Public Economics for Public Policy
Part II: Tools of Public Finance

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Sciences Po *MPA 2023-2024*

Today's Lecture

Chapter 2 in Gruber's

Understand key concepts in public economics:

- Constrained utility maximization
- Demand, Supply, and how it relates to welfare measures
- First and Second Welfare Theorems

Theoretical tools: The set of tools designed to understand the mechanics behind economic decision making.

Economists model individuals' choices using the concepts of utility function maximization subject to budget constraint and possibly, other constraints (e.g., a floor on work hours).

May seem like a "narrow view of human behavior," but this is a relatively general framework that can be augmented.

Empirical tools: The set of tools designed to analyze data and answer questions raised by theoretical analysis.

Perhaps one of the big contributions of economists to social science more generally is the development of "econometrics" to measure not only variables (statistics), but also relationships between variables using data.

Overview

Theoretical Tools

Constrained Utility Maximization

Demand and Supply

Learning About Social Preferences

Empirical Tools

The Identification Problem

Observational Data

Quasi-Experiments

Theoretical Tools

Individuals: make decision based on their environment, characteristics, and preferences.

- Policies are part of that environment and affect behaviors
- They **reveal their preferences** from their observable behaviors

Human interactions: simplest representation of interaction = market

- Define / Characterize equilibrium in market interactions

Government: takes action that affect equilibrium outcomes and thus welfare

Utility function: A utility function is some mathematical function translating consumption into utility:

$$U = u(X_1, X_2, X_3, ...)$$

where X_1, X_2, X_3, and so on are the quantity of goods $1, 2, 3, ...$ consumed by the individual

Example with two goods: $u(X_1, X_2) = \sqrt{X_1 \cdot X_2}$ with X_1 number of movies, X_2 number of books

Individual utility increases with the level of consumption of each good

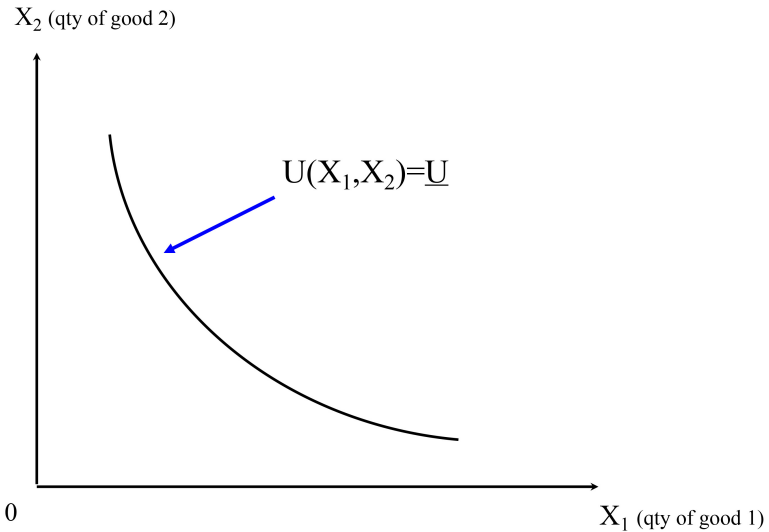
Indifference curve: A graphical representation of all bundles of goods that make an individual equally well off

Mathematically, indifference curve giving utility level $\underline{U}$ is given by the set of bundles (X_1, X_2) such that $u(X_1, X_2) = \underline{U}$

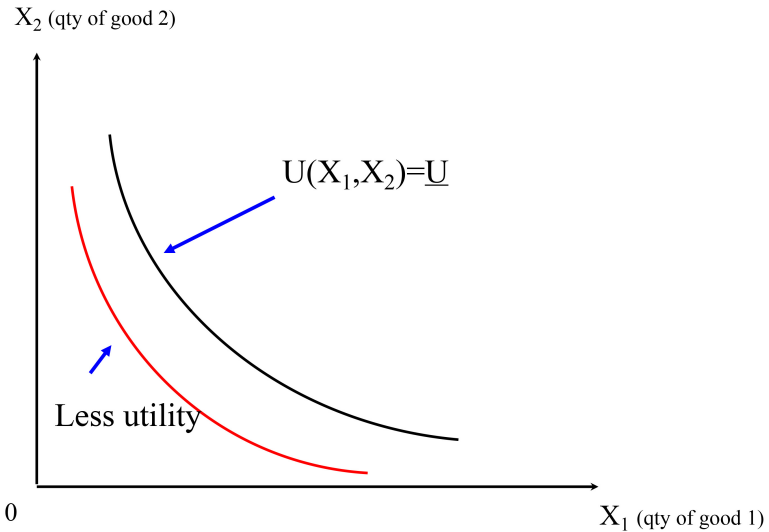
Indifference curves have two essential properties, both of which follow naturally from the more-is-better assumption:

1. Consumers prefer higher indifference curves.
2. Indifference curves are always downward sloping

Indifference Curve



Indifference Curve



Marginal utility: the additional increment to utility obtained by consuming an additional unit of a good:

Marginal utility of good 1 is defined as:

$$MU_1 = \frac{\partial u}{\partial X_1} \approx \frac{u(X_1 + dX_1, X_2) - u(X_1, X_2)}{dX_1}$$

It is the derivative of utility with respect to X_1 keeping X_2 constant (called the partial derivative)

Example: $u(X_1, X_2) = \sqrt{X_1 \cdot X_2} \Rightarrow \frac{\partial u}{\partial X_1} = \frac{\sqrt{X_2}}{2\sqrt{X_1}}$

This utility function described exhibits the important principle of **diminishing marginal utility**: $\partial u / \partial X_1$ decreases with X_1: the consumption of each additional unit of a good gives less extra utility than the consumption of the previous unit

Typically, we make 2 assumptions about the form of the utility function:

1. Non-satiation (more is better):
$$\frac{\partial u}{\partial X_1} > 0$$
2. Diminishing marginal utility:
$$\frac{\partial^2 u}{\partial X_1^2} < 0$$

Marginal utility mighy NOT be decreasing in consumption: “addictive goods” (Becker and Murphy, 1988)

Marginal rate of substitution (MRS): The *MRS* is equal to (minus) the slope of the indifference curve, the rate at which the consumer will trade the good on the vertical axis for the good on the horizontal axis.

Marginal rate of substitution between good 1 and good 2 is:

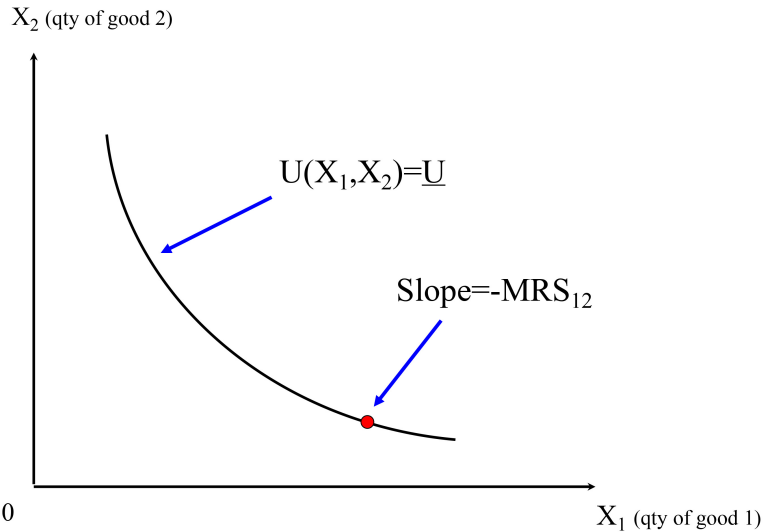
$$MRS_{1,2} = \frac{MU_1}{MU_2}$$

Individual is indifferent between 1 unit of good 1 and $MRS_{1,2}$ units of good 2.

