Economics of Information

Lecture 1

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18th March 2019

Website

https://staccioli.org/teaching

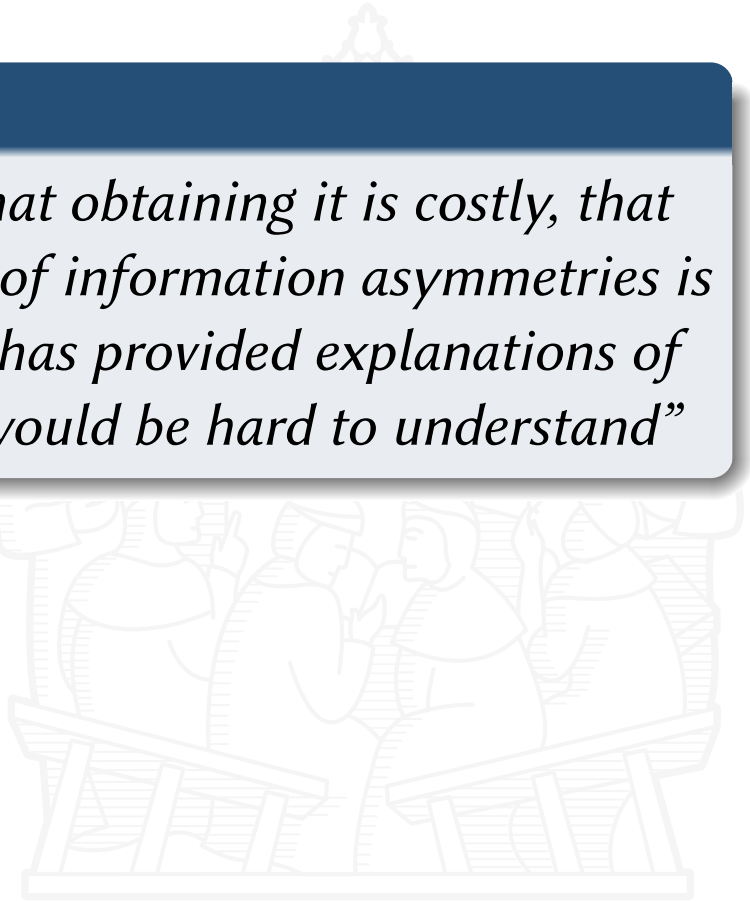
Joseph Eugene Stiglitz

- 273,000+ Scholar™ citations
- born on February 9, 1943 in Gary, Indiana, USA
- 1964: B.A. at Amherst College
- 1967: Ph.D. at MIT
- 2001: Professor at Columbia University
- 2001: Nobel Memorial Prize in Economic Sciences *"for [his] analyses of markets with asymmetric information"*
- 2017: Ph.D. *honōris causā* at Scuola Superiore Sant'Anna 🙂

Why Economics of Information

Stiglitz (2000, p.1441)

"The recognition that information is imperfect, that obtaining it is costly, that there are important asymmetries, that the extent of information asymmetries is affected by actions of firms and individuals [...] has provided explanations of economic and social phenomena that otherwise would be hard to understand"



XVIII and XIX Century antecedents

Smith

- as firms raise interest rates, the best borrowers drop out of the market
- if lenders knew perfectly the risks associated with borrowers, they would charge each with an appropriate risk premium
- but lenders don't know the risk properties of each borrower

Marshall

- paying workers higher wages may increase their productivity
- employers are unable to perfectly monitor the performed tasks

- Smith, Marshall, Weber, Sismondi and Mill were all aware of information problems, but did not conceive of them as such
- discussions of information were caveats at the end of the analysis, never the core

The Chicago School

Marshall (1890) *"Nātūra non facit saltum"*

so long as information were not too imperfect, economies with almost perfect information would look very much like economies with perfect information

Stigler (1967)

- many of the seeming imperfections of capital markets can be explained by transactions costs (including information costs)
- once these costs were taken into account, capital markets are efficient

The Chicago School (cont'd)

- Arrow-Debreu general equilibrium theory simply ignored information considerations
- there was widespread hope that properties that held for economies with perfect information (e.g. welfare theorems) would also hold for economies with imperfect information
- ideally, individuals would equate marginal benefits of acquiring additional information to marginal costs, tracing out demand curves for information

WRONG !

