NBER WORKING PAPER SERIES

SUPPLIER RESPONSES TO WAL-MART'S INVASION OF MEXICO

Leonardo Iacovone
Beata Smarzynska Javorcik
Wolfgang Keller
James R. Tybout

Working Paper 17204
http://www.nber.org/papers/w17204

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 2011

We thank Andy Bernard, Jan De Loecker and the audiences at the 2008 LACEA, the 2009 NBER Spring Productivity Meeting, and the 2009 Princeton Summer Trade Conference for comments and suggestions. 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 National Bureau of Economic Research, the World Bank, its Executive Directors or the countries they represent.

NBER working papers are circulated for discussion and comment purposes. They have not been peer-reviewed or been subject to the review by the NBER Board of Directors that accompanies official NBER publications.

© 2011 by Leonardo Iacovone, Beata Smarzynska Javorcik, Wolfgang Keller, and James R. Tybout. All rights reserved. Short sections of text, not to exceed two paragraphs, may be quoted without explicit permission provided that full credit, including © notice, is given to the source.

Supplier Responses to Wal-Mart's Invasion of Mexico
Leonardo Iacovone, Beata Smarzynska Javorcik, Wolfgang Keller, and James R. Tybout
NBER Working Paper No. 17204
July 2011
JEL No. F23,L1,O33

ABSTRACT

This paper examines the effect of Wal-Mart'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 Wal-Mart's entry, we develop 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 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 regions with differing levels of Walmex presence during the years 1994 to 2002.

Leonardo Iacovone
1818 H St, NW, Mail-stop J8-808
Private and Financial Sector Development
Africa Region, The World Bank
1818 H St, NW, Mail-stop J8-808
Washington, DC 20433
Liacovone@worldbank.org

Beata Smarzynska Javorcik
University of Oxford
beata.javorcik@economics.ox.ac.uk

Wolfgang Keller
Department of Economics
Fisher Hall
Princeton University
Princeton, NJ 08544
and University of Colorado
and also NBER
Wolfgang.Keller@colorado.edu

James R. Tybout
Department of Economics
Penn State University
517 Kern Graduate Building
University Park, PA 16802
and NBER
jtybout@psu.edu

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 ascendence on Mexico's manufacturers of consumer goods. After summarizing the ways in which Walmex changed the retail market, we formalize the effects of these changes on consumer good suppliers using an industrial evolution model that builds on Ericson and Pakes (1995) and Weintraub et al (2008). Its key distinctive feature is that heterogeneous producers can choose each period whether to sell their output through *Walmex* or traditional retailers. Those that opt for *Walmex* reach a larger consumer base, but they must accept *Walmex*'s pricing schedule, and this generally leads to lower mark-ups.

Importantly, our modeling exercise was informed by a series of interviews on the impact of *Wal-Mart*'s FDI that we conducted with Mexican firm representatives and industry experts.[2] Those interviewed frequently mentioned that *Walmex*'s 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.

Simulations of our model show that it delivers exactly these predictions. The availability of a

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

[2] We 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).

Walmex option can cause producers to self-select into two groups on the basis of their product's appeal to consumers. Firms that enter the current period offering high-appeal 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 end of the product appeal distribution, while others scale back their investments. In addition, firms that switch to *Walmex* see their prices and mark-ups fall, especially those producing moderate- as opposed to high-appeal goods. And finally, high-appeal firms gain market share when the *Walmex* option arrives, while low-appeal firms contract or exit entirely.

While we lack the data necessary to estimate the structural parameters of our model, we show it is consistent with the observed behavior of Mexican producers during the *Walmex* expansion period 1994 through 2002. Specifically, using plant-level panel data obtained from the Mexican Statistical Office (INEGI), we find the predicted adjustments in size distributions, productivity distributions, investment, and innovative activity occurred exactly where one would expect them: among producers who both (1) produced the types of goods sold at *Walmex and* (2) were located in regions where *Walmex* established a presence. These results are based on an estimator that treats the local presence of both *Walmex* and non-*Walmex* retailers as endogenously determined.

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

[3] See 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 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 (2011) 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.

(FDI) on host country firms.[5] To the analysis of the reduced-form effect of FDI that is typical in this literature, our approach adds a dynamic structural model that describes the nature of the linkages between *Wal-Mart* and its upstream suppliers and also characterizes firms' behavior in key dimensions such as sales, upgrading, and productivity.[6] Third, our work adds to the heterogenous firm literature by describing a new way in which changes in the business environment lead to dramatically different responses by firms with different productvity levels or product appeal.[7] And finally, 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 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 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

[5]Surveys of the literature include Keller (2010), Lipsey and Sjoholm (2005), as well as Görg and Greenway (2004).

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

[7]In 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, and Iacovone, Keller, and Rauch 2011).

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

> innovations that *Walmex* imported from the United States. *Walmex* not only introduced 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 similar

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

organizational changes in their relationships with suppliers such as centralized warehousing and the use of palettes.

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 partially diffused 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 —

[10] RPCs 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.

[11] According 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 them on to the suppliers of discounted goods.

especially short term working capital-for small and medium-size enterprises.(Klapper 2006)

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. Figure 1 shows the location of various formats of *Wal-Mart* shops in the year 1993 across the thirty-two Mexican states. Since differences in demand play a key role for *Wal-Mart*'s expansion, we have shaded the states 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 Aurreras*, 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.

[12] We 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, 2011). 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 states of Mexico throughout the period of 1993 to 2007. Finally, note that the establishment of distribution centers has generally followed the opening of stores. Thus the distribution centers have tended to reinforce the effects of the stores on local suppliers' access to *Walmex*'s consumer base.

We will exploit these expansion patterns when we test for the effects of *Walmex* on consumer goods suppliers in Section 4. 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 moves goods to a very large customer base makes it very attractive to producers. However, this is tempered by the price concessions per unit of product appeal (or quality) of the product 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

[13] This assertion is based on our interviews with executives.

its large consumer base allows its suppliers to reap scale economies and argues that this justifies the lower wholesale prices it demands. And, as mentioned earlier, *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.

The ability of *Walmex* to demand increases in quality of the goods, relative to its price, 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 trucks which they use to distribute their products nationwide, smaller producers are usually unable to bear the cost of product distribution 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 the larger market size versus the lower quality-adjusted price they receive when deciding whether to use *Walmex* as a retailer.

The presence of *Walmex* also 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 from one year to the next that kick in when producers do not upgrade their product. 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 reaps the benefits of a cost-reducing innovation.

We now turn to describing a formal model of these interactions.

3.2 A Model of *Walmex*' Upstream Industry

Drawing on Pakes and McGuire (1994), Pakes and Ericson (1995), and Weintraub, Benkard and van Roy (2008), 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 (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.

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 project. 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:

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

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 unobserved idiosyncratic features of consumer i. The parameter β_w is positive because products available at *Walmex* are relatively 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

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

where:

[14] 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.

[15] Holmes (2011) also uses a logit specification, but makes the opposite assumption that consumers lose satisfication by shopping at *Wal-Mart* rather than other retailers.

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

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

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

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

We make several assumptions at this point to keep the model tractable. 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 $\overline{P}_j$—depends upon ξ_j according to:

$$\overline{P}_j = P_0 + \theta_3 \ln(\xi_j), \ \theta_3 > 0. \tag{4}$$

This specification implies that the improvements in product quality ease *Walmex's* price ceiling, while reductions in quality relative to the outside good force firms 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: $\xi_j \geq \overline{\xi} \ \forall j \in \mathbf{W}^1$, where $\mathbf{W}^1 = \{j | w_j = 1, j \in \mathbf{I}\}$ is the set of suppliers who do business with *Walmex*.

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 $\overline{\mathbf{P}}^1 = \{\overline{P}_j|j \in \mathbf{W}^1\}$. The associated profits for the j^{th} non-*Walmex* firm are

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

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, and h_j^0 is the share function (2) evaluated at $\mathbf{P} = \overline{\mathbf{P}}^1 \cup \mathbf{P}^0$, $\boldsymbol{\xi}$, and $\mathbf{w}$.[16] 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:

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

where h_j^1 is given by (2) evaluated at the same $\mathbf{w}_{-j}$ and $\boldsymbol{\xi}$, but at the equilibrium price vector that would obtain if firm j were to switch to *Walmex*. 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:

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

[16] 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.

While multiple equilibria may exist, we limit our attention to equilibria in which all firms above some quality 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 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 entrerpreneurs 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 comparisions 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 $\left\{\xi^1, ..., \xi^K\right\}$, $\xi^i < \xi^{i+1}\ \forall i \in I^+$, 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:

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

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 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} quality level. Similarly, let $\mathbf{s}_{-j}$ be the same vector, except in that it leaves firm j out of the count.[17] Then firm j chooses its R&D level to solve:

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

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

[17] 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.

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. (2008).[18]

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

3.2.4 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. Then, by comparing simulated equilibria under two polar cases—complete access to Walmex and zero access to Walmex—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

[18] 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.

Table 1: Parameters used for Simulation

Parameter	Parameter determines	Value
C	Marginal costs	1.5
β_w	*Walmex* boost	1.0
$\overline{\xi}$	Minimum *Walmex* appeal	2.0
θ_3	Product appeal-price relationship	0.4

occurred in regions where *Walmex*'s presence has grown.