Example:

$$u(X_1, X_2) = \sqrt{X_1 \cdot X_2} \Rightarrow MRS_{1,2} = \frac{X_2}{X_1}$$

Indifference Curve and MRS



Budget constraint: A mathematical representation of all the combinations of goods an individual can afford to buy if she spends her entire income.

$$p_1 X_1 + p_2 X_2 = Y$$

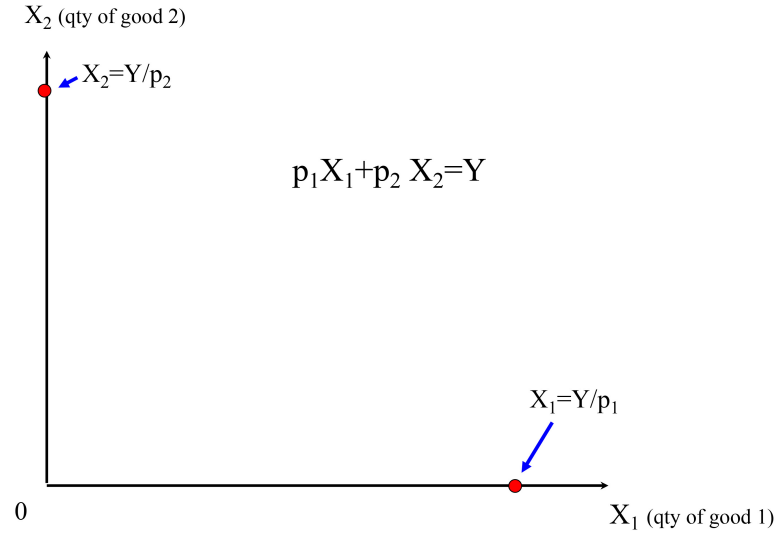
with p_i the price of good i, and Y the disposable income

Budget constraint defines a linear set of bundles the consumer can purchase with its disposable income Y

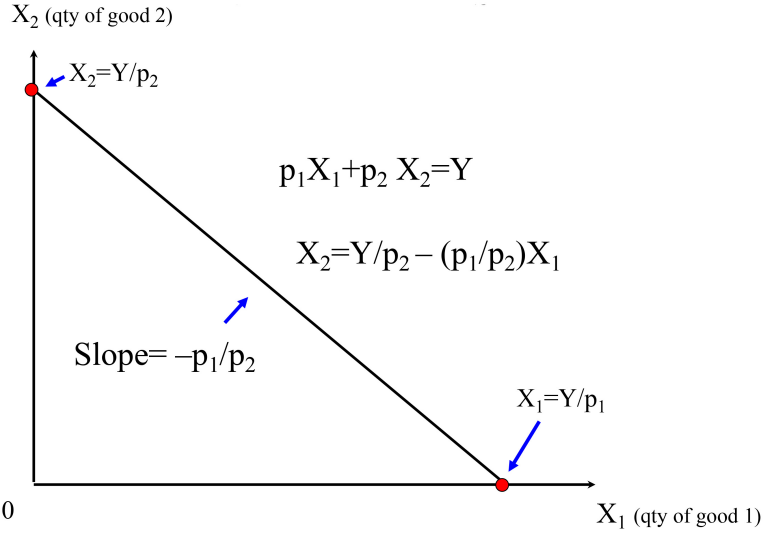
$$X_2 = \frac{Y}{p_2} - \frac{p_1}{p_2} X_1$$

The slope of the budget constraint is $-p_1/p_2$

Budget Constraint



Budget Constraint



Individual maximizes utility subject to budget constraint:

$$\max_{X_1, X_2} u(X_1, X_2) \text{ subject to } p_1 X_1 + p_2 X_2 = Y$$

Solution: $MRS_{1,2} = \frac{p_1}{p_2}$

Proof: Budget implies that $X_2 = (Y - p_1 X_1)/p_2$

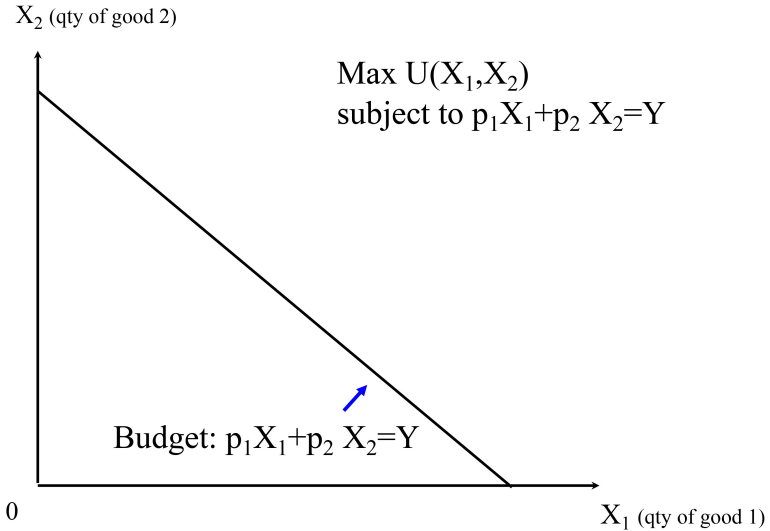
Individual chooses X_1 to maximize $u(X_1, (Y - p_1 X_1)/p_2)$

The first order condition (FOC) is:

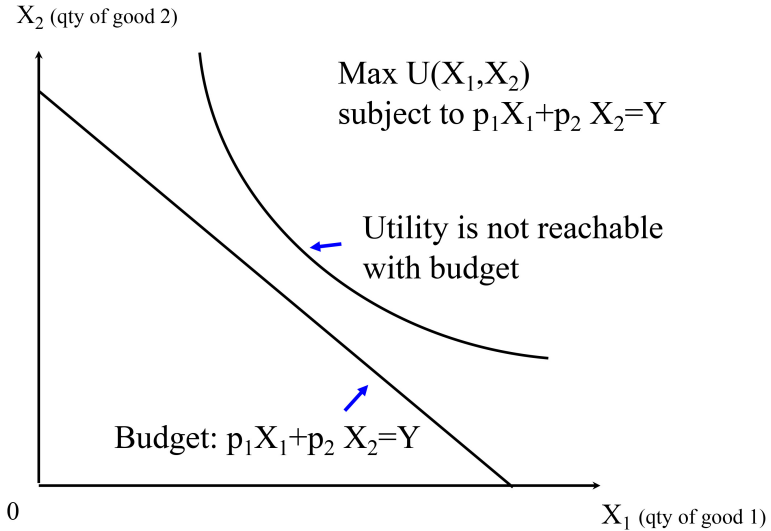
$$\frac{\partial u}{\partial X_1} - \frac{p_1}{p_2} \cdot \frac{\partial u}{\partial X_2} = 0$$

At the optimal choice, the individual is indifferent btw buying 1 extra unit of good 1 for \$ p_1 and buying p_1/p_2 extra units of good 2 (also for \$ p1).

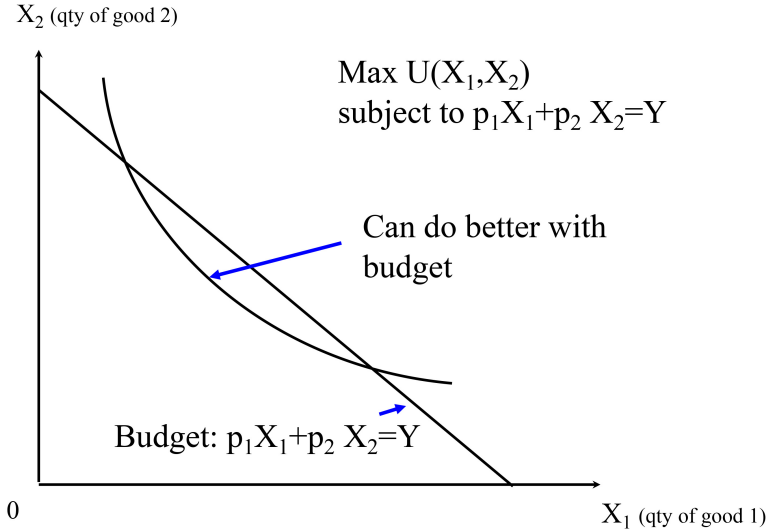
Utility Maximization



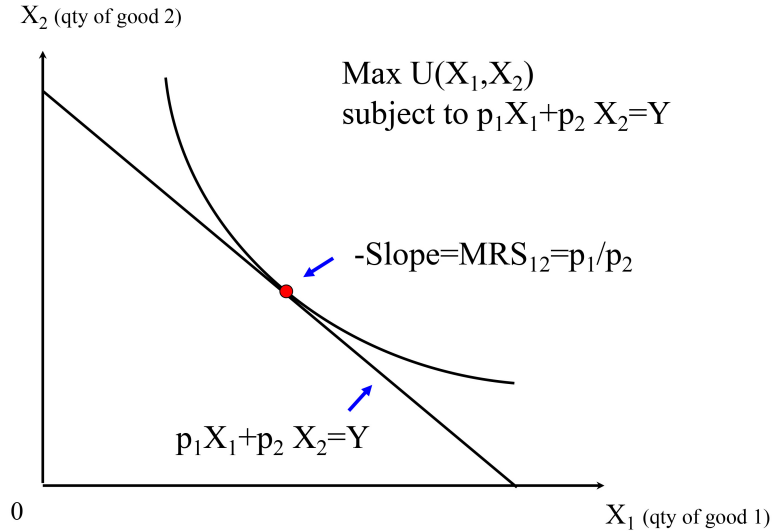
Utility Maximization



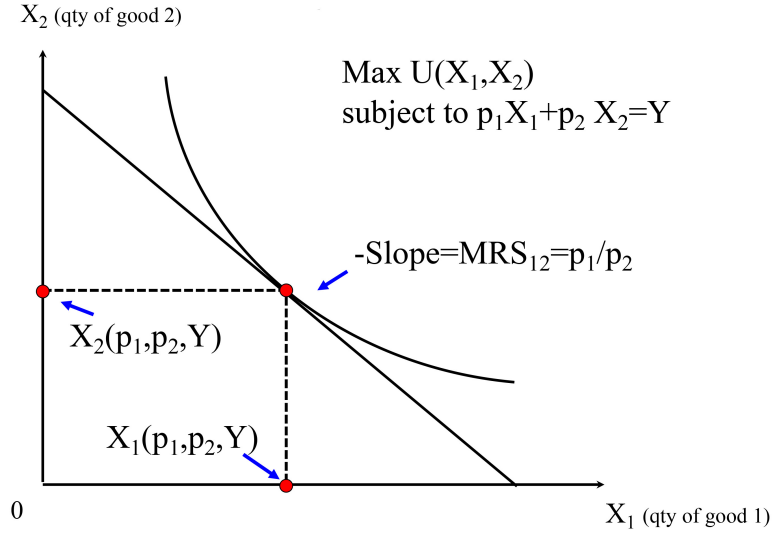
Utility Maximization



Utility Maximization



Utility Maximization



Let us denote by $p = (p_1, p_2)$ the price vector

Individual maximization generates demand functions $X_1(p, Y)$ and $X_2(p, Y)$

How does $X_1(p, Y)$ vary with p and Y?

