG_j^i \times s_{jt}$, where WG_j^i takes a value of unity for plants that produce *any* category of good carried by Walmex, perishable or not. These sets of plants do not differ fundamentally in terms of key characteristics; for example, while 11% of the plants producing perishable goods exhibit positive levels of R&D expenditures, the figure for plants in non-perishable goods industries is similar (12%).

Finally, we need to characterize firms' adjustments in market share, innovative activity, and pricing.

[23] We base our list of goods carried by Walmex on information from on Walmex's website, store visits, and industry analysis. In Appendix 3 we show the six-digit industries that are sold at Walmex, as well as the subset of industries that we classify are perishable.

These dimensions of performance are proxied by the variables listed in Table S in the appendix.[24] Log sales and log prices obviously proxy for market shares and prices, respectively. Log R&D spending and log investment proxy for investments in product improvement. Use of imported inputs and log wages proxy for input quality, and thus for product appeal. Finally, Log TFP is a proxy for investments in process innovation, which—though strictly not part of our model—are also a consequence of the Schumpeterian forces created by Walmex. (Section 4 below discusses these variables in more detail.) Each outcome variable is expressed as a deviation from its six-digit industry-wide period-t average value, which ensures that the identification of Walmex effects is based on changes in the shapes of industry distributions.[25]

Identification To test whether Mexican manufacturers with different product types and product appeal have responded to Walmex in the predicted way, we fit the following regression for each product appeal category (q) and each producer characteristic (v):

$$\begin{aligned} Y_{jt}^{vi} = \beta_1^{qv} PG_j^i + \beta_2^{qv} \left[PG_j^i \times s_{jt} \right] + \beta_3^{qv} TUS_t^i + \beta_4^{qv} TMEX_t^i \\ + \beta_5^{qv} \left[PG_j^i \times GDP_{jt} \right] + \alpha_{jt}^{qv} + \varepsilon_{jt}^{qvi}, \quad q \in \{1,..,4\}, v \in \{1,..,7\} \end{aligned} \tag{7}$$

Here, i indexes the plant, j indexes each Mexican state, t is the indicator for year, and $q \in \{1, 2, 3, 4\}$ indicates which product appeal (initial size) category the plants in the subsample belong to.

The variable Y_{jt}^{vi} is one of our outcome variables. For example, when $v = 1$ it measures the sales of plant i located in state j in year t. (This notation makes explicit both i and j dimensions even though each plant is present in only one state.) For each outcome variable, we obtain four sets of parameter estimates corresponding to the four subsamples based on initial sales quantiles.

[24] Note that the exact number of observations differs across variables due to missing data. We drop observations with missing values or zeros for domestic sales. For all other variables, we add 1 to observations with zero values before taking logs.

[25] Alternatively, we have included industry-period fixed effects on the right hand side of the equation, finding similar results.

As discussed above, the interaction variable, $PG_j^i \times s_{jt}$, is the focus of our analysis. For a given outcome variable, v, the *level* of its coefficient, β_2^{qv}, measures the effect of Walmex's local presence on type-q producers who supply goods of the kind carried by Walmex relative to the effect of Walmex on other types of producers—for example, manufacturers of industrial chemicals or steel I-beams. *Differences* in β_2^{qv} across size categories (q), given v, indicate how these relative responses depend upon plants' product appeal. For example, if the appearance of Walmex causes perishable goods suppliers with limited appeal (low-q) to contract and perishable goods suppliers with broad appeal (high-q) to expand, we would expect to find $\widehat{\beta}_2^{11} < 0 < \widehat{\beta}_2^{41}$.

To address the possibility of endogeneity and omitted variable bias, equation (7) also includes other factors that might affect plant-level sales or investment choices. In addition to PG_{ij}, we include state-by-year fixed effects, α_{jt}, to control for those state- and time-specific variables that directly affect local manufacturers and are also correlated with Walmex's market share.[26] For example, firms in rapidly expanding states might invest relatively more in innovation, and Walmex might expand its retail space relatively aggressively in these same states. Further, to allow for the possibility that demand for different types of goods scales differently with market size, we interact the gross domestic product of plant i's state with our perishable goods dummy ($PG_{ij} \times GDP_{jt}$).[27] Finally, we include Mexican and U.S. nominal tariff rates, $TMEX_t^i$ and TUS_t^i, respectively, at the six-digit industry level. These are included to capture changes in the degree of foreign competition that were brought about by the NAFTA phase-in.[28] Variants on this baseline specification with plant fixed effects and an alternative definition of producing a Walmex-relevant good will be considered in section 4.4 below.

