Supplier Responses to Wal-Mart’s Invasion of Mexico

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Equilibrium price setting when products differ in quality
Mexico: a globalization shock

![Graph showing the relationship between price and quality. The graph has a sharp drop at quality level 2, indicating a significant impact on price. The x-axis represents quality, ranging from 1 to 4, and the y-axis represents price, ranging from 1.5 to 2.6. The graph shows a steep increase in price as quality increases past level 2.]
Wal-Mart offers its retailing services to Mexican firms

![Graph showing the relationship between price and quality with lines for different retailing services.]
Wal-Mart’s Invasion of Mexico: the argument

- **Wal-Mart** enters after NAFTA and Mexico’s joining the GATT in 1985
- **Wal-Mart** brings its business practices to Mexico
- The FDI triggers massive reshuffling among Mexican producers
  - **Wal-Mart** increases their market size (national distribution)
    - Heterogeneous firms: strong firms gain, weak firms lose
- **Wal-Mart**’s FDI gives incentives to innovate and upgrade
  - Upgrading required to ensure compatibility w/ **Wal-Mart**
    - Heterogeneous firms: strong firms upgrade, weak firms do not
Overview

1. Firm interviews in Mexico as input for modeling the impact of Wal-Mart on Mexican suppliers (summarized in Javorcik, Keller, and Tybout 2008)

2. Simulation of sales, upgrading, pricing and other firm responses

3. Regression evidence on the same variables using Mexican micro data
**The Invasion**

- **Wal-Mart** entered Mexico via joint venture with *Bodegas Aurrera* in 1992
  - Bought controlling interest in 1997 and became *Wal-Mart de México* (*Walmex*)

- **Walmex** is Mexico’s largest private employer since 2003

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![Distribution of Retail Chain Sales in 2008](image-url)
Walmex store formats

**Bodega Aurrera**

Tiendas de descuento austeras que ofrecen mercancía básica, alimentos y artículos para el hogar al mejor precio.

- **Propuesta de valor:** Precio
- **M² promedio:** 3,040
- **Participación sobre ventas totales:** 33.7%

**Walmart**

Hipermercados que ofrecen el más amplio surtido de mercancía, desde abarrotes y perecederos hasta ropa y mercancías generales.

- **Propuesta de Valor:** Precio y Surtido
- **M² promedio:** 8,160
- **Participación sobre ventas totales:** 28.2%

**Sam’s Club**

Club de precios con membresía, enfocado en negocios y consumidores que compran a los mejores precios.

- **Propuesta de valor:** Precio, volumen, mercancía nueva y diferenciada
- **M² promedio:** 7,520
- **Participación sobre ventas totales:** 27.0%

**Superama**

Supermercados ubicados en zonas residenciales.

- **Propuesta de valor:** Calidad, conveniencia y servicio
- **M² promedio:** 1,650
- **Participación sobre ventas totales:** 5.1%
Regional Distribution Centers

- Walmex stores are supplied by regional distribution centers (CEDIS), as well as direct deliveries from producers.

- 30 percent of perishable goods are bought locally directly from suppliers.

- Supplying a single CEDIS gives a producer access to the entire network.
Walmex’ geographic expansion patterns: summary

- *Walmex* started out in the most populated area—partly because *Aurrera* was already there.

- *Walmex* expanded by adding stores throughout Mexico, rather than gradually radiating out from the center.
  - In contrast to *Wal-Mart’s* strategy in the United States (Holmes 2007).

- Distribution centers followed stores, so suppliers’ proximity to stores means they have good access to *Walmex*.
Becoming a Walmex supplier: the pros

- Substantial increase in market size
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Getting ready for Wal-Mart is like “getting into a company version of basic training with an implacable Army drill sergeant” (Fishman 2003).
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Wal-Mart’s Invasion of Mexico

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- Getting ready for *Wal-Mart*
  - is like "getting into a company version of basic training with an implacable Army drill sergeant"
  - "helps everything: customer focus, inventory management, speed to market" (Fishman 2003)
Becoming a Walmex supplier: the cons

