

Supplier Responses to *Wal-Mart's* Invasion of Mexico¹

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Abstract

This paper examines the impact of foreign direct investment on the industry structure, productivity performance, and the rate of innovation of domestic firms by studying the entry of *Wal-Mart* into Mexico following the 1994 North American Free Trade Agreement. We present a dynamic industry model in which firms decide whether to sell their products through *Walmex* (short for *Wal-Mart 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 quality, and it forces them to accept relatively low prices. Simulations of the model show that the arrival of *Walmex* separates potential suppliers into two groups. Those with relatively high-quality products choose *Walmex* as their retailer, whereas those with lower quality 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 our information gathered by interviewing Mexican manufacturers. We find also strong evidence for the heterogeneous supplier responses from regressions based on several panel data sets of Mexican producers.

1 Introduction

After joining the General Agreement on Tariffs and Trade (GATT) in 1986, Mexico adopted a more welcoming stance toward foreign investors and opened its borders to foreign trade. Taking stock of these developments—as well as the North American Free Trade Agreement (NAFTA) negotiations and the growing purchasing power of Mexico’s middle class in 1991—*Wal-Mart* invested in a joint venture with a major Mexican retailer (Chavez 2002). Following six years of explosive growth, *Wal-Mart* took majority control of its investment, becoming *Wal-Mart de Mexico* (*Walmex* for short). By 2001 it controlled nearly half of the Mexican retail market, and by 2003 it had become Mexico’s largest private employer, (Chavez 2002, Case 2004).¹

This paper analyzes the effects of *Walmex*’s ascendance on Mexico’s manufacturers of consumer goods. In our framework, heterogeneous firms in an upstream industry have to decide whether to sell their products through *Walmex* or through traditional retailers. We show that this induces crucial dynamic firm choices on how much to sell, at what price, and how much to invest in product upgrading. These predictions are then confronted with micro evidence on how *Walmex* entry actually changed producer behavior in Mexico.

Our model highlights the advantages and disadvantages of becoming a *Walmex* supplier. Key among the former is access to a larger domestic consumer base. The latter include sub-optimally low prices and continuous pressure to raise the quality, or appeal, of one’s product. Embedding these effects in an industrial evolution model, we show that the arrival of *Walmex* can cause consumer-goods producers to self-select into two groups on the basis of their product’s popularity. Firms that sell high quality products choose to sell through *Walmex*, while the rest continue selling through traditional retailers. Further, some of the former firms invest more in product upgrading, especially at the upper

¹For details of Wal-Mart’s expansion into Mexico see Chavez (2002), Tegel (2003), and Javorcik, Keller, and Tybout (2008).

end of the product quality distribution, while others scale back their investments. In addition, firms that switch to selling through *Walmex* see their price and mark-up fall, especially those producing moderate- as opposed to high-quality products. And finally, high quality firms gain market share, while low quality firms contract or exit entirely.

The evidence we present comes from two sources. First, we conducted interviews with Mexican firm representatives and industry experts. Those interviewed frequently mentioned that *Walmex*' entry had considerably sharpened the distinction of high- versus low-performing firms. They also stated that, among firms choosing to deal with *Walmex*, the productivity effects were often positive.² Second, we analyze several plant-level panel data sets on Mexican manufacturers of consumer goods. These data, obtained from the Mexican Statistical Office (INEGI), allow us to examine whether the predicted patterns on industry restructuring, pricing, productivity, upgrading, and innovation are most striking among producers who should have been most affected: those in regions where *Walmex* established a presence, and those who produce the types of goods sold at *Walmex*. The results provide strong support for our analysis.

Our study contributes to a number of literatures. First and most obviously, it adds to the growing body of evidence on the causes and effects of *Wal-Mart*'s operations.³ Unlike most of this literature, however, it focuses on *Wal-Mart*'s effects on upstream manufacturers rather than its effects on other retailers.⁴ Second, we extend the large literature concerning the impact of foreign direct investment on host country firms.⁵ Here, too, our contribution is atypical, since we use a dynamic structural model to describe the nature of the linkages between *Wal-Mart* and its upstream suppliers, and we characterize

²We have conducted two series of interviews on which we are drawing, in the years 2005 and 2007; results from the 2005 interviews are summarized in Javorcik, Keller, and Tybout (2008).

³See Basker (2007) for an overview.

⁴*Wal-Mart*'s entry into U.S. regions has been found to be associated with lower retail prices (Basker 2005a), while the evidence on job creation has been mixed (Basker 2005b). Using a model of strategic competition to analyze market share reallocation between two major-*Wal-Mart* and *Kmart*— and a fringe of smaller retailers, Jia (2006) finds that *Wal-Mart* is largely responsible for the demise of small discount retailers. Holmes (2006) examines the dynamic pattern of store openings in the U.S. to estimate *Wal-Mart*'s implied gain from establishing stores near to each other, due perhaps to the sharing infrastructure, distribution centers, and advertising expenditures.

⁵Surveys of the literature include Keller (2007), Lipsey and Sjöholm (2005), as well as Görg and Greenway (2004).

firms' behavior in many dimensions, including sales volumes, pricing, wage payments, investment, technology upgrading, and exit decisions.⁶ Third, our work adds to the heterogeneous firm literature by describing a new way in which changes in the business environment lead to dramatically different responses by firms with different productivity levels or product quality levels.⁷ And finally, extending the computational work developed by Weintraub et al. (2007), we contribute a new application to the growing empirical literature on industry dynamics.⁸

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

2 The *Wal-Mart* invasion in Mexico

2.1 Changes in business practices

As we have noted elsewhere, *Walmex* acted as a catalyst for two fundamental changes in the Mexican retail sector:

First, the sector modernized its warehousing, distribution, and inventory management.

Second, it changed the way it interacted with its suppliers. The former changes partly reflected the growing availability of information technology. But they also reflected the innovations that *Walmex* imported from the United States. *Walmex* not only introduced

⁶The reduced-form impact of global retail chains on supplying industries is estimated in Javorcik and Li (2008).

⁷In particular, a number of recent papers in the trade literature link product market conditions to joint adjustments in market shares and investments in innovation (Yeaple, 2005; Ederington and McCalman, 2007; Bustos, 2007; Constantini and Melitz, 2008; Verhoogen, 2008.)

⁸Akerberg, Benkard, Berry, and Pakes (forthcoming) provide a recent survey of this literature.

the system of channeling deliveries from suppliers through centralized warehouses, it also require[d] delivery trucks to have appointments and drivers to carry standard identification cards. Those that missed appointments were subject to fines. Shipments [had to] be on standardized palettes (rentable from *Walmex*), they [had to be] shrink-wrapped with corner protectors, and they [were] subject to third-party quality audits. (Javorcik, Keller, and Tybout 2008)

Walmex has maintained two separate distribution systems in Mexico: one for its supermarket chains and one for *Sam's* chain of wholesale stores.⁹ Many producers serve both types of distribution centers. The principal difference between the two is the size of product packaging. All suppliers have the option of delivering their products to a single distribution center, but those with multiple plants around the country are encouraged to deliver to multiple centers. A single truck-load is the usual unit of delivery volume, though three centers are able to receive deliveries of smaller sizes and aggregate them into full truck-loads. Distribution centers specialize in terms of product type: dry goods, clothing, and perishables, including frozen products. Further, only some of the perishables sold in *Walmex* stores are channeled through distribution centers—many are purchased locally. Thus, proximity to *Walmex* retailers is particularly important for perishable goods producers.

Centralized distribution systems, the use of palettes, and other innovations introduced by *Walmex* have diffused to the other major retail chains. According to Tegel (2003), in the early 2000s *Walmex* was "the only Mexican retail chain that [had] its own centralized distribution system. Suppliers thus [could] deliver their goods just once to any of 11 *Walmex* depots scattered across the country, rather than to each individual store." Interviews conducted for this study in 2005 and 2007 revealed that since the time of Tegel's writing, other major retailers have followed suit and introduced centralized warehousing and the use of palettes.

⁹Its clothing store chain *Suburbia* and restaurant chain *VIP* support separate distribution centers as well.

Despite this diffusion of retail practices, *Walmex* has remained a technological leader in Mexico. This is partially because *Walmex* continues to make improvements to its distribution system, and partly because local competitors have not always adopted *Walmex*'s innovations. For example, while all perishables sold by *Walmex* were packaged into carton boxes and wooden crates in 2003, 90 percent of them were packaged in replenishable plastic containers (RPCs) by 2007.¹⁰ The leading Mexican supermarket chain, *Soriana*, already uses this technology and some others are in the process of introducing it. But *Soriana* is the only retailer besides *Walmex* that has a cold chain. Similarly, *Walmex* is the only retailer that uses computerized tracking of sales and inventories and is able to provide suppliers with daily sales and inventory figures at the level of individual stores.

The profound changes in the retail sector, initiated by *Walmex* and diffusing somewhat to other retailers, have resulted in a significant decline in distribution costs faced by Mexican suppliers. And critically, the spectacular expansion of *Walmex*'s retail network has allowed its suppliers to reach a larger segment of the Mexican market. Several other factors make *Walmex* an attractive downstream retailer. First, it pays the agreed upon amount on time, while other supermarket chains are often late with payments or subtract arbitrary fees from the payment.¹¹ Second, the high creditworthiness of *Wal-Mart* allows its suppliers to benefit from factoring. Factoring involves selling commercial trade receivables in order to obtain working capital. Thus rather than waiting 30 or 90 days to receive a payment, a *Wal-Mart* supplier may sell for a small fee its account receivables and immediately obtain working capital. In many countries, factoring has become an important source of financing-especially short term working capital-for small and medium-size enterprises.