3.3 Model Simulations

To generate our simulation experiments, we adapt Weintraub et al's (2010) code to accomodate profit functions with endogenous retailer choice.[19] The key parameter values we use are reported in Table 1 and the simulation results are summarized in Figure 5.

The first (upper-left) panel of this figure 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).[20] When the option to sell through *Walmex* is offered to firms, the lower quality (or appeal) 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 product 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 product 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 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* equilbrium. To the

[19] For details on the equilibrium concept and solution algorithm, the reader is referred to Weintraub et al. (2007).

[20] The 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.

contrary, 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 to 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.

Once the quality level rises above about 2.5, firms–all of whom retail through *Walmex*–innovate more than they did in the absence of *Walmex* (Figure 5, top right). The accompanying increase in product quality (see equation 5) together with the price setting in the presence of *Walmex* implies a lower quality-adjusted price, and therefore higher sales (see equation 1). In contrast, low-quality firms, which do not sell through Walmex and also do not upgrade their product, will tend to experience lower sales because their quality-adjusted price increased. Our model therefore predicts a reallocation of market shares from low- to high-quality firms.

The model predicts for capital investment a pattern similar to the one we have found for innovation (Figure 5, lower left): firms that decide to retail through Walmex choose higher investment rates than firms that stick with traditional retailers. More generally, in a model with multiple dimensions of innovation (product, process, organizational, etc) it is reasonable to believe that firms that choose to sell through *Walmex* will generally do more of all of these things compared to firms that decide not to go through *Walmex*. We therefore expect that productivity gains after *Walmex* entry will be concentrated among firms that decide to sell through *Walmex*.

The final panel of Figure 5 shows that, although *Walmex* increases industry-wide sales by making products more accessible and lowering their prices relative to product appeal, it reduces the number of suppliers. It is a consequence of the fact that firms at all but the highest appeal 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-appeal 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 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"*.[21] 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).

[21] 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.

Our sample includes 6,867 plants spread across 205 classes of activity. 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. 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 for examining 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. We use the EIM data for the period 1994-2002 covering the same 205 *clases*. The principal difference with EIA is its periodicity, its data content (it records the physical 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. 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.

We combine the plant-level data with time series information on the number and floor space of

Walmex stores in each Mexican state. To construct our measure of access to *Walmex*, we express *Walmex* floor space in each state as a share of total retailer floor space, which we obtained from the *Asociacion Nacional Tiendas de Autoservicio y Departamentales* (ANTAD).[22] In this calculation, the floor space of all four of *Walmex* relevant store formats in Mexico (*Wal-Mart Supercenters, Bodegas Aurrera, Sam's,* and *Superamas*) are combined. Data are missing for some years, in part because *Walmex* did not participate in the industry association ANTAD in all years. We have estimated the missing floor space data based on the number of *Walmex* stores by state, using information that was provided to us by *Walmex* itself. Details can be found in Appendix 1.

In the following we discuss the empirical approach of this section.

4.2 Empirical strategy

To examine whether the model gives a good description of producers' reactions to *Walmex*, we estimate a series of reduced form regressions. These regressions relate the cross-establishment distributions of variables such as sales and R&D to the presence of *Walmex* and non-*Walmex* retailing opportunities. *Walmex* effects on local industry structures are identified by differences in differences. The first dimension in which we distinguish establishments is their product type: we contrast those 6-digit industrial clasifications that include goods carried by *Walmex* with those that do not. The other 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.

In principle, proximity to a *Walmex* distribution center should give a supplier access to *Walmex's* national consumer base. However, proximity to *Walmex*'s retail stores should improve access for several reasons. First, producers located close to *Walmex* stores are likely to be better informed about the goods *Walmex* carries and the supplier-buyer relationships it offers. Second, our interviews

[22] Non-*Walmex* retailers here include Mexican-owned stores as well as other foreign-owned chains such as *Carrefour* and *HEB*. We are grateful to Mauricio Varela for help with these data.

with *Walmex* executives, Mexican firms, and industry experts suggest that *Walmex* makes an effort to source from local producers. 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.

4.2.1 Relating *Walmex* presence to industry structure

We are interested in whether producers with different levels of product appeal respond to *Walmex*'s presence differently, as implied by our model. To this end we sort our sample of Mexican suppliers into quartiles $q \in \{1,2,3,4\}$ based on their initial sales levels, since our model implies that sales are monotonic with product appeal, ξ.[23] Differential responses can then be gauged using estimates of:

$$\left(Y_{it} - \overline{Y}_{j(i)t}\right) = \beta_1^{q(i)} W\_G_i + \beta_2^{q(i)} (W\_G_i \times S\_W_{j(i)t}) + \beta_3^{q(i)} S\_W_{j(i)t} + \beta_4^{q(i)} TAR_{j(i)t}^{US} + \beta_5^{q(i)} TAR_{j(i)t}^{MEX} + \beta_6^{q(i)} \ln GDP_{j(i)t} + \beta_7^{q(i)} \left(WG_i \times \ln GDP_{j(i)t}\right) + \alpha_t^{q(i)} + \mu_{j(i)}^{q(i)} + \varepsilon_{it}, \tag{7}$$

where the superscript $q(i)$ allows parameters to vary with establishment i's size quartile, and 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.

The two key explanatory variables in this regression are W_G_i, a dummy identifying establishments whose 6-digit product categories are found at *Walmex* stores, and $S\_W_{j(i)t}$, *Walmex*'s share of the retail market in establishment i's region, $j(i)$.[24] The interaction term $W\_G_i \times S\_W_{j(i)t}$ measures the effect of *Walmex*'s regional presence on producers who supply the type of goods carried by *Walmex* versus other types of producers, and comparisons of β_2^q across size quantiles indicate how the

[23] Quartile cut-offs are specific to firms' 4-digit industries. To avoid simultaneity problems, we do not let quartile assignments vary over time for a given establishment. Firms are assigned to a quartile based on their position in the sales distribution in 1994. INEGI did not make an effort to systematically record firm entry, so our data set does not include new entrants.

[24] To construct W_G, we classify goods on the basis of information available on *Walmex*'s website, store visits, and industry analysis.

responses of producers in these product categories depend upon product appeal.

The remaining variables are controls: GDP_{st} is the log of the gross domestic product of the establishment's state, and $TAR_{j(i)t}^{MEX}$ and $TAR_{j(i)t}^{US}$ are Mexican and U.S. nominal tariff rates, respectively, in the establishment's 6-digit industry.[25] These latter variables are included to capture changes in the degree of competition that were brought about by the NAFTA liberalizations. Finally, we include time effects, α_t^q, which capture nationwide changes in market conditions that affect all establishments in the quartile equally.

4.2.2 Endogeneity of *Walmex* expansion patterns

When *Walmex* first entered Mexico, its store locations were predetermined by the existing retail outlets of its joint venture partner, *Bodegas Aurrera*. But thereafter *Walmex* was free to choose the location of new stores, and those soon accounted for most of *Wal-Mart*'s floor space in Mexico. As Figures 1 to 4 show, while *Walmex* expanded beyond the Mexico City area, some areas were clearly served earlier and more densely than others. For example, despite its relative proximity to the capital, the state of Oaxaca saw its first *Walmex* only in the year 2002 (Figure 4).

Since *Walmex* expansion patterns have almost surely responded to local economic conditions, and these conditions are not completely captured by regional *GDP* figures, we treat *Walmex*'s market shares as endogenous when estimating (7). To do so, we think of Walmex as playing a Markov-perfect game in floor space choices with local retailers, region by region. Then we approximate the policy functions of Walmex and the rival retailers (treated as a single firm) as reduced-form functions of the characteristics of the local economy. Specifically, we express the log of current *Walmex* floorspace in state j ($\ln FW_{jt}$) as a function of the log of lagged *Walmex* floorspace, the log of lagged non-*Walmex* retail floorspace in the same state ($\ln NFW_{jt-1}$), recent size of the regional economy

[25] 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

$(\ln GDP_{jt-1}, \ln GDP_{jt-2})$, state effects, and country-wide time effects.[26] Also, reversing the roles of $\ln FW_{jt}$ and NFW_{jt},we obtain an analogous equation to characterize the floorspace of non-*Walmex* retailers:

$$
\begin{aligned}
\ln FW_{jt} &= \gamma_1 \ln FW_{jt-1} + \gamma_2 \ln FNW_{jt-1} \\
&\quad + \gamma_3 \ln GDP_{jt-1} + \gamma_4 \ln GDP_{jt-2} + \mu_j + \varsigma_t + \omega_{jt} \qquad (8)\\
\ln FNW_{jt} &= \delta_1 \ln FW_{jt-1} + \delta_2 \ln FNW_{jt-1} \\
&\quad + \delta_3 \ln GDP_{jt-1} + \delta_4 \ln GDP_{jt-2} + \widetilde{\mu}_j + \widetilde{\varsigma}_t + \widetilde{\omega}_{jt} \qquad (9)
\end{aligned}
$$

After estimating these equations using a standard instrumental variable (IV) estimator for dynamic panel data (Blundell and Bond 1998), we use them to impute *Walmex's* predicted share of the local retail market for each state and year, given local conditions in the previous period:

$$
\widehat{S\_W}_{jt} = \frac{\exp(\widehat{FW}_{jt})}{\exp(\widehat{FW}_{jt}) + \exp(\widehat{FNW}_{jt})} \qquad (10)
$$

These instrumented market shares should be free of correlation with the error ε_{it} in equation (7). Thus, when they are used in place of actual market shares when estimating that equation, they should afford consistent estimation of $\beta_2^{q\prime}s$.