- even small information costs can have large consequences
- decentralisation through the price system does *not* generally result in a (constrained) Pareto optimum

Alternative critiques of the standard paradigm

other assumptions of the Arrow-Debreu model

- complete markets
- no enforcement problem

BUT

- imperfections of knowledge (e.g. asymmetries of information) imply that market and contracts cannot be complete
- there cannot be markets in contingencies that have not yet been conceived (Knightian uncertainty vs. quantifiable risk)
- if information were perfect, individuals would be paid *if and only if* they completed the agreed-upon task, in the agreed-upon manner, in the agreed-upon time, and courts would quickly determine who is right
- incentive issues wouldn't exist

Example

- equity markets are better in sharing risk than bond markets or loans

PUZZLE: why relatively little new capital is raised through equity?

Townsend (1979) *costly state verification*

- books cannot be well audited (especially true in developing countries)
- insiders of a firm have more information than outsiders
- outsiders are aware of this
- then issuing equity conveys a (noisy) signal that shares are overpriced
- market responds by lowering the price
- this discourages the firm from issuing new shares

XX Century antecedents

Hayek (1945)

- the standard competitive equilibrium model solves a particular information problem: information about *scarcity*
- decentralised price system ensures the efficient allocation of scarce resources
- even if nobody knows preferences/technology of all agents/firms price conveys all the relevant information
- price is a sufficient statistics

XX Century antecedents (cont'd)

BUT besides information about scarcity, there are other information problems in an economy

selection: focus on the *characteristics* of the items being transacted

- employers want to know the productivity of workers
- investors want to know the return of assets
- insurance companies want to know the lifespan of their clients

incentive: focus on the *behaviour* of the counterparts of a contract

- employers want to know how hard workers work
- lenders want to know what risks borrowers take
- insurers want to know what care their clients take to avoid an accident

these problems are intertwined with the exchange process and prices do *not* solve the information problem of scarcity

An intellectual revolution

> *"The fundamental breakthrough in the economics of information [is] the recognition that information [is] fundamentally different from other commodities"* [ĭbīdem, p.1448]

information is a sort of *public good*

- consumption is *nonrivalrous*
- difficult (and socially inefficient) to *exclude* others from enjoying it

- moreover, each piece of information is different from others

An intellectual revolution (cont'd)

- a piece of information cannot be purchased like a chair
- an individual can look at a chair and ascertain its properties before purchasing it
- but if the seller of information tells the information she wishes to sell before the transaction, there is no reason the buyer will pay for it
- while an individual may repeatedly buy a product from some store, each piece of information has to be unique

- markets for information are inherently characterised by imperfections of information about what is being purchased
- mechanisms like *reputation*, which play no role in traditional competitive theory, are central

An intellectual revolution (cont'd)

MOREOVER

- information issues are intertwined with the production and sale of traditional commodities
- in traditional economics prices convey all relevant information

BUT

- there are a variety of other ways in which economically relevant information is conveyed
- prices convey information other than that about scarcity

- producers and consumers realise that their actions convey information, and this affects (re)actions
- the simple theory of consumer and producer behaviour does *not* describe actual behaviour in several central aspects

Toward equilibrium analysis

Diamond (1971)

- if everyone has even arbitrarily small search costs $\varepsilon > 0$
- then equilibrium price will be the monopoly price !
- equilibrium welfare losses associated with imperfections are out of proportion to the magnitude of the search costs themselves

- if individuals have differing levels of search costs $\varepsilon_i \neq \varepsilon_j$
- then there is an equilibrium price *distribution*

- Arrow-Debreu model is far from robust !

Toward equilibrium analysis (cont'd)

- if what people know is endogenous
- then what people don't know is also endogenous

- firms know that it is costly for customers to search, and exploit that
- managers know that it is costly for shareholders to monitor them...
- in *equilibrium* market participants might actually create noise, forcing other participants to spend valuable resources to undo, at least partially, this artificially created noise

Edlin and Stiglitz (1995)