One possible concern is that our $\widehat{\beta}_2$ estimates will reflect the competition from the foreign producers

[26] Note that including the state-year effects, α_{jt}, makes it uncessary (and impossible) to include s_{jt} as a stand-alone variable.

[27] State-level GDP is obtained from INEGI (www.inegi.org.mx).

[28] The Mexican tariffs were obtained from the Ministry of Economics (www.economia.gob.mx), while for U.S. tariffs we employ figures prepared by John Romalis, see http://faculty.chicago.gsb.edu/john.romalis/research/TariffL.ZIP

that Walmex brings to local markets. This is possible, but if anything we expect foreign competition to bias our methodology against finding the effects predicted by our model. One reason is that large firms are more likely than small firms to produce close substitute for imported goods, and therefore are relatively likely to be hurt by foreign competition (Holmes and Stevens, 2014). A second reason is that perishable producers are relatively insulated from foreign competition by virtue of transport costs.

4.3 Results

We are now prepared to discuss our econometric findings concerning producers' responses to a local Walmex presence. Recall that we are interested in whether Walmex's presence caused local producers of consumer goods to react at all ($\widehat{\beta}_2^{qv} \neq 0$), and to the extent that reactions occured, whether they systematically differed across firms at different points in the size/appeal spectrum ($\widehat{\beta}_2^{qv} \neq \widehat{\beta}_2^{q'v}, q \neq q'$). Estimates of $\widehat{\beta}_2^{qv}$ are collected in Table 2; the full set of estimates of equation (7) can be found in Appendix 2.

4.3.1 The reallocation of market shares across plants

Consider first our estimates of Walmex effects on sales at different positions in the initial firm size distribution. According to the model, low-ξ firms should contract when Walmex appears as a retailing option because these firms do not find it profitable to meet Walmex's conditions, but they nonetheless find themselves competing with cheap Walmex goods in the retail market. High-ξ firms, on the other hand, opt to sell through Walmex and thus expand as they gain access to Walmex's larger consumer base.

Turning to the estimates, the response of sales to Walmex is indeed negative and significant for the smallest size quartile of plants ($\widehat{\beta}_2^{11} = -3.765$). For other size quartiles, the coefficients on $PG \times s$

Table 2: **Walmex Effects on Producer Characteristics ($\widehat{\beta}_2^{qv}$) by Initial Plant Size**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Fixed	Intermediate			
	Sales	R&D	Investment	Imports	Wages	Prices	TFP
Small	-3.765***	-1.165**	-0.827	-34.384***	-0.688**	-0.286*	-0.923**
($q = 1$)	[0.549]	[0.455]	[1.098]	[9.566]	[0.217]	[0.150]	[0.441]
Midsmall	0.187	-0.018	0.251	-10.765	0.056	0.368**	-0.151
($q = 2$)	[0.306]	[0.365]	[0.845]	[7.605]	[0.152]	[0.114]	[0.266]
Midlarge	-0.142	0.842	1.157	-23.269**	-0.022	-0.154	-0.511**
($q = 3$)	[0.298]	[0.558]	[1.026]	[8.329]	[0.153]	[0.107]	[0.247]
Large	-0.372	0.618	-1.769	23.370**	0.404**	-0.034	0.265
($q = 4$)	[0.344]	[0.811]	[1.211]	[8.782]	[0.158]	[0.099]	[0.292]
Pooled sample	-0.727**	0.092	-0.280	-8.706**	-0.036	0.032	-0.150
	[0.242]	[0.282]	[0.532]	[4.194]	[0.086]	[0.120]	[0.146]
H_0: Small = Large p-value	< 0.001	0.028	0.282	< 0.001	< 0.001	0.080	0.012
H_0: All four equal p-value	< 0.001	0.027	0.260	< 0.001	0.001	0.001	0.082

are much smaller in absolute size and statistically insignificant, though the "Midlarge" and "Large" values are slightly negative, contrary to our theory. Because of the large negative value for $\widehat{\beta}_2^{11}$, we can easily reject the null hypothesis that small firms react to Walmex the same way as others (H_0: $\beta_2^{11} = \beta_2^{q1}, q = 2, 3, 4$).[29] These patterns are broadly consistent with the predictions of our model.[30]

4.3.2 Walmex and upgrading

R&D Spending and fixed investment Our simulations show that firms selling their goods through Walmex have a relatively strong incentive to improve their products' appeal. Also, from industry reports as well as the interviews we know that such firms need to upgrade various aspects of their operations to guarantee compatibility with Walmex business practices. Some of these activities

[29] Because the four subsamples associated with different q values are disjoint, we treat our estimates of $\widehat{\beta}_2^{qv}$ as independent across q when performing statistical tests. The p values given in Table 2 are for one-sided tests.