One complication arises in estimating (8): *Walmex* was completely absent in some states during the early sample years. We deal with the associated selection problem using a Heckman (1979) correction.[27] The region- and time-specific probabilities needed to construct this correction are obtained

[26] Walmex floor space is the sum of floor space in *Walmex* Supercenters, *Bodega* shops, *Sam*'s and *Superamas* in the province. Recall that while the first three store types sell groceries and other consumer products, *Superama* is a grocery store.

[27] For predicting non-*Walmex* floor space we do not need a selection correction or the Wooldridge (2005) estimator because first-time entry is not an issue.

Table 2: Summary Statistics

	Obs.	Mean	Std. Dev.	Min	Max
Log domestic sales	37,353	9.56	1.77	-0.14	15.53
R&D spending	41,262	0.60	1.70	0.00	12.60
Investment	37,946	3.60	3.53	-4.68	14.72
Imported inputs (%)	37,092	20.37	29.04	0.00	100.00
Average wage	38,758	3.09	0.64	0.00	6.65
Price	31,154	5.21	0.42	3.67	7.28
TFP	37,595	-0.21	0.92	-11.74	8.93

using a dynamic probit model with unobserved effects, estimated using Wooldridge's (2005) technique. Estimates of this probit and of equations (8) and (9) are provided along with further discussion in Appendix 1.

4.3 Results

We are now prepared to discuss our econometric findings concerning producers' responses to a local *Walmex* presence. For this exercise we study the plant characteristics listed in Table 2, each of which is expressed in logs and used in turn as the Y variable in equation (7).[28]

Several observations merit note. First, we measure investments three ways: with R&D spending, with investments in physical capital, and with reliance on imported inputs, which we take to improve products. Second, the EIM data allow us to construct time series on prices for individual goods produced, establishment by establishment. These we aggregate to establishment-level series on output prices, using Tornqvist indices. Also, since the resulting series reflect heterogeneous product mixes, we normalize each establishment-level price to a value of 100 in the base period. Third, the same establishment-level information from the EIM allows us to construct a measure of total factor productivity. Here again we deal with heterogeneous products by normalizing all total factor productivity measures to 100 in the base period and we construct series for real outputs as plant-specific Tornqvist

[28] 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.

Table 3: *Walmex* Effects on Producer Characteristics ($\widehat{\beta}_2^q$) by Initial Establishment Size*

	Sales	R&D	Fixed Investment	Intermediate Imports	Wages	Prices	TFP
Small (q=1)	-5.273***	-0.468	-2.385	-22.140*	-0.596**	-0.266	-0.809
	[0.770]	[0.567]	[1.500]	[13.239]	[0.300]	[0.219]	[0.606]
Midsmall (q=2)	0.328	-0.055	-3.631**	-5.595	0.263	0.364**	0.521
	[0.448]	[0.478]	[1.199]	[10.565]	[0.216]	[0.158]	[0.368]
Midlarge (q=3)	0.121	0.219	-1.812	20.958**	-0.348*	0.151	0.103
	[0.392]	[0.635]	[1.296]	[10.372]	[0.189]	[0.143]	[0.305]
Large (q=4)	2.988***	1.984**	-0.310	11.031	1.793***	0.060	0.912**
	[0.444]	[0.927]	[1.515]	[10.760]	[0.193]	[0.123]	[0.361]
Pooled sample	-0.032	0.287	-2.080**	2.760	0.285**	0.148*	0.412**
	[0.324]	[0.345]	[0.709]	[5.538]	[0.115]	[0.076]	[0.191]

*Complete results from estimated equations are reported in Appendix 2

indicies of the quantities of individual goods produced. 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). Finally, the exact number of observations varies across variables due to missing data.

Having constructed these variables, we examine their association with local Walmex retailing opportunities using each in turn as the dependent variable in equation (7). This yields four sets of parameter estimates for each variable, corresponding to the four subsamples based on initial sales quantiles. Given the number of parameters estimated, we relegate the complete set of findings to Appendix 2 and focus here on the difference-in-difference coefficients ($\widehat{\beta}_2^q$). These are collected in Table 3, along with their standard errors.

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 our 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 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.

These adjustment patterns are precisely what our estimates imply. The response of log sales to *Walmex*'s market share is large and negative for the smallest size quartile ($\widehat{\beta}_2^1 = -5.273$), while it is large and positive for the biggest producers ($\widehat{\beta}_2^4 = 2.988$). Responses in the middle quantiles are insignificant, as is the estimated response for the pooled sample. Thus the results indicate that focusing on the response of the mean (or median) plant misses the key result that firms at different points in the quality distribution respond in different ways to *Walmex*' presence.

4.3.2 *Walmex* and upgrading

R&D Spending and fixed investment Our simulations suggest that firms selling through *Walmex* have a relatively strong incentive to improve their products' appeal. Also, from industry reports as well as the interviews summarized above we know that such firms 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, 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 3 shows the results.

As with domestic sales, the pooled sample results indicate that Wal-Mart has had an insignificant overall effect on R&D. However, increased local *Walmex* presence has induced the largest firms to significantly increase their R&D spending ($\widehat{\beta}_2^4 = 1.984$) while it has induced the smallest firms to cut back on innovative spending ($\widehat{\beta}_2^1 = -0.468$). (The latter effect is not statistically 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 (Figure 5, upper right panel). At the same time, the *Walmex* impact on R&D of different plants is not as precisely estimated as *Walmex* effect on their sales.

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 3. In contrast to R&D, the overall impact of *Walmex* has been to reduce investment: $\widehat{\beta}_2^{pooled} = -2.080$. But once again, the quantile-specific results indicate that there are differences in terms of how much capital investments were cut. Generally, the cuts were larger among smaller firms, and the largest firms' investments are essentially flat. With negative or zero investment responses to *Walmex*, the results suggest that cooperation with *Walmex* requires less capital investments than technology investments. At the same time, the relatively high investment levels for larger firms are consistent with the market share reallocation from smaller to larger firms that we have documented above.

Imported Intermediate Inputs An 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 would be 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 3 shows that the arrival of *Walmex* tends to raise the share of imported intermediates for larger firms, while the opposite is true for smaller firms. The coefficients are significantly different from zero for the moderately large (q=3) and the smallest plants (q=1), respectively, although they are not very precisely estimated. The findings suggest that entry of Walmex sharpens the differences between firms in terms of their sourcing of intermediate inputs along the same lines as for R&D and sales: relatively small firms, producing goods of relatively low quality, import a lower share of intermediate inputs while larger firms, which produce products of relatively high quality, import a greater share of their intermediates from abroad.

We now turn to the average wage received by the employees.

Average Wages 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. But 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.

To this end column 5 of Table 3 presents $\widehat{\beta}_2$ estimates for which the log average wage is the left-hand side variable. We see that the arrival of *Walmex* strongly raises the average log wage at the largest plants ($\widehat{\beta}_2^4$=1.793), while changes in average log wages at other establishments are either insignificant ($\widehat{\beta}_2^2 = 0.263$) or negative ($\widehat{\beta}_2^1 = -0.596$, $\widehat{\beta}_2^3 = -0.348$). This pattern suggests that among large producers, the combination of technology upgrading, *relatively* strong capital accumulation, and greater rents due to stronger sales worked to the benefit of employees.

We now analyze how the firms' price setting changes with the increased presence of *Walmex*.

4.3.3 *Walmex* and prices

Our model predicts that conditional on product appeal, the entry of *Walmex* leads to a relative decline in the prices of firms that sell through *Walmex* (Figure 5, upper-left panel). In estimating equation (7) for the pooled sample, we find that log prices increased with the arrival of *Walmex*, on average ($\widehat{\beta}_2^{pooled} = 0.148$). Relative to this, the estimate for the largest firms suggests a lower price growth, at $\widehat{\beta}_2^4 = 0.060$. This is consistent with the model's prediction that large firms, which are likely to sell through Walmex, are held to relatively low prices.

At the same time, $\widehat{\beta}_2^4$ is not precisely estimated, and it would be impossible to reject the hypothesis that it is equal to the overall effect of 0.148. Moreover, according to the model, the firms with the strongest relative decline in their quality-adjusted price are those with quality just above the threshold. If the threshold is close to the median-sized plant in our sample, this suggests that the *Walmex* effect for moderately large firms should be lower than $\widehat{\beta}_2^4$, whereas if anything we find the opposite. Thus, even if we ignore the low albeit imprecise estimate for the smallest firms ($\widehat{\beta}_2^1$) that our model clearly does not capture, there is no strong support for the pricing prediction of our model.

One reason for this might be price responses to tariff changes, although the tariff coefficients in our pricing regressions appear to be small (refer to Table A7, Appendix 2). It may also be that the smallest firms are relatively strongly affected by new import competition, in particular from China.[29] Consistent with this, we find that the mark-up of price over cost for the smallest firms declines much more strongly than for the largest firms.