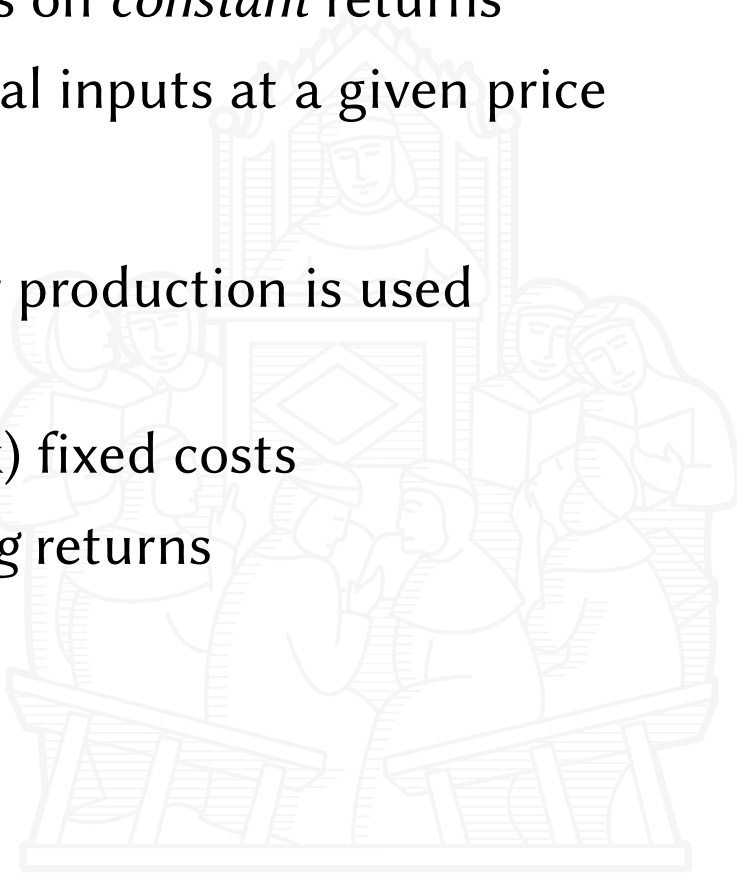
- managers' differential information over outsiders is a source of rent
- managers recognise this and take actions to increase the asymmetry

Information and industrial structure

- the usual logic of the price system depends on *constant* returns
- a firm can acquire more or less conventional inputs at a given price

BUT

- the same technical information needed for production is used regardless of the scale of production
- technical information generates (non-sunk) fixed costs
- this can lead to extreme forms of *increasing* returns



Information and industrial structure (cont'd)

MOREOVER

- once obtained, technical information can be used by others, even though the original owner still possesses it
- it is much cheaper to *re*-produce information than to produce it
- it is difficult to make information into property
- IPRs are designed to create *artificial scarcity* that doesn't exist naturally
- they (supposedly) create incentives for the acquisition of information and may cause well known inefficiencies

Information and industrial structure (cont'd)

- IPRs offer only a partial protection
- technical knowledge may be diffused
  1. by interfirm mobility of personnel
     - is knowledge embedded in an employee actually property of the firm?
  2. by the launch of a new product
     - the existence of the product signals that it can be produced

$$\Pr(\text{success}) = \Pr(\text{success is feasible}) \times \Pr(\text{project succeeds} \mid \text{success is feasible})$$

     - if $\Pr(\text{success is feasible}) \to 1$, the expected return must non-decrease
  3. by written dissemination (e.g. academic publications)
  4. informal interpersonal contacts
     - economies of spacial agglomeration, industrial districts

the ability of information to move cheaply among individuals and firms has analogues with so-called *'fugitive resources'*

Information and industrial structure (cont'd)

- in standard economic theory the firm is a locus of knowledge, embodied in a production possibility set
- but where is knowledge located ? where does it reside ?
- some of it might be stored in a *proprietary* database
- but the most important part is embodied in individuals, acquired by means of interaction with other workers and sources outside the firm

BUT

- in the neoclassical model workers are *not* part of the firm
- they are input purchased on the market
- dilemma: what knowledge is *peculiar* to a firm ?

