MOT1421: Economic Foundations
Week 4: Technological Change & Innovation

Lecture Note W4:

- General concepts: technological change and innovation
- Technological change: the neoclassical approach
    - The growth accounting model of Robert Solow
- Technological change: evolutionary economics

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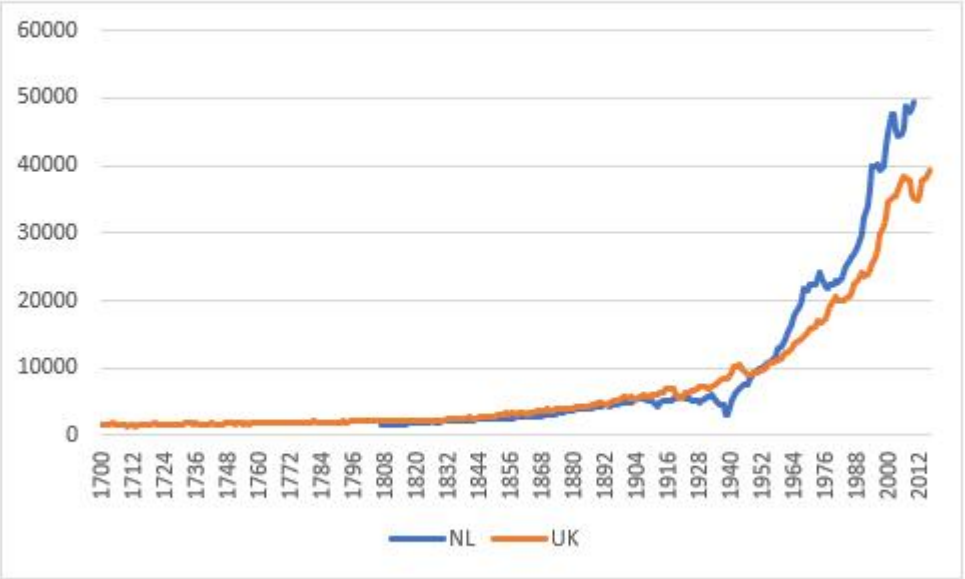
Week 4: Technological Change

Living standards began to rise following the *Industrial Revolution* (± 1800-1830) -> due to: **Technological progress** & capital formation (per worker)

Figure 1
Per capita real income
in the U.K. (1700-2016) and the Netherlands (1807-2016)



Source: Maddison Project Database 2018; link:

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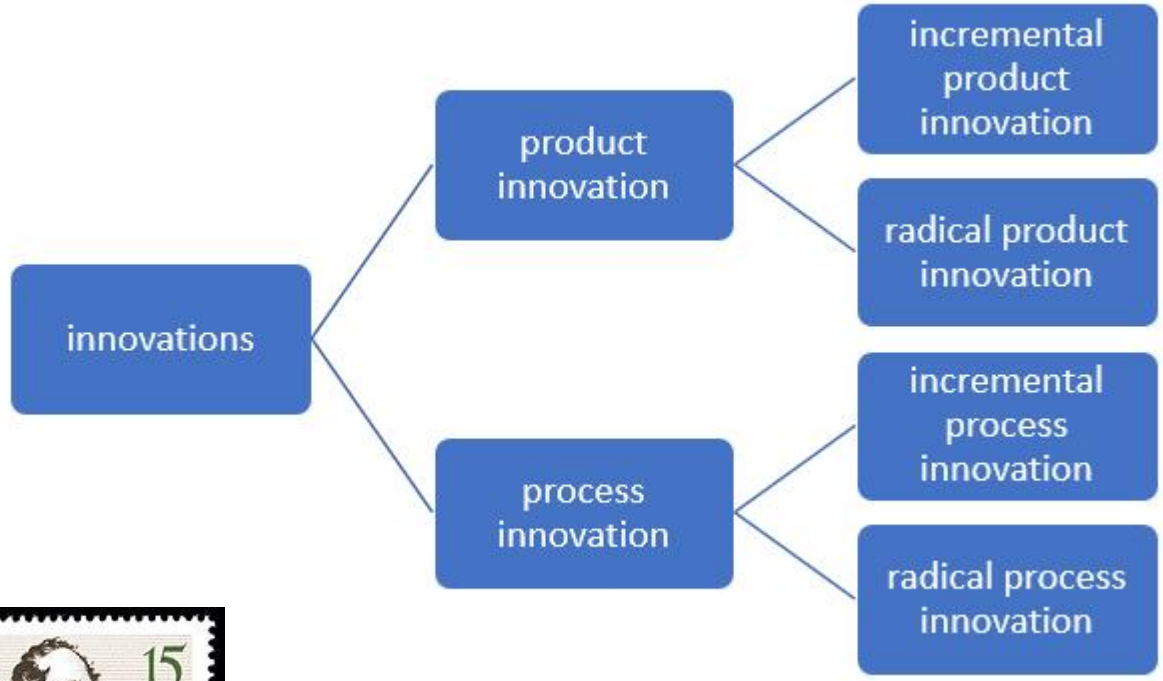
Innovation:

- **Technology-push**
- **Demand-pull**

  (J. Schmookler)
- **National System of Innovation** (F. List).



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Week 4: Growth Accounting and TFP growth

Economic growth (rising per capita income at constant prices) depends on:

1. Technological progress
2. Rising capital intensity (K/L ratio)

Question: how much does technological progress contribute to economic growth?

Method: the **growth accounting model** (Robert Solow)

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Week 4: Growth Accounting and TFP Growth

Based on a constant-returns-to-scale Cobb-Douglas production function, we can derive the following expression for the growth rate of per capita income (at constant prices) – see Lecture Note W-4:

$$\hat{\lambda} = \hat{a} + (1 - \alpha) \times \hat{\kappa} \qquad (6)$$

where lambda-hat = the growth rate of per capita income (at constant prices); kappa-hat = the growth rate of capital intensity; and a-hat =the growth rate of total-factor-productivity (TFP) (= a measure of neutral technological progress); (1 – alpha) = the exponent for K in the Cobb-Douglas production function.

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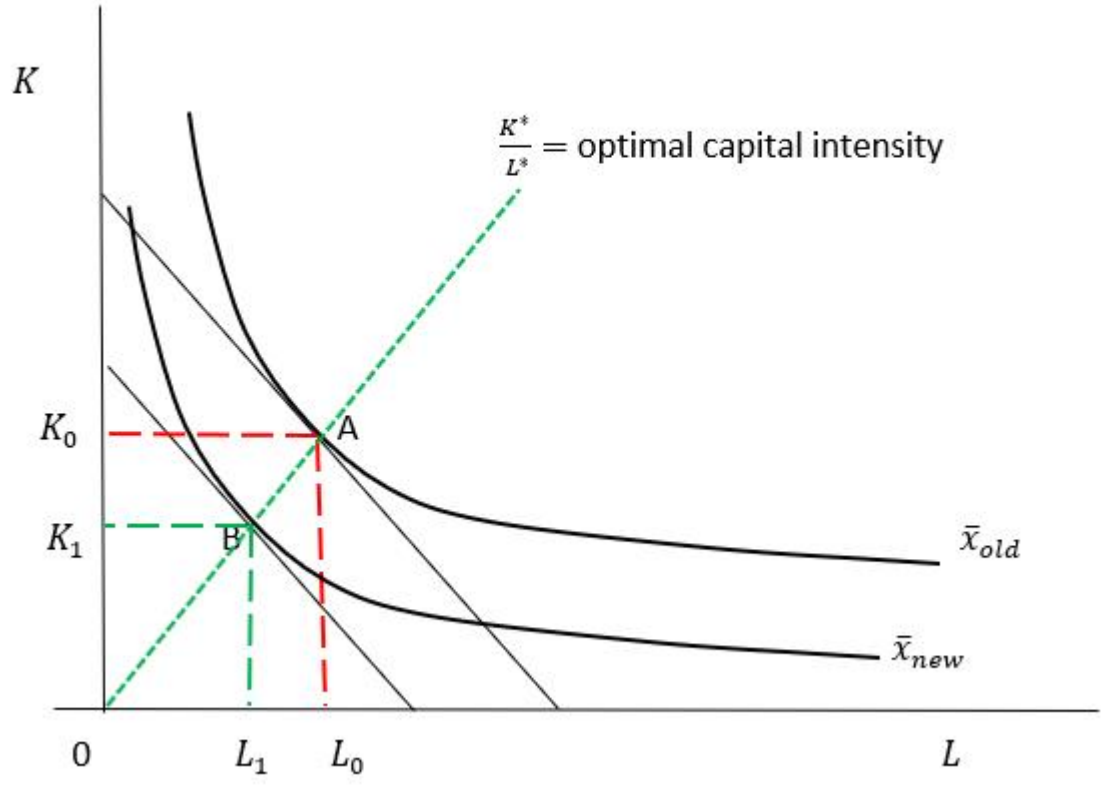
Week 4: Growth Accounting and TFP Growth

TFP growth = neutral technological progress.