We now examine the effect of Walmex expansion on the productivity of its suppliers.

[29] This channel is outside of the analysis here but see Iacovone, Keller, and Rauch (2011).

4.3.4 *Walmex* and firm productivity

In our model, firms' technology investments stochastically raise their product appeal. But innovations and upgrading activities are likely to affect productivity levels as well. In this section we examine whether the arrival of *Walmex* led to this type of adjustment.

In the last column of Table 3 we report the results of estimating (7) with total factor productivity (TFP) as the left hand side variable. The pooled sample results show that the local expansion of *Walmex* are associated with productivity increases, on average ($\widehat{\beta}_2^{pooled} = 0.412$). And as the estimates for the individual size groups make clear, these overall productivity gains are due largely to significant gains among the largest firms ($\widehat{\beta}_2^4 = 0.912$), while the productivity changes among the other firms are insignificantly different from zero ($\widehat{\beta}_2^1 = -0.809$, $\widehat{\beta}_2^2 = 0.521$, $\widehat{\beta}_2^3 = 0.103$). This result is consistent with the findings on sales, R&D, and wages, where we also found a major distinction between the top quartile and all other firms.

We have also considered labor productivity (not reported) as an alternative measure of productivity, which leads to similar results as TFP. One difference is that with labor productivity the difference between the *Walmex* impact on the smallest versus the largest plants productivity is also statistically different at standard levels.[30]

To sum up, the responses of Mexican firms to *Walmex* are—in multiple dimensions, and with the exception of prices—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 pooled sample results indicate that focusing on the response of the typical establishment would have meant missing much of the adjustment process.

[30] We have also examined the effects of Walmex' entry on the exit behavior of upstream plants. They are close to zero and do not vary much across plants.

5 Conclusions

This paper provides new microfoundations for the within- and between-firm productivity gains that are frequently observed in countries after they liberalize their trade and FDI regime. Analyzing 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 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 product quality and pricing. Simulations of the model show that firms producing high-quality products should react differently from others to the arrival of *Walmex*. High-quality firms will upgrade in order to sell their product through *Walmex*, while low-quality firms will not. At the industry-level, the model predicts that productivity and the rate of innovation may increase, both because market shares are reallocated to the stronger firms and because within-firm performance improves.

We find support for these simulation results from regressions showing the impact of *Walmex* on Mexican plants between 1993 and 2002. There is evidence that the arrival of *Walmex* has bisected the distribution of Mexican plants: high-quality firms tend to repond differently to *Walmex* than low-quality firms in terms of both current behavior and investment patterns. Our regression results are strongest on sales and productivity. We find that high-quality firms have sold more and become more productive in response to *Walmex*' FDI in Mexico, while low-quality firms have lost ground in both dimensions. At the same time, our results are less clear on pricing, where our analysis does not yield a clear pattern. Future work will have to clarify whether this finding is unique to the behavior of Mexican plants or not; in the latter case the model will have to be modified so that the decision to sell through *Walmex* depends not only on quality but also additional factors, such as the specific geographic location of the supplier relative to both Walmex retail stores and Walmex distribution centers.

Our analysis shows that trade and FDI liberalization may have important indirect effects. Not only did the FDI deregulation of NAFTA that facilitated Wal-Mart's entry into Mexico reshape Mexico's retail market, but as we showed it also had a major impact on the upstream supplying manufacturing industries. The relationships we have studied also reveal that performance increases in the goods producing sector may have had their source in other sectors of the economy. This is important because most formal analysis to date has focused on the goods producing sector, which is shrinking rapidly in many advanced economies, while in contrast other sectors of the economy are much less well understood.

Finally, our analysis suggests there may be high returns to identifying the exact reasons for changes in firm performance in response to trade and FDI liberalization. In the present case, several of the major mechanisms came up in the interviews that were conducted, where we heard what Walmex offers to and demands from its would-be suppliers. This adds a valuable new perspective to the literature on measured productivity changes, which does not typically shed much light on the underlying mechanisms.

References

[1] Ackerberg, D., L. Benkard, S. Berry, and A. Pakes (forthcoming), "Econometric Tools for Analyzing Market Outcomes", Handbook of Econometrics, Vol. 6, North-Holland.

[2] Arellano, M., and O. Bover (1995), "Another look at the instrumental variable estimation of error-components models", Journal of Econometrics 68(1): 29-51.

[3] Aw, Bee Yan and Chen, Xiaomin and Roberts, Mark J. (2001), "Firm-level evidence on productivity differentials and turnover in Taiwanese manufacturing," *Journal of Development Economics* 66(1), pages 51-86.

[4] Basker, E. (2007), "The Causes and Consequences of Wal-Mart's Growth", *Journal of Economic Perspectives* 21, Summer: 177-198.

[5] Basker, E. (2005a), "Selling a Cheaper Mousetrap: Wal-Mart's Effect on Retail Prices", *Journal of Urban Economics* 58: 203-229.

[6] Basker, E. (2005b), "Job Creation or Destruction? Labor Market Effects of Wal-Mart's Expansion", *Review of Economics and Statistics* 87(1): 174-183.

[7] Berry, S. (1994), "Estimating Discrete-Choice Models of Product Differentiation," *RAND Journal of Economics*, vol. 25(2), pages 242-262.

[8] Blundell, R., and S. Bond (1998), "Initial conditions and moment restrictions in dynamic panel data models", Journal of Econometrics 87: 115-143.

[9] Business Planning Solutions (2005), *The Economic Impact of Wal-Mart*, Washington, D.C.

[10] Bustos, P. (2010), "The Impact of Trade on Technology and Skill Upgrading: Evidence from Argentina", *American Economic Review*.

[11] Case, B. (2004), "Welcoming Wal-Mart to Mexico", Dallas Morning News, November 9, 2004.

[12] Caves, Douglas W., Laurits Christensen, and Erwin Diewert (1982), "Output, Input, and Productivity Using Superlative Index Numbers," *Economic Journal*, 92, pp. 73-96.

[13] Chavez, M. (2002),"The Transformation of Mexican Retailing with NAFTA," *Development Policy Review* 20(4), pp 503-13.

[14] Costantini, J., and M. Melitz (2008), "The Dynamics of Firm-Level Adjustment to Trade Liberalization" in textitThe Organization of Firms in a Global Economy, E. Helpman, D. Marin, and T.Verdier (eds.), Harvard University Press.

[15] Ericson, R. and A. Pakes (1995) "Markov-Perfect Industry Dynamics: A Framework for Empirical Work," Review of Economic Studies, 62, 53-82.

[16] Durand, C. (2007), "Externalities from foreign direct investment in the Mexican retailing sector", *Cambridge Journal of Economics*, February, 1-19.

[17] Ederington, J. , and P. McCalman (2008), "Endogenous Firm Heterogeneity and the Dynamics of Trade Liberalization", *Journal of International Economics* 74: 422-440.

[18] Fishman, Charles (2003). "The Wal-Mart You Don't Know," Fast Company (December) 77. Downloaded February 15, 2006 from http://pf.fastcompany.com/magazine/77/walmart.html.

[19] Görg, H., and D. Greenaway (2004), "Much ado about nothing? Do domestic firms really benefit from foreign direct investment?", *World Bank Research Observer* 19.

[20] Holmes, Thomas J. (2011). "The Diffusion of Wal-Mart and Economies of Density," *Econometrica*, 79(1): 253-302.

[21] Iacovone, L., W. Keller, and F. Rauch (2011), "Innovation Responses to Import Competition", mimeo, Princeton University, March.

[22] Javorcik, B., W. Keller, and J. Tybout (2008), "Openness and Industrial Responses in a Wal-Mart World: A Case Study of Mexican Soaps, Detergents and Surfactant Producers", *World Economy*, December.

[23] Javorcik, B. and Y. Li (2008), Do the Biggest Aisles Serve a Brighter Future? Global Retail Chains and Their Implications for Romania", World Bank Policy Research Working Paper # 4650.

[24] Jia, Panle (2006), "What Happens when Wal-Mart comes to Town? An Empirical Analysis of the Discount Retailing Industry", MIT working paper.

[25] Keller, W. (2010), "International Trade, Foreign Direct Investment, and Technology Spillovers", in Handbook of the Economics of Innovation, B. Hall and N. Rosenberg (eds.), Elsevier North Holland Publishers.

[26] Klapper, Leora (2006), "The role of factoring for financing small and medium enterprises," *Journal of Banking & Finance*, 30(11): 3111-3130

[27] Lipsey, R., and F. Sjoholm (2005), "The Impact of Inward FDI on Host Countries: Why so Different Answers?", in *Does FDI Promote Development*? (eds. T. Moran, E. Graham, and M. Blomstrom), Institute of International Economics, Washington, DC.

[28] McKinsey (2003), *New Horizons: Multinational Company Investment in Developing Countries*, McKinsey Global Institute, Washington, DC.

[29] Pakes, A., and P. McGuire (1994), "Computing Markov-Perfect Nash Equilibria: Numerical Implications of a Dynamic Differentiated Product Model," RAND Journal of Economics vol. 25(4), pages 555-589, Winter.

