Part I: Introduction to Economics

1. The Principles and Practice of Economics
2. Economic Methods and Economic Questions
3. Optimization: Doing the Best You Can
4. Demand, Supply, and Equilibrium
Chapter 2
Economic Methods and Economic Questions

2019.9.16.
The Scientific Method

Causation and Correlation

Economic Questions and Answers

Appendix: Constructing and Interpreting Graphs
KEY IDEAS

- A **model** is a simplified description of reality.
- Economists use **data** to evaluate the accuracy of models and understand how the world works.
- **Correlation** does not imply **causality**.
KEY IDEAS

- **Experiments** help economists to measure cause and effect.
- **Economic research** focuses on questions that are important to society and can **be answered** with models and data.
Question: Is college worth it?
2.1 The Scientific Method

The **scientific method** (also referred to as **empiricism**) is composed of two steps:

1. **Developing** models that explain some part of the world.
2. **Testing** those models using **data** to see how closely the model matches what we actually observe.
Models and Data

What is this?
Does it look like anyone you know?
• A Model (模型) is a simplified description, or representation, of the world.

Is this an airplane?
What’s the shortest distance between two points?

Exhibit 2.1 Flying from New York to Tokyo Requires More Than a Flat Map
Exhibit 2.2 New York City Subway Map
An Economic Model

Returns to education: (教育的報酬)

• Assumption— one more year of education results in a 10% increase in future earnings.

• If you would earn $15 per hour with 12 years of education, with one more year of education (your first year of college) you would earn:

$$15 \times 1.10 = 16.50$$
• If you would earn $16.50 with 13 years of education, with one more year of education (2nd year of college), you would earn:

\[ \$16.50 \times 1.10 = \$18.15 \]

• The third year: \$18.15 \times 1.1 = \$19.97

• The fourth year: \$19.97 \times 1.1 = \$21.97
Hypothesis: (假說)

- Getting a college degree (years 13-16) increases wages from $15 to $21.97, or 46.5%.

\[
\frac{21.97 - 15}{15} = 0.4647
\]
Two important features of models:

1. They are not exact. Not everyone will see his or her wages increase by 10% with every additional year of education.

2. They generate predictions that can be tested with data.
• Hypothesis: Each additional year of education increases wages by **10%**.

• True **or** False?
Q: How much more do workers with a college education earn?

Exhibit 2.3 Average Annual Earnings of 30-Year-Old Americans by Education Level (2014 data)
How much higher is the wage for college graduates than for high school graduates?

- College = $51,215
- High School = $32,912
- College results in a wage that is 57% higher.

\[
\frac{51,215}{32,912} = 1.56
\]

- Model predicted 46%. Is that close enough?
- If college graduates earn, on average, $51,215/year, does that mean that all college graduates earn that much?
### 表7 初任人員平均每人月經常性薪資—按行業及教育程度別分

<table>
<thead>
<tr>
<th>項目別</th>
<th>國中及以下</th>
<th>高中（職）</th>
<th>專科</th>
<th>大學</th>
<th>研究所及以上</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>102年</strong></td>
<td>20,690</td>
<td>21,946</td>
<td>23,890</td>
<td>26,915</td>
<td>32,017</td>
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<tr>
<td><strong>103年</strong></td>
<td>20,986</td>
<td>22,341</td>
<td>24,304</td>
<td>27,193</td>
<td>32,269</td>
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<tr>
<td>103年較102年增減百分比 (%)</td>
<td>1.43</td>
<td>1.80</td>
<td>1.73</td>
<td>1.03</td>
<td>0.79</td>
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</tbody>
</table>

