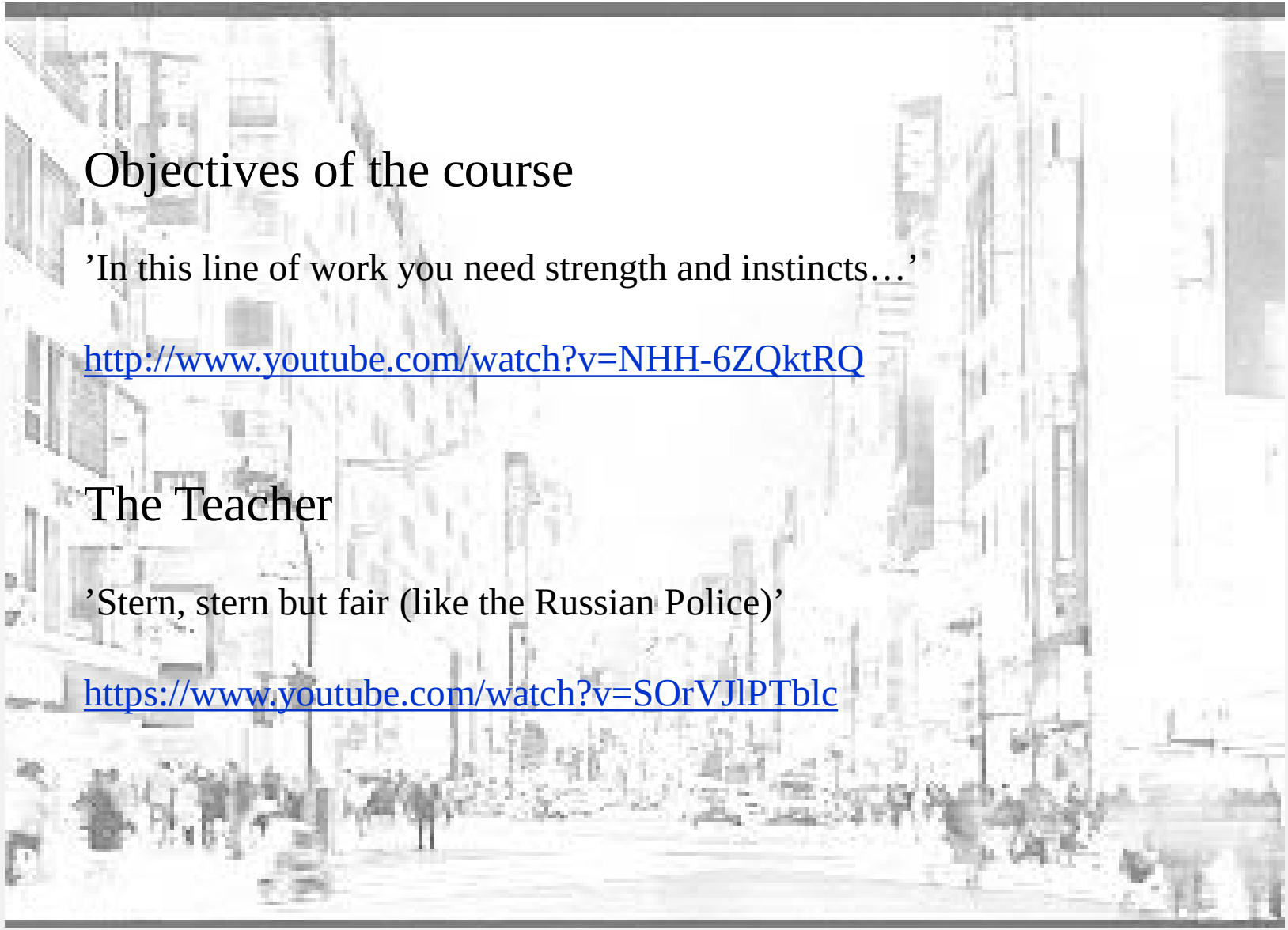
IO micro3 2019
(Contemporary Industrial Organization: A Quantitative Approach)

Mikko Mustonen



Objectives of the course

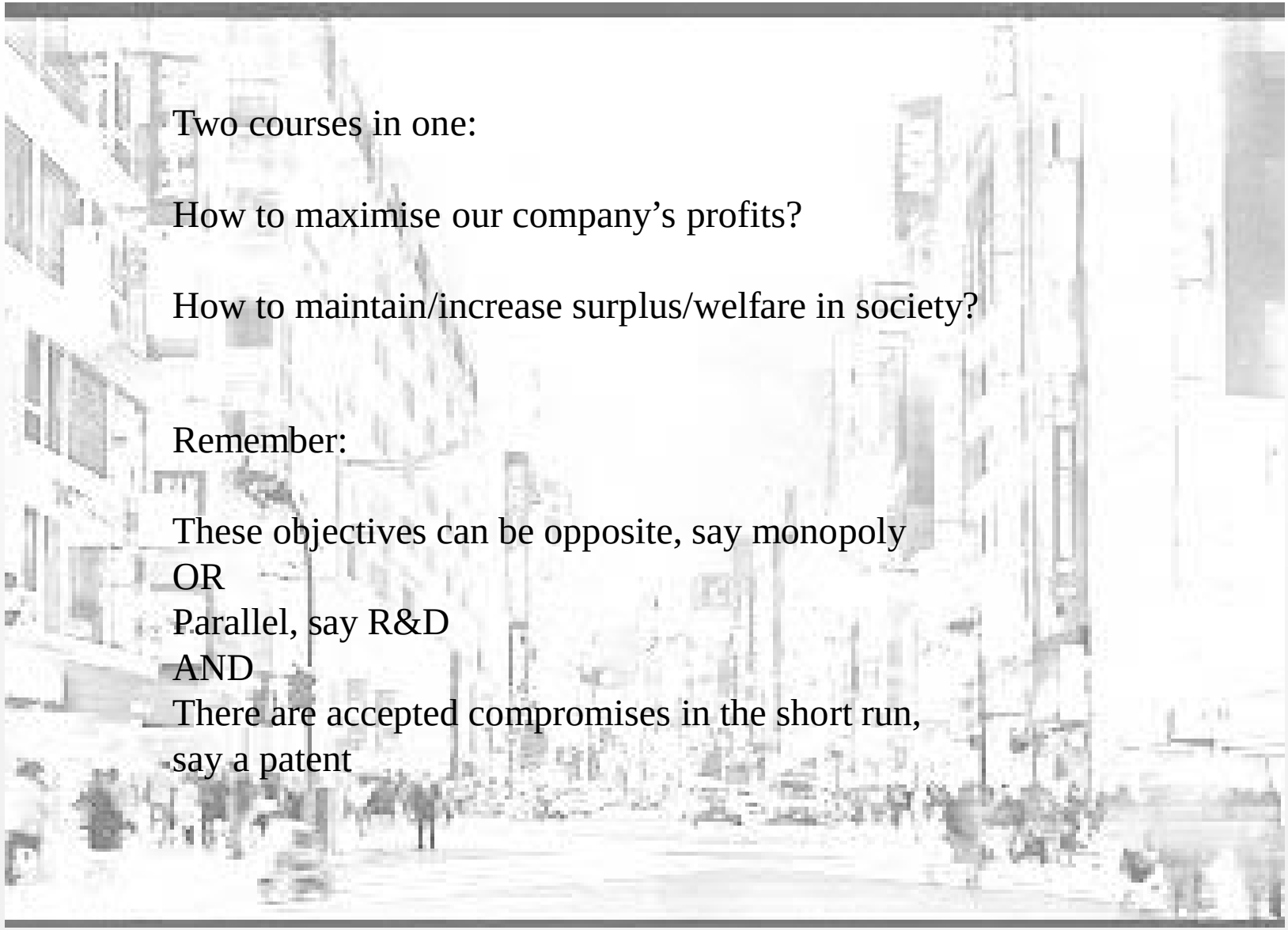
’In this line of work you need strength and instincts…’