[30] Tegel, S. (2003), "Every Day Higher Sales: Mal-Mart Wunderkind Walmex shows them how it's done in a down economy: The Giant 24," Latin Trade (August). Downloaded February 15, 2006 from http://www.findarticles.com/p/articles/mi_m0BEK/is_8_11/ai_106860473

[31] Verhoogen, E. (2008), "Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector", *Quarterly Journal of Economics*, May.

[32] Wal-Mart de Mexico (2006), Annual Report 2006, accessed on the Internet in 2007.

[33] Weintraub, G. L. Benkard, and B. Van Roy (2008), "Markov Perfect Industry Dynamics with Many Firms", *Econometrica* 76 1375-1411.

[34] Weintraub, G., C. L. Benkard, and B. Van Roy. (2010) "Computational Methods for Oblivious Equilibrium," *Operations Research* 58(4) Part-2, pp. 1247-1265.

[35] Wooldridge, J. (2005), "Simple Solutions to the Initial Conditions Problem in Dynamic, Nonlinear Panel Data Models with Unobserved Heterogeneity", *Journal of Applied Econometrics* 20: 39-54.

[36] Yeaple, S. (2005), "Firm Heterogeneity, International Trade, and Wages", *Journal of International Economics* 65 (1): 1-20.

Appendix 1: Modeling Retail Floorspace

Our econometric analysis of *Walmex*'s effects on upstream industries is based on variation in *Walmex* retail floor space relative to its local competitors. This appendix describes the sources of our retail floor space data and summarizes our estimation of the predicted floor space shares.

Information on Retail Activity

While *Wal-Mart de Mexico* supplied us with figures on the number of retail stores by year and Mexican state, they did not provide us with data on the retail floor space of its stores. Such data can be found in the publication of the industry association, *Asociacion Nacional Tiendas de Autoservicio y Departamentales* (ANTAD). However, Walmex did not participate in all our sample years in this association, and the data are therefore incomplete.

We employ *Walmex* floor space data for the years 1995 to 2001, with the exception of 1998, from the ANTAD yearbooks.[31] Data for the year 1998 is linearly interpolated from the 1997 and 1999 values, while the year 2002 is extrapolated from the 2001/2000 growth trend. The *Walmex* floor space by state for the years 1993 and 1994 is estimated in proportion to the number of *Walmex* stores by state. We also estimate the local floor space for 1993 and 1994 from the 1997/94 and 1998/95 growth trends, respectively.

Predicted retail floor space

As discussed in the text, *Walmex* was not present in all states for all years of the sample, and moreover, this decision was likely taken by *Walmex* in a non-random fashion. When estimating the Walmex policy function (8) we deal with the associated selection problem by including an inverse Mills ratio as an explanatory variable.

To constuct the inverse Mills ratio, we must first obtain estimates of the probability that Walmex is present in each state for each sample year. We generate these probabilities using using a dynamic probit

[31] We are grateful to Mauricio Varela for sharing his data with us.

model, dealing with unobserved heterogeneity and the initial conditions problem as in Wooldridge (2005). This amounts to including a number of variables in the probit estimation in addition to the predictors of interest: (1) the initial realization on all lagged endogeneous variables, and (2) each exogenous variable as a separate variable, broken down by time period (one variable per time period). In our case, the initial realizations of the endogeneous variables are (i) whether *Walmex* was present in a particular state in the year 1993, and (ii) the 1993 value of local floor space in a given state. The exogenous variable in our case is lagged state-specific GDP. Results of the dynamic probit are reported in the first column of Table A1.

When estimating (8), we use the panel techniques developed by Arellano and Bover (1995) and Blundell and Bond (1998). In doing so, we treat local floor space and the Mills ratio implied by our probit model as endogeneous, and we treat lagged state-level GDP as predetermined. The results are shown in the second column of Table A1. Note that *Walmex* floor space tends to be high whenever local floor space is high, while it also is positively related to state-level GDP. The correlation of predicted with actual *Walmex* floor space is 0.95.

The policy function for traditional retailers (9) was estimated in the same way as (8), except no selection correction was needed. The third column of Table A1 shows the corresponding results. It is perhaps not surprising that there is more persistence in local floor space than *Walmex* floor space (coefficient of 0.86 on the lagged local floor space, versus 0.67 for lagged *Walmex* floor space in column 2). Also local floor space responds positively to state-level GDP. At the same time, *Walmex* floor space has a lower impact on local floor space than local retailers have on *Walmex* (coefficient of 0.03 in column3, versus 0.22 in column 2). The correlation of the predicted with actual local floor space is 0.99. Finally, the predicted share of *Walmex* floor space used to estimate equation (7) is constructed from the predicted values of the regressions reported in columns 2 and 3 as $\widehat{S\_W}_{jt} = \frac{\exp(\widehat{FW}_{jt})}{\exp(\widehat{FW}_{jt})+\exp(\widehat{FNW}_{jt})}$.

Table A1: Walmex and non-Walmex Floor Space

	Walmex present (probit)	log Walmex floor space ($\ln FW$)	log non-Walmex floor space ($\ln FNW$)
log Walmex floor space, t-1	-5.455***	0.620***	0.030
$DW_{t-1} \cdot (\ln FW_{t-1})$	[0.204]	[0.001]	[0.129]
log local floor space, t-1	-3.232***	0.216***	0.856***
$(\ln FNW_{t-1})$	[0.245]	[0.010]	[0.001]
log state GDP, t-1	-22.764***	1.305***	0.281***
$(\ln GDP_{t-1})$	[0.177]	[0.001]	[0.005]
log state GDP, t-2	–	-1.242***	-0.204***
$(\ln GDP_{t-2})$		[0.001]	[0.051]
Walmex not present, t-1	-54.645***	–	–
$1 - DW_{t-1}$	[0.196]		
Inverse Mills ratio	–	-0.499***	–
		[0.134]	
Walmex present, 1993	36.944***	–	–
DW_{1993}	[1.00]		
log local floor space, 1993	8.306***	–	–
$DW_{1993} \cdot \ln FW_{1993}$	[0.064]		
log state GDP, all years	yes	no	no
Year effects	yes	yes	yes
log-likelihood	-16.18		
N	288	174	203

*Standard errors appear in square brackets below each coeffficient

Appendix 2: Estimates of Equation (7)

The tables below provide estimated parameters and standard errors for equation (7), quantile by quantile, as well as for the pool panel of establishments. The variable $\widehat{S\_W}$ is constructed as described in Appendix 1. Coefficients for the interaction term $W\_G \times \widehat{S\_W}$ correspond to those reported in Table 3 of the text.

Table A2: Log Real Sales†

	Quartile				
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	All
Walmex Product	-5.586***	0.481	1.730**	-1.792**	-0.766
(W_G)	[1.113]	[0.664]	[0.601]	[0.650]	[0.481]
Share interaction	-5.273***	0.328	0.121	2.988***	-0.032
$(W\_G \times \widehat{S\_W})$	[0.770]	[0.448]	[0.392]	[0.444]	[0.324]
Walmex share	1.670	0.848	-0.109	-0.816	0.224
$\widehat{S\_W}$	[1.080]	[0.636]	[0.576]	[0.608]	[0.465]
U.S. tariff	0.056***	0.005	-0.016***	-0.023***	-0.001
(TAR^{US})	[0.008]	[0.005]	[0.004]	[0.005]	[0.003]
Mexican tariff	-0.013***	0.001	0	0.007**	-0.002
(TAR^{MEX})	[0.004]	[0.002]	[0.002]	[0.002]	[0.002]
regional GDP	0.323	-0.108	0.008	0.118	-0.106
$\ln GDP$	[0.700]	[0.433]	[0.382]	[0.429]	[0.315]
GDP interaction	0.353***	-0.039	-0.091**	0.076**	0.047*
$W\_G \times \ln GDP$	[0.066]	[0.039]	[0.035]	[0.038]	[0.028]
R^2	0.036	0.025	0.019	0.043	0.018
N	5,887	9,331	10,545	10,681	37,353

†Shares are instrumented as described above. Standard errors appear in square brackets below each coeffficient

Table A3: R&D†

	Quartile				
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	All
Walmex Product	-0.126	0.411	-1.925**	-3.565**	-1.274**
(W_G)	[0.818]	[0.716]	[0.973]	[1.364]	[0.512]
Share interaction	-0.468	-0.055	0.219	1.984**	0.287
$(W\_G \times \widehat{S\_W})$	[0.567]	[0.478]	[0.635]	[0.927]	[0.345]
Walmex share	0.374	-0.276	1.176	1.121	0.713
$\widehat{S\_W}$	[0.762]	[0.691]	[0.919]	[1.272]	[0.491]
U.S. tariff	0.012**	0.019***	-0.007	-0.016	0.001
(TAR^{US})	[0.006]	[0.005]	[0.007]	[0.010]	[0.004]
Mexican tariff	0.001	-0.002	-0.005*	0.003	-0.001
(TAR^{MEX})	[0.003]	[0.003]	[0.003]	[0.004]	[0.002]
regional GDP	0.704	-1.127**	-0.673	1.273	-0.058
$\ln GDP$	[0.508]	[0.472]	[0.612]	[0.892]	[0.335]
GDP interaction	0.006	-0.023	0.114**	0.168**	0.068**
$W\_G \times \ln GDP$	[0.048]	[0.042]	[0.057]	[0.080]	[0.030]
R^2	0.02	0.0099	0.011	0.013	0.0033
N	7,494	10,293	11,223	11,212	41,262