#### 工業部門

<table>
<thead>
<tr>
<th>行業</th>
<th>國中及以下</th>
<th>高中（職）</th>
<th>專科</th>
<th>大學</th>
<th>研究所及以上</th>
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<tr>
<td>矿業及土石採取業</td>
<td>20,631</td>
<td>23,109</td>
<td>24,750</td>
<td>28,082</td>
<td>32,243</td>
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<tr>
<td>製造業</td>
<td>20,765</td>
<td>22,156</td>
<td>24,161</td>
<td>27,051</td>
<td>32,301</td>
</tr>
<tr>
<td>電力及燃氣供應業</td>
<td>22,377</td>
<td>24,379</td>
<td>27,436</td>
<td>31,587</td>
<td>34,522</td>
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<tr>
<td>用水供應及污染整治業</td>
<td>20,935</td>
<td>23,074</td>
<td>25,541</td>
<td>27,456</td>
<td>30,933</td>
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<tr>
<td>營造業</td>
<td>22,814</td>
<td>23,866</td>
<td>25,107</td>
<td>27,596</td>
<td>32,063</td>
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</table>

#### 服務業部門

<table>
<thead>
<tr>
<th>行業</th>
<th>國中及以下</th>
<th>高中（職）</th>
<th>專科</th>
<th>大學</th>
<th>研究所及以上</th>
</tr>
</thead>
<tbody>
<tr>
<td>批發及零售業</td>
<td>21,072</td>
<td>22,341</td>
<td>24,323</td>
<td>27,258</td>
<td>32,258</td>
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<td>運輸及倉儲業</td>
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<td>住宿及餐飲業</td>
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<td>28,143</td>
<td>31,805</td>
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<td>資訊及通訊傳播業</td>
<td>20,689</td>
<td>21,506</td>
<td>22,976</td>
<td>24,646</td>
<td>27,313</td>
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<td>金融及保險業</td>
<td>21,212</td>
<td>22,402</td>
<td>24,351</td>
<td>27,055</td>
<td>31,762</td>
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<td>不動產業</td>
<td>22,636</td>
<td>24,676</td>
<td>26,860</td>
<td>30,577</td>
<td>35,717</td>
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<tr>
<td>專業、科學及技術服務業</td>
<td>20,169</td>
<td>22,842</td>
<td>25,006</td>
<td>28,625</td>
<td>32,228</td>
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<td>支援服務業</td>
<td>20,925</td>
<td>21,985</td>
<td>23,706</td>
<td>25,632</td>
<td>29,224</td>
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<td>教育服務業</td>
<td>20,620</td>
<td>21,128</td>
<td>22,047</td>
<td>24,027</td>
<td>28,659</td>
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<td>醫療保健服務業</td>
<td>21,495</td>
<td>22,801</td>
<td>25,136</td>
<td>28,853</td>
<td>33,329</td>
</tr>
<tr>
<td>藝術、娛樂及休閒服務業</td>
<td>20,898</td>
<td>21,687</td>
<td>23,365</td>
<td>25,204</td>
<td>28,674</td>
</tr>
<tr>
<td>其他服務業</td>
<td>20,899</td>
<td>21,495</td>
<td>22,807</td>
<td>24,232</td>
<td>26,845</td>
</tr>
</tbody>
</table>
Argument by Anecdote

• How does Bill Gates’ level of education affect his income?
Another Useful Model: Circular-Flow Diagram

- The circular-flow diagram is a **visual model** of the economy that shows how dollars flow through markets among **households** and **firms**.

- **Firms (廠商)**
  - **Revenue (收入)**: Produce and sell goods (財貨) and services (勞務)
  - **Spending (支出)**: Hire and use factors of production (生產要素)

- **Households (家戶)**
  - **Revenue (收入)**: Own and sell factors of production
  - **Spending (支出)**: Buy and consume goods and services
The Circular Flow

This diagram is a schematic representation of the organization of the economy. Decisions are made by households and firms. Households and firms interact in the markets for goods and services (where households are buyers and firms are sellers) and in the markets for the factors of production (where firms are buyers and households are sellers). The outer set of arrows shows the flow of dollars, and the inner set of arrows shows the corresponding flow of inputs and outputs.
• Markets for **Goods and Services**
  • Firms sell
  • Households buy

• Markets for **Factors of Production**
  • Households sell
  • Firms buy

• **Factors of Production**
  • Inputs used to produce goods and services
  • Land, labor, and capital
2.2 Causation and Correlation

The Red Ad Campaign Blues

• Sales go up 25% during campaign with lots of red images at Walmart.

• Does red ad cause sales increase?