http://www.youtube.com/watch?v=NHH-6ZQktRQ

The Teacher

’Stern, stern but fair (like the Russian Police)’

https://www.youtube.com/watch?v=SOrVJlPTblc



Two courses in one:

How to maximise our company's profits?

How to maintain/increase surplus/welfare in society?

Remember:

These objectives can be opposite, say monopoly
OR
Parallel, say R&D
AND
There are accepted compromises in the short run, say a patent

Lectures, the book and the game or alternatively a course essay.
Three short home assignments.

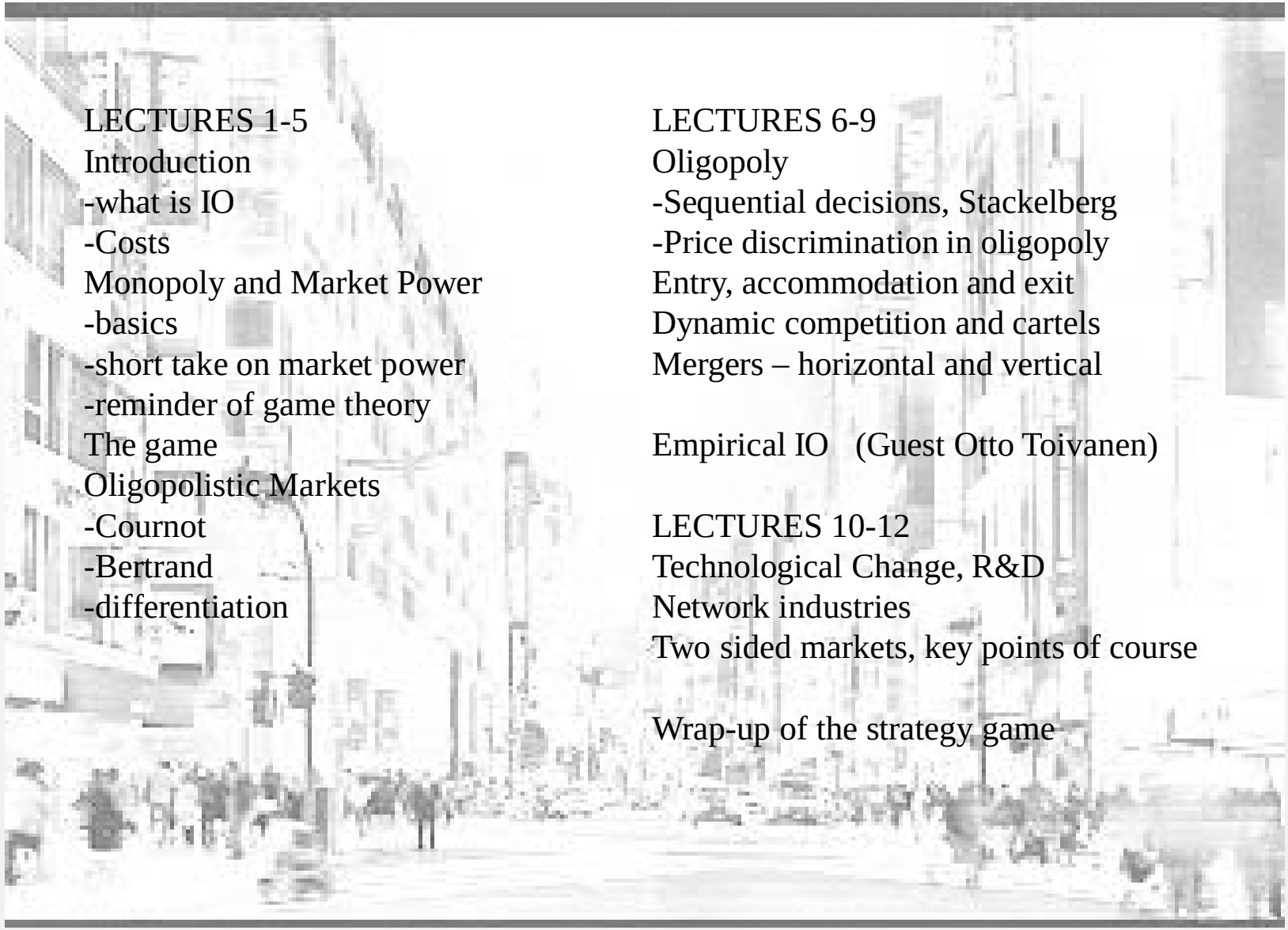
7.1 to 14.2 lectures, First exam 21.2 (corrected 8.1)

Knowledge in game theory?

Micro pricing, policy?