†Shares are instrumented as described above. Standard errors appear in square brackets below each coeffficient

Table A4: Investment†

	Quartile				
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	All
Walmex Product	-1.041	-4.523**	-0.108	-1.459	-2.054*
(W_G)	[2.162]	[1.791]	[1.999]	[2.235]	[1.053]
Share interaction	-2.385	-3.631**	-1.812	-0.31	-2.080**
($W\_G \times \widehat{S\_W}$)	[1.500]	[1.199]	[1.296]	[1.515]	[0.709]
Walmex share	-0.377	2.672	2.847	-1.243	0.578
$\widehat{S\_W}$	[1.984]	[1.723]	[1.877]	[2.090]	[1.006]
U.S. tariff	0.052***	0	0.016	-0.01	0.012
(TAR^{US})	[0.014]	[0.013]	[0.013]	[0.016]	[0.007]
Mexican tariff	-0.011	-0.005	-0.007	-0.005	-0.006*
(TAR^{MEX})	[0.007]	[0.007]	[0.006]	[0.007]	[0.004]
regional GDP	-0.161	-3.784**	-0.977	1.142	-1.304*
$\ln GDP$	[1.322]	[1.180]	[1.255]	[1.477]	[0.688]
GDP interaction	0.068	0.286**	0.031	0.082	0.135**
$W\_G \times \ln GDP$	[0.128]	[0.105]	[0.118]	[0.131]	[0.062]
R^2	0.045	0.015	0.014	0.029	0.0084
N	6,895	9,431	10,276	10,356	37,946

†Shares are instrumented as described above. Standard errors appear in square brackets below each coeffficient

Table A5: Intermediate Input Imports†

	Quartile				
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	All
Walmex Product	-78.268***	-42.425**	-9.9	-7.98	-32.531***
(W_G)	[19.303]	[15.644]	[15.951]	[15.754]	[8.210]
Share interaction	-22.140*	-5.595	20.958**	11.031	2.76
($W\_G \times \widehat{S\_W}$)	[13.239]	[10.565]	[10.372]	[10.760]	[5.538]
Walmex share	14.853	-0.989	-10.838	-5.758	-1.385
$\widehat{S\_W}$	[18.821]	[15.022]	[15.342]	[14.957]	[8.004]
U.S. tariff	0.471***	0.240**	-0.141	-0.147	0.055
(TAR^{US})	[0.133]	[0.113]	[0.109]	[0.111]	[0.058]
Mexican tariff	0.134**	0.038	-0.044	-0.057	-0.009
(TAR^{MEX})	[0.066]	[0.057]	[0.051]	[0.051]	[0.028]
regional GDP	17.026	1.951	-0.342	0	3.339
$\ln GDP$	[12.156]	[10.232]	[10.137]	[10.449]	[5.403]
GDP interaction	4.539***	2.289**	0.355	0.224	1.720***
$W\_G \times \ln GDP$	[1.141]	[0.920]	[0.937]	[0.927]	[0.483]
R^2	0.089	0.031	0.03	0.027	0.026
N	6,001	9,310	10,506	10,368	37,092

†Shares are instrumented as described above. Standard errors appear in square brackets below each coeffficient

Table A6: Wages†

	Quartile				
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	All
Walmex Product	-0.312	-0.174	-0.950**	-0.614**	-0.662***
(W_G)	[0.431]	[0.321]	[0.292]	[0.285]	[0.171]
Share interaction	-0.596**	0.263	-0.348*	1.793***	0.285**
$(W\_G \times \widehat{S\_W})$	[0.300]	[0.216]	[0.189]	[0.193]	[0.115]
Walmex share	-0.34	0.104	-0.423	-0.421	-0.254
$\widehat{S\_W}$	[0.411]	[0.309]	[0.277]	[0.266]	[0.164]
U.S. tariff	0.013***	0.010***	0.006**	-0.008***	0.004**
(TAR^{US})	[0.003]	[0.002]	[0.002]	[0.002]	[0.001]
Mexican tariff	0.001	0.001	-0.003***	-0.001	-0.001*
(TAR^{MEX})	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
regional GDP	0.342	0.480**	0.483**	0.390**	0.413***
$\ln GDP$	[0.270]	[0.210]	[0.184]	[0.188]	[0.112]
GDP interaction	0.018	0.004	0.060***	0.015	0.034***
$W\_G \times \ln GDP$	[0.026]	[0.019]	[0.017]	[0.017]	[0.010]
R^2	0.036	0.027	0.037	0.045	0.019
N	6,692	9,652	10,695	10,766	38,758

†Shares are instrumented as described above. Standard errors appear in square brackets below each coeffficient

Table A7: Prices†

	Quartile				
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	All
Walmex Product	-0.194	0.281	-0.348	0	-0.006
(W_G)	[0.321]	[0.234]	[0.219]	[0.179]	[0.113]
Share interaction	-0.266	0.364**	0.151	0.06	0.148*
$(W\_G \times \widehat{S\_W})$	[0.219]	[0.158]	[0.143]	[0.123]	[0.076]
Walmex share	-0.067	-0.082	-0.113	-0.223	-0.132
$\widehat{S\_W}$	[0.307]	[0.224]	[0.209]	[0.173]	[0.110]
U.S. tariff	0.003	0	0	-0.001	0
(TAR^{US})	[0.002]	[0.002]	[0.001]	[0.001]	[0.001]
Mexican tariff	-0.002*	0.002**	-0.001	0.001*	0
(TAR^{MEX})	[0.001]	[0.001]	[0.001]	[0.001]	[0.000]
regional GDP	-0.265	0.121	0.142	-0.103	0.023
$\ln GDP$	[0.202]	[0.149]	[0.138]	[0.121]	[0.074]
GDP interaction	0.017	-0.02	0.017	-0.002	-0.001
$W\_G \times \ln GDP$	[0.019]	[0.014]	[0.013]	[0.011]	[0.007]
R^2	0.036	0.014	0.013	0.012	0.0038
N	4,586	7,837	9,073	9,634	31,154

†Shares are instrumented as described above. Standard errors appear in square brackets below each coeffficient

Table A8: TFP†

	Quartile				
	Smallest (q=1)	MidSmall (q=2)	MidLarge (q=3)	Large (q=4)	All
Walmex Product	-2.082**	0.503	1.209**	-0.542	-0.082
(W_G)	[0.855]	[0.549]	[0.471]	[0.533]	[0.284]
Share interaction	-0.809	0.521	0.103	0.912**	0.412**
($W\_G \times \widehat{S\_W}$)	[0.606]	[0.368]	[0.305]	[0.361]	[0.191]
Walmex share	-0.532	0.253	-0.31	-0.61	-0.303
$\widehat{S\_W}$	[0.818]	[0.514]	[0.446]	[0.496]	[0.271]
U.S. tariff	0.014**	0.002	-0.008**	0.001	0.002
(TAR^{US})	[0.006]	[0.004]	[0.003]	[0.004]	[0.002]
Mexican tariff	0.004	-0.003	0.001	0	0
(TAR^{MEX})	[0.003]	[0.002]	[0.001]	[0.002]	[0.001]
regional GDP	-0.261	0.277	-0.134	0.042	-0.075
$\ln GDP$	[0.536]	[0.350]	[0.297]	[0.353]	[0.185]
GDP interaction	0.119**	-0.036	-0.071**	0.026	0
$W\_G \times \ln GDP$	[0.051]	[0.032]	[0.028]	[0.031]	[0.017]
R^2	0.014	0.011	0.015	0.02	0.0044
N	6,442	9,397	10,522	10,334	37,595

†Shares are instrumented as described above. Standard errors appear in square brackets below each coeffficient