Those are called price and income effects

Example: $u(X_1, X_2) = \sqrt{X_1 \cdot X_2}$ then $MRS_{1,2} = X_2/X_1$

Utility maximization implies $X_2/X_1 = p_1/p_2$ and hence $p_1X_1 = p_2X_2$

Budget constraint $p_1X_1 + p_2X_2 = Y$ implies $p_1X_1 = p_2X_2 = Y/2$

Demand functions: $X_1(p, Y) = Y/(2p_1)$ and $X_2(p, Y) = Y/(2p_2)$

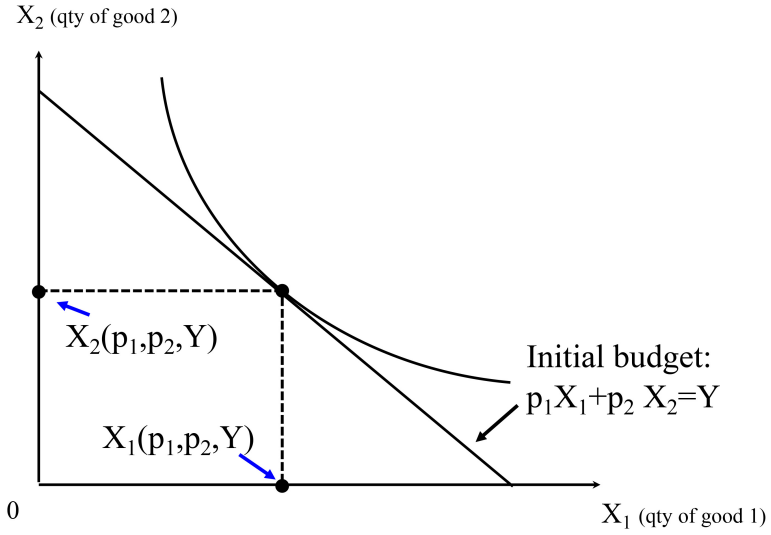
Income effect is the effect of giving extra income Y on the demand for goods: How does $X_1(p, Y)$ vary with Y?

Normal goods: Goods for which demand increases as income Y rises: $X_1(p, Y)$ increases with Y (most goods are normal)

Inferior goods: Goods for which demand falls as income Y rises: $X_1(p, Y)$ decreases with Y (example: you use public transportation less when you are rich enough to buy a car)

Example: if leisure is a normal good, you work less (i.e. get more leisure) if you are given a transfer

Indifference Effects: Y increases to $Y + \Delta Y$



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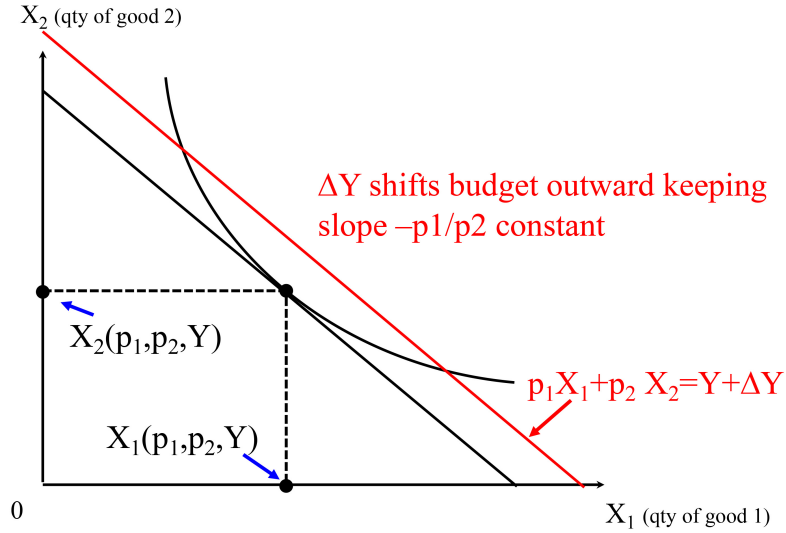

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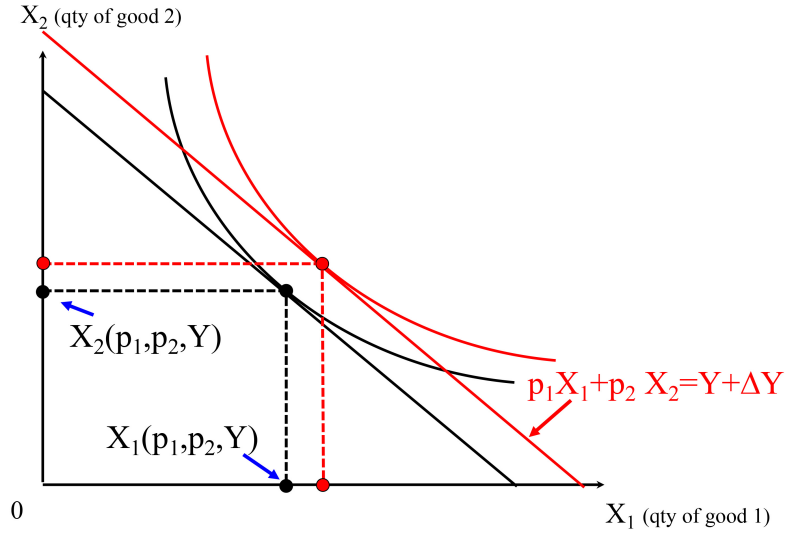

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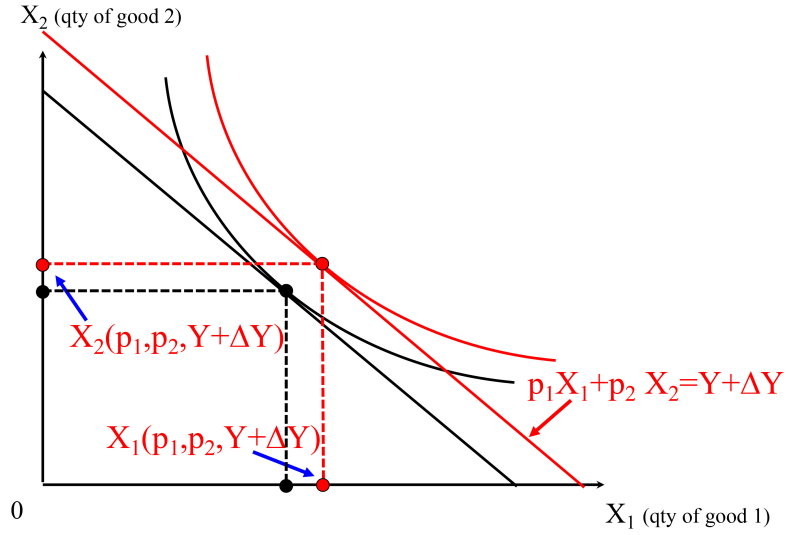


How does $X_1(p_1, p_2, Y)$ vary with p_1?