Lecture notes, lectures…and an excellent new textbook

Course homepage IMPORTANT: see that MyCourses sends you e-mail notices



LECTURES 1-5
Introduction
-what is IO
-Costs
Monopoly and Market Power
-basics
-short take on market power
-reminder of game theory
The game
Oligopolistic Markets
-Cournot
-Bertrand
-differentiation

LECTURES 6-9
Oligopoly
-Sequential decisions, Stackelberg
-Price discrimination in oligopoly
Entry, accommodation and exit
Dynamic competition and cartels
Mergers – horizontal and vertical

Empirical IO (Guest Otto Toivanen)

LECTURES 10-12
Technological Change, R&D
Network industries
Two sided markets, key points of course

Wrap-up of the strategy game

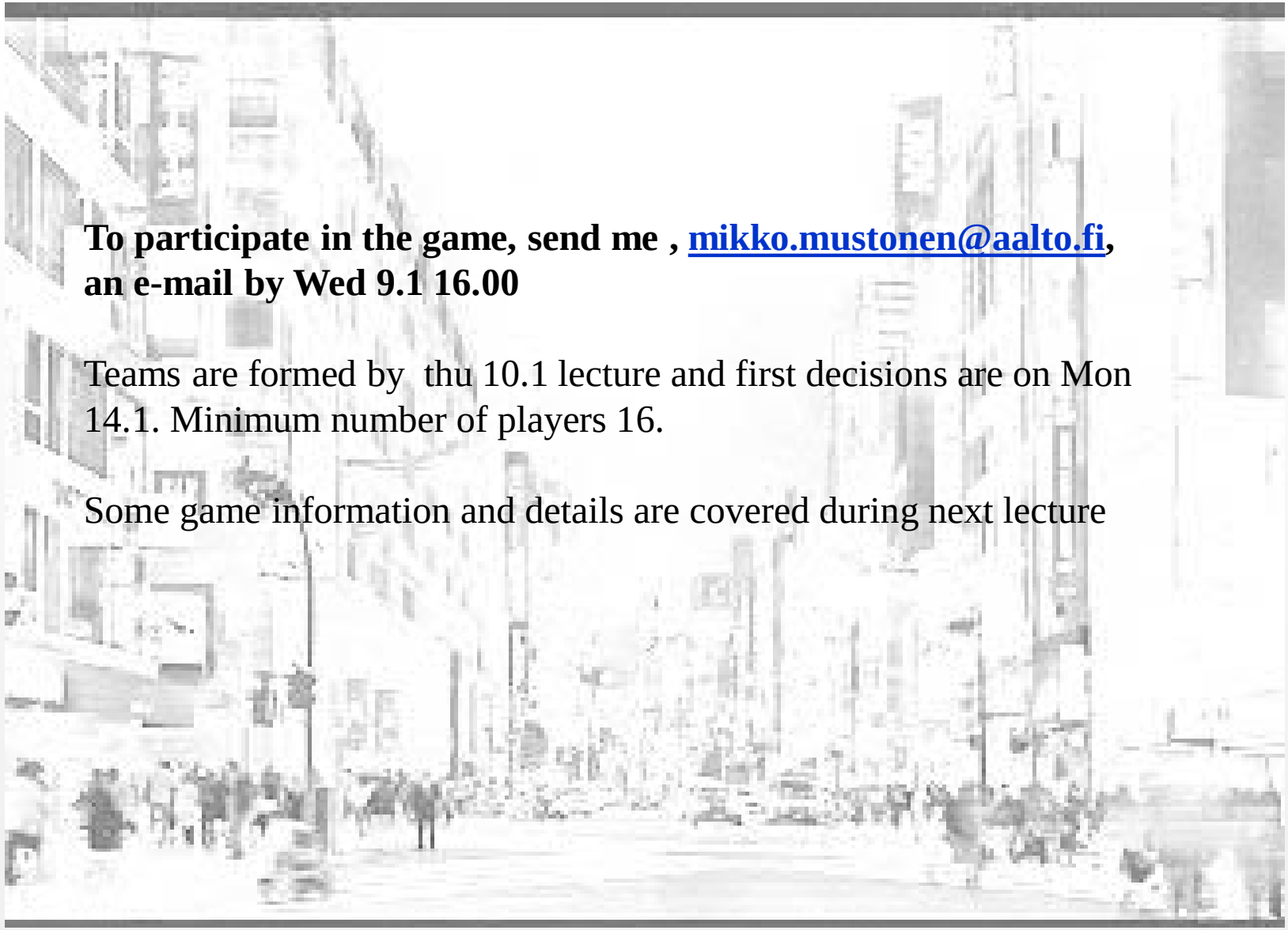
Severin Borenstein's Strategy Game

https://csg.haas.berkeley.edu/

Eight firms compete on four differentiated markets
Different (randomized) costs
In Cournot fashion, deciding on capacities
Uncertain ending of game

Teams formed randomly
Prizes for Winners – monetary and better…

Game decisions input each **Mon 19.00 and Thu 19.00**
Game start: First capacity decisions **Mon 14.1 19.00**
By **Tue 19.00 and by Fri 19.00** 'Board minutes' as email to me
Game ends sometimes in Feb-March…
Game issues at the end of lectures



To participate in the game, send me , mikko.mustonen@aalto.fi, an e-mail by Wed 9.1 16.00

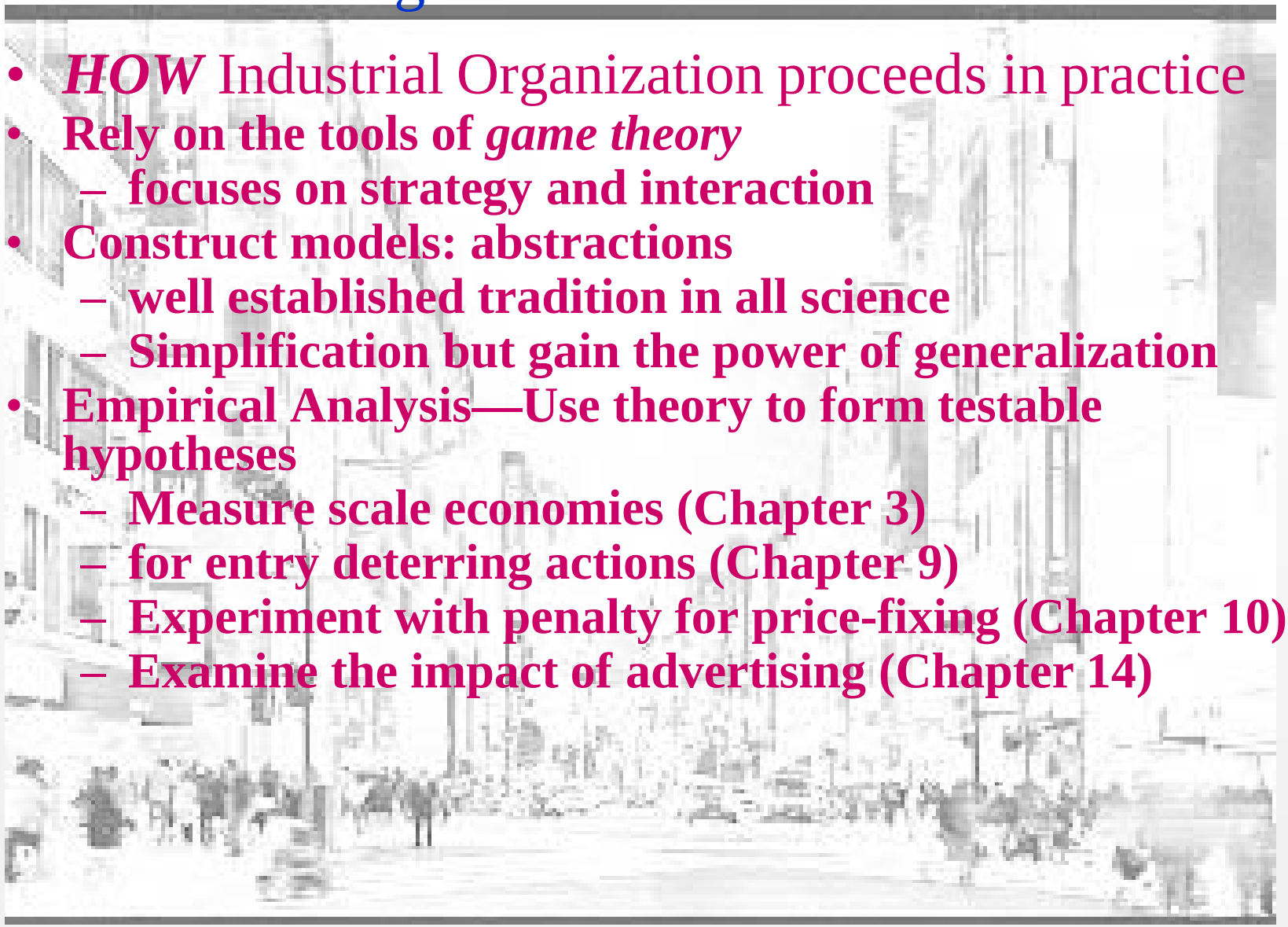
Teams are formed by thu 10.1 lecture and first decisions are on Mon 14.1. Minimum number of players 16.