Information and industrial structure (cont'd)

- labour mobility is neither zero nor infinite
- then patterns of information dynamics are moderate and predictable
- a firm can treat and value its information base as an *asset*
- value of a *going concern* considerably exceeds $\sum$ physical assets
- knowledge embedded in production workers, managers, technical personnel… constitutes a large share of market capitalisation
- Becker (1962) *'firm-specific human capital'*
- each firm has a different way of *coding* information (e.g. *routines*)
- the code is itself part of the firm's information base
- $\exists$ multiple optimal codes
- choice is highly path-dependent

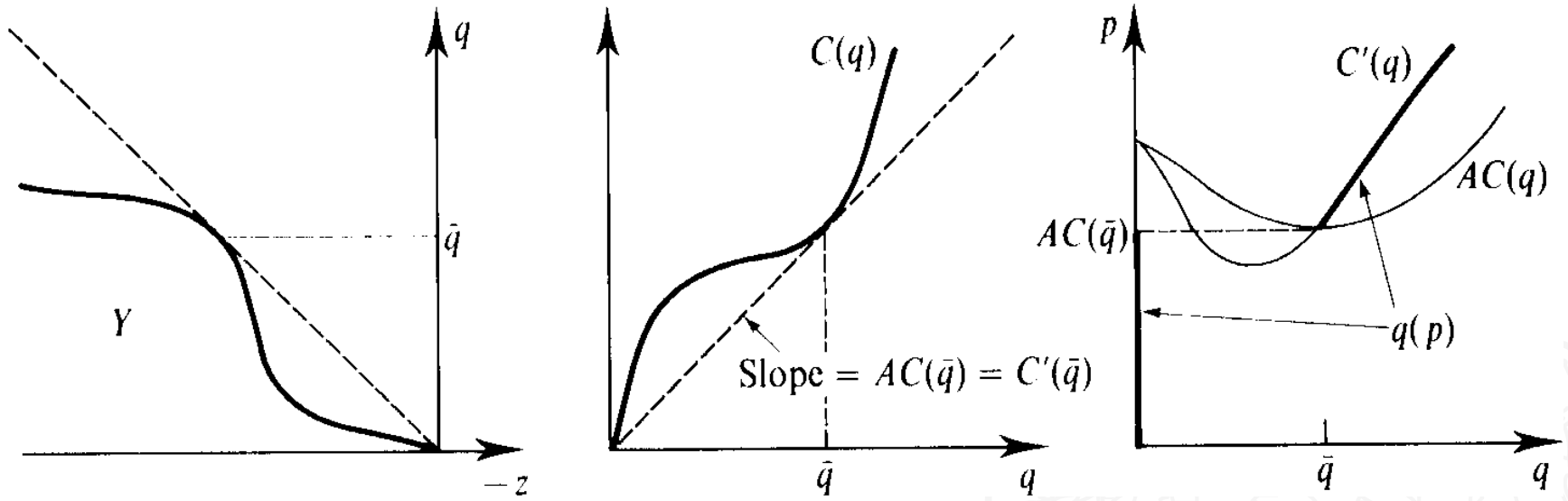
Overturning standard wisdom

"Nātūra non facit saltum" revisited

- many observations are of discrete phenomena
- e.g. an individual purchases insurance policy A or B
- a particular observation may change beliefs in a discrete way
- within information economics discontinuities abound

