ACE TRADING WORLD

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MODELING

Modeling has been known to exist for several years, there are record of mathematical models being used by ancient cultures from Babylon, Egypt or India by the year of 2 000 BC. At those times, the models were very simple, used to solve everyday problems through geometry. Based o this knowledges many more models were created thanks to Thales, Pythagoras, Euclid and many others.

By 250 BC these models were applied by Eratosthenes to discover the distance between Earth and Sun, Earth and Moon and discover the circumference of the Earth itself.

At 150 AD Ptolemy created a mathematical model for the solar system with circles and epicircles to discover it's movement.

MODEL TYPES

- Theoretical or Empirical
- Linear or Non Linear
- Static or Dynamic
- Explicit or Implicit
- Discrete or Continuous
- Deterministic or Stochastic
- Deductive, Inductive or Floating
- Homogeneous or Heterogeneous

AGENT-BASED MODELS

Agent-based models were first conceptualized in the late 1940's but it didn't move further than a simple concept at that time, as there was not enough computer power to handle such models.

Some basic models started to appear by 1970 with Thomas Schelling's segregation model. In his time all the results were obtained using coins and graph paper. Many other adventured in this field also, without proper computer capacities for their work.

By 1990 the first computer programs for agent-based models started to appear with StarLogo, Swarm and NetLogo, and with them more complex models started to be developed.

APLICATION AREAS

- Biology
- Computer Sciences
- Demography
- Economy
- Epidemiology
- Physics
- Psychology
- Sociology

ECONOMIES SYSTEMS

Micro Behaviors	• Buy/Sell • Feed • Reproduce
Global Regularities	• Employment • Growth Rates • Social Conventions
Interaction Patterns	• Trade Relationships • Schedules

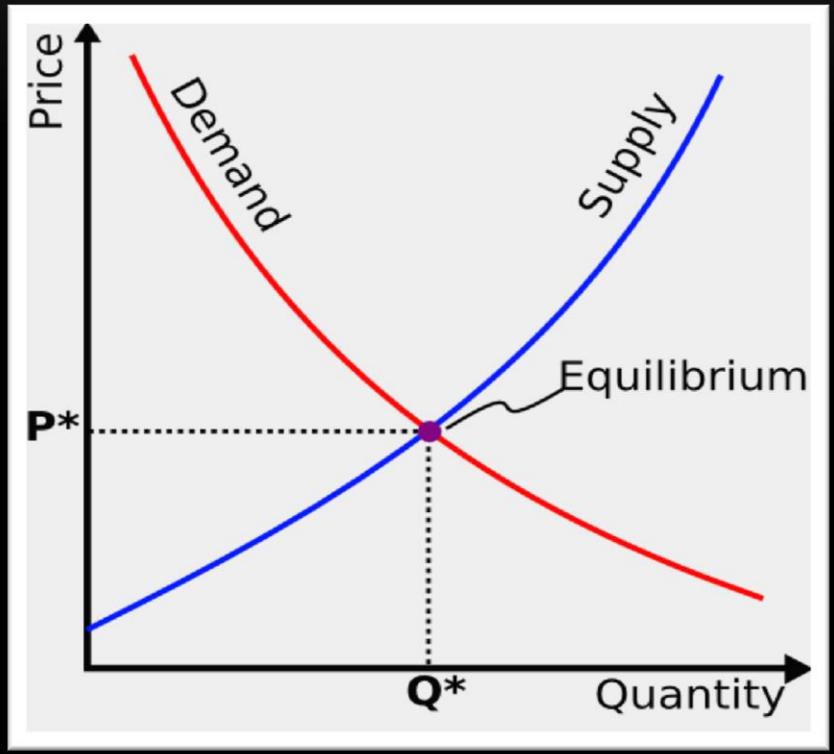
WALRASIAN EQUILIBRIUM MODEL

- Created by Leon Walras (1834-1910), a French economist.
- It is the fundamental way most economists think when trying to make a model;
- It is highly dependent of a Walrasian Auctioneer (the supposition that all that it is produced it is sold and that all needs are met)
- It delivers an equilibrium allocation that is Pareto efficient;
- This problem sums up to a simple optimization problem.

WALRASIAN EQUILIBRIUM MODEL

The postulates:

- Finite number of price-taking profit-maximizing firms who produce goods or services of different type and quality;
- Finite number of consumers of different tastes who maximize their utility, given the prices and their payed dividends;
- Walrasian Auctioneer, that assures that all that it is produced is also sold and all necessities are met;



$$Q_S(P) = Q_D(P)$$

WALRASIAN EQUILIBRIUM MODEL

The problems:

- This model does not allow strategic behavior from the firms or consumers;
- It seems like there is a middle entity that mediates the prices and it does not allow face-to-face interactions;
- The actions of other agents don't make any difference.

REAL WORLD

- There is no middle entity that regulates all prices of firms' products;
- It may happen that firms produce something that doesn't end up being sold (consumers may have no money for it, or they may don't want to buy that product);
- The actions of consumers make a difference between each other (one consumer may fully purchase a product leaving none to the others).