Some game information and details are covered during next lecture

Introduction

- ***WHAT*** is Industrial Organization
- Study of how firms behave in markets
- Whole range of business issues
  - price of flowers; payment to be official sponsor of major events
  - which new products to introduce
  - merger decisions
  - methods for attacking or defending markets
- Industrial Organization takes a ***Strategic view*** of how firms interact

Industrial Organization In Practice

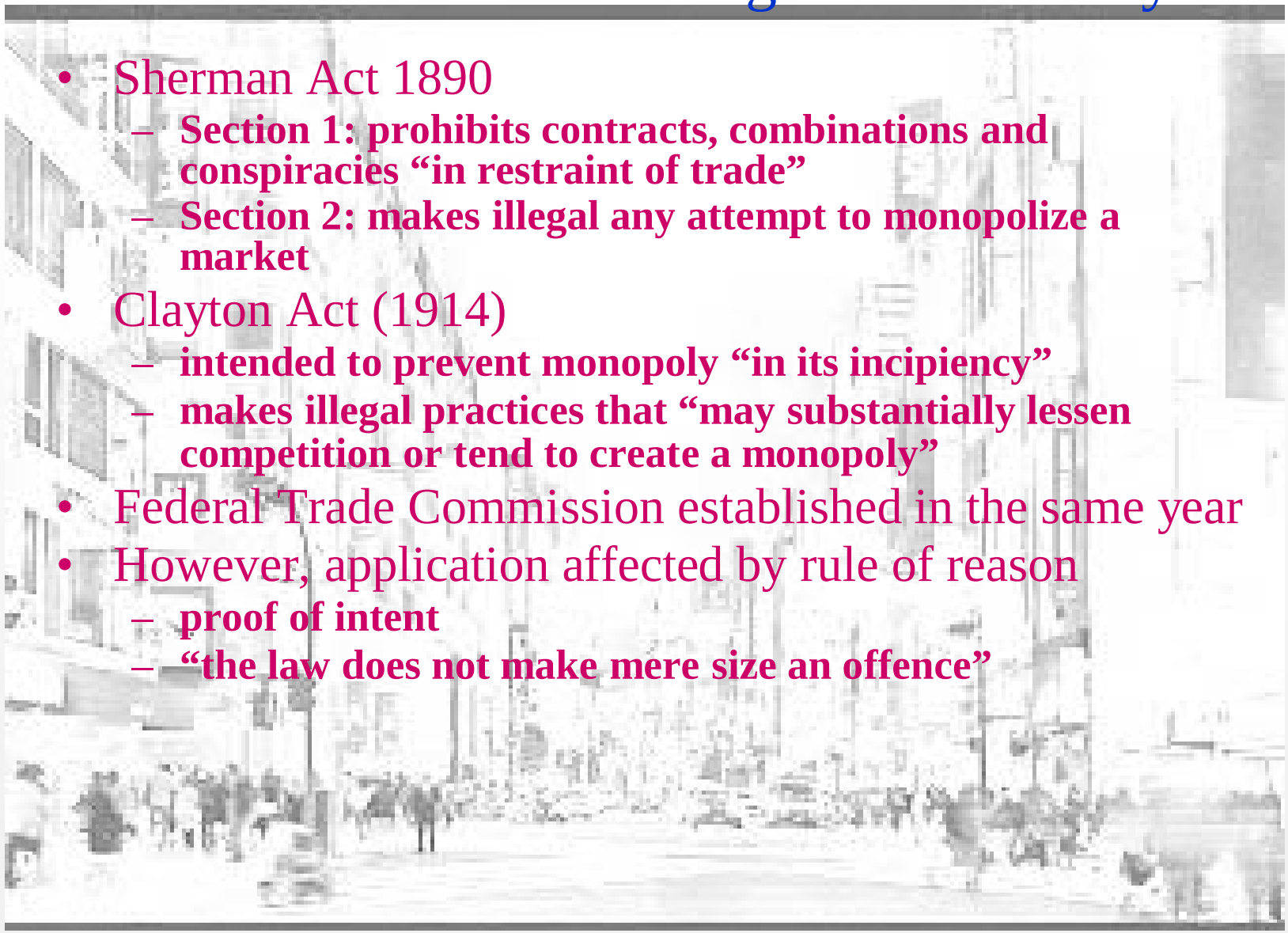


- ***HOW*** Industrial Organization proceeds in practice
- **Rely on the tools of *game theory***
  - **focuses on strategy and interaction**
- **Construct models: abstractions**
  - **well established tradition in all science**
  - **Simplification but gain the power of generalization**
- **Empirical Analysis—Use theory to form testable hypotheses**
  - **Measure scale economies (Chapter 3)**
  - **for entry deterring actions (Chapter 9)**
  - **Experiment with penalty for price-fixing (Chapter 10)**
  - **Examine the impact of advertising (Chapter 14)**