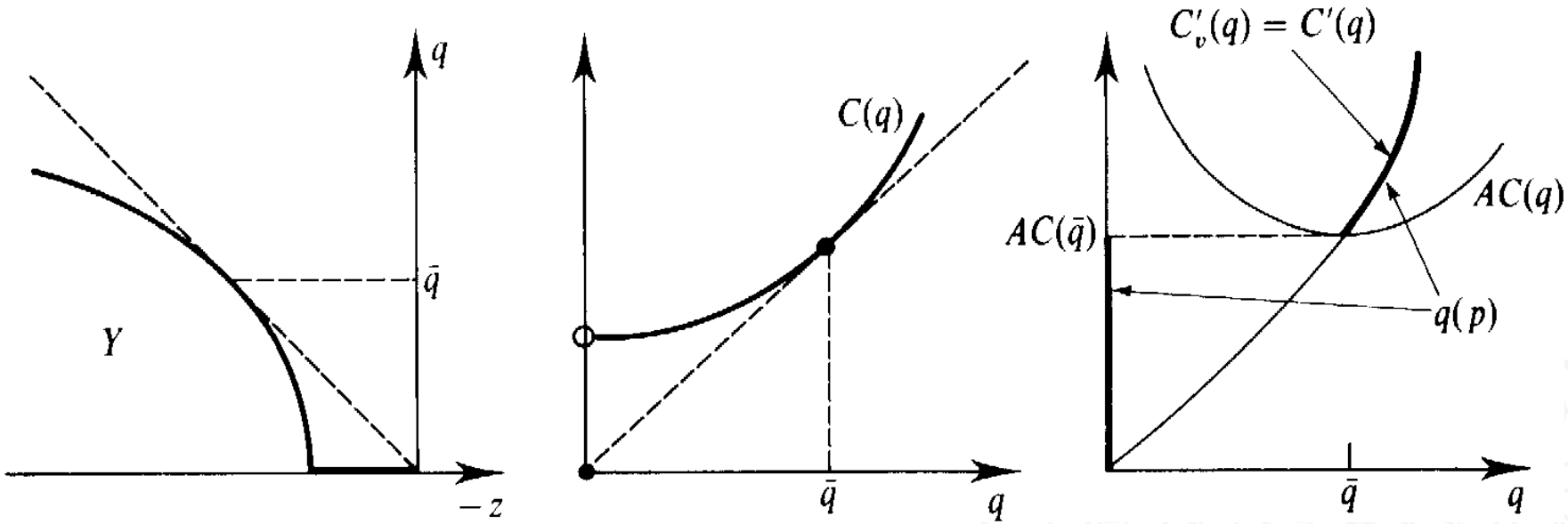
- discontinuities arise when there are nonconvexities in the relevant sets
- information is naturally associated with nonconvexities
- benefits of information increase with its production/utilisation
- costs of acquiring information are *fixed*
- information becomes an increasingly important part of the economy
- fixed costs play an increasing role

Overturning standard wisdom (cont'd)



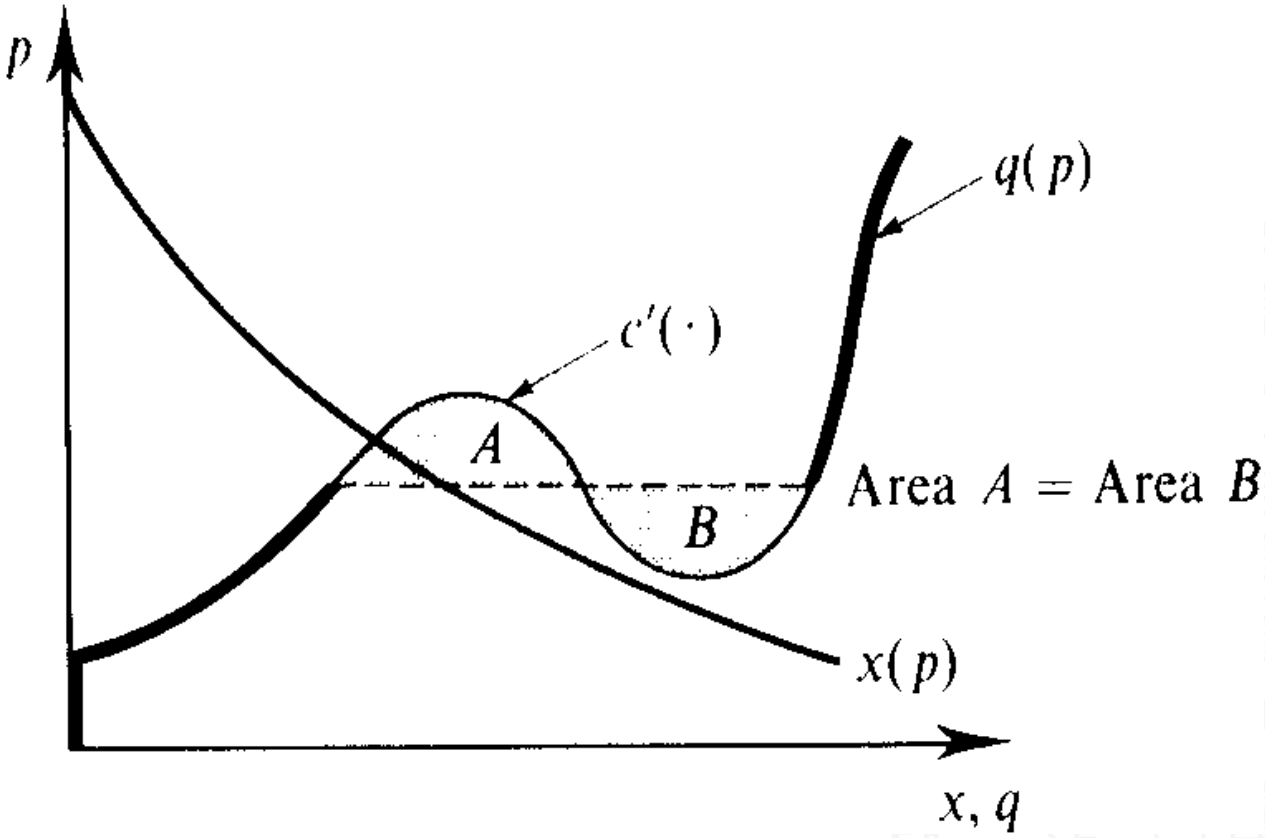
Source: Mas-Colell, Whinston and Green (1995, p.144, fig. 5.D.3)

