Superstores or Mom and Pops?
Market Size, Technology Adoption, and TFP Differences

David Lagakos
Federal Reserve Bank of Minneapolis

June 19, 2008
Per-Capita Income Differences Explained by TFP

- Vast differences in Y/L across countries

- Y/L explained largely by total factor productivity (TFP)
  - Hall & Jones, 99
  - Klenow & Rodríguez-Clare, 96
  - Many others
My Focus: TFP Differences in Retail Sector

- Large sector $\sim 15\%$ to $20\%$ of employment

- Disaggregated productivity data: new implications for TFP
Conventional Theory of Low TFP

Policies that limit competition and foster rent seeking
Conventional Theory of Low TFP

*Policies that limit competition and foster rent seeking*

- Barriers to technology adoption (Parente & Prescott, 94; 99)
- Lack of market competition (Schmitz, 02; 05)
- Lack of "social infrastructure" (Hall & Jones, 99)
- Misallocation across producers (Klenow & Hsieh, 07)
- Worker resistance to new technology (Clark, 87; 07)
My Theory of Retail TFP Differences

- Developing countries have incentives to *choose* low-TFP technologies in retail
My Theory of Retail TFP Differences

- Developing countries have incentives to *choose* low-TFP technologies in retail
- Two retail technologies:
  - High-TFP ”Modern” stores (e.g. supermarkets)
  - Low-TFP ”Traditional” stores (e.g. mom and pops)
My Theory of Retail TFP Differences

- Developing countries have incentives to *choose* low-TFP technologies in retail

- Two retail technologies:
  - High-TFP "Modern" stores (e.g. supermarkets)
  - Low-TFP "Traditional" stores (e.g. mom and pops)

- Modern stores require sufficient *market size*
  - Must recoup large fixed costs
My Theory of Retail TFP Differences

- Developing countries have incentives to *choose* low-TFP technologies in retail

- Two retail technologies:
  - High-TFP ”Modern” stores (e.g. supermarkets)
  - Low-TFP ”Traditional” stores (e.g. mom and pops)

- Modern stores require sufficient *market size*
  - Must recoup large fixed costs

- Limited market size in developing countries
  - Low household income
  - High household transport costs (limited car ownership)
Evidence For Market Size & Challenge to Barriers Theory

I document that in developing countries

- Modern store technology not operated inefficiently

- Spatial evidence
Evidence For Market Size & Challenge to Barriers Theory

I document that in developing countries

- Modern store technology *not* operated inefficiently
  - Modern store TFP roughly on par with US

- Spatial evidence
Evidence For Market Size & Challenge to Barriers Theory

I document that *in developing countries*

- Modern store technology *not* operated inefficiently
  - Modern store TFP roughly on par with US

- Spatial evidence
  - Modern stores located mostly in largest markets
Retail TFP Measurement

- **Data Sources**
  - US - BEA GDP-by-Industry Accounts
  - Mexico - 1999 Censo Comercial
  - Thailand - 2002 Business Trade and Services Survey
- **Modern Store** = establishment with 20+ workers
- **Output** = Value Added at PPP $, Deflated
- **Productivity Measure:** TFP

\[ Y = TFP \cdot L^\alpha \cdot K^{1-\alpha} \]
Low TFP in Developing Country Retail Sector
But Very High TFP in Modern Stores

TFP (US Retail Sector = 100)

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>Thailand</th>
<th>Mexico</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retail Sector</td>
<td>100</td>
<td>40</td>
<td>37</td>
</tr>
<tr>
<td>Modern</td>
<td>91</td>
<td>82</td>
<td></td>
</tr>
<tr>
<td>Traditional</td>
<td>25</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>
Vast Compositional Differences Drive TFP Differences

Percent of Retail Employment

Modern

US
24
Thailand
19
Mexico

Traditional

US
25
Thailand
76
Mexico
81

Legend:
- US
- Thailand
- Mexico
What Explains Retail Compositional Differences?

