Incentives for a Multi-Product Sales Force: Theory and Evidence

Xiaolin Li
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Outline

- Introduction
- Context and Data Description
- Initial Analysis
- Structural Model
- Conclusion
Multi-Product Sales Forces

- Sales forces generally consist of people with different abilities.
- Sometimes all salespeople sell all products, other times salespeople specialize in one or more products.
Related Literature

- Large theory literature on incentive design, mainly with homogenous agents and a single product (Prendegrast, 1999 review)
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Heterogeneous products:

- Weinberg (1975, 1978): Commission structure should be based on equal fractions of each product's realized gross margin
- Lal and Srinivasan (1993): Commission rates should be higher for easier-to-sell products
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- Heterogeneous agents:
  - Lazear (2000): Incentive plans have significant ‘sorting’ effect

- However
  - No literature on heterogeneous products and heterogeneous agents

However
Research Questions

- What is the impact of heterogeneity in people and products on sales?
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  - What is the impact on sales of having a specialized vs. a multi-product sales force?
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What is the impact on sales of having a specialized vs. a multi-product sales force?

What is the impact on sales of having a single-rate vs. equally costly multi-rate plan?
Our Approach

- Empirical context: Indian firm selling big-ticket items
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- Estimate optimal responses of agents to incentives
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- Empirical context: Indian firm selling big-ticket items
- Estimate optimal responses of agents to incentives
- Explore alternative incentive plans
Preview of Findings

- Holding total cost (wages) the same
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  - Specialization (i.e., assigning higher ability people to harder-to-sell products and lower ability people to easier-to-sell products) increases sales of harder-to-sell products by 26% and reduces sales of easier-to-sell products by 50% (total sales reduce by 30%)

- Incentive homogeneity (i.e., single-rate plan) decreases sales of harder-to-sell products by 15% and increases sales of easier-to-sell products by 19% (total sales increase by 8%)
Holding total cost (wages) the same

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Empirical Context

- Firm in India selling vacation time-share properties
Empirical Context

Product line:
- 1 bedroom: harder to sell
- Studios: easier to sell

All salespersons sell full product line

Incentives differ across products
Product line:
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Empirical Context

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Takeaway: Lower commission rates for easier to sell product (studios)
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Data Description

3 years of data on 66 sales agents
Identities and designations
Quarterly sales on each product
Incentive plans
Data Description

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Data Description

- 3 years of data on 66 sales agents
  - Identities and designations
  - Quarterly sales on each product
  - Incentive plans
Data Description

**Units of Rooms Sold**

- **Per quarter**
- **One Bedrooms**
- **Studios**

**Quarterly Sales ($ Millions)**

- **One Bedrooms**
- **Studios**
## Data Description

### Outcomes

- **Studios are the dominant product**
- **Evidence for salesperson heterogeneity**

<table>
<thead>
<tr>
<th>Quantile</th>
<th>% Studios (units)</th>
<th>% Studios ($)</th>
<th>% Studios ($ Incentives)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>80.00%</td>
<td>71.39%</td>
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<td>88.30%</td>
<td>81.46%</td>
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</tr>
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<td>96.32%</td>
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**Reduced Form Analysis**

\[ Sales_{ijt} = \alpha + \beta_1 \ast ability_i + \beta_2 \ast ProductDummies_j + \beta_3 \ast Time_t + \epsilon_{ijt} \]

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability</td>
<td>0.18 (0.06) ***</td>
<td></td>
<td>1.60 (0.06) ***</td>
<td></td>
</tr>
<tr>
<td>1 BR</td>
<td>-6.55 (0.40) ***</td>
<td>-7.03 (0.41) ***</td>
<td>-1.61 (0.13) ***</td>
<td>-1.64 (0.11) ***</td>
</tr>
<tr>
<td>Year 2010</td>
<td>-1.05 (0.44) **</td>
<td>-1.21 (0.44) ***</td>
<td>-0.27 (0.14) *</td>
<td>-0.31 (0.12) **</td>
</tr>
<tr>
<td>Year 2011</td>
<td>-1.72 (0.84) **</td>
<td>-2.03 (0.85) **</td>
<td>-0.61 (0.27) **</td>
<td>-0.58 (0.24) **</td>
</tr>
<tr>
<td>Quarter 2</td>
<td>-2.32 (0.67) ***</td>
<td>-2.67 (0.67) ***</td>
<td>-0.64 (0.21) ***</td>
<td>-0.73 (0.19) ***</td>
</tr>
<tr>
<td>Quarter 3</td>
<td>-1.98 (0.67) ***</td>
<td>-2.40 (0.68) ***</td>
<td>-0.56 (0.21) ***</td>
<td>-0.68 (0.19) ***</td>
</tr>
<tr>
<td>Quarter 4</td>
<td>-1.96 (0.67) ***</td>
<td>-2.27 (0.67) ***</td>
<td>-0.59 (0.21) ***</td>
<td>-0.64 (0.19) ***</td>
</tr>
<tr>
<td>Sales Person FE</td>
<td>**</td>
<td></td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Cons_</td>
<td>Included</td>
<td>Included</td>
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</tr>
<tr>
<td>Pseudo R-square</td>
<td>0.1721</td>
<td>0.2095</td>
<td>0.1658</td>
<td>0.2680</td>
</tr>
<tr>
<td>Obs. Summary</td>
<td>829 left-censored obs at unit sales &lt;= 0, 227 uncensored obs</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\* \( p < 0.1 \), \** \( p < 0.05 \), \*** \( p < 0.01 \)
Takeaways:

- Higher ability salespersons sell more
- Studios outsell 1 bedrooms; pattern holds across all levels of salesperson ability
- Evidence of seasonality in sales

Summing up: The evidence so far seems to clearly indicate differences in outcome (sales) associated with differences in product type and salesperson ability
We build a structural model tailored to our empirical context that accommodates:

- two products
- heterogeneity in ability of salespersons
- heterogeneity in ease of selling products
Structural Model

Multi-product line: $i \in \{1, \ldots, N\}$

Heterogeneity in ease of selling products: $k_i$

Heterogeneity in ability of salespersons: $\phi = [\phi_L, \phi_H]$

Production function:

$y_{ij} = \phi_j k_i e_{ij}^{1/2} + \epsilon_{ij}$, $\epsilon_{ij} \sim N(0, \sigma_{ij}^2)$

Cost function:

$c = \frac{1}{2}(e_1 + e_2 + \ldots + e_N)$

Incentive plan:

$R_i, W = R_1 y_1 + \ldots + R_N y_N$
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\[ Max_{e_1, \ldots, e_N} E U^A = \sum_{i=1}^{N} R_i E y_i - C(e_1, \ldots, e_N) - \frac{r}{2} \sum_{i=1}^{N} R_i^2 \sigma_i^2 \]

where

\[ y_i = \phi k_i e_i^{0.5} + \epsilon_i \]

\[ W = R_1 y_1 + \ldots + R_N y_N \]

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\begin{align*}
    e_1^* &= \left( \frac{k_1 R_1}{k_N R_N} \right)^2 \left[ \sum_{i=1}^{N-1} \frac{\frac{1}{2} \phi k_i R_i R_N}{k_i R_i} \right]^{2/3} \\
    \vdots \\
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\[
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\[y_i = \phi k_i e_i^{0.5} + \epsilon_i\]

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  \frac{e_i^*}{e_i} &= \left(\frac{k_i R_i}{k_j R_j}\right)^2
\end{align*}
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Structural Model

From Data:
Two types of salespersons based on their designations
- Sales executives: 40 agents
- Managers: 26 agents

(Robustness check: FEs)

Observed commission rates on each product

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    | Selling Price (per unit) | Compensation (per unit) | Incentive Share (% of compensation/sales) |
    |--------------------------|--------------------------|------------------------------------------|
    | Bedrooms                 | $332,009                 | $9,833                                   | 2.96%                                    |
    | Studios                  | $256,450                 | $7,000                                   | 2.73%                                    |

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- To estimate
  - Relative ease of selling: \( k \) (1 BRs normalized as 1)
  - Ability of salespersons: \( \phi = [\phi_{ex}, \phi_{mg}] \)
  - GMM
## Estimation Results

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<th>Parameters</th>
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<td>0.73 (0.02) **</td>
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<td>$k$</td>
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** p<.05

Takeaways:

Significant differences in salespeople ability levels across designations.

Relative ease of selling studios ($k$) is consistent with institutional knowledge.
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- Relative ease of selling studios ($k$) is consistent with institutional knowledge
Mixed or Specialized Sales Force?

Assign high-ability salespersons to harder-to-sell product, keeping total wage costs of the firm the same
Mixed or Specialized Sales Force?

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Mixed or Specialized Sales Force?

- Assign high-ability salespersons to harder-to-sell product, keeping total wage costs of the firm the same

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<th>Effort</th>
<th>Studios (Easy)</th>
<th>1 BRs (Hard)</th>
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<tbody>
<tr>
<td>High ability agent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low ability agent</td>
<td></td>
<td></td>
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<tr>
<td>(26)</td>
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Current Condition

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<th>185.66</th>
<th>95.31</th>
<th>86.24</th>
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<tr>
<td>Specialized Sales Force</td>
<td>0</td>
<td>356.04</td>
<td>322.08</td>
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</tr>
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Mixed or Specialized Sales Force?