¹⁰RPCs have many advantages over carton boxes and wooden crates. They are more sanitary and better keep the desired temperature. They also reduce the handling costs as they have a standardized weight, are more stable and easier to move, fit exactly on a pallet and can be easily stocked one on top of another. Finally, they are more environmentally friendly.

¹¹According to interviews with Mexican entrepreneurs, supermarket chains often match rebates offered to consumers by their competitors. While *Wal-Mart* will cover the costs of such impromptu rebates, other supermarket chains try to pass on the suppliers of discounted goods.

The benefits of dealing with *Walmex* come at a cost, however. Because it controls such a large share of the retailer market, it has far greater bargaining power than its rivals. This allows it to drive down its suppliers' profit margins, making take-or-leave-it offers. Often it extracts price concessions ranging from 5 to 25 percent below the prices of the same product at other outlets.¹² Further, *Walmex* demands annual wholesale price reductions of those suppliers who do not improve their product from one year to the next. "Those firms that are unable to frequently introduce new goods—and thus avoid establishing a benchmark price—are squeezed relatively more (Fishman 2003). Those suppliers that balk at Wal-Mart's demands are simply discontinued, and new suppliers are brought in" (Javorcik, Keller, and Tybout 2008). In section 3 below, we will develop a model that captures each of these features of the Mexican retail sector in the *Walmex* era.

2.2 The geography of *Walmex*'s growth

Different suppliers gained access to the option to sell through *Walmex* at different points in time. In Figures 1 to 4, we show the growth of *Walmex* in terms of geographic space over the years 1993 to 2007. This also highlights some differences to *Wal-Mart*'s evolution in the United States. Figure 1 shows the location of various formats of *Wal-Mart* shops in the year 1993 across the thirty-two Mexican provinces. Since differences in demand play a key role for *Wal-Mart*'s expansion, we have shaded the provinces in terms of population density. The darker the color, the higher is population density, which in 1993 attains its maximum in the area of the Mexico City (*Distrito Federal*).

Among the different *Wal-Mart* formats, we distinguish *Bodega Aurrerás*, which are lower end grocery stores, *Superamas*, which are basic big box stores that do not sell food, and *Walmex Supercenters*, which are "big box" stores that sell groceries. Finally, *Sam's Club* is a bulk version of the *Supercenter*. We also note the location of *Walmex* distribution centers, of which there were nine in 2007.

¹²We base these percentages on studies of Walmart in the United States (Basker (2005a, Business Planning Solutions 2005). For discussion of these studies, see Javorcik, Keller, and Tybout (2008).

Wal-Mart's geographic expansion strategy in Mexico differed from its strategy in the United States, where it gradually radiated out from Bentonville, Arkansas (see Holmes 2007). Although it began in the highly populated central areas, reflecting the existing locations of its venture partner (*Aurrera*), it quickly planted stores in the far North-West as well as in the South-East of Mexico (Figure 2). At the same time, as Figures 3 and 4 indicate, the concentration of *Walmex* stores remains higher in the central provinces of Mexico throughout the period of 1993 to 2007. Finally, note that the establishment of distribution centers has generally followed the opening of stores.

We will exploit these expansion patterns when we test for the effects of *Walmex* on consumer goods suppliers in section 4 below. Before we do so, however, we develop an industrial evolution model with retailers that generates our testable predictions.

3 Modeling Upstream Industry Evolution with *Walmex*

3.1 The Essential *Walmex* Effects

Walmex does two things that consumers like. First, it brings together many products that they wish to purchase in convenient locations, thereby decreasing their transactions costs. And thanks to its unique computerized inventory and sales tracking system, *Wal-Mart* is considered to be the only chain that is "never out of stock."¹³ Second, *Wal-Mart* offers quality merchandise at very competitive prices.

Taken alone, the fact that *Walmex* efficiently move goods to a very large customer base makes it very attractive as a retailer. However, its appeal to producers is tempered by the price concessions that *Walmex* demands. The suppliers we interviewed reported being asked for a "logistics discount," effectively compensating *Walmex* for the lower distribution costs it realizes with its centralized logistics and sourcing system. Similarly, *Walmex* recognizes that its large consumer base allows its suppliers to reap scale economies, and argues that this justifies the lower wholesale prices it demands. And

¹³This assertion is based on our interviews with executives.

as mentioned above, *Walmex* expects annual declines in prices from all of its suppliers. Even large multinationals may have a hard time resisting price cuts, according to one executive—if *Walmex* does not like the way negotiations are going in Mexico, it will escalate them to the level of U.S. headquarters of both firms.

The ability of *Walmex* to demand quality increases or price cuts also stems from the fact that by lowering the distribution costs it has turned many small producers previously operating in their local markets into national suppliers, selling under their own brands or *Walmex*'s store brands. While major industry players often own a fleet of truck which they use to distribute their products nationwide, smaller producers are usually unable to bear the cost of product distributing beyond their locality. By allowing small producers to deliver their products locally and have them distributed nationwide, *Wal-Mart* turned small producers into viable competitors of the large players.

Producers weigh these two effects when deciding whether to use *Walmex* as a retailer. Of course, suppliers' decisions are affected by the decisions of the competitors. It is quite possible that, when the option to retail through *Walmex* first appears, only few or even a single firm finds it profitable to become a *Walmex* supplier. But once this has happened, the mix of quality and price available to consumers is changed, and non-*Walmex* suppliers will typically be forced to adjust their prices downward in response to the lower prices of the *Walmex* good. Once this has occurred, other producers pay a smaller penalty in terms of price reduction by switching to *Walmex*. But they also stand to gain less in terms of market share than the first switcher, since now several firms would share the stock of *Walmex* consumers. If the first effect dominates, it is possible that a snowballing could occur once *Walmex* successfully woos a critical mass of firms, many others find it optimal to switch as well. And the heightened competitive pressures introduced by *Walmex* may well drive some marginally profitable firms to exit the market entirely. The reduction in payoffs as more and more firms share the *Wal-Mart* consumers is offset to some degree if *Walmex* acts as a trading company for its suppliers

and ships their goods also to foreign *Wal-Marts*.

In addition to pricing decisions, the presence of *Walmex* affects incentives to engage in process or product innovation. Anecdotal evidence and interviews suggest that making product improvements allows suppliers to escape the mandatory price cuts. Similarly, suppliers can obtain higher prices by introducing new product varieties. Interviewees in Mexico often reported that *Walmex* wants to source products that are different from those supplied to the competing supermarket chains. Finally, the usual Schumpeterian forces are at play when *Walmex* increases the size of the customer base, and thereby increases the number of units over which one can reap the benefits of a cost-reducing innovation.

3.2 The Industrial Evolution Model

Drawing on Pakes and McGuire (1994), Pakes and Ericson (1995), and Weintraub, Benkard and van Roy (2007), here we develop an industrial evolution model that captures these main consequences of *Walmex*'s presence. The model characterizes supplying firms' pricing decisions, retailer choices, investments in product quality improvements, and entry as well as exit decisions.

The structure of our model is similar to Weintraub et al.'s (2007), 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.

3. Taking stock of *Walmex*'s take-it-or-leave-it price offer and minimum quality requirements, each incumbent firm decides whether to use *Walmex* as its retailer or deal with traditional retailers.
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; others are free to choose their own 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.

3.2.1 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 level ξ_{jt} relative to goods outside the industry of interest,¹⁴ and (suppressing time subscripts) express the net indirect utility of product j for the i^{th} consumer as:

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

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 unobserved

¹⁴Quality in this model is determined by the consumers; along these lines, ξ_{jt} may also capture product appeal which firms can affect through advertising.

idiosyncratic features of consumer i . The parameter β_w is positive because, when a product is available at *Walmex*, it becomes more accessible to the average consumer.¹⁵

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

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

where:

$$h_j = h(j|\mathbf{w}, \mathbf{P}, \boldsymbol{\xi}) = \frac{\exp[\bar{U}_{ij}]}{\sum_{\ell} \exp[\bar{U}_{i\ell}] + 1}, \quad (2)$$

$\mathbf{w} = \{w_j | j \in \mathbf{I}\}$, $\mathbf{P} = \{P_j | j \in \mathbf{I}\}$, and $\boldsymbol{\xi} = \{\xi_j | j \in \mathbf{I}\}$. Further, if all firms sell all of their output through traditional retailers (i.e., $w_j = 0 \forall j \in \mathbf{I}$), the set of pure strategy Bertrand-Nash prices satisfies (2), (1) and:

$$P_j = C_j + \frac{Y + \theta_2 C_j (1 - h_j)}{1 + \theta_2}, \quad j \in \mathbf{I} \quad (3)$$

where C_j is the marginal cost of production for firm j (Berry 1994).

We make several assumptions at this point. First, firms differ in terms of their product quality, but not their marginal costs. Thus, we hereafter drop the j subscript on C . Second, 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. Third, *Walmex*'s take-it-or-leave-it price offer to any supplier j —hereafter denoted \bar{P}_j —depends upon ξ_j according to:

¹⁵Holmes (2007) also uses a logit specification, but makes the opposite assumption that consumers lose satisfaction by shopping at Wal-Mart rather than other retailers.

$$\bar{P}_j = P_0 + \theta_3 \ln(\xi_j), \theta_3 > 0, \quad (4)$$

$\mathbf{w} = \{w_j | j \in \mathbf{I}\}$ and $\boldsymbol{\xi} = \{\xi_j | j \in \mathbf{I}\}$. This specification not only increases the return to investments in product quality positive for *Walmex* suppliers, it implies that when firms experience quality declines relative to the outside good they will be forced to cut their prices as discussed in section 2 above. Finally, in addition to the pricing constraint (4), we assume that *Walmex* imposes a minimum quality standard on all its suppliers: $\xi_j \geq \bar{\xi} \forall j \in \mathbf{W}^1$, where $\mathbf{W}^1 = \{j | w_j = 1, j \in \mathbf{I}\}$ is the set of suppliers who do business with *Walmex*.