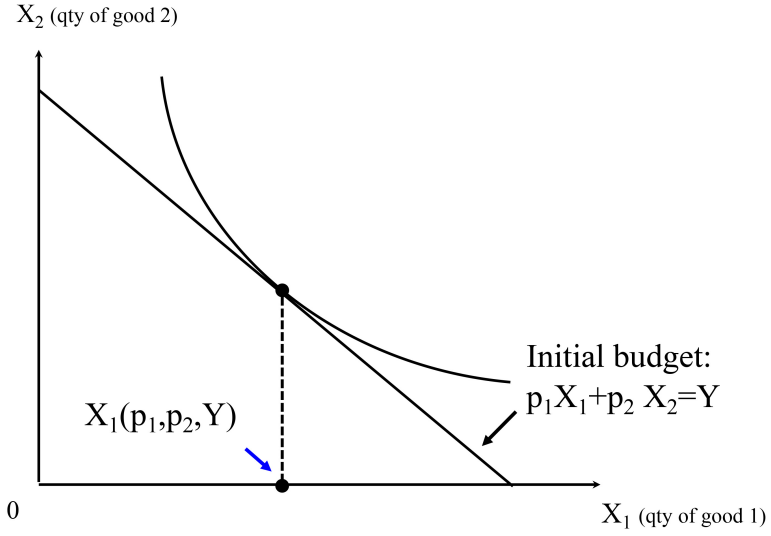
Changing p_1 affects the slope of the budget constraint and can be decomposed into 2 effects:

1) **Substitution effect**: Holding utility constant, a relative rise in the price of a good will always cause an individual to choose less of that good

2) **Income effect**: A rise in the price of a good will typically cause an individual to choose less of all goods because her income can purchase less than before

For normal goods, an increase in p_1 reduces $X_1(p_1, p_2, Y)$ through both substitution and income effects

Price Effects: p_1 increases to $p_1 + \Delta p_1$



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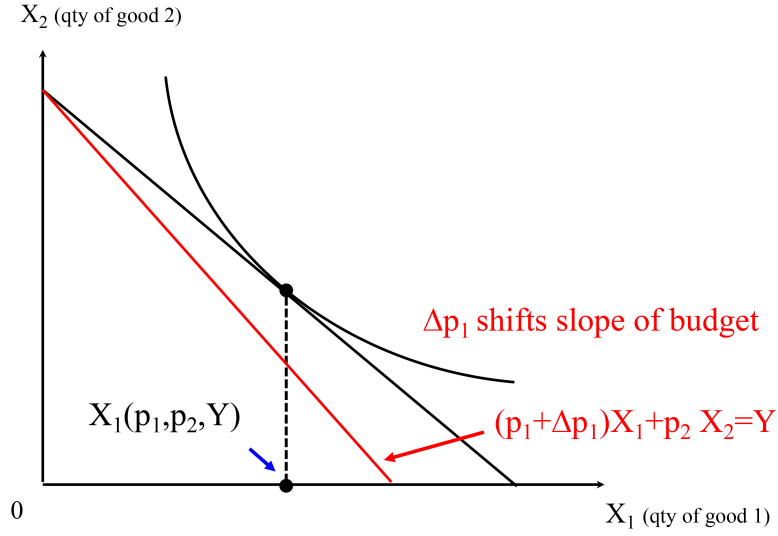

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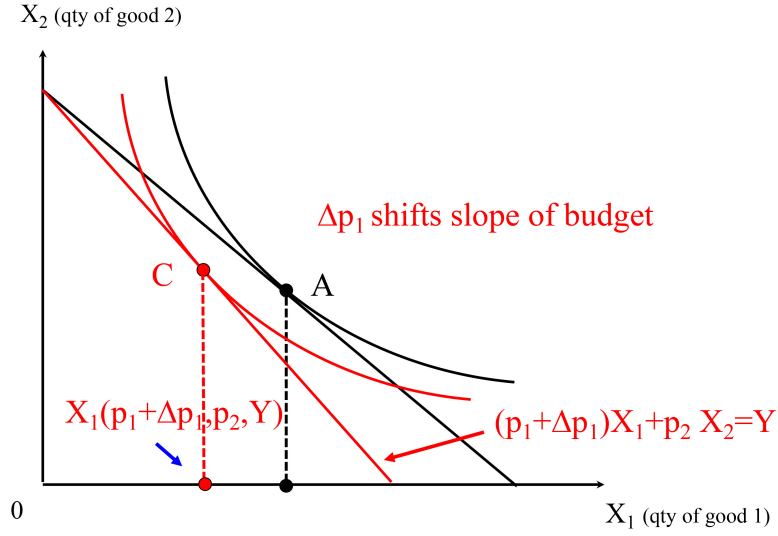

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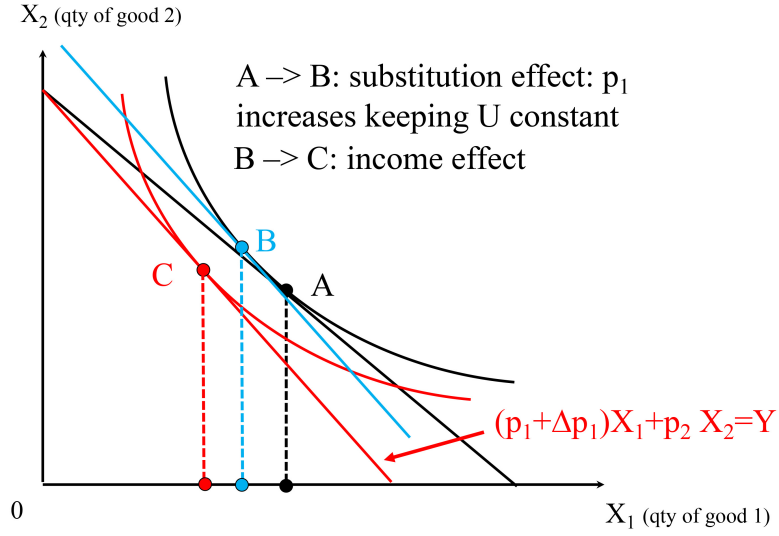


Framework that allows to study how consumers will respond to policies that change prices or income

Example: Tax that doubles the price of movies

Income Effect: Tax makes consumers poorer

- Consumers reduce their consumption of normal goods

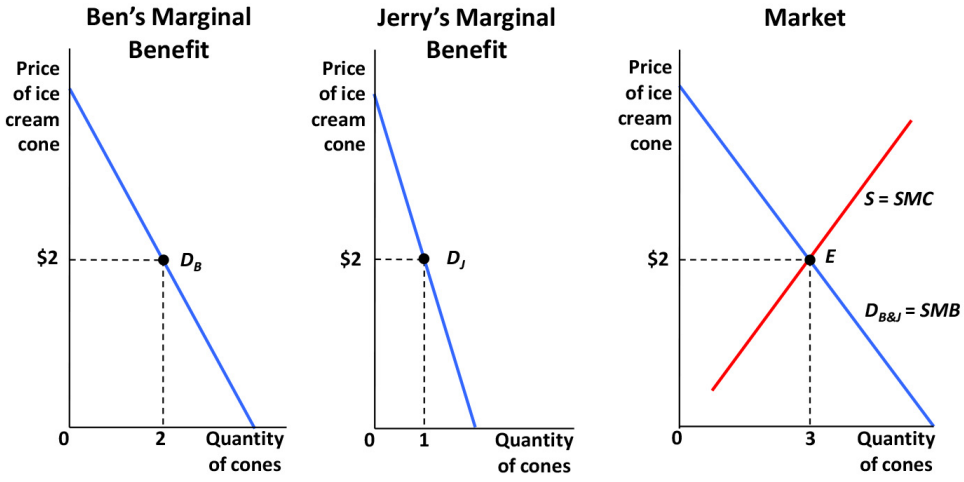
Substitution Effect: Tax increases the **relative price** of movies

- Consumers substitute away from movies to books

Aggregate Demand

Each individual has a demand $x(p, Y)$ for each good that depends on the price p of the good (and on their own income and other things potentially).

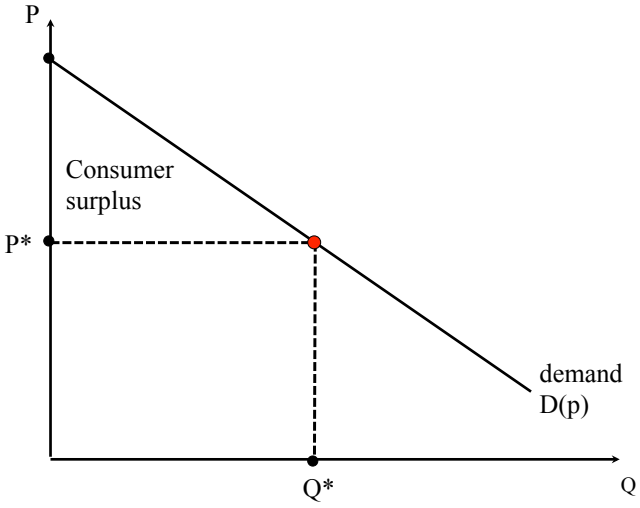
Aggregating across all individuals (i.e., “summing the demand of all individuals”), we get aggregate demand $D(p)$ for the good (the sum of individual demands at that price).