FIGURE 1

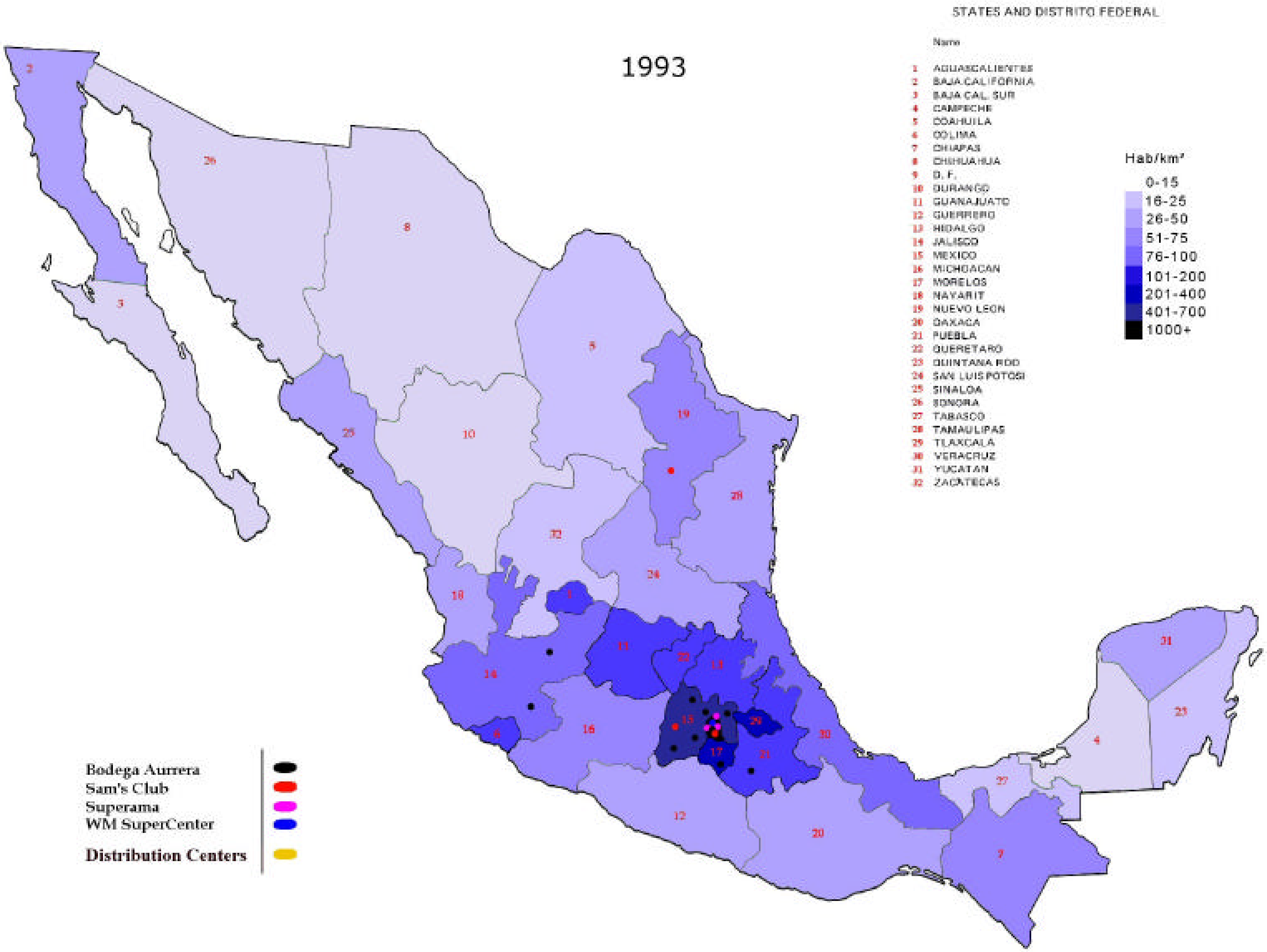
1993
STATES AND DISTRITO FEDERAL
Name
1 AGUASCALIENTES
2 BAJA CALIFORNIA
3 BAJA CAL. SUR
4 CAMPECHE
5 COAHUILA
6 COLIMA
7 CHIAPAS
8 CHIHUAHUA
9 D. F.
10 DURANGO
11 GUANAJUATO
12 GUERRERO
13 HIDALGO
14 JALISCO
15 MEXICO
16 MICHOACAN
17 MORELOS
18 NAYARIT
19 NUEVO LEON
20 OAXACA
21 PUEBLA
22 QUERETARO
23 QUINTANA ROO
24 SAN LUIS POTOSI
25 SINALOA
26 SONORA
27 TABASCO
28 TAMAULIPAS
29 TLAXCALA
30 VERACRUZ
31 YUCATAN
32 ZACATECAS
Hab/km²
0-15
16-25
26-50
51-75
76-100
101-200
201-400
401-700
1000+
Bodega Aurrera
Sam's Club
Superama
WM SuperCenter
Distribution Centers

FIGURE 2

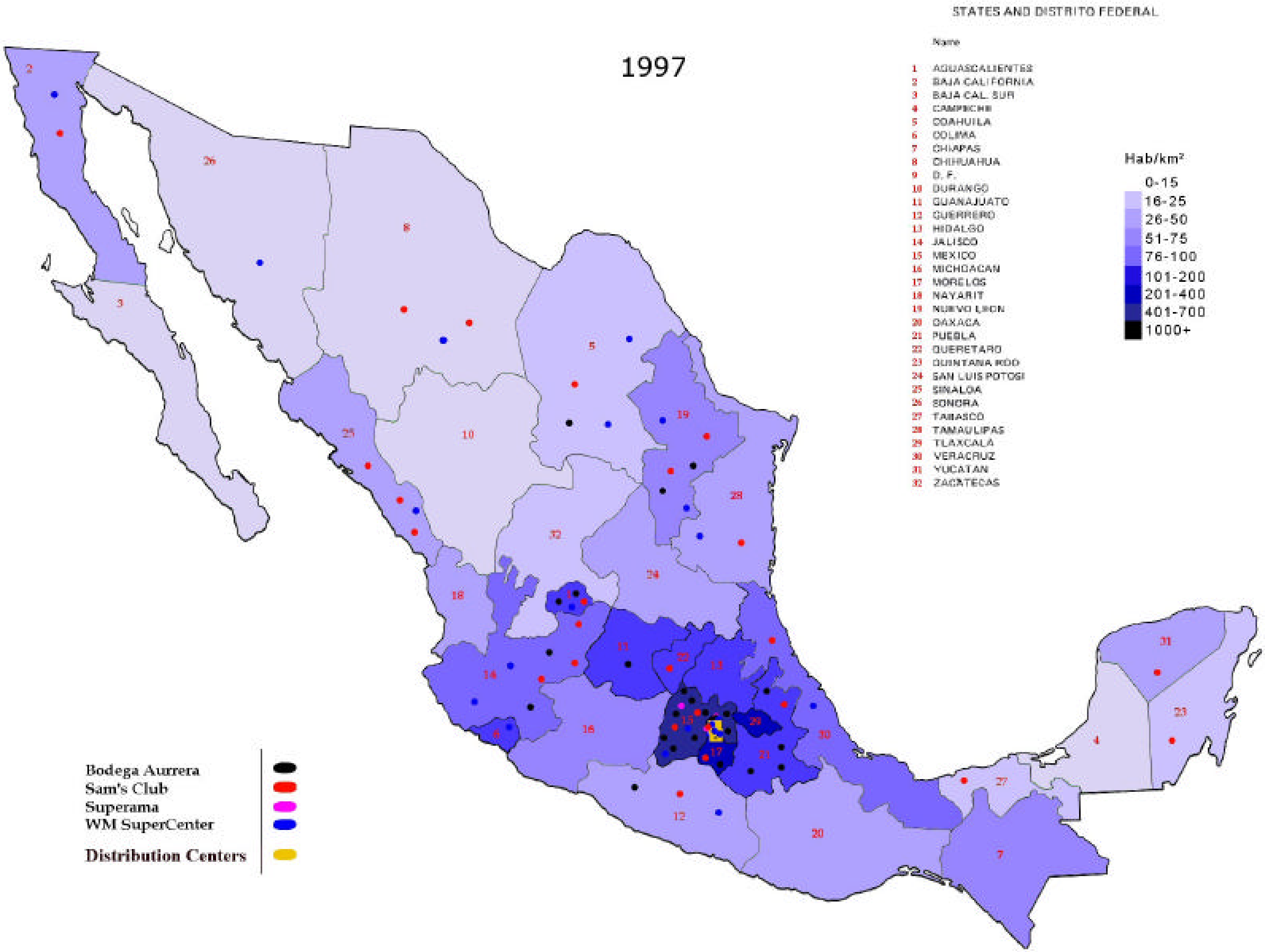
1997
STATES AND DISTRITO FEDERAL
Name
1 AGUASCALIENTES
2 BAJA CALIFORNIA
3 BAJA CAL. SUR
4 CAMPECHE
5 COAHUILA
6 COLIMA
7 CHIAPAS
8 CHIHUAHUA
9 D. F.
10 DURANGO
11 GUANAJUATO
12 GUERRERO
13 HIDALGO
14 JALISCO
15 MEXICO
16 MICHOACAN
17 MORELOS
18 NAYARIT
19 NUEVO LEON
20 OAXACA
21 PUEBLA
22 QUERETARO
23 QUINTANA ROO
24 SAN LUIS POTOSI
25 SINALOA
26 SONORA
27 TABASCO
28 TAMAULIPAS
29 TLAXCALA
30 VERACRUZ
31 YUCATAN
32 ZACATECAS
Hab/km²
0-15
16-25
26-50
51-75
76-100
101-200
201-400
401-700
1000+
Bodega Aurrera
Sam's Club
Superama
WM SuperCenter
Distribution Centers