Overturning standard wisdom (cont'd)



Source: Mas-Colell, Whinston and Green (1995, p.145, fig. 5.D.4)

Overturning standard wisdom (cont'd)



Source: Mas-Colell, Whinston and Green (1995, p.324, fig. 10.C.8)

Overturning standard wisdom (cont'd)

Greenwald and Stiglitz (1986)

- insurance market with moral hazard
- if individuals undertake risky actions, insurers increase premium
- but then it's in no one's interest to exert greater care
- if information is imperfect or markets are incomplete
- then competitive markets are *not* (constrained) Pareto efficient
- some individuals can be made better off without making anyone else worse off
- government interventions will in general lead to Pareto improvements
- the economy cannot be efficiently decentralised
- welfare theorems fail !

Overturning standard wisdom (cont'd)

Shapiro and Stiglitz (1984)

- in an agency problem the distribution of wealth affects the scope for
  - screening: a richer person is better able to work for low wages initially, before her high ability is discovered
  - incentives: a richer person is better able to absorb losses
- the standard equity/efficiency separation doesn't hold
- Coase's conjecture fails !

Grossman and Stiglitz (1976, 1980)

- if information is costly
- then there is an *"equilibrium amount of disequilibrium"*
- persistent discrepancies between price and fundamental value
- this provides incentives for individuals to obtain *costly* information

Overturning standard wisdom (cont'd)

Law of one price revisited

- even with many producers, each may face a downward sloping demand curve because of information imperfections
- monopolistic competition better describes market equilibrium

Law of competitive pricing revisited

- in presence of moral hazard, reputation mechanisms are required to induce 'good' behaviour
- in order to make losing reputation costly there *must* be rents
- $p > MC$!

Existence of equilibrium

- demand can differ from supply *in equilibrium* !

Applications

- one of the problems with testing the theory is that there are often alternative hypotheses which are also consistent with the conclusions

- if securities are imperfect substitutes, each face a downward sloping demand curve, and an increase in supply will lead to a fall in price
- screening and signalling models explain why graduates receive higher salaries, but so do the standard human capital models

IMF bailouts in East Asia

- critics focus on the moral hazard problem
- bailout combined with the support of exchange rates attenuated incentives
  - for lenders to engage in due diligence
  - for borrowers to have adequate cover for risk

Applications (cont'd)

Sharecropping (Stiglitz, 1974)

- intuitively, if workers gave landlords a large share of their output, their efforts would be attenuated
- if information were perfect a wage contract would be optimal
- but since effort cannot be observed the share is designed precisely to give the worker incentive
- effort is lower than with a rental contract, but workers cannot typically bear the risk or even afford it, and enforcement is loose
- empirical studies have confirmed the information-theoretic models
- economics of information also gives insights on why schemes of micro-credit and peer-monitoring work

Capital constraints and the Theory of the Firm

- information economics can be used to explain credit rationing and the limitations in the use of equity finance
- empirical research confirms the predictions even in developed countries
- investment is affected by firm cash flow and net worth
- small firms, firms paying out low dividends, firms that do not have access to the commercial paper market… are more likely to be constrained
- in a standard neoclassical model these variables would not matter
- only the returns to the investment relative to the cost of capital would
- Modigliani and Miller (1958): *" capital structure irrelevance principle"*

Applications (cont'd)