Since there are no sunk costs associated with starting or stopping a *Walmex* relationship, suppliers choose their retailers period by period, without worrying about the implications of their current choices for their future retailing options. When the subset \mathbf{W}^1 of incumbent firms chooses to use *Walmex* as their retailer, and the remaining incumbent firms $\mathbf{W}^0 = \{j | w_j = 0, j \in \mathbf{I}\}$ compete pure Bertrand-Nash in prices, the set of prices for these non-*Walmex* firms—hereafter denoted $\mathbf{P}^0 = \{P_j | j \in \mathbf{W}^0\}$ —solves (1), (2) and (3), given that *Walmex* firms' prices are fixed at $\bar{\mathbf{P}}^1 = \{\bar{P}_j | j \in \mathbf{W}^1\}$. The associated profits for the j^{th} non-*Walmex* firm are

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

where h_j is given by the share equation (2) evaluated at $\mathbf{P} = \bar{\mathbf{P}}^1 \cup \mathbf{P}^0$, $\boldsymbol{\xi}$, and \mathbf{w} , and the vector $\mathbf{w}_{-j} = (w_1, w_2, \dots, w_{j-1}, w_{j+1}, \dots, w_N)$ collects the retailing decisions of all firms *except* firm j . 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:

$$\pi_j = \pi(j, w_j = 1 | \mathbf{w}_{-j}, \boldsymbol{\xi}) = (\bar{P}_j - C) \cdot h_j \cdot M$$

where h_j is given by (2) evaluated at the same \mathbf{w}_{-j} and $\boldsymbol{\xi}$ but at the new equilibrium price vector.

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:

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

While multiple equilibria may exist, we limit our attention to equilibria in which all firms above some quality threshold sell their product through *Walmart*, 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 $\pi^*(\xi_j, \boldsymbol{\xi}_{-j})$, where $\boldsymbol{\xi}_{-j}$ gives the product quality levels for all incumbent firms except j 's. (Thus $\boldsymbol{\xi} = \xi_j \cup \boldsymbol{\xi}_{-j}$.)

3.2.2 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 entrepreneurs create new firms, they incur sunk start-up costs (hereafter ϕ_e), and when they shut down their firms they receive its 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 quality (ξ) evolves over time, and the processes that these quality 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 quality next period, hereafter denoted ξ'_j . Further, assume that for any firm j , all realizations

on ξ_j s are elements of a discrete ordered set $\{\xi^1, \dots, \xi^K\}$, $\xi^i < \xi^{i+1} \forall i \in I^+$, 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 quality with exogenous probability δ , firm j 's product quality evolves according to:

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

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 quality and the product quality of all of its rivals. It then decides whether to continue operating or shut down. If it does continue 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 $\mathbf{s} = (s_1, s_2, \dots, s_K)$, where s_i is the number of firms that are currently at the i^{th} quality level level. Similarly, let \mathbf{s}_{-j} be the same vector, except in that it leaves firm j out of the count.¹⁶ Then firm j chooses its R&D level to solve:

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

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: $\Omega_j(\mathbf{s}'_{-j} | \mathbf{s}_{-j})$. 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

¹⁶This vector contains the same information as ξ_{-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 competitors, it is better suited for analysis of the dynamic equilibrium.

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 quality, ξ_e .

3.2.3 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 have been developed; we rely on the approach developed by Weintraub et al. (2007).¹⁷

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 (so $\Omega_j(\mathbf{s}'_{-j}|\mathbf{s}_{-j})$ is a degenerate distribution). The associated equilibrium concept is called an "oblivious equilibrium" by Weintraub et al. (2007) to highlight the assumption that firms ignore the variations in \mathbf{s}_{-j} due to idiosyncratic product quality shocks. The following simulations are based on extending the Weintraub et al. (2007) work to allow for endogenous retailer choice as discussed above. For details on the equilibrium concept and solution algorithm, the reader is referred to Weintraub et al. (2007).

¹⁷The 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 $\Omega_j(\mathbf{s}'_{-j}|\mathbf{s}_{-j})$ is the square of this very large number. Akerberg et al. (forthcoming) provide a useful discussion of solution techniques in the context of dynamic model estimation.

3.3 Model Simulations

To demonstrate the main implications of our model, we simulate our model at parameter values that generate plausible size distributions of suppliers, entry and exit patterns, R&D patterns, and firm mark-ups. Then we shut down the option to sell through *Walmex* and examine the associated adjustments in behavior. The key parameter values for these simulations are as follows:

Parameter	Without <i>Walmex</i>	With a <i>Walmex</i> option
C	1.5	1.5
β_w	1.0	1.0
$\bar{\xi}$	–	2.0
θ_3	–	0.4

Figure 5 presents the simulation results. The first (upper-left) panel of Figure 5 shows that in the absence of *Walmex*, all firms have substantial mark-ups, and price increases slightly with product quality (the smooth [blue] line at a price of about 2.4).¹⁸ When the option to sell through *Walmex* is offered to firms, the lower quality firms decline to do so, even some with quality above the minimum acceptable to *Walmex*. Accordingly, these firms continue to price around 2.4, maintaining a large mark-up over their marginal cost of 1.5. On the other hand, those with quality of roughly 2.2 find it worth their while to sell through *Walmex* and take a major price cut because they gain access to a much larger consumer base. The higher the firm’s quality, the more attractive *Walmex* is, since their market share increases almost in proportion to their quality, and since *Walmex* is willing to let high quality firms charge higher prices.

It is noteworthy that the firms with 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. To the contrary,

¹⁸The lack of price sensitivity to quality reflects the fact that even high-quality firms have small market shares, so changes in its product appeal does not lead to large changes in their market power.

they would have preferred that *Walmex* had never become an option for anyone. However, once the option is there, competition from suppliers who sell through it causes these firms do worse if they rely on traditional retailers than if they cut their prices and tap into *Walmex*'s large consumer base.

The top-right panel of Figure 5 shows that the lowest quality firms that sell through *Walmex* invest less in innovation—and thus innovate less frequently—than they would have if they had not had a *Walmex* option (the *Walmex* case has a higher maximum innovation, for the highest-quality firms). This is also true of those firms that opt to remain with traditional retailers. The reason is that these firms lose market share (and profit margin) relative to the high quality firms when *Walmex* becomes a retailing option. Accordingly, the returns to successful innovation for these firms become smaller. We find a similar pattern for capital investment (Figure 5, lower left).

The final panel of Figure 5 shows that, although *Walmex* increases industry-wide sales by making products more accessible and lowering their prices, it strongly reduces the number of suppliers. This is a consequence of the fact that firms at all but the highest quality levels earn lower operating profits when *Walmex* is present. So, against the positive welfare effects of *Walmex* for consumers who are able to consume high-quality brands at a more convenient location and a lower price, one must weigh the capital losses imposed on entrepreneurs whose profitability is reduced, sometimes to the point of exit, and the welfare losses of consumers who preferred the brands that are driven from the market.

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 evidence from micro data

4.1 Data sources and definitions

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 Geografía e*

Informática (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*”.¹⁹ Each plant is classified by industry (*clase*) on the basis of its principal product. The industry classification is equivalent to the 6-digit level Mexican System of Classification for Productive Activities (CMAP).

Our sample includes 6,867 plants spread across 205 classes of activity. The sampling framework is based on the 1993 industrial census. In each of the selected 205 *clases* the survey samples the largest firms until the coverages reaches 85% of the sectoral output. In sectors with fewer than 20 plants, all entities are surveyed. Moreover, 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. This feature of the dataset makes it particularly suitable to examine the question at hand.

The *Encuesta Industrial Mensual* is a monthly survey that is collected by INEGI to monitor short-term trends and dynamics. The survey has been run in parallel with the EIA and has covered the same plants. The EIM panel is available for the period 1994-2004 covering the same 205 *clases*. The principal difference with EIA is its periodicity, its data content (it includes the quantity and value of domestic sales, which allows for calculation of unit values) as well as the level of aggregation (plant-product rather than plant level). We aggregate monthly EIM data into annual observations.

The EIM contains information on 3,396 unique products. Each *clase* contains a list of products, which was developed in 1993 and remained unchanged during the entire period under observation.

¹⁹In 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.

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”, “rompopo”, 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 our dataset.

4.2 Empirical strategy

To examine whether the model gives a good description of the suppliers’ reactions to *Walmex*, we estimate a series of reduced form regressions. These regressions relate the cross-establishment distributions of crucial measures such as sales and prices to key dimensions influenced by *Walmex*. We adopt a difference in differences approach. The first dimension in which we distinguish establishments is their product type: we contrast those 6-digit industries that produce goods carried by *Walmex* with those producing other types of goods. The other key dimension is the geographic location of the establishments: we posit that establishments located in proximity to *Walmex* stores should be affected to a larger extent than those located farther away.

Although proximity to a *Walmex* distribution center may give a supplier access to *Walmex*’s national consumer base, proximity to *Walmex*’ retail stores matters for three reasons. First, producers located close to *Walmex* stores may be better informed about the type of products sold by *Walmex*, their characteristics and pricing. Second, our interviews with *Walmex* executives, Mexican firms and industry experts suggest that *Walmex* makes an effort to source from producers located in the region of *Walmex* operations. This effort is made in order to appeal to the tastes of local consumers, cut

down on transportation costs (especially for perishables) and build goodwill in local communities. Third, a large *Walmex* presence induces non-*Walmex* retailers in the region to exit or reduce the margins they offer to their suppliers.