Ben's Marginal Benefit
Price of ice cream cone
$2
D_B
0
2
Quantity of cones
Jerry's Marginal Benefit
Price of ice cream cone
$2
D_J
0
1
Quantity of cones
Market
Price of ice cream cone
$S = SMC$
$2
E
$D_{B\&J} = SMB$
0
3
Quantity of cones

At price p, demand is $D(p)$ and p is the \$ value for consumers of the marginal (last) unit consumed

$\Rightarrow$ **Consumer surplus** can be measured as area below the demand curve and above the price horizontal line

Aggregate Demand



Definition: The % change in demand caused by a 1% change in the price of that good

$$\varepsilon^D = \frac{\%\text{ change in quantity demanded}}{\%\text{ change in price}} = \frac{\Delta D/D}{\Delta p/p} = \frac{p}{D}\frac{dD}{dp}$$

Elasticities are widely used because they are **unit free**

$\varepsilon^D = pD'(p)/D(p)$ is a function of p and hence can vary with p along the demand curve

When $D(p) = D_0 \cdot p^{\varepsilon}$ with D_0, ε fixed parameters:

Then $\varepsilon^D = \varepsilon$ is constant (called iso-elastic demand function)

Properties of Elasticity of Demand

1. Typically negative, since quantity demanded typically falls as price rises.
2. Typically not constant along a demand curve.
3. With vertical demand curve, demand is **perfectly inelastic** $(\varepsilon = 0)$.
4. With horizontal demand curve, demand is **perfectly elastic** $(\varepsilon = -\infty)$.
5. The effect of one good's prices on the demand for another good is the **cross-price** elasticity. Typically, not zero.

Producers

Producers (typically firms) use technology to transform inputs into outputs

- Inputs = labor and capital; Outputs = consumption goods

Narrow economic view: Goal of producers is to maximize profits

- Profits = sales of outputs minus costs of inputs

Production decisions (for given prices) define supply functions

Simple case: Profits $\Pi = p \cdot Q - c(Q)$ where $c(Q)$ is cost of producing quantity Q

- $c(Q)$ is increasing and convex (means that $c'(Q)$ increases with Q)

Profit maximization: $\max_Q [p \cdot Q - c(Q)]$

- $\Rightarrow c'(Q) = p$: marginal cost of production equals price

Defines the **supply curve** $Q = S(p)$

Supply curve $S(p)$ is the quantity that firms in aggregate are willing to supply at each price: typically upward sloping with price due to decreasing returns to scale

At price p, producers produce $S(p)$, and the \$ cost of producing the marginal (last) unit is p

Elasticity of supply ε^S is defined as:

$$\varepsilon^S = \frac{\%\text{ change in quantity suplied}}{\%\text{ change in price}} = \frac{\Delta S/S}{\Delta p/p} = \frac{p}{S}\frac{dS}{dp}$$

$\varepsilon^S = pS'(p)/S(p)$ is a function of p and hence can vary with p along the supply curve

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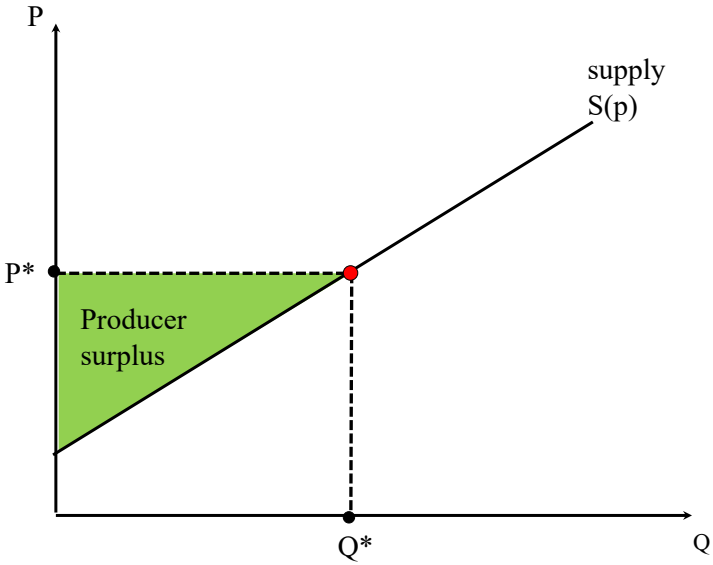
Supply Curves



Demanders and suppliers interact on markets

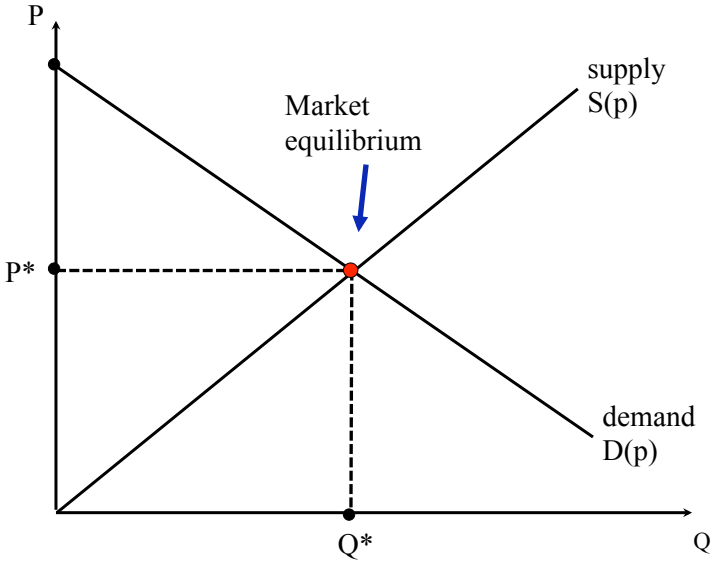
Market equilibrium: The equilibrium is the price p^* such that $D(p^*) = S(p^*)$

In the simple diagram, p^* is unique if $D(p)$ decreases with p and $S(p)$ increases with p

If $p > p^*$, then supply exceeds demand, and price needs to fall to equilibrate supply and demand

If $p < p^*$, then demand exceeds supply, and price needs to increase to equilibrate supply and demand

Market Equilibrium



Economic Surplus

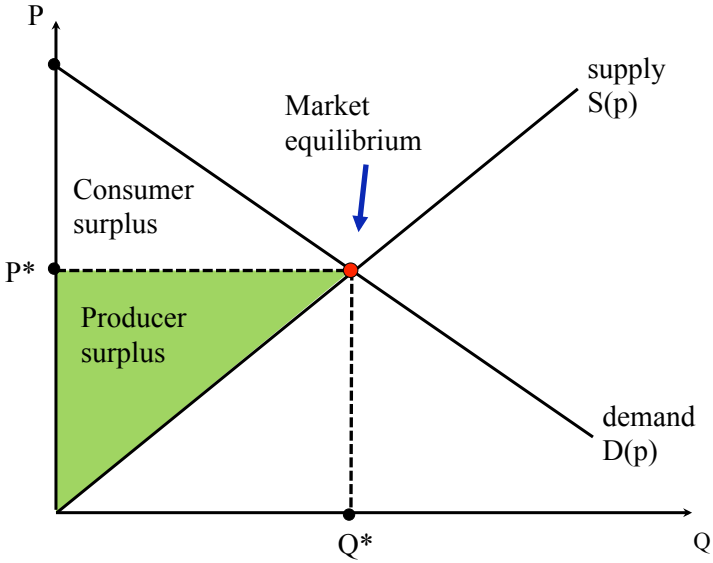
Economic surplus represents the net gains to society from all trades that are made in a particular market, and it consists of two components: consumer and producer surplus.

Consumer surplus: The benefit that consumers derive from consuming a good, above and beyond the price they paid for the good. It is the area below demand curve and above market price.

Producer surplus: The benefit producers derive from selling a good, above and beyond the cost of producing that good. It is the area above supply curve and below market price.

Total economic surplus: The sum of consumer surplus and producer surplus. It is the area above supply curve and below demand curve

Economic Surplus



First Fundamental Theorem of Welfare Economics:

> The competitive equilibrium where supply equals demand, maximizes total economic surplus (sometimes called "efficiency")

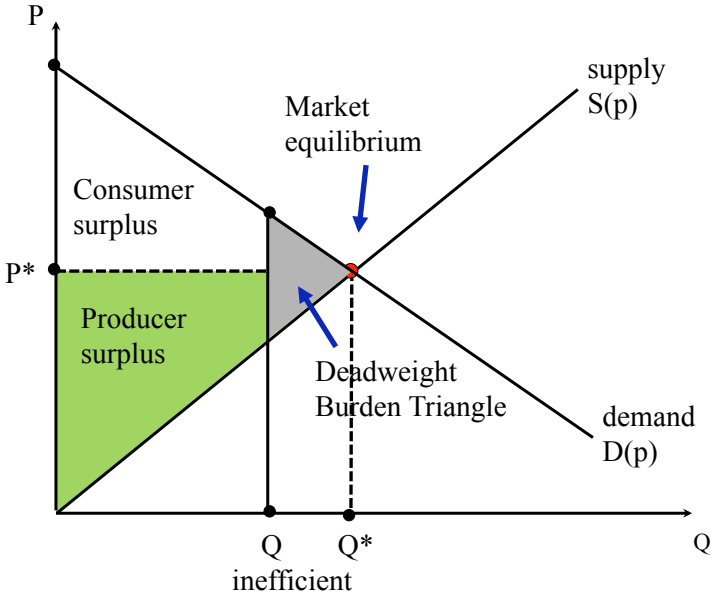
Economic surplus just counts dollars regardless of who gets them ($1 to rich producer better than $.99 to poor consumer) $\Rightarrow$ 1st welfare theorem is blind to distributional aspects

Deadweight loss: The reduction in economic surplus from denying trades for which benefits exceed costs when quantity differs from the efficient quantity

Key rule: Deadweight loss triangle points to the efficient allocation, and grows outward from there

The simple efficiency result from the 1-good diagram can be generalized into the first welfare theorem (Arrow-Debreu, 1940s), most important result in economics

Competitive Equilibrium Maximizes Economic Surplus



Generalization: 1st Welfare Theorem

1st Welfare Theorem: If (1) no externalities, (2) perfect competition [individuals and firms are price takers], (3) perfect information, (4) agents are rational, then private market equilibrium is **Pareto efficient**

Pareto efficient: Impossible to find a technologically feasible allocation that improves everybody's welfare

Pareto efficiency is desirable but a very weak requirement (a single person consuming everything is Pareto efficient)

Government intervention may be particularly desirable if the assumptions of the 1st welfare theorem fail, i.e., when there are market failures $\Rightarrow$ Govt intervention can potentially improve everybody's welfare

Second part of class considers such market failure situations

2nd Welfare Theorem

Even with no market failures, free market outcome might generate substantial inequality. Inequality is seen as one of the biggest issue with market economies.