PROCUREMENT PROCESSES

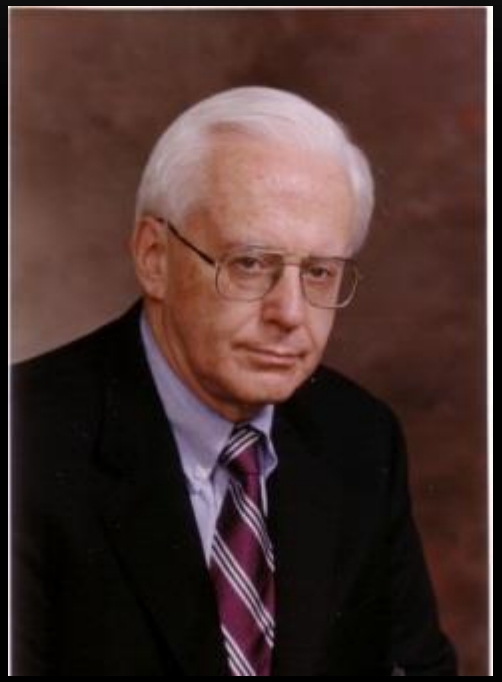
- This process is no more than a study of the market by the consumers i.e., the firms present their product and price to the consumer and then the consumer chooses which firm's product to buy;
- Usually consumers buy the product from the firm who sells it cheaper;
- If the cheapest product lacks quality, the consumer searches the firm that sells the product cheaper and with the right quality.

PROCUREMENT PROCESSES

- To improve the Walrasian Equilibrium, one could change the equilibrium assumptions for procurement processes.
- This simplification also leads to an equilibrium, but it isn't possible to determine it before hand, one must wait for several iterations until convergence is found.
- There is always the question of how many iterations are needed for convergence. That is unknown!

"The theory of value is not satisfactory without a description of the adjustment processes that are applicable to the economy and of the way in which individual agents adjust to disequilibrium. In this sense, stability analysis is of far more than merely technical interest. It is the first step in the reformulation of the theory of value"

Franklin M. Fisher



PROCUREMENT PROCESSES

This change makes a drastic modification in the outcome of the Walrasian Equilibrium Model. We no longer have the simplicity of an easy optimization problem. Now we may have a problem that can't be solved analytical ways. This comes from several complications as asymmetric information, social norms, coordination failure, mutual learning and so on…

Luckily now we have powerful computers that help us solve these problems.

AGENT-BASED COMPUTATIONAL ECONOMICS (ACE)

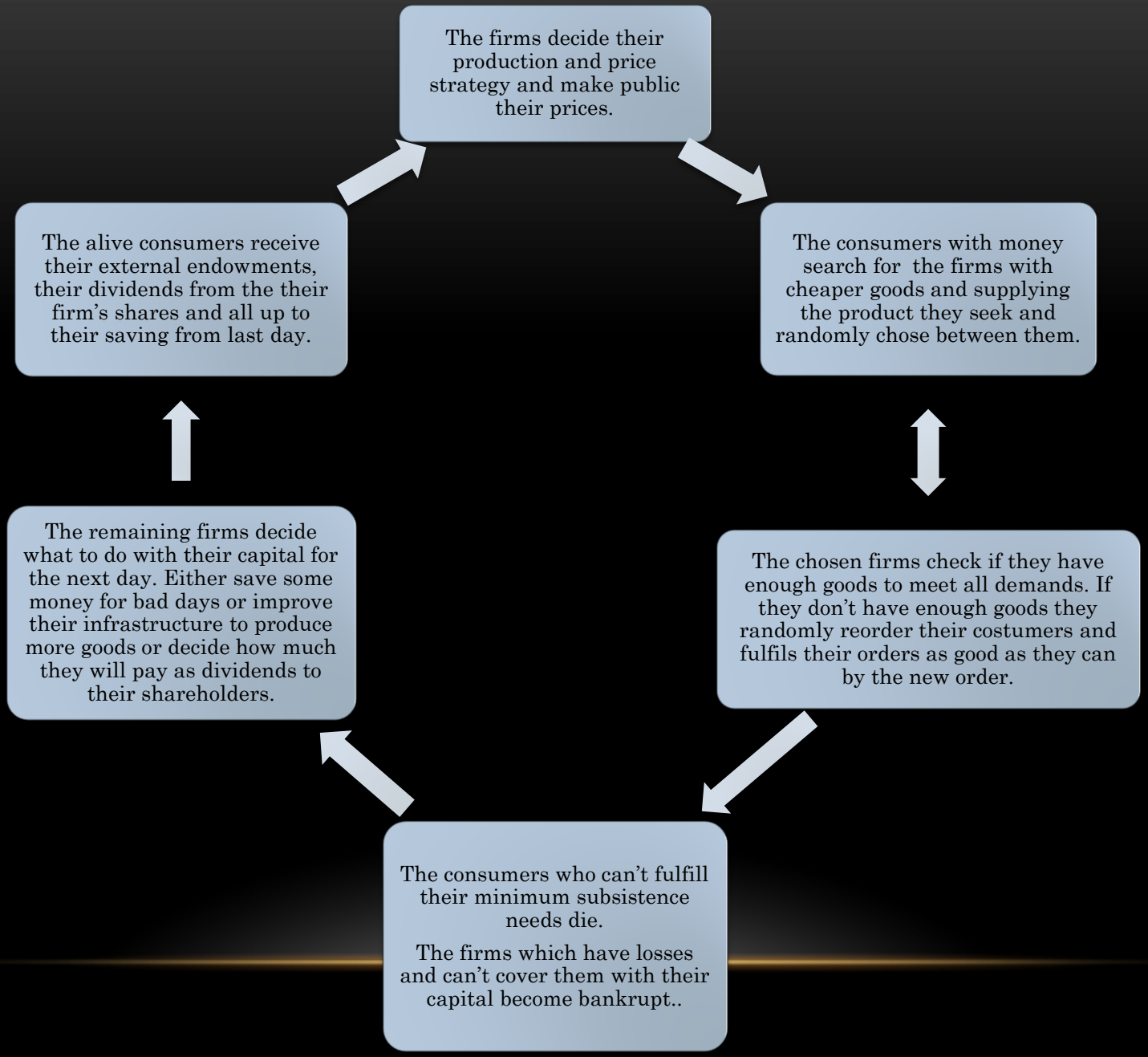
What are agents in the first place?