In order to avoid imposing a functional form on the relation between *Walmex*'s presence and the distribution of producer characteristics, we use quantile regressions. For the q^{th} quantile, our specification is:

$$\begin{aligned}
(Y_{it} - \bar{Y}_{jt}) &= \beta_1^q \ln(N_{st}) + \beta_2^q WMX_j + \beta_3^q \ln(N_{st}) \times WMX_j \\
&+ \beta_4^q \ln(GDP_{st}) + \beta_5^q \ln(GDP_{st}) \times WMX_j \\
&+ \beta_6^q TAR_{jt}^{MEX} + \beta_7^q TAR_{jt}^{US} + \alpha_t^q + \varepsilon_{it}^q, \quad i \in \text{state } s, \text{ industry } j
\end{aligned} \tag{7}$$

Here Y_{it} is the outcome variable for establishment i at time t , expressed as a deviation from its (6-digit) industry-wide period- t average value. By using this deviation form, we limit the identification of *Walmex* effects to changes in the shapes of industry distributions. N_{st} is the sum of the number of *Walmex* supercenters, *Bodega* shops, *Sam's* and *Superamas* in the establishment i 's state.²⁰ WMX_j is a dichotomous variable identifying manufacturing establishments that produce goods carried by *Walmex*.²¹ GDP_{st} is the gross domestic product of the establishment's state. Note that a restricted version of our model would replace the first five right-hand side terms with WMX_j , $\ln(N_{st}/GDP_{st})$ and $\ln(N_{st}/GDP_{st}) \times WMX_j$. Therefore the number of *Walmex* stores can be thought of as measured relative to the size of the establishment state's economy. We include time fixed effects, α_t^q , which capture changes affecting all establishments equally. Finally, TAR_{jt}^{MEX} and TAR_{jt}^{US} are Mexican

²⁰Recall that while the first three store types sell groceries and other consumer products, *Superama* is a grocery store.

²¹Goods are classified on the basis of information available on *Walmex*'s website, store visits and detailed industry analysis.

and U.S. nominal tariff rates, respectively, in the establishment’s 6-digit industry.²² These variables are important in addressing changes in the degree of competition brought about by the NAFTA liberalizations.

In this formulation, the coefficient β_3^q captures the differential effects of supplying a *Wal-Mart*-type consumer good in regions where *Walmex* has a strong versus weak presence. In the following, we estimate equation (7) for key variables whose cross-establishment distribution is affected by *Walmex* presence according to our theory. Among these is, first of all, the establishment’s domestic sales, because if a particular supplier goes through *Walmex* this should translate into gains in its domestic market share. We then examine a number of measures that capture aspects of technology- and product quality upgrading triggered by *Walmex*, such as R&D spending and the composition of the labor force. Also, we study whether *Walmex*’ arrival is associated with productivity changes for the establishments. Finally, since changes in prices are a central part of the story, with firms selling through *Walmex* generally lowering their quality-adjusted price, we also trace out pricing behavior across heterogeneous firms in response to *Walmex* entry.²³

Table 1 shows summary statistics for the data set. On top, we provide information on the distribution of the outcome variables Y_{it} across establishments and over time, while at the bottom summary statistics for the independent variables are given.

4.2.1 The reallocation of market shares across establishments

We first estimate equation (7) with real domestic sales as the dependent variable. Results are reported in Table 2, first column. The results are obtained via simultaneous quantile regression, with each block of results corresponding to a particular quintile. A number of test statistics are reported at the bottom

²²The 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>

²³When taking logs we add 1 to those observations with zero values. The exception is firms with missing values or zeros for domestic sales, which we drop.

of the column.

First, domestic sales are positively associated with the number of *Wal-Mart* stores, and that is true for establishments of all sizes (see results across quintiles). While this might be in part due to the increased *Walmex* presence, an equally likely explanation is that *Walmex* picks regions for its store openings that in general experience an increase in overall sales. Second, establishments that sell *Wal-Mart*-type products typically sell less, especially if they are relatively small; however, in large markets, this effect is moderated (see the coefficients on WMX_j and $\ln(GDP_{st}) \times WMX_j$).

Of key interest to us however is how sales of establishments react to the presence of *Walmex* if they are selling a *Wal-Mart*-type product. The theory predicts that the best firms are more likely to accept a deal with *Walmex*, which allows them to enjoy higher market shares and expand their sales, while the firms choosing not to sell to *Walmex* see their sales squeezed down. From Table 2, the coefficient on the number of *Walmex* stores multiplied by *Wal-Mart* product, $\ln(N_{st}) \times WMX_j$, is about -21% for the smallest firms (20th quintile) and 7% for the largest firms (80th quintile). The result that an increased *Walmex*-presence leads to a reallocation of sales from small firms (low product quality) to larger firms (higher product quality) is just what one expects when larger firms decide to sell through *Walmex* while smaller firms do not. Thus, these results confirm the prediction of our model.²⁴

At the bottom of the table, we report results from tests of parameter equality of the interaction coefficient β_3^q across quintiles. Since the β_3^q coefficients are quite precisely estimated, it comes at no surprise that for all possible quintile comparison we can reject the null that the coefficients are identical at the 10% level.²⁵ In particular, the first row result indicates that the β_3^q coefficient for the 20th quintile is significantly smaller than that of the 80th quintile with more than 99% probability (p-value < 0.01). The evidence in support of the model is summarized in Figure 6, upper left corner,

²⁴These heterogeneous-response estimates can be considered causal effects as long as *Walmex*' entry conditional on the included regressors is orthogonal to the regionally prevailing distribution of firm quality.

²⁵These inferences are based on the simultaneously estimated bootstrapped standard errors.

where we plot the four quintile coefficients of the sales regression bounded above and below by their standard errors.

More generally, the results indicate that focusing on the response of the mean (or median) establishment misses the key result that firms at different points in the quality distribution respond in different ways to *Walmex*' presence.

We now turn to measures that shed light on technology- and quality-upgrading.

4.2.2 *Walmex* and upgrading across firms

R&D Spending From industry reports as well as the interviews summarized above we know that firms selling through *Walmex* frequently need to upgrade various aspects of their operations to guarantee compatibility with *Walmex* business practices. Some of these activities are likely to involve formal R&D spending, and in this section we examine whether *Walmex* entry has led to differential R&D spending patterns for *Walmex*- and non-*Walmex* suppliers; column 2 of Table 2 shows the results.

The coefficients on the $\ln(N_{st}) \times WMX_j$ interaction for the 40th and 60th quintile are, with -4.8% and -7.3%, respectively, lower than for the firms at the highest (80th) quintile, where the coefficient is zero. Given that the time and industry fixed effects eliminate the overall R&D growth over this period, these results indicate that firms with already high R&D spending raise these investments further relative to firms with moderately high to low R&D spending. The estimates are also shown in Figure 6, top-right. The tests at the bottom of Table 2 indicate that these differences are also significant. This increase in the concentration of innovative activity at the top through the arrival of *Walmex* is in line with what our model predicts—, see Figure 5, panel B.

While these results are in line with our model, we also see that—contrary to expectations—the R&D spending among firms in the lowest quintile is not significantly lower than among the highest-quintile firms. One notes however that the R&D results appear to be somewhat fragile, often predicting

coefficients of zero. This may have to do with the fact that more than 75% of establishments do not engage in formal R&D spending (see Table 1, top), and the regression estimates are primarily identified from cross-quintile variation in the data. We therefore turn also to other indicators of upgrading activity in an effort to expand on the R&D results.

Skill Intensity It is likely that *Walmex*' utilization of modern business practices such as its increased use of information technology for computerized tracking of sales and inventories required its suppliers to shift the composition of their workforce towards higher-skilled workers to be fully *Walmex*-compatible. More generally, product upgrading may require a larger input of skilled labor. Therefore we now seek evidence on a differential shift of the skill composition in the labor forces of *Walmex* versus non-*Walmex* suppliers. Column 3 of Table 2 presents results with the skill intensity, defined as the share of skilled workers in total employment, as the dependent variable.

We see that although the proliferation of *Walmex* stores has been accompanied by a general increase in the skill intensity of the labor force—the coefficients on $\ln(N_{st})$ are positive across the board—, for sellers of *Wal-Mart*-type products there is a qualitative difference between firms with a relatively low-skilled initial labor force compared to firms with a relatively high-skilled one. As the regression estimates (summarized in the lower left panel of in Figure 6) indicate, the work force in the 80th quintile of firms becomes on average significantly more skilled, whereas the bottom forty percent of firms experience on average a de-skilling of their work force. These results are consistent with our findings on changes in R&D spending, and they also confirm the general idea that *Wal-Mart*'s increasing presence in Mexico has led to a bifurcation among manufacturing firms.

Average Wage Next we turn to the average wage received by the employees. As long as workers are paid their marginal product, rising wages are due either to between-worker skill upgrading, where low-skilled workers are replaced by high-skilled workers, or within skill upgrading through worker training.

If *Walmex* induces suppliers to opt for a more highly skilled labor force, one expects the average wage of *Walmex* suppliers to increase. Consistent with this, we see that for the highest quintile of firms that produce *Wal-Mart*-type products, wages go up by about 6%, whereas the average wage on the low end falls by about 5%. This difference between the top paying firms and the low-paying firms of more than 10% is large enough to move the average firm from the median to the 75th percentile in terms of wage payments.²⁶ Thus, the results suggest that the arrival of *Walmex* may lead to economically large skill upgrading among its suppliers. Looking at Figure 6, lower-right panel, confirms that there are systematic and significant differences in responses towards *Walmex* across firms.