Figure 5
Neutral technological progress



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Week 4: Growth Accounting and TFP Growth

TFP growth is determined as a **RESIDUAL**.

Assume that we have the following (historical) data on:

- Lambda-hat = 2.5%
- Kappa-hat = 3%
- Alpha = 2/3

Then we can use: (7) $\hat{a} = \hat{\lambda} - (1 - \alpha) \times \hat{\kappa}$

to calculate TFP growth: a-hat = 2.5% - (1 – 2/3) x 3% = 1.5%

Conclusion: TFP growth "accounts for" 60 per cent of per capita real income growth. Note: TFP growth is also "a measure of our ignorance ....."

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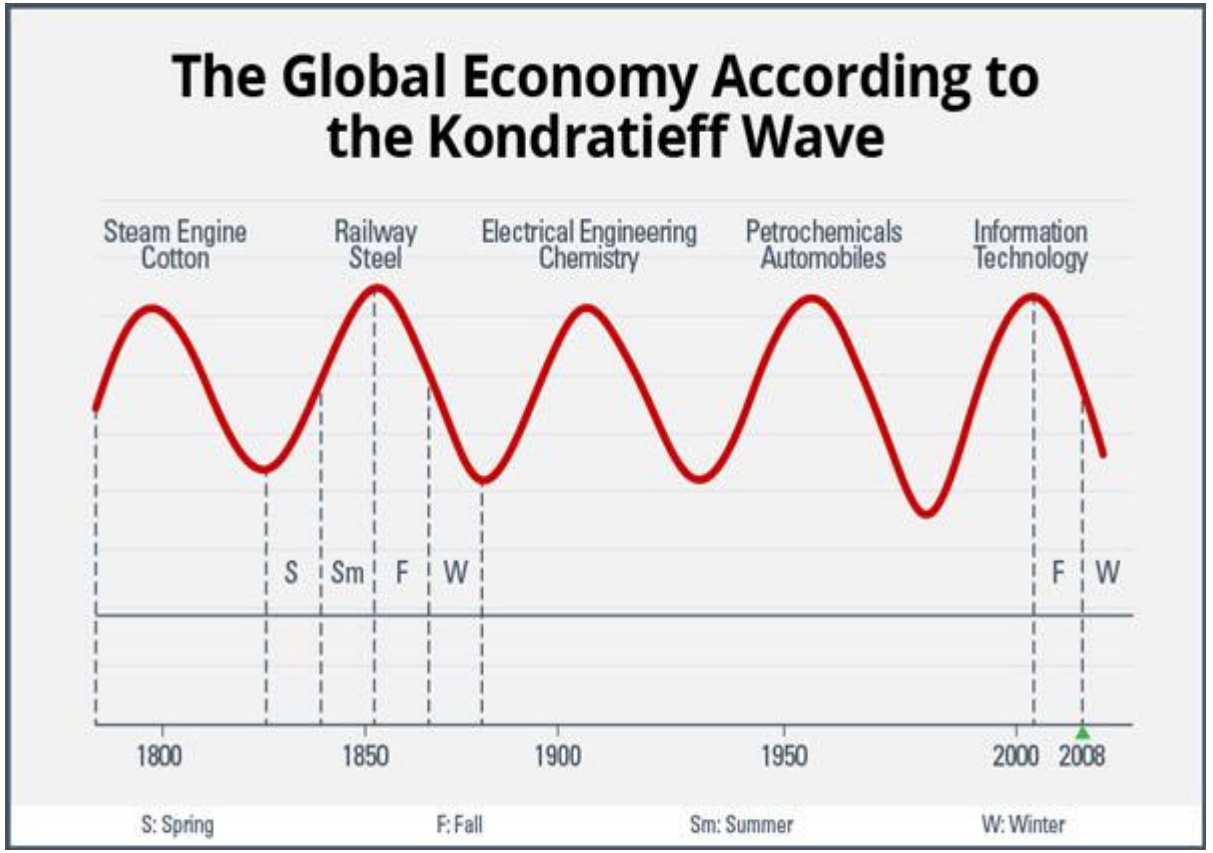
Week 4: Technological Change: Evolutionary Economics

Joseph Schumpeter:

Economic growth is “driven” by innovation.

Fluctuations in innovation cause fluctuations in investment and those cause (long) cycles in economic growth (booms & busts).



