Global Takeoff of New Products
Role of Economics, Culture, & Country Innovativeness

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Observation

- New products either
  - takeoff: success
  - never takeoff: failure

- We rarely see even growth
Sales of a New Product

- Even
- Takeoff
- No takeoff
Sales of Microwaves for 3 Major Countries

[Graph showing sales of microwaves for France, Germany, and the UK from 1970 to 1990]
Research Questions

- Is Takeoff a distinct phenomenon?
- Does it vary by country?
- If so, does economics or culture explain variation?
- Can we model and predict takeoff?
- Should firms use sprinkler or waterfall strategy?
- In which countries to launch first?
Importance

- Takeoff involves growth of about 300%
- Takeoff requires enormous resources
- Takeoff marks beginning of success
Contribution

• Bass diffusion model captures new product adoptions assuming takeoff & slowdown

• We try to predict takeoff and slowdown:
Definitions

• Takeoff
  – The transition from introduction to growth in the product life cycle
  – First major turning point in curve
  – First large increase in growth rate

• Time to Takeoff
  – Period between introduction & takeoff
Reason for Takeoff

• From Management of Technology
  – New products introduced on technological waves
  – Initially well known but expensive, not popular
  – When benefit/price ratio rises above competing technology, sales take off
• Takeoff is binary, time dependent event
Technological Life Cycles

Time

Benefit/$

takeoff

Technological breakthrough
Measuring Takeoff

• Problem:
  – Growth rates high when base sales low
  – Need standard across countries

• Solution: use growth rate & penetration
  – Using Heuristic: 1st year growth > 50% when penetration > 1%
  – Threshold: adjusts continuously for both
Threshold of Takeoff

Growth %

Penetration
Advantages of Threshold Rule

Provides

- A simple metric for analysts
- A standard for comparisons across countries
- A heuristic of takeoff for managers
Success in Identifying Takeoff

- For US, over 90%
- For Europe, over 95%
- For World in progress (now using a 2% rule)
Modeling Takeoff

- Hazard Model:
  - Probability of takeoff given it has not
  - $= f$ (baseline hazard plus effect of explanatory variables)

- Reasons for using: Hazard Model
  - Models binary time dependent event - takeoff
  - Gives nonlinear baseline probabilities
  - Allows for time varying explanatory variables
  - Allows for censored data
Parametric Hazard Model

\[ h\{t|X(t)\} = \{f(t)|X(t)\}/\{S(t)|X(t)\} \]
\[ = h_0\{t|X(t)\} g(X(t)) \]

We use a logistic hazard function, for which:

\[ h\{t|X(t)\} = \{\lambda \alpha(\lambda t)^{\alpha-1}\}/\{1+(\lambda t)^\alpha\} \]

\[ \alpha = 1/\sigma \quad = \text{characteristic of distribution} \]
\[ \lambda = e^{-\beta X} \quad = \text{hazard ratio} \]
Why Time-to-Takeoff May Vary

- Reasons for variation: characteristics of
  - Country
  - Product category
  - Firm’s strategy: price

- Country itself can be explained by
  - Economics
  - Culture
  - Information access
Variables

- Economic variables
  - Economic wealth
  - Economic progressiveness
  - Openness of economy
  - Economic role of women
- Cultural variables
  - Uncertainty avoidance
  - Religion
  - Work Climate
- Information Access
  - Media intensity
  - Mobility
  - Education
- Category
  - Market penetration
  - Prior takeoffs
  - Year of introduction
  - Electronic (entertain) vs K&L (work)
Measures for Variables

- **Economic variables**
  - Economic wealth GDP
  - Economic progress GINI
  - Openness of economy Imp/Exp EU member
  - Economic role women % work

- **Cultural variables**
  - Uncertainty avoidance Hofstede
  - Religion % protest
  - Work Climate climate

- **Information Access**
  - Media intensity index
  - Mobility index
  - Education % school

- **Category**
  - Market penetration lag pen
  - Prior takeoffs number
  - Year of introduction year
  - Electronic vs K&L dummy
Three Studies

1. US: 1 country x > 40 categories
2. Europe: 16 countries x 10 categories
3. Globe: 40 countries x > 20 categories
European Data