Imported Intermediate Inputs In addition to the skill composition of the labor force, another important dimension of firm upgrading is often the quality of intermediate goods that it employs. Indeed, we were told by several interviewees that using better inputs is an easy way of upgrading product quality. While we do not have direct information on the quality of intermediates, we do know the fraction of intermediates 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.

From Table 3, first column, as well as Figure 7, upper-left panel, we see that the arrival of *Walmex* raises the share of imported intermediates for the highly importing firms by much more than for the other firms. Since these are typically the firms producing higher quality goods, they will be more likely to sell through *Walmex* than other firms. Thus we find that the arrival of *Walmex* also intensifies the sorting of firms in terms of intermediate goods upgrading.

We also note that while generally the US and Mexican tariff rates do not have a large impact on the

²⁶We focus on the difference between the β_3^q across quintiles because the industry and time fixed effects eliminate the overall trends in wage payments.

left hand side variables, intermediate input imports are naturally affected by tariff rates. Specifically, high Mexican tariff rates are associated with lower intermediate imports, although firms that import a sizable share of their inputs are relatively less affected by that. We also find that Mexican firms that import 50 or more percent (in the 80th quintile, see Table 1) of their intermediates have a strongly declining imported inputs share as U.S. tariffs go up.

Capital investments We now turn to our capital investments as our final measure of upgrading. 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 often leads to improvements for example by reducing downtimes of the equipment.

The pattern of capital investment predicted by the model is quite similar to that for technology investments, see Figure 5, lower-left panel: the arrival of *Walmex* means large firms (in terms of investment) raise their investment while smaller firms tend to lower their that capital investment. More generally, *Walmex* entry makes investment more sensitive to heterogeneity in terms of firm quality. Our quantile regression results in Table 3 and Figure 7 confirm these predictions. In particular, firms in the 80th quintile invest more than other firms. Moreover, investment of the firms that are located around the quality threshold determining which firms sell through *Walmex*—the 40th quintile— falls especially sharply, in line with the investment response predicted by the model (see Figure 5, lower left).

We now turn to analyzing firm productivity.

4.2.3 *Walmex* and firm productivity

Innovating and upgrading activity is likely to translate into different productivities. In the model, firms decide on technology investments towards product quality improvements, which stochastically raises firm productivity. In this section we examine whether the arrival of *Walmex* impacts labor

productivity of Mexican firms.

In Table 3 we report the results of estimating (7) with labor productivity as the left hand side variable (third column). As before, the parameter of key interest is β_3^q , measuring the differential effect of changes in the regional presence of *Walmex* for firms that do, and do not supply a *Wal-Mart* type good. We see that productivity at the top end increases with a coefficient of about 13% (80th percentile), while at the low end productivity stays unchanged or actually declines (-2.7%, standard error of 2.1% for the 20th percentile). Also for firms with moderately high productivity a stronger presence of *Walmex* is associated with higher productivity, with a β_3 of about 6% at the 60th percentile. Figure 7 shows the resulting monotonic pattern of productivity effects across quintiles. These results indicate that the arrival of *Walmex* triggers firm choices that reinforce the productivity differences that existed before.²⁷

Finally, we analyze how the firms' price setting changes with the increased presence of *Walmex*.

4.2.4 *Walmex* and prices

As our measure of firm price, we use the establishment-level price index we constructed from information on unit values of the individual products each establishment sells in Mexico. The price index for each producer is normalized to 100 for 1994, and growth rates in prices are thereafter constructed using the products that were sold both at time t and $t - 1$. Changes in prices are weighted by the share of the product sales in the establishment's total sales.

The model predicts that conditional on product quality, the entry of *Walmex* leads to a relative decline in the price of firms that sell through *Walmex* (see Figure 5, upper-left panel). Moreover, this decline in the quality-adjusted price is particularly strong for firms that are just above the quality

²⁷We have also extended these results by looking at multi-factor instead of labor productivity (not reported). The multi-factor productivity results follow the same pattern—high productivity firms gain relatively more— though the differences are not as large as for labor productivity. This may be driven by the result that firms that are good candidates to sell through *Walmex* are also making larger capital investments, as shown above.

threshold. How do these predictions compare with the evidence from quantile regressions? In Table 3 and Figure 7, we show quantile regression results for firm price as the dependent variable in equation (7).²⁸ The influence of *Walmex* on low-price firms (at the 20th percentile) is around 3%, albeit it is rather imprecisely estimated, and one cannot rule out that the response at the 20th and 80th percentile is the same (Table 3, column 4, bottom). In contrast, firms with intermediate product qualities lower their prices relatively. This is particularly the case for firms that charge a moderately low price (at the 40th percentile). Thus, the overall response of Mexican firms to an increasing presence of *Walmex* looks strikingly similar to what the model predicts.

To sum up, there is strong evidence that the response of Mexican manufacturing firms to the increased presence of *Wal-Mart* is captured very well by our model. The arrival of a dominant retailer bi-sects the distribution of supplying firms and leads to drastically different adjustments for several key firm choices. More generally, the results indicate that focusing on the response of the mean (or median) establishment would be grossly misleading, because it flies in the face of considerable heterogeneity across establishments as to how *Walmex* affects their economic prospects.

²⁸These results do not include time fixed effects. The indexing of prices (the value of 100 in the year 1994 for all firms) means that time fixed effects in addition to industry fixed effects would eliminate most of the variation in the data.

5 Summary

This paper studies the effects of Wal-Mart's entry into Mexico on upstream suppliers of merchandise and food. Testable predictions are developed using a dynamic industry model in which the firms that do not exit firms choose how much to invest in innovation and whether to sell their products through *Walmex*. In making the latter decision, they weigh the benefits of increased access to consumers against the constraints that *Walmex* places on their pricing and product quality. Simulations of the model show that firms producing high-quality products should react differently from others to the arrival of *Walmex*. At the industry-level, the model predicts that productivity and the rate of innovation may increase, in part because of firm exits. These simulations accord well with results of firm interviews conducted in Mexico and with the results of quantile regression based on information of Mexican firms.

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Table 1: Summary Statistics

Outcome variables (LHS variables)

Variable	mean	sd	p5	p10	p25	p50	p75	p90	p95	N
Price	5.12	0.44	4.62	4.62	4.62	5.12	5.48	5.71	5.85	40073
Labor productivity	4.23	1.07	2.64	3.07	3.64	4.22	4.84	5.51	5.94	53672
Average wage	3.12	0.64	2.13	2.36	2.73	3.12	3.51	3.92	4.18	54552
Skill intensity	0.31	0.20	0.06	0.09	0.16	0.26	0.41	0.58	0.73	48896
Investment	3.58	3.43	0.00	0.00	0.00	3.74	6.47	8.22	9.14	52795
Imported inputs (%)	19.32	28.54	0.00	0.00	0.00	0.34	32.65	69.36	84.35	52586
R&D spending	0.57	1.69	0.00	0.00	0.00	0.00	0.00	2.58	5.13	51310
Domestic sales	9.55	1.73	6.75	7.40	8.43	9.56	10.72	11.77	12.36	52861

All variables except for Skill intensity and imported input share are in logs

Right-hand side variables corresponding to the regression with LHS = Average wage

Variable	mean	sd	p5	p10	p25	p50	p75	p90	p95	N
ln(#WalMartStores) x WalMartProd	0.37	0.99	0.00	0.00	0.00	0.00	0.00	1.61	3.37	54552
ln(#WalMartStores)	2.53	1.40	0.00	0.69	1.39	2.56	3.81	4.32	4.39	54552
WalMartProduct	0.17	0.38	0.00	0.00	0.00	0.00	0.00	1.00	1.00	54552
TAR US	2.02	3.16	0.00	0.00	0.00	0.38	3.53	6.21	8.14	54552
TAR MEX	6.14	7.02	0.00	0.20	1.16	4.22	8.84	14.46	18.00	54552
ln (GDP)	18.19	0.99	16.58	16.77	17.48	18.24	18.86	19.51	19.60	54552
ln(GDP) x WalMartProd	3.12	6.81	0.00	0.00	0.00	0.00	0.00	17.67	18.55	54552

