Leon Walras (1834-1910)

- Second founder on neoclassical economics
- One of the founders of marginal revolution (with W.S. Jevons and C. Menger)
- *Elements of Pure Economics*, 1874
- Originated General Equilibrium Theory (GET)

Walras' GET

- GET is the analysis of the economy in which all sectors are considered simultaneously.

- All markets are considered in their interrelationships at once, you can analyze direct and indirect effects of any change in economic system, cross-market changes and the like.

- Walras's contribution was to model the GE system in a formal, mathematical manner.

- What is the difference between partial equilibrium analysis (PEA) and general equilibrium theory (GET)?

Marshall's PEA and Walras' GET

- GE is more abstract than PE – more factors are assumed to be held constant in PE than in GE.
- In PE we allow only a very limited number of variables to vary– all others are assumed constant.
  - For example PE: $p_1 = f(q_1, p_2, \text{income})$
  - GE: $p_1 = f(q_1, \ldots q_n, p_2, \ldots p_n, \text{income})$
- GE allows many more variables to change, but not all of economic variables.
  - For example, in most of GE models we assume that the preferences, the technology of production, population, institutional framework of the society do not change.
- But all other economic factors, mainly prices and quantities on every market are assumed to be variables to be explained in GET.

Walras and GET

- In GE, a single change in the price of any single commodity will have <u>repercussions in the whole system, in every market</u>.

- Real incomes (I/p) of consumers will change and consumers will respond by changing their consumption patterns, they will change their <u>final demands for all other goods</u> (if only slightly in some cases), $D_i = f(p_i, ..., I/p)$.

- Firms <u>will also change they output</u> (in reaction to changing demand for their products). $S_i = f(p_i, ...)$

- <u>Prices of factors of production</u> (capital, labour etc.) will also change since firms are changing their demands for factors (e.g., $w_i = MP_L*p_i$)

- And the <u>distribution of income</u> in the society will also be different.
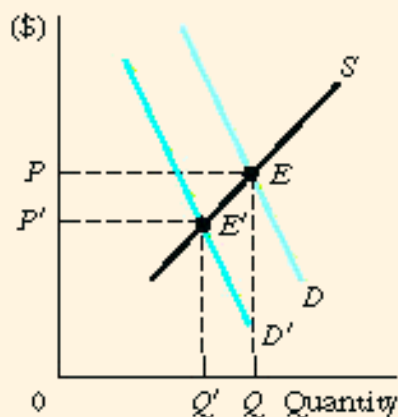
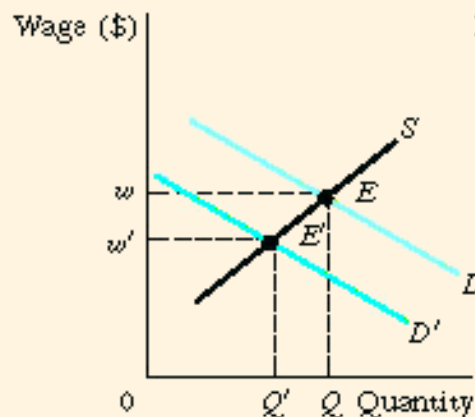# General equilibrium effects – an example
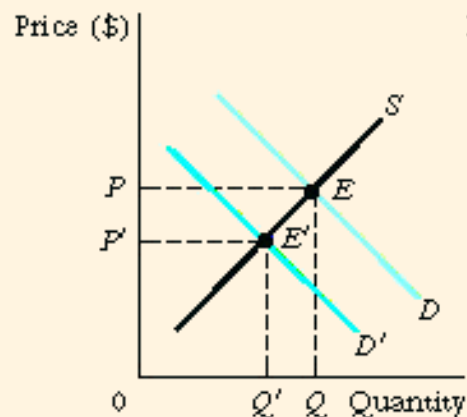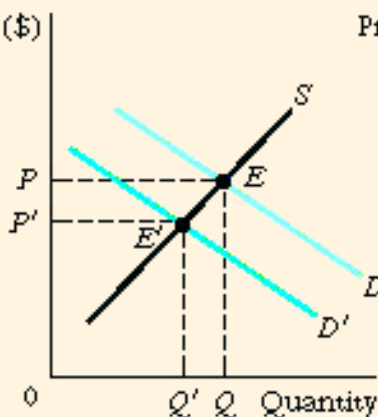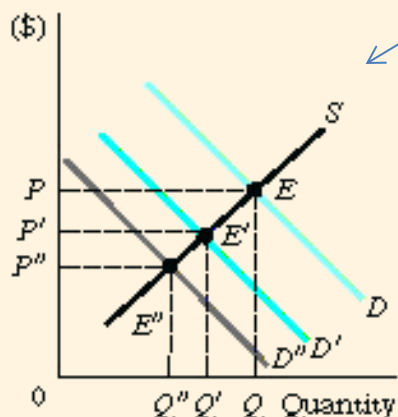

(a) New automobiles: Impact effect
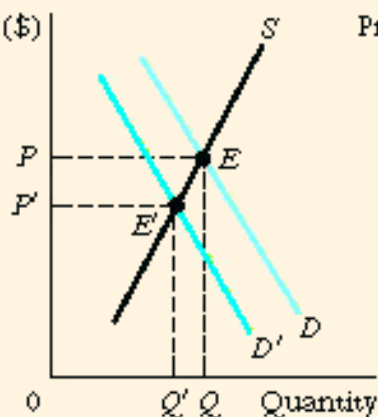
(b) Steel

(c) Gasoline

(d) Autoworkers

(e) Steaks

(f) New automobiles: General equilibrium implications

Why this second-order effect occurs?