- This paper: market size differences
- Spatial Evidence: in poor countries, most modern stores in large markets
Modern Store Employment Shares within Mexico

Deciles -- Income per Square Mile Distribution

Percent of Retail Employment in Modern Stores

<table>
<thead>
<tr>
<th>Decile</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>3</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>27</td>
</tr>
<tr>
<td>7</td>
<td>30</td>
</tr>
<tr>
<td>8</td>
<td>34</td>
</tr>
<tr>
<td>9</td>
<td>38</td>
</tr>
<tr>
<td>10</td>
<td>49</td>
</tr>
</tbody>
</table>
Model Overview

- Formalize market size theory
- Gauge quantitative importance of market size
- Quantify effects of policies related to market size
Households & Spatial Structure

Spatial Structure

- Households live along circumference of circle (Salop, 1979, Hotelling, 1929)
- Unit measure of households, unit circumference

Households

- Exogenous income $y$, distribution $G(y)$
- Identical distribution at each point on circle
Two Retail Store Technologies

▶ Modern Store

- Relatively lower marginal cost \( mc_M \)

- Must pay fixed cost

▶ Traditional Store

- Higher marginal cost \( mc_T \)

- NO fixed cost
Store Competition

- First Stage - Entry
  - If enter, choose technology M or T
  - M stores placed evenly along circle
  - T stores placed evenly along circle

- Second Stage - Pricing
  - Stores pick prices $p_M$ and $p_T$

- Entry until zero profits
Results: Store Location & Pricing

Traditional stores

- Locate at each point on circle
- Price at marginal cost: $p_T = mc_T$

Modern stores

- Price above marginal cost: $p_M > mc_M$
- Price below traditional stores: $p_M < p_T$
Household Preferences & Budget Constraint

- Preferences
  
  \[ U = \log(c_M + c_T) + \log(1 - h_M - h_T) + \alpha A \]

- Automobile
  
  \[ A \in \{0, 1\} \]

- Budget Constraint
  
  \[ y \geq p_M c_M + p_T c_T + p_A A \]
Household Shopping Decision: Price vs Distance Tradeoff

\[ p_M \xrightarrow{\chi} p_T \xrightarrow{\chi} p_M \]

Fixed shopping time cost

\[ h_M \equiv \begin{cases} 
  x \cdot \tau_A & \text{If auto owner} \\
  x \cdot \tau_B & \text{If non-auto owner} 
\end{cases} \]

Auto reduces transport costs

\[ \tau_A < \tau_B \]
Proposition 1

Optimal Household Behavior. For a household with income and modern-store distance \((x, y)\), shopping at the modern store is optimal when \(x\) satisfies

\[
x < \tilde{x}_i \equiv \frac{1 - p_M/p_T}{\tau_i}
\]

where \(i \in \{A, B\}\) indexes the optimal transportation choice. Purchasing an auto is optimal when \(x\) and \(y\) satisfy

\[
y > y_A(x) \equiv \frac{p_A}{1 - \psi(x) \exp(-\alpha)}
\]

where

\[
\psi(x) \equiv \begin{cases} 
(1 - \tau_B x)/(1 - \tau_A x) & \text{if } x \leq \tilde{x}_B \\
(p_M/p_T)/(1 - \tau_A x) & \text{if } \tilde{x}_B < x \leq \tilde{x}_A \\
1 & \text{if } x > \tilde{x}_A.
\end{cases}
\]
Solution to Household Problem
Sector Aggregate Productivity Determined by Composition

- Modern Employment Share

\[ \mu \equiv \frac{L_M + \bar{L}}{L_T + L_M + \bar{L}}. \]

- Producer productivity

- \( LP_M \equiv \frac{Y_M}{L_M + \bar{L}} \)

- \( LP_T \equiv \frac{Y_T}{L_T} \)

- Sector productivity

\[ LP = \frac{Y_M + Y_T}{L_M + \bar{L} + L_T} = \mu LP_M + (1 - \mu) LP_T. \]
Main Qualitative Results

Modern store employment share $\mu$, and retail productivity, is

- Increasing in income
- Decreasing in transport costs $\tau_A$
- Decreasing in auto price $p_A$
Main Qualitative Results

Modern store employment share $\mu$, and retail productivity, is

- Increasing in income
- Decreasing in transport costs $\tau_A$
- Decreasing in auto price $p_A$

Higher income / lower transport costs help modern store recoup fixed costs
Quantitative Importance of Market Size

- Parameterize model to match ‘typical’ developing country
- Multiply income by 4 (to reach US level)
- Compute model’s predictions for modern share
Quantitative Importance of Market Size

- Parameterize model to match ’typical’ developing country
- Multiply income by 4 (to reach US level)
- Compute model’s predictions for modern share
- Conclusion (in Paper): Income explains $\sim 1/2$ retail TFP gap
Policy Implications

Relevant Policies

1. Transportation Infrastructure
2. Taxes on new car purchases/imports
3. Bans on used car imports
Conclusions

- Low income can lead to lower TFP
  - Retail: Can account for roughly 1/2 of TFP gap
  - Broader relevance: non-tradeable sectors

- Household goods can be complementary to new technologies

- Novel implications about which government policies hurt TFP