[30] Changes in *average* size cannot be discerned from these regressions because all dependent variables are expressed as deviations from time-specific means.

will involve formal R&D spending, so we next examine whether Walmex entry has led to differential R&D spending patterns for Walmex- and non-Walmex suppliers. The second column of Table 2 shows the results.

We find that, in line with the model, R&D activities for small firms decline relative to those of larger firms. In particular, the Walmex interaction coefficient $\widehat{\beta}_2^{12}$ is estimated at -1.165 with a standard error of 0.455, whereas the same coefficient for the next-to-largest quarter of firms is $\widehat{\beta}_2^{32} = 0.842$ and the coefficient largest quarter of firms is $\widehat{\beta}_2^{42} = 0.618$. The p value for the null $\beta_2^{12} = \beta_2^{32}$ is 0.004 and the p-value for the null $\beta_2^{12} = \beta_2^{42}$ is 0.028. So the results indicate that the arrival of Walmex has led to a striking (and statistically significant) shift of R&D from the smallest to the larger firms in the sample. This shift in R&D affects the profitability of firms both in the short- and in the long-run, and importantly, it would be missed entirely in an analysis that only examines the mean response of firms to Walmex arrival.

In our model, R&D is the only way firms can increase their product appeal. But in practice, firms have a number of ways to do so. We now turn to several of these that are observable in our data set, starting with fixed capital investments.

Capital Investment New investment will raise productive capacity if successive vintages of capital goods become better over time. Even when capital is homogenous new investment will reduce the average age of the firm's capital stock, which can lead to improvements by reducing downtimes of the equipment. Our investment results are shown in the third column of Table 2. In general, they are relatively weak, with none of the four estimates of β_2^{q3} being statistically significant. Accordingly, this type of investment does not appear to have responded much to Walmex's growing market presence.

Imported Intermediate Inputs An important dimension of firm upgrading is the quality of intermediate goods that it employs. Indeed, we were told by several interviewees that using better inputs was a relatively easy way of upgrading product quality. While direct information on the quality of intermediates is not available to us, we do know the fraction of intermediate inputs that are imported by each firm. As long as imported intermediates are typically higher quality than domestic ones—a plausible assumption—changes in the share of imported intermediates provide information on whether firms respond to Walmex through upgrading their intermediate goods sourcing.

The fourth column of Table 2 shows that the arrival of Walmex raises the share of imported intermediates for the top firms, while in contrast smaller firms typically import less of their intermediates in the presence of Walmex. A plausible explanation is that Walmex sharpens the differences between firms in terms of their sourcing of intermediate inputs, with smaller firms, producing goods of relatively low quality, importing a lower share of intermediate inputs while the largest firms raise the quality of their products by importing a greater share of their intermediates from abroad. This result points to the same dichotomy between larger and smaller firms that we saw in the case of sales and R&D, and it is in line with the model that we have laid out above.

Wages On the one hand, if workers are paid the value of their marginal product, the cross-plant wage distribution should simply reflect differences in the mix of workers employed by different producers. In particular, plants using more sophisticated technologies need higher-skilled workers, and thus should pay higher wages. On the other hand, if labor market frictions limit arbitrage across employers, wage dispersion may also reflect rent sharing between workers and employers, with rents responding to recent capital accumulation, technology investments, or increases in product appeal. Walmex's presence may have affected wages through all of these channels, but without matched employer-employee data we cannot source out their individual roles. We can, however, look at their net effect.

Column 5 of Table 2 presents $\widehat{\beta}_2^{qv}$ estimates from equation (7) with the log average wage as the left-hand side variable. There is a clear pattern: Walmex's arrival has led to lower wages at the smallest and to higher wages at the largest firms, with wage payments at mid-sized firms in between.

The combination of stronger sales, R&D, and upgrading for large firms has apparently led large firms to hire more skilled workers or reap higher rents, with either of the two leading to higher wages paid to workers. These wage results are another important finding consistent with the firm responses predicted by the model.

4.3.3 Walmex and prices

Our model predicts that conditional on product appeal, firms opting to sell their output through Walmex may be forced to reduce their prices (Figures 5a, 5b). However, Walmex's suppliers can relax this pricing constraint by upgrading their products, and to some extent they will choose to do so.

What do the data show? Our estimates of price effects are reported in column 6 of Table 2. The arrival of Walmex has increased the price charged by firms of moderate size (second quartile) relative to the prices charged by larger firms. This is in line with our model because larger firms are more likely to choose to retail through Walmex and thus subject to pressure on price by Walmex. Moreover, firms in the lowest quality quantile tend to reduce their prices. This finding fits less well with the predictions of the model; it may be due to upward-sloping marginal cost schedules and the output contraction effects discussed above.