Table 2: Sales, R&D, and Skill of the Labor Force

	Domestic sales	R&D spending	Skill intensity	Wage
<i>20th Quintile</i>				
In(#WalMartStores)	0.159*** (0.014)	-0.027*** (0.009)	0.009*** (0.002)	0.049*** (0.006)
WalMartProduct	-5.264*** (0.871)	0.441* (0.262)	0.081 (0.088)	-0.882*** (0.334)
In(#WalmartStores) x WalMartProd	-0.214*** (0.038)	0.019 (0.013)	-0.009** (0.005)	-0.049*** (0.011)
In (GDP)	-0.247*** (0.020)	0.027** (0.012)	-0.012*** (0.002)	-0.033*** (0.009)
In(GDP) x WalMartProd	0.316*** (0.053)	-0.039** (0.016)	-0.005 (0.005)	0.055*** (0.020)
<i>40th Quintile</i>				
In(#WalMartStores)	0.101*** (0.012)	0.012*** (0.004)	0.015*** (0.001)	0.048*** (0.005)
WalMartProduct	-2.582** (1.020)	-0.693*** (0.269)	-0.140* (0.074)	-0.720*** (0.214)
In(#WalmartStores) x WalMartProd	-0.066 (0.043)	-0.048*** (0.012)	-0.013*** (0.004)	-0.032*** (0.010)
In (GDP)	-0.175*** (0.018)	-0.016*** (0.006)	-0.014*** (0.002)	-0.029*** (0.006)
In(GDP) x WalMartProd	0.151** (0.061)	0.033** (0.016)	0.009** (0.005)	0.044*** (0.013)
<i>60th Quintile</i>				
In(#WalMartStores)	0.097*** (0.017)	0.014*** (0.004)	0.022*** (0.002)	0.032*** (0.005)
WalMartProduct	-1.073 (0.962)	-1.110*** (0.302)	-0.006 (0.113)	-0.283 (0.207)
In(#WalmartStores) x WalMartProd	-0.007 (0.035)	-0.073*** (0.016)	-0.004 (0.005)	0.007 (0.009)
In (GDP)	-0.122*** (0.026)	-0.024*** (0.005)	-0.018*** (0.003)	-0.008 (0.008)
In(GDP) x WalMartProd	0.062 (0.058)	0.062*** (0.019)	0.001 (0.007)	0.015 (0.013)
<i>80th Quintile</i>				
In(#WalMartStores)	0.089*** (0.015)	0.000 (0.001)	0.027*** (0.003)	0.017** (0.007)
WalMartProduct	-1.122 (0.968)	0.000 (0.103)	0.210 (0.149)	0.578*** (0.183)
In(#WalmartStores) x WalMartProd	0.072* (0.042)	0.000 (0.013)	0.020*** (0.006)	0.059*** (0.010)
In (GDP)	-0.100*** (0.023)	0.000 (0.001)	-0.019*** (0.004)	0.019* (0.011)
In(GDP) x WalMartProd	0.059 (0.059)	0.000 (0.006)	-0.012 (0.009)	-0.038*** (0.011)
No. of obs.	52861	51310	48896	54552
<i>Tests of cross-quintile parameter equality on In(#WalMartStores) x WalMartProduct: p-values</i>				
20th vs 80th	0.00	0.24	0.00	0.00
20th vs 60th	0.00	0.00	0.30	0.00
20th vs 40th	0.00	0.00	0.14	0.05
40th vs 80th	0.00	0.00	0.00	0.00
40th vs 60th	0.06	0.50	0.03	0.00
60th vs 80th	0.02	0.00	0.00	0.00

All specifications include year fixed effects and a constant, as well as Mexican and US tariff rates (coeff's not reported)
Notes: we dropped cases of domestic sales ==0

Table 3: Intermediate Inputs, Investment, Productivity and Pricing

	Imported intermediates	Capital investment	Labor productivity	Price
<i>20th Quintile</i>				
In(#WalmartStores)	-1.098*** (0.229)	0.098*** (0.023)	0.055*** (0.008)	-0.032*** (0.008)
WalMartProduct	-34.605*** (12.305)	-3.542** (1.719)	-0.012 (0.417)	0.155 (0.240)
In(#WalmartStores) x WalMartProd	-2.478*** (0.488)	-0.191** (0.093)	-0.027 (0.021)	0.030*** (0.012)
In (GDP)	0.377 (0.320)	-0.185*** (0.031)	-0.067*** (0.012)	0.011 (0.009)
In(GDP) x WalMartProd	2.314*** (0.745)	0.187* (0.108)	-0.003 (0.026)	-0.011 (0.015)
<i>40th Quintile</i>				
In(#WalmartStores)	-0.638*** (0.192)	0.294*** (0.045)	0.038*** (0.008)	-0.006*** (0.001)
WalMartProduct	-24.366*** (3.682)	-10.502*** (2.342)	0.432 (0.269)	0.083* (0.045)
In(#WalmartStores) x WalMartProd	-0.541** (0.247)	-0.534*** (0.109)	0.008 (0.011)	0.004** (0.002)
In (GDP)	-0.925*** (0.227)	-0.502*** (0.068)	-0.050*** (0.011)	0.005*** (0.002)
In(GDP) x WalMartProd	1.638*** (0.223)	0.660*** (0.143)	-0.029* (0.016)	-0.005* (0.003)
<i>60th Quintile</i>				
In(#WalmartStores)	-0.248*** (0.085)	0.176*** (0.037)	0.033*** (0.009)	0.001 (0.003)
WalMartProduct	-28.443*** (2.171)	-2.516* (1.519)	0.896*** (0.210)	0.369*** (0.082)
In(#WalmartStores) x WalMartProd	-0.759*** (0.106)	-0.123* (0.069)	0.062*** (0.013)	0.016*** (0.004)
In (GDP)	-0.528*** (0.109)	-0.337*** (0.058)	-0.054*** (0.011)	-0.002 (0.004)
In(GDP) x WalMartProd	1.702*** (0.129)	0.160* (0.092)	-0.057*** (0.012)	-0.022*** (0.005)
<i>80th Quintile</i>				
In(#WalmartStores)	-0.422 (0.594)	0.134*** (0.034)	0.022** (0.010)	-0.009 (0.005)
WalMartProduct	-37.044** (15.889)	-1.774 (1.872)	1.693*** (0.403)	0.786*** (0.139)
In(#WalmartStores) x WalMartProd	1.591** (0.628)	0.062 (0.082)	0.127*** (0.023)	0.027*** (0.006)
In (GDP)	-0.558 (0.819)	-0.328*** (0.053)	-0.034** (0.016)	0.023*** (0.007)
In(GDP) x WalMartProd	1.410 (0.949)	0.090 (0.113)	-0.105*** (0.025)	-0.047*** (0.008)
No. of obs.	52586	52795	53672	40073

Tests of cross-quintile parameter equality on In(#WalmartStores) x WalMartProduct: p-values

20th vs 80th	0.00	0.01	0.00	0.77
20th vs 60th	0.00	0.53	0.00	0.17
20th vs 40th	0.00	0.00	0.11	0.02
40th vs 80th	0.00	0.00	0.00	0.00
40th vs 60th	0.36	0.00	0.00	0.00
60th vs 80th	0.00	0.00	0.00	0.06

All specifications include Mexican and US tariff rates, and columns 1-3 also time fixed effects (coeff's not reported)