2nd Welfare Theorem: Any Pareto Efficient allocation can be reached by

1. Suitable redistribution of initial endowments [individualized lump-sum taxes based on individual characteristics and not behavior]
2. Then letting markets work freely

$\Rightarrow$ No conflict between efficiency and equity

2^{nd} Welfare Theorem fallacy

In reality, 2^{nd} welfare theorem does not work because redistribution of initial endowments is not feasible (because initial endowments cannot be observed by the government)

$\Rightarrow$ govt needs to use **distortionary** taxes and transfers based on economic outcomes (such as income or working situation)

$\Rightarrow$ Conflict between efficiency and equity: **Equity-Efficiency trade-off**

First part of class considers policies that trade-off equity and efficiency

Social Welfare Functions

Economists incorporate distributional aspects using **social welfare functions** (instead of just adding $ of economic surplus)

Social welfare function (SWF): A function that combines the utility functions of all individuals into an overall social utility function

General idea is that one dollar to a disadvantaged person might count more than one dollar to a rich person

Utilitarien Social Welfare Function

With a utilitarian social welfare function, society's goal is to maximize the sum of individual utilities:

$$SWF = \sum_{i=1}^{N} U_i = U_1 + U_2 + \ldots + U_N$$

The utilities of all individuals are given equal weight, and summed to get total social welfare

If marginal utility of money decreases with income (satiation), utilitarian criterion values redistribution from rich to poor

Taking \$1 for a rich person decreases his utility by a small amount, giving the \$1 to a poor person increases his utility by a large amount

$\Rightarrow$ Transfers from rich to poor increase total utility

Rawls (1971) proposed that society's goal should be to maximize the well-being of its worst-off member. The Rawlsian SWF has the form:

$$SWF = \min(U_1, U_2, \ldots, U_N)$$

Since social welfare is determined by the minimum utility in society, social welfare is maximized by maximizing the well-being of the worst-off person in society (=maxi-min)

Rawlsian criterion is even more redistributive than utilitarian criterion: society wants to extract as much tax revenue as possible from the middle and rich to make transfers to the poor as large as possible

Other Social Justice Principles

Standard welfarist approach is based on individual utilities. This fails to capture important elements of actual debates on redistribution and fairness

1. Just deserts: Individuals should receive compensation congruent with their contributions (libertarian).

   $\Rightarrow$ Taxes should be tailored to government benefits received

2. Commodity egalitarianism: Society should ensure that individuals meet a set of basic needs (seen as rights) but that beyond that point income distribution is irrelevant

   $\Rightarrow$ Rich countries today consider free education, universal health care, retirement/disability benefits as rights

3. Equality of opportunity: Society should ensure that all individuals have equal opportunities for success

   $\Rightarrow$ Individuals should be compensated for inequalities they are not responsible for (e.g., family background, inheritance, intrinsic ability) but not for inequalities they are responsible for (being hard working vs. loving leisure)

Testing People Social Preferences

Saez-Stantcheva ’16 survey people online (using Amazon MTurk) by asking hypothetical questions to elicit social preferences. Key findings:

1. People typically do not have “utilitarian” social justice principles (consumption lover not seen as more deserving than frugal person)
2. People put weight on whether income has been earned through effort vs. not (hard working vs. leisure lover)
3. People put a lot of weight of what people would have done absent the government intervention (deserving poor vs. free loaders)

Testing People Social Preferences

Which of the following two individuals do you think is most deserving of a $1,000 tax break?

Individual A earns $50,000 per year, pays $10,000 in taxes and hence nets out $40,000. She greatly enjoys spending money, going out to expensive restaurants, or traveling to fancy destinations. She always feels that she has too little money to spend.

Individual B earns the same amount, $50,000 per year, also pays $10,000 in taxes and hence also nets out $40,000. However, she is a very frugal person who feels that her current income is sufficient to satisfy her needs.

- ◯ Individual A is most deserving of the $1,000 tax break
- ◯ Individual B is most deserving of the $1,000 tax break
- ◯ Both individuals are exactly equally deserving of the tax $1,000 break

>>

Testing People Social Preferences

Which of the following two individuals is most deserving of a $1,000 tax break?

Individual A earns $30,000 per year, by working in two different jobs, 60 hours per week at $10/hour. She pays $6,000 in taxes and nets out $24,000. She is very hard-working but she does not have high-paying jobs so that her wage is low.

Individual B also earns the same amount, $30,000 per year, by working part-time for 20 hours per week at $30/hour. She also pays $6,000 in taxes and hence nets out $24,000. She has a good wage rate per hour, but she prefers working less and earning less to enjoy other, non-work activities.

- ◯ Individual A is most deserving of the $1,000 tax break
- ◯ Individual B is most deserving of the $1,000 tax break
- ◯ Both individuals are exactly equally deserving of the $1,000 tax break

>>

Testing People Social Preferences

We assume now that the government can increase benefits by $1,000 for some recipients of government benefits.

Which of the following four individuals is most deserving of the $1,000 increase in benefits?

Please drag and drop the four individuals into the appropriate boxes on the left. The upper box, marked 1 should contain the individual you think is most deserving. The box labeled "2" should contain the second most-deserving individual, etc.. Please note that you can put two individuals in the same box if you think that they are equally deserving.

Individual A gets $15,000 per year in Disability Benefits because she cannot work due to a disability and has no other resources.

Individual B gets $15,000 per year in Unemployment Benefits and has no other resources. She lost her job and has not been able to find a new job even though she has been actively looking for one.

Individual C gets $15,000 pear year in Unemployment Benefits and has no other resources. She lost her job but has not been looking actively for a new job, because she prefers getting less but not having to work.

Individual D gets $15,000 per year in Welfare Benefits and Food Stamps and has no other resources. She is not looking for a job actively because she can get by living off those government provided benefits.

Source: survey in Saez and Stantcheva (2013)

Testing People Social Preferences

Table 2: Revealed Social Preferences

	(1)	(2)	(3)	(4)
A. Consumption lover vs. Frugal				
	Consumption lover > Frugal	Consumption lover = Frugal	Consumption lover < Frugal	
# obs. = 1,125	4.1%	74.4%	21.5%	
B. Hardworking vs. leisure lover				
	Hardworking > Leisure lover	Hardworking = Leisure lover	Hardworking < Leisure lover	
# obs. = 1,121	42.7%	54.4%	2.9%	
C. Transfer Recipients and free loaders				
# obs. = 1,098	Disabled person unable to work	Unemployed looking for work	Unemployed not looking for work	Welfare recipient not looking for work
Average rank (1-4) assigned	1.4	1.6	3.0	3.5
% assigned first rank	57.5%	37.3%	2.7%	2.5%
% assigned last rank	2.3%	2.9%	25.0%	70.8%

Notes: This table reports preferences for giving a tax break and or a benefit increase across individuals in various scenarios. Panel A considers two individuals with the same earnings, same taxes, and same disposable income but high marginal utility of income (consumption lover) vs. low marginal utility of income (frugal). In contrast to utilitarianism, 74% of people report that consumption loving is irrelevant and 21.5% think the frugal person is most deserving. Panel B considers two individuals with the same earnings, same taxes, and same disposable income but different wage rates and hence different work hours. 54.4% think hours of work is irrelevant and 42.7% think the hardworking low wage person is more deserving. Panel C considers transfer recipients receiving the same benefit levels. Subjects find the disabled person unable to work and the unemployed person looking for work much more deserving than the abled bodied unemployed or welfare recipient not looking for work.