4.3.4 Walmex and firm productivity

For the sake of tractability, our dynamic model only allowed one type of endogenous investment. Specifically, R&D stochastically led to product innovations that raised firms' product appeal. But a more general formulation would have shown that firms with access to a larger customer base also have Schumpeterian incentives to invest in *process* innovations that improves their technical efficiency. We now look for evidence of this type of response to Walmex.

In the last column of Table 2 the results of estimating (7) with total factor productivity (TFP) as the left hand side variable are reported.[31] We find that the arrival of Walmex increases the productivity of large relative to small firms (p-value 0.012). In particular, while the Walmex interaction coefficient point estimate $\widehat{\beta}_2^{qv}$ for the set of largest firms is positive, at 0.265 (standard error of 0.292), the point estimates of $\widehat{\beta}_2^{qv}$ for the other three quartiles of firms are negative (for the first and third quartile significantly so). The largest firms are those with the highest propensity of choosing to retail through Walmex. This allows them to reap productivity gains both from Walmex innovations in distribution and logistics and their own increased R&D and upgrading investments that we have documented above. Our productivity results are thus in line with the dynamic model of firms' retailing choice in section 3 above.

To summarize the previous section, there is strong evidence from the statistical tests at the bottom of Table 2 that the responses of firms that differ in size to Walmex entry are not the same, and moreover, for all outcome variables except fixed investment we find a significantly stronger reaction of large firms compared to that of small firms.[32] This evidence provides some initial support for our model.

4.4 Alternative specifications

In this section we describe the results of two important alternative specifications. In the first of these, we include plant fixed effects, μ^i, in the estimating equation:

$$\begin{aligned} Y_{jt}^{vi} = \beta_2^{qv}\left[PG_j^i \times s_{jt}\right] + \beta_3^{qv} TUS_t^i + \beta_4^{qv} TMEX_t^i \\ + \beta_5^{qv}\left[PG_{ij} \times GDP_{jt}\right] + \alpha_{jt} + \mu^i + \varepsilon_{jt}^i. \end{aligned} \tag{8}$$

[31] Our TFP measure corresponds to a technical efficiency measure under the assumption that product quality and intermediate input quality remain fixed through time for any given firm. Then, growth in the ratio of sales revenues to our firm-specific output prices reflects growth in physical output, and growth in expenditures on intermediate inputs relative to our input price deflator reflects growth in the physical volume of intermediate inputs used. To the extent that product innovations occur, the price of a given quantity of output will drift upward over time, causing the growth in physical production volumes to be understated. In turn, this will lead to an understatement of growth in technical efficiency.

[32] While the prediction of the model for the price charged is subtle, the result that prices of midsmall firms tend to go up relative to prices of larger firms (Table 2, column 6) is in line with the model, see Figure 5a.

Table 3: Walmex Effects on Producer Characteristics ($\widehat{\beta}_2^{qv}$) by Initial Plant Size - Plant Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Fixed	Intermediate			
	Sales	R&D	Investment	Imports	Wages	Prices	TFP
Small	0.459	-2.871**	–2.347	-21.573*	0.275	0.197	0.595
($q = 1$)	[0.794]	[1.033]	[1.939]	[12.240]	[0.310]	[0.296]	[0.825]
Midsmall	-1.115**	0.486	-3.184*	-15.441	-0.656**	-0.373*	-0.078
($q = 2$)	[0.467]	[0.984]	[1.715]	[10.123]	[0.229]	[0.191]	[0.519]
Midlarge	0.803*	0.737	-0.258	-9.885	-0.308	0.492**	-0.221
($q = 3$)	[0.476]	[1.560]	[2.250]	[12.485]	[0.237]	[0.206]	[0.521]
Large	-0.021	3.447	-1.169	-3.921	-0.006	-0.165	0.789
($q = 4$)	[0.472]	[2.754]	[2.770]	[13.226]	[0.233]	[0.254]	[0.586]
Pooled sample	-0.093	-0.114	-1.681	-14.140**	-0.275**	0.211**	0.260
	[0.256]	[0.740]	[1.064]	[5.807]	[0.120]	[0.106]	[0.290]
H_0: Small = Large p-value	0.302	0.016	0.364	0.164	0.234	0.177	0.424
H_0: All four equal p-value	0.032	0.030	0.754	0.782	0.067	0.016	0.537

The inclusion of plant fixed effects implies that our estimates are capturing exclusively within-plant changes that are triggered by the arrival of Walmex.[33] The results are shown in Table 3.