• The red-themed campaigns were mostly concentrated during the Christmas season.
Causation versus Correlation

- **Causation** occurs when one thing directly affects another.
  - Example: pulling an all-nighter will make you tired.

- **Correlation** means that there is a *mutual relationship* between two things.
  - Positive correlation— they both change in the same direction
  - Negative correlation— they change in opposite directions
  - Example: shorter skirt lengths are associated with good economic conditions
  - *spurious correlation.*
Why *isn’t* correlation the same thing as *causality*?

1. Omitted variables

   If we *ignore* something that *contributes* to cause and effect, then that something is an omitted variable. A correlation might not make sense until the omitted variable is *added*.

*Exhibit 2.4 An Example of an Omitted Variable*

The amount of red content in the store’s ads is positively correlated with the growth of the store’s revenue. In other words, when ads are red themed, the store’s month-over-month sales revenue tends to grow the fastest. However, the redness does not cause the store’s revenue to rise. The Christmas season causes the store’s ads to be red and the Christmas season also causes the store’s sales revenue to rise. The Christmas season is the omitted variable that explains the positive correlation between red ads and revenue growth.
2. Reverse causality

Reverse causality is when there is cause and effect, but it goes in the opposite direction as what we thought.

Example: gambling and healthier older people
Experimental Economics and Natural Experiment

How can we tell the difference between causality and correlation? Experiments

1. Controlled = subjects are randomly put into treatment (something happens) and control (nothing happens) groups by the researcher.
   • Problem: difficult to do with economics studies

2. Natural = subjects end up in treatment or control groups due to something that is not purposefully determined by the researcher.
Q: How much do wages increase when an individual is compelled by law to get an extra year of schooling?

In 1947, the U.K. raised the minimum drop-out age from 14 to 15. (An natural experiment)

- Those students reaching age 14 before 1947 = control group
- Those students reaching age 14 in 1947 or after = treatment group
2.3 Economic Questions and Answers

Two properties of a good economic question:

1. Relevant and important
   Economic research contributes to social welfare.

2. Can be answered
   Economic questions can be answered empirically.
Appendix: Constructing and Interpreting Graphs

- A well-designed graph *summarizes* information with a simple visual display.
- The old adage “a picture is worth a thousand words.”
A Study About Incentives

• Would you study harder for this economics class if we paid you $50 for earning an A? What if we raised the stakes to $500?

• Sally Sadoff, Steven Levitt, and John List carried out an experiment at two high schools in the suburbs of Chicago over the past several years in which they used incentives to change students’ behavior.

• How an increase in a financial reward affects student test scores.
Experimental **Design**

- There are two high schools in Chicago Heights, and both have a problem with student dropouts.
- Each student was *randomly* placed into one of the following three groups:
  - **Control Group**: No students received financial compensation for meeting special standards established by experimenters (which are explained below).
  - **Treatment Group with Student Incentives**: Students would receive $50 for each month the standards were met.
  - **Treatment Group with Parent Incentives**: Students’ parents would receive $50 for each month the standards were met.
A student was deemed to have met the monthly standards if he or she:

1. did not have a D or F in any classes during that month,
2. had no more than one unexcused absence during that month,
3. had no suspensions during that month.
Describing Variables

Pie Charts

Exhibit 2A.1 Chicago Heights Experiment Participants by Race
Bar Charts

Exhibit 2A.2 Proportion of Students Meeting Academic Standards by Experimental Group
Time Series Graphs

Exhibit 2A.3 Participants Meeting All Standards by Month
Scatter Charts

Exhibit 2A.4 Advertisements and Sales

\[ \text{Slope} = \frac{15}{900} \]

Rise = (35 - 20) = $15 million
Run = (1,000 - 100) = 900 ads
Cause and Effect

- Paying money for the students’ performance causes them to improve their academic performance because Chicago Heights Experiment was implemented using the principle of randomization.

- The experimenters split students into groups randomly, so each experimental group had an equal representation of students and their attributes.

- Any difference between the groups’ academic performance at the end of the experiment was due to the difference the experimental treatment imposed, such as differences in financial incentives.
Correlation Does Not Imply Causality

Exhibit 2A.5 Ice Cream Production and Drownings in the United States