Technology Diffusion and Long Term Forecasting: Application to Growth of Wireless Mobile Services

AT&T Symposium
August 3-4 2006

M. Hosein Fallah, Ph.D.
Elias Aravantinos
Wesley J. Howe School of Technology Management
Stevens Institute of Technology
Hoboken, NJ 07030
Outline

- Forecasting
- Technology Diffusion
- Modeling growth of Wireless services
- Problems with Mobile Diffusion Forecasts
- Case Analysis for Greece
- Issues and observations
- Implications of the study
- Future Research
Forecasting

People do forecasts all the time
- Manufacturing
- Sales
- Financial performance
- Natural phenomena

- Short term forecast
  - Daily weather
- Long term
  - Global warming
What is Diffusion?

**Diffuse** means spread out, scatter, pour in different directions

*Webster Dictionary*

Diffusion of an innovation is the process by which innovation is communicated among and adopted by the members of a social system.
Technology Diffusion

- People naturally resist change
- The adoption behavior for a new technology tends to follow an “S curve”
- Common diffusion models: Bass, Gompertz, Fisher-Pry

The growth pattern of a new technology can be represented in general by a function of the form

\[ f(e^{-g(t)}) \]
The Gompertz Model

- The Gompertz model is asymmetric, with the adoption rate slowing down as it progresses.
- The formula for the Gompertz model can be written as:

\[ y(t) = e^{-e^{b(t-a)}} \]

- Where “a” is the year the growth reaches the inflection point on the curve. This point normally correspond to 37% of the saturation level.
- “b” measures the speed of diffusion.
Diffusion of Some Past Innovations

Figure 1.1
Adoption Rates of Various Communication Technologies

Percent of U.S. Households

Wireless Saturation Level

- Diffusion of most technologies in the past was bounded by the total population.
- Saturation levels were below 1.
- Wireless mobile has changed the paradigm
- Everyone above age 10 can carry a cell phone.
- Some people may have multiple phones or multiple SIM Cards.
- In some countries Wireless mobile penetration has already past 100%
- So, where is the ceiling?
Wireless Growth for Selected Countries (Actual)
Wireless Growth for Selected Countries (Forecast)
Forecasts with Traditional Models

- Short term forecasts could be very reliable
- Accuracy of long term forecasts varies with
  - Amount of the historical data
  - Where we are on the “S” curve
  - Potential external factors
    - Technological, social, economic factors
- Methods for improving long term forecasts
  - Delphi Method
  - Analogy* and interpolation from similar observations

Approach to Improving Longer Term Forecasts

Short Term

Historical Data → Forecasting Model → New Forecast

Longer Term

Historical Data → Forecasting Model → New Forecast

Other Information Relevant to the Future
## Similarities between Greece and Italy

<table>
<thead>
<tr>
<th>Similarities</th>
<th>Greece</th>
<th>Italy</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP/capita</td>
<td>$23,000</td>
<td>$28,000</td>
</tr>
<tr>
<td>APRU</td>
<td>$27</td>
<td>$30.2</td>
</tr>
<tr>
<td>UMTS services launch</td>
<td>2004</td>
<td>2004</td>
</tr>
<tr>
<td>Population group</td>
<td>15-64 years: 66.7%</td>
<td>15-64 years: 66.8%</td>
</tr>
<tr>
<td>Total median age</td>
<td>40.5</td>
<td>41.7</td>
</tr>
</tbody>
</table>
Wireless Mobile Growth- Italy vs. Greece

![Graph showing the growth of wireless mobile services in Italy and Greece from 1994 to 2005.](graph.png)
Actual vs. Forecasts for Greece—Application of Analogy

Year

Wireless Growth (Density)

Greece
Greece from Italy
Greece from Gompertz
Issues and Observations

- Wireless technology is evolving very rapidly
- Countries are also going through policy changes that affects growth of wireless services
- Existing diffusion models can not realistically predict growth more than a year or two, particularly for rapidly evolving technologies
- While the notion of “S” curve is fundamentally sound, the current models have significant limitations for longer term forecasting because they look only backward and not forward.
- The logistic models need to be augmented with other forward looking information from the lead markets using analogy to improve long term forecasting
Implications of the Study

- Improved models for diffusion of communications technologies will help service providers with better planning for
  - Infrastructure
  - Substitution of traditional services with advanced services
  - Resource management
  - Global expansions
Future Work

- Further assess application of analogy to long term forecasting
- Improve and generalize the approach as a modified Gompertz model
- Validate model application and forecast reliability
- Explore applications to broadband services