- Countries: 16 Western European
- Categories: 10: 4 entertainment, 6 work
- Total: 137 x about 30 years on each
- Source: Economist Intelligence Unit
  Euromonitor, GFK, UN, EC
  Libraries, Firms, Friends
# Categories

<table>
<thead>
<tr>
<th>Category</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entertain/Electronic</strong></td>
<td></td>
</tr>
<tr>
<td>Computer</td>
<td>12</td>
</tr>
<tr>
<td>CD Player</td>
<td>8</td>
</tr>
<tr>
<td>VCR</td>
<td>16</td>
</tr>
<tr>
<td>Color TV</td>
<td>3</td>
</tr>
<tr>
<td><strong>Work/K&amp;L</strong></td>
<td></td>
</tr>
<tr>
<td>Microwave</td>
<td>16</td>
</tr>
<tr>
<td>Dryer</td>
<td>15</td>
</tr>
<tr>
<td>Freezer</td>
<td>15</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>16</td>
</tr>
<tr>
<td>Dishwasher</td>
<td>15</td>
</tr>
<tr>
<td>Washers</td>
<td>15</td>
</tr>
</tbody>
</table>
Key Questions

- Will time-to-takeoff vary?
- Why will time-to-takeoff vary?
Poll: For Europe

- Will time-to-takeoff across countries be:
  - Strong
  - Weak
  - None?
- Which variables will explain time to takeoff?
  - Economics
  - Culture
  - Category?
Regarding Countries?

- Which group will take off first?
  - Large or small economies?
  - Latin/Mediterranean, mid-Europe, Scandinavian?
- Which of 16 countries will be first?
<table>
<thead>
<tr>
<th>Country</th>
<th>Time To Takeoff</th>
<th>No</th>
<th>Country</th>
<th>Time To Takeoff</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>3.7</td>
<td>9</td>
<td>Spain</td>
<td>7.4</td>
<td>8</td>
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<tr>
<td>Norway</td>
<td>4.0</td>
<td>7</td>
<td>Italy</td>
<td>7.9</td>
<td>8</td>
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<td>Sweden</td>
<td>4.4</td>
<td>8</td>
<td>UK</td>
<td>8.5</td>
<td>6</td>
</tr>
<tr>
<td>Finland</td>
<td>4.6</td>
<td>8</td>
<td>Portugal</td>
<td>9.3</td>
<td>7</td>
</tr>
<tr>
<td>Belgium</td>
<td>5.0</td>
<td>9</td>
<td>France</td>
<td>9.4</td>
<td>7</td>
</tr>
<tr>
<td>Austria</td>
<td>5.1</td>
<td>7</td>
<td>Greece</td>
<td>9.8</td>
<td>6</td>
</tr>
<tr>
<td>Swiss</td>
<td>5.3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>5.8</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>6.3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>6.5</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Group</td>
<td>Years</td>
<td>Categories</td>
<td>St Dev</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-------</td>
<td>------------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scandinavian</td>
<td>4.1</td>
<td>32</td>
<td>3.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid Europe</td>
<td>5.8</td>
<td>41</td>
<td>4.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mediterranean</td>
<td>8.4</td>
<td>35</td>
<td>6.3</td>
<td></td>
<td></td>
</tr>
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</table>
## Category Effects Very Strong

*Time to Takeoff by Categories*

<table>
<thead>
<tr>
<th>Class</th>
<th>Countries</th>
<th>Years</th>
<th>St Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entertainment</td>
<td>33</td>
<td>2.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Work</td>
<td>76</td>
<td>7.7</td>
<td>2.5</td>
</tr>
<tr>
<td>Overall</td>
<td>109</td>
<td>6.1</td>
<td>3.2</td>
</tr>
</tbody>
</table>
What Variables Explain Takeoff (From Hazard Model)

• Three variables very strong and robust:
  – Type of product category
  – Prior takeoffs in other countries
  – Market penetration

• Culture important but not strong

• Economics, size of country, density of population, unimportant
### Estimates of Hazard Model
(with 4 variables & 3 factors)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Takeoff-Prob</th>
<th>“t-stat”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Products</td>
<td>-.78</td>
<td>5.2</td>
</tr>
<tr>
<td>Penetration((t-1))</td>
<td>.75</td>
<td>-2.2</td>
</tr>
<tr>
<td>Prior Takeoffs</td>
<td>.34</td>
<td>-3.8</td>
</tr>
<tr>
<td>Uncertainty Avoidance</td>
<td>.20</td>
<td>-2.9</td>
</tr>
</tbody>
</table>