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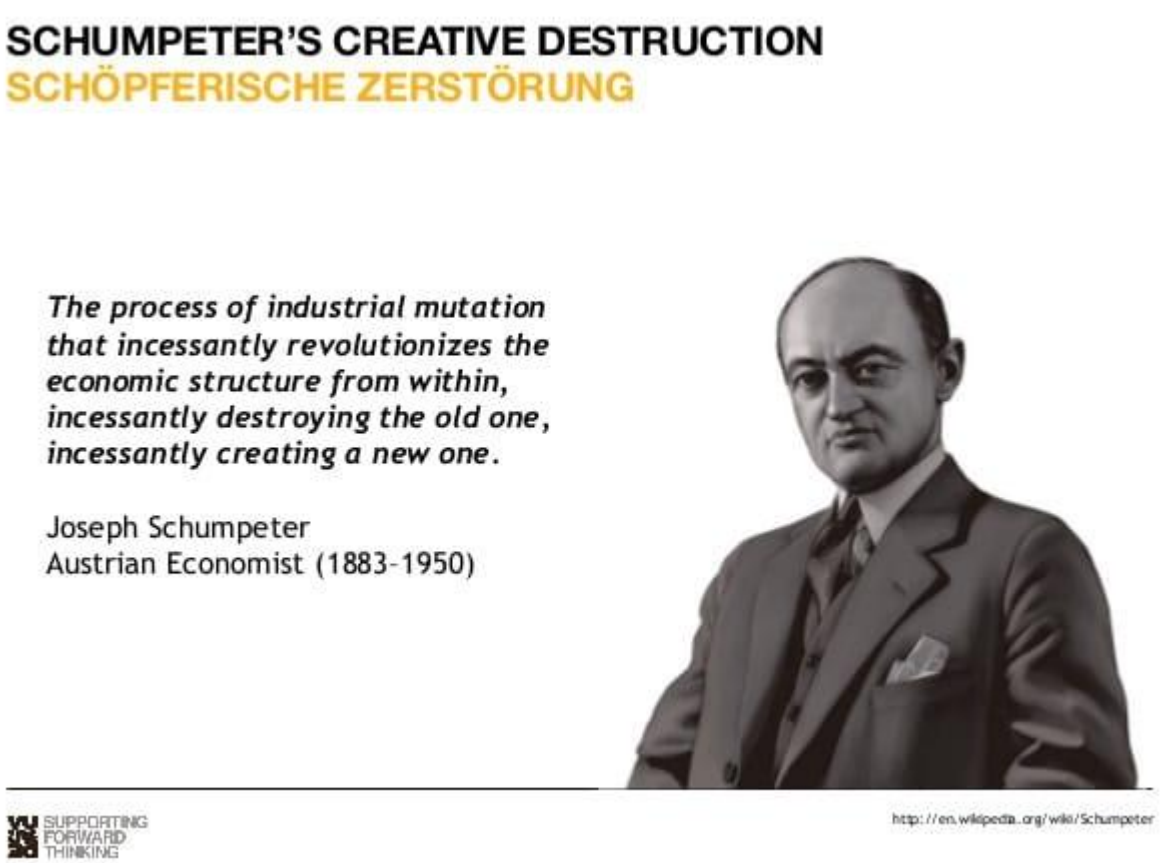
Week 4: Technological Change: Evolutionary Economics

Joseph Schumpeter:

central role for the profit-seeking entrepreneur in innovation.



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Week 4: Technological Change

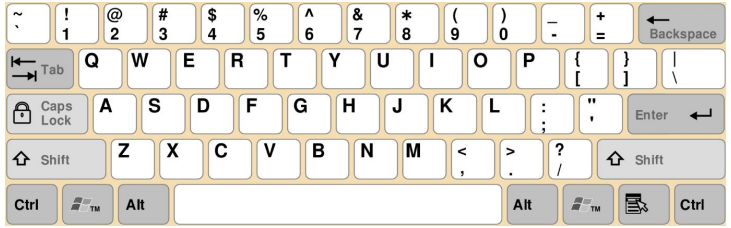
Following the Schumpeterian approach, **evolutionary economics** places the firm and the entrepreneur at the centre of the theory.

Evolutionary economics rejects the neoclassical assumption of instrumental rationality, and instead uses the concepts of **bounded rationality** and **routines.**

A second building block of evolutionary economics is **adaptation**: routines get updated based on learning from experience. Other mechanisms are **selection** and **imitation**.