Notes: we dropped cases of domestic sales ==0

FIGURE 1

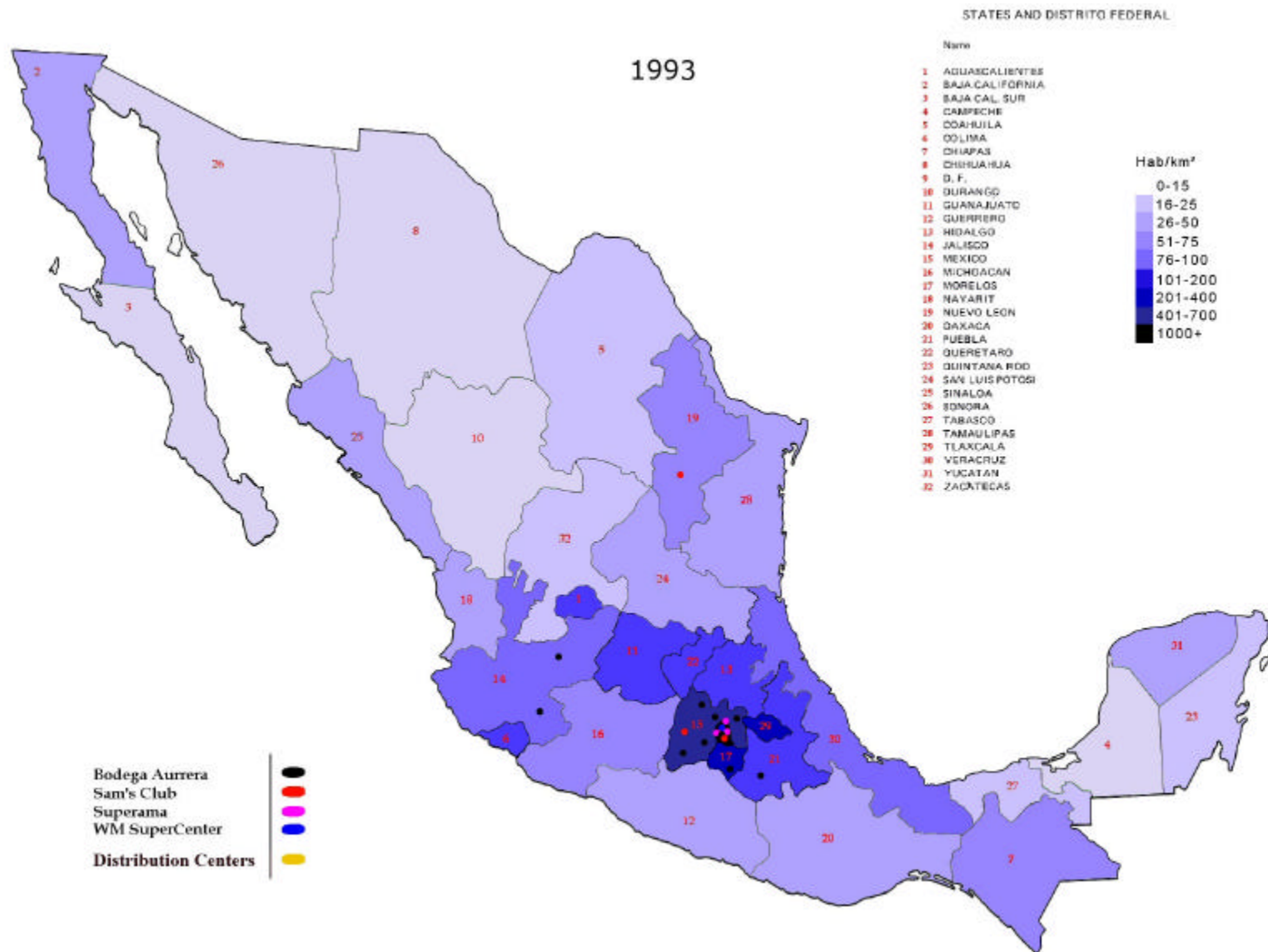


FIGURE 2

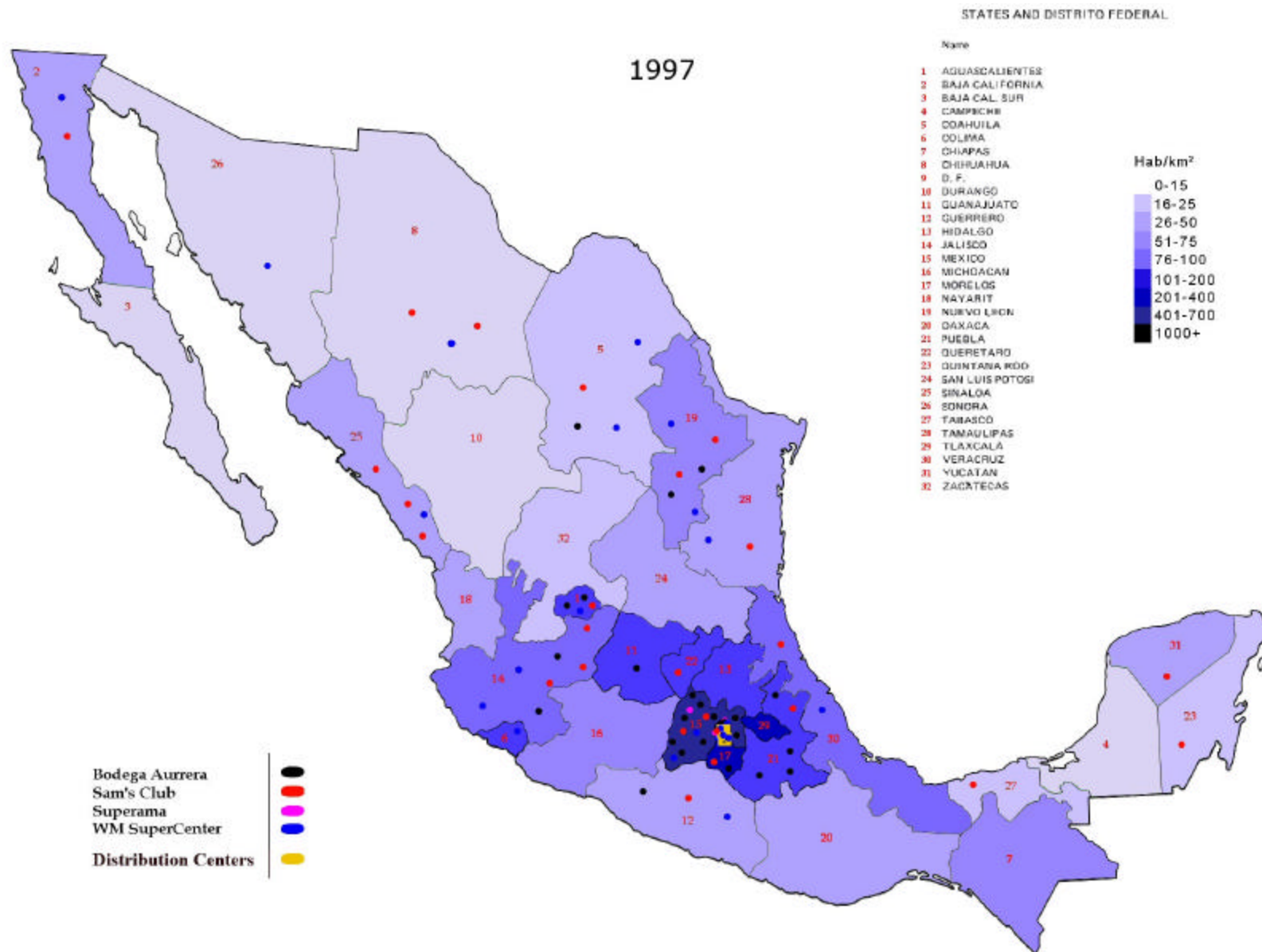


FIGURE 3

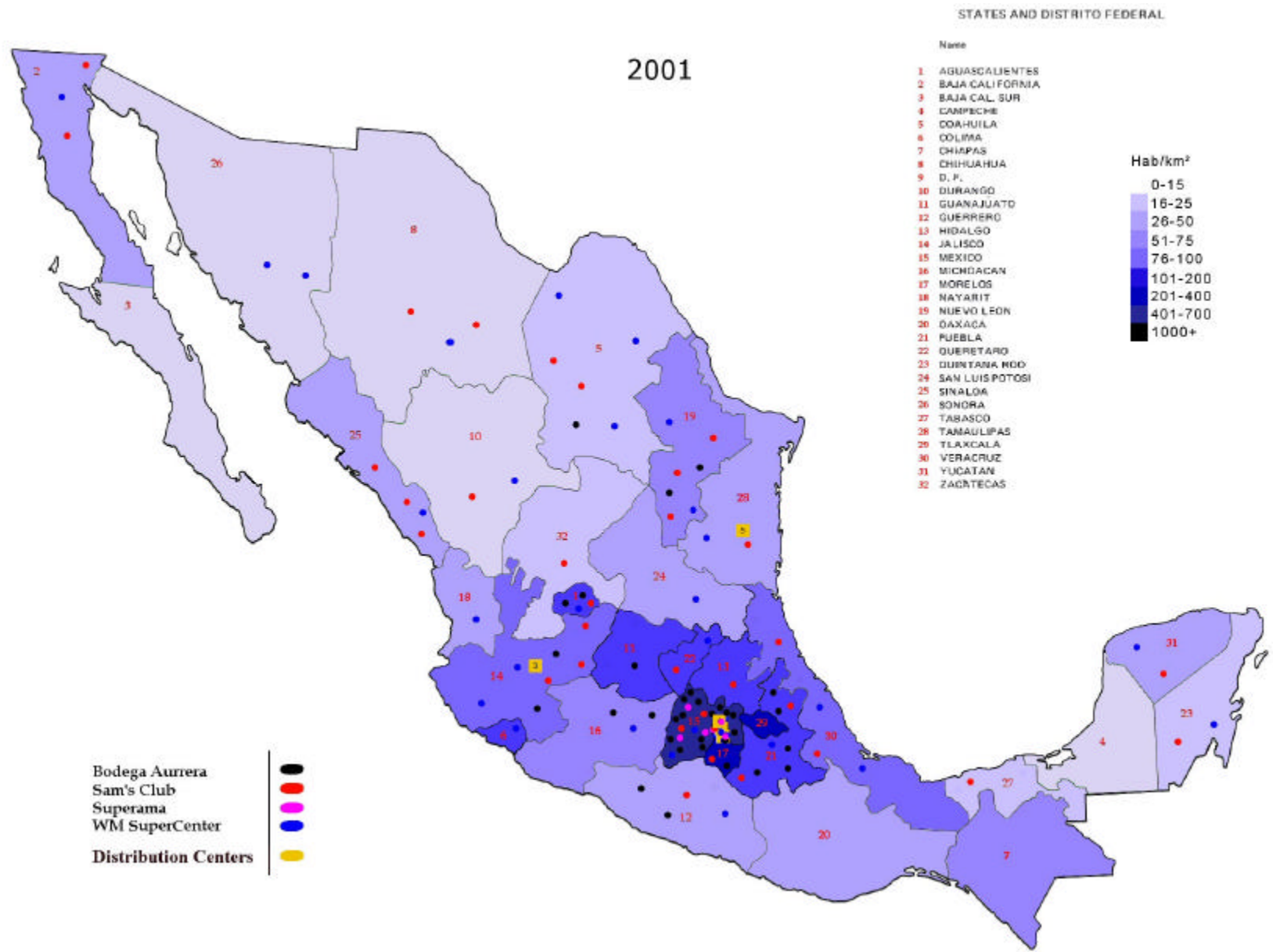


FIGURE 4

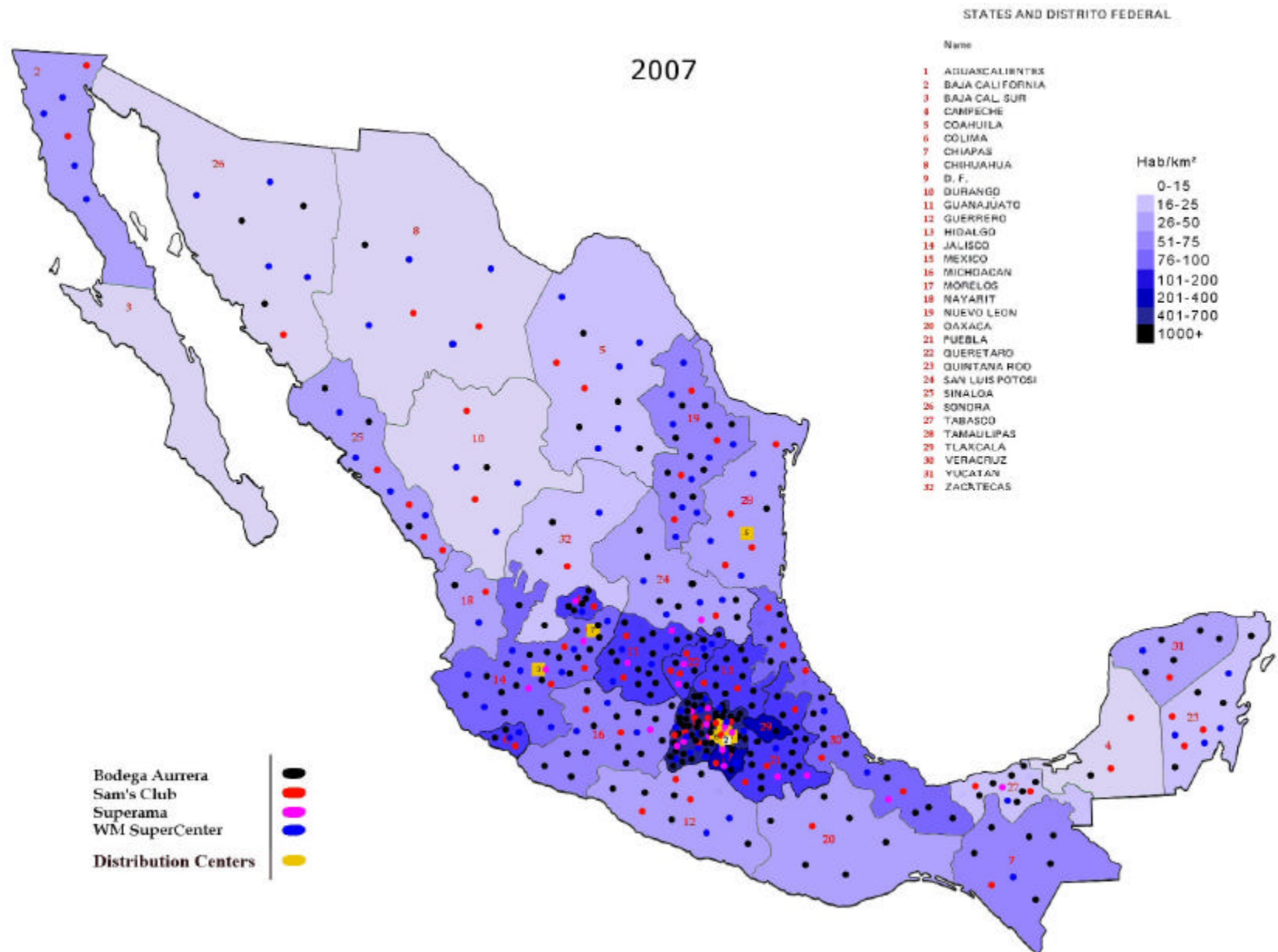


Figure 5: Model Simulations