Motivation for Industrial Organization Study

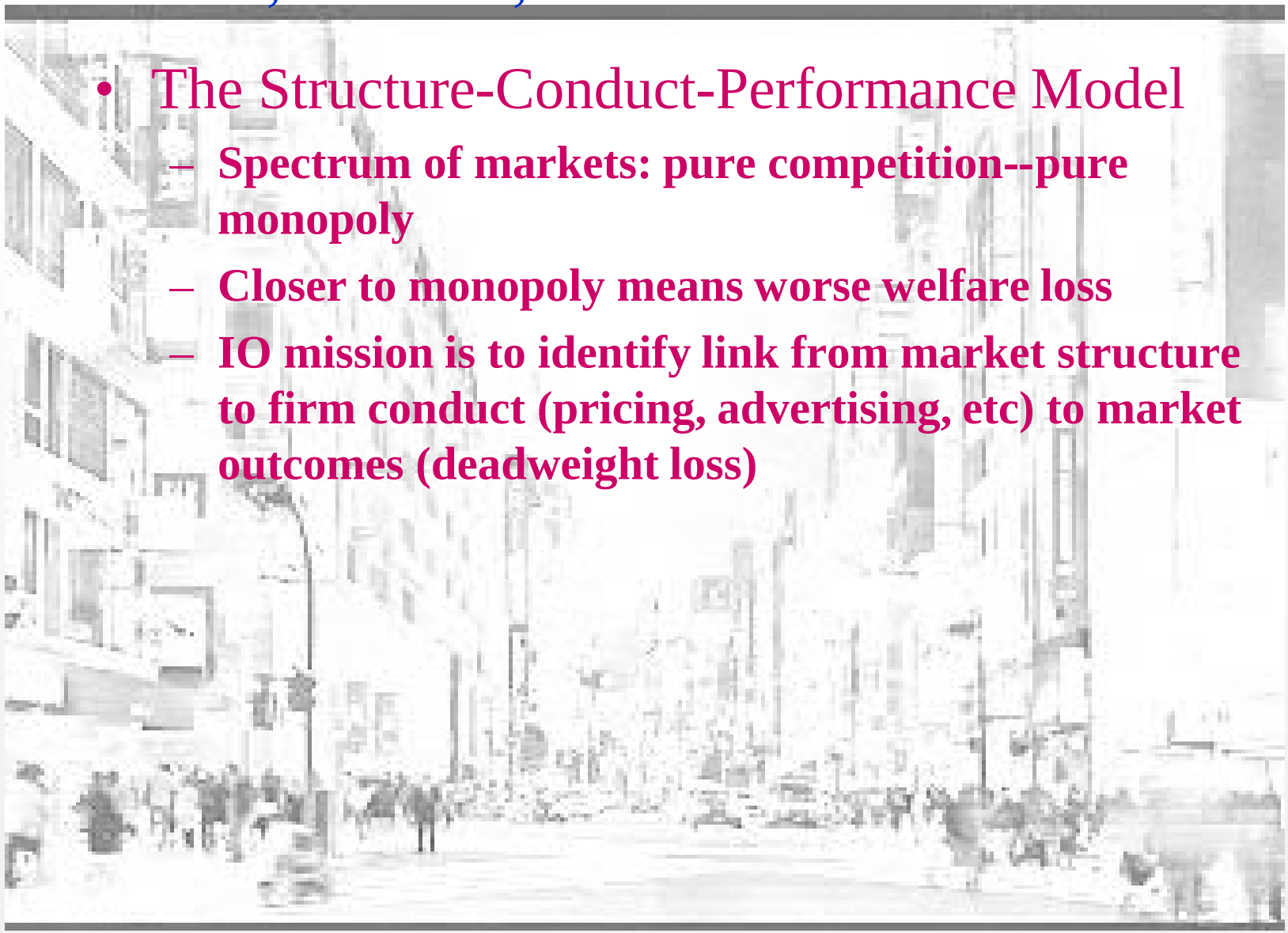
- ***WHY*** do Industrial Organization?
- Long-standing concern with market power
  - Sherman Antitrust Act (Standard Oil)
  - Need for anti-trust policy recognized by Adam Smith
  - ***"The monopolists, by keeping the market constantly under stocked, by never fully supplying the effectual demand, sell their commodities much above the natural price."***
  - ***"People of the same trade seldom meet together, even for merriment or diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices."***
- Sherman Act 1890
  - **Section 1: prohibits contracts, combinations and conspiracies "in restraint of trade"**
  - **Section 2: makes illegal any attempt to monopolize a market**

Motivation for Industrial Organization Study 2



- Sherman Act 1890
  - **Section 1: prohibits contracts, combinations and conspiracies "in restraint of trade"**
  - **Section 2: makes illegal any attempt to monopolize a market**
- Clayton Act (1914)
  - **intended to prevent monopoly "in its incipiency"**
  - **makes illegal practices that "may substantially lessen competition or tend to create a monopoly"**
- Federal Trade Commission established in the same year
- However, application affected by rule of reason
  - **proof of intent**
  - **"the law does not make mere size an offence"**

Structure, Conduct, and Performance



- The Structure-Conduct-Performance Model
  - **Spectrum of markets: pure competition--pure monopoly**
  - **Closer to monopoly means worse welfare loss**
  - **IO mission is to identify link from market structure to firm conduct (pricing, advertising, etc) to market outcomes (deadweight loss)**

Chicago and Post-Chicago Frameworks

- The Chicago School
  - **Good as well as bad reasons for monopoly including superior skill and technology**
  - **Potential entry can discipline even a monopoly**
  - **Structure is endogenous/causality difficult to determine**
- Post-Chicago
  - **Game Theoretic Emphasis**
  - **Competitive Discipline can Fail**
  - **Careful econometric testing to determine correct policy in actual cases**
    - ***ADM (collusion)***
    - ***Toys R Us (exclusive dealing)***
    - ***American Airlines (predatory pricing)***
    - ***Merger wave (Maytag and Whirlpool)***

The New Industrial Organization

- **The "New Industrial Organization" is a blend of features**
  - **theory in advance of policy**
  - **recognition of connection between market structure and firms' behavior**
- **Contrast pricing behavior of:**
  - **grain farmers at first point of sale**
  - **gas stations: Texaco, Mobil, Exxon**
  - **computer manufacturers**
  - **pharmaceuticals (proprietary vs. generics)**