FIGURE 3

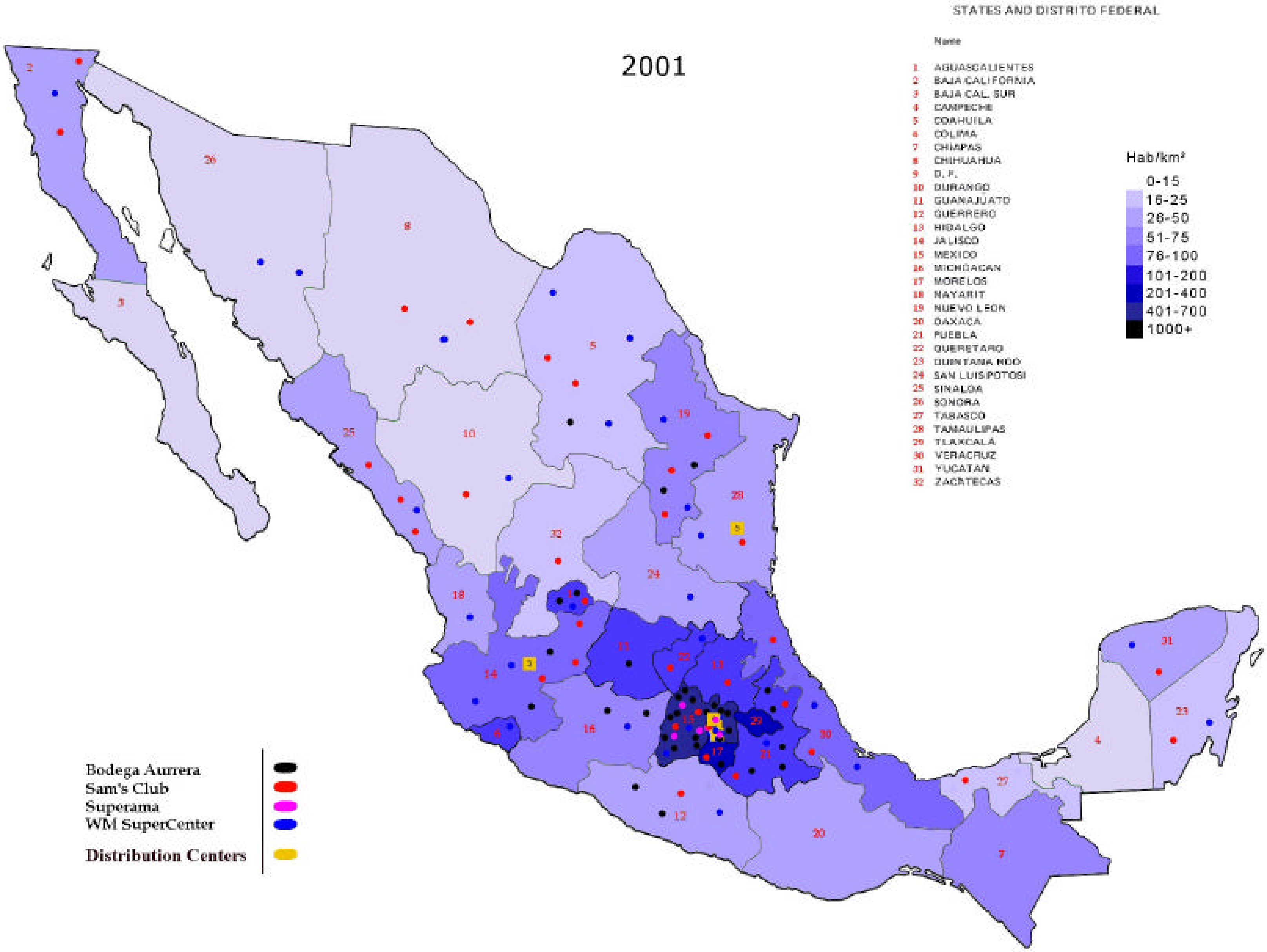
2001
STATES AND DISTRITO FEDERAL
Name
1 AGUASCALIENTES
2 BAJA CALIFORNIA
3 BAJA CAL. SUR
4 CAMPECHE
5 COAHUILA
6 COLIMA
7 CHIAPAS
8 CHIHUAHUA
9 D. F.
10 DURANGO
11 GUANAJUATO
12 GUERRERO
13 HIDALGO
14 JALISCO
15 MEXICO
16 MICHOACAN
17 MORELOS
18 NAYARIT
19 NUEVO LEON
20 OAXACA
21 PUEBLA
22 QUERETARO
23 QUINTANA ROO
24 SAN LUIS POTOSI
25 SINALOA
26 SONORA
27 TABASCO
28 TAMAULIPAS
29 TLAXCALA
30 VERACRUZ
31 YUCATAN
32 ZACATECAS
Hab/km²
0-15
16-25
26-50
51-75
76-100
101-200
201-400
401-700
1000+
Bodega Aurrera
Sam's Club
Superama
WM SuperCenter
Distribution Centers

FIGURE 4

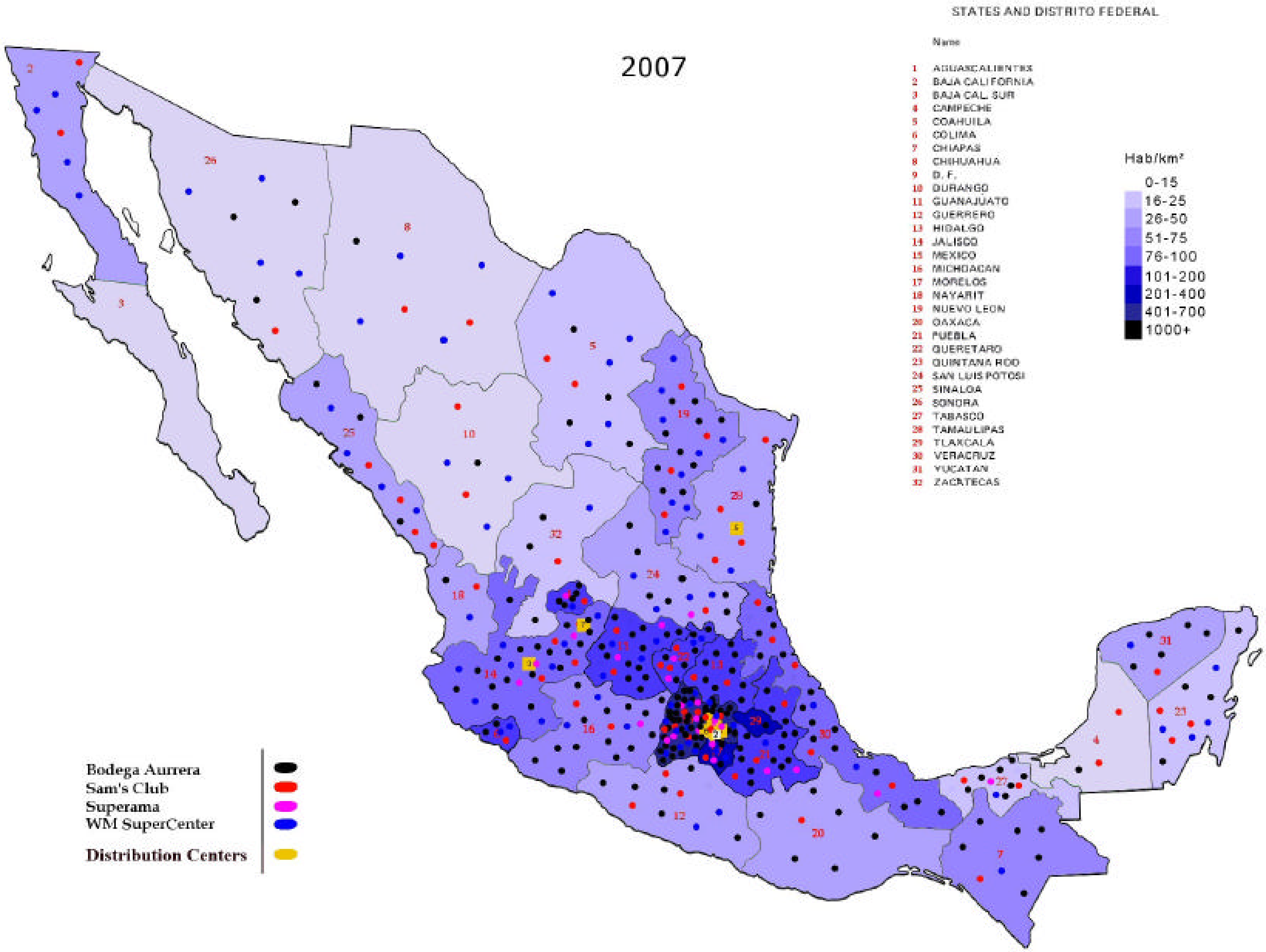
2007
STATES AND DISTRITO FEDERAL
Name
1 AGUASCALIENTES
2 BAJA CALIFORNIA
3 BAJA CAL. SUR
4 CAMPECHE
5 COAHUILA
6 COLIMA
7 CHIAPAS
8 CHIHUAHUA
9 D. F.
10 DURANGO
11 GUANAJUATO
12 GUERRERO
13 HIDALGO
14 JALISCO
15 MEXICO
16 MICHOACAN
17 MORELOS
18 NAYARIT
19 NUEVO LEON
20 OAXACA
21 PUEBLA
22 QUERETARO
23 QUINTANA ROO
24 SAN LUIS POTOSI
25 SINALOA
26 SONORA
27 TABASCO
28 TAMAULIPAS
29 TLAXCALA
30 VERACRUZ
31 YUCATAN
32 ZACATECAS
Hab/km²
0-15
16-25
26-50
51-75
76-100
101-200
201-400
401-700
1000+
Bodega Aurrera
Sam's Club
Superama
WM SuperCenter
Distribution Centers

Figure 5: Model Simulations