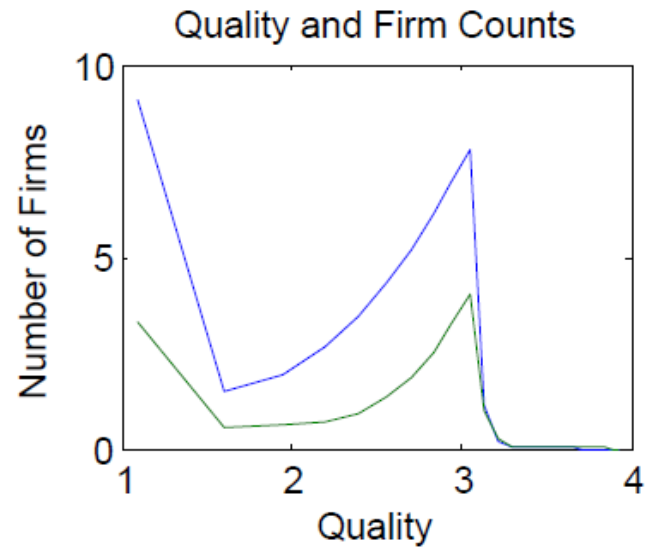
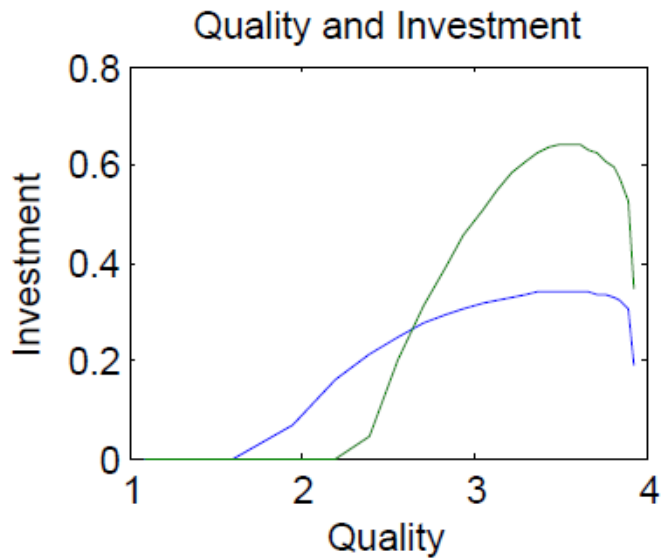
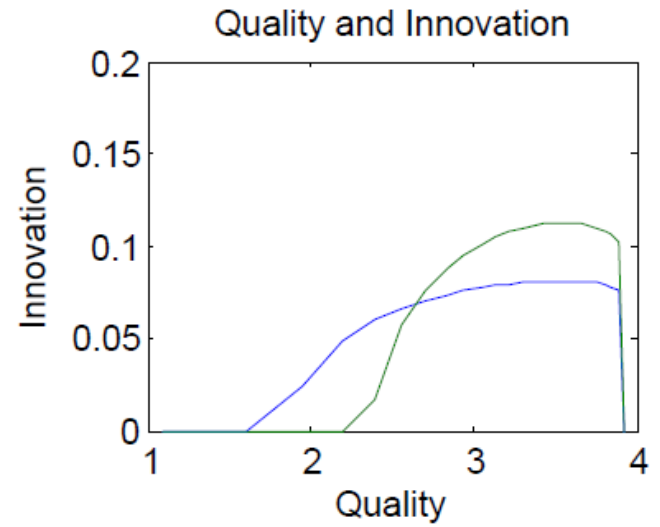
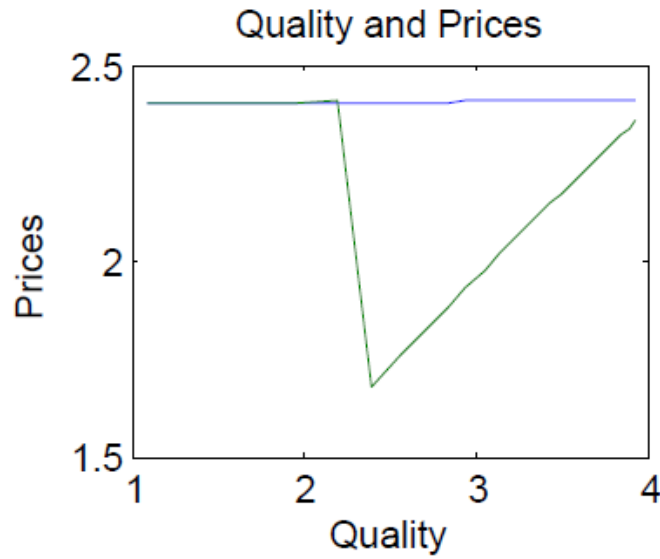


Figure 6

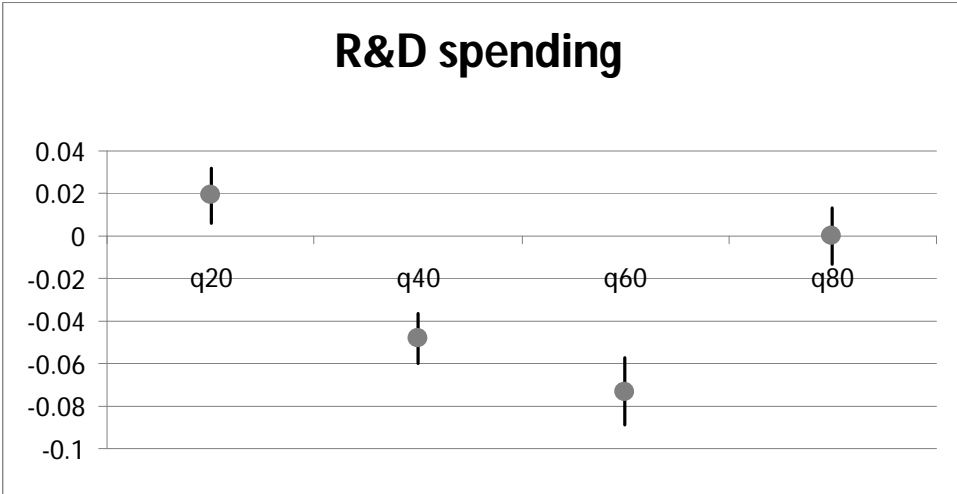
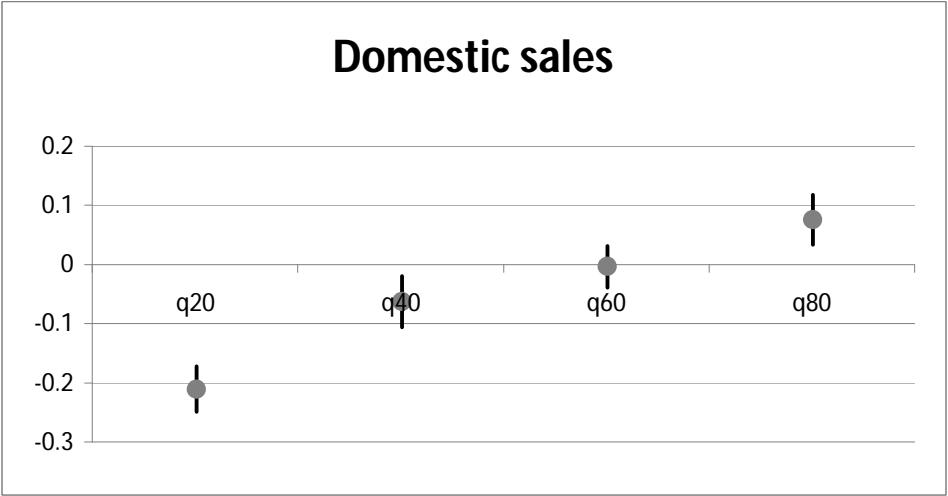


Figure 7