- *Walmex* keeps negotiations with its suppliers as stark as possible—both the bargaining environment and the number of negotiable contract features (price, quality, quantity)

> “If Wal-Mart takes something the wrong way, it’s like Saddam Hussein. You just don’t want to piss them off”

(Paul Kelly, business consultant; Javorcik, Keller, and Tybout 2008)
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- For a supplier to complain about *Wal-Mart’s* approach

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A simple model of Walmex’ upstream industry

- Indirect utility from a unit of product \( j \) for consumer \( i \):
  \[
  U_{ij} = \theta_1 \ln(\xi_j) + \beta w_j + \theta_2 \ln(Y - P_j) + \epsilon_{ij}
  \]
  \[
  \overset{\text{def}}{=} \bar{U}_{ij} + \epsilon_{ij}.
  \]

  \( \xi_j \): Quality of good supplied by firm \( j \)
  
  \( P_j \): Price of good \( j \)
  
  \( Y \): Income of representative consumer
  
  \( w_j \): = 1 if \( j \) retails through Walmarx, 0 otherwise
  
  \( \epsilon_{ij} \): Type 1 extreme value, iid across consumers and goods

- If firm \( j \) sells through Walmarx, it makes its product more accessible to consumers, so more consumers choose it
Firms’ products differ in terms of their current quality, $\xi_j$

At the beginning each period, each type of firm decides whether to exit for scrap value or continue operating

Potential entrants decide whether to create new firms

Those that continue choose a level of investment in innovation
  - Investment increases the probability of quality improvement
The choice of retailing

- Each incumbent firm decides whether to sell through *Walmex* ($w_j = 1$ or $w_j = 0$)
  - The benefit: Access to *Walmex* consumer base
  - The cost: *Walmex* dictates a low price

- Pure Bertrand product market competition for firms not selling through *Walmex*
Nash Equilibrium

- In equilibrium
  - The transition density for the industry states is correctly understood by all agents
  - Spot markets clear at optimal price ($P_j$) and retail ($w_j$) choices
  - Optimal investments towards quality improvements are made

- Given parameters, we solve for the *oblivious* equilibrium numerically
  - Oblivious equilibrium: approximation technique introduced by Weintraub, Benkard and Roy (2007)
Optimal price setting

- Firms selling through *Walmex* must meet a minimum quality level and price at:
  \[ \bar{P}_j = P_0 + \theta_3 \ln(\xi_j), \ \theta_3 > 0 \]

- The remaining firms do best to price at:
  \[ P_j = \frac{Y + \theta_2 C_j(1 - h_j)}{1 + \theta_2 (1 - h_j)}, \ j \in \mathcal{I} \]

where

\[ h_j = h(j|\mathbf{w}, \mathbf{P}, \xi) = \frac{\exp[U_{ij}]}{\sum_{\ell} \exp[U_{i\ell}] + 1} \]
Equilibrium retailing choice

- Firms anticipate second stage equilibrium prices for each quality level.
- Given the decisions of their competitors \((w_{-j})\), they make the profit-maximizing \(\text{Walmex}\) choice by comparing
  
  \[
  \pi_j = \pi(j, w_j = 0|w_{-j}, \xi) = (P_j - C) \cdot h_j \cdot M
  \]

  and

  \[
  \pi_j = \pi(j, w_j = 1|w_{-j}, \xi) = (\bar{P}_j - C) \cdot h_j \cdot M
  \]

- Equilibria in retailing choices obtain when:
  
  \[
  \left[ \pi_j(j, w_j = 1|w_{-j}, \xi) - \pi_j(j, w_j = 0|w_{-j}, \xi) \right] \cdot w_j 
  + \left[ \pi_j(j, w_j = 0|w_{-j}, \xi) - \pi_j(j, w_j = 1|w_{-j}, \xi) \right] \cdot (1 - w_j) \geq 0 \quad \forall j.
  \]
Product quality investments

- $r_j$ is the current level of R&D of the $j^{th}$ producer in order to influence its product quality next period, hereafter denoted $\xi_j$

- Product quality realizations are elements of a discrete ordered set

- Quality moves at most one position for each firm per period
The evolution of product quality over time

- With R&D effort $r$, a firm’s probability of success is $\frac{ar}{1+ar}$.