Assign high-ability salespersons to hard product, keeping costs of the firm the same

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<th>Sales (units)</th>
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<td>990</td>
</tr>
<tr>
<td></td>
<td>1517 units</td>
</tr>
<tr>
<td>Specialized Sales Force</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>694 units</td>
</tr>
</tbody>
</table>

- Current Condition: 1517 units, Total Revenue: $389,034, ($388,138 - 897,897)(-26.21%)
- Specialized Sales Force: 694 units, 633 units, Total Revenue: $177,976 (-54.26%), $210,162 (+26.21%)
# Single vs. Multi-Rate Incentives?

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<th>Low Ability</th>
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Current Case

- **1314 units**
- **527 units**
- **327,034**

Single Commission Case I ($R_1=R_2=9833$)

- **2013 units**
- **474 units**
- **673,606**

Single Commission Case II ($R_1=R_2=7000$)

- **1797 units**
- **423 units**
- **601,280**
## Single vs. Multi-Rate Incentives?

- Assign same commission rate to both products

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<tbody>
<tr>
<td></td>
<td>Studios (Easy)</td>
<td>1 BRs (Hard)</td>
</tr>
<tr>
<td><strong>High ability agent (40)</strong></td>
<td>990</td>
<td>527</td>
</tr>
<tr>
<td><strong>Low ability agent (26)</strong></td>
<td>1517 units</td>
<td>501 units</td>
</tr>
<tr>
<td><strong>Low ability agent (26)</strong></td>
<td>2013 units</td>
<td>474 units</td>
</tr>
<tr>
<td><strong>Current Case</strong></td>
<td>1314</td>
<td>699</td>
</tr>
<tr>
<td><strong>Single Commission Case I (R1=R2=9833)</strong></td>
<td>1173</td>
<td>624</td>
</tr>
<tr>
<td><strong>Single Commission Case II (R1=R2=7000)</strong></td>
<td>1797 units</td>
<td>423 units</td>
</tr>
</tbody>
</table>
Conclusions

Heterogeneity in sales force has significant impacts on effort and sales. Specialized salesforce increases sales of focal products, but huge opportunity costs on uncarried products. Multi-rate incentives increases sales of products with higher incentives, but huge opportunity costs on products with lower incentives. Effect of heterogeneity on product sales depends crucially on relative ease of selling and distribution of ability.
Conclusions

- Heterogeneity in sales force has significant impacts on effort and sales
  - Specialized salesforce increases sales of focal products, but huge opportunity costs on uncarried products
  - Multi-rate incentives increases sales of products with higher incentives, but huge opportunity costs on products with lower incentives
- Effect of heterogeneity on product sales depends crucially on relative ease of selling and distribution of ability
Thank You!
Backup Slides
Heterogeneous Effect 2: Single vs. Multi-Rate Incentives

<table>
<thead>
<tr>
<th>Effort</th>
<th>Product 1</th>
<th>Product 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>High ability agent</td>
<td>24.75</td>
<td>20.26</td>
</tr>
<tr>
<td>Low ability agent</td>
<td>8.18</td>
<td>6.70</td>
</tr>
</tbody>
</table>

Current Case

<table>
<thead>
<tr>
<th>Commission Case I ((R1=R2=9833))</th>
<th>Effort</th>
<th>Product 1</th>
<th>Product 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Commission Case II ((R1=R2=7000))</td>
<td>29.33</td>
<td>24.01</td>
<td>6.90</td>
</tr>
</tbody>
</table>

Effort increase compared toCurrent Case:

- Product 1: +32.73% for High ability agent, +18.51% for Low ability agent
- Product 2: +32.72% for High ability agent, +18.51% for Low ability agent

Effort decrease compared toCurrent Case:

- Product 1: -5.50% for High ability agent, -15.65% for Low ability agent
- Product 2: -5.50% for High ability agent, -15.65% for Low ability agent
Heterogeneous Effect 2: Single vs. Multi-Rate Incentives

- Assign same commission rate to both products

<table>
<thead>
<tr>
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</tr>
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<tr>
<td></td>
<td>Product 1</td>
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<tr>
<td></td>
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</tr>
<tr>
<td>Current Case</td>
<td>24.75</td>
</tr>
<tr>
<td>Single Commission</td>
<td></td>
</tr>
<tr>
<td>Case I (R1=R2=9833)</td>
<td>32.85 (+32.73%)</td>
</tr>
<tr>
<td>Single Commission</td>
<td></td>
</tr>
<tr>
<td>Case II (R1=R2=7000)</td>
<td>29.33 (+18.51%)</td>
</tr>
</tbody>
</table>