People favor redistribution if they feel inequalities are “unfair” but views on what is fair differ

$\Rightarrow$ Redistribution supported when people don’t have control [education for children, health insurance for the sick, retirement/disability benefits for the elderly/disabled unable to work]

$\Rightarrow$ Less support when people have some or full control [unemployment, being low income]

$\Rightarrow$ Less support when people don’t “belong” (us vs. them)

Some people tend to frame things: individuals have control (personal responsibility), govt should just enforce rules

Others tend to frame things: many forces in society beyond individuals’ control (“we are all in this together”), society should provide nurturing

Conclusion: Two General Rules for Govt Intervention

1. Market Failures: Government intervention can help if there are market failures
2. Redistribution: Free market generates inequality. Govt taxes and spending can reduce inequality

   First part of course will analyze 2), second part of course will analyze 1)

Empirical Tools

Empirical public finance: The use of data and statistical methods to measure the impact of government policy on indi- viduals and markets (example: how an increase of taxes affects work behavior)

Correlation: Two economic variables are correlated if they move together (example: height and weight across individuals)

Causality: Two economic variables are causally related if the movement of one causes movement of the other (example: good nutrition as an infant increases adult height)

Explore spurious correlation with http://www.tylervigen.com/spurious/random

The Important Distinction between Correlation and Causality

There are many examples where causation and correlation can get confused.

In statistics, this is called the *identification problem*: given that two series are correlated, how do you identify whether one series is causing another?

The attempt to interpret a correlation as a causal relationship without sufficient thought to the underlying process generating the data is a common problem.

For any correlation between two variables A and B, there are three possible explanations, one or more of which could result in the correlation:
1) A is causing B
2) B is causing A
3) Some third factor is causing both

The general problem that empirical economists face in trying to use existing data to assess the causal influence of one factor on another is that one cannot immediately go from correlation to causation.

Randomized trial: The ideal type of experiment designed to test causality, whereby a group of individuals is randomly divided into a treatment group, which receives the treatment of interest, and a control group, which does not.

Treatment group: The set of individuals who are subject to an intervention being studied.

Control group: The set of individuals comparable to the treatment group who are not subject to the intervention being studied.

Randomized trials have been used in medicine for many decades and have become very popular in economics, especially devel- opment economics in the last 15 years

Bias: Any source of difference between treatment and control groups that is correlated with the treatment but is not due to the treatment.

Having large sample sizes allows researchers to eliminate any consistent differences between groups by relying on the sta- tistical principle called the *law of large numbers*: the odds of getting the wrong answer approaches zero as the sample size grows.

Statisticians develop methods to evaluate the precision of es- timates and create confidence intervals around estimates

Why we Need to Go Beyond Randmized Trials

Even the gold standard of randomized trials has some potential problems.

1) External validity: The results are only valid for the sample of individuals who volunteer to be either treatments or con- trols, and this sample may be different from the population at large (e.g., randomized experiment in Sweden or US would not necessarily generate the same results)

2) Attrition: Individuals may leave the experiment before it is complete. Reduction in the size of samples over time, which, if not random, can lead to bias estimates.

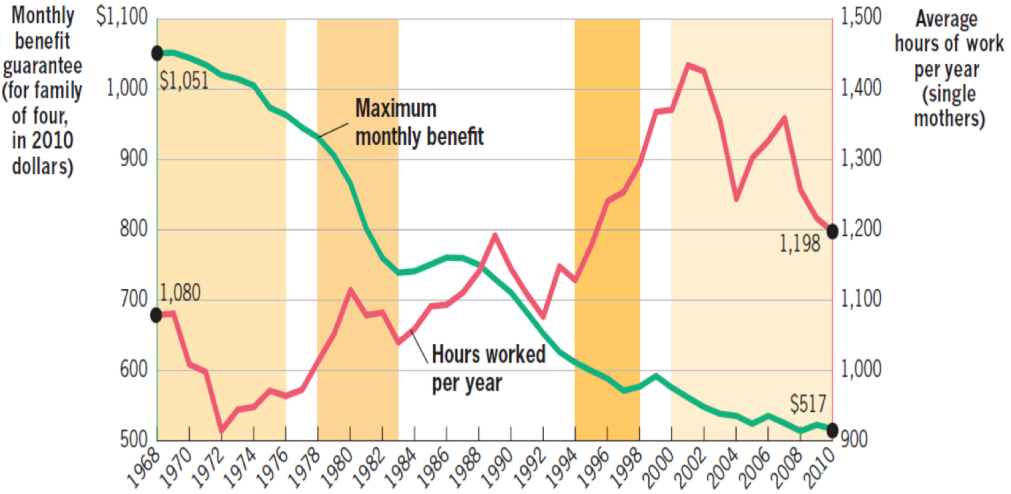
Outside randomized experiments, bias is a pervasive problem that is not easily remedied. There are, however, methods available that can allow us to approach the gold standard of randomized trials.

Observational data: Data generated by individual behavior observed in the real world, not in the context of deliberately designed experiments.

Time series analysis: Analysis of the co-movement of two series over time.

Cross-sectional regression analysis: Statistical analysis of the relationship between two or more variables exhibited by many individuals at one point in time.

Time Series Analysis: Cash Welfare Guarantee and Hours Worked Among Single Mothers



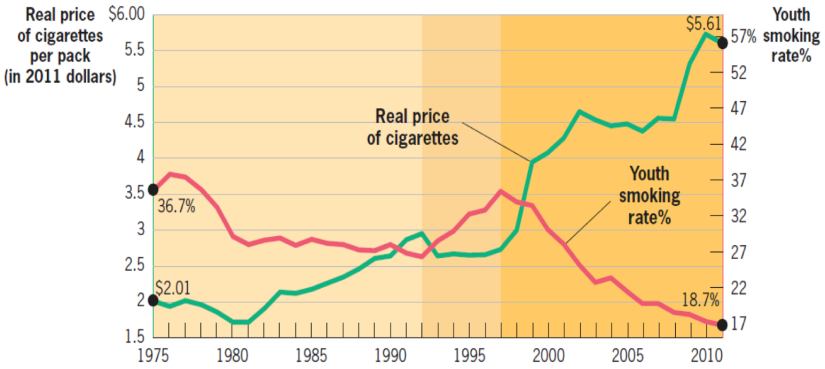
Problems with Time Series Analysis

1) Although this time series correlation is striking, it does not necessarily demonstrate a causal effect of TANF benefits on labor supply

When there is a slow-moving trend in one variable through time, as is true for the general decline in income guarantees over this period, it is very difficult to infer its causal effects on another variable.

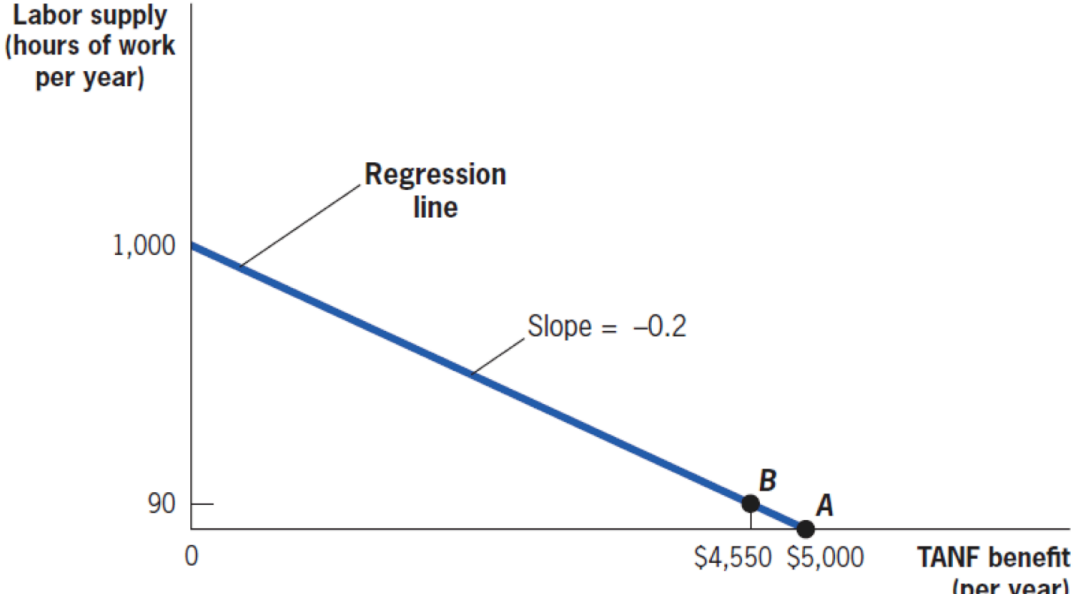
2) Other factors get in the way of a causal interpretation of this correlation over time; factors such as economic growth and a more generous Earned Income Tax Credit (EITC) can cause bias in this time series analysis because they are also correlated with the outcome of interest.

Time Series Analysis: Cash Welfare Guarantee and Hours Worked Among Single Mothers



- Sharp, simultaneous changes in prices and smoking rates in 1993 and 1998–onward
- Known causes: price war, tobacco settlements

Cross-Sectional Regression Analysis: Labor Supply and TANF Benefit



Regression line: The line that measures the best linear approximation to the relationship between any two variables.

$$Y = X\beta + \varepsilon$$

X is the independent variable data (TANF benefit guarantee)

Y is the dependent variable data (labor supply)

β is the coefficient that measures the effect of X on Y

ε is the error term (captures variations in Y not related to X).

