

# Overview: Consumer Demand and Characteristics

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- Estimation of Demand for Product Characteristics
  - Adjusting Prices for Quality Change
  - Consumer valuation and discrete choice
- Important Aspects of Demand
  - Dynamics
  - Network externalities

## Demand and Product Characteristics

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- Issues:
  - How do you sort out price effects when the quality of goods is changing over time?
  - How are changes in product design evaluated?
- Example of the problem: PCs
  - IBM analysis of the demand for computers
  - Demand for software (e.g. spreadsheets)

## Concepts Underlying “Hedonic” Prices

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- For products with several quality characteristics:
  - View the product as a composite “bundle” of characteristics
  - The price of the product (the “bundle”) reflects the amount of each characteristic and the (implicit) price of each characteristic
- ‘Hedonic price’ = ‘Price of characteristic’

## Hedonic Price Analysis: The Basic Idea

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- Estimate the “prices” of the characteristics in the bundled product, using price data and multiple regression.
- That is: Estimate  $P = f(\text{characteristics, time})$ 
  - Use regression parameters to find what characteristics are highly valued (I.e., high prices)
  - Use model to predict prices, compare observed price changes, and so forth
    - Constant product “quality” = Hold fixed the bundle of characteristics

## Early Hedonic Price Analyses

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- **Waugh** -- price of asparagus at Faneuil Hall in 1920's.  
*Characteristics:* average diameter of stalks, dispersion in stalk diameter, inches of green color, etc.
- **Court** -- prices of auto models in the U.S., 1920-35.  
*Characteristics:* horsepower, length, weight of auto model, etc.
- **Chow** -- rental prices of mainframe computers in the U.S., 1960-65.  
*Characteristics:* multiplication time (MT), memory size (MEM) and access time (AT), etc.

## Chow's Analysis of Mainframe Computer Prices, 1960-65

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- Data: rental prices of 82 computers in the U.S., 1960-65, as well as measures of MT, MEM, and AT
- Estimated Price Equations:

$$\ln P = -0.104 - 0.064 \ln MT + 0.579 \ln MEM - 0.141 \ln AT$$

$$- 0.140 \cdot D_{61} - 0.489 \cdot D_{62} - 0.594 \cdot D_{63} - 0.925 \cdot D_{64} - 1.163 \cdot D_{65}$$

where  $D_{xx}$  is an indicator variable equal to one in year  $xx$ , else equals zero

- How to interpret estimated coefficients
  - $\ln MT$ ,  $\ln MEM$ , and  $\ln AT$
  - $D_{61}$  through  $D_{65}$

## Value of Changing Product Characteristics

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### Approximate Price Changes for Changes in Characteristics

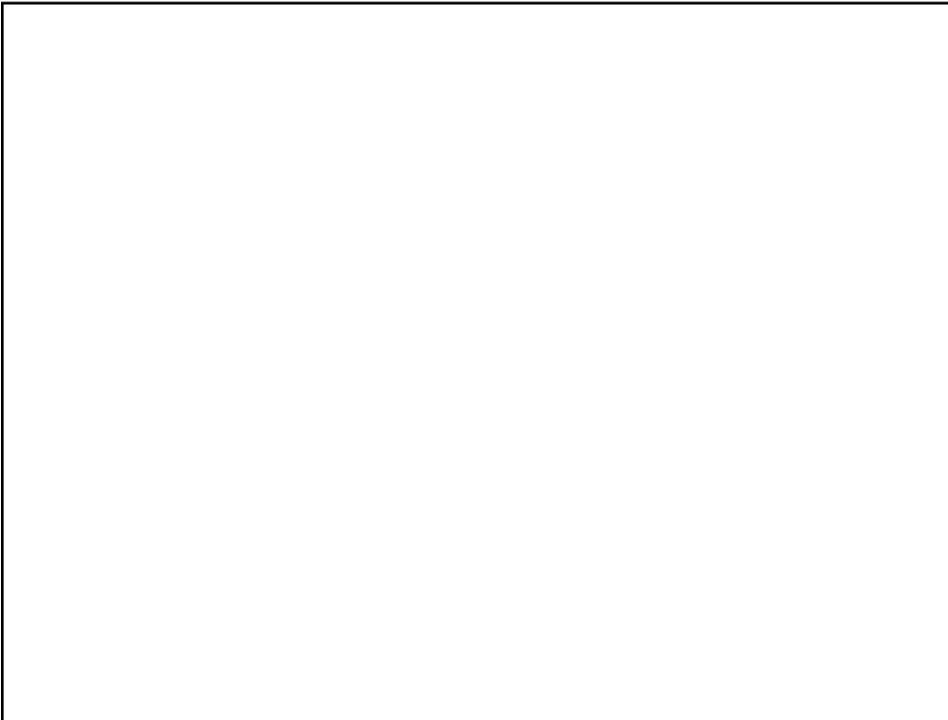
| Characteristic | Change | $\Delta P$ |
|----------------|--------|------------|
| MT             | -10%   | 0.64%      |
| MEM            | +10%   | 5.79%      |
| AT             | -10%   | 1.41%      |