Plant Fixed Effects Column 1 of Table 3 confirms the earlier result that the arrival of Walmex affects firms differently. In particular, sales of firms in the second quartile fall while sales of the larger firms in the third quartal rise. Since the larger firms are more likely to retail through Walmex this is in line with our model. In the case of R&D, the second column on Table 3 shows a positive coefficient of 3.447 for the largest firms (standard error of 2.754), while the smallest firms, with a coefficient of -2.871 (standard error of 1.033) cut down on R&D. This shift of R&D from the small to large firms is qualitatively the same that we found without plant fixed effects, however now the effects are magnified, and they are most striking for the mid-small versus mid-large firms. Overvall, we still reject the null

[33]The inclusion of plant fixed effects μ^i eliminates the variable PG^i from the specification.

that firms in all size categories react to Walmex in the same way (p-value 0.030).

Recall that the inclusion of plant fixed effects implies that only within-plant changes over time are remaining. One of the consequences appears to be that the distinction between the four size classes becomes somewhat less sharp. For example, we see that investment of smaller firms falls relative to investment of larger firms (column 3), with the decline for firms in the second, not the first quartile, being most severe. Further, the arrival of Walmex reduces the extent to which small firms purchase imported intermediate inputs, compared to larger firms (column 4). Both of these results are consistent with the predictions of the model laid out above.

What happens to wages in a given plant with the arrival of Walmex? According to column 5, wages at the relatively small firms of the second quartile fall relative to wages at larger firms. This is what we expect given the model's prediction. However adding plant effects eliminates our earlier result that Walmex raises the wages paid at top firms.

Regarding prices, there is evidence for lower prices for a range of firms, specifically those in the second and fourth quartile. However, in contrast to the model's prediction, firms in the third quartile set higher prices with the arrival of Walmex (column 6).

Finally, while the estimates on within-plant productivity changes due to Walmex are generally not very precise (column 7), with 0.789 the highest point estimate is obtained for the largest firms. Since these firms are most likely choosing to retail through Walmex, this is in line with the model.

Overall, a focus on within-plant changes over time means that we can less frequently than before reject the null that large firms react stronger than small firms to Walmex. It appears that the distinction between the size classes becomes less sharp once one focuses on within changes. At the same time, we continue to find evidence that the responses of the larger firms ($q = 3, 4$) are larger than those of the smaller ($q = 1, 2$) firms, which is in line with our model.

All Walmex Goods We now turn to a second variation of our estimating equation. The identification of the Walmex effect on local retailers is shifted from the set of perishable goods to all goods that are retailed by Walmex (see Table 4 for results).While based on our interviews we expect the Walmex effect to be strong for perishable goods, a number of key Walmex innovations are not limited to perishable goods, and thus an effect should be felt by any supplier producing for the broader set of all goods retailed through Walmex (both sets of goods are shown in Appendix 3). In terms of the estimation equation, this amounts to replacing the indicator variable for perishable goods, PG_j^i, with an indicator for a Walmex good, WM_j^i, both linearly as well as in the interaction with the Walmex share of local floor space, s_{jt}:

$$\begin{aligned} Y_{jt}^{vi} = \beta_1^{qv} WM_j^i + \beta_2^{qv} \left[WM_j^i \times s_{jt} \right] + \beta_3^{qv} TUS_t^i + \beta_4^{qv} TMEX_t^i \\ + \beta_5^{qv} \left[WM_j^i \times GDP_{jt} \right] + \alpha_{jt} + \varepsilon_{jt}^i. \end{aligned} \tag{9}$$

It is clear from the results that Mexican producers of different sizes have reacted very differently to the arrival of Walmex. Just as in our baseline results (Table 2), we find that large firms respond at a *higher* rate than others for all variables except prices and fixed investment. These firms gain relative to small firms in terms of sales, investment, and productivity, while they upgrade their production with more imported intermediates, more skilled labor, and more R&D. Further, although price adjsutments by the smallest firms do not fit our model's predictions, the remaining size categories do exhibit a broad pattern of lower prices as size increases, consistent with constraints imposed on pricing by a retailing through Walmex. Overall, there is strong support for the model from these findings.

To sum up, we have seen that in all three specifications–perishable goods, plant fixed effects, and all Walmex goods–, large firms overwhelmingly respond stronger to Walmex' arrival than smaller firms, and the difference is generally significant (see Tables 2, 3, and 4). In particular, we find that in more than 70% of the cases formal tests reject the null hypothesis that firms of different sizes respond in the