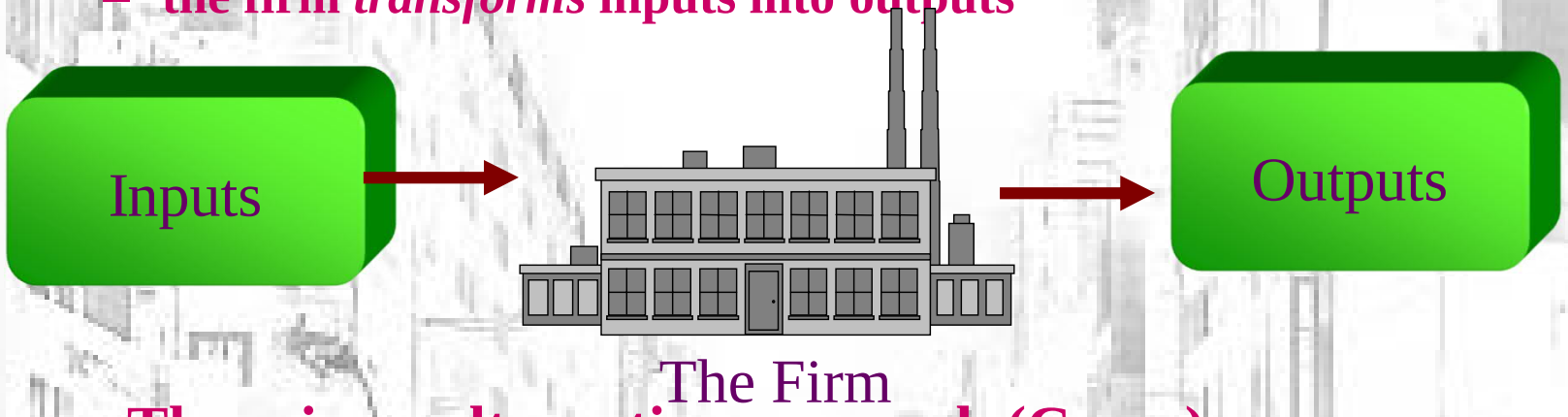
Contemporary Industrial Organization

- **WHAT: The study of imperfect competition and strategic interaction**
- **HOW:**
  - **Build on game theory foundation**
  - **Derive empirically testable propositions**
  - **Econometric estimates of relations predicted by theory**
- **WHY:**
  - **Motivated largely by antitrust concerns**
  - **Also interest in private solutions to inefficient market outcomes**

Technology and Cost

The Neoclassical View of the Firm

- **Concentrate upon a neoclassical view of the firm**
  - **the firm *transforms* inputs into outputs**



- **There is an alternative approach (Coase)**
  - **What happens *inside* firms?**
  - **How are firms structured? What determines size?**
  - **How are individuals organized/motivated?**

The Single-Product Firm

- **Profit-maximizing firm must solve a related problem**
  - **minimize the cost of producing a given level of output**
  - **combines two features of the firm**
    - ***production function*: how inputs are transformed into output**

Assume that there are n inputs at levels x_1 for the first, x_2 for the second,…, x_n for the nth. The production function, assuming a single output, is written:

$$q = f(x_1, x_2, x_3, \ldots, x_n)$$

- ***cost function*: relationship between output choice and production costs. Derived by finding input combination that minimizes cost**

$$\underset{x_i}{\text{Minimize}} \sum_{i=1}^{n} w_i x_i \quad \text{subject to } f(x_1, x_2, \ldots, x_n) = q_1$$

Cost Relationships

- **This analysis has interesting implications**
  - **different input mix across**
    - **time: as capital becomes relatively cheaper**
    - **space: difference in factor costs across countries**
- **Analysis gives formal definition of the *cost function***
  - **denoted C(Q): total cost of producing output Q**
  - **average cost = AC(Q) = C(Q)/Q**
  - **marginal cost: cost of one more unit**
    - **formally: MC(Q) = dC(Q)/d(Q)**
- **Also consider sunk cost**
  - **incurred on entry independent of output**
  - **cannot be recovered on exit**

Cost Relationships 2

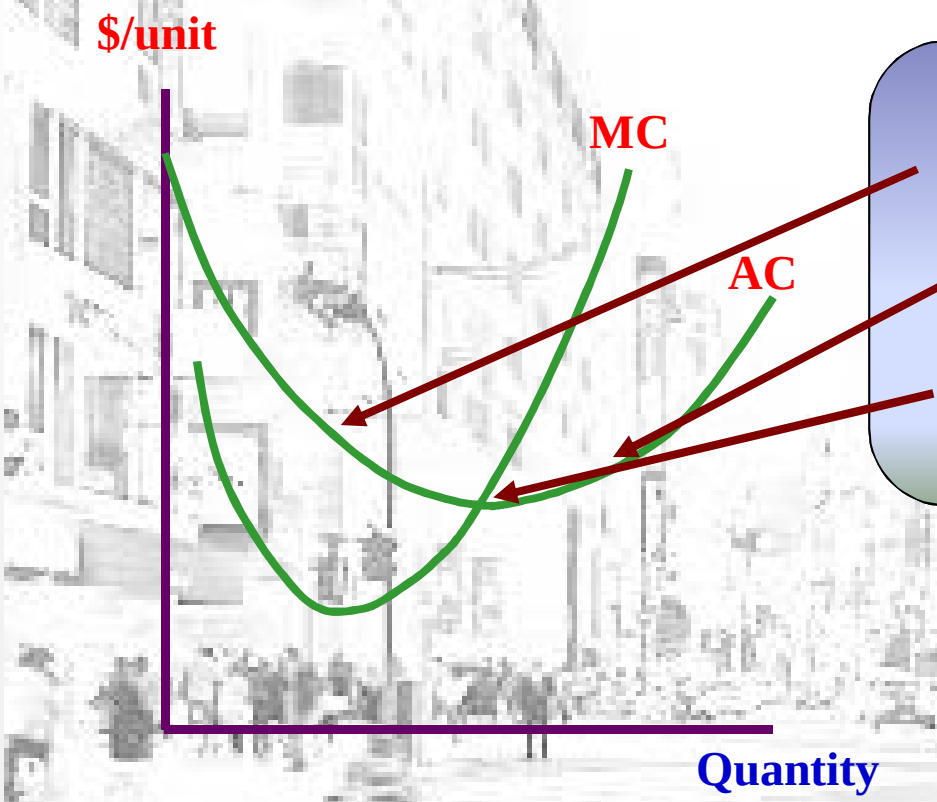
- **The relationship between average and marginal cost is**

$$\frac{dAC(q)}{dq} = \frac{d[C(q)/q]}{dq} = \frac{qC'(q) - C(q)}{q^2} = \frac{q[MC(q) - AC(q)]}{q^2}$$