Quality-Adjusted Price Index  
(holds constant all quality attributes)

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| Year               | $\ln P$ | $P [= e^{\ln P}]$ |
|--------------------|---------|-------------------|
| 1960               | 0       | 1.000             |
| normalized<br>1961 | -.140   | 0.870             |
| 1962               | -.489   | 0.613             |
| 1963               | -.594   | 0.552             |
| 1964               | -.925   | 0.397             |
| 1965               | -1.163  | 0.313             |

$\Delta P/\text{yr} = -20.8\%$  (quality adjusted)



## How Do Consumers Evaluate Different Products?

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- Hedonic analysis gives market evaluations of product characteristics.
- How is this related to consumer evaluation?
- Suppose you had data on households that recently bought a PC.
  - Different households and different types of PCs.
  - How could you study this data?

(This is what marketing people do all the time!)

## Discrete Choice Models

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- Model the value of the PC type  $j$  to household  $k$  as
$$U_{jk} = f(\text{characteristics of product } j, \text{ characteristics of household } k)$$
- Discrete Choice Model:
  - Household  $k$  chooses  $j$  if  $U_{jk}$  is greater than  $U_{j'k}$ ,  
for all other  $j'$
  - With unobserved (random) characteristics, model *probability* of purchase
  - Logit, Probit, Multinomial Logit (see Marketing).

# Important Aspects of Demand

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- Dynamic effects
  - Short run elasticity smaller than long run
  - Long run elasticity smaller than short run
- Network externalities

# Dynamic Effects on Demand I

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- Full effects (price, income, etc.) can take time to appear
  - Habits and persistence
  - Adaptation/adjustment of related goods
  - Adjustment costs
- SR Elasticity  $\ll$  LR Elasticity
  - Eventual impact is larger than initial impact

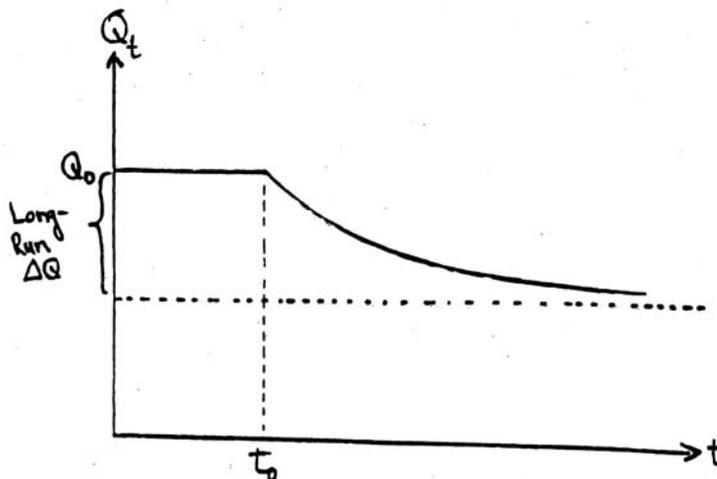


Figure 1: Typical Dynamic Demand Responses to Price Increase or Income Drop

## Dynamic Effects on Demand II

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- Durable goods can exhibit huge initial effects, that subsequently taper off
  - Purchase timing: Great Price NOW.
  - Adjustment of stock through new sales/investment
- SR Elasticity  $\gg$  LR Elasticity
  - Initial impact on sales can be large relative to eventual impact

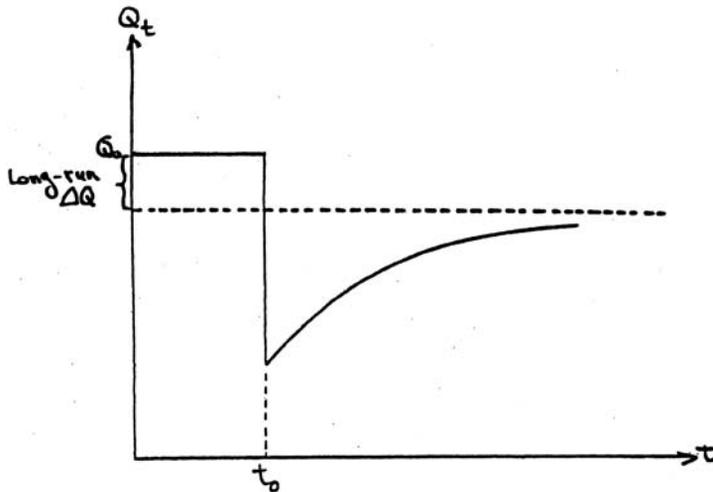


Figure 2: Stock Adjustment Effect

## Network Externalities

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- Suppose the value of a product to a consumer depends on how many others are using it
- How would this affect demand structure?
- How would this affect business planning?