A third building block of evolutionary economics is **technological path dependence.**

(see QWERTY versus Dvorak)



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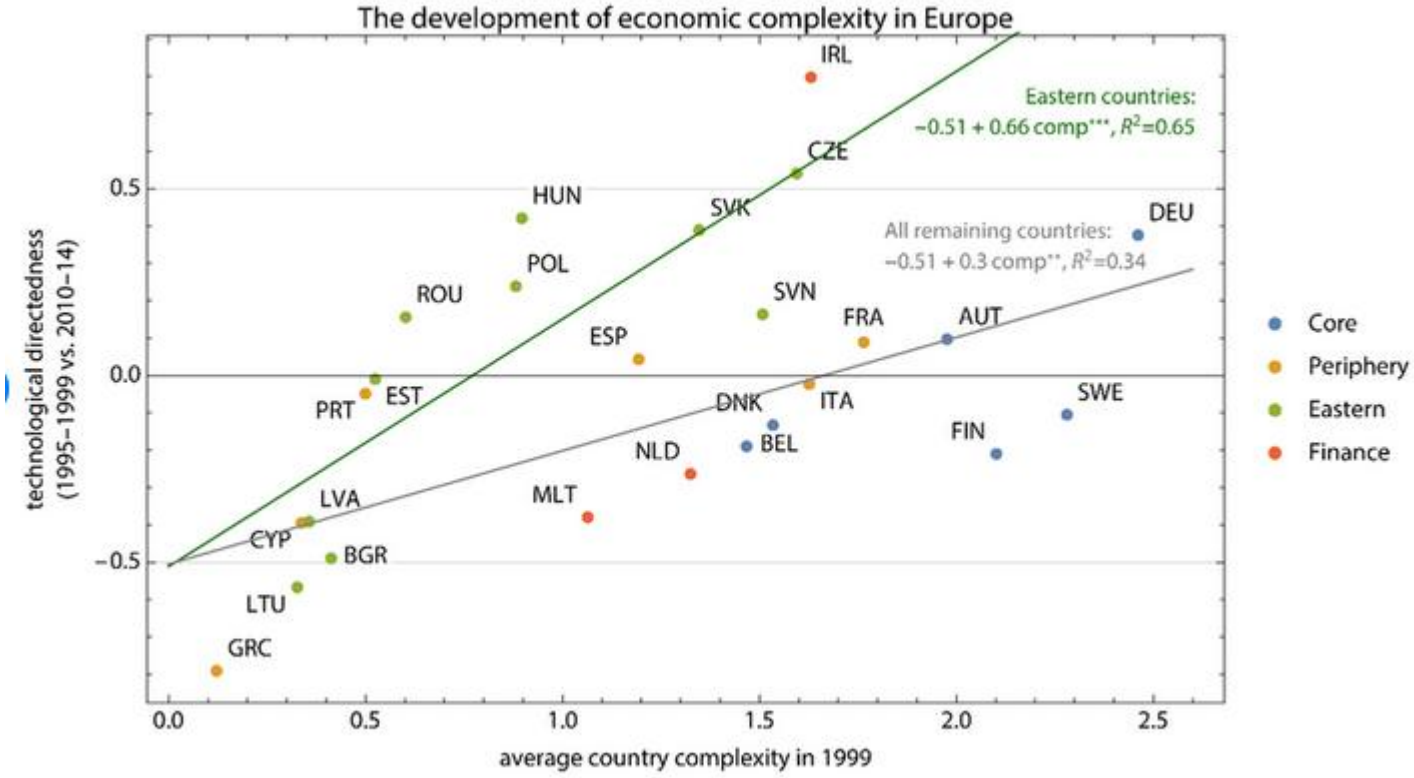
Week 4: Path Dependence (at the country level)

Those EU countries that had a better technological starting position in 1999 tend to show a more positive technological development dynamic during 2010-14.

Source: Gräbner *et al*. (2018).



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Week 4: Path Dependence & increasing returns to scale

Suppose there are 2 firms in the market, each one of them using a different technology to produce a similar good/service. Each of the technologies exhibits **increasing returns to scale**, i.e. average cost of production decline as output expands.

Learning curve:

The firm that succeeds in running down the learning curve the fastest, will out-compete the other firm. 'Initial conditions' (history) matters; which technology comes to dominate cannot be predicted.