Table 4: Walmex Effects on Producer Characteristics ($\widehat{\beta}_2^{qv}$) by Initial Plant Size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Sales	R&D	Fixed Investment	Intermediate Imports	Wages	Prices	TFP
Small	-2.551***	-0.116	-1.659**	-15.119**	-0.449***	-0.077	-0.523*
($q = 1$)	[0.342]	[0.286]	[0.689]	[6.056]	[0.136]	[0.098]	[0.276]
Midsmall	0.013	0.112	-1.762	0.391	0.011	0.178**	0.136
($q = 2$)	[0.197]	[0.243]	[0.559]	[4.912]	[0.099]	[0.072]	[0.166]
Midlarge	0.029	0.078	-0.980	9.691*	-0.204**	0.085	0.082
($q = 3$)	[0.179]	[0.334]	[0.621]	[5.024]	[0.092]	[0.068]	[0.147]
Large	1.316***	1.246**	-1.076	6.417	0.776***	0.049	0.443**
($q = 4$)	[0.203]	[0.477]	[0.708]	[5.186]	[0.092]	[0.058]	[0.168]
Pooled sample	-0.127	0.259	-1.220**	0.331	0.040	0.083*	0.145
	[0.150]	[0.177]	[0.333]	[2.613]	[0.054]	[0.035]	[0.089]
H_0: Small = Large p-value	< 0.001	0.007	0.278	0.003	< 0.001	0.132	0.001
H_0: All four equal p-value	< 0.001	0.102	0.746	0.011	< 0.001	0.197	0.027

same way to Walmex' entry across all outcome variables. For sales, R&D, and productivity, there is also typically a significantly larger response of the largest compared to the smallest firms. We conclude that the responses of Mexican firms to Walmex are—in multiple dimensions, with the exception of fixed investment and prices, where the evidence is weak and the prediction more subtle, respectively—well captured by our model. The arrival of a dominant retailer bisects the distribution of supplying firms and leads to dramatically different choices at large versus small firms. More generally, the results indicate that focusing on the response of the typical establishment would have meant missing much of the adjustment process.

5 Summary and Conclusions

In the last few years the debate on the the liberalization of the services sector has take a central stage in various emerging markets, most recently in India. In light of this debate, we have characterized a new mechanism through which FDI in the retail sector affects industrial structures and efficiency in developing countries. Specifically, we have argued that the deregulation of FDI under NAFTA not only transformed Mexico's retail market, it reshaped upstream manufacturing industries in doing so. In addition to analyzing Mexican experiences, we have brought a new perspective to the empirical literature on FDI and host-country productivity, which has not typically shed much light on the underlying forces at work. In addition, our analysis of FDI in the retailing sector has broadened the perspective of the theoretical literature, which to date has focused on the goods-producing sectors.

The linkages we highlight between retailers and manufacturers are based on interviews we conducted with representatives of both sectors. Given their perspectives on the Walmex's business model and its implications, we develop a dynamic model of an upstream manufacturing industry in which heterogeneous firms endogenously enter and exit. Each period, incumbent firms decide how much to invest in quality-enhancing innovation and whether to sell their products through Walmex or a traditional retailer. Those that choose Walmex do so because the benefits of a larger customer base outweigh the costs of conforming to Walmex's constraints on product quality and pricing.

Simulations of the model suggest that high-quality firms should choose to sell their product through Walmex and increase their investments in innovation, while low-quality firms should do the opposite or exit altogether. Thus the appearance of Walmex in Mexico should have polarized upstream industries, exacerbating differences in sales volume and product quality between large and small firms, while reducing the total number of domestically-produced varieties available to consumers. Industry-level innovation and consumer welfare may nonetheless have increased, both because market shares are reallocated to the stronger firms and because these firms should have invested more in innovation.

Exploiting geographic and temporal variation in the location of Walmex stores, and noting that perishable goods suppliers are relatively sensitive to the proximity of retailers, we find evidence in manufacturing survey data to support these predictions. Specifically, high-quality firms have sold more and become more productive in response to Walmex's FDI in Mexico, while low-quality firms have lost ground in both dimensions.

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Appendix 1: Firm Interviews

This study is based on two rounds of firm interviews, in the years 2005 and 2007, broadly following the methodology outlined in Yin (2002). In the earlier year, we focused on producers in the soaps, detergents, and surfactants (SDS) industry in Mexico, while in the later year we supplemented this information with new interviews from a variety of industries. Generally we found that Walmex impact in the SDS industry was quite typical.

As reported in Javorcik, Keller, and Tybout (2008), initially we identified through internet searches, consultations with industry associations and visits to supermarkets thirteen companies operating in the SDS industry in Mexico. These were: Procter & Gamble, Henkel Capital, Colgate-Palmolive, Fábrica de Jabones La Corona, Sánchez y Martín S.A. de C.V., Alen, Latinoamericana de Detergentes S.A. C.V., Fábrica de Jabón la Reinera, Advanced Research Laboratorios de México (Carepro), Industrias H24, Grupo Aguaviento, Pinta Piel S.A. de C.V., Distribuidora Casam S.A. de C.V. We selected ten of these to keep the costs of the interview study within our budget. Of these ten firms we interviewed six, giving a response rate of 60%. More information on the protocol that was adopted in these interviews is given in Javorcik, Keller, and Tybout (2008).