Ordinary least square regression (OLS) estimates β without bias if ε is not correlated with X

The estimated coefficient $\hat{\beta}$ is reported with standard errors in parentheses

Example: $\hat{\beta}$ = .5(.1) should be understood as β is in confidence interval $(.5 - 2 \times .1, .5 + 2 \times .1)$ = (.3, .7) with probability 95%.

We have standard errors because we do not know the exact value of β

When estimated coefficient is more than twice the standard error, we can conclude that it is significantly positive (i.e., is above zero with probability 95%).

Example with Real-World Data: Labor Supply and TANF Benefits

The result summarized in Figure 3-4 seems to indicate strongly that mothers who receive the largest TANF benefits work the fewest hours. Once again, however, there are several possible interpretations of this correlation.

One interpretation is that higher TANF benefits are causing an increase in leisure.

Another possible interpretation is that in places with high TANF benefits, mothers have a high taste for leisure and wouldn't work much even if TANF benefits weren't available (this means exactly that ε is correlated with X)

Control Variables

It is essential in all empirical work to ensure that there are no factors that cause consistent differences in behavior across two groups (ε) and are also correlated with the independent variable X

Control variables: Additional variables Z that are included in cross-sectional regression models to account for differences between treatment and control groups that can lead to bias

$$Y = X\beta + Z\gamma + \varepsilon$$

In TANF case, Z would include race, education, number of children to control for demographic differences across states

Empirically, add Z variables and assess whether they change the estimate β. If estimate β varies a lot, we cannot be confident that identification assumption holds

Quasi-experiments (also called natural experiments)

Changes in the economic environment that create nearly iden- tical treatment and control groups for studying the effect of that environmental change, allowing public finance economists to take advantage of quasi-randomization created by external forces

Example: one state (Arkansas) decreases generosity of wel- fare benefits while another comparable state (Louisiana) does not. Single mothers in Arkansas are the Treatment (T) group, Single mothers in Louisiana are the control (C) group.

We consider a Treatment group (T) and a Control group (C) and outcome Y

Simple difference estimator: $D = Y^{T,After} - Y^{C,After}$ is the difference in average outcomes between treatment and control after the change

In randomized experiment, simple difference $D = Y^{T,After} - Y^{C,After}$ is sufficient because T and C are identical before the treatment

In quasi-experiment, T and C might not be comparable before treatment. You can compute $D^{Before} = Y^{T,Before} - Y^{C,Before}$

If $D^{Before} = 0$, you can be fairly confident that $D = Y^{T,After} - Y^{C,After}$ estimates the causal effect

If simple difference $D^{Before} = Y^{T,Before} - Y^{C,Before}$ is not zero, you can form the **Difference-in-Difference estimator**

$$DD = [Y^{T,After} - Y^{C,After}] - [Y^{T,Before} - Y^{C,Before}]$$

This measures whether the difference between treatment and control changes after the policy change

DD identifies the causal effect of the treatment if, absent the policy change, the difference between T and C would have stayed the same (this is called the parallel trend assumption)

	1996	1998	Difference
Arkansas			
Benefit guarantee ($)	5,000	4,000	-1,000
Hours worked	1,000	1,200	200
Louisiana			
Benefit guarantee ($)	5,000	5,000	0
Hours worked	1,050	1,100	50

Problems with Quasi-Experiments

With quasi-experimental studies, we can never be completely certain that we have purged all bias from the treatment– control comparison.

Quasi-experimental studies present various robustness checks to try to make the argument that they have obtained a causal estimate.

Examples: find alternative control groups, do a placebo com- paring treatment and control *DD* when no policy change took place, etc.

Best way to check validity of *DD* estimator is to plot times series and assess whether a clear break between the two groups happens at the time of the reform

Two Graphical Examples

1) Effects of lottery winnings on labor supply from Imbens, Rubin, Sacerdote AER'01

Ideal quasi-experiment to measure income effects as lottery generates random assignment conditional on playing $\Rightarrow$ Very compelling graph, DD is convincing

2) Effects of the 1987 EITC expansion (tax credit for low income workers with kids) on labor supply from Eissa and Liebman QJE'96

Compares single mothers (Treatment) to single females with no kids (Control) $\Rightarrow$ No compelling break in graph around 1987, DD is not convincing

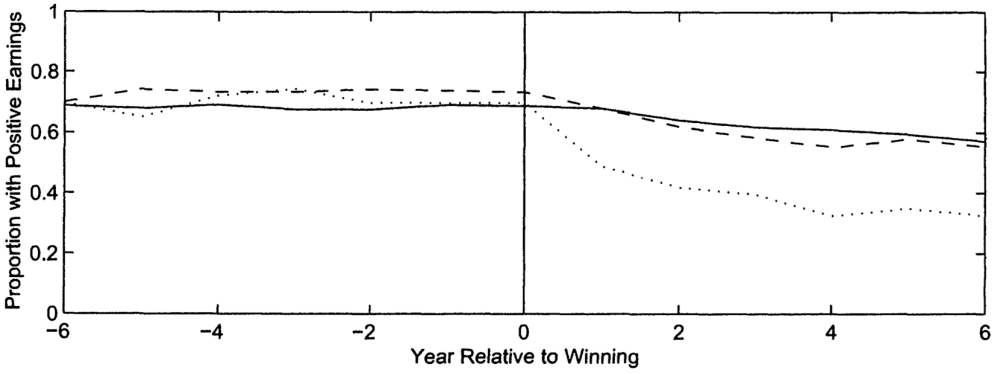
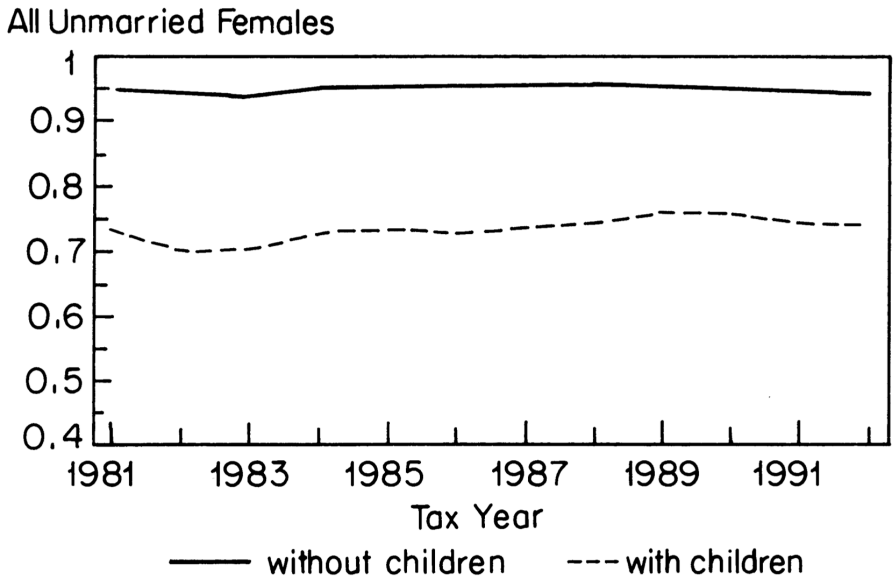


FIGURE 2. PROPORTION WITH POSITIVE EARNINGS FOR NONWINNERS, WINNERS, AND BIG WINNERS

Note: Solid line = nonwinners; dashed line = winners; dotted line = big winners.


All Unmarried Females
1
0.9
0.8
0.7
0.6
0.5
0.4
1981
1983
1985
1987
1989
1991
Tax Year
without children
with children

Structural estimates: Builds a theoretical model of individual behavior and then estimates the parameters of the model. Estimates of the features that drive individual decisions, such as income and substitution effects or parameters of the utility function.

Reduced form estimates: Measures of the total impact of an independent variable on a dependent variable, without de- composing the source of that behavior response in terms of underlying parameters of the utility functions

Reduced form estimates are more transparent and convinc- ing but structural estimates are more directly useful to make predictions for alternative policies

Conclusion

The central issue for any policy question is establishing a causal relationship between the policy in question and the out- come of interest.

We discussed several approaches to distinguish causality from correlation. The gold standard for doing so is the randomized trial, which removes bias through randomly assigning treat- ment and control groups.

Unfortunately, however, such trials are not available for ev- ery question we wish to address in empirical public finance. As a result, we turn to alternative methods such as time series analysis, cross-sectional regression analysis, and quasi- experimental analysis.

Each of these alternatives has weaknesses, but careful consid- eration of the problem at hand can often lead to a sensible solution to the bias problem that plagues empirical analysis.

THANK YOU!

These slides are available on my website: https://bluebery-planterose.com/teaching

These slides are partly based on courses by: Ghazala Azmat, Raj Chetty, Emmanuel Saez, Stefanie Stantcheva, and Gabriel Zucman.