\( U^2 \) 50% (vs null model without distribution)
Assessing Models’ Predictive Ability

- Re-estimate model excluding 1 target category each time
- Forecast explanatory variables of target category
  - At introduction: from mean of other categories
  - One-year-ahead: by mean changes over time
- Predict target category
- Compare actual vs. predicted
  - For 1st predicted takeoff (error of 1.2 yrs)
  - At introduction (error of 1.9)
Strategic Implications 1

- Use baseline Hazard as guide to decide whether or not to pull the plug
When to Pull the Plug?

Use Baseline Hazard of Takeoff
Strategic Implications 2

• Managing takeoff
  – Simulate hazard of takeoff for various levels of marketing variables (e.g., price)
  – Choose level that gives optimum time of takeoff
How Control Takeoff?
_simulate for 3 levels of annual price reduction_
Strategic Implications 3

Introducing new products

• Use waterfall strategy: introduce first in
  – Innovative regions (e.g., Scandinavian)
  – Small innovative countries (e.g., Denmark)

• Reasons
  – Lowers risk
  – Increases speed of takeoff
  – Provides learning for big markets
## Mean Lead & Lags in Year of Takeoff By Country Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Lead (Yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scandinavian</td>
<td>2.6</td>
</tr>
<tr>
<td>Mid Europe</td>
<td>1.3</td>
</tr>
<tr>
<td>Mediterranean</td>
<td>-3.3</td>
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<td>UK</td>
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<td>-7.0</td>
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<tr>
<td><strong>Range</strong></td>
<td><strong>10</strong></td>
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<tr>
<td>Country</td>
<td>Takeoff</td>
</tr>
<tr>
<td>-----------</td>
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<td>UK</td>
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<tr>
<td>France</td>
<td>-0.4</td>
</tr>
<tr>
<td>Italy</td>
<td>-2.1</td>
</tr>
</tbody>
</table>
Conclusions for Europe

- Takeoff varies distinctly by country
  - Scandinavian countries distinctly earlier takeoffs
  - Mediterranean countries distinctly late
  - Yet firms introduce first in English-speaking countries, large economies, use sprinkler strategy

- Hazard model can predict takeoff
  - Category characteristics have strong predictive value
  - Use for deciding when to pull the plug
  - Use for controlling takeoff
Extension to Global Takeoff

- Over 20 categories
- Over 47 countries
- 402 product x category combinations
Categories

- **Post 1990**
  - DVD player, Digital camera, MP3 player, MD player, Hand-held computer

- **1960-1990**
  - Microwave oven, VTR, Personal computer, CD player, Video camera, Cell phone, Internet

- **Pre 1960**
  - Dishwasher, Freezer, Dryer, Washing machine
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<th>Japan</th>
<th>Brazil</th>
</tr>
</thead>
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<td>Venezuela</td>
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<td>India</td>
<td>Chile</td>
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<td>Thailand</td>
<td>Mexico</td>
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<td>France</td>
<td>Indonesia</td>
<td>Canada</td>
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<td>Morocco</td>
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<tr>
<td>UK</td>
<td>Ireland</td>
<td></td>
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</table>
Patterns by Country

- Japan, Scandinavian countries most “innovative”
- North American, major mid-European countries highly innovative
- Latin countries across continents similar
- South-East Asian countries rank higher than Mediterranean countries
- Emerging Asian economies lag despite rapid economic growth
Time-to-takeoff by Category

- Big differences across categories
- Mean across all categories is 9 years
  - 7 years for entertainment products
  - 13 years for work products
Conclusions of Global Study

• Takeoff varies distinctly by categories
  – Entertainment much shorter than work
  – Big time x region x category interactions
• Convergence in takeoff across countries
  – esp for entertainment products in recent years
• Yet takeoff varies distinctly by country
  – Japan & Scandinavian c. lead world
  – Especially for work products
Lessons

- Big differences across countries
  - Waterfall strategy has benefits
- Big differences across products categories
- Model can predict takeoff
  - Do not assume linear growth
- Model can help control takeoff
  - Price most critical
Thank you!