In the second set of interviews with four more firms in the year 2007, we adopted a more directed approach that was in part designed to cross-check the information obtained earlier. The purpose of the second round of interviews was also to confirm the earlier finding from discussions with two industry associations, the National Chamber of Processing Industries (Camera Nacional de la Industria de Transformacion) and the National Association of Retailer and Department Stores (Association Nacional de Tiendas de Abarrotes y Departamentales), that the SDS industry is typical for how Walmart's entry has affected upstream Mexican firms.

In addition, the second round of interviews helped to clarify the impact of Walmart as more time had passed. While our evidence is clearly limited we sensed a noticeable improvement in the general sentiment of Mexican producers towards Walmart. Finally, note that executives of Walmex itself were among the interviewees in our 2007 round. This is important because it allows us to match up information provided by Walmex suppliers with that from non-Walmex suppliers as well as Walmex itself to arrive at a consistent picture.

Appendix 2: Estimates of Equation (7)

The tables in this appendix provide estimated parameters and standard errors for equation (7), quantile by quantile, as well as for the pooled panel of establishments.

Table A1: Log Real Sales†

	Quartile				All
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	
Perishable Good	-9.673***	-0.842	-0.01	0.066	-3.323***
(PG)	[1.435]	[0.850]	[0.859]	[0.932]	[0.660]
Share interaction	-3.765***	0.187	-0.142	-0.372	-0.727**
($PG \times S$)	[0.549]	[0.306]	[0.298]	[0.344]	[0.242]
U.S. tariff	0.034***	-0.001	-0.009**	-0.016***	0.001
(TAR^{US})	[0.005]	[0.003]	[0.003]	[0.003]	[0.002]
Mexican tariff	-0.012***	-0.002	-0.004**	0.001	-0.001
(TAR^{MEX})	[0.003]	[0.002]	[0.001]	[0.002]	[0.001]
GDP interaction	0.575***	0.043	0.015	0.038	0.200***
$PG \times \ln GDP$	[0.085]	[0.050]	[0.050]	[0.054]	[0.039]
R^2	0.055	0.038	0.032	0.06	0.024
N	8821	13555	14648	14872	52861

Standard errors appear in square brackets below each coeffficient. Coefficients for the interaction term PG x s correspond to those reported in Table 3 of the text.

Table A2: R&D†

	Quartile				All
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	
Perishable Good	-2.110*	-0.503	-2.139	-1.832	-1.730**
(PG)	[1.178]	[1.010]	[1.587]	[2.175]	[0.762]
Share interaction	-1.165**	-0.018	0.842	0.618	0.092
($PG \times S$)	[0.455]	[0.365]	[0.558]	[0.811]	[0.282]
U.S. tariff	0.009**	0.014***	0.002	-0.031***	-0.001
(TAR^{US})	[0.004]	[0.004]	[0.005]	[0.008]	[0.003]
Mexican tariff	0	-0.001	-0.001	0	0
(TAR^{MEX})	[0.002]	[0.002]	[0.003]	[0.004]	[0.001]
GDP interaction	0.133*	0.03	0.11	0.101	0.097**
$PG \times \ln GDP$	[0.070]	[0.059]	[0.093]	[0.127]	[0.045]
R^2	0.041	0.025	0.026	0.022	0.0067
N	9665	12977	13725	13837	51310

Standard errors appear in square brackets below each coeffficient. Coefficients for the interaction term PG x s correspond to those reported in Table 3 of the text.

Table A3: Investment[†]

	Quartile				
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	All
Perishable Good	0.673	-3.17	-1.706	-2.737	-3.338**
(PG)	[2.885]	[2.355]	[2.987]	[3.279]	[1.456]
Share interaction	-0.827	0.251	1.157	-1.769	-0.28
($PG \times S$)	[1.098]	[0.845]	[1.026]	[1.211]	[0.532]
U.S. tariff	0.033***	-0.006	-0.009	-0.006	0.002
(TAR^{US})	[0.010]	[0.009]	[0.009]	[0.011]	[0.005]
Mexican tariff	-0.012**	-0.005	0.006	-0.009*	-0.002
(TAR^{MEX})	[0.005]	[0.005]	[0.005]	[0.005]	[0.003]
GDP interaction	-0.006	0.175	0.066	0.21	0.192**
$PG \times \ln GDP$	[0.171]	[0.139]	[0.175]	[0.192]	[0.086]
R^2	0.062	0.029	0.032	0.051	0.015
N	10058	13375	14049	14261	52795

Standard errors appear in square brackets below each coeffficient. Coefficients for the interaction term PG x s correspond to those reported in Table 3 of the text.