- **So average cost is increasing whenever it is less than marginal cost.**

Cost curves: an illustration

Typical average and marginal cost curves



Relationship between AC and MC

If MC < AC then AC is falling

If MC > AC then AC is rising

MC = AC at the minimum of the AC curve

Cobb Douglas Cost Minimization

- **A common production function is Cobb-Douglas**

$$q = x_1^{\alpha} x_2^{\beta}$$

- **The associated Lagrangian function is:**

$$L = w_1 x_1 + w_2 x_2 + \lambda\left(q - x_1^{\alpha} x_2^{\beta}\right) + F$$

Which gives the first-order conditions

$$\frac{\partial L}{\partial x_1} = w_1 - \lambda\alpha x_1^{\alpha-1} x_2^{\beta} \quad \Rightarrow \quad w_1 x_1 = \lambda\alpha q$$

$$\frac{\partial L}{\partial x_2} = w_2 - \lambda\beta x_1^{\alpha} x_2^{\beta-1} \quad \Rightarrow \quad w_1 x_2 = \lambda\beta q$$

$$\frac{\partial L}{\partial \lambda} = q - x_1^{\alpha} x_2^{\beta-1}$$

Cost Minimization 2

- **These equations give**

$w_1x_1 + w_2x_2 = \lambda(\alpha+\beta)q$ **for total costs and**

$$\left(\frac{w_1x_1}{\alpha}\right)^{\alpha} = \lambda^{\alpha}q^{\alpha}$$

$$\left(\frac{w_2x_2}{\beta}\right)^{\beta} = \lambda^{\beta}q^{\beta}$$

$$\lambda = \left(\frac{w_1}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{w_2}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} q^{\frac{1}{\alpha+\beta}-1}$$

Which gives total costs:

$$C(w_1, w_2, q) = \left(\frac{w_1}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}}\left(\frac{w_2}{\beta}\right)^{\frac{\beta}{\alpha+\beta}}(\alpha+\beta)q^{\frac{1}{\alpha+\beta}} + F$$

Average Costs

Average cost, Average variable cost, and average fixed costs

$$AC(q) = \frac{(w_1 x_1 + w_2 x_2) + F}{q} = \left(\frac{w_1}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}} \left(\frac{w_2}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} (\alpha+\beta) q^{\frac{1}{\alpha+\beta}-1} + \frac{F}{q}$$

$$AVC(q) = \frac{(w_1 x_1 + w_2 x_2)}{q} = \left(\frac{w_1}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}} \left(\frac{w_2}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} (\alpha+\beta) q^{\frac{1}{\alpha+\beta}-1}$$

$$AFC(q) = \frac{F}{q}$$

Marginal Cost

- **Marginal cost is the increase in cost resulting from a small change in output**
  - ***MC*(*q*) = *dC*(*q*)/*dq*.**
- **In Cobb-Douglas, we have:**

$$MC(q) = \frac{dC(q)}{dq} = \left(\frac{w_1}{\alpha}\right)^{\frac{\alpha}{\alpha+\beta}} \left(\frac{w_2}{\beta}\right)^{\frac{\beta}{\alpha+\beta}} q^{\frac{1}{\alpha+\beta}-1}$$

Cost and Output Decisions

- **Firms maximizes profit where MR = MC *provided***
  - **output should be greater than zero**
  - **implies that price is greater than average variable cost**
  - ***shut-down decision***
- **Enter if price is greater than average total cost**
  - **must expect to cover sunk costs of entry**

Economies of scale

- **Definition: average costs fall with an increase in output**
- **Represented by the *scale economy index***

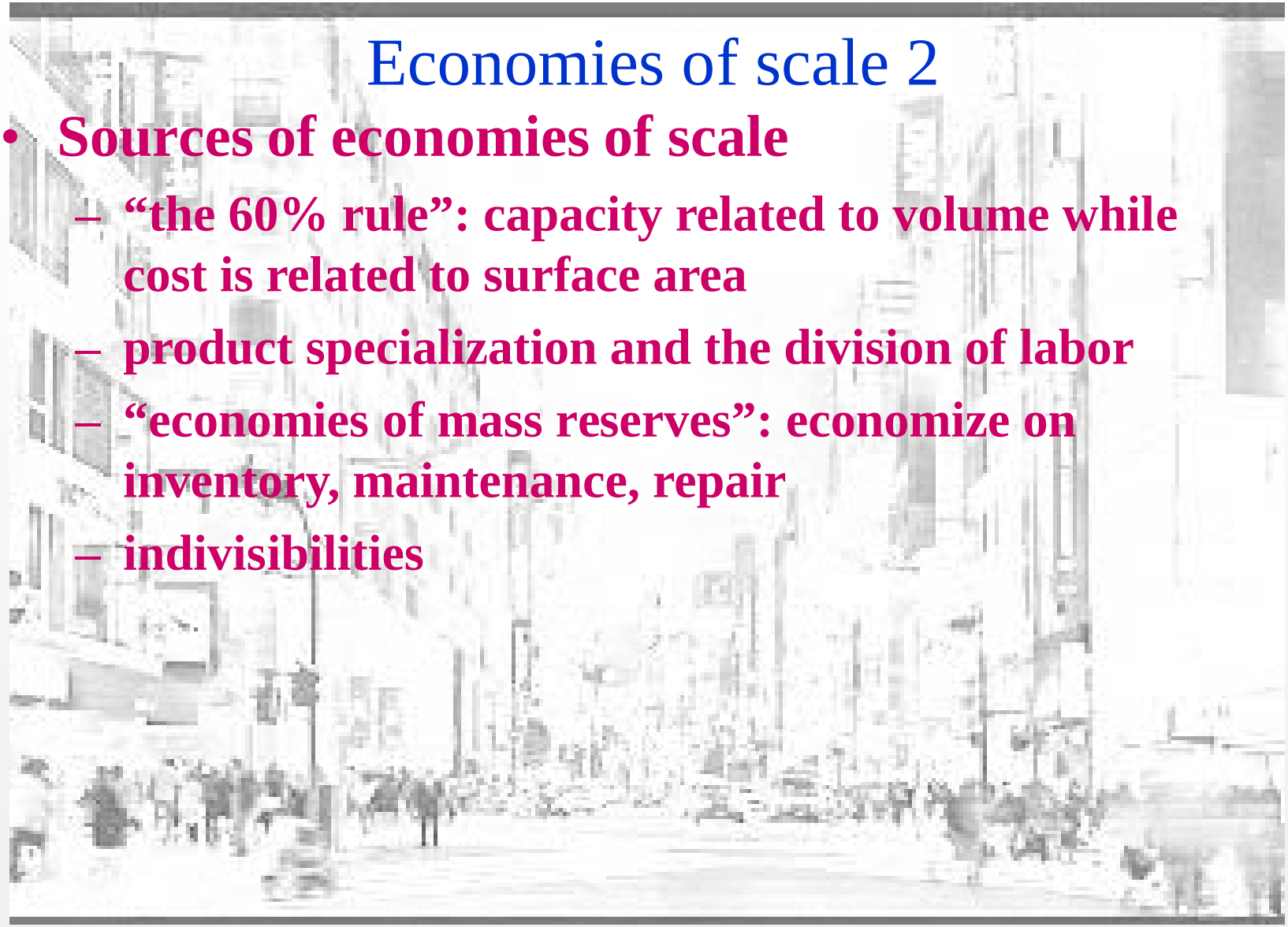
$$S = \frac{AC(Q)}{MC(Q)}$$

- **S > 1: economies of scale**
- **S < 1: diseconomies of scale**
- **S is the inverse of the elasticity of cost with respect to output**

$$\eta_C = \frac{dC(Q)}{C(Q)} \Big/ \frac{dQ}{Q} = \frac{dC(Q)}{dQ} \Big/ \frac{C(Q)}{Q} = \frac{MC(Q)}{AC(Q)} = \frac{1}{S}$$