- Firms lose a quality step with exogenous probability $\delta$.

- The quality transition probabilities are

|       | \( \Pr \left[ \xi_j' = \xi_i + 1 | \xi_j = \xi_i \right] \) |
|-------|---------------------------------------------------------------|
| **Up**| \( \Pr \left[ \xi_j' = \xi_i + 1 | \xi_j = \xi_i \right] = \frac{ar_j}{1+ar_j} (1 - \delta) \) |
| **Constant**| \( \Pr \left[ \xi_j' = \xi_i | \xi_j = \xi_i \right] = \left( 1 - \frac{ar_j}{1+ar_j} \right) (1 - \delta) + \frac{ar_j}{1+ar_j} \delta \) |
| **Down**| \( \Pr \left[ \xi_j' = \xi_i - 1 | \xi_j = \xi_i \right] = \left( 1 - \frac{ar_j}{1+ar_j} \right) \delta \) |
Bellman equation

Let the $i^{th}$ element of $s = (s_1, s_2, ..., s_K)$ be the number of firms in the industry at quality level $\zeta^i$

Let $s_{-j}$ be the same vector, except in that it leaves firm $j$ out of the count

Let $\pi^* (\zeta^j, s_{-j})$ be the profits of firm $j$ when it is at quality $\zeta^j$, and the remainder of the industry is at $s_{-j}$

Then optimal decisions are characterized by:

$$V (\zeta^j, s_{-j}) = \max \left[ \phi_s, \max_{r_j} \left\{ \pi^* (\zeta^j, s_{-j}) - c_r \cdot r + \beta E_{\Omega_j} \left[ V (\zeta^j, s'_{-j}) \right] \right\} \right]$$
Entry and exit

- Firms enter at some common initial quality level when the expected profits exceeds the (exogenous) cost of creating a new firm.

- Firms exit when the scrap value $\phi_s$ exceeds its continuation value.
## Simulations: main parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Without <em>Walmex</em></th>
<th>With <em>Walmex</em> option</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C$ : Marginal costs</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>$\beta_w$ : Walmex boost</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>$\xi$ : Min. Walmex quality</td>
<td>n.a.</td>
<td>2.0</td>
</tr>
<tr>
<td>$\theta_3$ : Quality-price rel’n</td>
<td>n.a.</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Price setting in the Walmex world
R&D investment

Blue line: No *Walmex*

Green line: *Walmex* is present
Product quality upgrading

Blue line: No *Walmex*  
Green line: *Walmex* is present
The number of firms

Blue line: No *Walmex*  
Green line: *Walmex* is present
Key model implication

- Both static and dynamic responses to *Wal*mex vary across the quality distribution:

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
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</thead>
<tbody>
<tr>
<td><strong>Sales</strong></td>
<td>↓↓↓</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td><strong>Innovation &amp;</strong></td>
<td></td>
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<tr>
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</tr>
<tr>
<td><strong>Price</strong></td>
<td></td>
<td>↓</td>
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</tbody>
</table>
Simulations: specific results

1. Net exit occurs (39 firms → 20 firms)

2. Operating profits increase by 23%

3. Exit and entry rates fall (3.5% → 1.8%)

4. Consumer surplus rises by 2%
Regression evidence: key data

- Panel data on Mexican manufacturing establishments (1993 to 2002)
  - Almost 7,000 establishments (= plants) across 205 industry groups
  - Source: INEGI

- Number of *Walmex* stores, by state and over time

- Information on whether products are carried by *Walmex*, or not

- Control variables: State GDPs, US and Mexican tariff levels, and fixed effects
Estimation

- Identification: *Are establishments that sell a Walmex-type product affected differently when Walmex’ regional presence increases, compared to establishments that do not sell Walmex-type products?*