Table A4: Intermediate Input Imports[†]

	Quartile				
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	All
Perishable Good	-34.947	-6.991	-124.403***	24.143	-32.064**
(PG)	[25.242]	[21.104]	[24.005]	[23.777]	[11.467]
Share interaction	-34.384***	-10.765	-23.269**	23.370**	-8.706**
($PG \times S$)	[9.566]	[7.605]	[8.329]	[8.782]	[4.194]
U.S. tariff	0.494***	0.133*	-0.059	-0.249**	0.06
(TAR^{US})	[0.092]	[0.078]	[0.076]	[0.079]	[0.040]
Mexican tariff	0.05	-0.073	0.037	-0.015	-0.008
(TAR^{MEX})	[0.050]	[0.045]	[0.039]	[0.039]	[0.021]
GDP interaction	2.695*	0.571	7.049***	-1.827	1.856**
$PG \times \ln GDP$	[1.495]	[1.246]	[1.405]	[1.391]	[0.675]
R^2	0.11	0.037	0.037	0.037	0.027
N	9006	13533	14596	14489	52586

Standard errors appear in square brackets below each coeffficient. Coefficients for the interaction term PG x s correspond to those reported in Table 3 of the text.

Table A5: Wages†

	Quartile				
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	All
Perishable Good	-0.186	-0.539	-1.011**	0.061	-0.577**
(PG)	[0.571]	[0.424]	[0.441]	[0.429]	[0.237]
Share interaction	-0.688**	0.056	-0.022	0.404**	-0.036
($PG \times S$)	[0.217]	[0.152]	[0.153]	[0.158]	[0.086]
U.S. tariff	0.007***	0.006***	0.006***	-0.005***	0.003***
(TAR^{US})	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]
Mexican tariff	0	0	-0.001	-0.002**	-0.001
(TAR^{MEX})	[0.001]	[0.001]	[0.001]	[0.001]	[0.000]
GDP interaction	0.023	0.029	0.057**	-0.002	0.034**
$PG \times \ln GDP$	[0.034]	[0.025]	[0.026]	[0.025]	[0.014]
R^2	0.052	0.046	0.048	0.053	0.028
N	9942	13892	14791	14913	54552

Standard errors appear in square brackets below each coeffficient. Coefficients for the interaction term PG x s correspond to those reported in Table 3 of the text.

Table A6: Prices†

	Quartile				
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	All
Perishable Good	-1.393***	0.408	-0.263	0.44	-0.02
(PG)	[0.388]	[0.315]	[0.307]	[0.272]	[0.151]
Share interaction	-0.286*	0.368**	-0.154	-0.034	0.031
($PG \times S$)	[0.150]	[0.114]	[0.107]	[0.099]	[0.056]
U.S. tariff	0.004**	0	-0.002	-0.001	0
(TAR^{US})	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]
Mexican tariff	0	0.001	-0.001**	0.001	0
(TAR^{MEX})	[0.001]	[0.001]	[0.001]	[0.000]	[0.000]
GDP interaction	0.080***	-0.027	0.018	-0.025	0.001
$PG \times \ln GDP$	[0.023]	[0.019]	[0.018]	[0.016]	[0.009]
R^2	0.069	0.024	0.02	0.024	0.0058
N	6263	10276	11421	12081	40073

Standard errors appear in square brackets below each coeffficient. Coefficients for the interaction term PG x s correspond to those reported in Table 3 of the text.

Table A7: TFP†

	Quartile				All
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	
Perishable Good	-2.119*	0.647	1.188*	0.072	0.231
(PG)	[1.153]	[0.731]	[0.708]	[0.782]	[0.396]
Share interaction	-0.923**	-0.151	-0.511**	0.265	-0.15
$(PG \times S)$	[0.441]	[0.266]	[0.247]	[0.292]	[0.146]
U.S. tariff	0.010**	-0.002	-0.003	0.001	0.001
(TAR^{US})	[0.004]	[0.003]	[0.002]	[0.003]	[0.001]
Mexican tariff	0.005**	-0.001	0	-0.002	0
(TAR^{MEX})	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]
GDP interaction	0.123*	-0.038	-0.06	0.006	-0.01
$PG \times \ln GDP$	[0.069]	[0.043]	[0.041]	[0.046]	[0.023]
R^2	0.035	0.025	0.029	0.028	0.0091
N	9607	13540	14522	14346	52976

Standard errors appear in square brackets below each coeffficient. Coefficients for the interaction term PG x s correspond to those reported in Table 3 of the text.