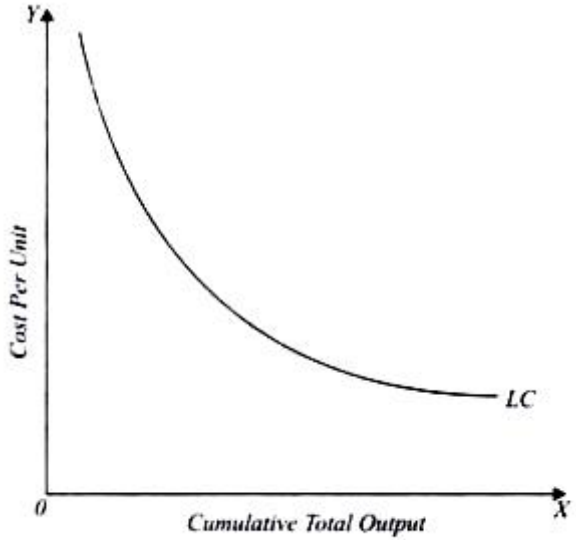

Fig. 19.16. *The Learning Curve*

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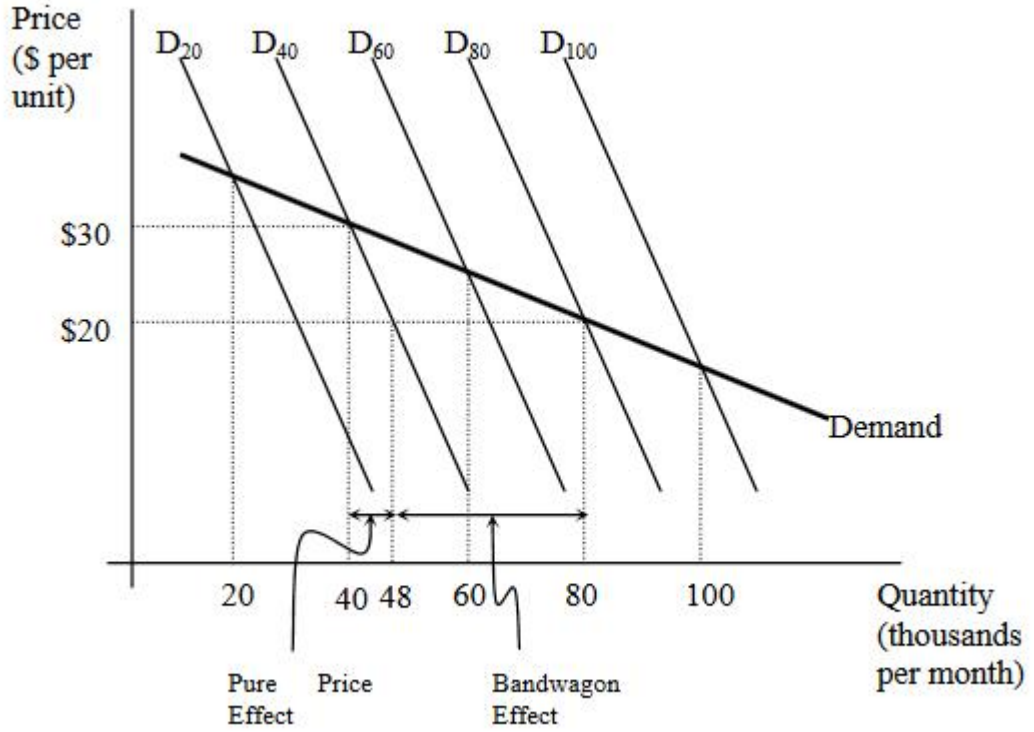
Week 4: Path Dependence & Network Externalities

Positive network externalities:

the more people already own a product in the market, the more the demand for that product will increase.

In this case, we will face a so-called "Bandwagon effect", as every new consumer will demand more than she/he would have if there hadn't been a bandwagon to jump on to.



Examples: software; internet; credit cards; pharmaceuticals

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An Evolutionary Market Model (HST Chapter 16)

- **Selection mechanism**: firm with highest profit margin (= fittest firm) manages to increase its market share; the other two firms lose market share.
- **Imitation mechanism**: (technologically) lagging firms imitate the leading firm, reduce unit cost and gain market share.

IF THE SELECTION MECHANISM IS STRONG RELATIVE TO IMITATION -> TENDENCY TOWARDS MONOPOLY (CONCENTRATION ↑)	IF THE IMITATION MECHANISM IS STRONG RELATIVE TO SELECTION -> TENDENCY TOWARD OLIGOPOLY WITH STABLE MARKET SHARES

Note: selection is not necessarily favouring the efficient firm (with the lowest unit cost), but favour the **fittest firm** (which has the highest profit margin). The one that wins need not be the best—it may have come to dominate partially by chance.