Use simultaneous quintile regressions:

\[
(Y_{it} - \bar{Y}_{jt}) = \beta_1^q \ln(N_{st}) + \beta_2^q WMX_j + \beta_3^q \ln(N_{st}) \times WMX_j + \beta_4^q \ln(GDP_{st}) + \beta_5^q \ln(GDP_{st}) \times WMX_j + \beta_6^q TAR_{jt}^{MEX} + \beta_7^q TAR_{jt}^{US} + \alpha_t^q + \varepsilon_{it}^q,
\]

where \(i \in \text{state } s, \text{industry } j\); e.g., in the first results, dependent variable \(Y_{it}\) is domestic sales of establishment \(i\) in year \(t\)

- \(q\) is the quintile of the sales distribution (generally, the \(Y_{it}\) variable dist’n)
### Summary statistics

#### Innovation & Upgrading

<table>
<thead>
<tr>
<th></th>
<th>Sales</th>
<th>R&amp;D Expend.</th>
<th>Skill Intensity</th>
<th>Imported Interm. Inputs</th>
<th>Av. Wage</th>
<th>Capital Investment</th>
<th>Labor Product'y</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td>9.55</td>
<td>0.51</td>
<td>0.31</td>
<td>0.19</td>
<td>3.12</td>
<td>3.58</td>
<td>4.23</td>
<td>5.12</td>
</tr>
<tr>
<td><strong>S.D.</strong></td>
<td>1.73</td>
<td>1.61</td>
<td>0.20</td>
<td>0.29</td>
<td>0.64</td>
<td>3.43</td>
<td>1.07</td>
<td>0.44</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>52861</td>
<td>57495</td>
<td>48896</td>
<td>52586</td>
<td>54552</td>
<td>52795</td>
<td>53672</td>
<td>40073</td>
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### Walmex and changes in sales for small versus large firms

<table>
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<tr>
<th></th>
<th>20th percentile</th>
<th>80th percentile</th>
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<tr>
<td><strong>ln(#WalMartStores)</strong></td>
<td>0.159***</td>
<td>0.089***</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.015)</td>
</tr>
<tr>
<td><strong>WalMartProduct</strong></td>
<td>−5.264***</td>
<td>−1.122</td>
</tr>
<tr>
<td></td>
<td>(0.871)</td>
<td>(0.968)</td>
</tr>
<tr>
<td><strong>ln (#WalMartStores) × WalMartProduct</strong></td>
<td>−0.214***</td>
<td>0.072*</td>
</tr>
<tr>
<td></td>
<td>(0.038)</td>
<td>(0.042)</td>
</tr>
<tr>
<td><strong>ln(StateGDP)</strong></td>
<td>−0.247***</td>
<td>−0.100***</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.023)</td>
</tr>
<tr>
<td><strong>ln(StateGDP) × WalMartProduct</strong></td>
<td>0.316***</td>
<td>0.059</td>
</tr>
<tr>
<td></td>
<td>(0.053)</td>
<td>(0.059)</td>
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Number of obs: 52,861; regression also includes constant, tariff levels, and time fixed effects; bootstrapped standard errors in parentheses.
Changes in sales across quintiles

Coefficient on $\ln(\#\text{WalmexStores}) \times \text{WalMartProduct}$

- $q_{20}$
- $q_{40}$
- $q_{60}$
- $q_{80}$
Changes in R&D spending across firms

Wal-Mart’s Invasion of Mexico
Skill composition as another indicator of upgrading
Importing intermediate inputs from abroad
Walmex and labor productivity changes

![Graph showing productivity changes for different quantiles (q20, q40, q60, q80)]
Establishment-level prices incorporate product-level information; index = 100 in 1994, no time fixed effects
Supplier response: Model versus data

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- **Upgrading**

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Summary

- Wal-Mart’s entry had a major impact on Mexico’s manufacturing industry.
- We find static reallocation (between-firm) and dynamic (within-firm) effects.
- The industry evolution model matches the interview and quantitative evidence well.
Implications

- Empirical analysis ought to bring possible heterogeneous responses more into focus
  - Market share gains versus losses
  - More technology spending versus less
  - Firm- and labor force upgrading versus downgrading

- Upstream-downstream relations appear to be important for assessing the impact of trade and FDI liberalization on market size, technological change, and welfare