Agents may possesse many forms:

Individuals	Social Groupings	Institutions	Biological Entities	Physical Entities
• consumers • workers	• families • governement agencies	• markets • Regulatory systems	• crops • livestock	• infrastructures • weather

There can even be structured agents i.e.,

a college may have teachers, students and so on


The firms decide their production and price strategy and make public their prices.
The consumers with money search for the firms with cheaper goods and supplying the product they seek and randomly chose between them.
The chosen firms check if they have enough goods to meet all demands. If they don't have enough goods they randomly reorder their costumers and fulfils their orders as good as they can by the new order.
The consumers who can't fulfill their minimum subsistence needs die.
The firms which have losses and can't cover them with their capital become bankrupt..
The remaining firms decide what to do with their capital for the next day. Either save some money for bad days or improve their infrastructure to produce more goods or decide how much they will pay as dividends to their shareholders.
The alive consumers receive their external endowments, their dividends from the their firm's shares and all up to their saving from last day.

PRIMARY OBJECTIVES

- Empirical Understanding
- Normative Understanding
- Qualitative Insight and Theory Generation
- Methodological Advancement

EMPIRICAL UNDERSTANDING

In this field ACE researchers try to understand why some global regularities evolve and others persist when there is no centralized planning or control. So it is interesting to understand how come free (of a single behaviour) agents end up following some patterns.

NORMATIVE UNDERSTANDING

In this topic researchers try to find out how good a model is by putting it to test and see if it is plausible. For example, if we have an agent whose goal is to live the longest possible life, although he will have many ways to extend his life (like eating healthy, not smoking, doing sports and so on) he couldn't possibly live till 150 years.

QUALITATIVE INSIGHT AND THEORY GENERATION

From a deep and systematic examination of the dynamics of one model, researchers try to find out why certain outcomes become regular and others are almost non-existent.

METHODOLOGICAL ADVANCEMENT

Here researchers try to develop the software tools to better help modelers test their own models and guide them on the best practices for how to test their model. An example for the latter is that modelers when testing their model, they should first test each of their agents without interaction with other agents (checking if the firms are producing goods or services, if consumers are able to buy or die,...)

ACE POSITIVE ASPECTS

1. With a good starting model of the real world one can test exactly how the institution of a new law may affect the model.
2. Besides trying to find an equilibrium for a determined model, one can try to find what are the steps to achieve that equilibrium, for example, in a model with 2 possible equilibrium besides finding out what are the ods for each outcome, it can also be found out what sequence of events generates one equilibrium and the other.

ACE POSITIVE ASPECTS

3. In ACE models, agents may even be allowed to communicate between themselves, permitting attempts to generate pre-made deals.
4. ACE models allow the introduction of space to the model, permitting agents to move from a place to another and/or not allow to agents to be in the same place simultaneously.
5. These models give much more autonomy to each agent than other modeling procedures.

ACE NEGATIVE ASPECTS

1. If the starting model isn't complete, i.e., lacks some details (like allowing the disappearance of some agents through death, bankruptcy…) the model can't be corrected when the lack becomes apparent.
2. Also these models are dependent of pseudo random starting conditions.
3. There is also an issue if the real world is fated.

DEFINITION 1

A complex adaptive system is a complex system that includes reactive units, i.e., units capable of exhibiting systematically different attributes in reaction to changing environmental conditions.

DEFINITION 2

A complex adaptive system is a complex system that includes goal-directed units, i.e., units that are reactive and that direct at least some of their reactions towards the achievement of built-in (or evolved) goals.

DEFINITION 3

A complex adaptive system is a complex system that includes planner units, i.e., units that are goal-directed and that attempt to excert some degree of control over their environment to facilitate achievement of these goals

What type of agent are you?

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