## Some Puzzles about Corporate Strategy and Pricing

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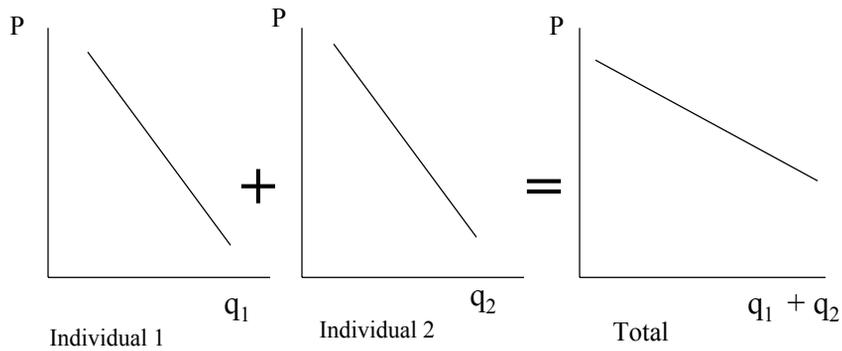
- Expenditure on the Windows 95 launch
- Valuations of Internet Companies in 1999
- Huge Standardization efforts with hardware
  - DVD's, USB versus Firewire, etc.

# Network Externalities

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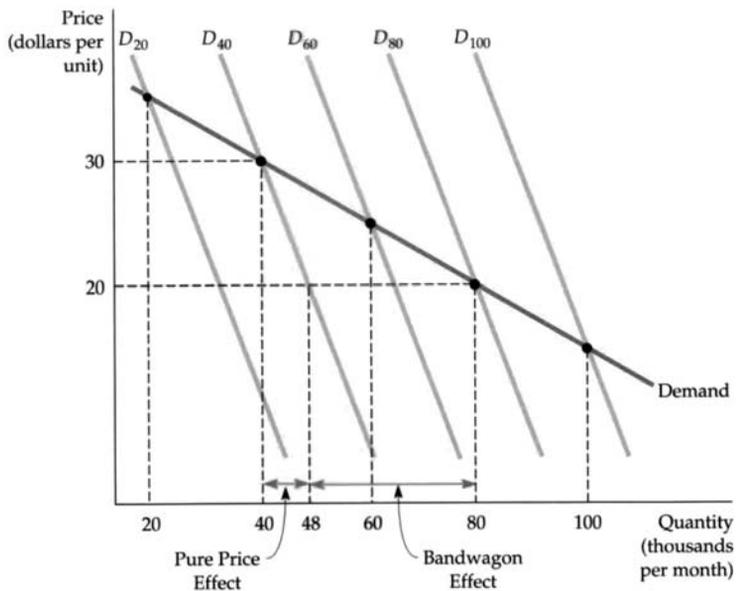
- The product is *more* valuable to you if it is used by others. Your demand is greater with more users.
  - Direct network externality : email
  - Indirect network externality : Playstation
- Implication
  - Current demand depends on installed base (existing users)
  - Appearance of more price sensitivity/elasticity

## Independent Consumers: The Standard Setting



What '2' buys does not affect '1's demand curve, or vice versa  
(Not true with interdependence)

Figure 4.16 Positive Network Externality: Bandwagon Effect



# Network Externality in Spreadsheets

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## Price Premium

- |                                      |      |
|--------------------------------------|------|
| • Lotus brand premium                | 75%  |
| • Graph capability                   | 58%  |
| • Compatible with Lotus              | 105% |
| • Link to external data-bases        | 73%  |
| • Link to others through LAN         | 23%  |
| • Update multiple worksheets at once | 23%  |

## Becoming a Product ‘Standard’

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- With network externalities, companies race to have their product become the only one used, the ‘standard.’
  - Example: Windows
  - Example: Ebay.com, B2B sites
- “Prime the Pump” for Explosive Growth

## Snob Effects

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- The product is *less* valuable to you if it is used by many others.
  - Rolex watches
  - Luxury automobiles
- Implication
  - Current demand depends on perception of usage of others
  - Appearance of less price sensitivity/elasticity

## Take Away Points

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- Hedonic analysis gives the market valuation of product characteristics, which is key to design and pricing.
- Dynamic effects can make you seriously over- or underestimate elasticity, leading to big pricing errors.
- Network externalities are an extreme source of competitive advantage. Distinguish direct and indirect externalities.