Corporate governance

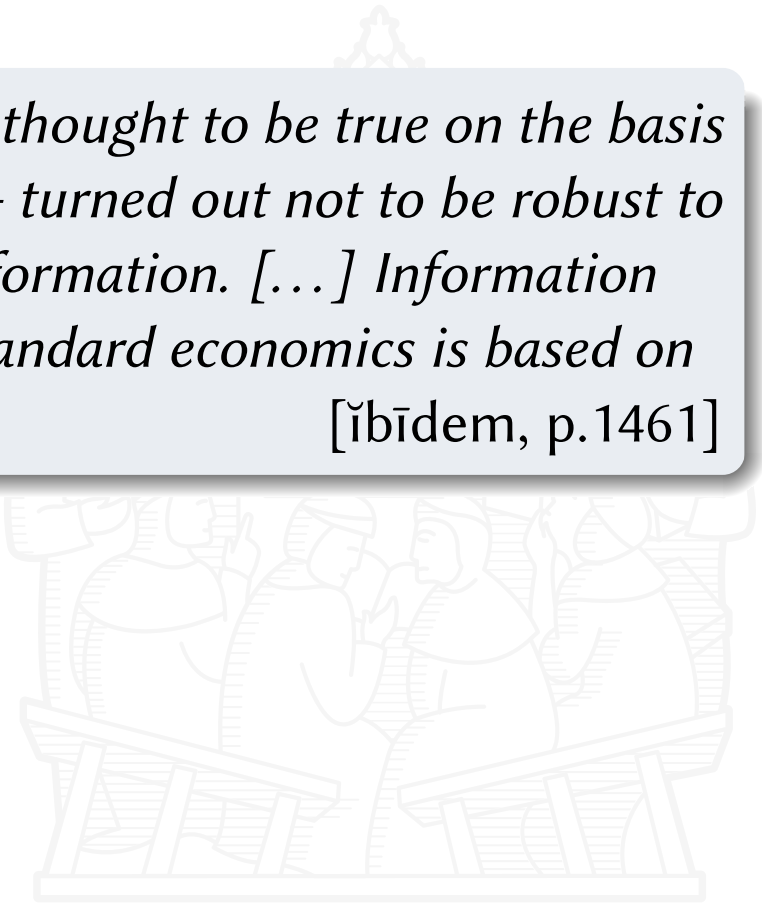
- Marshall (1897): CG is one of the main unexplained issues in economics
- in the XIX Century managers were regarded as engineers who look up in the book of blueprints for the most efficient technologies
- not decision makers trying to figure out, in the presence of highly imperfect information, what actions were most likely to maximise value
- why were managers well behaved in spite of a seeming absence of explicit incentives? why did they behave as if they were the owners of the firm
- Marshall attributed the success of the British corporation in no small measure to a combination of British breeding and upbringing
- information economics provides more convincing explanations
- managerial incentive schemes are designed to align interests of managers with those of stakeholders

Wrap up

- the key question is how the economy adapts to new information, creates new knowledge, and how that knowledge is disseminated, absorbed, and used
- there are many dimensions to knowledge and information beyond scarcity
- information is not uniquely conveyed through market prices but also by actions, quantities, etc…
- information conveyed by prices is not just related to scarcity
- agents recognise that their own actions affect other agents' actions, and behaviour cannot described by traditional consumption and production theories
- many of the standard results do not hold due to pervasive nonconvexities associated to informational imperfections

Main takeaway

"much of what economists believed — what they thought to be true on the basis of research and analysis over almost a century — turned out not to be robust to considerations of even slight imperfections of information. [...] Information economics has made us reali[s]e that much of standard economics is based on foundations resting on quicksand" [ĭbīdem, p.1461]



Outline of the course

1. Introduction and motivation
   Stiglitz (2000), Arrow (1996, ICC)
2. Nonconvexities in technology
   Arrow (1996, Empirica)
3. Introductory models of moral hazard
   Rasmusen (2007)
4. Introductory models of adverse selection
   Rasmusen (2007)
5. Unemployment as a discipline device
   Shapiro and Stiglitz (1984)
6. Asymmetric information in credit markets
   Grossman and Stiglitz (1980)

Thank you for your attention!

see you tomorrow

Tuesday, 19th March

h. 18:00 – Aula 14 DAF