Formalization of GE model by Walras

- Walras expressed this interdependence of all markets in terms of mathematical equations.
- Assumed perfect competition; consumers maximize utility, firms maximize profits
- To formulate GE model, he wrote down 4 sets of equations
  - equations describing the conditions for market equilibrium for n final products (supply = demand, for final products)
  - equations describing determination of market prices for final products (p = MC, no economic profits , no losses)
  - equations describing the conditions for market equilibrium for m factors of production (supply = demand, for factors of production)
  - equations for optimal employment of factors of production by firms for m factors (how inputs transform into products)

Walras' model in mathematical form
(*n* final commodities, *m* factors of production)

price-cost equalities	$p_i = \sum_j b_{ji} w_j = \mathbf{B}_i \mathbf{w}$	(n equations)
output market equilibrium:	$x_i = D_i(\mathbf{p}, \mathbf{w})$	(n equations)
factor market equilibrium:	$v_j = \mathbf{B}_j \cdot \mathbf{x}$	(m equations)
market factor supplies:	$v_j = F_j(\mathbf{p}, \mathbf{w})$	(m equations)

so we have $(2n + 2m)$ equations. The unkowns are:

quantity of produced goods:	x_i	(n unknowns)
quantity of factors:	v_j	(m unknowns)
output prices:	p_i	(n unknowns)
factor prices:	w_j	(m unknowns)

so we have $(2n + 2m)$ unknowns.

B_i are production coefficients – amount of a given **factor** necessary to **produce** a unit of final product *i*.

Research questions in GET asked by Walras

- Walras asked, <u>is general equilibrium theoretically possible</u>? Is there a set of prices and quantities, which clears all markets at one time (supply is equal to demand)?
  - This is the problem of the <u>existence of solution</u> to GE model. (1)
- But there are also other important questions for GE theory, in which Walras was interested in.
  - 2) Is there <u>only one</u> set of prices and quantities that is the solution of GE model? This is the so-called problem of <u>uniqueness</u> (of GE solution)
  - 3) Will the solution be a <u>stable equilibrium</u> or an unstable equilibrium? This is the problem of <u>stability</u> of GE solution.

Why stability is important?

Walras' 'solution' to the existence of GE problem

- Thought that it is enough to <u>count the number of variables</u> to be calculated in the model and <u>the number of independent mathematical equations in the model</u>.

- If the number of variables (prices and quantities of final goods and factors of production -- 2m +2n) <u>equals</u> the number of independent equations (2m +2n), then <u>there is one solution</u> of a GE model.

- Is this proof correct?

Walras' proof of the solution to the GE system of equations

- No, Walras' proof is mathematically wrong (not rigorous), since
  - 1) there might be no solution to such a system (the system of equations can be contradictory)
  - 2) there may be more than one solution (maybe infinitely many),
  - 3) the solution can be economically meaningless (negative prices or solution not in the domain of real numbers).
- It took about 80 years to provide a rigorous proof (Arrow and Debreu 1954)

Walras' views on economic policy

- Wanted to use abstract GE model in economic policy
- Argued that free competition results in a greatest possible satisfaction of wants, so he urged states to attempt, through, legislation, to create systems of perfectly competitive markets.
- But he also argued that
- „It is quite clear that if one imagines that commodities were sold at high price to the rich and a low price to the poor, the former would only have to give up superfluous goods, while the latter would be able to afford necessities. Consequently, there would be a large increase in utility"
- It is consistent with unrestricted markets? What social welfare criterion is he using here?

Walras on policy, cont.

- He thought of himself as (non-Marxian) socialist, and proposed that government intervention is desirable in many areas. Might be called an advocate of <u>market socialism</u>.

- For example, he demanded that state should <u>take away all land rents from the landowners</u>, because they represent <u>unearned, unjust income</u>.

- Thanks to this nationalization of land, there would be no need for taxation of income from labour and capital

- If that would happen, Walras thought, the distribution of income would not be so unequal in the (correctecd) capitalism.

- Are his proposals internally consistent? Would they work in practice?

Vilfredo Pareto (1848-1923)

- extended the analysis of Walras and applied it to welfare economics to analyze the welfare implications of various policies

- In the 1890s Pareto formulated a formal criterion to be used in evaluating economic outcomes and policies. This criterion is very-well known today, and named as <u>Pareto optimality criterion.</u>

- <u>Pareto optimum</u> is defined as an allocation of resources in an economy, in which <u>it is impossible to make someone better off without making someone else worse off.</u>

Pareto optimality.
We have the following allocations in two-person society.
<u>Which is Pareto optimal?</u>

- A) (5,6)

- B) (3,5)

- C) (1000,5)

- D) (5,10)

- Problems with Pareto optimality

- *Are Pareto-optimal states unique?*

- *Would you like to live in C)?*

- *Are Pareto improvements (movements to Pareto-optimal states) often found in reality?*

Pareto on optimality criterion

- Pareto wanted to prove that the allocation, which is the <u>solution to the general equilibrium model, is Pareto optimal.</u>

- This proposition – the competitive equilibrium in GE model is Pareto opitmal allocation – has later (since 1950s) became to be known as the <u>First Fundamental Theorem of Welfare Economics</u> (FFTWE)

- FFTWE is sometimes described as the formalization of the invisible hand mechanism of Adam Smith

  - Is this correct?