Economies of scale 2

- **Sources of economies of scale**
  - **“the 60% rule”: capacity related to volume while cost is related to surface area**
  - **product specialization and the division of labor**
  - **“economies of mass reserves”: economize on inventory, maintenance, repair**
  - **indivisibilities**



Indivisibilities, sunk costs and entry

- **Indivisibilities make *scale of entry* an important strategic decision:**
  - ***enter large with large-scale indivisibilities: heavy overhead***
  - ***enter small with smaller-scale cheaper equipment: low overhead***
- **Some indivisible inputs can be redeployed**
  - **aircraft**
- **Other indivisibilities are highly specialized with little value in other uses**
  - ***market research expenditures***
  - ***rail track between two destinations***
- **Latter are *sunk costs*: nonrecoverable if production stops**
- **Sunk costs affect market structure by affecting entry**

Nokia N 95 Cost structure

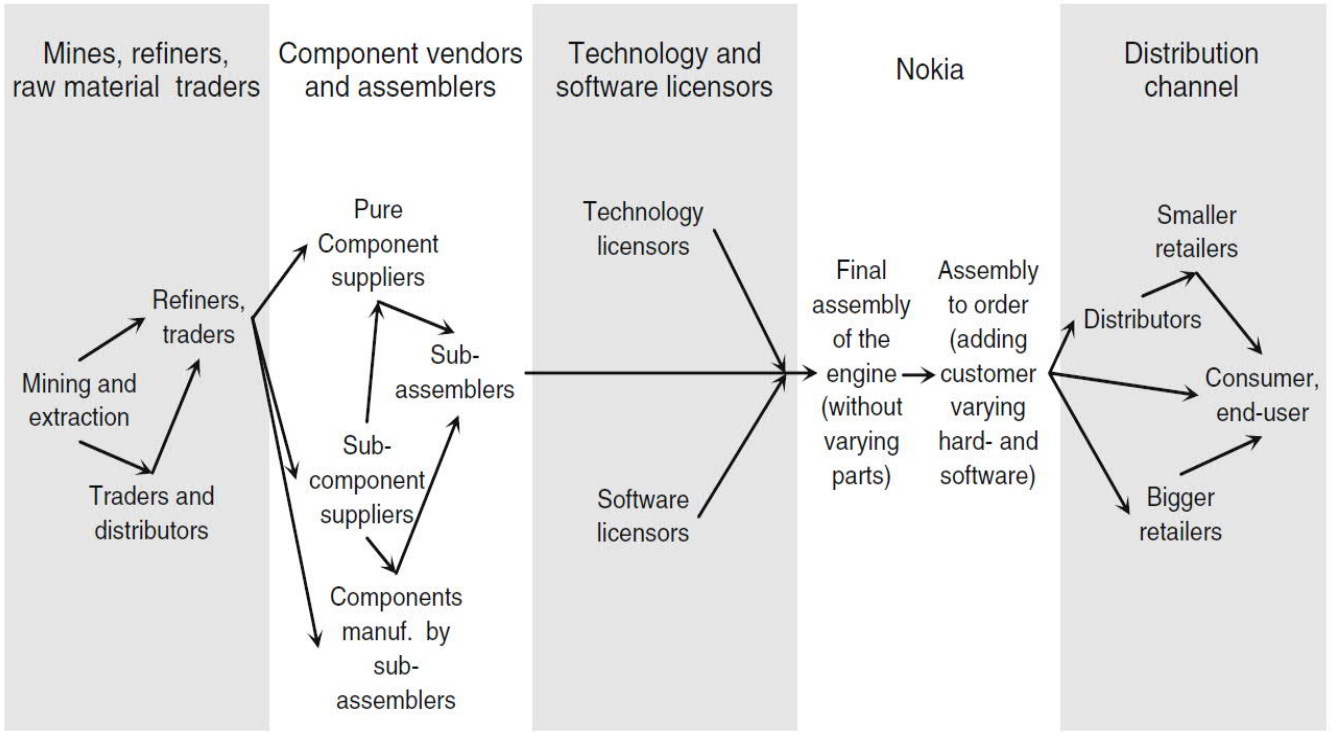


Fig. 1 A stylized supply chain of the *Nokia N95*

Table 1 The bill of materials (BOM) of the *Nokia N95* in 2007

Description	€	%
Processors	34.3	17.3%
Display	21.6	10.9%
Main camera module (5 million pixels)	16.5	8.3%
Memories	14.5	7.3%
Battery pack	3.0	1.5%
Video conference camera (VGA)	1.2	0.6%
Other integrated circuits (excl. processors and memories)	31.5	15.9%
Mechanics	18.7	9.4%
All other hardware inputs	21.1	10.6%
BOM (excl. supporting material, license fees and final assembly)	162.4	81.8%
Supporting material	15.5	7.8%
BOM (excl. license fees and final assembly)	177.9	89.6%
GSM/WCDMA license fees	13.5	6.8%
Symbian operating system	3.0	1.5%
Other license fees	4.2	2.1%
BOM (excluding final assembly)	198.6	100.0%

Table 2 The value added breakdown of the *Nokia N95* listed by supply chain participant,%

Suppliers of material inputs	11%
Software and other companies selling licenses	3%
Nokia	50%
Distributors	3%
Retailers	11%
Unaccountable inputs	3%
Vendors of vendors	19%

Source: ETLA

Subtracting all downstream costs from the price *Nokia* sells the phone to the distribution channel yields its own value added, €269. This value added is allocated to direct and indirect in-house labor costs (e.g., in its manufacturing/assembly, innovation, advertising, design, marketing, financial, legal, and management functions), depreciation of tangible and intangible assets, investments, and operating profit. It also includes some aspects of outsourcing, which we were unable to separate from Nokia's internal functions: purchases of "billable hours", some R&D and software sub-contracting, outbound logistics, and certain externally provided warranty and other services.

Careful studies of industry sources and our interviews suggest that the final assembly/manufacturing cost of the *N95* is €11.5, i.e., 2% of the pre-tax final sales price.[7] Thus, even